

# **Geochemical and petrographic evidence for the Vredefort proximal impact ejecta in the Northern Cape, South Africa**

By

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Thesis

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# Abstract

## Petrographic and geochemical evidence for the Vredefort proximal impact ejecta in the Northern Cape, South Africa

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The advancement of the understanding of hypervelocity impacts lies in discovering impact structures and both proximal and distal impact ejecta. This study uses petrographic and geochemical techniques to investigate the occurrence of Vredefort proximal impact ejecta in the Paleoproterozoic Maremane Dome, South Africa.

Anomalous spherical objects ca. 15 mm in apparent diameter have been observed near the top of the Doornfontein Conglomerate Member in the Maremane Dome, South Africa. The objects were previously described as pisolites formed by laterization. The Doornfontein Conglomerate Member was thought to be a conglomerate unit formed by erosion and karstification of the Maremane Dome during the tectonic uplift. However, these interpretations appear to not fully explain most observations in the Doornfontein Conglomerate Member and anomalous objects and are therefore a concern.

Through petrographic techniques intergraded with geochemical techniques, this work investigated 24 drill core samples with the anomalous objects from the Doornfontein Conglomerate Member in the Maremane Dome to test the hypothesis that the samples could be related to the Vredefort structure. The drill core samples are clay-rich and ferruginised matrix-supported breccias. The samples occur between the Hartley Formation (1.93 Ga) and Ongeluk Formation ( $2.22 \pm 13$  Ga), implying that the samples may occur within a permissible time of formation of the Vredefort structure (2.02 Ga). The samples are  $<5R_c$  ( $R_c$ ; distance between the centre of the crater and final rim of the crater) from the centre of the Vredefort structure, suggesting that the samples may occur within an expected distance from the Vredefort structure for Vredefort proximal impact ejecta. The samples appear to be similar to impact breccias in the Stac Fada impact ejecta layer. The anomalous objects in the samples appear to be accretionary lapilli and resemble accretionary lapilli formed by impact processes based on their large size, typically darker crusts and lithic rock fragments aligned typically parallel to the margins. The occurrence of the accretionary lapilli at the top of the Doornfontein Conglomerate Member is also analogous to the occurrence of accretionary lapilli at the top of the impact breccias in the Stac Fada impact ejecta layer.

Based on optical microscopy and scanning electron microscopy, the samples contain potential shocked quartz and zircon grains with possible planar deformation features and planar fractures induced by impacts. Low siderophile element abundances, especially Ni, Co, Cr and Ir, were detected in the samples using instrumental neutron activation analysis, but Ir was only detected in a single sample, measuring 0.58 ppb. Although the siderophile element abundances are low, they may result from an impact because the siderophile element abundances appear to be lowered and diluted by ferruginisation and hydrothermal fluids, which appear to have crystallised rutile and anatase determined by Raman spectroscopy.

Due to the absence of sediment reworking, varying thickness and continuous intergradation without a grain size change in the lithofacies identified for the samples and the sample's similarity to the impact breccias in the Stac Fada impact ejecta layer, the samples are suggested to have been emplaced as a ground-hugging density current ejecta that propagated outwards from the Vredefort impact site, forming the Vredefort proximal impact ejecta.

The proposed Vredefort proximal impact ejecta is the first described occurrence of the proximal impact ejecta associated with this impact structure. This is also true for the

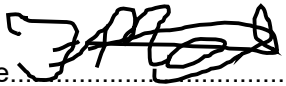
continuous ejecta blanket of the Vredefort structure. The proposed discovery of the Vredefort proximal impact ejecta and continuous ejecta blanket of the Vredefort structure will provide a glimpse of the Vredefort impact ejecta's record because a considerable amount of this record is still unknown.



## Declaration

I declare that *Petrographic and geochemical evidence for the Vredefort proximal impact ejecta in the Northern Cape, South Africa* is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

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Signature.....

Date: 01/11/2021

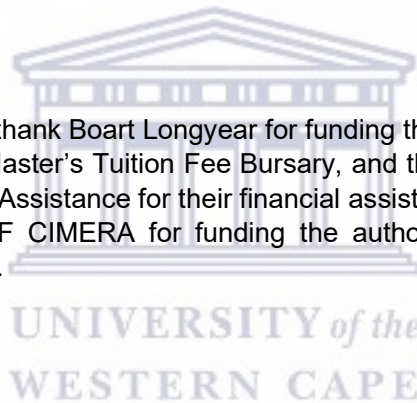


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## Preface

It took two years to complete this thesis at the University of the Free State and the University of the Western Cape at the Department of Geology and Department of Earth Science, respectively. This thesis contains six chapters, in which Chapter 1 introduces hypervelocity impact events, shock metamorphism, meteorite geochemical signatures, accretionary lapilli and the thesis aims. Chapter 2 describes the study areas and their regional geological setting. Chapter 3 describes how sampling was conducted and provides the petrographic and geochemical methods used for this study. Chapter 4 provides the results of sampling, petrography and geochemistry. Chapter 5 discusses, interprets and implicates the results, and Chapter 6 concludes the work.





# Chapter 1: Introduction

Hypervelocity impact events occur when impactors such as meteorites, asteroids, and comets, collide with the surface of solid planetary bodies, i.e., terrestrial planets, asteroids and natural satellites of gaseous planets (Shoemaker, 1977; French, 1998; Glass & Simonson, 2013; Osinski & Pierazzo, 2013; Flamini et al. 2019). Hypervelocity impact events are the most common processes affecting the planetary surfaces in the Solar System and typically result in the formation of impact craters and impact structures on the surface of the solid planetary bodies (Figure 1A) (Taylor, 1992; French, 1998). One of the earliest pieces of evidence for the occurrence of impact craters was found during the Galileo era after Galileo discovered abundant impact craters on the surface of the Moon (French, 1998). However, the most definitive evidence for impact craters was provided during the 1900s by exploring the Solar System using humans and spacecrafts (Figure 1A). The Apollo mission crew provided high-quality images of the surface and impact craters of the Moon (Taylor, 1992). Moreover, spacecraft imaging indicated that impact craters are the most abundant geographic features on solid planetary bodies (Taylor, 1982).

Impact structures also occur on Earth (Figure 1B). There are currently about 200 impact structures recognised on Earth, which are incorporated in the Earth Impact Database (Schmieder & Kring, 2020). The largest three are the 2.02 Ga Vredefort structure (South Africa) with a ~180 to 300 km diameter, 1.85 Ga Sudbury structure (Canada) with a ~260 km diameter, and 65 Ma Chicxulub structure (Mexico) with a diameter of ~180 km (French, 1998). It is likely that the number of impact structures on Earth was higher than known today because the Earth's surface is constantly renewed by plate tectonic processes, volcanic eruptions, re-deposition, and aeolian, hydrologic, and biogenic erosions (Stöffler et al. 2006; Komatsu et al. 2014). In addition, the ocean covers roughly 75% of the Earth's surface and can thus obscure the record of impact structures on Earth (French, 1998).

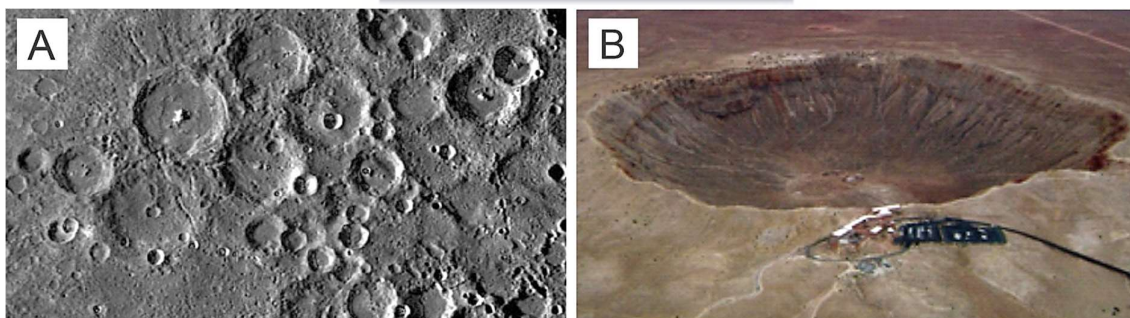


Figure 1: (A) A heavily cratered surface of Mercury in the northwest quadrant near the equator. The image was taken by the Mercury Messenger spacecraft (Glass & Simonson, 2013). (B) A bowl-shaped Meteor Crater (50 000 years old) with a 1.2 km diameter in Arizona, USA (Reimold & Gibson, 2010).

## 1.1 Impact cratering

The formation of impact craters initiates immediately when the impactor strikes the surface (Figure 2) and comprises three stages: (1) contact and compression stage; (2) excavation stage, and; (3) modification stage (Melosh, 1989). The stages naturally follow each other smoothly, grading into one another. During the compression stage, the impactor strikes the surface and compresses the target rocks to shock pressures as high as >100 GPa (GPa; Gigapascals) (Figure 2) (Melosh, 1989; French, 1998). The compression and kinetic energy of the impactor form hemispherical shock waves that propagate through the target rocks at speeds faster than the speed of sound (Figure 2). The compression causes shock metamorphism, melting and vaporisation of the target rocks and the impactor (Figure 2) (Gault

et al. 1968). The vaporised impactor and target rock material form an impact plume and can expand outwards at velocities similar to those of the impact (Figure 2) (Melosh, 1989). The duration of the contact and compression stage is up to 1.0 seconds (Melosh, 1989; French, 1998).

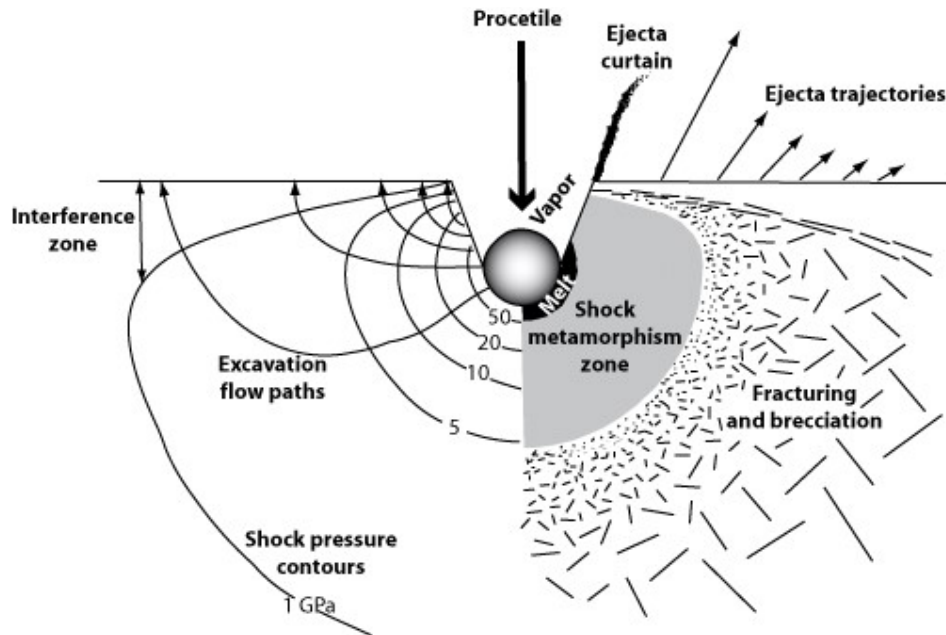


Figure 2: A section showing the excavation flow lines and shock pressures at the point of impact (Melosh, 1989). Shock pressure isobars (pressure in GPa) form within the target surface and radiate outwards from the point of impact. The pressure peaks between the impactor and target surface and declines outward, creating concentric hemispherical zones of varying shock effects (located on the right side). These hemispherical zones cause melting (>50 GPa), shock deformation features (5-50 GPa), and fracturing and brecciation (1-5 GPa). During the excavation stage, two processes occur: (1) ejection of fragments and impact ejecta (upward-pointing arrows over the surface) and; (2) sub-surface flow of target rocks and formation of the transient crater (arrows cutting isobars on the left side). Figure adapted from Melosh (1989).

During the excavation stage, a rarefaction or tensional wave that unloads the high shock pressure forms behind the shock wave that propagates into the impactor (Ahrens & O'Keefe, 1972). Furthermore, during this stage, the crater starts to open up and form by ejecting target material outwards from the impact site and creating an excavation flow around the centre of the forming crater (Figure 2) (Melosh, 1989; Grieve, 1991). The flow directions differ with position within the target rocks, where along the upper levels, the rocks are displaced primarily upwards and outwards (Figure 2). In the lower levels, the rocks are displaced primarily downwards and outwards (Figure 2). These movements ultimately form a bowl-shaped depression, referred to as the transient cavity or transient crater, within the target surface (Figure 2) (Maxwell, 1977; Grieve et al. 1977; Melosh, 1989). Compared to the contact and compression stage, the duration of the excavation stage is from a few seconds to 100 seconds (Melosh, 1989; French, 1998).

During the modification stage, the transient crater is modified into three different types of structures, namely simple craters, complex craters, and multiring basins (French, 1998). Simple craters develop as bowl-shaped depressions and are the smallest structures (Melosh, 1989), and complex craters are larger structures and more complex in form (Grieve et al. 1977; Grieve, 1991). Multiring basins form by impactors that are tens to hundreds of kilometres across (Melosh, 1989). The duration of this stage is less than 60 seconds for small structures and a few minutes for large structures (Melosh, 1989; French, 1998).

## 1.2 Shock metamorphism

As shock waves propagate from the impact point, they subject the target rocks to severe physical conditions. As a result, distinct shock-metamorphic features develop in the target rocks (Figure 2) (Melosh, 1989; French, 1998). The shock-metamorphic features are used as evidence for an impact origin to identify impact structures and rocks of impact origin (Figure 2) (Stoffler & Langenhorst, 1994; Grieve et al. 1995; French, 1998; Guillaume-Feignon et al. 2020). The most widely used and accepted shock-metamorphic features for identifying impact structures and rocks that underwent shock-metamorphism are planar deformation features (PDFs) in shocked mineral grains, especially silicate minerals (typically quartz and feldspar) (French & Short, 1968; Stoffler & Langenhorst, 1994; French & Koeberl, 2010). Planar deformation features (PDFs) are multiple sets of closely spaced, narrow, and parallel planar regions of amorphous material. Individual PDFs are usually 2 to 10  $\mu\text{m}$  spaced and usually <2 to 3  $\mu\text{m}$  narrow (French, 1998). A type of PDFs referred to as decorated PDFs are also accepted as evidence for shock-metamorphism (Figure 3) (French, 1998). Decorated PDFs occur mainly in altered and geologically old rocks and form when PDF-bearing amorphous silica recrystallises back to quartz, forming trails of small fluid inclusions along original PDF planes (Figure 3) (French, 1998; Cannon et al. 2010).

Shock-metamorphic features such as planar fractures are also a diagnostic criterion for identifying rocks and minerals that underwent shock metamorphism (Figure 2). Planar fractures mainly occur in quartz grains and represent parallel sets of multiple planar cracks or cleavages (Robertson et al. 1968; Stoffler & Langenhorst, 1994; Grieve et al. 1996; French et al. 1997). Individual planar fractures are usually 5.0 to 10  $\mu\text{m}$  wide and 15 to 20  $\mu\text{m}$  spaced (French, 1998).

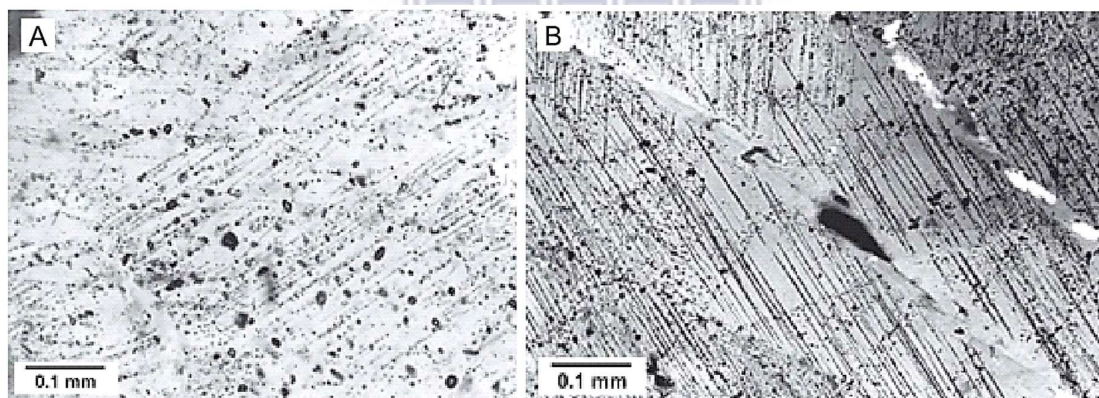


Figure 3: (A) Shocked quartz grain (cross-polarised light) with multiple sets of decorated PDFs with arrays of small fluid inclusions. This sample (CSF-66-39) is from a granite gneiss inclusion in the Onaping Formation, Sudbury structure. (B) Quartz grain (cross-polarised light) with multiple sets of decorated PDFs with trails of small fluid inclusions within original PDF planes. This sample (DCR-11-63B) is from a Precambrian basement gneiss in Canada's Carswell Lake structure. Both images are obtained from French (1998).

## 1.3 Proximal and distal impact ejecta

Impactites are rocks formed by impact processes and can occur in proximal and distal impact ejecta (Figure 2) (French, 1998). Impact ejecta is any target material, often mixed with impactor material, deposited beyond the transient crater's rim and consists of melt droplets, melt fragments, accretionary lapilli, and solid ejecta (Schulte et al. 2010). Proximal and distal impact ejecta often contains evidence of impact in the form of shock-metamorphic features and meteorite geochemical signatures. Proximal impact ejecta is ejecta deposited close to the impact crater, and distal impact ejecta is ejecta deposited further from the impact crater (Figure 2) (Melosh, 1989). Using the crater radius method ( $R_c$ ; the distance between the centre of the crater and the final rim of the crater), about half of the impact ejecta settles within  $2 R_c$  from the centre of the impact crater to form a continuous ejecta blanket (French, 1998). Roughly



90% of impact ejecta accumulates in  $<5 R_c$ , forming proximal impact ejecta. In comparison, distal impact ejecta occurs at  $>5 R_c$  and forms about 10% of ejecta.

Impact ejecta provides valuable information about the history of impact bombardment on Earth even when the source impact structures themselves have not been identified (French, 1998). Impact ejecta can reveal unknown and missing information about the effects of impact events on, for example, the biology, environment and geology on Earth. Impact ejecta deposits have been used to directly link impact events with atmospheric, biological and oceanic events present in the stratigraphic record in which they occur (French, 1998). A notable example is the Phanerozoic Chicxulub structure, where an ejecta blanket consisting of proximal ejecta and distal ejecta from the structure was identified before discovering the actual structure. The ejecta blanket and Chicxulub impact event were correlated with the mass extinction event at the Cretaceous-Paleogene (K-Pg) boundary at about 66.05 Ma (Alvarez et al. 1980; Smit & Hertogen, 1980; Sprain et al. 2018). The K-Pg event formed a thin clay layer that has been identified in more than 350 marine and terrestrial sites across the globe, containing shock-metamorphic features and high abundances of siderophile elements, especially Ir (Smit, 1999; Claeys et al. 2002). The layer also has accretionary lapilli and impact spherules (Gradstein et al. 2012).

Another example is the  $1199 \pm 70$  Ma Stac Fada impact ejecta breccia layer in Scotland which is emplaced similar to ignimbrites from a volcano and was thus once interpreted to be volcanically derived (Lawson, 1972) but is now thought as an impact ejecta deposit sourced from an impact crater that has never been discovered (Amor et al. 2008). The Stac Fada impact ejecta layer is recognised to be of impact origin primarily because it contains shocked quartz grains and an extraterrestrial chromium isotope signature (Amor et al. 2008). The Stac Fada ejecta layer consists of massive suevites grading upwards without a contact into massive suevites with accretionary lapilli and accretionary lapilli fragments overlaid by a clast-supported dust pellet thin layer (Branney & Brown, 2011). Although it is now thought that the emplacement of the sequence is by an impact density current, the sequence resembles ignimbrites with accretionary lapilli emplaced by pyroclastic density currents at volcanoes.

Impact ejecta has also been discovered from the Sudbury structure in a proximal to distal impact ejecta layer of breccia at 10 locations 500 to 700 km east of the Sudbury structure in the Paleoproterozoic iron ranges of northern Michigan, USA (Cannon et al. 2010; Huber & Koeberl, 2017). Evidence for an association with the Sudbury structure is from radiometric age constraints of 1875 Ma and 1830 Ma from pre-and post-impact events in the breccia layer (Cannon et al. 2010). Sudbury ejecta also occurs in sites in Minnesota in USA and Ontario in Canada and, together with that from the ten sites, form an extensive ejecta layer (Addison et al. 2005). This layer shows variations in thicknesses, lithology, and sedimentary settings. As a result of these variations and others, most of the sites where Sudbury ejecta occurs were previously described and interpreted to have formed by typical terrestrial processes, but PDFs in shocked quartz grains indicate that the layer is a product of an impact (Cannon et al. 2010). The breccia layer also contains accretionary lapilli at most sites. It has been proposed that the layer may be used as a timeline that correlates stratigraphic sequences of separated iron ranges, the correlation which has been debated for a long time (Cannon et al. 2010).

## 1.4 Accretionary lapilli

Accretionary lapilli are a size classification of pyroclastic rocks and are by definition between 2 and 64 mm in diameter (Figure 4) (Fisher & Waters, 1970; Schmincke et al. 1973; Schumacher & Schmincke, 1995; Neuendorf et al. 2005). Pyroclastic rocks greater than 64 mm in diameter are called “bombs” when viscous and “blocks” when solid (Fisher & Waters, 1970; Schmincke et al. 1973; Schumacher & Schmincke, 1995; Neuendorf et al. 2005).

Accretionary lapilli are typically spherical to subspherical and have a concentric structure (concentrically zoned) consisting of nuclei, mantles and crusts (Figure 4) (Warne et al. 2002). The crusts are the outer rims, mantles are the main bodies, and nuclei are the central cores of the accretionary lapilli (Figure 4) (Warne et al. 2002). The grain size of accretionary lapilli usually grades outwards from coarse-grained nuclei to fine or very fine-grained crusts and mantles (Figure 4) (Warne et al. 2002).

Accretionary lapilli (impact accretionary lapilli) can form by the aggregation of particles by impact processes and are regarded as a special type of impact ejecta (Figure 4) (Moore & Peck, 1992; Warne et al. 2002; Cannon et al. 2010; Huber & Koeberl, 2017). Accretionary lapilli can also form by the aggregation of particles as a result of volcanic processes (volcanic accretionary lapilli) and form accretionary lapilli that are almost indistinguishable from those formed by impact processes (Figure 4) (Fisher & Waters, 1970; Schmincke et al. 1973; Schumacher & Schmincke, 1995; Neuendorf et al. 2005; Glass & Simonson, 2013). As a result, models for forming volcanic accretionary lapilli have been used to describe the formation of impact accretionary lapilli (Pope et al. 2005; Glass & Simonson, 2013).

Reimer (1983a) attributed five forces to forming accretionary lapilli: (1) electrostatic attraction; (2) capillary pressure of pore fluids; (3) crystallisation of dissolved matter; (4) van der Waals forces, and; (5) sintering at high temperature. However, impact and volcanic accretionary lapilli form under different mechanisms and conditions (Mueller et al. 2018). A few models have been provided to explain the formation of impact and volcanic accretionary lapilli. The formation of volcanic accretionary lapilli is thought to occur in a turbulent volcanic plume or ash cloud with a high moisture content by the accretion of ash around particles or nuclei (Fisher & Waters, 1970; Schmincke et al. 1973; Reimer, 1983a; Fisher & Schmincke, 1984; Gilbert & Lane, 1994). The ash cloud is derived from the generation of large volumes of volcanic ash into the atmosphere, which can have an initial velocity as high as  $500 \text{ m.s}^{-1}$  and contain particles with diameters greater than  $10 \mu\text{m}$  (Huber & Koeberl, 2017). Through rain moving between dry eruption clouds, ash can bound together to form accretionary lapilli (Fisher & Schmincke, 1984). Alternatively, the particles in a laterally expanding and rising, turbulent wet ash clouds of base surges can agglomerate to form accretionary lapilli (Fisher & Schmincke, 1984). The formation of volcanic accretionary lapilli has also been proposed to occur by the agglomeration of raindrops and grains rolling downslope in ash deposits (Reimer, 1983a).

Similar to volcanic accretionary lapilli, a few models have been provided to explain the formation of impact accretionary lapilli. The Yancey and Guillemetter (2008) and Johnson and Melosh (2014) models propose that the distal accretionary lapilli from the Chicxulub crater were formed by the aggregation of particles within a cooling impact ejecta plume. Grieve et al. (2010) attributes the accretionary lapilli in the Onaping Formation (fallback eject) in the Sudbury crater to have formed by a melt-fuel coolant interaction (MFCI). This implies that water from the surrounding flowed into the crater and caused phreatomagmatic eruptions promoting the aggregation of particles. The formation of accretionary lapilli in the Ries Crater has been interpreted as the fallback of melt-rich impact breccia, forming suevite during deposition and the collapse of un-lithified suevitic breccias under the influence of gravity (Graup, 1981; Stöffler et al. 2013).

There are only very few best examples of impact accretionary lapilli, and they include the Sudbury crater (~260 km in diameter; accretionary lapilli discovered both within the fallback ejecta and ~400-700 km from the centre of the crater; Addison et al. 2005), Chicxulub impact crater (~180 km in diameter; accretionary lapilli found ~500-1800 km from the crater; Yancey & Guillemette, 2008), Ries crater (~24 km in diameter; accretionary lapilli discovered in within-

crater suevites; Graup, 1981), Tookoonooka crater (~55 km in diameter; accretionary lapilli found in the proximal ejecta blanket; Bron & Gostin, 2012), Alamo breccia (the diameter of the crater is unclear; accretionary lapilli discovered in the proximal ejecta blanket; Warner & Kuehner, 1998), and Stac Fada breccia (the diameter of the crater is unclear; accretionary lapilli found in the proximal ejecta blanket; (Amor et al. 2008).

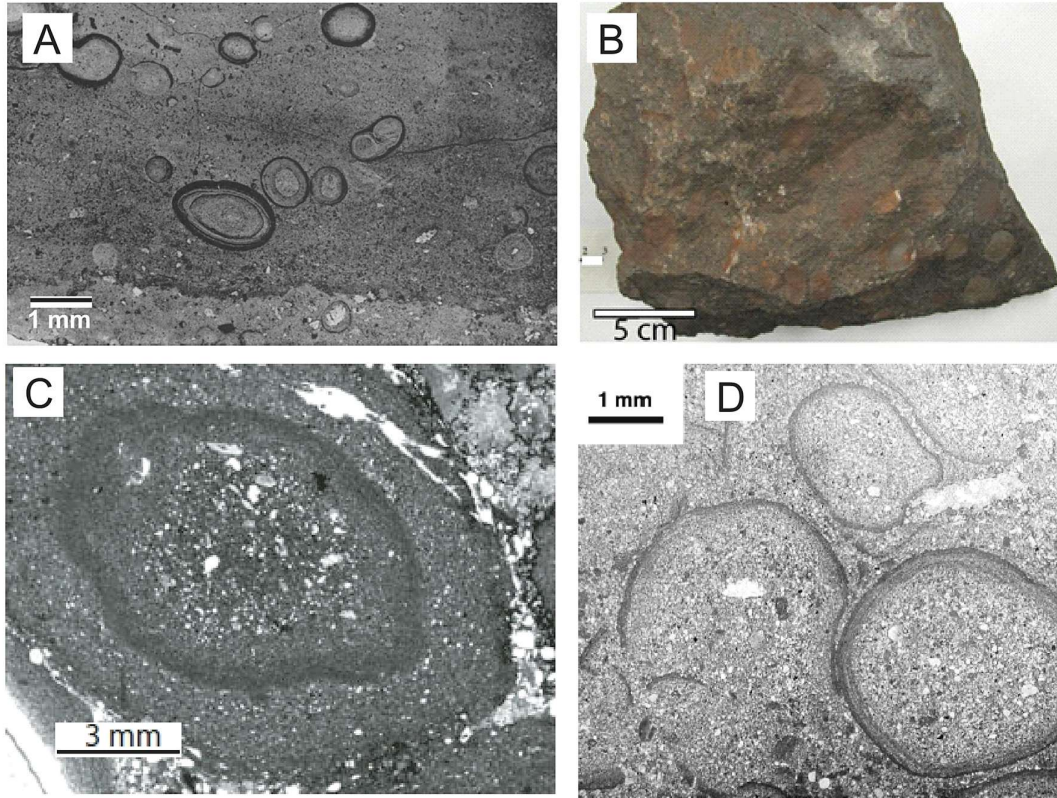


Figure 4: (A) Volcanic accretionary lapilli from Madras, Oregon (Moore & Peck, 1962). Note the concentric structures of the accretionary lapilli and that they consist of nuclei, mantles and crusts. (B) The dark red to brown spherical particles in the rock are impact accretionary lapilli and occur within an iron-rich matrix (Huber & Koeberl, 2017). The sample is from the McClure site, Sudbury impact layer. (C) A photomicrograph of an impact accretionary lapillus from Connors Creek in the Sudbury impact layer (Cannon et al. 2010). Note the internal zonation of the accretionary lapillus. (D) A photomicrograph of Alamo impact accretionary lapilli, which are deformed, circular, and fragmented (Warne et al. 2002).

## 1.5 Meteorite geochemical signatures

During an impact event, unique meteorite geochemical signatures may be imprinted on impactites and used to corroborate an impact origin of suspected impactites even if they lack shock-metamorphic features. The recognised meteorite geochemical signatures for this purpose are siderophile elements, namely platinum group elements (PGE's) (PGE's; Pt, Ir, Os, Ru and Rh) and Ni, Co and Cr (Tagle & Hecht, 2006; French & Koeberl, 2010; Koeberl, 2014). The presence of high Ir concentrations within suspected impactites is most commonly used and cited as evidence for impact (Koeberl, 2002; Koeberl, 2014). These siderophile elements are used for this purpose because their concentrations in meteorites are generally high while very low in terrestrial crustal rocks (100 to 1000 times lower) (Koeberl, 2002; Koeberl, 2014). High abundances in Cr and chondritic ratios (Ni/Co, Ni/Cr and Co/Cr) are widely used to identify chondritic impactors (Palme et al. 1978; Koeberl, 2014).



## 1.6 Vredefort impact structure

As stated above, of the 200 impact structures recognised on Earth, the Vredefort structure is one of them. The Vredefort structure is  $2\,020 \pm 5$  million years old and is the oldest known structure on Earth (Leroux et al. 1994; Kamo et al. 1996; Koeberl et al. 1996). The structure occurs roughly 120 km southwest of Johannesburg, South Africa. The Vredefort structure is estimated to have been formed by a meteorite with a 10 to 15 km diameter (McCarthy & Rubidge, 2005; Morrow, 2009). The impact excavated  $\sim 70\,000$  km<sup>3</sup> volume of the crust, caused a magnitude 14 seismic event and released 100 million megatons of energy (McCarthy & Rubidge, 2005). The Vredefort structure comprises a central core of a mostly uplifted crystalline basement about 45 km in diameter, consisting of mainly granitoid gneisses and incorporates highly metamorphosed shales, ironstones, and mafic to ultramafic lavas (Reimold & Gibson, 2010). The Vredefort structure is recognised as an eroded residue of a very complex impact crater based on its circular configuration, uplifted central core and occurrences of shatter cones, high-pressure quartz polymorphs (coesite and stishovite) and shock planar micro-deformation features in quartz and zircon grains (Wieland et al. 2005). The original crater was about 300 km across, but the structure is today vastly eroded, with 5 to 11 km of the vertical material eroded (McCarthy et al. 1990; Gibson & Wallmach, 1995; French, 1998; Gibson, 2002).

The rocks of the Vredefort structure are excellently exposed in the northern and north-western parts of the structure but are mostly buried below younger rock formations in the south and south-east parts (Reimold & Gibson, 2010). In these parts, the surface cover is extensive fertile soil that developed from underneath shales and dolerite intrusions of the 300-180 million-year-old Karoo Supergroup. However, it has been corroborated by geophysical investigations and other geological studies that the older rocks occur close to the surface under this cover. This central region is enclosed by a roughly 20 km extensive collar, consisting of usually vertical, or overturned, sedimentary and volcanic rock layers of the Dominion Group (3.074 Ga), as well as the Witwatersrand (2.650-2.710 Ga), Ventersdorp ( $\sim 2.710$  Ga), and Transvaal (2.650-2.150 Ga) Supergroups (Reimold & Gibson, 2010).

The Vredefort structure has been studied in considerable detail, especially after it was confirmed that it was formed by a meteorite impact in the mid-1990s (Kamo et al. 1996). Some studies focused on identifying Vredefort impact ejecta, whether proximal impact ejecta or distal impact ejecta and so far, only two Vredefort distal impact ejecta have been discovered. The first is within the Grænsesø impact spherule layer in Greenland, but due to poor chronological constraints, this layer could also be related to the Sudbury impact (Chadwick et al. 2001). The Grænsesø impact spherule layer also has insufficient indicators for a meteorite impact, namely PGE's, shock-metamorphic features and a low Ir concentration of 0.02 ppb. The second Vredefort distal impact ejecta deposit was discovered in the Zaonega Formation in Russia based on a moderate Ir concentration of 0.75 ppb and a meteoritic Ru/Ir ratio of 2 (Huber et al. 2014). The age of the Zaonega Formation is variously constrained at  $1.975 \pm 0.024$  Ga (Sm-Nd),  $1.980 \pm 0.057$  Ga (Pb-Pb), and 2.050 Ga (Re-Os) and, as such, occurs within the  $\sim 2.02$  Ga age of the Vredefort impact (Huber et al. 2014).

Although Vredefort distal impact ejecta has been discovered, Vredefort proximal impact ejecta has never been discovered. Compared to the Chicxulub impact structure, a structure of this magnitude should probably have produced proximal impact ejecta as part of an impact ejecta layer over a regional to a global distance of Earth. Compared to the Vredefort meteorite, the Chicxulub structure was formed by an impactor with a 10 to 12 km diameter (Hilderbrand et al. 1991; Sharpton et al. 1993; Morgan & Warner, 2002; Claeys, 2006). The ejecta formed by the Chicxulub impact was distributed worldwide, marking the K-Pg stratigraphic boundary (Claeys et al. 2002; Smit, 2003). The continuous impact ejecta blanket of the Chicxulub

structure occurs from the crater margin to Belize, well over 400 km from the crater rim (Ocampo et al. 2002). Given its large-scale parameters compared to the Chicxulub impact, the Vredefort impact event would have probably formed impact ejecta that would have potentially been distributed worldwide and at least identifiable from the crater margin of the Vredefort structure to several hundreds of kilometres away from the crater margin.

## 1.7 Focus on the geology of the research area

Anomalous spherical to subspherical, dark red to brown concentric objects ca. 15 mm in apparent diameter are found in the Maremane Dome of the Transvaal Supergroup, Northern Cape province in South Africa. The anomalous objects have been observed in drill cores and outcrops at different locations along strike for more than 60 km (Gutzmer & Beukes, 1998). The objects have previously been interpreted as hematite-rich pisolites formed by laterization. The anomalous objects occur in the Doornfontein Conglomerate Member, which is part of the Gamagara Formation and interpreted to be a conglomerate unit consisting of conglomerates and shales. The Doornfontein Conglomerate Member has previously been interpreted to have formed by erosion and karstification of the Maremane Dome during the tectonic uplift (Grobelaar et al. 1995; Carney & Mienie, 2003). The base of the Doornfontein Conglomerate Member has an erosional unconformity referred to as the pre-Gamagara unconformity. Underlying the Doornfontein Conglomerate Member is the Wolhaarkop Breccia, which is a breccia unit belonging to the Ghaap Group and interpreted as a collapse breccia formed by the collapse of banded iron formations of the Asbestos Hills sub-group into sinkholes formed by the dissolution and karstification of the dolomites of the Ghaap Group (Carney & Mienie, 2003; Smith & Beukes, 2016). The Doornfontein Conglomerate Member, anomalous objects and Wolhaarkop Breccia stratigraphically occur between the 1.93 Ga (Cornell et al. 1998) andesitic lavas of the Hartley Formation and  $2.22 \pm 13$  Ga (Cornell et al. 1996) Ongeluk Formation. Thus, the deposits occur within a permissible window of time of formation of the Vredefort structure (~2.02 Ga). They also occur within an expected distance from the Vredefort structure for the Vredefort proximal impact ejecta. More information with figures about the Gamagara Formation, Doornfontein Conglomerate Member and Wolhaarkop Breccia will be provided in Chapter 2.

Although the above interpretations are geologically sound, they appear to be controversial because they do not fully explain the observations and occurrences of the anomalous objects and features characterising the Doornfontein Conglomerate Member and Wolhaarkop Breccia. The following reasons force us to reconsider the existing interpretations of the formation of the cited geological formations:

- The Wolhaarkop Breccia appears to possess the following characteristics: (1) consists of inclusion of local rocks as clasts in a clay-rich matrix; (2) shows alteration of the local substrate during deposition, and; (3) consists of two types of breccias, namely the upper polymict breccia and lower monomict breccia. These characteristics are similar to those of breccias formed by impact processes and may similarly suggest that impact processes may have played a role in forming the Wolhaarkop Breccia. In addition, there are identical outcrops along strike throughout the Maremane Dome, which would require an enormous cave system that would somehow collapse symmetrically across the entire 150 km long section, which is unrealistic.
- The Doornfontein Conglomerate Member appears not to be a conglomerate unit consisting of conglomerates and shales and formed by erosion and karstification. Instead, the Doornfontein Conglomerate Member appears to consist of angular clasts of shale, quartz, hematite, chert and serpentine, angular very-grained lithic rock fragments and the anomalous spherical to subspherical objects in a clay-rich matrix forming a matrix-supported breccia. The matrix-supported breccia is similar to breccias formed by impact processes.



- The anomalous objects' large size and concentric structure suggest that they are not pisolites formed by laterization. Instead, the anomalous objects resemble accretionary lapilli.

## 1.8 Aims

This study will investigate drill core samples from the Doornfontein Conglomerate Member in the Maremane Dome to determine their possible association with the Vredefort structure. The investigation uses petrographic and geochemical methods, describing the lithology, mineralogy, geochemistry and petrography of the Doornfontein Conglomerate Member and anomalous objects to better understand how they formed. The investigation focuses on examining shocked mineral grains in the samples, especially quartz and zircon grains, and shock-metamorphic features, mainly PDFs and planar fractures, in shocked grains. The investigation also analysed the samples for meteorite geochemical signatures, precisely Ir, Ni, Co and Cr. The Wolhaarkop Breccia was only be investigated by direct observations of outcrops in the field and drill cores. The final goal of the study was to test the hypothesis that these deposits could be from the Vredefort structure. (The anomalous concentric objects will be referred to as accretionary lapilli starting from Chapter 2).



## Chapter 2: Geological Setting

The drill core samples in this study are collected from the Doornfontein Conglomerate Member in the Maremane Dome in the Griqualand West Basin of the Transvaal Supergroup, South Africa. The Transvaal Supergroup was deposited in a vast epeiric sea on top of the Kaapvaal Craton from ~2.7 to 2.0 Ga (Beukes, 1983). The Transvaal Supergroup is ~15 km thick and contains chemical and clastic sedimentary rocks and volcanic rocks preserved in three discrete basins: (1) Transvaal Basin; (2) Griqualand West Basin, and; (3) Kanye Basin (Figure 5) (Beukes, 1983).

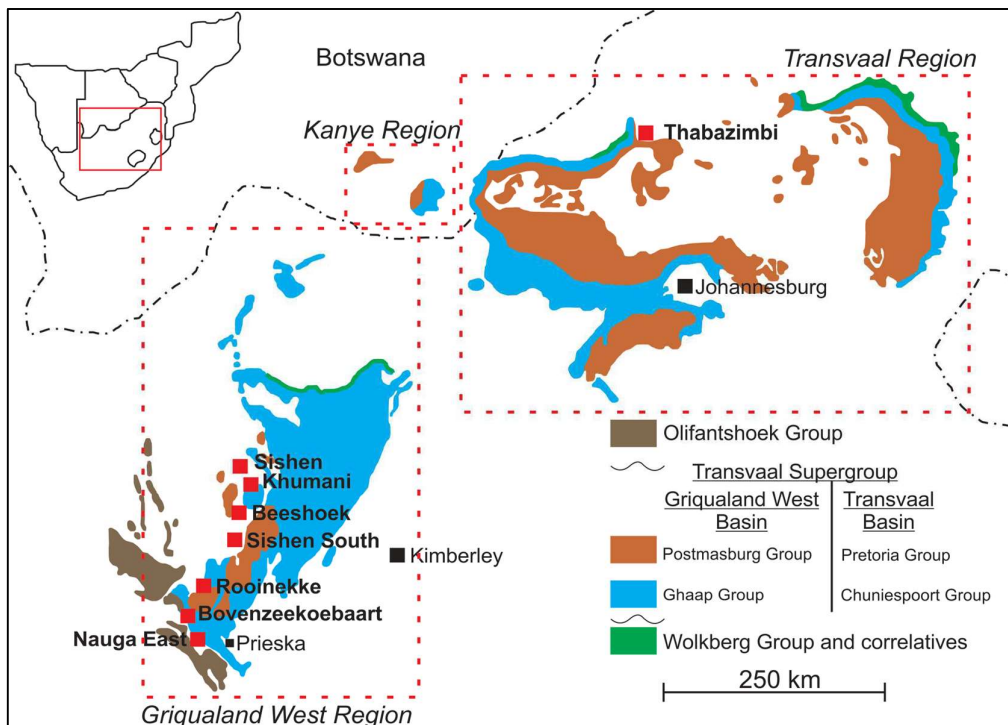


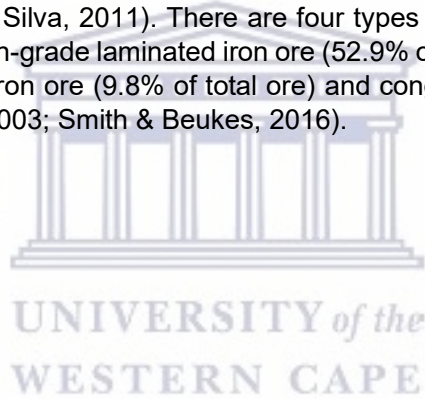
Figure 5: A simplified geological map of the Transvaal Supergroup (Smith & Beukes, 2016). Note the Transvaal, Griqualand and Kanye basins and their respective locations.

### 2.1 Regional Geology

The Griqualand West Basin (Figure 6 & Figure 7), to which the Maremane Dome belongs, lies on the southwestern margin of the Kaapvaal Craton. At ~2.4 Ga, the Kheis orogeny along the western margin of the Kaapvaal Craton deformed the Griqualand West Basin and formed large-scale, open folding of the Transvaal Supergroup (Carney & Mienie, 2003). This deformation event initiated the first phase of the Maremane double-plunging anticline (Maremane Dome) (Figure 6) (Carney & Mienie, 2003; Smith & Beukes, 2016). More compression from the Kheis orogeny between 2.0 and 1.7 Ga resulted in intense erosion of pre-existing structures on the edge of the Kaapvaal Craton (Visser, 1998). The Maremane anticline underwent more uplift, erosion and karstification and facilitated the deposition of the Gamagara Formation and the formation of the Olifantshoek Group (Carney & Mienie, 2003). Coeval with the uplift and erosion, dissolution and karstification occurred in dolomites of the Ghaap Group (Figure 6 & Figure 7). The dolomites locally formed deep sinkholes, resulting in the overlying banded iron formations of the Asbestos Hills sub-group collapsing into them (Figure 6 & Figure 7) (Carney & Mienie, 2003; Smith & Beukes, 2016). The collapse formed the Wolhaarkop Breccia, which occurs between the dolomites of the Campbell Rand sub-group and the banded iron formations of the Asbestos Hills sub-group (Figure 7).

The Gamagara Formation is considered the base of the ~2.1 to 1.83 Ga Olifantshoek Group and unconformably overlies the Ghaap Group (Figure 6 & Figure 7) (Van Schalkwyk & Beukes, 1986; Friese & Alchin, 2007). The Gamagara Formation consists of, from base to top, the Doornfontein Conglomerate Member, Sishen Shale Member, Marthaspoort Quartzite Member, and Paling Shale Member and is also known as Lucknow and Mapedi Formations (Figure 7) (Grobbelaar et al. 1995). The Doornfontein Conglomerate Member consists of shales and conglomerates (Figure 7) and shows upward-fining cycles (Van Schalkwyk & Beukes, 1986). The Sishen Shale Member consists of interbedded shales (Figure 7) and shows a transgression cycle (Grobbelaar et al. 1995). The base of the Doornfontein Conglomerate Member has an erosional unconformity referred to as the pre-Gamagara unconformity (Figure 6 & Figure 7). Two additional transgression cycles are shown by the Marthaspoort Quartzite Member and Paling Shale Member. The Gamagara Formation has been thrust over by the Makganyene Formation (Postmasburg Group) (de Villiers & Visser, 1977) and Ongeluk Formation (Postmasburg Group) (Figure 6) (Schütte, 1992). Stratigraphically, the Gamagara Formation is overlain by andesitic lavas of the Hartley Formation (Figure 7) dated 1.93 Ga (Cornell et al. 1998). The Ongeluk Formation also consists of andesitic lavas dated  $2.22 \pm 13$  Ga (Cornell et al. 1996).

The Maremane Dome (Figure 6) contains significant amounts of high-grade iron ore and is mainly comprised of dolomites of the Campbell Rand sub-group and iron deposits of the Asbestos Hills sub-group (da Silva, 2011). There are four types of iron ores identified in the Maremane Dome, namely high-grade laminated iron ore (52.9% of total ore), massive iron ore (28.8% of total ore), breccia iron ore (9.8% of total ore) and conglomeratic iron ore (8.6% of total ore) (Carney & Mienie, 2003; Smith & Beukes, 2016).



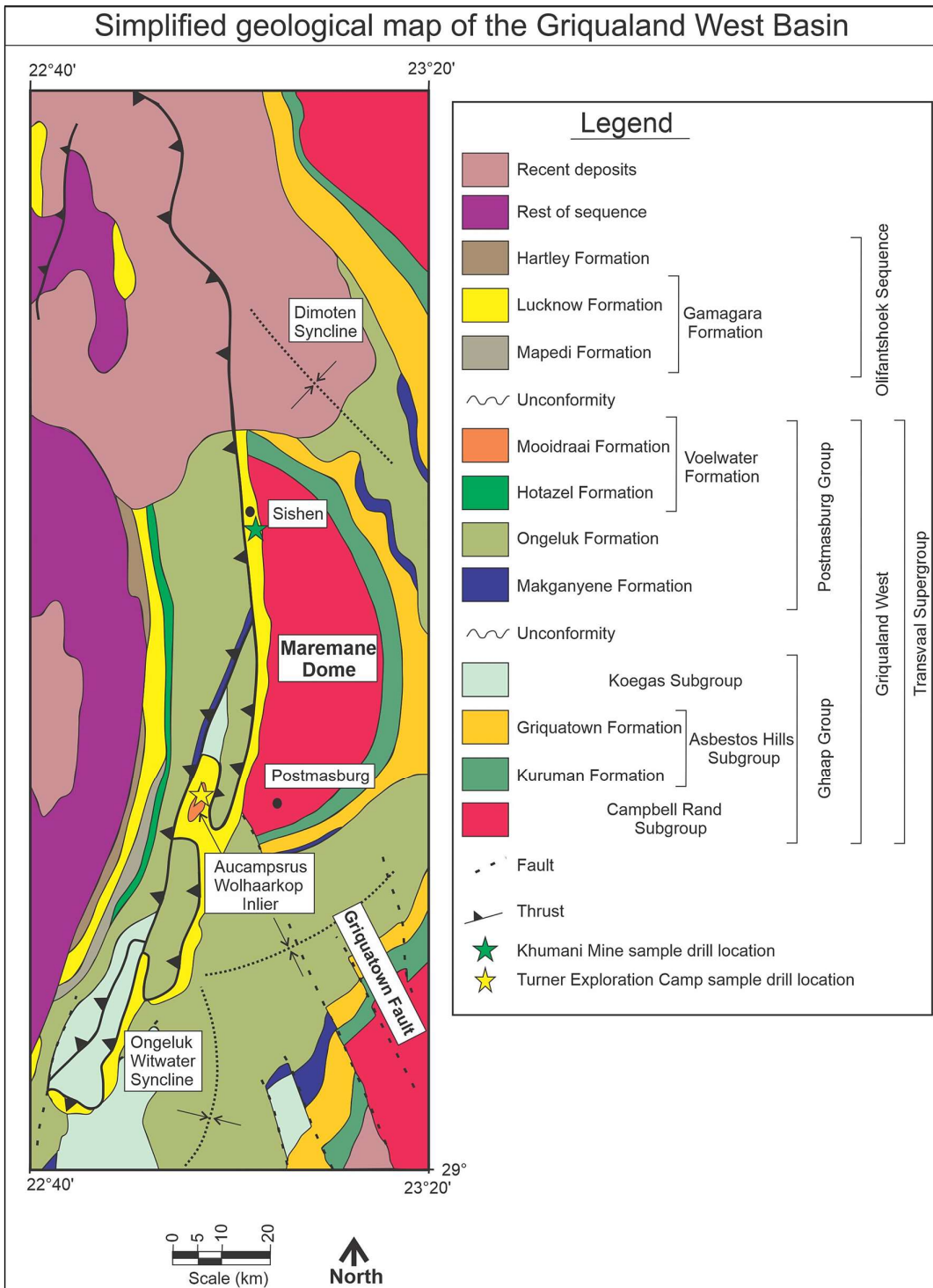


Figure 6: Simplified geological map of the Griqualand West Basin. Note the Maremane Dome and locations of the study areas, Khumani Mine (green star) and Turner Exploration Camp (yellow star) in the Gamagara Formation of the Griqualand West Basin. Figure modified after Grobelaar et al. (1995).

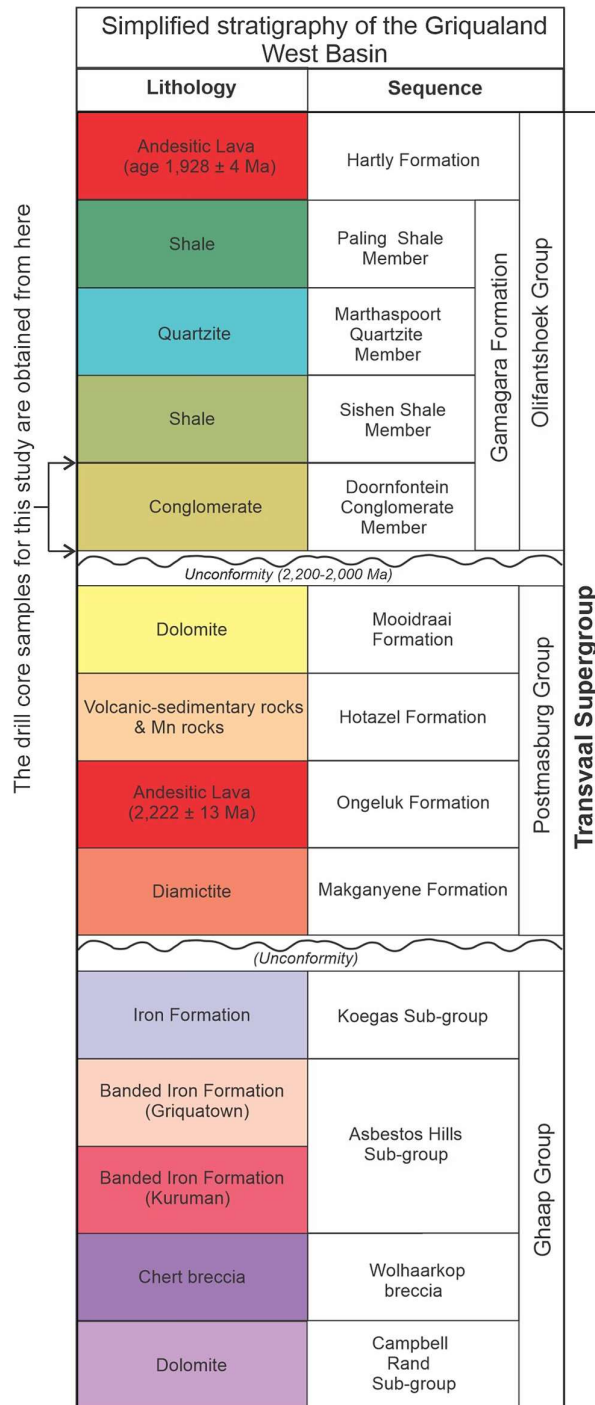


Figure 7: Simplified stratigraphy of the Griqualand West Basin. Observe that the drill core samples for this study are collected from the Doornfontein Conglomerate Member.

## 2.2 Study Areas

The drill core samples in this study are from Khumani Mine near Sishen and Turner Exploration Camp near Postmasburg in the Northern Cape (Figure 6 & Figure 8). The samples from Khumani Mine are ~447 km from the centre of the Vredefort structure, whereas those from Turner Exploration Camp are ~459 km away. The lower and upper diameter limits of the Vredefort structure are 180 km and 300 km, respectively (Morrow, 2009). Using the 180 km diameter, the samples from Khumani Mine are 4.9 crater radii from the centre of the Vredefort

structure and 5.1 crater radii away for Turner Exploration Camp (Figure 8). Using the 300 km diameter, the samples from Khumani Mine are 3.0 crater radii from the centre of the Vredefort structure and 3.1 crater radii away for Turner Exploration Camp (Figure 8).

### **2.2.1 Khumani Mine**

The drill core samples from Khumani Mine form part of a drill core that Assmang Limited drilled near the northern margin of the Maremane Dome (Figure 6). The hole number of the drill core is ACK1\_21, and the depth is from 0 to 160.57 m and at 27°52'23.40"S 22°59'57.80"E. From the bottom to the top, the drill core intersected the Wolhaarkop Breccia (depth from 158.68 to 160.57 m), Doornfontein Conglomerate Member (depth from 103.14 to 158.68 m), Sishen Shale Member (depth from 86 to 103.14 m), Marthaspoort Quartzite Member, Paling Shale Member and Kalahari Tertiary cover. The accretionary lapilli (anomalous objects) are found at depth ~106 to 107 m and form part of the Doornfontein Conglomerate Member.

### **2.2.2 Turner Exploration Camp**

The drill core samples from Turner Exploration Camp form part of a drill core that Shango Solutions drilled near the southern margin of the Maremane Dome next to the Aucampsrus Wolhaarkop Inlier (Figure 6). The hole number of the drill core is TN00002, and the depth is from 0 to 104 m and at 28°14'13.90"S 22°54'44.60"E. From the bottom to the top, the drill core intersected the Wolhaarkop Breccia (depth from 87 to 104 m), Doornfontein Conglomerate Member (depth from 45 to 87 m), Sishen Shale Member (depth from 42 to 45 m), Marthaspoort Quartzite Member, and Nelani Formation. The accretionary lapilli (anomalous objects) at this site are found at depth ~60 to 71 m and form part of the Doornfontein Conglomerate Member.





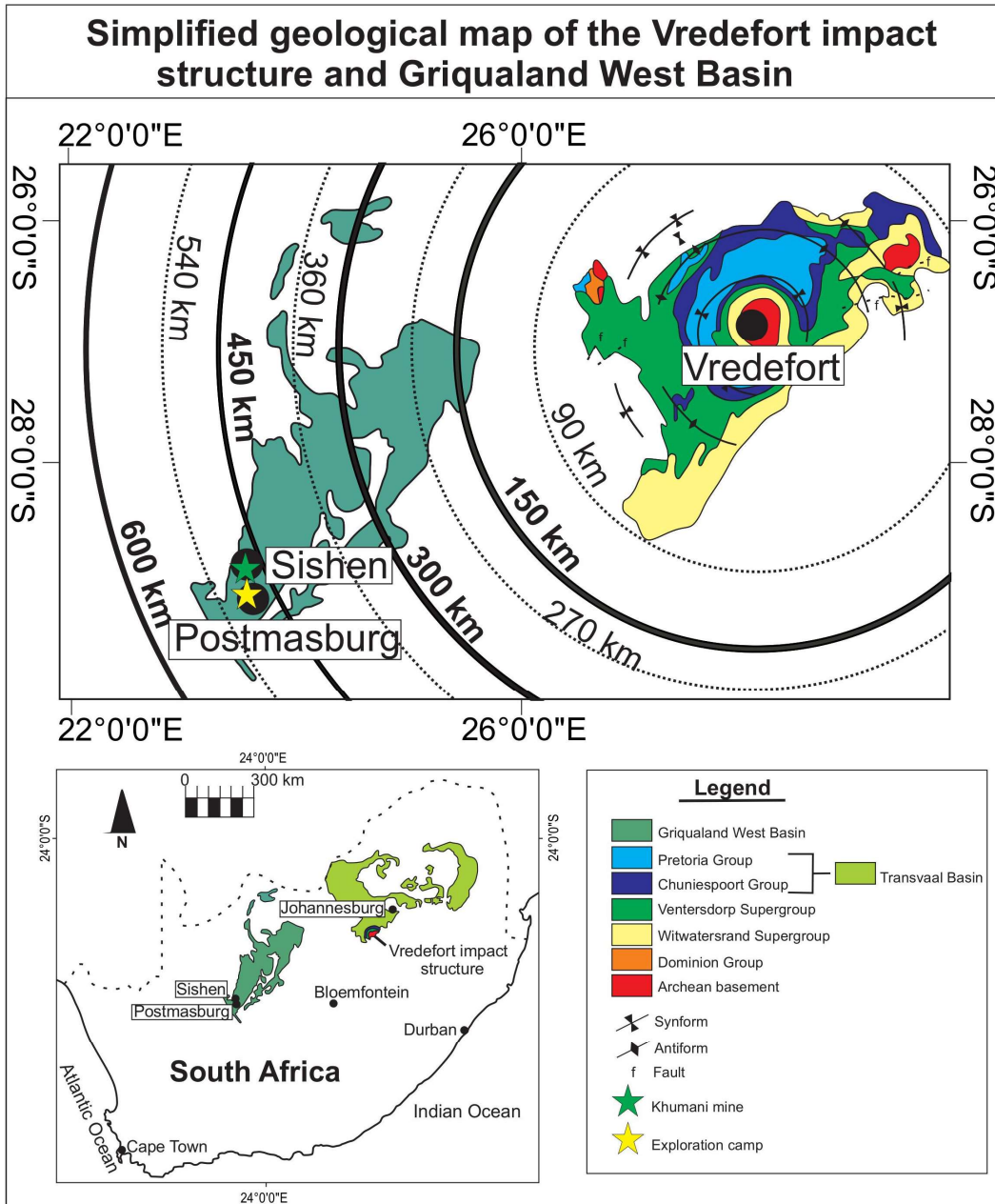


Figure 8: Simplified geological map of the Vredefort impact structure and Griqualand West Basin. The solid lines represent the 300 km upper diameter limit of the Vredefort structure, and the broken lines represent the 180 km lower diameter limit of the Vredefort structure. Note the locations of Khumani Mine (green star) and Turner Exploration Camp (yellow star) in the Griqualand West Basin. The samples from Khumani Mine are ~447 km from the centre of the Vredefort structure, whereas those from Turner Exploration Camp are ~459 km away. Using the 180 km diameter, the samples from Khumani Mine are 4.9 crater radii from the centre of the Vredefort structure and 5.1 crater radii away for Turner Exploration Camp. Furthermore, using the 300 km diameter, the samples from Khumani Mine are 3.0 crater radii from the centre of the Vredefort structure and 3.1 crater radii away for Turner Exploration Camp. Figure modified after Grobelaar et al. (1995) and Turtle and Pierazzo (1998).

## **Chapter 3: Methodology**

This chapter describes how sampling was conducted and provides petrographic and geochemical methods used for this study.

### **3.1 Sampling**

A total of 24 representative drill core samples were selected for collection. Six samples were collected from Khumani Mine on the 15th of October 2020, and the remaining 18 from Turner Exploration Camp on the 16th of October 2020.

#### **3.1.1 Khumani Mine**

The drill core samples from Khumani Mine are ACKS1, ACKS2, ACKS3, ACKS4, ACKS5, and ACKS6, occur from depth 106 to 108 m and form part of the Doornfontein Conglomerate Member (Figure 6 & Figure 7). The samples ACKS1, ACKS2 and ACKS3 have accretionary lapilli.

#### **3.1.2 Turner Exploration Camp**

The drill core samples from Turner Exploration Camp are TNS1 to TNS18, occur from depth ~60 to 86 m and form part of the Doornfontein Conglomerate Member (Figure 6 & Figure 7). The samples TNS1, TNS2, TNS3, TNS4 and TNS5 have accretionary lapilli. The samples from both study areas and the Wolhaarkop Breccia from Turner Exploration Camp were initially examined by direct observations at the study areas to determine their lithology, composition, and texture. The samples were further examined by direct observations back at the University of the Free State to examine their other characteristics, including the number of accretionary lapilli in each sample. Furthermore, Fe (wt.%) abundances of the samples from Khumani Mine were estimated at the University of the Free State based on direct estimations of how much Fe each sample contains. Fe (wt.%) abundances of the samples from Turner Exploration Camp were provided to this study by Jonathan Hainsworth, an official from Turner Exploration Camp. The assay method used to analyse the drill core at Turner Exploration Camp is XRF Fused Bead at the Société Générale de Surveillance (SGS) Laboratory, located at United Manganese of Kalahari (UMK) Mine near Hotazel in the Northern Cape Province, South Africa.

## **3.2 Petrography**

The petrographic instruments used for this study are optical microscopy and scanning electron microscopy.

### **3.2.1 Optical Microscopy**

In geology, optical microscopy is used to identify rocks, minerals, and other geological features using 30  $\mu\text{m}$  thin sections. For this study, optical microscopy was used at the University of the Western Cape to examine 24 thin sections for shocked mineral grains, especially quartz and zircon grains and shock-metamorphic features, mainly PDFs and planar fractures in quartz and zircon. Optical microscopy was further used to determine the thin sections' mineral compositions and petrographic characteristics. The thin sections were studied in cross polarised light and plane polarised light, and their photomicrographs were taken.

### **3.2.2 Scanning Electron Microscopy**

Scanning Electron Microscopy (SEM) uses thin sections for imaging by scanning a specimen with a beam of electrons and displaying the signal from the electron detector as images on a computer monitor (Reed, 2005). Based on a detection mode, either compositional or topographic data can be obtained. Secondary-Electron (SE) images provide topographic



information, while backscattered-electron (BSE) images provide compositional (Z-contrast) information about the specimen (Reed, 2005). For elemental mapping and analysis, an EDS (energy dispersive spectroscopy) is used.

SEM was used in this study to examine the polished thin sections. Accordingly, the SEM instrument Zeiss Merlin Gemini 2 was used at Stellenbosch University in South Africa to examine carbon-coated thin sections of the samples TNS1 and TNS18 in BSE. Overview BSE images and compositional EDS maps of these thin sections and carbon-coated thin sections of the samples ACKS1 and TNS2 were also obtained. The petrographic characteristics and mineral compositions of the thin sections were also examined. The SEM instrument was operated under a 9.3 to 9.5 mm working distance and a 10 to 20 kV excitation voltage.

### **3.3 Geochemistry**

Three geochemical methods, namely X-ray fluorescence spectroscopy, instrumental neutron activation analysis and Raman spectroscopy, were used to analyse the samples.

#### **3.3.1 X-Ray Fluorescence Spectroscopy**

X-Ray Fluorescence (XRF) spectroscopy is an analytical method where fluoresced X-rays emitted by a sample are presented with either wavelength-dispersive or energy-dispersive detector systems. The wavelength of the emitted X-rays determines elements, and the intensity of the emitted X-rays determines their concentrations. Thus, XRF is an analytical instrument used for qualitative and quantitative geochemical analysis. For more information about XRF, see Gill (1997) and Verma (2007). The samples in this study were analysed for major elements and trace elements using XRF spectroscopy at the University of Vienna, Austria. For sample preparation, the samples were crushed in an agate mortar and pestle and ground to a homogenous powder in an agate ball mill. Water, carbon dioxide, and other volatiles were released from the powder using powder aliquots dried at 110 °C in a muffle furnace. Loss of ignition (LOI) was determined at 110°C, 850°C and 1050°C and the ignited powder was mixed with lithium metaborate flux, and the subsequent melt dissolved in HNO<sub>3</sub>. Fusion discs were used to analyse major elements and pressed powder pellets for trace elements.

#### **3.3.2 Instrumental Neutron Activation Analysis**

Instrumental Neutron Activation Analysis (INAA) is an analytical method that requires no chemical preparations of samples (Taylor, 2001). In INAA, a sample is subjected to a high flux of neutrons in a nuclear reactor and releases radioactive isotopes that usually decay by beta decay (Taylor, 2001). The emission of radioactive isotopes and radioactive decay for each element is known, so utilising this information, INAA is used for qualitative and quantitative analysis of isotopes. INAA was used at the University of Vienna to analyse the 24 samples in this study for meteorite geochemical signatures (trace elements), especially Ir, Ni, Co and Cr, and major elements. For sample preparation, the samples were first crushed in plastic sample bags, then crushed using a jaw crusher and later crushed to powder with an automatic agate mill. Aliquots were placed into polyethylene vials, irradiated within a nuclear reactor and left to cool before they were cleaned with hot water, NaOH and HCl to eliminate contamination. See Koeberl (1993) and Koeberl and Huber (2000) for more information about sample preparation and analytical procedures for INAA.

#### **3.3.3 Raman Spectroscopy**

Raman spectroscopy is an analytical technique that uses focused or non-focused laser radiation to illuminate a specimen, usually a thin section, to provide information about atomic bonds (Foucher et al. 2021). Raman spectroscopy is generally integrated with an optical microscope to enable the localisation of interest areas and perform analyses at the micrometre

scale (Foucher et al. 2021). During the illumination, Raman spectra are generated for which the footprint can vary from roughly one micron to hundreds of microns in a cross-section diameter (Raman & Krishnan, 1928; Lewis & Edwards, 2001; Edwards et al. 2013). Raman spectra are two sets of wavelength-shifted bands occurring at the frequency of the incident laser radiation from the Rayleigh line, in which the long-wavelength set of Raman bands consists of the Stokes Raman spectrum, whereas the low-wavelength set consists of the anti-Stokes Raman spectrum and is weaker in intensity than the Stokes Raman spectrum (Edwards, 2000; Edwards & Carter, 2001; Edwards et al. 2013).

### **Titanium dioxide**

Titanium dioxide (TiO<sub>2</sub>), the only naturally occurring titanium oxide (Ti-oxide) at atmospheric pressure, has three polymorphs: (1) rutile; (2) anatase and; (3) brookite and can hold a wide range of minor elements, which reflect their crystallisation environments (Meinhold, 2010; Adlakha et al. 2020). Rutile is a stable phase, but both anatase and brookite are metastable (Curnan & Kitchin, 2015; Plavsa et al. 2018; Adlakha et al. 2020; Pinto et al. 2020). Rutile has been found in high-and low-temperature conditions, but anatase has only been found in low-temperature environments (Adlakha et al. 2020). Regardless of polymorph stability, rutile is the most frequent Ti-oxide polymorph in the Earth's crust (Meinhold, 2010). It can be found in metamorphic rocks ranging from greenschist to granulite and eclogite; in sedimentary rocks as detrital and authigenic grains; in igneous rocks, mainly evolved granitic rocks; and in hydrothermally altered rocks and metallic mineral deposits (Černý et al. 1989; Schandl et al. 1990; Scott, 2005; Agangi et al. 2019). Naturally occurring rutile and its chemical variability have been studied for a long time, particularly concerning the substitution of Ti by high field strength elements (HFSE), like Nb and Ta, of which it is a significant host stage (Pinto et al. 2020). Therefore, the chemical element contents of rutile provide a tool for understanding geochemically fingerprinting processes like magmatism or metamorphism (Foley et al. 2002; Win et al. 2017). In comparison to metamorphic and magmatic origins, hydrothermal rutile has received fewer studies, as seen by the scarcity of references (Rabbia et al. 2009; Cabral et al. 2011; Cabral et al. 2013; Shulaker et al. 2015). The studies compared the results of various thermometric techniques used to study rutile crystallisation in hydrothermal quartz-dominated veins. Because Ti is insoluble in most aqueous fluids, rutile is usually resistant to hydrothermal modification once it has crystallised (Pinto et al. 2020).

Because of its relationship with low-temperature and aqueous environments such as diagenetic sedimentary systems, anatase has not received the same level of interest from geoscientists as rutile (Brindley & Robinson, 1947; Nagelschmidt et al. 1949; Raman & Jackson, 1965). Anatase is a common authigenic mineral in siliciclastic sedimentary rocks, and it is most likely formed by the breakdown of detrital titaniferous minerals such as Ti-rich oxides, biotite, and titanite (Morad & Aldahan, 1986; Pe-Piper et al. 2011). The temperature-induced phase transition of anatase to rutile has been studied under various experimental conditions, but there are no investigations on rutile to anatase conversions in the scientific literature (Pinto et al. 2020).

Part of the goal of this study was to use Raman spectroscopy to analyse the thin sections TNS1 and TNS18 to identify different naturally-occurring TiO<sub>2</sub> polymorphs, specifically rutile and anatase, and evaluate them in relation to hydrothermal activity and alteration in the samples. Target zones were marked on the thin section for analysis. A Horiba LabRAM HR800 Evo Raman Microscope was used to gather the Raman spectra of the targeted phases at the Zavaritsky Institute of Geology and Geochemistry Ural Branch of the Russian Academy of Science in Russia. The chosen objective was paired with a He-Ne laser source with an excitation of 633 nm, granting 600 gr/mm.

## Chapter 4: Results

This chapter provides results for sampling, petrography and geochemistry. The samples from both study areas have been categorised into three lithofacies based on their lithology and composition, namely Unit A, Unit B and Unit C. Unit C is only found in the samples from Turner Exploration Camp.

### 4.1 Khumani Mine

The samples from Khumani Mine are described below, and their results are presented in Table 1 for sample and accretionary lapilli descriptions for sampling. For more information on Khumani Mine, see Appendix A.1 for sample photos, Appendix A.2 for thin section photos and Appendix A.3 for scanning electron microscopy photomicrographs.

#### 4.1.1 Sample description

The samples from Khumani Mine are from the Doornfontein Conglomerate Member. The samples are ferruginous, dark red to brown, and matrix-supported breccias with angular clasts of quartz, shale, hematite, chert, and serpentine (Figure 9). The matrix is clay-rich, with the clasts varying from 1 to 3 mm in size. Pyrite clasts, joints dipping at  $\sim 40^\circ$  and quartz veins seldomly occur within the samples. The breccias show no signs of sediment reworking and form Unit A occurring from depth 108 to 155 m. From depth 105 to 108 m, the matrix of the breccias contains ferruginous, spherical to subspherical and dark red to brown accretionary lapilli. The accretionary lapilli constitute a component of an accretionary lapilli-rich breccia called Unit B and overlie Unit A. Unit B transitions above Unit A seamlessly without a grade change or contact.



Figure 9: A photograph of sampled drill core at Khumani Mine.

#### Accretionary lapilli

The observed accretionary lapilli have been categorised into four types based on their form: (1) nucleated accretionary lapilli; (2) non-nucleated accretionary lapilli; (3) accretionary lapilli with irregular margins, and; (4) accretionary lapilli fragments (Figure 10). The composition of



the accretionary lapilli is hematite, but small amounts of quartz occur in some accretionary lapilli. Some accretionary lapilli, especially nucleated accretionary lapilli, contain angular, very fine-grained lithic rock fragments.

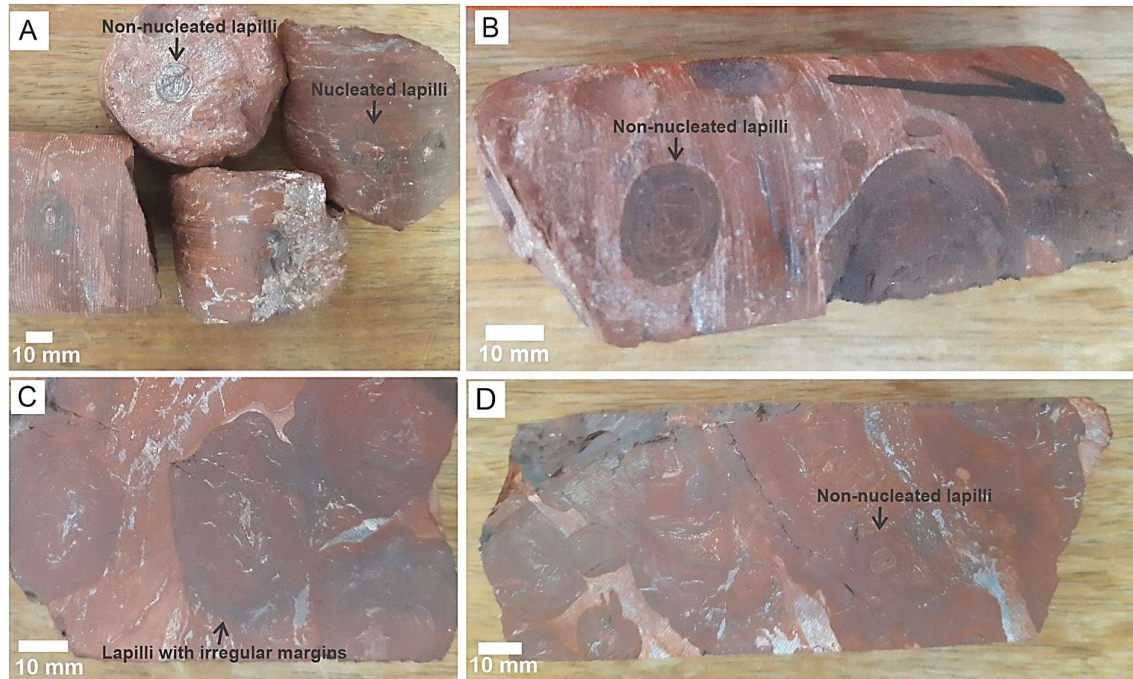


Figure 10: (A-D) Photographs of dark red to brown samples with accretionary lapilli collected from Khumani Mine. The samples are ferruginous, clay-rich, matrix-supported breccias; the black arrows indicate the accretionary lapilli. (A) Spherical to subspherical, dark red to brown nucleated accretionary lapilli with a concentric structure consisting of nuclei, mantles and crusts. (A & B) Spherical non-nucleated accretionary lapilli with a concentric structure consisting of mantles, crusts and no nuclei. (C) Accretionary lapilli with irregular margins (irregular accretionary lapilli) with a concentric structure comprised of mantles, crusts and no nuclei. Note subtle concentric layering formed by alternating hematite- and quartz-rich concentric layers. (D) Non-nucleated accretionary lapilli surrounded by irregular accretionary lapilli.

### Nucleated accretionary lapilli

The nucleated accretionary lapilli are the most common accretionary lapilli in the samples and consist of a concentric structure comprising nuclei, mantles, and crusts (Figure 10). However, the concentric structure of some of the nucleated accretionary lapilli does not have a crust. The nucleated accretionary lapilli are spherical to subspherical and have long and short apparent diameters that vary between 8.0 and 15 mm and 5.0 and 14 mm, respectively (Figure 10). The nuclei of the nucleated accretionary lapilli are on-centre, and their long and short apparent diameters vary from 1.0 to 9.0 mm and 1.0 to 7.0 mm, accordingly (Figure 10). The nuclei are subround to round, spherical to subspherical, and composed of hematite, but a few are composed of very fine-grained quartz grains (Figure 10). Approximately 3.0 mm thick, very fine-grained lithic rock fragments rarely occur in some nuclei.

The nucleated accretionary lapilli typically have coarse-grained nuclei, medium-grained mantles and fine-grained crusts and result in the accretionary lapilli grading outward in grain size. They also usually have a sharp transition between the nuclei and the mantles. The concentric structure of the nucleated accretionary lapilli also consists of alternating hematite- and quartz-rich concentric layers that typically occur in the mantles and less in the crusts. The concentric layers can reach five layers within individual mantles and crust. The mantles consist of hematite, and their apparent thickness varies from 2.0 to 5.0 mm (Figure 10). The crusts vary from 1.0 to 5.0 mm in apparent thickness and are typically darker than the mantles and nuclei (Figure 10).

### **Non-nucleated accretionary lapilli**

The second most common accretionary lapilli in the samples are non-nucleated accretionary lapilli. The non-nucleated accretionary lapilli are similar to nucleated accretionary lapilli in that they consist of a concentric structure comprising mantles, crusts and no nuclei (Figure 10). The non-nucleated accretionary lapilli are dark red to brown, consist of only hematite and are one of the largest accretionary lapilli in the samples (Figure 10). The largest example is roughly 30 mm in apparent diameter, which is close to bomb size (Neuendorf et al. 2005), and the smallest example is ~10 mm in apparent diameter (Figure 10). The non-nucleated accretionary lapilli are typically well-round and spherical (Figure 10). The mantles of the non-nucleated accretionary lapilli are fine-grained, ~10 to 20 mm, while the crusts are very fine-grained and 3.0 to 7.0 mm in apparent thickness (Figure 10). Both the mantles and crusts are composed of hematite, and some crusts are darker than the mantles.

### **Irregular accretionary lapilli**

The accretionary lapilli with irregular margins are typically subspherical, deformed, distorted, and the largest observed accretionary lapilli in the samples (Figure 10). For easy reference, the accretionary lapilli with irregular margins are referred to as irregular accretionary lapilli in this study. The long and short apparent diameters of the irregular accretionary lapilli vary from 15 to 40 mm and 10 to 35 mm, respectively (Figure 10). Although the irregular accretionary lapilli are close to bomb size (Neuendorf et al. 2005), they are typically ~25 mm in apparent diameter. The irregular accretionary lapilli have a concentric structure with mantles, crusts and nuclei (Figure 10). However, the concentric structure of most of the irregular accretionary lapilli only has mantles, crusts and no nucleus. The mantles typically have about 15 hematite-rich concentric layers, which also form part of the concentric structure, whereas the crusts contain a few concentric layers, less than 10. A few quartz-rich concentric layers also occur (Figure 10). The mantles are medium-grained and vary from 10 to 35 mm, and the crusts are fine-grained and vary from 4.0 to 10 mm in apparent thickness (Figure 10). The crusts are typically the darkest component of the accretionary lapilli.

The accretionary lapilli fragments are the least common accretionary lapilli in the samples and are derived from broken accretionary lapilli, especially crusts and mantles. The accretionary lapilli fragments are angular and subspherical.

## **4.1.2 Petrography**

The results of petrography for the samples from Khumani Mine are described in this section and provided in Table 2 for sample and accretionary lapilli descriptions for optical microscopy.

### **Optical Microscopy**

The thin sections prepared from Khumani Mine samples are ferruginous and opaque under optical microscopy; therefore, their examination with this instrument was complicated. However, SEM and photographs of the thin sections were used to assist in describing the thin sections. The thin sections are matrix-supported breccias with a clay-rich matrix containing angular clasts of hematite, mica, feldspar, a few fine-grained lithic rock fragments and rarely amorphous silica. Similar to the above sample description section, the breccias form Unit A. Ferruginous, dark red to brown accretionary lapilli forming Unit B and overlying Unit A were also observed with optical microscopy (Figure 11 & Figure 12). Shocked grains and PDFs were not identified in the thin sections.

### **Accretionary lapilli**

The accretionary lapilli identified with optical microscopy are nucleated accretionary lapilli and irregular accretionary lapilli (Figure 11 to Figure 12). Although the accretionary lapilli are widely ferruginous and overprinted by hematite, they preserve their concentric structure. The accretionary lapilli are composed of hematite, but coarse- to very fine-grained amorphous

silica rarely occur in some accretionary lapilli (Figure 11). The identified nucleated accretionary lapilli are spherical to subspherical and round, and their long and short apparent diameters vary from 4.0 to 30 mm and 4.0 to 25 mm, respectively (Figure 11). The nuclei of the nucleated accretionary lapilli are typically well round and spherical to subspherical, and their long apparent diameters vary from 4.0 to 6.0 mm, and their short apparent diameters from 2.0 to 4.0 mm (Figure 11). The nuclei rarely incorporate angular, very fine-grained lithic rock fragments about 2.0 mm thick (Figure 11). The nucleated accretionary lapilli typically have a sharp to gradual transition from coarse-grained in the nuclei to medium-grained in the mantles (Figure 11). A sharp to gradual contact also occurs from medium-grained mantles to fine-grained crusts. The mantles and crusts are 2.0 to 4.0 mm and 1.0 to 2.0 mm thick, respectively (Figure 11). Five to sixteen alternating hematite- and quartz-rich, ~1.0 mm thick concentric layers occur in most mantles and rarely in the crusts. The crusts are typically the darkest component of the accretionary lapilli (Figure 11).

The characteristics of the irregular accretionary lapilli could not be sufficiently determined due to the widespread alteration and opaqueness of the thin sections. However, the irregular accretionary lapilli are the largest observed accretionary lapilli in the thin sections, measuring >30 mm in size (Figure 12). Almost all the observed irregular accretionary lapilli have a concentric structure consisting of mantles, crusts and rarely nuclei (Figure 12). The concentric structure of the irregular accretionary lapilli also consists of about 20 alternating hematite- and quartz-rich concentric layers commonly in the mantles and less common in the crusts (Figure 12).





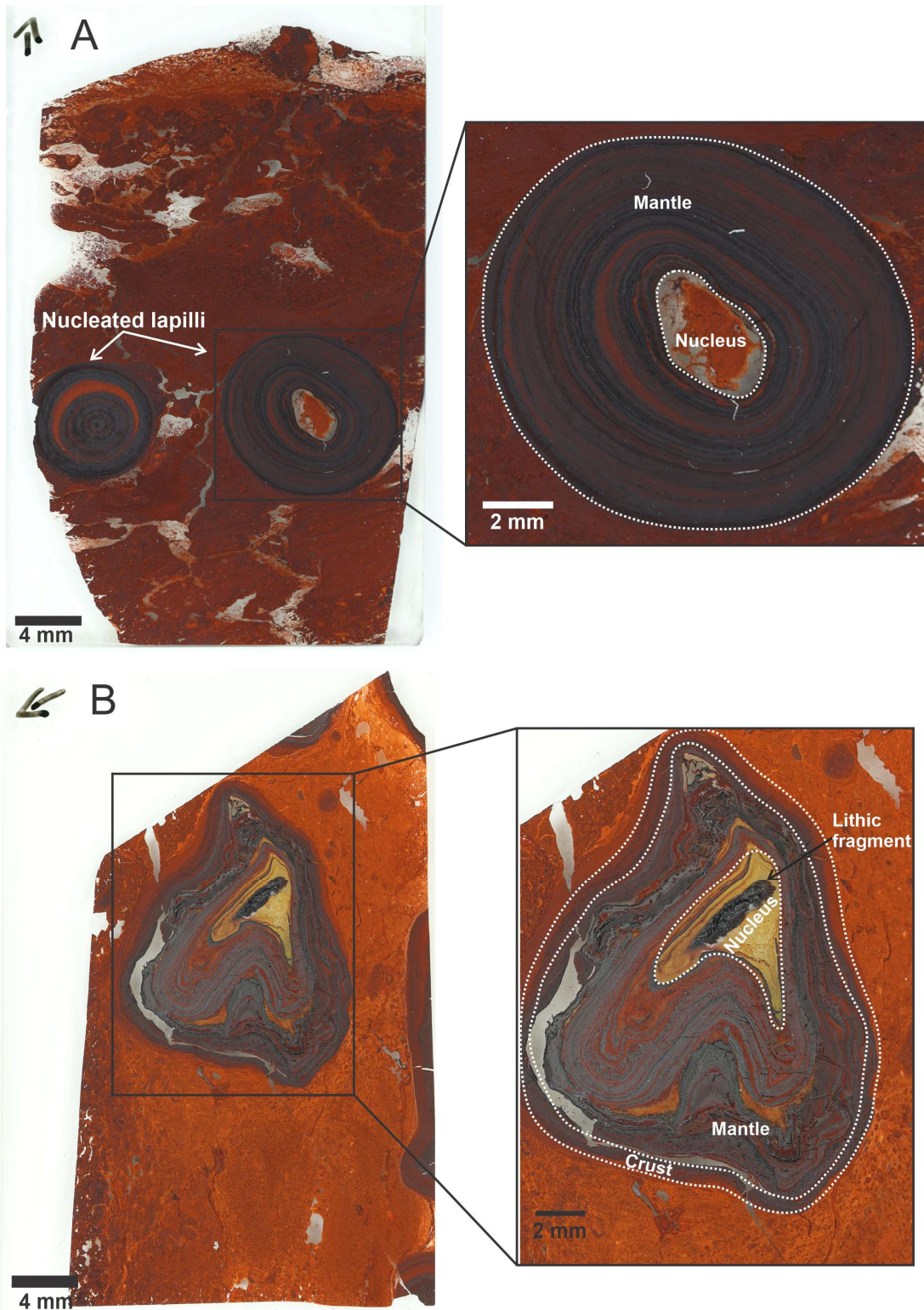


Figure 11: (A-B) Photographs of the thin sections prepared from the samples ACKS1 (A) and ACKS6 (B) with accretionary lapilli. The marked arrows on the left side of the thin sections indicate the direction facing upwards. The thin sections are extensively altered and overprinted by hematite, but the concentric structure of the accretionary lapilli is still present. (A) A spherical nucleated accretionary lapillus with a nucleus, mantle and no crust. Observe the several concentric layering formed by concentric layers predominantly composed of hematite and less quartz. (B) A subspherical nucleated accretionary lapillus with a nucleus, mantle and crust. Notice the



very fine-grained lithic rock fragment in the nucleus, several concentric layers in the mantle and a few concentric layers in the crust.

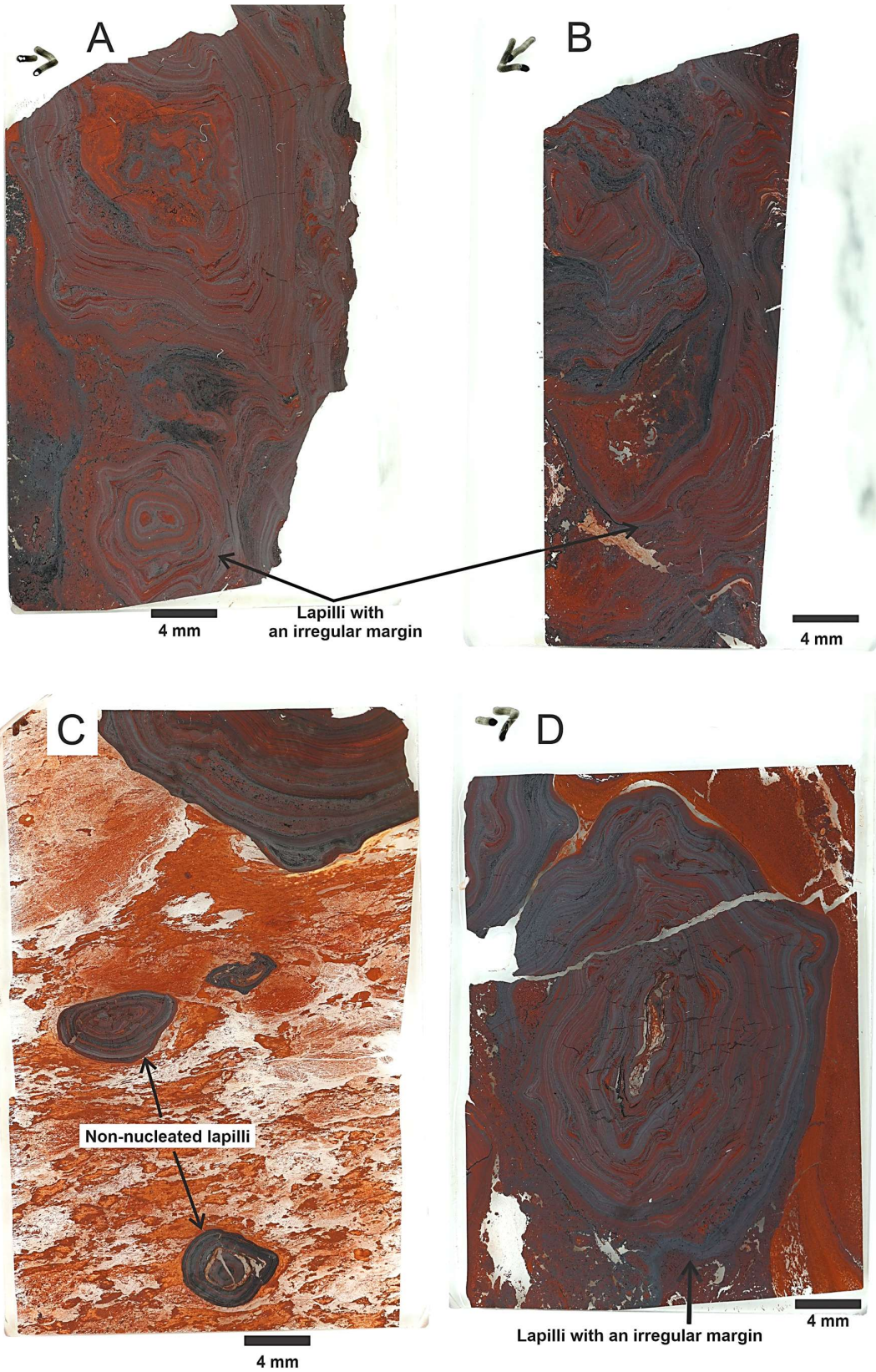


Figure 12: (A-D) Photographs of the thin sections prepared from the samples ACKS4 (A), ACKS4 (B), ACKS3 (C) and ACKS2 (D) with accretionary lapilli. Besides the thin arrows indicating the accretionary lapilli, the thick marked



arrows on the thin sections indicate which direction the thin section is facing upwards. (A-B) Irregular accretionary lapilli with crusts, mantles and no nuclei. The mantles and crusts have several concentric layers. (C) Non-nucleated accretionary lapilli consisting of mantles, crusts and no nuclei. The crusts and mantle contain several concentric layers composed of hematite. (D) A subspherical irregular accretionary lapillus.

### Scanning Electron Microscopy

Two accretionary lapilli (Unit B) ~10 mm in apparent diameter in the thin section ACKS1 were examined and analysed using SEM, and the results are described in this section (Figure 13 & Figure 14). The two accretionary lapilli identified are nucleated and non-nucleated (Figure 13 & Figure 14). The non-nucleated accretionary lapillus contains a concentric structure consisting of a mantle, crust and no nucleus (Figure 13). The crust is the finest-grained component of the accretionary lapillus, and the mantle is the coarsest-grained component. Thus, the concentric structure fines outward in grain size from the mantle to the crust. The accretionary lapillus also has a sharp to gradational contact between the mantle and crust (Figure 13). The accretionary lapillus is extensively altered and overprinted by Fe (hematite), and as a result, the crust and mantle are composed virtually of Fe, less Si and Al, and depleted in K (Figure 13). The crust and mantle contain entrained lithic rock fragments aligned typically parallel to the margins (Figure 13). The concentric structure of the non-nucleated accretionary lapillus also consists of alternating Si (quartz)- and Fe (hematite)-rich concentric layering in the mantle and crust (Figure 13). The concentric layering is thinner in the crust and thicker in the mantle.

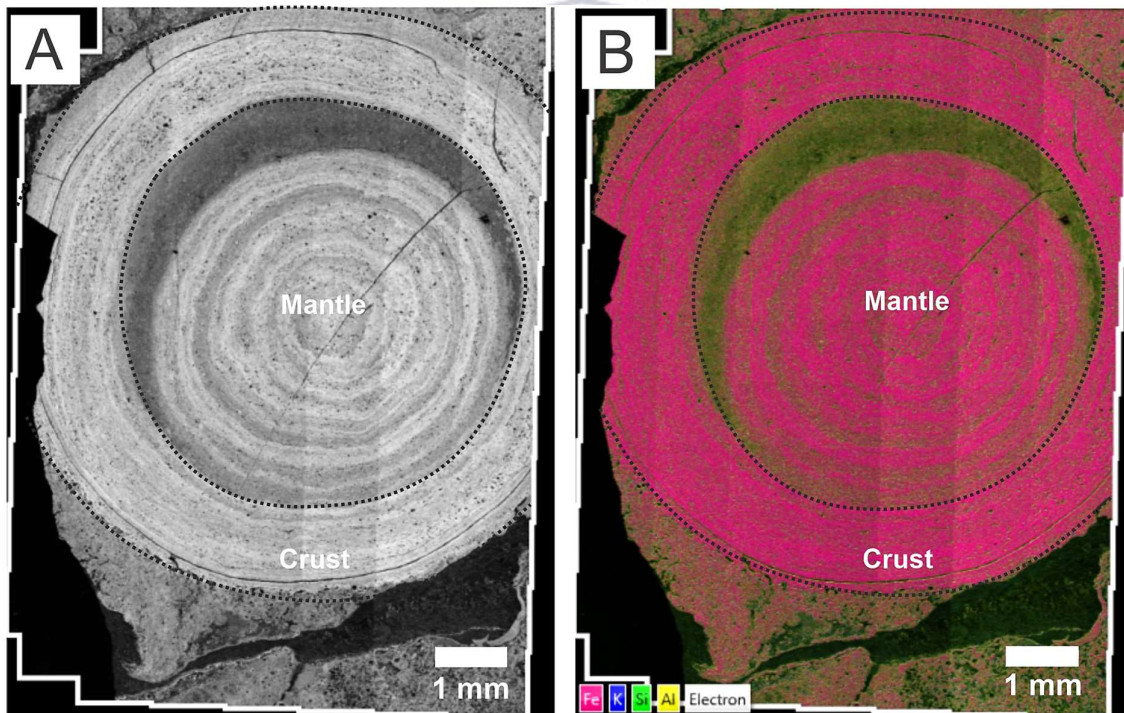


Figure 13: SEM images of a non-nucleated accretionary lapillus from the sample ACKS1. (A) A BSE image showing that the accretionary lapillus is very fine-grained and consists of a mantle and crust with several concentric layers. Note that the concentric layers are thinner in the crust and thicker in the mantle. The accretionary lapillus has a sharp to gradational contact between the mantle and crust. The accretionary lapillus contains entrained lithic rock fragments aligned roughly parallel to the margin of the accretionary lapillus. (B) A compositional EDS map indicating the accretionary lapillus is composed of Fe (hematite) and less Si and Al, whereas K is depleted. The concentric layering is formed by alternating Si- and Fe-rich concentric layers.

Compared to the non-nucleated accretionary lapillus, the observed nucleated accretionary lapillus is also extensively altered and overprinted by Fe (hematite) and has a concentric structure consisting of a nucleus, mantle, and crust (Figure 13 & Figure 14). The accretionary

lapillus is composed less of Si and Al and depleted in K (Figure 14). The concentric structure of the nucleated accretory lapillus fines outward in grain size from coarse-grained in the nucleus to fine-grained in the crust, whereas the mantle is medium-grained (Figure 14). The concentric structure also has several concentric layerings in the mantle and crust formed by alternating Si (quartz)-, Fe (hematite)- and Al-rich layers (Figure 14). The accretory lapillus is also similar to the non-nucleated accretory lapillus in that it has sharp to gradational contacts between the mantle and crust and between the nucleus and mantle (Figure 13 & Figure 14). The crust appears to contain entrained lithic rock fragments aligned parallel to the margins (Figure 14).

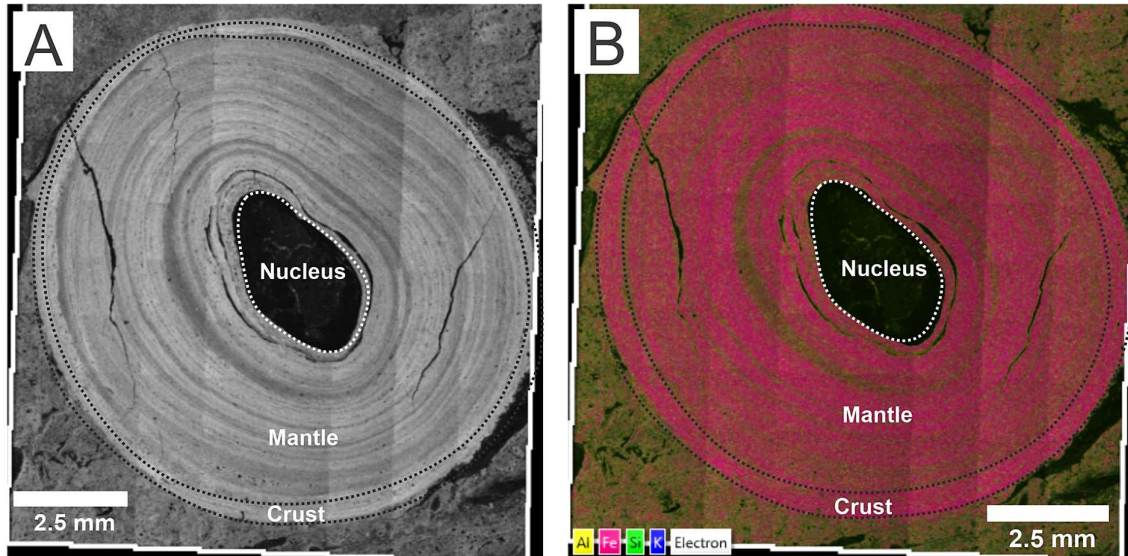


Figure 14: SEM images of a nucleated accretory lapillus from the sample ACKS1. (A) A BSE image of the accretory lapillus with a nucleus, mantle and crust. Note that concentric layering occurs in both the mantle and crust. The accretory lapillus is fine-grained and contains entrained lithic rock fragments aligned roughly parallel to the margin. A sharp contact occurs between the nucleus and mantle and between the mantle and crust. (B) A compositional EDS map showing that the accretory lapillus is composed of predominantly Fe (hematite), low Si and Al and depleted in K. The concentric layering is formed by alternating Si- and Fe-rich concentric layers.

### 4.1.3 Geochemistry

This section describes the major elements, trace elements and rare earth elements results of the samples from Khumani Mine. The results are presented in Table 3 for XRF analysis, Table 4 for the measured Fe (wt.%) abundances and Table 5 for INAA analysis.

#### Major elements

The measured Fe (wt.%) abundances indicate that the samples are low-grade ores with Fe abundances varying from 25.0 (ACKS1, ACKS2, ACKS4 and ACS6) to 35.0 wt.% (ACKS3 and ACKS5) and averaging ~33.0 wt.%. The Fe<sub>2</sub>O<sub>3</sub> abundances from XRF analysis range from 20.0 (ACKS3) to 56.0 wt.% (ACKS4) and have an average of 42.7 wt.%. Similar to the measured Fe abundances, the Fe<sub>2</sub>O<sub>3</sub> abundances indicate that the samples are low-grade ores. According to the XRF analysis, the sample's second and third predominant oxides are Al<sub>2</sub>O<sub>3</sub> and SiO<sub>2</sub>. The Al<sub>2</sub>O<sub>3</sub> abundances range between 20.0 (ACKS4) and 35.0 wt.% (ACKS3) and average ~25.2 wt.%. The SiO<sub>2</sub> abundances vary from 18.0 (ACKS4) to 34.0 wt.% (ACKS3) and have an average of 23.8 %. The samples ACKS2, ACKS4 and ACKS6 contain the same SiO<sub>2</sub> abundances of 20.0 wt.% and constitute the second-highest SiO<sub>2</sub> abundances. The samples also contain TiO<sub>2</sub>, CaO and K<sub>2</sub>O, but the abundances of these major oxides are low. The TiO<sub>2</sub> abundances range from 0.59 (ACKS2) to 1.0 wt.% (ACKS1) and average ~0.75 wt.%. The CaO abundances vary between 0.049 (ACKS1) and 0.037 wt.% (ACKS2) and have

an average of 0.044 wt.%. The K<sub>2</sub>O abundances range from 1.0 (ACKS2) to 2.0 wt.% (ACKS1), and average ~1.6 wt.%. The INAA results indicate that the samples have Fe abundances that range from 18.3 (ACKS3) to 48.6 wt.% (ACKS4) and have an Fe abundance average of 33.3 wt.%. The INAA Fe abundances also indicate that the samples are low-grade ores.

Plots showing major element variations vs depth for the samples are presented in Figure 15 for XRF analysis and Figure 16 for the measured Fe and INAA Fe abundances. Based on the plots for the XRF analysis, the samples show a general compositional trend in which samples with high abundances of Fe<sub>2</sub>O<sub>3</sub> inversely have low abundances of SiO<sub>2</sub>, TiO<sub>2</sub>, K<sub>2</sub>O, CaO and Al<sub>2</sub>O<sub>3</sub> (Figure 15). The trend is corroborated by the sample's Harker diagrams showing oxide variation patterns (Figure 17 & Figure 18). The patterns show a positive correlation between SiO<sub>2</sub> and TiO<sub>2</sub>, K<sub>2</sub>O, Na<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, and P<sub>2</sub>O<sub>5</sub> (Figure 17) and a negative correlation between Fe<sub>2</sub>O<sub>3</sub> and SiO<sub>2</sub>, TiO<sub>2</sub>, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, Na<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, and CaO (Figure 18) for the samples. The patterns also show a positive correlation between Fe<sub>2</sub>O<sub>3</sub> and Na<sub>2</sub>O for the samples (Figure 18).

Major elements patterns for the samples are given in Figure 19A. The patterns are analogous to the PAAS (Average Post-Archaean Australian Shale) and UC (Upper Crust) patterns which are plotted for comparison (Figure 19A). The patterns show that the samples are enriched in SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub> and K<sub>2</sub>O (Figure 19A). Although anomalously enriched in Fe<sub>2</sub>O<sub>3</sub>, the patterns indicate that the samples have TiO<sub>2</sub> abundances roughly similar to those of Fe<sub>2</sub>O<sub>3</sub>. The samples are slightly depleted in Na<sub>2</sub>O and prominently depleted in CaO. Compared to the PAAS and UC, the samples have higher patterns and abundances of SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub> and TiO<sub>2</sub> and lower patterns and abundances of CaO, K<sub>2</sub>O and Na<sub>2</sub>O (Figure 19A).

### Trace elements

The trace elements of interest in the samples for this study are Ir, Ni, Co and Cr. These elements have low abundances in the samples compared to meteorites (Glass & Simonson, 2013). Ni abundances range to 53.0 ppm (ACKS3) in the samples and are undetected in ACKS6. The abundances of Co vary from 5.73 (ACKS2) to 10.3 ppm (ACKS4) and Cr from 202 (ACKS3) to 552 ppm (ACKS1). Ir is undetected in the samples (Figure 16). The Ni, Co, and Cr abundance averages are ~43.3 ppm, 8.87 ppm, and 353 ppm, respectively. The highest Ni/Cr, Ni/Co, and Co/Cr ratios are 0.26, 9.32 and 0.04, respectively, and their averages are 0.14, 5.47 and 0.03, respectively. Plots showing trace elements and Fe (wt.%) variations vs depth for the samples from Khumani Mine are presented in Figure 16.

### Rare Earth elements

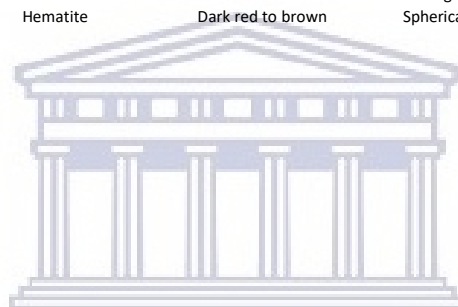
Extended trace elements patterns for the samples are shown in Figure 19B. The patterns are similar for most of the samples and are similar to the PAAS and UC patterns. Compared to the PAAS and UC, the samples have slightly higher patterns and abundances of extended trace elements (Figure 19B). The samples are prominently enriched in S, V, Cr, Ni, Sr, Zr and Ba and slightly depleted in Sc, Co, Y, Nb, and Zn (Figure 19B). For comparison, the PAAS and UC are enriched in V, Ni, Sr, Zr, Ba and Zn and slightly depleted in Sc, Co, Y, Nb and Cu.

Chondrite-normalized patterns for the samples, PAAS and UC, are presented in Figure 19C. The PAAS and UC patterns are plotted for comparison to the samples. The patterns indicate that the samples are enriched in HREE (Eu, Gd, Tm, Yb and Lu), depleted in LREE (La, Ce, Nd and Sm) and have positive Eu and Ce anomalies (Figure 19C). The PAAS and UC are also enriched in HREE, depleted in LREE and have positive Eu and Ce anomalies (Figure 19C). However, compared to the PAAS and UC, the samples have lower patterns and abundances of HREE and LREE, including the Eu and Ce anomalies.



Table 1: Sample and accretionary lapilli descriptions based on sampling results of Khumani Mine and Turner Exploration Camp samples.

Sample	Lithology		Occurrence	Composition	Colour	Accretionary lapilli				
	Depth (m)	Rock type				Shape	Long axis	Short axis	Nucleus	
<b>Khumani Mine</b>	ACKS1	106.42 - 106.57	Breccia	Present	Hematite	Dark red to brown	Spherical to subspherical	9-15 mm	9-15 mm	Nucleated
	ACKS1			Present	Hematite	Dark red to brown	Subspherical to irregular	9-15 mm	9-15 mm	Non-nucleated
	ACKS2	106.57 - 106.62	Breccia	Present	Hematite	Dark red to brown	Spherical to subspherical	5-30 mm	5-28 mm	Non-nucleated
	ACKS3	106.62 - 106.69	Breccia	Present	Hematite	Dark red to brown	Spherical to subspherical	4-31 mm	5-22 mm	Nucleated
	ACKS3			Present	Hematite	Dark red to brown	Spherical to subspherical	4-31 mm	5-22 mm	Nucleated
	ACKS4	106.69 - 106.80	Breccia	Present	Hematite	Dark red to brown	Irregular/subspherical	9-15 mm	8-12 mm	Absent
	ACKS5	106.8 - 106.93	Breccia	Present	Hematite	Dark red to brown	Irregular/subspherical	6-14 mm	6-13 mm	Absent
ACKS6	107.03 - 107.09	Breccia	Present	Hematite	Dark red to brown	Spherical to subspherical	6-29 mm	5-20 mm	Nucleated	
<b>Turner Exploration Camp</b>	TNS1	69.01 - 69.10	Paleosol	Present	Hematite	Brown	Angular fragment	5 mm	1 mm	Absent
	TNS2	69.10 - 69.15	Breccia	Present	Hematite	Dark red to brown	Spherical to subspherical	3-11 mm	2-5 mm	Nucleated
	TNS3	70.08 - 70.13	Breccia	Present	Hematite	Dark red to brown	Spherical to subspherical	4-9 mm	3-6 mm	Nucleated
	TNS4	70.23 - 70.28	Breccia	Present	Hematite	Dark red to brown	Spherical to subspherical	6-9 mm	3-5 mm	Nucleated
	TNS4			Present	Hematite	Dark red to brown	Spherical to subspherical	6-9 mm	3-5 mm	Non-nucleated
	TNS5	70.66 - 70.70	Breccia	Present	Hematite	Dark red to brown	Angular fragments	2-10 mm	1-3 mm	Absent
	TNS5	70.66 - 70.70	Breccia	Present	Hematite	Dark red to brown	Spherical to subspherical	4-20 mm	2-3 mm	Nucleated
	TNS6	70.81 - 70.87	Breccia	Absent						
	TNS7	71.20 - 71.23	Breccia	Absent						
	TNS8	72.77 - 72.82	Breccia	Absent						
	TNS9	74.13 - 74.23	Breccia	Absent						
	TNS10	74.52 - 74.58	Breccia	Absent						
	TNS11	75.08 - 75.13	Breccia	Absent						
	TNS12	75.42 - 75.46	Breccia	Absent						
	TNS13	76.44 - 76.49	Breccia	Absent						
	TNS14	77.67 - 77.73	Breccia	Absent						
	TNS15	78.17 - 78.30	Breccia	Absent						
	TNS16	79.00-79.05	Breccia	Absent						
TNS17	80.92 - 80.95	Breccia	Absent							
TNS18	86.73-86.87	Breccia	Absent							

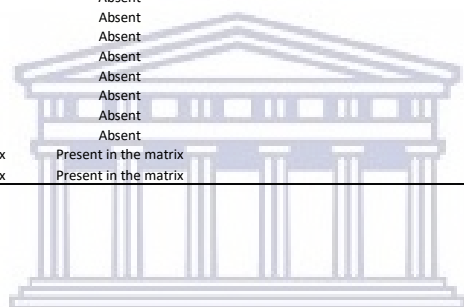


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Table 2: Descriptions of the samples and accretionary lapilli from Khumani Mine and Turner Exploration Camp based on sampling results.

Sample	Lithology		Accretionary lapilli									
	Depth (m)	Rock type	Occurrence	Shocked grains	Planar fractures or PDFs	Composition	Colour	Shape	Long axis	Short axis	Nucleus	
<b>Khumani Mine</b>	ACKS1	106.42 - 106.57	Breccia	Present	Absent	Absent	Hematite	Dark red to brown	Spherical to subspherical	4-8 mm	4-8 mm	Nucleated
	ACKS2	106.57 - 106.62	Breccia	Present	Absent	Absent	Hematite	Dark red to brown	Subspherical	30 mm	25 mm	Non-nucleated
	ACKS3	106.62 - 106.69	Breccia	Present	Absent	Absent	Hematite	Dark red to brown	Spherical to subspherical	4-20 mm	4-20 mm	Nucleated
	ACKS4	106.69 - 106.80	Breccia	Present	Absent	Absent	Hematite	Dark red to brown	Irregular	Greater than 30 mm	Greater than 30 mm	Absent
	ACKS5	106.8 - 106.93	Breccia	Present	Absent	Absent	Hematite	Dark red to brown	Spherical to subspherical	4 mm	4 mm	Nucleated
	ACKS6	107.03 - 107.09	Breccia	Present	Absent	Absent	Hematite	Dark red to brown	Subspherical	8 mm	4 mm	Nucleated
	ACKS6			Present	Absent	Absent	Hematite	Dark red to brown	Irregular	Greater than 30 mm	Greater than 30 mm	Absent
<b>Turner Exploration Camp</b>	TNS1	69.01 - 69.10	Paleosol	Present	Present in the matrix	Present in the matrix	Hematite	Brown	Angular fragment	5 mm	1 mm	Absent
	TNS2	69.10 - 69.15	Breccia	Present	Absent	Absent	Hematite	Dark red to brown	Spherical to subspherical	5-10 mm	4-8 mm	Nucleated
	TNS3	70.08 - 70.13	Breccia	Present	Absent	Absent	Hematite	Dark red to brown	Spherical to subspherical	4-9 mm	3-6 mm	Nucleated
	TNS4	70.23 - 70.28	Breccia	Present	Absent	Absent	Hematite	Dark red to brown	Angular fragments	2-5 mm	2-5 mm	Absent
	TNS5	70.66 - 70.70	Breccia	Present	Absent	Absent	Hematite	Dark red to brown	Angular fragments	2-10 mm	1-2 mm	Absent
	TNS5			Present	Absent	Absent	Hematite	Dark red to brown	Spherical	5 mm	5 mm	Nucleated
	TNS6	70.81 - 70.87	Breccia	Absent	Absent	Absent						
	TNS7	71.20 - 71.23	Breccia	Absent	Absent	Absent						
	TNS8	72.77 - 72.82	Breccia	Absent	Absent	Absent						
	TNS9	74.13 - 74.23	Breccia	Absent	Absent	Absent						
	TNS10	74.52 - 74.58	Breccia	Absent	Absent	Absent						
	TNS11	75.08 - 75.13	Breccia	Absent	Absent	Absent						
	TNS12	75.42 - 75.46	Breccia	Absent	Absent	Absent						
	TNS13	76.44 - 76.49	Breccia	Absent	Absent	Absent						
	TNS14	77.67 - 77.73	Breccia	Absent	Absent	Absent						
	TNS15	78.17 - 78.30	Breccia	Absent	Absent	Absent						
	TNS16	79.00-79.05	Breccia	Absent	Absent	Absent						
	TNS17	80.92 - 80.95	Breccia	Absent	Present in the matrix	Present in the matrix						
TNS18	86.73-86.87	Breccia	Absent	Present in the matrix	Present in the matrix							



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Table 3: Major and trace element compositions of Khumani Mine and Turner Exploration Camp samples. The compositions are obtained from XRF analyses of the samples. Major elements are presented as wt.% and trace elements as ppm. The MHC (Mount Holyoke College) standard, data from Dyar et al. (2019), is used for normalizing major and trace elements in certain geochemistry diagrams in this study. The PAAS (Post-Archaean Australian Shale) and UC (Upper Crust), data from Taylor and McLennan (1995), are used for comparison in certain geochemistry graphs in this study.

Samples	Khumani Mine						Turner Exploration Camp																		PAAS	UC	MHC	
	ACKS1	ACKS2	ACKS3	ACKS4	ACKS5	ACKS6	TNS1	TNS2	TNS3	TNS4	TNS5	TNS6	TNS7	TNS8	TNS9	TNS10	TNS11	TNS12	TNS13	TNS14	TNS15	TNS16	TNS17	TNS18				
SiO <sub>2</sub>	31,0	20,0	34,0	18,0	20,0	20,0	43,0	21,0	32,0	30,0	32,0	20,0	23,0	11,0	18,0	6,2	7,8	5,4	18,0	9,5	3,1	6,2	59,0	65,0	62,8			58,5
TiO <sub>2</sub>	1,0	0,6	1,0	0,6	0,7	0,6	2,0	0,4	0,9	1,2	0,9	0,2	0,8	0,4	1,0	0,3	0,3	0,3	1,1	0,4	0,3	0,5	0,7	1,1	1	0,5	1,2	
Al <sub>2</sub> O <sub>3</sub>	31,0	22,0	35,0	20,0	21,0	22,0	35,0	23,0	32,0	32,0	33,0	22,0	25,0	14,0	22,0	9,1	13,0	9,1	20,0	13,0	6,8	9,0	14,0	22,0	18,9	15,2	13,5	
Fe <sub>2</sub> O <sub>3</sub>	27,0	51,0	20,0	56,0	51,0	51,0	5,7	50,0	24,0	28,0	24,0	52,0	44,0	71,0	53,0	82,0	76,0	83,0	55,0	73,0	88,0	82,0	22,0	5,9	7,2	5	8	
MnO	0,02	0,04	0,02	0,05	0,05	0,05	n.d.	0,02	0,01	0,01	0,01	0,02	0,02	n.d.	n.d.	0,02	0,02	0,01	0,01	n.d.	n.d.	n.d.	n.d.	n.d.	0,1	0,08	0,2	
MgO	0,05	0,04	0,04	0,03	0,04	0,04	0,14	0,03	0,03	0,03	0,03	0,03	0,02	n.d.	0,01	0,02	n.d.	n.d.	0,03	0,04	n.d.	n.d.	0,04	0,08	2,2	2,2	5,6	
CaO	0,05	0,04	0,05	0,04	0,05	0,05	0,08	0,02	0,03	0,04	0,02	0,03	0,03	0,03	0,03	0,03	0,03	0,02	0,05	0,07	0,03	0,04	0,03	0,05	1,3	4,2	6	
Na <sub>2</sub> O	0,06	0,10	0,05	0,10	0,11	0,09	0,25	0,08	0,04	0,05	0,04	0,07	0,07	0,04	0,09	0,03	0,04	0,03	0,11	0,06	0,04	0,04	0,08	0,14	1,2	3,9	2,7	
K <sub>2</sub> O	2,00	1,00	1,60	1,10	1,80	1,80	3,70	0,22	0,15	0,17	0,11	0,19	0,14	0,10	0,25	0,11	0,20	0,17	0,33	0,23	0,09	0,11	0,69	1,80	3,7	3,4	2,2	
P <sub>2</sub> O <sub>5</sub>	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,4	0,2	0,2	0,1	0,1	0,16		0,16	
H <sub>2</sub> O	7,9	5,0	8,9	4,2	4,2	4,4	9,2	4,8	9,7	8,2	9,2	4,2	6,0	3,4	4,6	2,0	2,5	1,9	5,2	2,9	1,4	1,8	2,5	3,7				
LOI	7,9	5,0	8,9	4,2	4,2	4,3	9,2	4,8	9,7	8,2	9,2	4,2	6,0	3,4	4,6	2,0	2,5	1,9	5,2	2,9	1,4	1,8	2,5	3,7				
Total	100,2	99,9	100,7	100,2	99,0	100,1	99,2	99,7	99,0	99,8	99,3	98,8	99,2	100,0	99,2	99,8	100,0	100,0	100,0	99,6	99,9	99,8	99,1	99,8				
As	29,7	43,9	28,3	47,7	35,3	57,1	33,3	38,3	48,7	38,2	28,4	55,7	45,3	41,8	59,9	66,0	41,3	37,4	19,1	139,5	63,7	79,1	6,4	8,1		1,5	2,3	
Ba	212,9	251,3	210,7	270,4	254,4	303,7	326,7	56,9	68,4	65,1	52,1	58,6	70,3	43,8	71,5	49,9	42,6	51,5	99,0	97,4	46,9	59,1	58,3	80,3	650,0		618,1	
Ce	105,3	66,4	69,7	56,1	55,5	57,5	171,6	61,1	93,8	90,4	84,5	55,5	67,9	54,2	104,5	36,3	49,6	38,0	79,9	64,2	50,3	69,7	54,2	81,8	80,0	64,0	220,7	
Co	13,2	12,2	11,4	13,2	15,4	12,0	9,0	10,5	5,7	7,2	7,8	7,7	8,9	6,2	9,7	7,6	9,2	7,2	8,6	9,1	10,4	11,7	5,3	1,9	23,0	10,0	749,5	
Cr	478,8	431,2	199,2	274,3	313,9	343,0	1761,6	483,6	484,4	355,6	356,7	141,9	159,3	178,5	213,2	145,6	171,9	139,5	302,4	309,1	213,1	242,7	160,9	184,9	110,0	35,0	459,6	
Cu	65,7	52,5	66,1	52,9	44,2	51,2	66,7	41,5	24,1	29,8	29,0	49,0	39,0	42,2	36,9	49,3	44,5	50,6	34,4	41,3	53,3	49,4	15,2	17,3	50,0	25,0	555,3	
Ga	16,5	16,1	17,3	16,8	23,4	17,9	34,3	15,6	15,1	17,2	15,1	13,5	14,1	15,0	17,7	14,7	16,2	11,9	30,1	21,3	16,7	15,7	11,5	15,1			198,7	
La	44,0	18,3	29,6	16,0	19,0	18,1	83,8	19,3	40,7	37,4	34,4	10,3	34,4	16,7	36,4	9,6	18,1	12,2	40,8	19,6	4,8	20,0	18,2	38,9	38,0	30,0	192,7	
Mo	2,0	4,1	1,3	3,6	2,8	3,8	2,7	1,7	0,8	0,9	1,1	4,1	2,5	4,8	3,1	4,2	4,0	3,2	4,0	4,6	6,4	4,2	0,1	0,7			644,4	
Nb	15,6	10,2	15,6	10,0	10,1	11,1	35,0	8,2	17,2	20,1	16,1	2,9	13,2	7,2	19,2	4,7	5,3	5,1	17,9	6,0	3,9	7,4	6,3	13,1	19,0	25,0	193,8	
Nd	24,2	12,8	16,4	16,0	8,8	11,6	56,4	22,9	26,8	31,2	22,6	15,2	29,9	22,5	26,5	18,0	5,9	11,5	23,6	21,1	12,5	29,5	21,0	25,1	32,0	26,0	31,2	
Ni	41,8	51,2	45,1	46,1	47,5	40,4	66,5	18,2	17,3	16,7	20,5	24,0	17,6	17,2	16,4	18,6	20,9	14,6	24,4	42,9	31,2	59,5	9,8	12,1	55,0	20,0	397,6	
Pb	27,6	20,3	17,4	20,9	19,8	23,5	36,5	22,2	22,7	21,7	21,1	12,8	23,2	12,1	23,5	8,0	14,0	18,4	36,9	8,6	7,4	5,9	6,9	13,8			189,0	
Rb	38,9	20,4	34,1	22,1	37,9	37,7	142,2	10,4	8,4	10,7	6,6	11,6	9,2	6,4	14,5	7,2	9,1	8,0	14,6	19,0	7,4	8,9	14,2	39,8	160,0		157,3	
Sc	23,8	24,5	20,0	26,7	26,1	26,5	32,0	20,3	20,3	25,1	22,5	14,7	22,0	21,2	29,7	16,7	15,7	17,3	26,7	22,4	16,6	18,1	15,6	13,9	16,0	10,0	346,5	
Sn	9,5	10,0	9,2	10,5	11,1	9,7	12,7	9,4	8,2	6,9	10,2	10,7	10,3	12,4	12,3	10,6	10,4	14,1	14,1	9,8	12,5	13,8	7,0	9,9			633,1	
Sr	433,7	363,3	496,2	354,5	323,3	360,7	390,8	411,7	512,2	811,1	433,6	976,3	947,2	712,6	1032,4	671,7	555,6	416,9	640,1	2758,9	1000,6	1274,6	300,2	174,3	200,0		411,2	
Ta	0,4	<1	1,0	0,8	<1	1,5	3,6	<1	<1	2,5	2,2	<1	<1	2,1	<1	<1	<1	<1	<1	<1	<1	<1	0,7	0,8			2,2	1,7
Th	20,8	15,6	17,7	13,2	14,4	16,3	40,5	14,0	21,4	21,8	19,2	7,0	16,3	10,7	23,6	8,7	10,4	8,8	21,3	14,9	8,2	11,8	8,8	15,5	14,6	10,7	7,9	
U	2,9	4,4	3,7	4,7	3,7	6,6	15,1	2,9	4,0	7,5	4,3	5,7	5,4	2,9	6,0	4,2	3,8	4,1	7,0	13,1	4,5	9,9	2,5	2,4	3,1	2,8	1,8	
V	271,0	504,9	217,4	538,8	441,3	600,3	121,0	203,6	98,2	162,8	162,2	267,8	144,0	221,5	187,0	127,6	110,8	119,9	275,6	157,1	250,3	206,6	175,9	84,1	150,0	60,0	149,4	
W	1,0	5,9	1,4	8,5	2,2	9,3	5,0	3,5	1,2	2,9	2,4	3,7	<1	2,1	5,7	3,8	<1	10,1	6,2	6,1	2,7	8,4	<1				84,2	
Y	15,9	11,0	15,6	12,1	12,7	12,5	48,1	14,5	23,5	26,6	22,0	6,2	16,7	10,2	24,4	6,8	7,6	7,7	20,9	18,6	10,2	18,7	10,6	17,2	27,0	22,0	163,9	
Zn	2,6	6,2	2,5	7,6	4,6	5,9	26,8	4,9	3,2	3,1	3,7	8,6	4,9	5,2	4,9	7,7	5,7	9,5	5,2	5,8	5,7	7,8	1,6	2,0	85,0	71,0	33,9	
Zr	323,3	171,4	286,9	217,7	243,0	231,6	2305,5	638,2	942,0	686,8	766,3	135,5	338,9	213,4	518,7	117,4	120,1	140,0	360,6	236,6	160,8	392,9	178,8	286,6	210,0		327,9	

Table 4: Measured Fe (wt.%) abundances for the samples from Khumani Mine and essay Fe (wt.%) abundances for the samples from Turner Exploration Camp from Jonathan Hainsworth.

Sample	Khumani Mine						Turner Exploration Camp																			
	ACKS1	ACKS2	ACKS3	ACKS4	ACKS5	ACKS6	TNS1	TNS2	TNS3	TNS4	TNS5	TNS6	TNS7	TNS8	TNS9	TNS10	TNS11	TNS12	TNS13	TNS14	TNS15	TNS16	TNS17	TNS18		
Fe (wt.%)	25,0	25,0	35,0	25,0	35,0	25,0	3,0	35,0	20,0	51,0	32,0	50,0	52,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0	48,0	53,0	56,0	52,0	21,0	10,0

Table 5: Major and trace element compositions of Khumani Mine and Turner Exploration Camp samples. The compositions are obtained from INAA analyses of the samples. The major elements are presented as wt.% and trace elements as ppm and ppb. The MHC (Mount Holyoke College) standard, data from Dyer et al. (2019), is used for normalizing the major and trace elements in certain geochemistry diagrams in this study. The PAAS (Post-Archaean Australian Shale) and UC (Upper Crust), data from Taylor and McLennan (1995), are used for comparison in certain geochemistry diagrams in this study.

Samples	Khumani Mine						Turner Exploration Camp																		PAAS	UC	MHC	
	ACKS1	ACKS2	ACKS3	ACKS4	ACKS5	ACKS6	TNS1	TNS2	TNS3	TNS4	TNS5	TNS6	TNS7	TNS8	TNS9	TNS10	TNS11	TNS12	TNS13	TNS14	TNS15	TNS16	TNS17	TNS18				
Na	284.5	225.1	256.7	266.6	282.7	281.4	1490.5	172.4	184.3	243.7	194.7	191.1	208.5	119.2	197.6	130.1	138.1	135.8	239.6	248.6	181.1	151.7	167.2	418.8				
K (wt%)	1.8	0.8	1.4	1.0	1.5	1.6	3.5	0.1	0.2	0.1	0.1	0.2	<0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.2	<0.1	<0.1	0.3	1.1				
Sc	28.1	24.4	23.6	28.3	26.3	30.9	51.3	23.5	28.3	31.3	24.8	18.4	25.4	21.3	29.9	18.8	17.9	16.8	28.6	22.8	17.3	17.9	13.1	17.9	16.0	11.0	346.5	
Cr	487.2	367.5	201.8	260.9	279.8	324.9	1967.5	447.7	505.0	357.4	337.6	153.5	155.6	166.2	193.0	138.1	167.1	118.9	263.7	274.0	199.1	195.6	134.1	199.6	110.0	35.0	459.6	
Fe (wt%)	21.5	39.0	18.3	48.6	39.2	42.7	3.4	46.7	20.3	28.7	23.1	58.3	42.3	51.8	47.2	62.6	58.9	56.7	40.8	56.8	67.4	58.2	12.9	3.3				
Co	8.1	9.4	5.7	10.3	10.3	9.2	9.9	2.1	1.9	1.4	2.0	2.0	1.6	1.4	1.6	1.9	1.5	1.6	2.7	4.8	4.2	4.7	2.1	1.9	23.0	10.0	749.5	
Ni	50.2	50.4	53.4	31.1	39.3	<64	107.7	<57	22.2	<40	26.9	<66	<62	<62	<41	<63	<41	<33	<62	44.3	36.6	63.1	13.6	28.6	55.0	20.0	397.6	
Zn	<22	<18	<17	<23	<12	<19	55.1	<16	<23	<14	<17	<18	<21	<19	<12	<15	<11	<7	<18	<14	<3.8	<14	<14	<9	85.0	71.0	33.9	
Ga	30.1	50.5	27.4	62.4	18.0	142.6	22.5	147.4	26.5	92.5	66.0	90.4	69.5	26.0	125.4	64.3	25.9	61.9	138.0	62.5	89.3	188.4	15.5	14.1			198.7	
As	34.4	49.6	29.6	54.4	36.4	62.5	34.5	36.4	45.9	38.2	29.7	59.0	46.7	39.2	47.4	74.7	37.3	41.5	16.3	124.5	62.8	87.5	5.7	9.0		1.5	2.3	
Se	<3.1	<3.5	<2.9	<3.8	<2.1	<3.7	2.6	<3.4	<3.3	<2.4	<3.1	<3.6	<3.6	<3.6	<2.4	<3.6	<2.3	<1.8	<3.6	<2.6	<3.9	<3.4	<2.4	<1.3				970.3
Br	<1	0.6	0.4	1.0	0.4	0.5	<1.2	0.2	<1	0.4	<0.9	<2	0.4	0.3	0.7	0.9	0.6	0.8	<1.2	1.1	1.4	0.9	0.4	0.5				67.4
Rb	40.5	23.5	50.3	23.2	23.1	40.4	145.1	80.6	<11	30.2	23.2	132.8	11.8	<16	75.1	22.8	171.6	40.9	37.5	92.9	141.2	93.3	18.2	40.1	160.0	112.0	157.3	
Sr	381.6	225.2	344.6	238.1	224.5	237.4	314.1	243.6	405.0	535.9	269.4	655.3	741.0	543.0	631.7	530.4	435.9	274.7	358.8	1909.0	724.4	796.6	247.2	123.8	200.0	350.0	411.2	
Zr	221.8	103.8	172.0	158.0	162.0	162.5	1699.8	357.8	536.6	384.5	399.1	118.9	204.8	149.5	252.4	92.0	90.0	112.4	200.4	168.5	129.3	223.5	137.5	180.3	210.0	190.0	327.9	
Sb	1.1	2.4	1.6	1.5	1.6	3.6	0.5	3.6	0.8	1.7	2.2	2.0	1.4	1.8	3.3	3.3	1.4	3.0	2.5	1.7	2.0	3.7	0.9	1.1				0.4
Cs	1.2	0.9	1.2	1.0	1.1	0.7	3.7	0.3	0.4	0.4	0.3	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.7	0.4	0.4	0.5	1.0	15.0	3.7		543.7	
Ba	125.2	144.7	129.4	148.4	128.5	184.5	279.4	18.8	<44	44.8	28.2	<68	35.3	<56	5.7	31.7	<61	48.9	54.8	51.0	22.9	<47	25.4	46.3	650.0	550.0	618.1	
La	38.6	16.3	26.8	16.5	15.3	16.5	97.2	15.8	37.9	30.7	26.9	10.2	23.9	13.7	27.6	11.5	9.8	9.4	29.7	15.1	6.7	13.9	14.6	36.5	38.0	30.0	192.7	
Ce	89.0	35.3	57.1	40.8	35.3	36.9	197.5	37.1	82.7	64.1	51.8	24.7	51.6	32.5	57.3	27.5	26.2	20.5	52.7	34.2	14.3	31.0	39.3	73.2	80.0	64.0	220.7	
Nd	21.7	9.5	15.7	9.1	8.8	12.1	58.0	11.5	24.3	16.1	13.0	7.3	16.9	9.7	18.5	8.0	6.8	9.1	13.1	11.1	3.9	7.8	12.1	19.2	32.0	26.0	31.2	
Sm	3.3	1.9	2.8	2.0	1.8	2.0	10.9	2.4	4.5	3.5	3.0	2.0	3.9	2.2	3.7	1.7	1.3	1.4	3.0	3.4	1.3	2.7	2.5	3.7	5.6	4.5	6.5	
Eu	0.7	0.4	0.6	0.4	0.4	0.4	2.1	0.6	1.0	0.8	0.7	0.5	0.9	0.5	0.8	0.4	0.3	0.3	0.7	0.9	0.4	0.6	0.6	0.8	1.1	0.9	1.1	
Gd	4.1	2.3	2.8	2.1	1.4	1.9	9.7	2.4	4.0	3.4	3.3	<1.6	3.2	2.2	3.4	2.2	1.3	1.5	2.7	3.3	<1.8	2.6	1.9	3.1	4.7	3.8	5.8	
Tb	0.4	<0.1	0.4	0.3	0.3	<0.1	1.2	0.4	0.6	0.6	0.4	0.3	0.5	0.3	0.5	<0.1	0.2	0.2	0.4	0.7	0.3	0.6	0.4	0.5	0.8	0.6	1.0	
Tm	0.4	0.2	0.2	0.3	0.2	0.2	0.9	0.3	0.4	0.5	0.3	0.2	0.5	0.4	0.3	0.6	0.3	0.1	0.4	0.5	0.3	0.3	0.2	0.4	0.4	0.3	0.5	
Yb	1.7	1.0	1.4	1.2	1.1	1.2	7.4	1.5	3.1	2.7	2.2	0.6	1.7	1.0	2.1	0.8	0.7	0.7	2.0	1.8	1.0	1.7	1.5	2.1	2.8	2.2	3.3	
Lu	0.3	0.2	0.3	0.2	0.2	0.2	1.3	0.3	0.5	0.5	0.4	0.1	0.3	0.2	0.4	0.1	0.1	0.1	0.4	0.3	0.2	0.3	0.2	0.3	0.4	0.3	0.5	
Hf	8.5	3.8	6.6	5.6	5.7	5.6	70.2	14.5	26.6	17.2	17.0	2.9	8.6	4.7	10.8	2.4	2.7	2.8	7.7	5.2	3.4	7.6	5.3	7.5	5.0	5.8	6.2	
Ta	1.5	0.9	1.6	1.0	0.9	1.0	4.0	0.8	1.6	1.9	1.4	0.3	1.3	0.7	1.6	0.5	0.5	0.5	1.6	0.8	0.5	0.6	0.8	1.4	2.2		1.7	
W	n.d.	2.8	2.9	n.d.	n.d.	2.4	6.4	2.6	n.d.	3.8	4.5	n.d.	n.d.	n.d.	3.8	1.0	n.d.	1.7	6.1	n.d.	n.d.	1.9	n.d.	2.9				84.2
Os (ppb)	<534	<968	<855	<694	<507	<950	<1561	<1026	<614	<911	<901	<656	<662	<609	<1119	<822	<585	<814	<991	<715	<670	<1149	<366	<754				
Ir (ppb)	<3	<4.2	<3.4	<3.4	<1.9	<4.1	<6.3	<4.1	<3.2	<2.96	<3.8	<3.2	<3.1	<3.1	<2.5	<3.4	0.6	<1.8	<4.1	<2.4	<3.2	<3.5	<2.3	<1.9				
Au (ppb)	<1	<1.7	<1.3	<2	<1	<2.0	<2.4	<2.1	<1	<1.9	<1.6	<2	<2.1	<1	<2.1	<1.4	<1	0.4	<2.1	<2	<2	<2.3	<1	0.9				
Th	19.7	12.4	16.6	12.5	10.6	12.8	40.3	10.8	19.2	17.8	14.8	4.4	13.4	7.7	16.8	7.4	7.2	7.3	17.8	9.2	5.7	7.8	8.9	15.1	14.6	10.7	7.9	
U	2.1	2.5	1.7	3.2	1.7	2.9	14.5	1.8	2.3	2.8	2.0	2.0	2.3	1.4	2.5	1.8	1.5	2.3	2.9	2.8	1.8	2.3	1.3	1.5	3.1	2.8	1.8	

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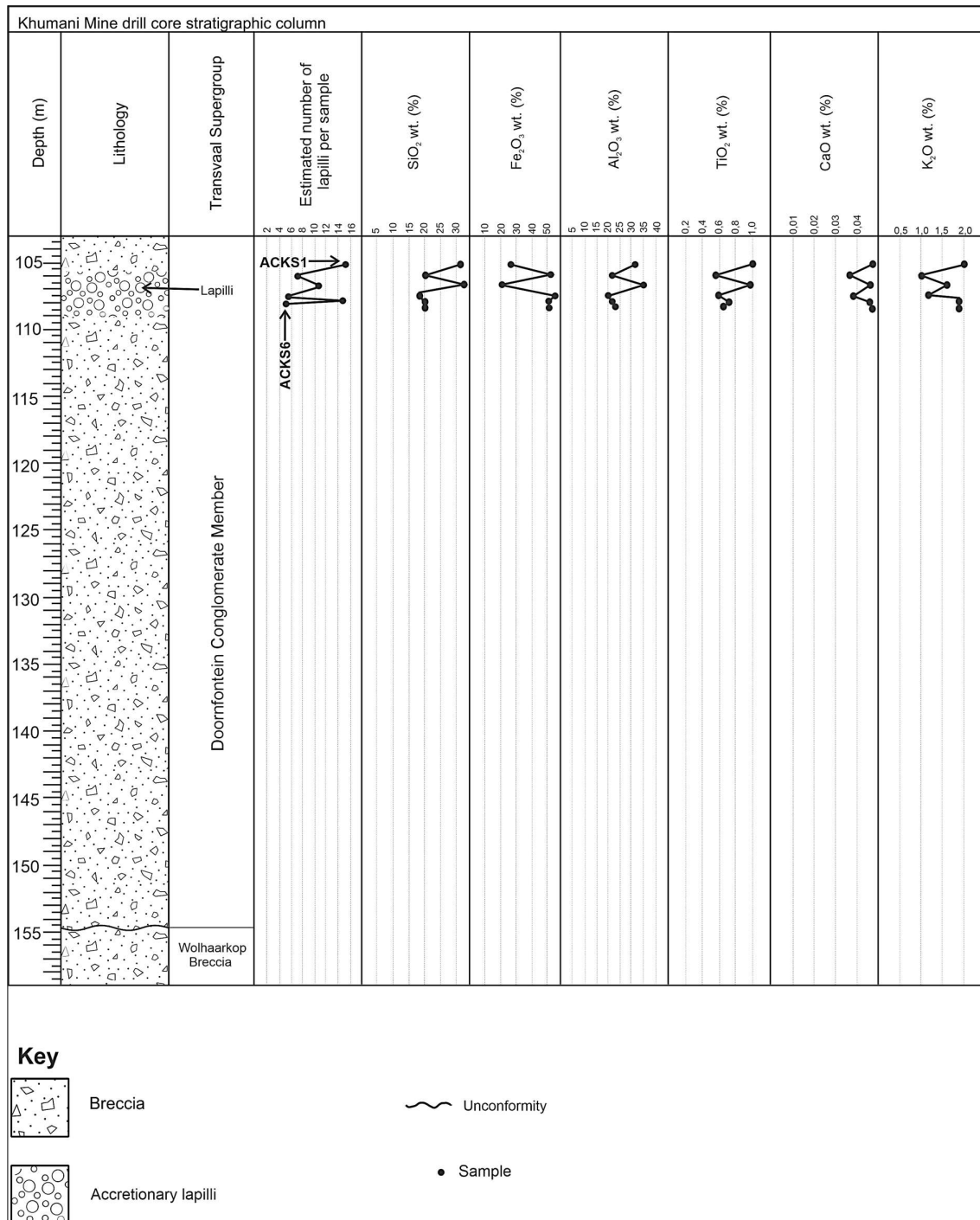


Figure 15: Plots showing major elements (oxides) variations vs depth for the samples from Khumani Mine. From top to bottom, the samples are ACKS1, ACKS2, ACKS3, ACKS4, ACKS5, and ACKS6. Note that the samples with high abundances of Fe<sub>2</sub>O<sub>3</sub> inversely have low abundances of SiO<sub>2</sub>, TiO<sub>2</sub>, K<sub>2</sub>O, CaO and Al<sub>2</sub>O<sub>3</sub>.



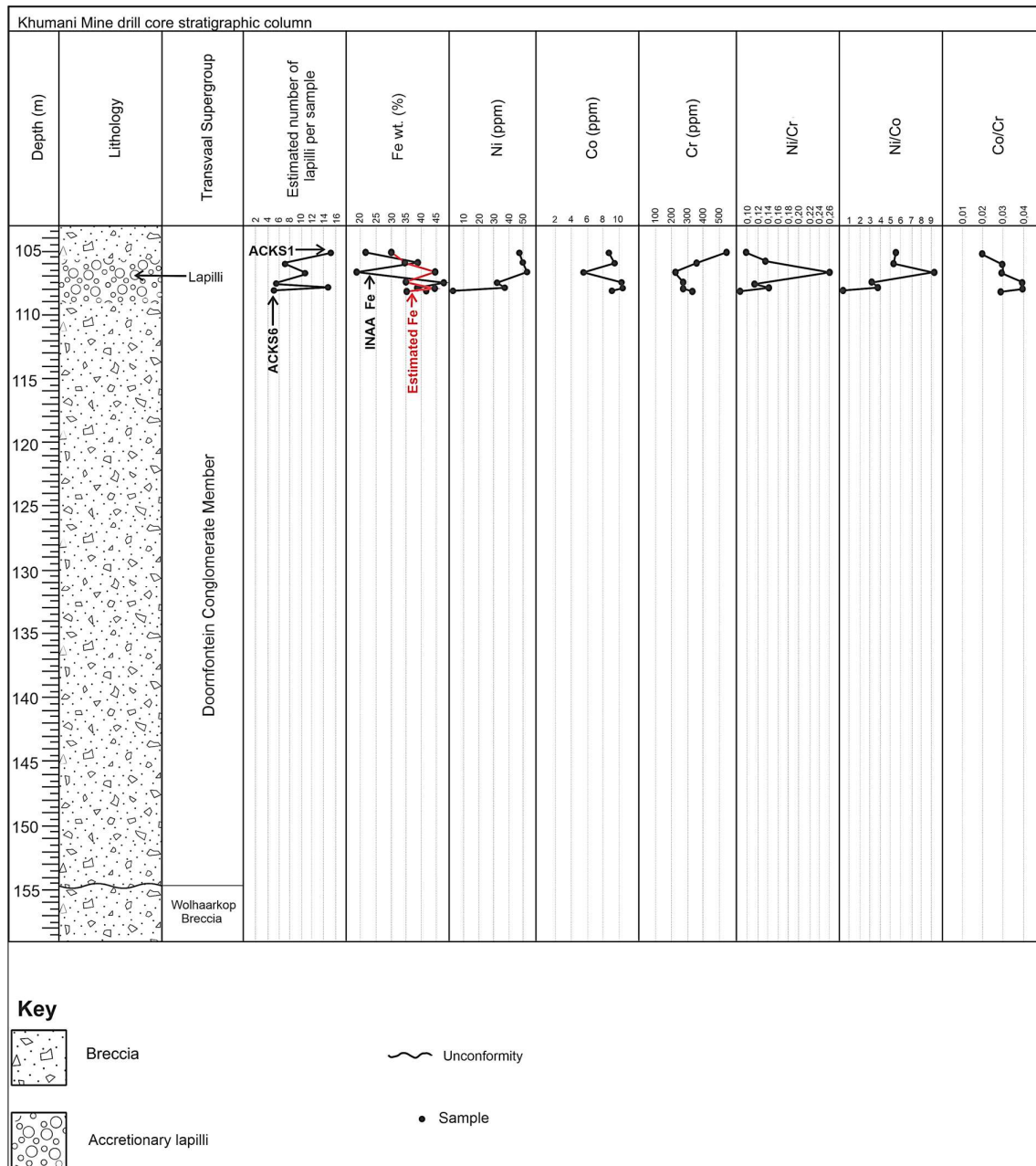


Figure 16: Plots showing trace elements and Fe (wt.%) variations vs depth for the samples from Khumani Mine.

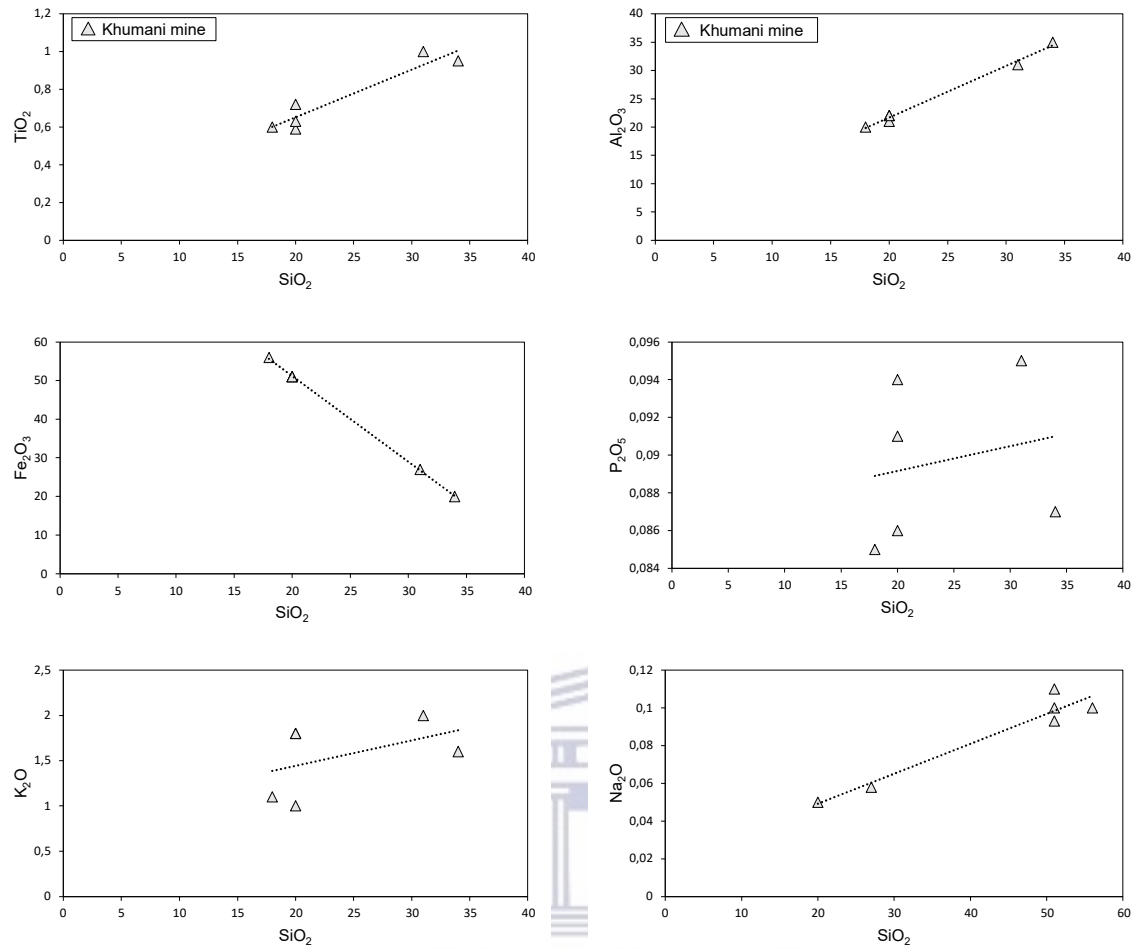


Figure 17: SiO<sub>2</sub> vs TiO<sub>2</sub>, K<sub>2</sub>O, Na<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, P<sub>2</sub>O<sub>5</sub> and Fe<sub>2</sub>O<sub>3</sub> Harker diagrams for the samples from Khumani Mine. The dotted lines represent linear regression lines/correlations for the Harker diagrams. Note the positive correlations between SiO<sub>2</sub> and TiO<sub>2</sub>, K<sub>2</sub>O, Na<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, and P<sub>2</sub>O<sub>5</sub> and a negative correlation between SiO<sub>2</sub> and Fe<sub>2</sub>O<sub>3</sub> for the samples.

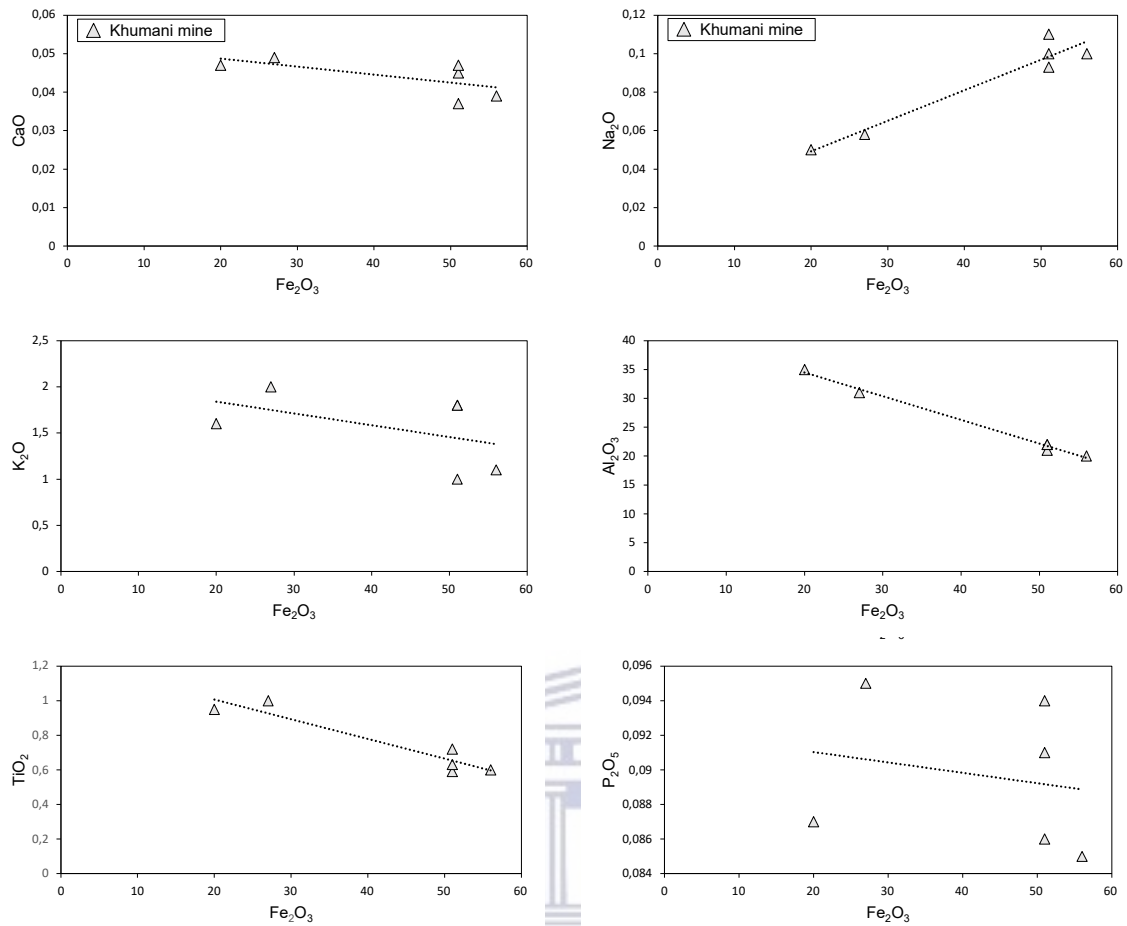


Figure 18:  $Fe_2O_3$  vs  $SiO_2$ ,  $TiO_2$ ,  $P_2O_5$ ,  $K_2O$ ,  $Al_2O_3$  and  $CaO$  Harker diagrams for the samples from Khumani Mine. The dotted lines represent linear regression lines/correlations for the Harker diagrams. Observe the negative correlations between  $Fe_2O_3$  and  $SiO_2$ ,  $TiO_2$ ,  $P_2O_5$ ,  $K_2O$ ,  $Al_2O_3$ , and  $CaO$  and a positive correlation between  $Fe_2O_3$  and  $Na_2O$  for the samples.

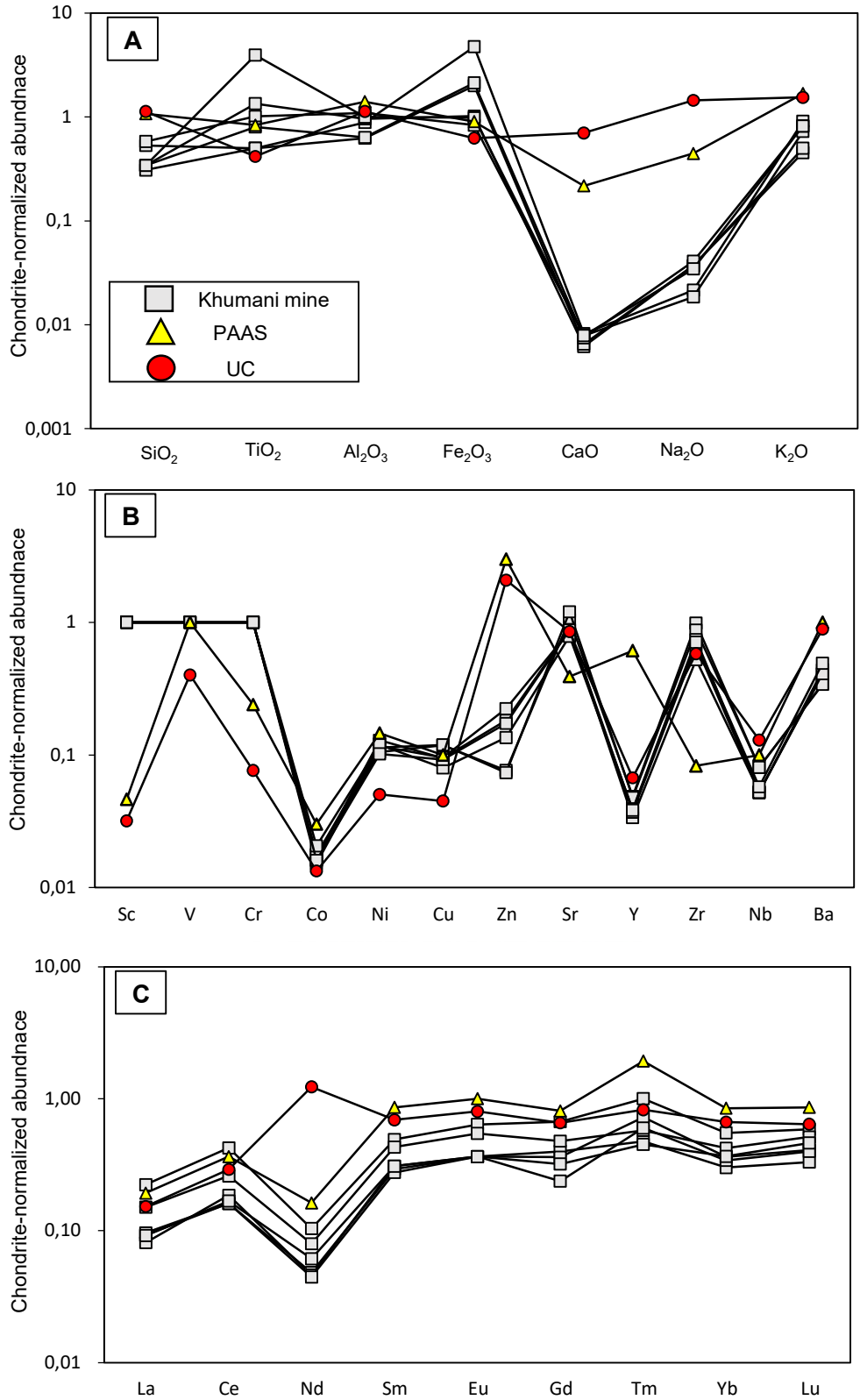


Figure 19: (A) Major element patterns and (B) extended trace element patterns compiled from XRF data, and (C) chondrite-normalized rare earth element patterns compiled from INAA data for the samples from Khumani Mine. Observe that the patterns are similar for most samples and are similar to the PAAS (Post-Archaean Australian



*Shale) and UC (Upper Crust). Major, trace, and rare earth element values are from Dyer et al. (2019) and are used for normalising and presented in Table 3. The PAAS (Post-Archaean Australian Shale) and UC (Upper Crust), data from Taylor and McLennan (1995) and shown in Table 3, are plotted for comparison.*



## 4.2 Turner Exploration Camp

The samples from Turner Exploration Camp are described below, and their results are given in Table 1 for sample and accretionary lapilli descriptions for sampling. For more information on Turner Exploration Camp, see Appendix B.1 for sample photos, Appendix B.2 for thin section photos, Appendix B.3 for scanning electron microscopy photomicrographs and Appendix B.4 for Raman spectroscopy photomicrographs and data.

### 4.2.1 Sample description

The Wolhaarkop Breccia, investigated at Turner Exploration Camp, is 17 m thick in the drill core (Figure 20) and consists of two types of breccias, namely the upper polymict breccia and lower monomict breccia (Figure 21). The polymict breccia is clast-supported, red to maroon and consists of angular clasts of quartz, banded iron formation, jasper, hematite and other clasts in a chert matrix. The monomict breccia is generally matrix-supported, grey to black and consists of white angular clasts of quartz in a chert matrix. Compared to the Doornfontein Conglomerate Member, the Wolhaarkop Breccia appears to be less ferruginous and overprinted by hematite and rarely contains disseminated pyrite and joints dipping at  $\sim 70^\circ$ . The observed Wolhaarkop Breccia in Khumani Mine drill core is  $\sim 2$  m thick.



Figure 20: A photograph of the drill core containing the polymict Wolhaarkop Breccia at Turner Exploration Camp.



Figure 21: A photograph of the drill core that contains the monomict Wolhaarkop Breccia at Turner Exploration Camp.

Overlying the Wolhaarkop Breccia is the Doornfontein Conglomerate Member, to which the samples from Turner Exploration Camp were collected (Figure 22). The samples from Turner Exploration Camp are similar to those from Khumani Mine. The samples from Turner Exploration Camp are ferruginous, matrix-supported breccias with angular clasts of shale, quartz, hematite, chert and serpentine, and angular, very fine-grained lithic rock fragments (Figure 22). The breccias are dark red to brown and have a clay-rich matrix with the clasts ranging to 3 mm in thickness (Figure 22). The breccias show an absence of sediment reworking. Disseminated pyrite clasts, quartz veins, and joints dipping at  $\sim 35^\circ$  occasionally occur within the breccias. The breccias form Unit A occurring between depths of 72.0 and 89.0 m. The breccias also contain spherical to subspherical, dark red to brown accretionary lapilli and angular accretionary lapilli fragments from depth 69.0 to 72.0 m (Figure 23). The accretionary lapilli-rich breccias form Unit B overlying Unit A, which seamlessly transitions into Unit B without a grain size change or contact. A cream-white paleosol forming Unit C occurring at depth 68.0 to 69.0 m and overlying Unit B was also sampled (Figure 24). The paleosol transitions above Unit B by a sharp contact and has compaction features and stylolites (Figure 24). The paleosol is weathered, clay-rich and composed of quartz, chert, chlorite, serpentine, and rarely hematite. As a result, the paleosol is neither ferruginous nor overprinted by hematite (Figure 24).



Figure 22: A photograph of the sampled drill core at Turner Exploration Camp.

### **Accretionary lapilli**

The observed accretionary lapilli from this site are nearly all nucleated, whereas the rest are accretionary lapilli fragments (Figure 23). The accretionary lapilli are ferruginous and overprinted by hematite (Figure 23). As a result, most of the accretionary lapilli are composed of hematite and rarely very fine-grained quartz. Nucleated accretionary lapilli rarely contain very-fine grained lithic rock fragments.

### **Nucleated accretionary lapilli**

The nucleated accretionary lapilli occur as dispersed and discrete bodies and are the smallest concentrically zoned accretionary lapilli in this study (Figure 23). The nucleated accretionary lapilli are well round to round and spherical to subspherical, but most are round and spherical (Figure 23). The long and short apparent diameters of the nucleated accretionary lapilli vary from 7.0 to 14.0 mm and 3.0 to 12.0 mm, respectively. The concentric structure of the nucleated accretionary lapilli typically fines outward from coarse-grained in the nuclei to fine-grained in the crusts, whereas the mantles are medium-grained (Figure 23). The long and short apparent diameters of the nuclei vary from 2.0 to 11.0 mm and 1.0 to 7.0 mm, respectively. The nuclei are roughly on the centre, well-round to round and spherical to spherical, but round and subspherical nuclei are prevalent (Figure 23). The nucleated accretionary lapilli always have a sharp contact between the nuclei and the mantles (Figure



23). Although the concentric structure of the nucleated accretory lapilli fines outward from the nucleus to the crust, some mantles are coarser-grained than the nuclei. The mantles are 2.0 to 7.0 mm thick, and most consist of very fine-grained quartz, while a few consist of hematite (Figure 23). The crusts are 2.0 to 5.0 mm thick, finer-grained than the mantles and composed of hematite (Figure 23). The crusts are the darkest component of the accretory lapilli (Figure 23). In most nucleated accretory lapilli, a sharp contact is present between the crusts and mantles. A few, less than 10, hematite-rich concentric layers occur in most mantles and seldomly in the crusts (Figure 23). A few concentric layers are quartz-rich (Figure 23).

The observed accretory lapilli fragments (Figure 23) in the samples are similar to those observed in the samples from Khumani Mine. As their name suggests, the accretory lapilli fragments are derived from fragmented or broken accretory lapilli, especially crusts and mantles (Figure 23). The accretory lapilli fragments vary between 2.0 and 3.0 mm in thickness and are typically angular and subspherical, and occur as discrete bodies in the matrix (Figure 23).

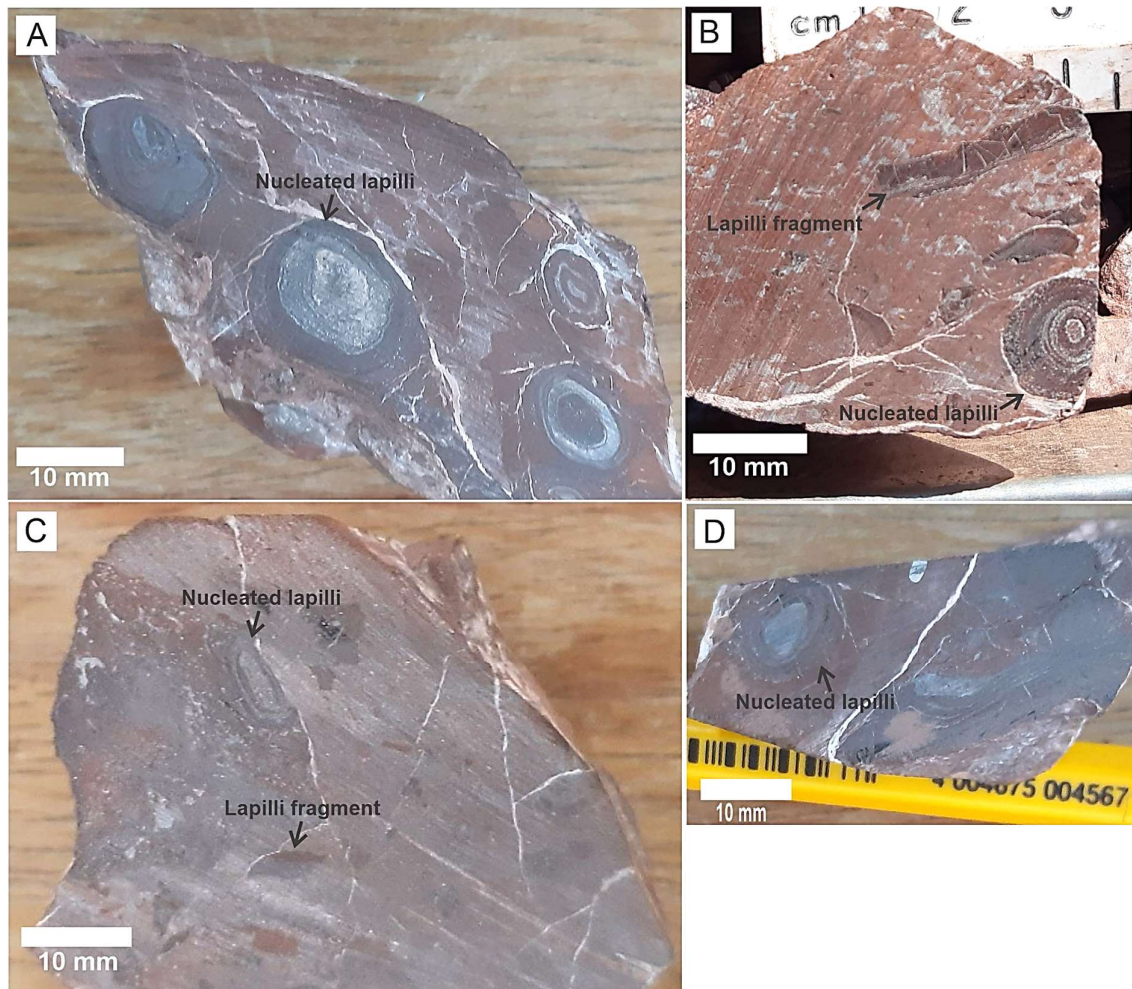


Figure 23: (A-D) Photographs of ferruginous samples with accretory lapilli from Turner Exploration Camp; the black arrows indicate the accretory lapilli. The samples are clay-rich matrix-supported breccias and are cut by chert hydrothermal veins. (A) Nucleated accretory lapilli with nuclei, mantles, and crusts. The nuclei and mantles consist of hematite and quartz, and the crusts consist of hematite. (B) Accretory lapilli fragments are derived from broken accretory lapilli, especially crusts and mantles. Note a nucleated lapillus with several, less than 10 concentric layers, in the mantle. (C) A nucleated accretory lapillus and an accretory lapilli fragment. (D) A nucleated accretory lapillus.





Figure 24: The paleosol from Turner Exploration Camp. Observe the compaction features and stylolites in the paleosol.

#### 4.2.2 Petrography

This section describes the results of petrography for the samples from Turner Exploration Camp. The samples' optical microscopy examination results are provided in Table 2 for sample and accretionary lapilli descriptions.

##### Optical Microscopy

Almost all the thin sections prepared from Turner Exploration Camp samples are ferruginous and opaque, and, as a result, the thin sections were difficult to examine with optical microscopy. SEM and photographs of the thin sections were used to describe the thin sections further. The thin sections indicate that the samples are clay-rich, matrix-supported breccias (Unit A) with a matrix composed of rutile, chlorite, mica, carbonate and rarely amorphous silica. Angular clasts of hematite, zircon, feldspar and very fine-grained lithic rock fragments also occur in the matrix. The breccias also contain nucleated accretionary lapilli and accretionary lapilli fragments (Unit B), which are entirely composed of hematite and seldomly amorphous silica (Figure 25 & Figure 26A). The paleosol (Unit C) contains round to angular potential shocked and un-shocked zircon and quartz grains in a clay-rich and weathered matrix composed of rutile, chlorite, serpentine, and rarely hematite (Figure 26B). An unaltered accretionary lapillus fragment occurs in the matrix of the paleosol (Figure 26B).

##### Accretionary lapilli

The observed accretionary lapilli in the breccias are nucleated and fragmented (Figure 25). The nucleated accretionary lapilli preserve their concentric structure, although it is clear they underwent extensive ferruginisation (Figure 25). The nucleated accretionary lapilli are well-round to round, vary in shape from spherical to subspherical, and their long and short apparent diameters range from 4.0 to 10.0 mm and 3.0 to 8.0 mm, respectively (Figure 25). The nuclei of the nucleated accretionary lapilli are well-round to round and typically spherical and less subspherical and have 1.0 to 5.0 mm apparent diameters (Figure 25). All the nuclei are composed of hematite except a few nuclei composed of quartz. Rare nuclei incorporate angular fine-grained lithic rock fragments. The mantles of the nucleated accretionary lapilli are 3.0 to 5.0 mm thick and often contain up to 6 concentric layers formed by alternating hematite- and quartz-rich concentric layers (Figure 25). The crusts of the nucleated accretionary lapilli are 1.0 to 2.0 mm thick and infrequently contain concentric layers (Figure 25). The nucleated accretionary lapilli grade outward in grain size from coarse-grained in the nuclei to fine-grained in the crusts. The mantles are medium-grained, and the crusts are the darkest component of the accretionary lapilli (Figure 25).

The accretionary lapilli fragments are angular and typically subspherical and have long and short thicknesses that vary from 2.0 to 10.0 mm and 1.0 to 5.0 mm, respectively (Figure 26A). The accretionary lapilli fragments appear to be derived from the crusts and mantles of fragmented accretionary lapilli.

**Shocked mineral grains**

A high abundance of potential shocked quartz and zircon grains have been found in three thin sections: (1) as discrete grains in the matrix of the thin section TNS1 (paleosol) (Figure 27) and; (2) as discrete grains in the matrix of the thin sections TNS17 and TNS18 (Figure 28). The shocked grains are present within more than half of the thin sections. Some shocked zircon grains have potential planar fractures forming parallel and closely spaced fractures (Figure 27). The planar fractures are 1.0 to 3.0 µm wide, spaced 2.0 to 5.0 µm and have two sets (Figure 27). Some quartz grains have potential decorated PDFs with trails of small fluid inclusions (Figure 28). The decorated PDFs appear to be poorly preserved, and the occurrence of well-preserved decorated PDFs appears to be typically low. The best-preserved PDFs have 1 to 3 sets, but single sets appear prevalent (Figure 28). The width and spacing of the best-preserved PDFs are respectively ~2.0 µm and 3.5 to 6.0 µm. Some shocked quartz grains appear to have PDFs with multiple sets.

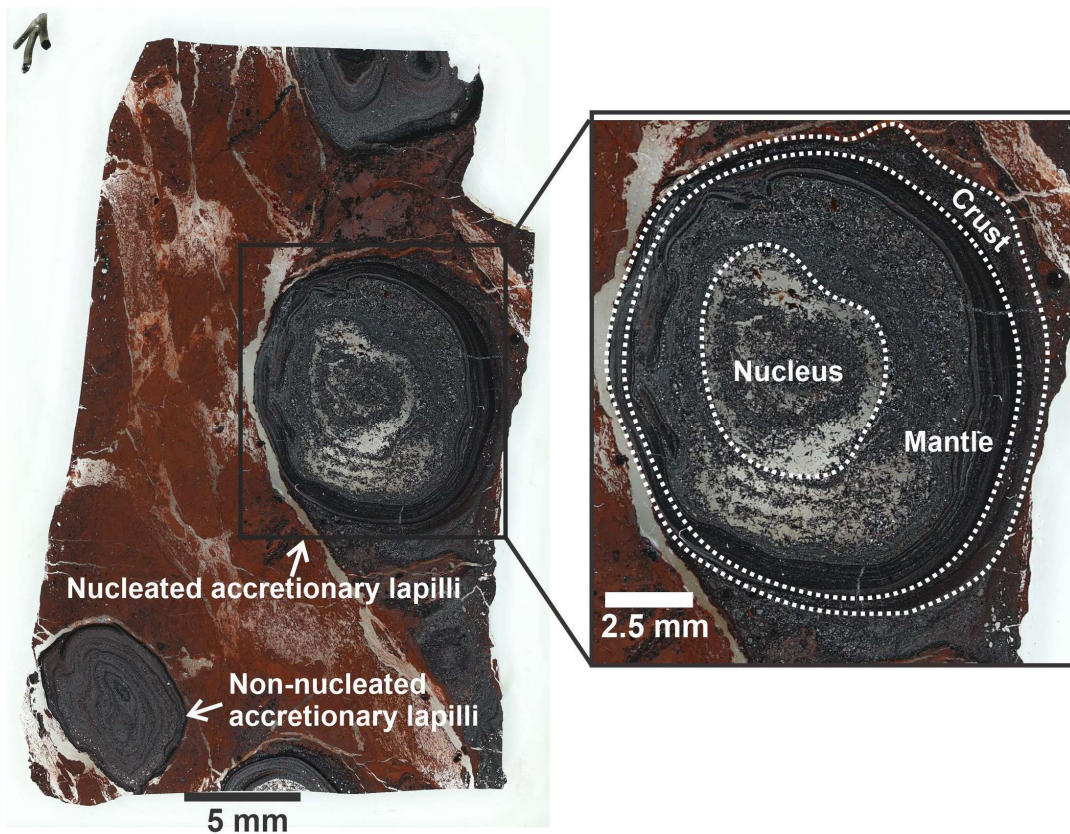


Figure 25: Photographs of a thin section with nucleated and non-nucleated accretionary lapilli prepared from the sample TNS2 from Turner Exploration Camp. Besides the thin arrows indicating the accretionary lapilli, the thick arrows on the thin sections indicate the direction facing upwards. The accretionary lapilli are extensively altered and overprinted by hematite and contain a concentric structure. The left annotated photograph shows the spherical shape, mantle, crust, and nucleus of the nucleated accretionary lapillus.



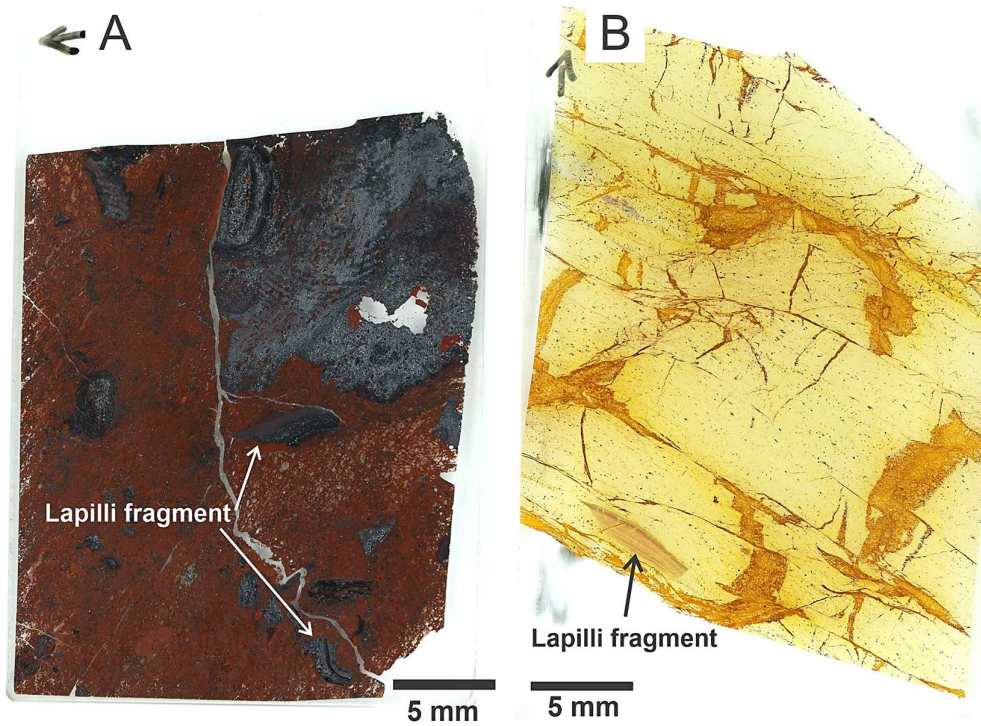


Figure 26: Photographs of the thin sections prepared from the samples TNS4 (A) and TNS1 (B) from Turner Exploration Camp. The black and white arrows indicate the accretionary lapilli in the thin sections. Besides the thin arrows indicating the accretionary lapilli, the thick arrows on the thin sections indicate which direction the thin section is facing upwards. (A) Accretionary lapilli fragments in a thin section that is extensively altered and overprinted by hematite. (B) A thin section of the paleosol (TNS1) showing compaction features and stylolites. An unaltered accretionary lapillus fragment occurs in the paleosol. Compared to the rest of the samples, this sample is not altered or overprinted by hematite.



Figure 27: A transmitted light, plane-polarized light photomicrograph of a possible shocked zircon grain with one set of possible planar features that crosscut the growth zoning. The shocked zircon is in thin section TNS1.

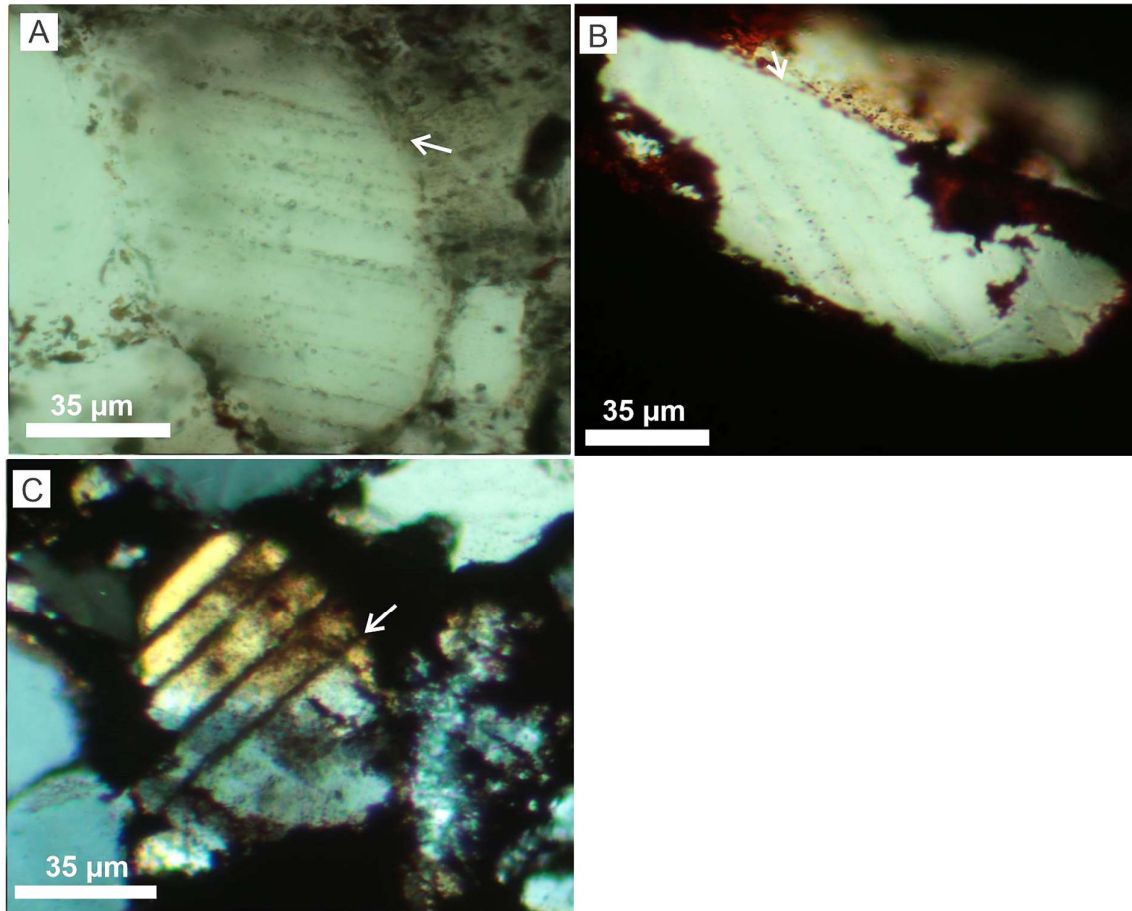


Figure 28: (A-C) Transmitted light, cross-polarized light photomicrographs of potential shocked quartz grains with potential decorated PDFs, samples from Turner Exploration Camp. The white arrows show the decorated PDFs. (A) A prominent set of decorated PDFs showing trails of small fluid inclusions. (B) A quartz grain with a single set of decorated PDFs with trails of small fluid inclusions. (C) A quartz grain with a single set of decorated PDFs infilled with hematite.

### Scanning Electron Microscopy

The SEM results for the thin sections TNS1, TNS2 and TNS18 are described below (Figure 29 to Figure 35). The thin section TNS18 is a clay-rich, matrix-supported breccia (Unit A) with grains of quartz, zircon and fine-grained mica (Figure 29 to Figure 31A). The grains range from subangular to angular, and some have irregular margins, but the grains are typically angular (Figure 31A). The grains range from ~10 to 90 µm in thickness and occur in a matrix consisting of euhedral acicular fine-grained mica and acicular ilmenite (Figure 29 to Figure 31A). Some parts of the matrix contain amorphous silica, and some zircon grains are metamict (Figure 31B). A hydrothermally deposited vein rich in Fe-oxide cuts across the thin section (Figure 32A). The thin section TNS2 forms Unit B and will be discussed below.

The thin section TNS1 is a clay-rich and weathered paleosol (Unit C) with typically well-round and rarely angular grains of zircon, quartz, and ilmenite (Figure 32 to Figure 35). Some of the zircon grains are metamict (Figure 34A). The grains range in size from ~10 to 100 µm and occur in a matrix consisting of phyllosilicates and acicular fine-grained mica (Figure 32 to Figure 35). An unaltered accretionary lapillus fragment is incorporated in this thin section and contains Al-silicate and Fe-oxide and appears to be cut by a hydrothermal vein (Figure 32). Another hydrothermal vein occurs within this thin section. The matrix also contains potential shocked zircon grains, with some having potential planar fractures, which are 2.0 to 5.0 µm wide and spaced 1.0 to 10 µm (Figure 35).



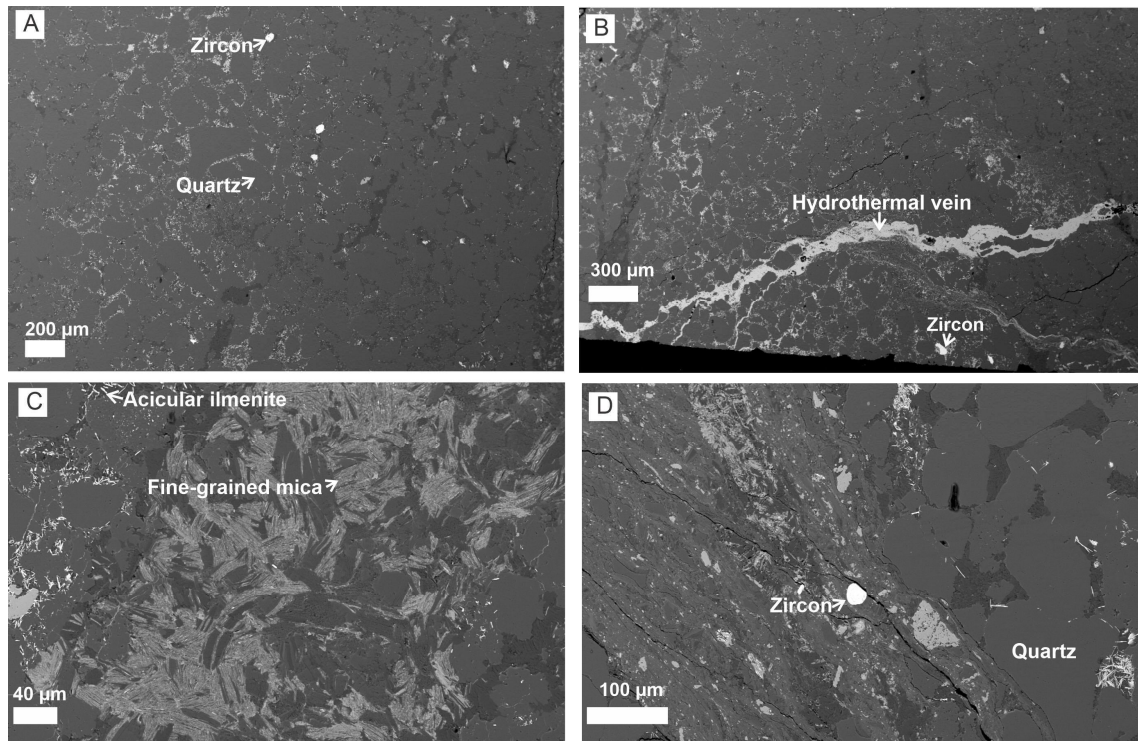


Figure 29: (A-D) SEM Photomicrographs of the sample TNS18; the white arrows show the minerals. Note the angular grains of quartz and zircon occurring in a matrix comprised of acicular fine-grained mica and acicular ilmenite. Also, note the hydrothermal vein rich in Fe-oxide in (B).

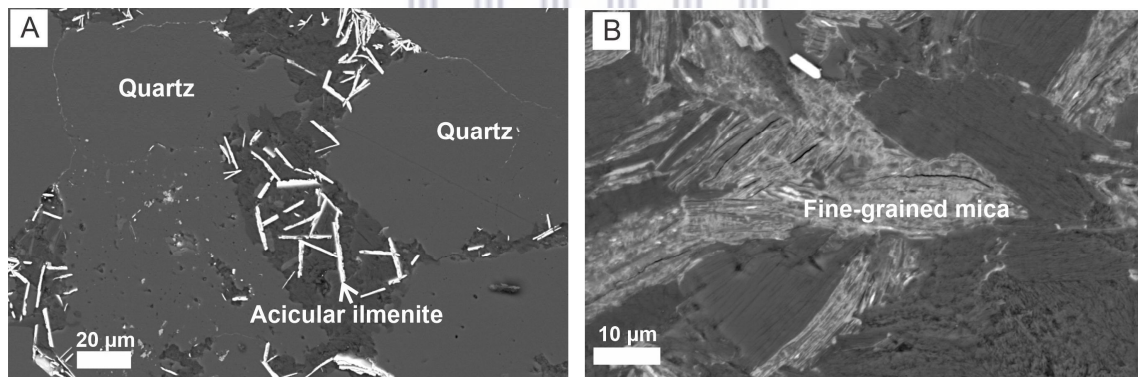


Figure 30: (A-B) SEM photomicrographs of the sample TNS18. (A) Angular grains of quartz with irregular margins in a matrix consisting of acicular fine-grained mica. (B) Acicular fine-grained mica.

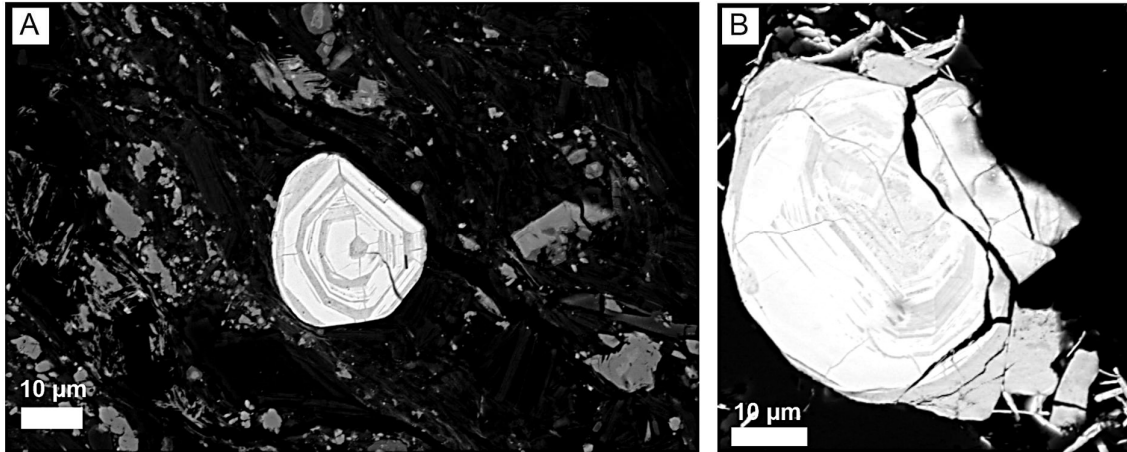


Figure 31: (A-B) SEM photomicrographs of zircon grains in the sample TNS18. (A) A zircon grain. (B) A fragmented zircon grain.

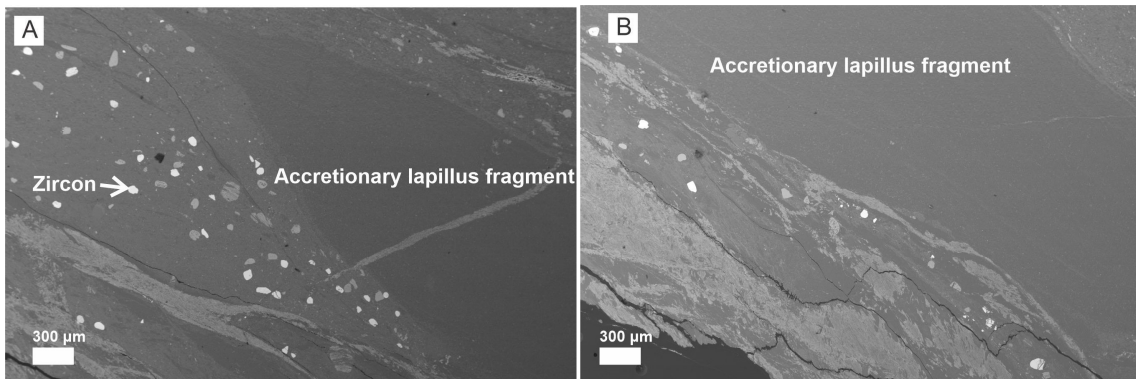


Figure 32: (A-B) SEM photomicrographs with an accretionary lapillus fragment in the sample TNS1. (A) Note the zircon grain and others indicated by the white arrow and the accretionary lapillus fragment. The grey minerals next to the zircon grains are ilmenites. (B) Observe the zircon grains next to the accretionary lapillus fragment.

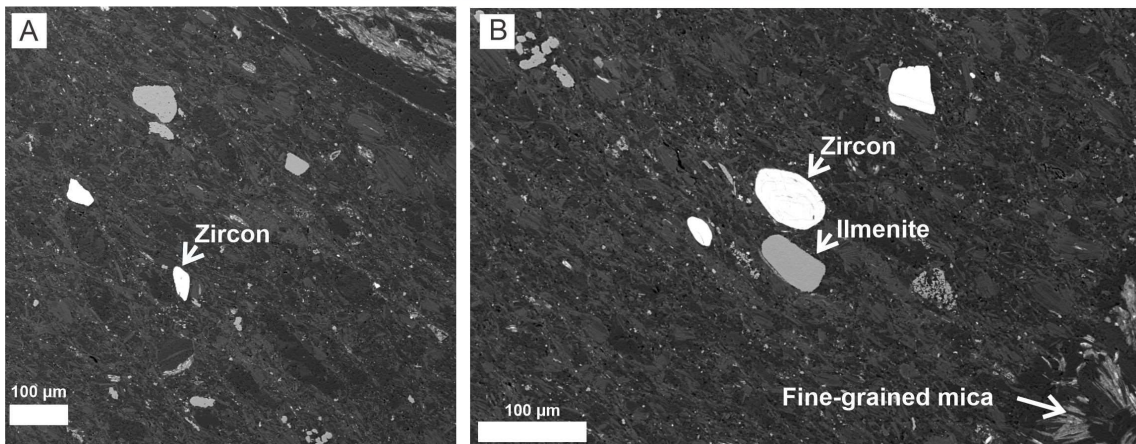


Figure 33: (A-B) SEM photomicrographs of the sample TNS1; the white arrows indicate the minerals. (A) Subangular to angular zircon grains in a fine-grained matrix. (B) Round to subangular and subspherical grains of zircon and ilmenite in a fine-grained matrix consisting of acicular fine-grained mica.



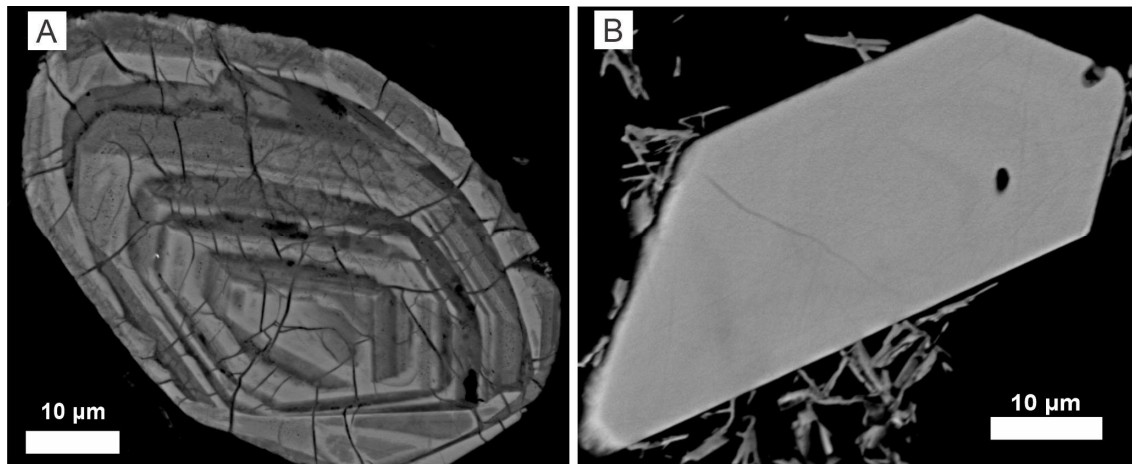


Figure 34: (A & B) SEM photomicrographs of the sample TNS1. (A) A metamict zircon. (B) A zircon grain.

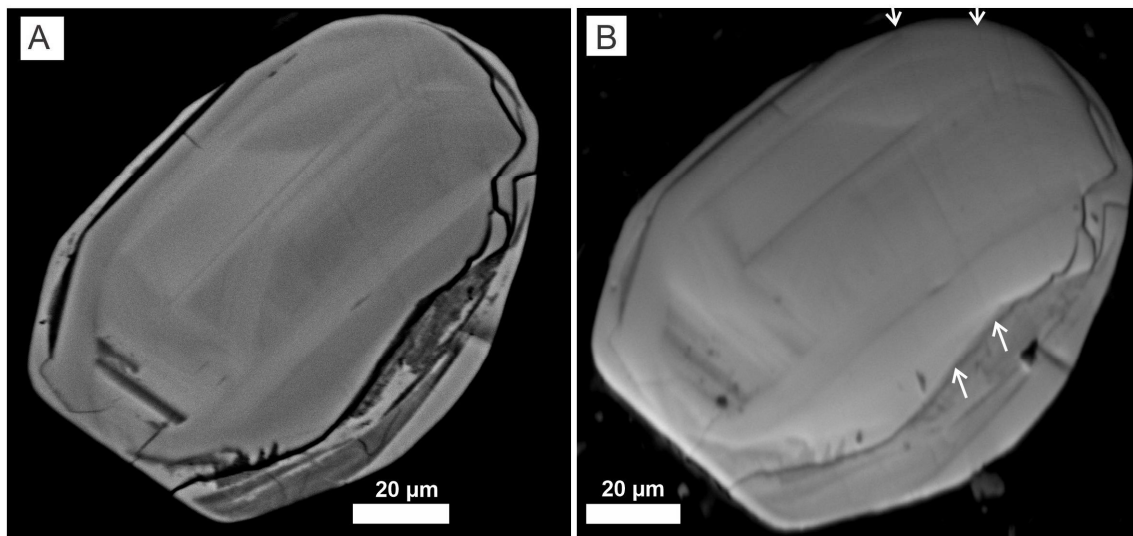


Figure 35: SEM photomicrographs of a zircon grain with potential planar fractures in the sample TNS1. (A) A BSE image of the zircon grain. (B) An orientation contrast image of the zircon grain with two sets of suspected planar features.

### Accretionary lapilli

Using SEM, a nucleated accretionary lapillus and non-nucleated accretionary lapillus (Unit B) have been identified in the thin section TNS2 (Figure 36 & Figure 37). The nucleated accretionary lapillus is subspherical and has a ~15 mm long diameter and ~10 mm short diameter (Figure 36). The nucleated accretionary lapillus contains the typical components of accretionary lapilli, i.e., a concentric structure with a nucleus, mantle and crust (Figure 36). The concentric structure of the nucleated accretionary lapillus fines outward in grain size from the nucleus, the coarsest-grained component, to the crust, the finest-grained component of the accretionary lapillus (Figure 36). The mantle is medium-grained and contains several concentric layerings, while the crust contains a few concentric layerings (Figure 36). The mantle, crust, and nucleus have gradual to sharp contacts between them (Figure 36). The crust is the darkest component of the accretionary lapillus and contains lithic rock fragments aligned parallel to the margins (Figure 36). The nucleated accretionary lapillus is extensively altered and overprinted by Fe (hematite), and as a result, it has a high abundance of Fe, less Si and Al and is depleted in K (Figure 36). The highest Fe abundances occur in the crust and progressively decrease towards the nucleus (Figure 36). In comparison, the highest Si and Al

abundances occur in the nucleus and progressively decrease towards the crust (Figure 36). The concentric layering consists of alternating Si- and Fe-rich concentric layers (Figure 36).

The non-nucleated accretionary lapillus has ~15 mm long and ~10 mm short diameters and is slightly distorted, forming a subspherical body (Figure 37). It has a concentric structure consisting of a mantle, crust and no nucleus (Figure 37). The crust is the finest-grained component, and the mantle is the coarsest-grained component of the accretionary lapillus (Figure 37). Thus, the accretionary lapillus fines outward in grain size from the mantle to the crust. The crust and mantle contain lithic rock fragments, which are typically aligned parallel to the margin. The concentric structure also consists of concentric layering in the mantle and the crust (Figure 37). The concentric layering is thicker than that in the nucleated accretionary lapillus (Figure 37). Compared to the nucleated accretionary lapillus, the non-nucleated accretionary lapillus is also altered and predominated by Fe, less Si and Al and is depleted in K (Figure 37). Most of the concentric layering in the non-nucleated accretionary lapillus is formed by concentric layers consisting of Fe and rarely Si (Figure 37). The matrix around the nucleated and non-nucleated accretionary lapilli appears unaltered and predominated by Si and less Fe and Al (Figure 38). The matrix also appears to contain coarse to medium grains of SiO<sub>2</sub> (Figure 38).

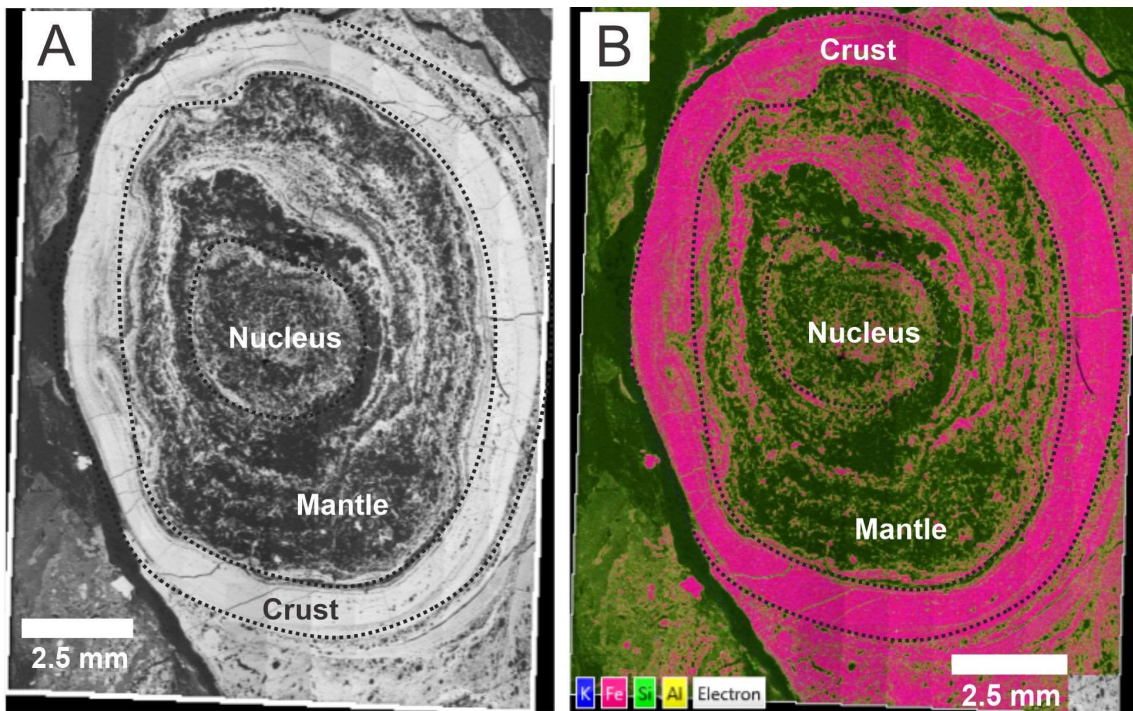


Figure 36: SEM images of the sample TNS2 with a subspherical nucleated accretionary lapillus. (A) A BSE image of the nucleated accretionary lapillus consisting of a nucleus, mantle and crust. The crust is the finest-grained component of the accretionary lapillus and contains concentric layering. The nucleus is the coarsest-grained component of the accretionary lapillus, followed by the mantle. Thus, the accretionary lapillus grades outward in grain size from the nucleus to the crust. Note gradual to sharp contacts between the nucleus and mantle and the mantle and crust. (B) A compositional EDS map of the nucleated accretionary lapillus, where Fe is highly concentrated in the crust compared to the mantle and nucleus. Si and Al are highly concentrated in the mantle and nucleus compared to the crust.



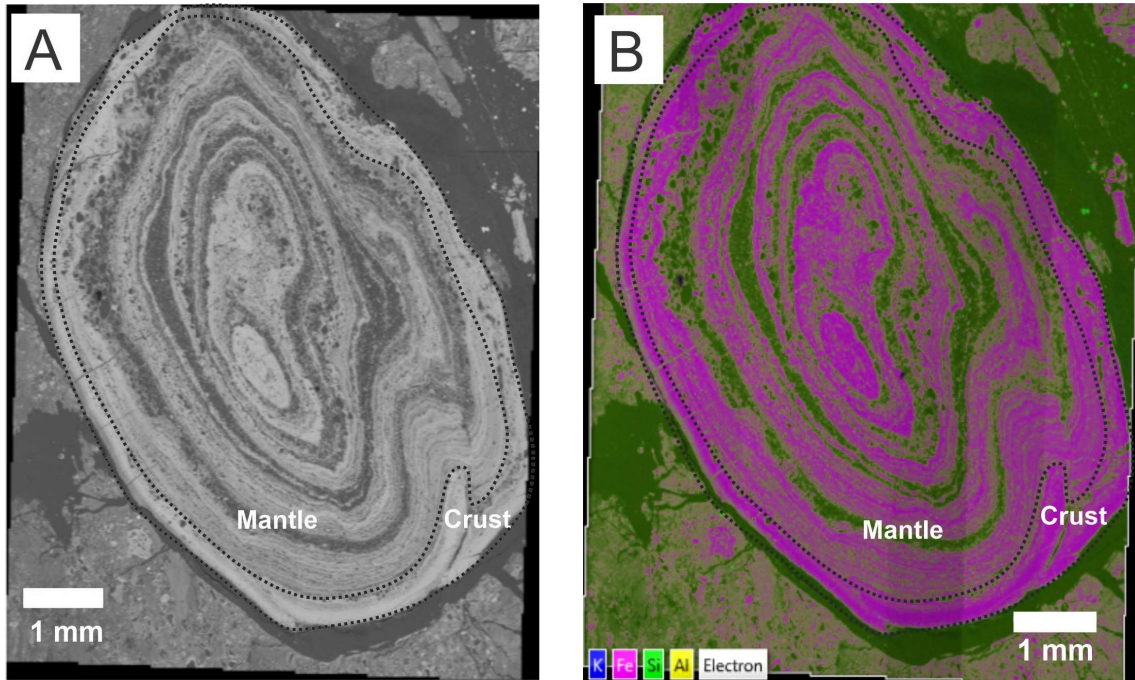


Figure 37: SEM images of the sample TNS2 with a non-nucleated accretionary lapillus. (A) A BSE image of the non-nucleated accretionary lapillus consisting of a mantle, crust and concentric layering. The coarsest-grained component of the accretionary lapillus is the mantle, whereas the crust is the finest-grained component. The accretionary lapillus has a sharp to gradual contact between the crust and the mantle. The accretionary lapillus contains entrained lithic rock fragments aligned roughly parallel to the crust's margins. (B) A compositional EDS map showing that the non-nucleated accretionary lapillus contains a high abundance of Fe. The concentric layering is formed by alternating Si- and Fe-rich concentric layers. The matrix around the accretionary lapillus appears to be less Fe-rich.

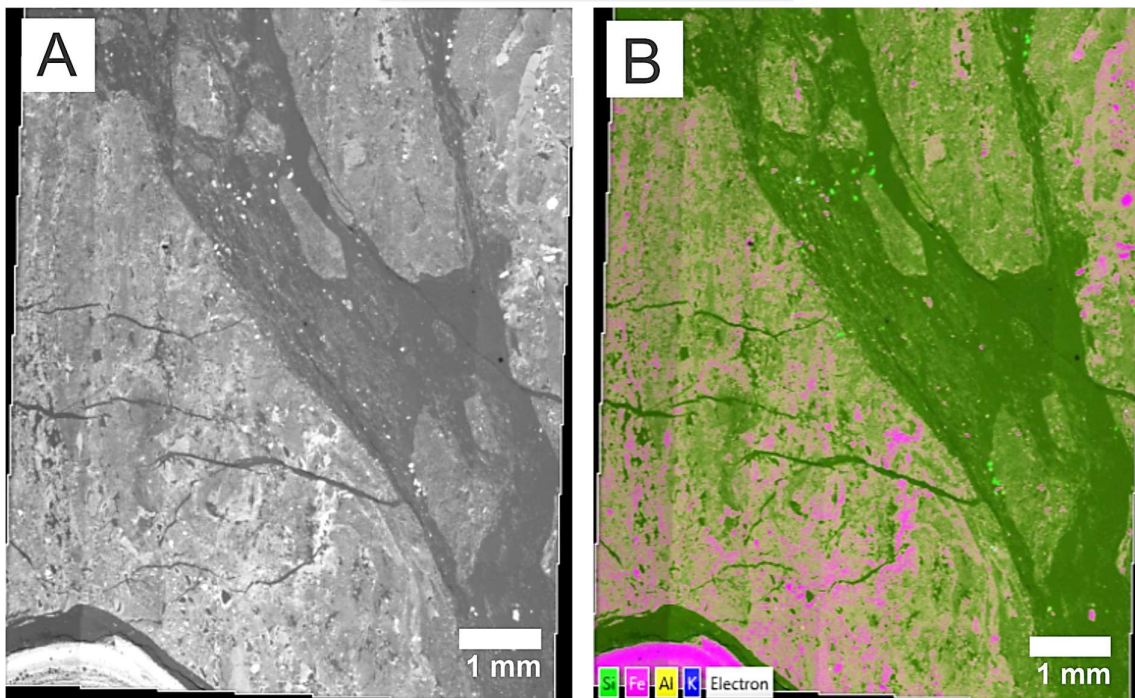


Figure 38: SEM images of the sample TNS2 showing the matrix around the accretionary lapilli. (A) A BSE image showing a quartz-vein in the matrix. (B) A compositional EDS map indicating that the matrix is predominated by Si and Al and less Fe.



### 4.2.3 Geochemistry

This section describes the geochemistry of the samples from Turner Exploration Camp, focusing on the major elements, trace elements and rare earth elements. The results of XRF, Fe assay and INAA for the samples are provided in Table 3, Table 4 and Table 5, respectively. This section will also describe titanium dioxide polymorphs in the samples analysed with Raman spectroscopy.

#### Major elements

Based on the XRF results, the most predominant major elements (oxides) in the samples are, in order of abundance:  $\text{Fe}_2\text{O}_3$ ,  $\text{SiO}_2$  and  $\text{Al}_2\text{O}_3$ . The  $\text{Fe}_2\text{O}_3$  abundances in the samples from this site are the highest in this study, ranging from 5.7 (TNS1) to 88.0 wt.% (TNS15) and average ~51.0 wt.%. The  $\text{SiO}_2$  abundances vary from 3.1 (TNS15) to 65.0 wt.% (TNS18), and average ~22.8 wt.%. The highest  $\text{Al}_2\text{O}_3$  abundance is 35.0 wt.% (TNS18), the lowest is 6.8 wt.% (TNS15), and the average for  $\text{Al}_2\text{O}_3$  abundances is ~19.7 wt.%. The samples also contain other oxides, namely  $\text{TiO}_2$ ,  $\text{CaO}$  and  $\text{K}_2\text{O}$ . The  $\text{TiO}_2$  abundances vary between 0.16 (TNS6) and 2.0 wt.% (TNS1), and their average is 0.71 wt.%. The  $\text{CaO}$  abundances are less than 0.1 wt.%, averaging ~0.037 wt.%. The  $\text{CaO}$  vary from 0.024 (TNS2) to 0.079 wt.% (TNS1). The  $\text{K}_2\text{O}$  abundances vary from 0.093 (TNS15) to 3.7 wt.% (TNS1), and their average is ~0.49 wt.%.

The assay Fe (wt.%) abundances of the samples range from 3.0 (TNS1) to 56 wt.% (TNS15) and have an average of 40.8 wt.%. The Fe abundances indicate that the samples are low-grade ores. The INAA Fe abundances of the samples vary from 3.34 (TNS18) to 67.4 wt.% (TNS15) and have an average of 41.1 wt.%. Based on the INAA Fe abundances, all the samples are low-grade ores except the sample TNS10, which has an Fe abundance of 62.6 wt.% and is a medium-grade ore.

Plots showing major elements variations vs depth for the samples from Turner Exploration Camp are presented in Figure 39 for XRF results and Figure 40 for assay Fe abundances and INAA Fe abundances. The samples show a compositional trend, where samples with high abundances of  $\text{Fe}_2\text{O}_3$  inversely have low abundances of  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{K}_2\text{O}$ ,  $\text{CaO}$  and  $\text{Al}_2\text{O}_3$  (Figure 41). The compositional trend is supported by the sample's Harker diagrams, where the Harker diagram patterns show a positive correlation between  $\text{SiO}_2$  and  $\text{TiO}_2$ ,  $\text{K}_2\text{O}$ ,  $\text{Na}_2\text{O}$ , and  $\text{Al}_2\text{O}_3$ , and a negative correlation between  $\text{SiO}_2$  and  $\text{P}_2\text{O}_5$  for the samples (Figure 41 & Figure 42). The patterns also show a negative correlation between  $\text{Fe}_2\text{O}_3$  and  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{P}_2\text{O}_5$ ,  $\text{K}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $\text{Al}_2\text{O}_3$ , and  $\text{CaO}$  and a positive correlation between  $\text{Fe}_2\text{O}_3$  and  $\text{P}_2\text{O}_5$  for the samples (Figure 42).

Plotted major element patterns for the samples and the PAAS and UC are provided in Figure 43A. The patterns are similar for most samples and are similar to the PAAS and UC. The patterns show that the samples are anomalously enriched in  $\text{Fe}_2\text{O}_3$  and subsequently enriched in  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{TiO}_2$  and  $\text{K}_2\text{O}$  (Figure 43A). The samples are slightly depleted in  $\text{Na}_2\text{O}$  and prominently depleted in  $\text{CaO}$ . The PAAS and UC are enriched in  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{CaO}$  and  $\text{Na}_2\text{O}$  and slightly depleted in  $\text{Fe}_2\text{O}_3$ ,  $\text{TiO}_2$  and  $\text{K}_2\text{O}$  (Figure 43A). Compared to the PAAS and UC, the samples have higher patterns and abundances of  $\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$  and  $\text{TiO}_2$  and lower patterns and abundances of  $\text{SiO}_2$ ,  $\text{CaO}$ ,  $\text{K}_2\text{O}$  and  $\text{Na}_2\text{O}$  (Figure 43A).

#### Trace elements

Plots showing trace elements variations vs depth for the samples from Turner Exploration Camp are given in Figure 40. The trace elements of interest for this study are Ir, Ni, Cr and Co. These elements have the highest abundances in the sample TNS1 but are low in abundance compared to meteorites (Figure 40) (Glass & Simonson, 2013). The highest Ni

abundance is 108 ppm (TNS1), whereas Ni is below detection limits in 10 samples. Co varies in abundance from 1.42 (TNS4 and TNS8) to 9.93 ppm (TNS1), and Cr from 119 (TNS12) to 1968 ppm (TNS1) (Figure 40). The Ni, Co, and Cr abundances averages are 43.0 ppm, 2.74 ppm and 332 ppm, respectively. Ir is only detected in the sample TNS11 and has a concentration of 0,58 ppb. The Ni/Co, Ni/Cr, and Co/Cr ratios are very similar across the samples and range to 13.5, 0.32 and 0.02, respectively. The Ni/Co, Ni/Cr, and Co/Cr ratios averages are respectively ~1.0, ~0.13, and 0.01.

### **Rare Earth elements**

Extended trace element patterns for the samples from this site indicate that the samples generally have higher patterns and higher enrichments of extended trace elements than the PAAS and UC (Figure 43B). The patterns also show that the samples are enriched in V, Ni, Cu, Zn and Ba and anomalously enriched in Sr and Zr (Figure 43B). The samples are slightly depleted in Sc, Cr, Y and Nb and have prominent depletions in Co (Figure 43B). In contrast, the PAAS and UC are enriched in V, Ni, Cu, Zn, Y, Nb and Ba and slightly depleted in Sc, Cr, Co, Cu, Sr, Zr and Ba (Figure 43B).

Chondrite-normalised patterns for the samples, PAAS and UC, are shown in Figure 43C. The patterns show that the samples are enriched in HREE (Eu, Gd, Tm, Yb and Lu), depleted in LREE (La, Ce, Nd and Sm) and have high positive Eu and Ce anomalies (Figure 43C). The PAAS and UC are also enriched in HREE, depleted in LREE and have high positive Eu and Ce anomalies (Figure 43C). However, the samples have slightly higher patterns and abundances of HREE, lower patterns and abundances of LREE and slightly higher Eu and Ce anomalies (Figure 43C).

### **Titanium dioxide**

Raman spectroscopy analysis of grains in the analysed thin sections revealed two TiO<sub>2</sub> polymorphs, rutile and anatase, depicted in Figure 44 and Figure 45, respectively. Brookite was not found in any of the analysed thin sections. Rutile is found in small but frequent grains in the weathered, clay-rich paleosol (TNS1) and ferruginous, matrix-supported breccia (TNS18). Under reflected light, the rutile is white to light brown and occurs as single, subrounded to sub-angular grains with longer diameters ranging from about 7 to 50 µm (Figure 44). The rutile is fine-grained and euhedral to subhedral grains with even boundaries, but some have partly corroded rims and cracks. A few rutiles are blocky, elongate, and fine-grained, while a few appear to be coarse-grained. Anatase has also been discovered in the weathered, clay-rich paleosol and ferruginous, matrix-supported breccia. Under reflected light, anatase is white to light brown, occurring as fine-grained evenly distributed grains, but some appear to form clusters (Figure 45). In thin section, anatase is distinguishable from rutile by its texture, which is generally subhedral to anhedral and fine-grained with even to uneven grain boundaries. Some anatase grains are spotty and porous with patchy growth, while some occur as irregular anhedral to lath-like disseminations.

Figure 46 and Figure 47 display the Raman spectra for the aforementioned respective rutile and anatase phases in the samples TNS1 and TNS18. The Raman spectra for rutile are focused on the 0 to 1200 cm<sup>-1</sup> range with Challagulla et al. (2017) used to identify rutile and differentiate it from anatase or other TiO<sub>2</sub> phases. The Raman spectra for rutile show three peaks around 252, 446, and 609 cm<sup>-1</sup>, as shown in Figure 46. The wide 252 cm<sup>-1</sup> peak is aligned with the 252 cm<sup>-1</sup> rutile peak in Challagulla et al. (2017). The peak at 446 cm<sup>-1</sup> is the most intense peak under consideration and correlates to Challagulla et al. (2017) rutile's 446 cm<sup>-1</sup> peak, which is also the most intense. Finally, the peak at 609 cm<sup>-1</sup> is nearly symmetric and corresponds with the 609 cm<sup>-1</sup> rutile peak described in Challagulla et al. (2017). Thus, the mentioned rutile peaks are typical of rutile peaks in the literature. Compared to rutile, the

anatase Raman spectra focus on the 0 to 1200  $\text{cm}^{-1}$  range, with Challagulla et al. (2017) being used to determine anatase and distinguish anatase from rutile or other  $\text{TiO}_2$  phases. Figure 47 illustrates the Raman spectra of anatase, which show five peaks about 145, 199, 399, 520, and 640  $\text{cm}^{-1}$ . The 145  $\text{cm}^{-1}$  peak is the most intense and aligned with the 145  $\text{cm}^{-1}$  peak in Challagulla et al. (2017). The 199  $\text{cm}^{-1}$  peak, which is the smallest, correlates with the 199  $\text{cm}^{-1}$  peak in Challagulla et al. (2017). The 399 and 520  $\text{cm}^{-1}$  peaks are respectively the third and fourth most intense, aligning with the 399 and 520  $\text{cm}^{-1}$  peaks in Challagulla et al. (2017). The last and second most intense peak at 640  $\text{cm}^{-1}$  is consistent with that in Challagulla et al. (2017).



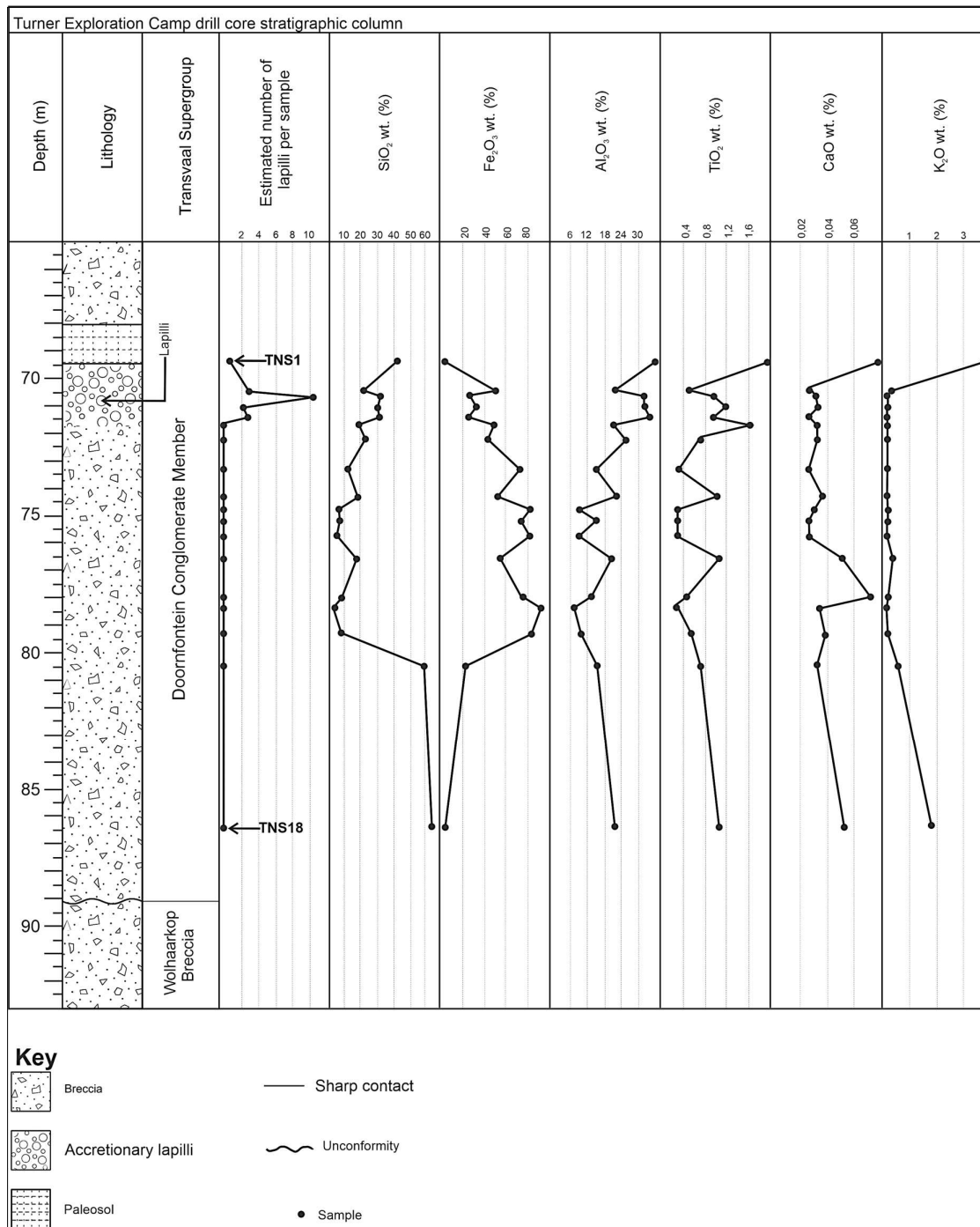


Figure 39: Plots showing major elements (oxides) variations vs depth for the samples from Turner Exploration Camp. From top to bottom, the samples are TNS1 to TNS18. Observe that the samples with high abundances of Fe<sub>2</sub>O<sub>3</sub> inversely have low abundances of SiO<sub>2</sub>, TiO<sub>2</sub>, K<sub>2</sub>O, CaO and Al<sub>2</sub>O<sub>3</sub>.

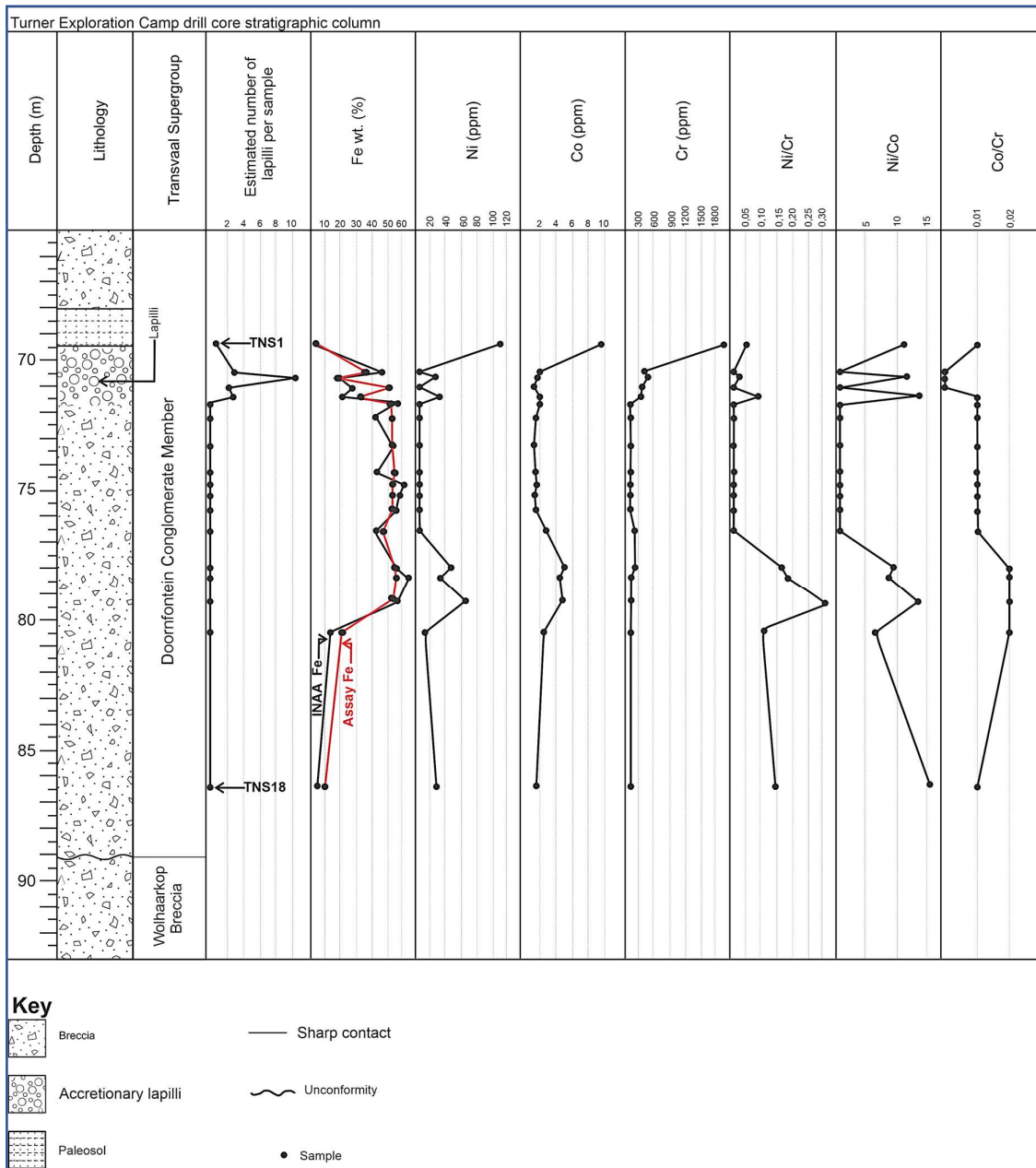


Figure 40: Plots showing trace elements and Fe (wt.%) variations vs depth for the samples from Turner Exploration Camp.



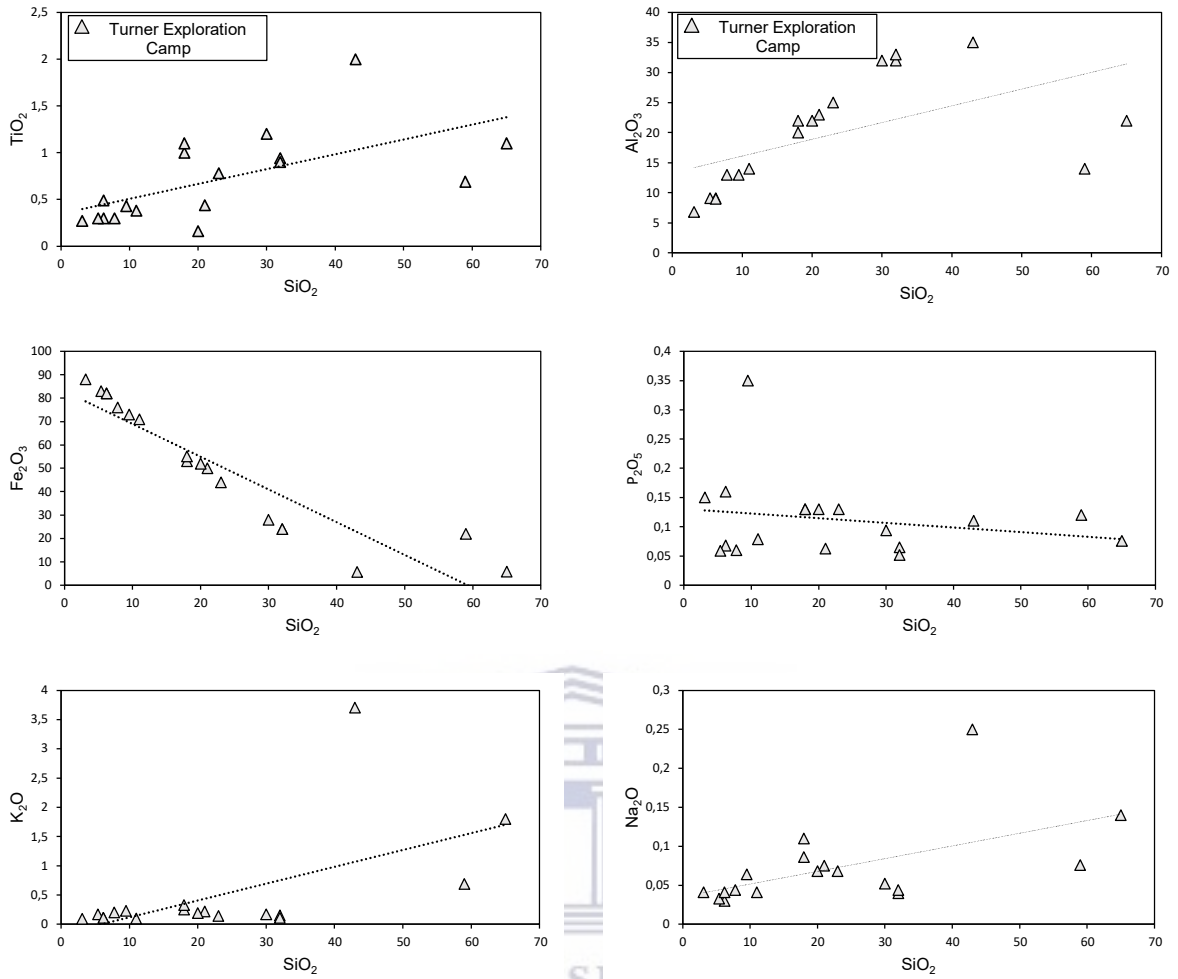


Figure 41: SiO<sub>2</sub> vs TiO<sub>2</sub>, K<sub>2</sub>O, Na<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, P<sub>2</sub>O<sub>5</sub> and Fe<sub>2</sub>O<sub>3</sub> Harker diagrams for the samples from Turner Exploration Camp. The dotted lines represent linear regression lines/correlations for the Harker diagrams. Note the samples' positive correlations between SiO<sub>2</sub> and TiO<sub>2</sub>, K<sub>2</sub>O, Na<sub>2</sub>O and Al<sub>2</sub>O<sub>3</sub>, and the negative correlations between SiO<sub>2</sub> and Fe<sub>2</sub>O<sub>3</sub> and P<sub>2</sub>O<sub>5</sub>.

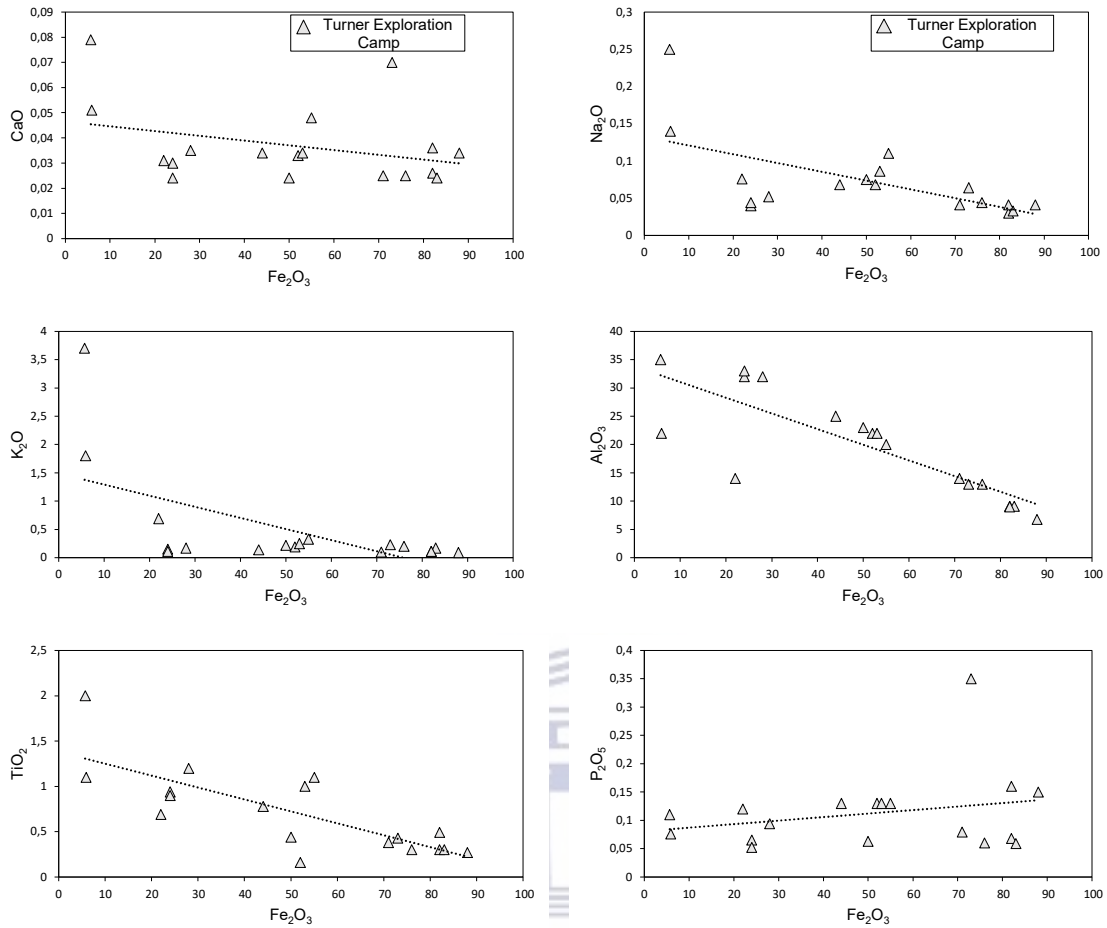


Figure 42:  $Fe_2O_3$  vs  $SiO_2$ ,  $TiO_2$ ,  $P_2O_5$ ,  $K_2O$ ,  $Al_2O_3$  and  $CaO$  Harker diagrams for the samples from Turner Exploration Camp. The dotted lines represent linear regression lines/correlations for the Harker diagrams. Note the negative correlations between  $Fe_2O_3$  and  $SiO_2$ ,  $TiO_2$ ,  $K_2O$ ,  $Al_2O_3$ , and  $CaO$  and the samples' positive correlation between  $Fe_2O_3$  and  $P_2O_5$ .

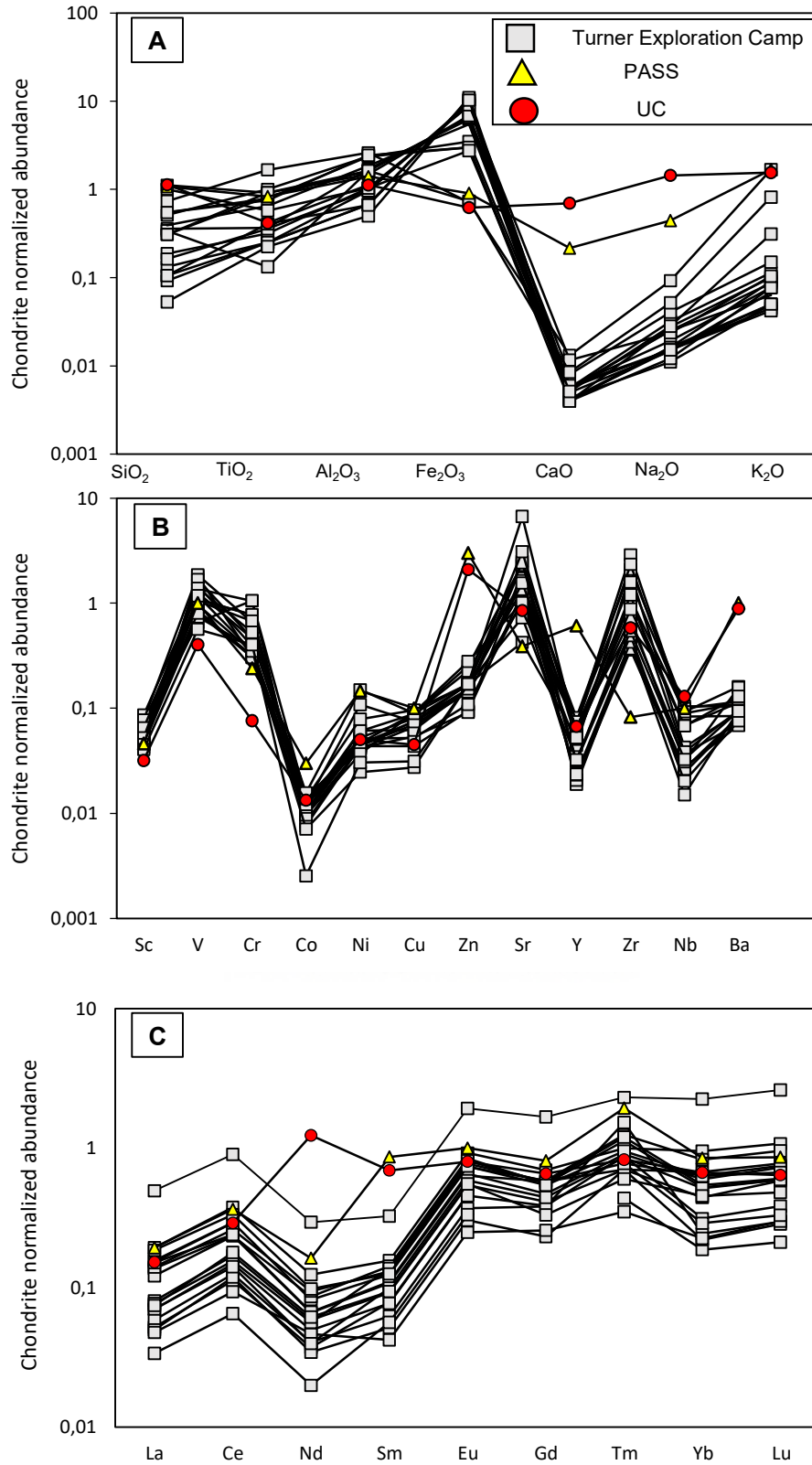


Figure 43: (A) Major element patterns and (B) extended trace element patterns compiled from XRF data, and (C) chondrite-normalized rare earth element patterns compiled from INAA data for the samples from Turner Exploration

*Camp.* Note that the patterns are similar for most samples and are similar to the PAAS (Post-Archaean Australian Shale) and UC (Upper Crust). Major, trace and rare earth element values from Dyer et al. (2019) are used for normalising and presented in Table 1. The PAAS (Post-Archaean Australian Shale) and UC (Upper Crust), data from Taylor and McLennan (1995) and shown in Table 1, are plotted for comparison.

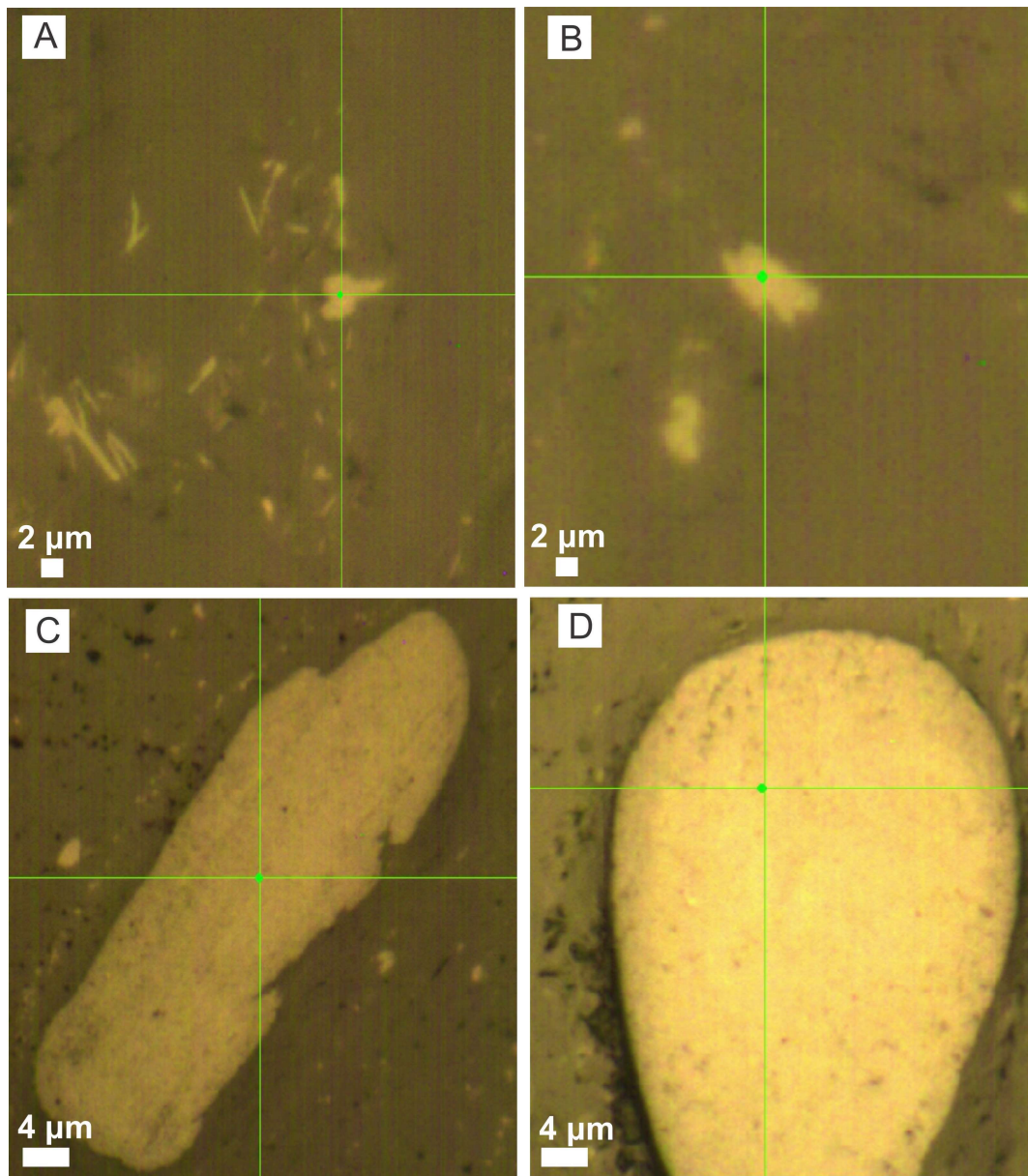


Figure 44: Raman spectroscopy photomicrographs of rutile grains in samples TNS18 (A & B) and TNS1 (C & D) under reflected light. The rutile grains are white to light brown and occur as single, subrounded to sub-angular grains. Furthermore, the rutile grains are fine-grained and euhedral with even boundaries.



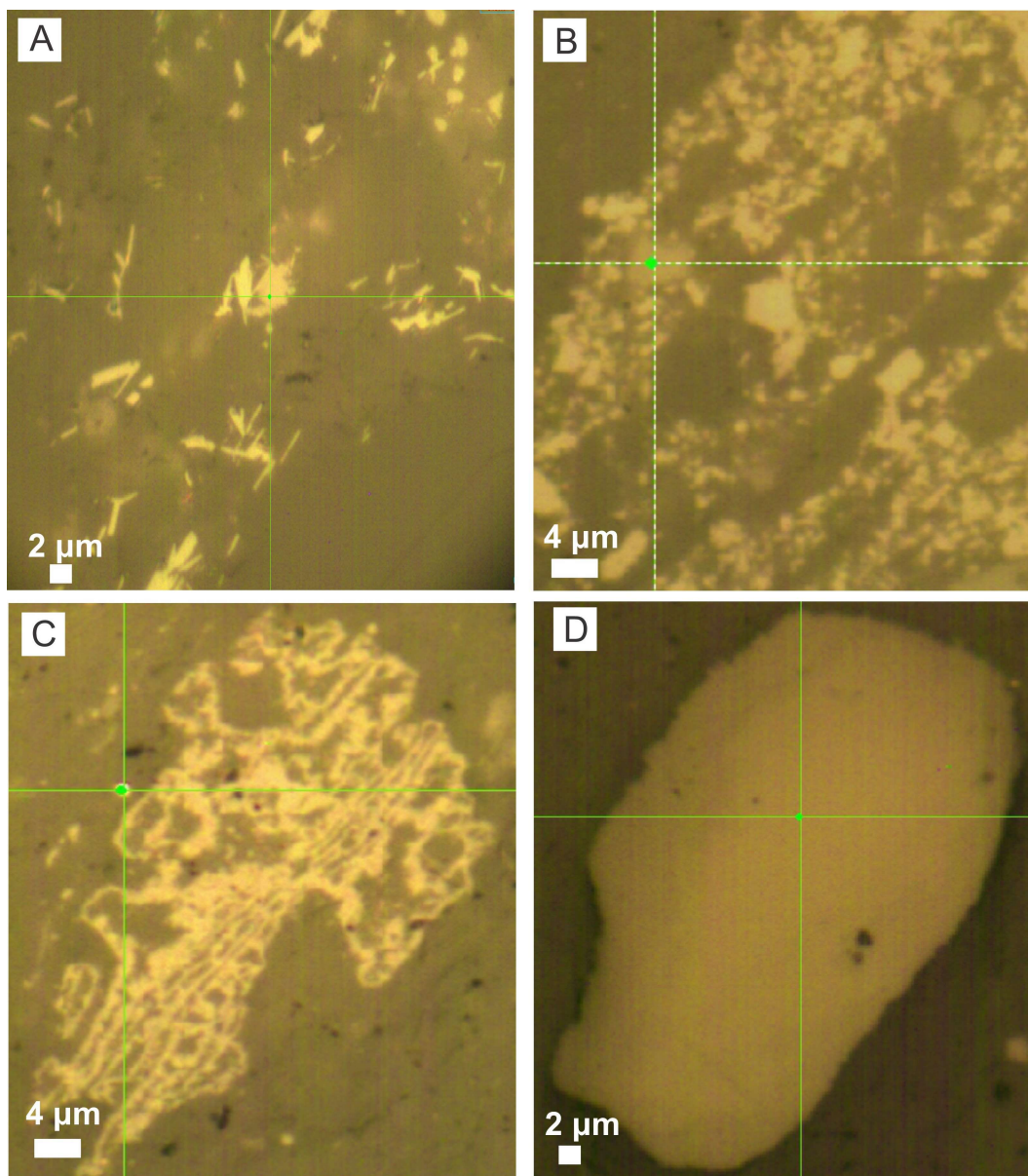


Figure 45: Raman spectroscopy photomicrographs of anatase grains in samples TNS18 (A) and TNS1 (B, C & D) under reflected light. The anatase grains are white to light brown, fine-grained and dispersed grains with even to uneven boundaries. The grains appear to be generally subhedral to anhedral. The anatase grain in C appears to be porous with patchy growth.

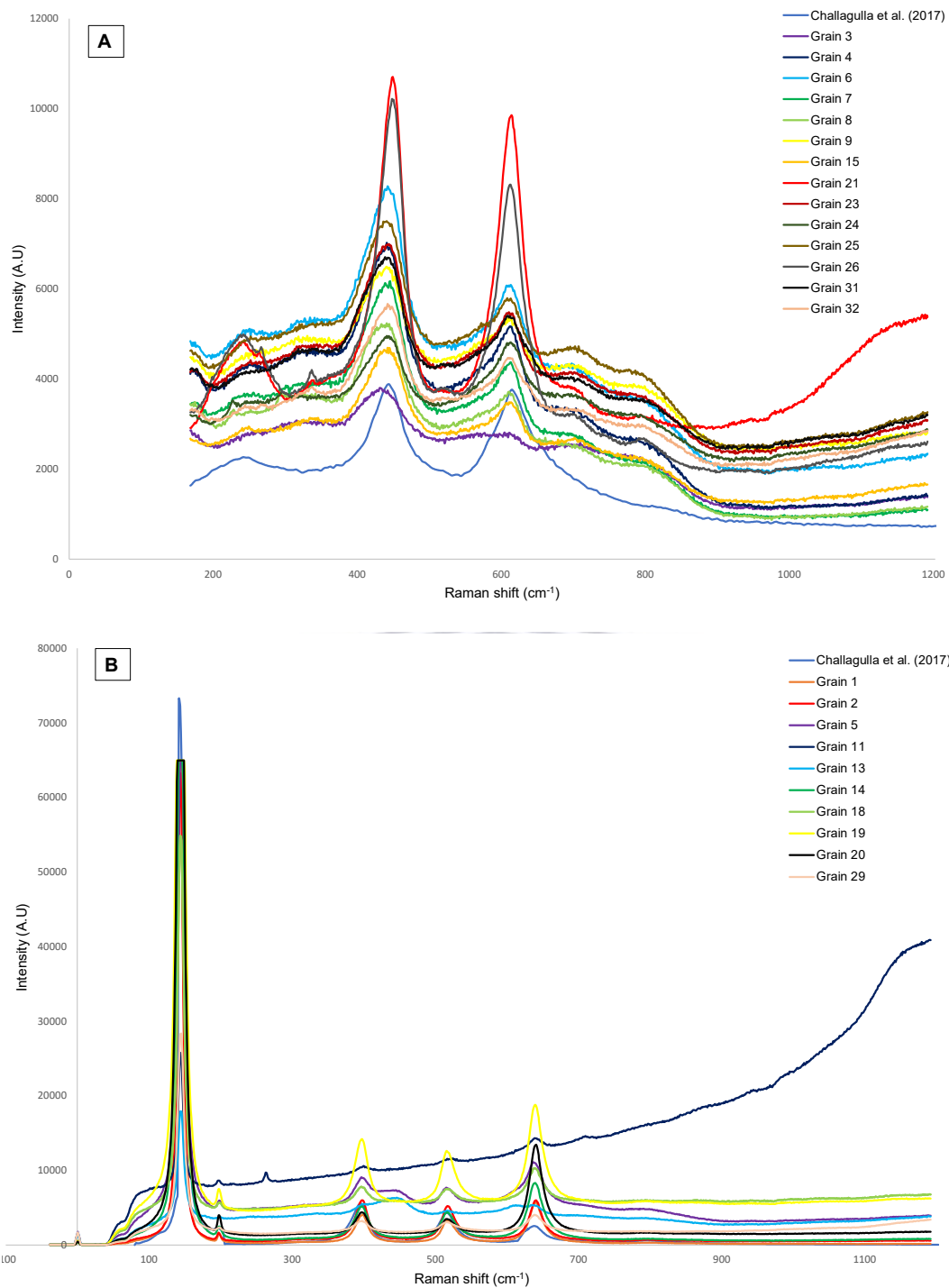


Figure 46: Raman spectra of (A) rutile and (B) anatase grains from sample TNS1. (A) Raman spectra of rutile grains with Challagulla et al. (2017) plotted to identify the rutile grains in the sample and differentiate them from anatase and any other titanium dioxide grains. (B) Raman spectra of anatase grains with Challagulla et al. (2017) plotted to identify the anatase grains in the sample and distinguish them from rutile grains. The rutile and anatase values for Challagulla et al. 2017 are provided in the appendix and can also be accessed on the RRUFF Database.

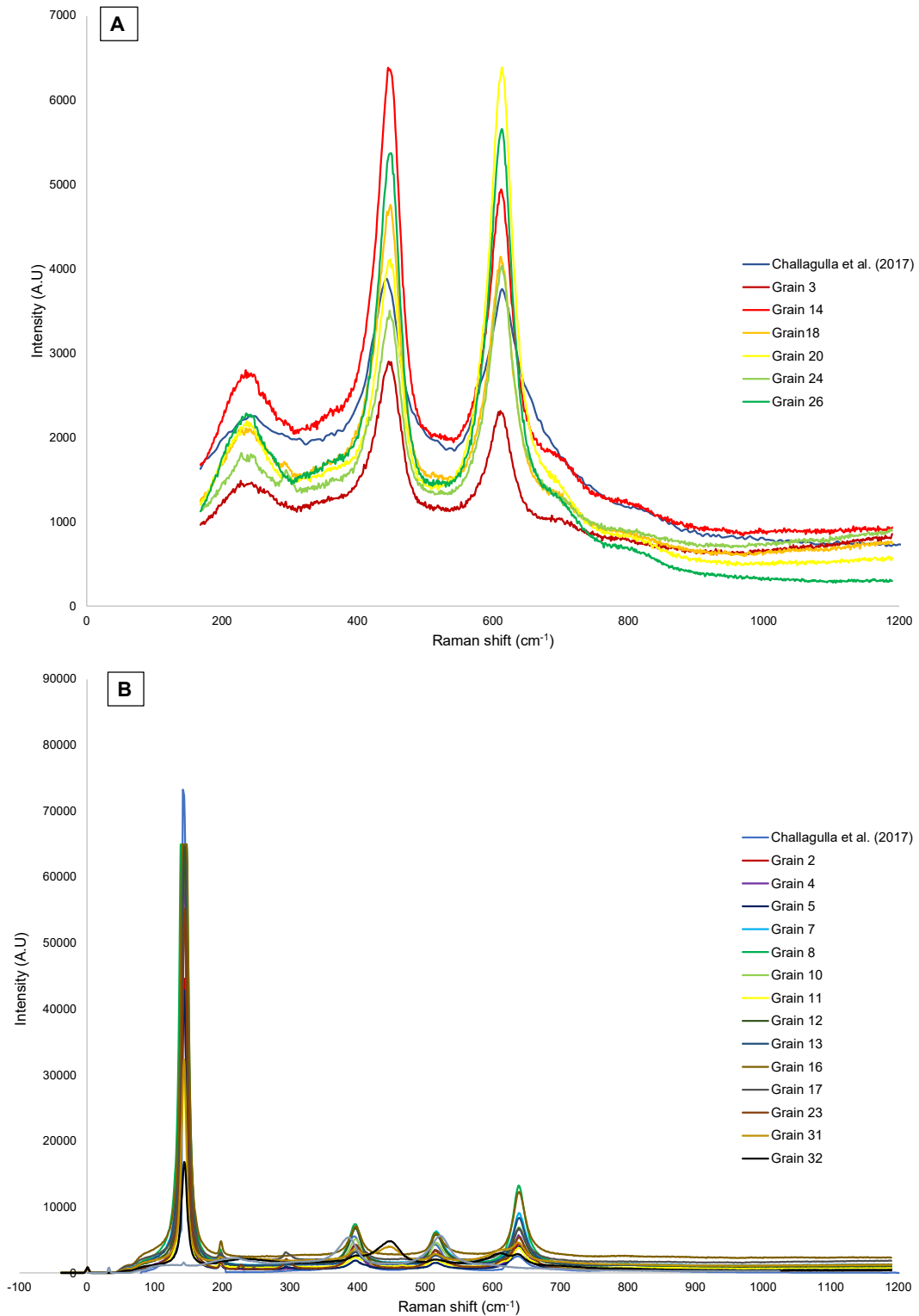


Figure 47: Raman spectra of (A) rutile and (B) anatase grains from sample TNS18. (A) Raman spectra of rutile grains with Challagulla et al. (2017) plotted for comparison and to identify rutile grains in the sample and differentiate them from those of anatase and other titanium dioxide grains. (B) Raman spectra of anatase grains with Challagulla et al. (2017) plotted to identify anatase grains in the sample. The rutile and anatase values for Challagulla et al. 2017 are provided in Appendix B.5 and can also be accessed on the RRUFF Database.



### 4.3 Wolhaarkop Breccia and accretionary lapilli in the field

A field trip was undertaken to Turner Exploration Camp and near Khumani Mine towards the completion of this study to further investigate the accretionary lapilli, Doornfontein Conglomerate Member and Wolhaarkop Breccia in the field. The outcrops were only investigated in the field without further petrographic or geochemical investigations. In outcrop, the Wolhaarkop Breccia conforms to the descriptions of the Wolhaarkop Breccia in the drill core at Turner Exploration Camp. The Wolhaarkop Breccia consists of two types of breccias, namely the upper polymict breccia and lower monomict breccia (Figure 48 & Figure 49). The polymict breccia is generally poorly-sorted, clast-supported and consists of locally derived angular rocks of quartz, banded iron formation, jasper, hematite and other rocks in a chert matrix (Figure 48). The monomict breccia is well-sorted, clast- to matrix-supported and consists of locally derived angular rocks of quartz in a chert matrix (Figure 49). The rocks forming the clasts in the polymictic breccia range from a few centimetres to meters thick, and most are tens of cm thick (Figure 48). In comparison, the clasts in the monomict breccia are a few cm thick and are generally smaller than those in the polymict breccia (Figure 49).

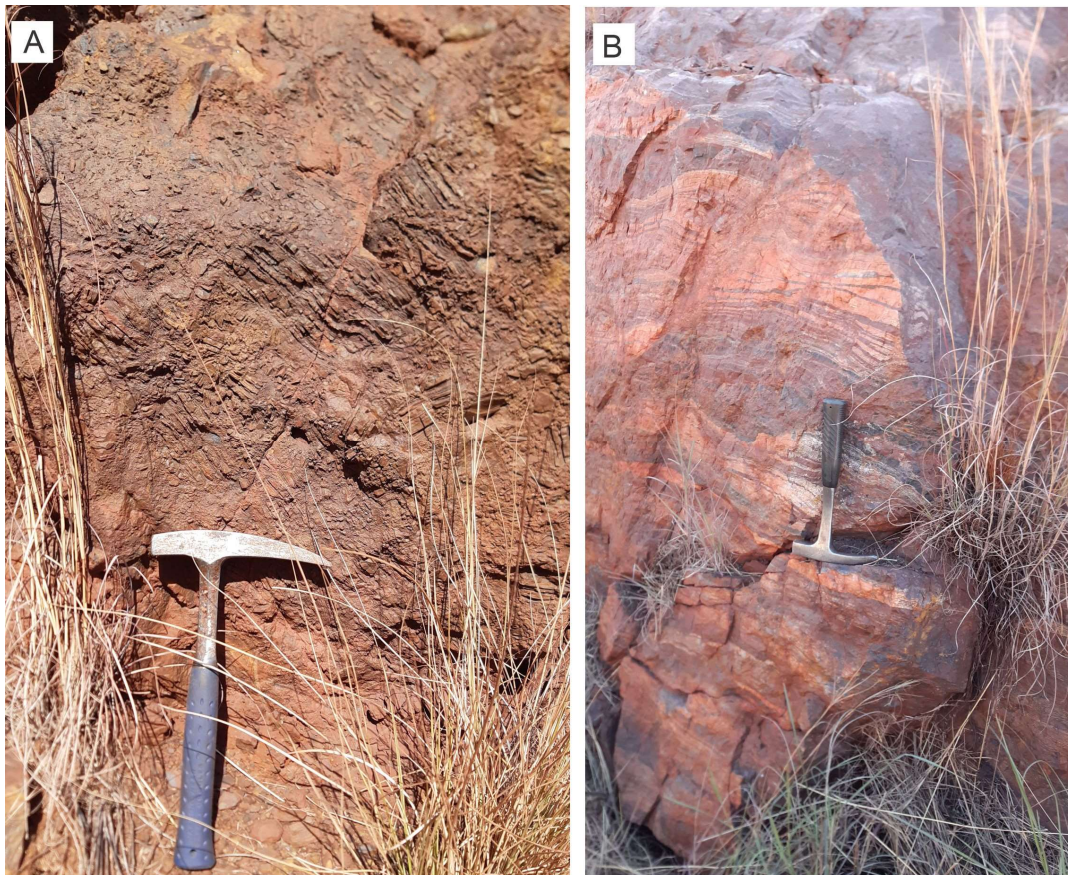


Figure 48: (A-B) Field photographs of the outcrops of the polymict Wolhaarkop Breccia in Kathu in the Northern Cape Province, South Africa. The breccia is red to maroon, clast-supported with a chert matrix. Observe the angular clasts of quartz, BIF, jasper and hematite clasts in the breccia.





*Figure 49: A field photograph of the outcrop of the monomict Wolhaarkop Breccia in Kathu in the Northern Cape Province, South Africa. The breccia is grey to black, matrix-supported with a chert matrix. Note the white angular clasts of quartz in the matrix.*

The observed accretionary lapilli in the field form part of the Doornfontein Conglomerate Member overlying the Wolhaarkop Breccia. The observed accretionary lapilli are nucleated, non-nucleated, irregular and fragmented accretionary lapilli (Figure 50 & Figure 51). Although the accretionary lapilli are altered by hematite, their concentric structure is preserved. The nucleated accretionary lapilli are ~15 mm in apparent diameter, typically spherical and have a concentric structure consisting of nuclei, mantles and crusts (Figure 50 to Figure 51). The concentric structure also consists of concentric layering formed by alternating Fe- (hematite) and Si (quartz)-rich layers in the mantles and crusts. The nuclei are the coarsest-grained component of the accretionary lapilli, the mantles are medium-grained, and the crusts are the finest-grained component. Thus, the concentric structure fines outward in grain size from the nuclei to the crusts. The nucleated accretionary lapilli are the most common accretionary lapilli in outcrop, and the non-nucleated accretionary lapilli are the second most common. However, the non-nucleated accretionary lapilli are very rare (Figure 50 & Figure 51).

The non-nucleated accretionary lapilli are ~17 mm in apparent diameter and typically spherical. The concentric structure of the non-nucleated accretionary lapilli does not contain nuclei; instead, it only contains mantles and crusts. The concentric structure fines outward in grain size from coarse-grained in the mantles to fine-grained in the crusts. The concentric structure also has several alternating Fe-rich and Si-rich concentric layers in the mantles and crusts. The irregular accretionary lapilli are the third most common accretionary lapilli, but they are rare. The accretionary lapilli fragments are also scarce and appear to be typically subspherical and angular.

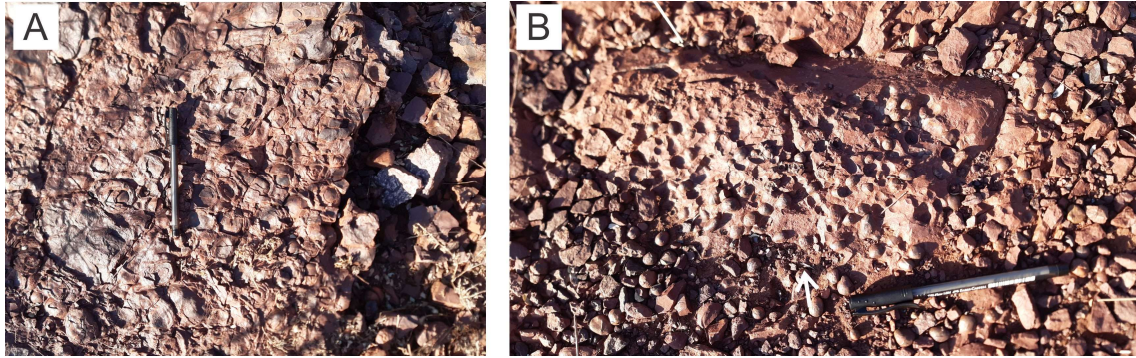


Figure 50: (A-B) Field photographs of the outcrops of the spherical accretionary lapilli in the Doornfontein Conglomerate Member in the Maremane Dome. The outcrops are in Kathu in the Northern Cape, South Africa, and their coordinates are S 27°49'50.45007", E 23°0'29.3719". The black pen on the figures is used for scale.

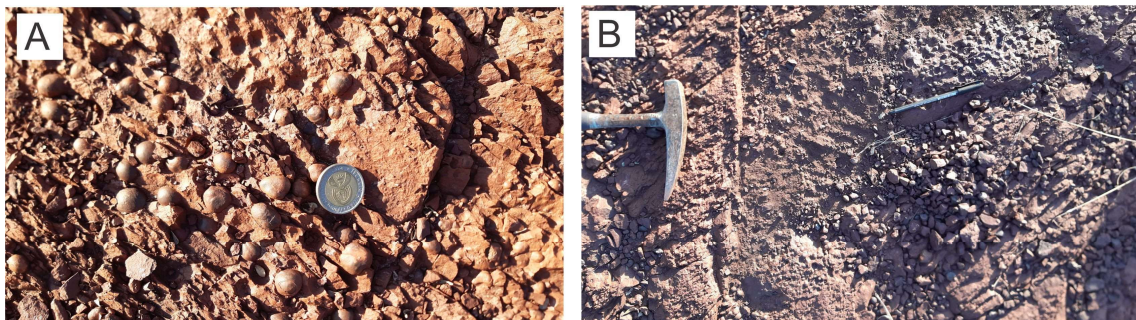


Figure 51: (A-B) Field photographs of the outcrops of the spherical accretionary lapilli in Kathu in the Northern Cape, South Africa. The coordinates of the outcrops are S 27°49'50.45007", E 23°0'29.3719". The money coin and hammer on the figures are used for scale.

#### 4.4 Summary of the results

The samples from both study areas have been categorised into three distinct lithofacies: (1) Unit A; (2) Unit B, and; (3) Unit C. The lithofacies from both study areas have been correlated and are presented in Figure 52. All the units appear to show no sediment reworking and poor sorting of the clasts. Unit A is a ferruginous, clay-rich and matrix-supported breccia consisting of angular clasts of quartz, hematite, chert, carbonate and serpentine and angular lithic rock fragments (Figure 52). Unit A contains potential shocked quartz grains with possible decorated PDFs and potentially shocked zircon grains containing planar microstructures. Unit A is the thickest unit, measuring ~50 m in thickness and does not contain accretionary lapilli (Figure 52). Unit B is a ferruginous, ~2 m thick, clay-rich and matrix-supported breccia (Figure 52). Unit B is indistinguishable from Unit A, except it contains ferruginous accretionary lapilli and accretionary lapilli fragments with no identified shocked mineral grains (Figure 52). Unit B transitions above Unit A seamlessly without a grade distinction or contact. Unit C is the upper unit, ~2 m thick and consists of a weathered, clay-rich paleosol composed of zircon, rutile, quartz, chert, chlorite, and serpentine (Figure 52). Unit C also possibly contains shocked quartz grains with potential decorated PDFs and potentially shocked zircon grains with planar fractures. Unit C only occurs in the samples from Turner Exploration Camp and is neither altered nor overprinted by hematite (Figure 52).

The accretionary lapilli in Unit B (Figure 52) are categorised into three types, namely nucleated, non-nucleated and irregular accretionary lapilli. Accretionary lapilli fragments, which are derived from broken accretionary lapilli, are also found in Unit B. The nucleated accretionary lapilli are spherical to subspherical, range up to 15 mm in apparent diameter and have a concentric structure with nuclei, mantles and crusts. The crusts are typically darker



than the mantles and nuclei. The non-nucleated accretionary lapilli are spherical to subspherical and vary from 10 to 30 mm in apparent diameter. They also have a concentric structure consisting of crusts, mantles and no nuclei. The crusts and mantles of some of the nucleated and non-nucleated accretionary lapilli contain entrained lithic rock fragments aligned parallel to the margins. The irregular accretionary lapilli have irregular margins and are the largest in this study, measuring between 15 and 40 mm and 10 and 35 mm across their long and short apparent diameters, respectively. The irregular accretionary lapilli also have a concentric structure, but some appear not to have a concentric structure. Several, less than 20, alternating Si (quartz)- and Fe (hematite)-rich concentric layers occur in the mantles and crusts of most of the nucleated, non-nucleated and irregular accretionary lapilli.

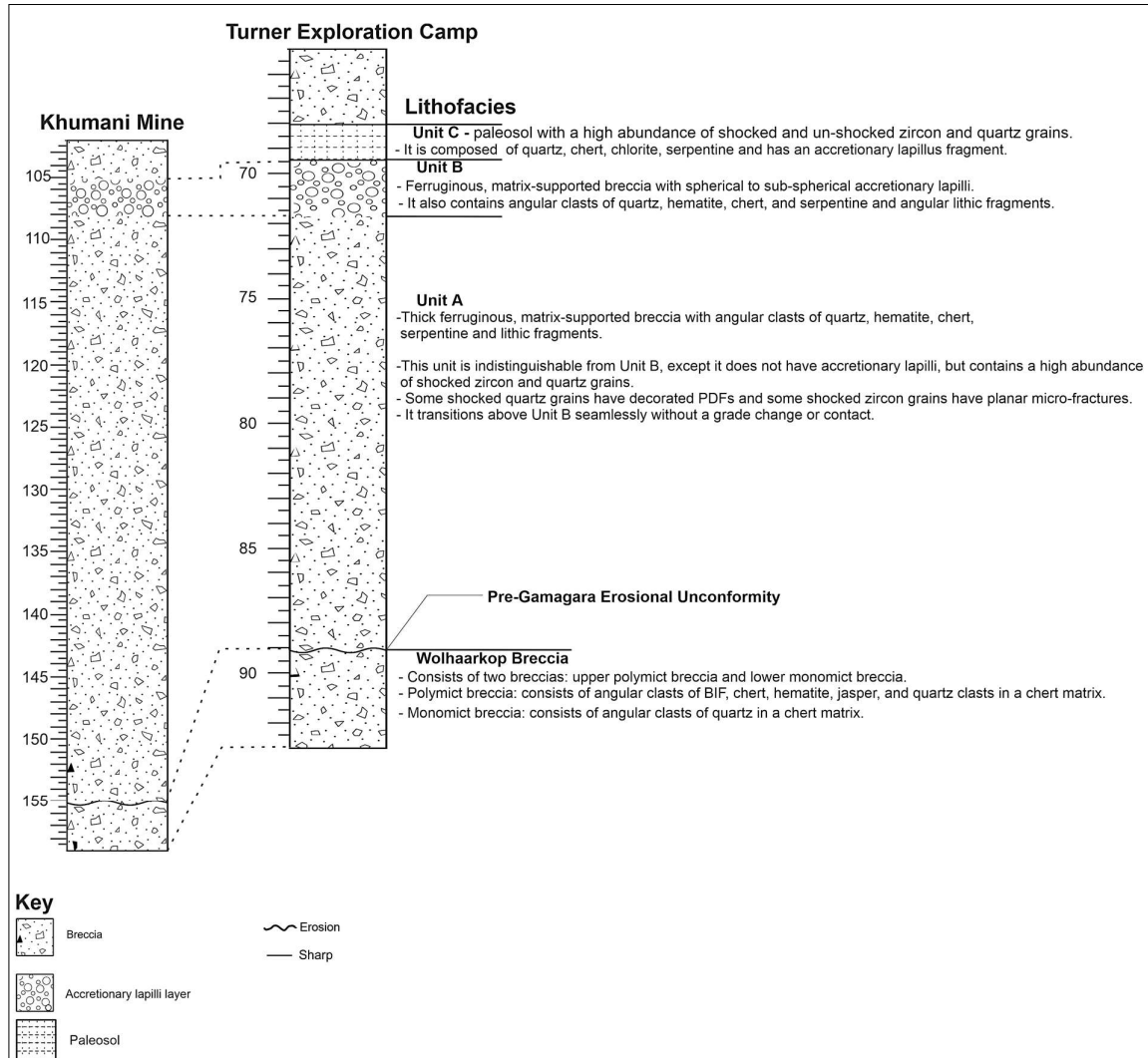


Figure 52: Correlated lithofacies (units A, B & C) of the samples and the Wolhaarkop Breccia from Khumani Mine and Turner Exploration Camp. The lithofacies are only of the study areas and exclude the described outcrops in the field.

## Chapter 5: Discussion

As stated in Chapter 1, this study aims to investigate a possible association of drill core samples from the Doornfontein Conglomerate Member in the Maremane Dome with the Vredefort structure. The drill core samples contain anomalous objects (accretionary lapilli) and are from Khumani Mine (ACKS sample series) and Turner Exploration Camp (TN sample series). This study also investigates a possible association of the Wolhaarkop Breccia in the Maremane Dome with the Vredefort structure.

### 5.1 Estimations of the distribution of Vredefort impact ejecta

#### 5.1.1 Estimations using the Chicxulub structure

The distribution of Vredefort impact ejecta can be roughly estimated based on similarities between the Chicxulub and Vredefort impact events. The Vredefort structure is estimated to have been formed by a meteorite with a 10 to 15 km diameter (McCarthy & Rubidge, 2005; Morrow, 2009). The impact excavated  $\sim 70\,000\text{ km}^2$  volume of the crust, caused a magnitude 14 seismic event and released 100 million megatons of energy (McCarthy & Rubidge, 2005). In comparison, the Chicxulub structure was formed by either an asteroid or comet with a 10 to 12 km diameter (Hilderbrand et al. 1991; Sharpton et al. 1993; Morgan & Warner, 2002; Claeys, 2006). The diameter of the transient crater cavity of the Chicxulub structure varied between 80 and 110 km, reached a depth of at least  $\sim 30$  km and excavated the crust (Yucatan crust) to a depth of at least  $\sim 15$  km (Morgan & Warner, 2002; Pierazzo & Melosh, 1999; Morgan et al. 2000). The ejecta formed by the Chicxulub impact was distributed worldwide, marking the K-Pg stratigraphic boundary (Claeys et al. 2002; Smit, 2003). The continuous impact ejecta blanket of the Chicxulub structure occurs from the crater margin to Belize, well over 400 km from the crater rim (Ocampo et al. 2002).

Given its large-scale parameters compared to the Chicxulub impact, the Vredefort impact would have possibly had a transient crater cavity with an 80 to 150 km diameter. The impact depth of the Vredefort impact would have probably been 35 to 50 km in depth, and the excavation 20 to 55 km in depth. Based on these estimations, the continuous impact ejecta blanket of the Vredefort structure would have probably been distributed worldwide and at least identifiable from the crater margin of the Vredefort structure to over possibly 600 km away from the crater margin. Based on the estimations, Vredefort proximal impact ejecta would occur at Turner Exploration Camp and Khumani Mine, which occur respectively at  $\sim 459$  km and  $\sim 447$  km from the centre of the Vredefort structure.

#### 5.1.2 Estimations using the Earth Impact Effects Program

A web-based computer program, the Earth Impact Effects Program by Collins et al. (2005), was used in this study to also estimate the distribution of Vredefort impact ejecta. As Collins et al. (2005) calls attention to it, please keep in mind that the results of this program are estimates based on existing knowledge of impact processes and should be used with caution. For estimations, this study used a constant impactor density of  $4000\text{ kg.m}^{-3}$  based on the density of  $3000\text{--}4000\text{ kg.m}^{-3}$  for most meteorites (Britt & Consolmagno, 2003) and a constant impactor velocity of  $18\text{ km.s}^{-1}$  based on an average velocity of  $18\text{ km.s}^{-1}$  for asteroids (O'Keefe & Ahrens, 1977; Collins et al. 2005). An average distance of 458 km calculated between Khumani Mine and Turner Exploration Camp and the Vredefort structure is used. An impact angle varying between  $45$  and  $60^\circ$  is used based on a steeply-inclined impact angle of  $45$  to  $60^\circ$  suggested for the Chicxulub impact (Collins et al. 2020). A Vredefort meteorite diameter ranging from 10 to 15 km is used based on the estimated Vredefort meteorite diameter of 10 to 15 km (McCarthy & Rubidge, 2005; Morrow, 2009).



As displayed in Table 6, calculations based on a Vredefort meteorite with a 10 km diameter and an impact angle of 45° suggest that the impact would have a transient crater diameter of 69.7 km, a transient crater depth of 24.6 km and a final crater with a 122 km diameter. The thickness of the impact ejecta is 2.19 m, and the mean fragment size is 1.47 cm. A Vredefort meteorite with a 12 km diameter and an impact angle of 50° would have a transient crater with an 82.5 km diameter and depth of 29.2 km and a final crater with a diameter of 147 km. The thickness of the impact ejecta would be 4.31 m with a mean fragment size of 1.79 cm. The impact would have a transient crater diameter of 95.2 km, a transient depth of 33.7 km, and a final crater diameter of 173 km, according to calculations based on a Vredefort meteorite with a 14 km diameter and a 55° impact angle. The impact ejecta is 7.62 m thick with a mean fragment diameter of 2.11 cm. A 15 km diameter Vredefort meteorite with a 60° impact angle would form a 102 km transient crater with a depth of 36.2 km and leave a 188 km diameter final crater. The impact ejecta would be 10.2 km thick with a mean fragment size of 2.3 cm. At the specified distance (458 km) from the impact structure, irrespective of the changing diameter of the Vredefort structure and impact angle, there would be a fine dusting of impact ejecta with occasional large fragments and ejecta would arrive 5.31 minutes after the impact. These estimations using the Earth Impact Effects Program are similar to those provided by using similarities between the Chicxulub and Vredefort impacts and suggest that ejecta would occur at Turner Exploration Camp and Khumani Mine.

*Table 6: Estimates of the transient crater diameter, transient crater depth and final crater diameter of the Vredefort structure using the Earth Impact Effects Program by Collins et al. (2005). The table also provides information about the estimated other characteristics of the Vredefort impact ejecta. For the estimates, the impact angle and meteorite/impactor diameter change from 45 to 60° and 10 to 15 km, respectively. An impactor density of 4000 kg.m<sup>-3</sup> and an impactor velocity of 18 km.s<sup>-1</sup> are constant with an average distance of 458 km.*

	Impact angle = 45°	Meteorite diameter = 10 km	Impact angle = 50°	Meteorite diameter = 12 km	Impact angle = 55°	Meteorite diameter = 14 km	Impact angle = 60°	Meteorite diameter = 15 km
<b>Transient crater diameter</b>	69.7 km		82.5 km		95.2 km		102 km	
<b>Transient crater depth</b>	24.6 km		29.2 km		33.7 km		36.2 km	
<b>Final crater diameter</b>	122 km		147 km		173 km		188 km	
<b>Arrival of ejecta</b>	5.31 minutes		5.31 minutes		5.31 minutes		5.31 minutes	
<b>Thickness of ejecta</b>	2.19 m		4.31 m		7.62 m		10.2 m	
<b>Mean fragment size</b>	1.47 cm		1.79 cm		2.11 cm		2.3 cm	

As shown in Figure 8, the drill core samples from Khumani Mine are ~447 km from the centre of the Vredefort structure, whereas those from Turner Exploration Camp are ~459 km away. Using the 180 km lower diameter limit of the Vredefort structure (Morrow, 2009), the samples from Khumani Mine are found to be 4.9 crater radii from the centre of the Vredefort structure and 5.1 crater radii away for Turner Exploration Camp (Figure 8). Using the 300 km upper diameter limit of the Vredefort structure (Morrow, 2009), the samples from Khumani Mine are 3.0 crater radii from the centre of the Vredefort structure and 3.1 crater radii away for Turner Exploration Camp (Figure 8). Thus, samples appear to occur within an expected distance from the Vredefort structure for Vredefort proximal impact ejecta.

## 5.2 Radiometric age constraints

The samples stratigraphically occur between the 1.93 Ga (Cornell et al. 1998) andesitic lavas of the Hartley Formation and  $2.22 \pm 13$  Ga (Cornell et al. 1996) Ongeluk Formation. Therefore, the lava formations incorporate the 2.02 Ga age (Kamo et al. 1996; French, 1998) of the Vredefort structure and suggest that the samples occur within a permissible window of time of formation of the Vredefort structure.

## 5.3 Lithofacies

The samples have been categorised into three distinct lithofacies: (1) Unit A, (2) Unit B, and (3) Unit C (Figure 52). The lithofacies are similar to lithofacies, thickness variations, and accretionary lapilli in the ~1.2 Ga Stac Fada impact ejecta in Scotland (Lawson, 1972; Sanders & Johnston, 1989; Turnbull et al. 1996; Amor et al. 2008; Branney & Brown, 2011). The lithofacies in the Stac Fada impact ejecta are divided into divisions A, B and C, but only divisions A and B are applicable to this study. Division A is the lowermost division and ranges between 4 and 10 m in thickness (Sanders & Johnston, 1989; Amor et al. 2008; Branney & Brown, 2011). Division A consists mainly of a clay-rich, matrix-supported suevite with poorly sorted angular fragments and former melt fragments. The division contains no accretionary lapilli and passes smoothly into Division B without a gradational or sharp contact (Branney & Brown, 2011). Division B overlies Division A and is indistinguishable from Division A, except it contains accretionary lapilli up to 15 mm in diameter, accretionary lapilli fragments and other aggregates. The division ranges from 1 to 3 m in thickness, and the accretionary lapilli are mostly matrix-supported (Lawson, 1972; Branney & Brown, 2011). Similar to Division A, Division B is a matrix-supported breccia containing angular lithic rock fragments and former melt fragments.

## 5.4 Accretionary lapilli

This study has referred the anomalous objects in the samples as accretionary lapilli (Figure 10 to Figure 23). Based on the size and internal structure of the anomalous objects (accretionary lapilli), this study would like to argue that the anomalous objects are not pisolites formed by laterization. By definition, pisolites are sedimentary rocks formed by nearly spherical pisoliths (or pisoids) and vary in diameter from 2.0 to 10 mm (Figure 53) (Palache et al. 1963; Scholle & Ulmer-Scholle, 2003; Lascelles, 2016). Pisoliths typically occur near the surface in extremely weathered terrains and consist of nuclei with aggregated particles such as hematite, quartz or lithic fragments enclosed by a cortex formed by one or more concentric layers (Figure 53). The concentric layers of the cortex usually have colloform banding (Palache et al. 1963; Scholle & Ulmer-Scholle, 2003; Simonson, 2003; Lascelles, 2016). Pisoliths usually have radial sprays that diverge outward from nuclei (Figure 53) (Simonson, 2003). Pisoliths are generally thought to form by the modification of concretions rich in sesquioxide in the soil or saprolite of intensely weathered terrains, and the concentric layers of the cortex form either in situ or during subsequent erosion (Morris, 1994; Eggleton & Taylor, 2006). Pisoliths from glauconite grains in greensands have been described to have been formed by replacement and centripetal deposition of iron oxides (Nahon et al. 1980). Pisoliths associated with iron ore, often referred to as pisolitic iron ore, are interpreted to be fluvial deposits (Morris & Ramanaidou, 2007). However, the precise formation mechanism for pisoliths in the soil is unknown, and the current formation models are speculative because pisoliths have never been observed forming in the soil (Lascelles, 2016).

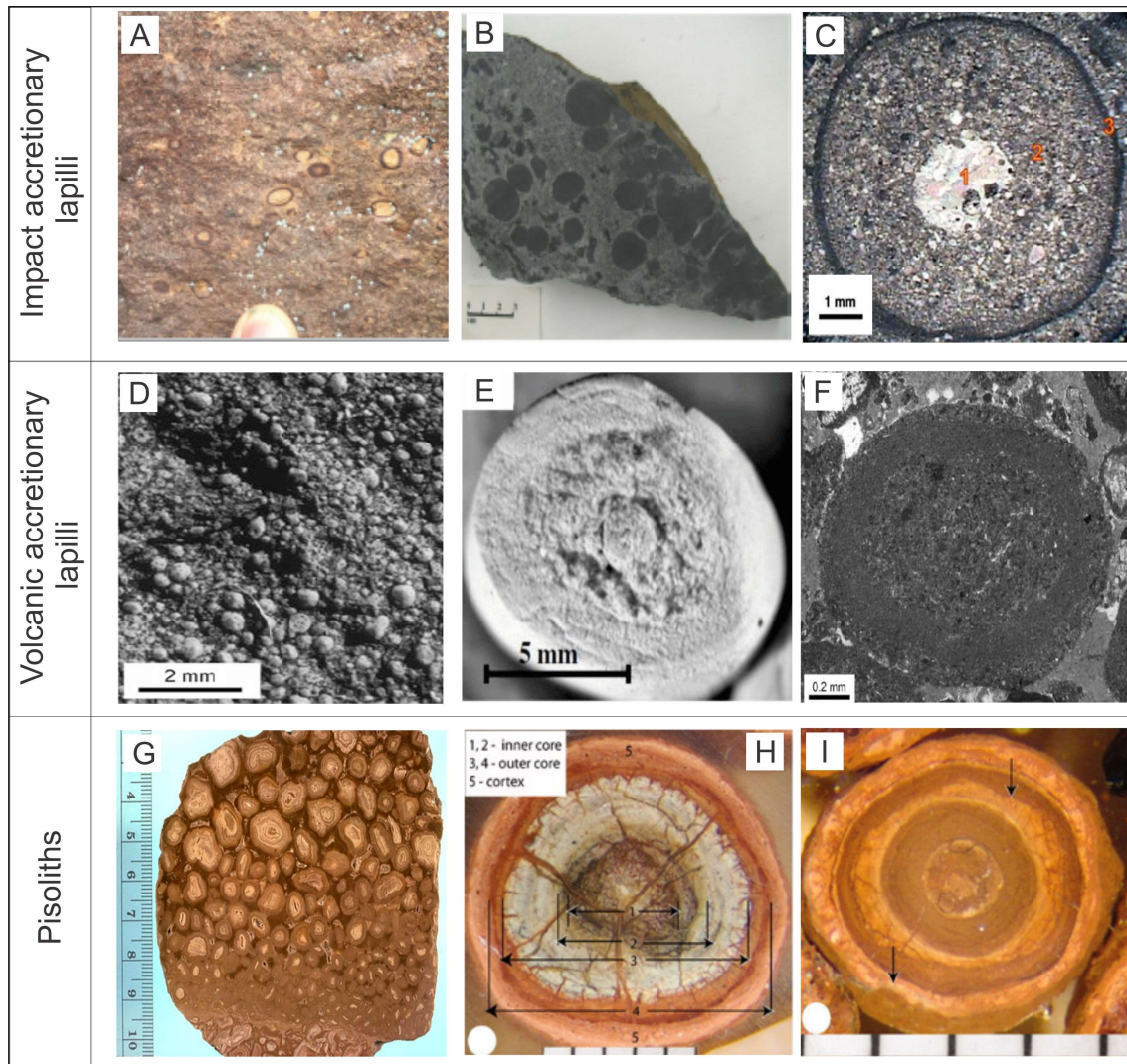


Figure 53: Impact accretionary lapilli, volcanic accretionary lapilli, and pisolites/pisololiths. (A) Impact accretionary lapilli from Stac Fada Member in Scotland with a concentric structure consisting of nuclei, mantles and crusts (Osinski et al. 2021). (B) A sample with impact accretionary lapilli from Hillcrest Part from the Sudbury impact ejecta (Huber & Koeberl, 2017). (C) A photomicrograph of a carbonate impact accretionary lapillus, where (1) indicates the nucleus, (2) a graded mantle and (3) the crust (Morgan, 2006). (D) A volcanic accretionary lapilli-rich layer in the Tumbiana Formation of the Hamersley Basin in Australia (Glass & Simonson, 2013). (E) An ultrafine accretionary lapillus with a nucleus, mantle and crust from the Oruanui ignimbrite proximal facies in New Zealand (Kósik et al. 2019). (F) A volcanic accretionary lapillus showing a concentric structure with a nucleus, mantle and crust from the Tumbiana Formation in the Hamersley Basin (Glass & Simonson, 2013). (G) A pisolitic dolomite polished slab in New Mexico from Yates Formation in the USA (Scholle, 1999). Note the reverse grading of grains and the fitting fabric, where grains have interlocking boundaries caused by compromised outer growth. (H & I) Pisoliths from Jacaranda pit in Australia. (H) A complex pisolith from Jacaranda with a cortex surrounding an inner core and outer core. (I) Pisoliths from Jacaranda with scour and fill (indicated by the arrow). Figures (H & I) were obtained from Taylor (2008).

The described characteristics of pisoliths/pisolites (Figure 53) appear not to be observed in the anomalous objects sampled here. In contrast to pisolites, the observed anomalous objects appear to most likely resemble accretionary lapilli formed by the aggregation of particles by impact and volcanic processes referred to as impact accretionary lapilli and volcanic accretionary lapilli (Figure 53). Impact and volcanic accretionary lapilli are typically indistinguishable from each other. Impact and volcanic accretionary lapilli are commonly spherical and have a concentric structure comprised of nuclei, mantles, and crusts (Figure 53) (Gilbert & Lane, 1994; Schumacher & Schmincke, 1995; Warme et al. 2002; Bron, 2010; Glass



& Simonson, 2013). The concentric structure typically fines outward in grain size from the nuclei to the crusts, and the accretionary lapilli usually have inclusions of lithic rock fragments or grains. Impact accretionary lapilli may additionally have meteorite geochemical signatures and lithic rock fragments with shock-metamorphic features (Warme et al. 2002; Yancey & Guillemette, 2008; Cannon et al. 2010; Bron, 2010; Huber & Koeberl, 2017). Furthermore, the crusts of impact accretionary lapilli are typically darker than the mantles and nuclei and usually have lithic rock fragments or matrix mineral grains aligned parallel to the margins (King & King, 1980). Due to the rigidity of their formation, the nuclei of volcanic accretionary lapilli typically consist of unsorted ash, lack a concentric structure and tangential mineral grains (Moore & Peck, 1962; Graup, 1981). Impact accretionary lapilli are likely to be larger than volcanic accretionary lapilli because of the energy scale difference between impact events and volcanism (Bron, 2010). During an impact event, impact ejecta is launched from an impact crater at an initial velocity of  $\sim 5 \text{ km.s}^{-1}$  and less than  $500 \text{ m.s}^{-1}$  for volcanic ejecta (Huber & Koeberl, 2017). Pope et al. (1999) observed an accretionary block with a 4.5 m diameter in the Chicxulub structure, attesting to the large energy-scale of impact events. Gilbert and Lane (1994) estimated a maximum size range of 0.7 to 20 mm for volcanic accretionary lapilli formed in an ash cloud with a 0.5 to 10 km thickness. Given the cited characteristics of volcanic and impact accretionary lapilli, the proposed accretionary lapilli potentially fit the description of accretionary lapilli formed by impact processes.

## 5.5 Shocked mineral grains

The samples in Unit A and Unit C from Turner Exploration Camp have been found to contain possible shocked zircon and quartz grains. Some of the shocked quartz grains have potential decorated PDFs with a single set that appear to be the most common. The spacing of the PDFs is 3.5 to 6.0  $\mu\text{m}$ , with the decorated PDFs adhering to the definition of PDFs. By definition, PDFs are planar deformation features with multiple sets of closely spaced, narrow, and parallel planar regions of amorphous material. Individual PDFs are usually 2.0 to 10  $\mu\text{m}$  spaced and usually  $< 2.0$  to 3.0  $\mu\text{m}$  narrow (French & Short, 1968; Stöffler & Langenhorst, 1994; French & Koeberl, 2010). The observed decorated PDFs are similar to those identified in several impactites and impact structures worldwide, for example, the decorated PDFs identified in breccia beds of the Sudbury impact ejecta by Cannon et al. (2010) in the USA (Figure 54). The width of well-preserved PDFs in the breccia beds is 1.0 to 2.0  $\mu\text{m}$ , and the spacing is 5.0 to 10.0  $\mu\text{m}$ . The PDFs have 1 to 3 sets, but single sets are prevalent (Cannon et al. 2010). Leroux (2005) identified similar decorated PDFs in the Ries Crater in Germany. Leroux (2005) noted that most decorated PDFs in the Ries Crater have widths between 0.01 and 0.1  $\mu\text{m}$  and a spacing between 0.1 and 0.3  $\mu\text{m}$ . The decorated PDFs in this study are also comparable to those in the 1.87-1.90 Ga (Nironen, 2003) Keurusselkä structure in Finland identified by Ferrière et al. (2010). Ferrière et al. (2010) described the decorated PDFs in the Keurusselkä structure to have fluid inclusions, a spacing between 2.0 and 10  $\mu\text{m}$  and multiple sets, but two sets are the most common. The PDFs were used as evidence to confirm the impact origin of the Keurusselkä structure.

Some shocked zircon grains in this study have possible planar fractures that developed parallel and closely spaced planes (Figure 27 to Figure 38). Based on their characteristics, the observed planar fractures conform to the description of planar fractures formed by shock metamorphism. Accordingly, planar fractures formed in mineral grains such as quartz and zircon by shock metamorphism are parallel sets of multiple planar cracks or cleavages in which individual planar fractures are usually 5.0 to 10  $\mu\text{m}$  wide and 15 to 20  $\mu\text{m}$  spaced (Robertson et al. 1968; Stöffler & Langenhorst, 1994; Grieve et al. 1996; French et al. 1997).



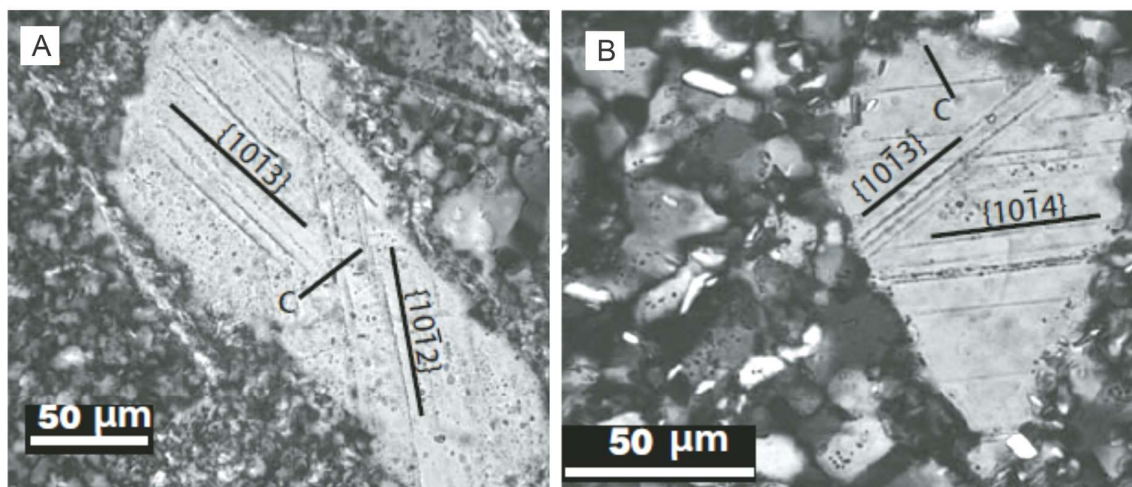


Figure 54: Planar deformation features in quartz grains in the USA's breccia beds of the Sudbury impact ejecta. (A) PDFs in Baraga Basin, outcrop at Huron River. (B) PDFs in Baraga Basin, drill core close to Huron River. The figures are obtained from Cannon et al. (2010).

## 5.6 Meteorite geochemical signatures

In this study, Ir is only detected in one sample and measures 0.58 ppb (Table 5). The fact that Ir is not detected in great abundance and is only detected in one sample does not mean that there is no possibility that the samples are of impact origin. The Ir detected abundance is similar to those measured in impact structures and impactites worldwide. For example, proximal impact ejecta from the Chicxulub structure contains less than 1.0 ppb Ir abundances, often varying from 0.8 to 1.0 ppb (Smit, 1999; Claeys et al. 2002; Goderis et al. 2013; Sprain et al. 2018). Breccias close to the crater rim of the Chicxulub structure contain little to absent Ir abundances (Smit, 1999). Samples from the peak ring of the Chicxulub structure contain Ir abundances of ~1.0 ppb (Smit, 1999; Claeys et al. 2002; Goderis et al. 2013; Sprain et al. 2018). The detected Ir is also comparable to that of 0.75 ppb measured in a Vredefort distal impact ejecta layer in the Zaonega Formation in Russia by Huber et al. (2014). The Zaonega Formation's Ir abundance is used only for comparison and not for testing because the calculated Ru/Ir ratio of 2 for the Zaonega Formation is meteoritic, whereas none is calculated in this study. A low Ir of 0.02 ppb was measured in another Vredefort distal impact ejecta layer in the Grænsesø impact spherule layer in Greenland by Chadwick et al. (2001). Although the Ir abundances are low, they are still slightly higher compared to typical upper continental crustal Ir abundances of ~0.04 ppb (Smit, 1999; Goderis et al. 2013; Chen et al. 2016). However, it should be noted that although the detected Ir in this study is low, we do not attempt to claim that it is a high abundance when it is not. Nonetheless, the samples appear to meet the diagnostic criteria for identifying impactites and impact structures and appear comparable to impactites and impact structures across the world. The results may suggest that the samples are associated with the Vredefort structure and possibly form part of the Vredefort proximal impact ejecta.

### 5.6.1 Chondrites and achondrites

The low Ir and other siderophile elements, precisely Ni, Cr and Co, abundances in the samples (proposed Vredefort proximal impact ejecta) and low Ir abundances in the Vredefort distal impact ejecta layers may potentially suggest that the causative meteorite contained low abundances of these elements (Table 5) (Schmidt et al. 2018). Thus, it is possible to deduce the type of causative meteorite for these Vredefort impact ejecta deposits. There are three main types of meteorites: (1) iron meteorites, (2) stony-iron meteorites, and; (3) stony meteorites (Glass & Simonson, 2013). Most meteorite falls on Earth are stony meteorites and

are categorised into two types, namely chondrites and achondrites. Chondrites are primitive meteorites from undifferentiated asteroids, whereas achondrites, irons and stony-iron meteorites are from differentiated asteroids and other planetary bodies (Glass & Simonson, 2013). Both achondrites and chondrites have several sub-groups based on their minerals, compositions and structures. Chondrites are mainly subdivided into ordinary, enstatite, and carbonaceous chondrites, whereas achondrites are primarily subdivided into eucrite, howardite, diogenite, shergottite, nakhlite and chassignite (Glass & Simonson, 2013). Chondrites generally have high abundances of siderophile elements. The averages for Ir, Ni, Cr and Co abundances between ordinary, carbonaceous and enstatite chondrites are ~560 ppb, ~15216 ppb, ~3315 ppb and ~714 ppb, respectively (Glass & Simonson, 2013). In comparison, achondrites have very low abundances of siderophile elements. The averages for Ir, Ni, Cr and Co abundances between eucrite, diogenite, shergottite, nakhlite and chassignite are ~0.66 ppb, ~139 ppm, ~3088 ppb and ~46 ppb, respectively (Glass & Simonson, 2013).

Based on the Ir, Ni, Cr and Co abundances for meteorites, it is possible that the meteorite that resulted in the formation of the proposed Vredefort proximal impact ejecta and Vredefort distal impact ejecta may have been an achondrite rather than a chondrite.

### 5.6.2 Iron enrichment

Alternatively, ferruginisation and alteration by hydrothermal activities may have reduced the abundances of Ir, Ni, Cr and Co in the samples by diluting them with hematite and other fluids after deposition into the Maremane Dome (Schmidt et al. 2018). The samples forming the proposed Vredefort proximal impact ejecta are predominated by  $\text{Fe}_2\text{O}_3$  and subsequently predominated by  $\text{SiO}_2$  and  $\text{Al}_2\text{O}_3$  (Table 3). The samples show a positive correlation between  $\text{SiO}_2$  and  $\text{TiO}_2$ ,  $\text{K}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $\text{Al}_2\text{O}_3$ , and  $\text{P}_2\text{O}_5$  and a negative correlation between  $\text{Fe}_2\text{O}_3$  and  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{P}_2\text{O}_5$ ,  $\text{K}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $\text{Al}_2\text{O}_3$ , and  $\text{CaO}$ . However, the samples from Khumani Mine show a positive correlation between  $\text{Fe}_2\text{O}_3$  and  $\text{Na}_2\text{O}$  (Figure 18), and those from Turner Exploration Camp show a negative correlation between  $\text{SiO}_2$  and  $\text{P}_2\text{O}_5$  (Figure 41) and a positive correlation between  $\text{Fe}_2\text{O}_3$  and  $\text{P}_2\text{O}_5$  (Figure 42).

The observed oxide abundances and correlations are similar to those observed by Smith and Beukes (2016) in iron ores of the Transvaal Supergroup. Smith and Beukes (2016) noted a strong enrichment in  $\text{Fe}_2\text{O}_3$  (from ~33-46 to ~73-98 wt.%) in the iron ores after comparing them with their unaltered precursor banded iron formations. Smith and Beukes (2016) also noted a prominent decrease in  $\text{SiO}_2$  from ~46 to less than 4.0 wt.% from the unaltered banded iron formations to the ores. The decline indicates drastic leaching of  $\text{SiO}_2$  and enrichment of  $\text{Fe}_2\text{O}_3$  by supergene and/or hydrothermal fluids during ore formation. Cannon et al. (2010) reported comparable abundances in the Sudbury impact ejecta, where an  $\text{SiO}_2$  abundance of 60.28 wt.% and  $\text{Fe}_2\text{O}_3$  of 24.2 wt.% were measured. In addition, very high  $\text{SiO}_2$  abundances (~95 wt.%) and low abundances of other oxides, including  $\text{Fe}_2\text{O}_3$ , were measured. The very high  $\text{SiO}_2$  abundances are thought to indicate prominent secondary silicification or immobilization of  $\text{SiO}_2$  by iron-rich fluids during ore formation (Cannon et al. 2010). Although they occur in small abundances compared to this study, Smith and Beukes (2016) also observed a drastic enrichment in  $\text{Al}_2\text{O}_3$  in iron ores in the Maremane Dome from unaltered banded iron formations (~0.1-0.3 wt.%) to the iron ores (~1.2-1.5 wt.%). The cause for this enrichment is thought to reflect  $\text{Al}_2\text{O}_3$  immobility during supergene weathering leading to a residual upgrade in  $\text{Al}_2\text{O}_3$ . An enrichment by hydrothermal processes is also proposed for the  $\text{Al}_2\text{O}_3$  upgrade (Smith & Beukes, 2016).

The observations by Smith and Beukes (2016) and Cannon et al. (2010) may suggest that the Vredefort proximal impact ejecta underwent enrichment of  $\text{Fe}_2\text{O}_3$  and mobilization and

removal of  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{P}_2\text{O}_5$ ,  $\text{K}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $\text{Al}_2\text{O}_3$ , and  $\text{CaO}$  by iron-rich hydrothermal fluids during ore formation post-deposition and post-impact. However, samples with low abundances of  $\text{Fe}_2\text{O}_3$  and high abundances of  $\text{SiO}_2$  may suggest silicification or immobilization of  $\text{SiO}_2$  by the iron-rich hydrothermal fluids post-deposition and post-impact. In addition, samples with low abundances of  $\text{Fe}_2\text{O}_3$  and high abundances of  $\text{Al}_2\text{O}_3$  may suggest immobilization or upgrade of  $\text{Al}_2\text{O}_3$  by iron-rich hydrothermal fluids.

### 5.6.3 Rutile and anatase

The origin of rutile and anatase phases in the samples can be attempted to be determined by using the mineral textures, assemblages, and mineral compositions of rutile and anatase phases in the samples (Hanaor & Sorrell, 2011; Adlakha et al. 2020; Pinto et al. 2020). Rutile has almost homogenous textures and nearly identical grains characterized by euhedral to subhedral grains with even boundaries, implying that the grains crystallized in less than several events, likely a single event, suggesting to be of the same origin (Adlakha et al. 2020). The textures are intact and fresh and may suggest that rutile post-dates the hydrothermal activity that ferruginised the samples crystallizing hematite. The rutile's euhedral and evenly distributed grains are similar to those in other hydrothermal rocks, in which rutile formed over a short period of time (Adlakha et al. 2020). Because hematite is hydrothermal and non-detrital, both rutile and hematite must have crystallised after the deposition of the Vredefort proximal impact ejecta. However, the round shape of rutile grains additionally suggests a detrital origin, which would predate ferruginisation (Adlakha et al. 2020). The presence of other heavy minerals such as zircon in this study also suggests the detrital origin of rutile (Adlakha et al. 2020). Suppose they are truly detrital, to acquire such moderate grain sizes with longer diameters ranging from about 7 to 50  $\mu\text{m}$ . In that case, they may have likely recrystallized and/or undergone Oswald ripening during hydrothermal activity. Ti is generally immobile during hydrothermal activity and metamorphism, but as a result of the breakdown or modification of precursor Ti-bearing minerals, such as ilmenite and rutile, both hydrothermal and metamorphic rutile can form (Hanaor & Sorrell, 2011; Adlakha et al. 2020; Pinto et al. 2020).

Similar to rutile, anatase is also generally homogenous and identical in the thin sections. Anatase grains are fine-grained, subhedral to anhedral and evenly distributed in the sample. Some anatase grains are spotty and porous and generally have corroded borders with uneven boundaries. These textural relationships show that in a coupled polymorphic dissolution-precipitation process, anatase precipitation occurred after the dissolution of rutile substrate content (Pinto et al. 2020). In fact, Smith et al. (2009) linked the prevalence of anatase in terrestrial environments to low-temperature aqueous environments, linking structural hydration and/or adsorption of other surface components to anatase's lower grain size compared to rutile. This remark is supported by the observations of hydrothermal alteration products in the analysed samples. It is also likely that rutile transformed to anatase through a thermodynamic temperature-induced phase transition, but studies investigating such transitions are scarce (Pinto et al. 2020). The Raman analysis findings of this study, when combined with the observed mineral textural and compositional relationships, point toward hydrothermal environmental conditions underpinning anatase (Morad & Aldahan, 1986; Pe-Piper et al. 2011; Pinto et al. 2020). Such a hydrothermal origin for anatase and rutile may suggest that on the titanium dioxide temperature-pressure phase transition reaction graph depicted in Hanaor and Sorrell (2011), both anatase and rutile may have crystallized concurrently at about 0 to 10 kbars and 490 to 600°C. Such hydrothermal fluids that crystallized rutile and anatase from solution are similar to the above ferruginisation and alternation events because they would have also possibly lowered the concentrations of Ir, Ni, Co and Cr in the samples by diluting them (Schmidt et al. 2018).



## 5.7 Formation of the Vredefort proximal impact ejecta

It is necessary to present a model explaining the occurrence and formation of the proposed Vredefort proximal impact ejecta in the Maremane Dome. The Vredefort structure consists of the Central Group and West Rand Group of the Witwatersrand Supergroup, Ventersdorp Supergroup, Pretoria Group of the Transvaal Supergroup and an Archean basement granite (Figure 8) (Bisschoff, 1982; Bisschoff, 1988; Kamo et al. 1996; Reimold & Gibson, 2010). These sequences were likely the target rocks for the Vredefort impact event and deposited as part of the impact ejecta. The Witwatersrand Supergroup is a 2.9 Ga intracratonic succession positioned in the centre of the Kaapvaal Craton and consists of conglomerates, tillites, mudstones, banded ironstones, quartzite and lava deposits (McCarthy & Rubidge, 2005; Tucker et al. 2016). The Ventersdorp Supergroup was formed from 2.729 to 2.665 Ga on the Kaapvaal Craton and is a volcano-sedimentary sequence reaching 8 km in thickness (Cornell, 1978; Tyler, 1979). The supergroup comprises lavas, pyroclastics, lacustrine siliciclastics and carbonate sedimentary rocks (van der Westhuizen et al. 2006). The Transvaal Supergroup was deposited in a vast epeiric sea on top of the Kaapvaal Craton from ~2.7 to 2.0 Ga (Beukes, 1983). The Transvaal Supergroup is ~15 km thick and contains chemical and clastic sedimentary rocks and volcanic rocks preserved in three discrete basins: (1) Transvaal Basin; (2) Griqualand West Basin, and; (3) Kanye Basin (Beukes, 1983).

Because of their close similarity, this study uses a model proposed by Branney and Brown (2011) for the emplacement of Stac Fada impact ejecta to explain the emplacement of the proposed Vredefort proximal impact ejecta. The possible absence of sediment reworking in units A, B and C may suggest that the units have a common impact origin (Amor et al. 2008; Branney & Brown, 2011). The close resemblance and continuous intergradation without a grain-size break between units A and B may also suggest a common impact origin (Amor et al. 2008; Branney & Brown, 2011). The varying irregular thicknesses in units A and B may suggest emplacement by a type of lateral density current (Figure 55A) (Scott et al. 1996; Branney & Brown, 2011). The relatively poor sorting of the clasts in unit A is comparable with that of density current deposits (Walker, 1871; Branney & Kokelaar, 1992). In comparison, the sorting of the breccias may be too poor to be comparable with fallout deposits (Branney & Brown, 2011). In addition, fallout deposits do not usually have varying thicknesses (Sparks et al. 1997). Ballistic sedimentation may have assisted ejecta deposition, but it appears that it cannot be attributed as the unit's primary emplacement process. This is because impact sedimentary structures such as scour marks or substrate deformation structures from ballistic deposits (Melosh, 1989) have not been identified in the units. Also, the grain sizes and thicknesses of ballistic deposits decrease rapidly with increasing distance from the source crater. This decrease in grain size and thickness does not appear to occur in the units when comparing samples from Turner Exploration Camp and Khumani Mine with each other. Finally, the breccia in this study is consistent with a larger impact but not with a cave collapse model.

### 5.7.1 Accretionary lapilli formation

The occurrence of accretionary lapilli and accretionary lapilli fragments at the top of Unit B and an accretionary lapillus fragment in Unit C also supports a density current origin for the units (Figure 55A). The nuclei, consisting of coarse-grained particles, reflect the first stages of particle aggregation in a buoyant impact plume (Figure 55B) (Warme et al. 2002; Bron, 2010; Branney & Brown, 2011). The mantles and crusts, consisting of finer-grained particles, reflect a subsequent growth stage during transport in a ground-hugging density current (Figure 55C) (Warme et al. 2002; Bron, 2010; Branney & Brown, 2011). The mantles and crusts are likely to have formed under conditions of increased temperature due to a lower altitude and high content of hot-melt particles in the ground-hugging part of the density current (Figure 55C) (Warme et al. 2002; Bron, 2010; Branney & Brown, 2011). This may have resulted in a



reduction of binding forces and the binding (adhering) of only finer-grained particles to the developing aggregate (Figure 55C) (Branney & Brown, 2011). Consequently, coarse-grained particles in the density current did not bind to the surfaces of the aggregates.

The absence of accretionary lapilli in Unit A (Figure 55) may be attributed to a time delay between the initial deposition of the density current and the first occurrence of accretionary lapilli in Unit B (Branney & Brown, 2011). Such a delay is supposed to occur and is likely a result of a few events: (1) the formation of a buoyant impact plume and its rise into the atmosphere (Figure 55A); (2) the aggregation of moist particles into aggregates in the plume (Figure 55B), and; (3) the growth and compaction of the aggregates in the ground-hugging part of the density current and formation of the accretionary lapilli (Figure 55C) (Gilbert & Lane, 1994; Brown et al. 2010; Branney & Brown, 2011). Consequently, by the time the first accretionary lapilli form in the density current, Unit A would already be deposited.



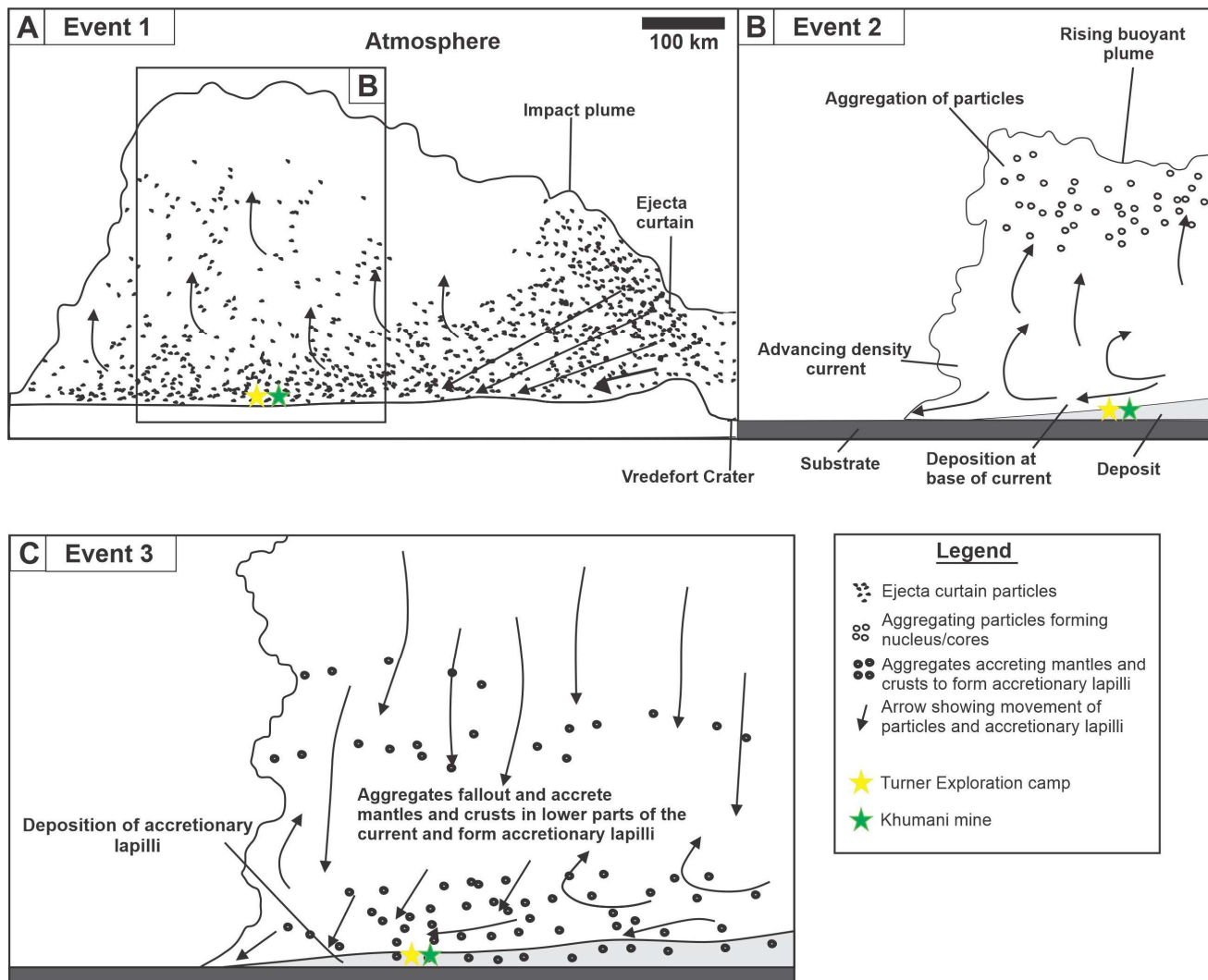


Figure 55: (A-C) Models intended to represent the emplacement of the Vredefort proximal impact ejecta by a ground-hugging density current. (A) During an impact, an impact plume consisting of hot ejecta material, abundant volatiles from the target rocks and groundwater forms and traps the air as it penetrates the atmosphere (Branney & Brown,

2011). The ejecta material falls to the surface as an ejecta curtain spreading rapidly from the impact sites as a density current (Branney & Brown, 2011). (B) As a result of the upper zone of the density current entraining atmospheric air, the density current expands and generates a buoyant dust plume (Branney & Brown, 2011). Within this expanding and rising plume, ash particles start to accrete. (C) Once the particles become aggregates and too large to be carried by the turbulence in the plume, they fall to lower parts of the density current, where they will dry out, accrete mantles and crusts (Branney & Brown, 2011). In this way, they become accretionary lapilli and get deposited with the breccias from the bottom of the current. The models are adapted and modified from Branney and Brown (2011).



## 5.8 Wolhaarkop Breccia

The Wolhaarkop Breccia unconformably underlies the Doornfontein Conglomerate Member (proposed Vredefort proximal impact ejecta). According to the accepted formation model, the Wolhaarkop Breccia was formed by dissolution and karstification of the dolomites of the Ghaap Group (Figure 6 & Figure 7) (Carney & Mienie, 2003; Smith & Beukes, 2016). According to the model, the dolomites locally formed deep sinkholes, resulting in the overlying banded iron formations of the Asbestos Hills sub-group collapsing into them (Figure 6 & Figure 7) (Carney & Mienie, 2003; Smith & Beukes, 2016). However, the formation model appears to be lacking and missing some details because it does not fully explain the observations and features of the Wolhaarkop Breccia. The model does not appear to mention that the Wolhaarkop Breccia consists of two types of breccias, namely the upper polymict breccia and lower monomict breccia. The polymict breccia consists of locally derived angular rocks of quartz, banded iron formation, jasper, hematite and other rocks in a chert matrix. The monomict breccia consists of locally derived angular rocks of quartz in a chert matrix. The rocks forming the clasts in the polymictic breccia range from a few centimetres to meters thick, and most are tens of cm thick (Figure 49). In comparison, the clasts in the monomict breccia are a few cm thick and are generally smaller than those in the polymict breccia (Figure 48). In addition, there are identical outcrops along strike throughout the Maremane Dome, which would require an enormous cave system that would somehow collapse symmetrically across the entire 150 km long section, which is unrealistic. The model also appears not to mention that the formation of the Wolhaarkop Breccia caused alteration and deformation of the local substrate.

Nevertheless, the above characteristics of the Wolhaarkop Breccia, namely the inclusion of local rocks, alteration of the local substrate and rapid decrease in grain size from the polymict breccia to the monomict breccia, may alternatively suggest that the Wolhaarkop Breccia was deposited by ballistic sedimentation. Ballistic sedimentation usually forms scour marks or substrate deformation structures, deforms the local substrate and causes the inclusion of local rocks (Melosh, 1989). This interpretation is possibly supported by the similarity of the Wolhaarkop Breccia to impact ejecta deposited by ballistic sedimentation from a few terrestrial impact structures. An excellent example is the Bunte Breccia, the continuous impact ejecta blanket of the Ries Crater (Hörz et al. 1983). The Bunte Breccia is interpreted to have been emplaced by ballistic sedimentation (Hörz et al. 1983). Ballistic emplacement of ejecta typically causes secondary cratering, the inclusion of local rocks and alteration of the local substrate (Oberbeck, 1975; Osinski, 2007). These characteristics are observed in the Bunte Breccia, which deformed the local substrate and consists of primary ejecta sourced from the transient crater (~31 vol%) and local rocks (~69 vol%) (Hörz et al. 1983; Osinski, 2007).

Similar to the Wolhaarkop Breccia, which is overlain by the Vredefort proximal impact ejecta, the Bunte Breccia is overlain by impact ejecta layers (von Engelhardt, 1990). The Bunte Breccia is overlain by a series of impact breccias (polymict crystalline breccias), impact melt-bearing breccias (suevites), and impact melt rocks (Engelhardt & Graup, 1984; von Engelhardt, 1990; Osinski, 2007). Similar to the Vredefort proximal impact ejecta, the impact breccias and impact melt rocks have been proposed to have been emplaced as either pyroclastic flows (Newsom et al. 1986; Bringemeier, 1994) or as ground-hugging impact melt-rich flows (Osinski, 2004). The emplacement mechanisms are consistent with several field observations, including a temporal time lag between the emplacement of the Bunte Breccia and the overlying breccias and impact melt rocks (Hörz et al. 1983). Thus, the formation of the ejecta deposits involved a two-stage emplacement mechanism (Hörz et al. 1983; Osinski, 2007).

The Wolhaarkop Breccia is also similar to impact ejecta occurring beyond the final crater rim of the Chicxulub structure consisting of two main types of ejecta deposits: (1) a polymict impact breccia, which is similar to the Bunte Breccia and interpreted to represent a continuous impact



ejecta blanket and; (2) suevite deposits overlying the continuous breccia, which are analogous to the Vredefort proximal impact ejecta (Kring, 2005).

Given that it shares similar characteristics with the continuous impact ejecta blankets of the Ries crater (namely ballistic sedimentation and overlain by impact ejecta layers) and the Chicxulub structure (namely polymict breccia and overlain by suevite deposits), the Wolhaarkop Breccia may hint that it may represent a continuous impact ejecta blanket of the Vredefort structure overlain by the proposed Vredefort proximal impact ejecta. A proposed erosional unconformity (pre-Gamagara unconformity) occurs between the base of the Doornfontein Conglomerate Member (proposed Vredefort proximal impact ejecta) and Wolhaarkop Breccia (proposed continuous impact ejecta blanket of the Vredefort structure), and it is estimated to be 2.2 to 2.0 Ga (Carney & Mienie, 2003; da Silva, 2011). As suggested for the emplacement of the Bunte Breccia and the overlying breccias and impact melt rocks (Hörz et al. 1983), this unconformity may alternatively represent a temporal time lag between the emplacement of the continuous impact ejecta blanket of the Vredefort structure and Vredefort proximal impact ejecta.

## 5.9 Stratigraphic correlation

It is clear that after the proposed Vredefort proximal impact ejecta was emplaced, it was extensively altered and heavily enriched in iron (hematite), which resulted in the formation of one of the world's largest iron ore deposits (da Silva, 2011). This iron enrichment is highly concentrated at the base of the Doornfontein Conglomerate Member (proposed Vredefort proximal impact ejecta) and is associated with the pre-Gamagara unconformity (Carney & Mienie, 2003; da Silva, 2011). This is why iron exploration in the Maremane Dome requires identifying and correlating the pre-Gamagara unconformity (Beukes & Gutzmer, 2008). Although iron ore resources occur in large quantities in the Maremane Dome, they are limited (da Silva, 2011). Thus, further exploration of the resources in the Maremane Dome is critical to meet local and international demands (Gutzmer et al. 2005). However, when attempting to identify and correlate the pre-Gamagara unconformity to locate ore resources in the Maremane Dome, the pre-Gamagara unconformity often causes problems and leads to misidentification of the ore resources (da Silva, 2011). This is because of two main reasons:

- (1) Conglomerates (proposed to be impact breccias) associated with high-grade iron ore deposits at the base of the Olifantshoek Group are classified as part of the Doornfontein Conglomerate Member in the Maremane Dome and as part of the Mapedi Formation outside the Maremane Dome (Beukes & Smit, 1987; da Silva, 2011). In addition, because iron-rich conglomerates in the Neylan Formation and Volop Formation of the Olifantshoek Group are similar to conglomerates in the Doornfontein Conglomerate Member, they are often confused with each other.
- (2) As a result of the Kheis orogeny, the Olifantshoek Group is folded and thrustured (Beukes & Smit, 1987; Van Niekerk, 2006). The folding and thrusting intensified towards the western margin of the Kaapvaal Craton and resulted in the duplication of the Olifantshoek Group by thrust sheets dipping to the west. Consequently, the hanging walls and footwalls of various red bed units in the thrust sheet are ambiguously correlated.

This study suggests using accretionary lapilli for stratigraphic correlations and as a time marker to combat incorrectly identifying and correlating the pre-Gamagara unconformity in the Maremane Dome. The accretionary lapilli are readily identifiable and occur above the iron ore resources, so the iron ore resources will be easily detectable.

## 5.10 Ejecta from the largest terrestrial impact structures

The largest impact structures on Earth, the Vredefort structure, Sudbury structure and Chicxulub structure, all have identified impact ejecta. The Sudbury impact ejecta has been identified in a breccia layer with accretionary lapilli in northern Michigan, USA (Cannon et al. 2010; Huber & Koeberl, 2017). The Sudbury impact ejecta also occurs in sites in Minnesota in USA and Ontario in Canada (Addison et al. 2005). The Chicxulub impact caused the mass extinction at the Cretaceous-Paleogene (K-Pg) boundary at about 66.05 Ma (Alvarez et al. 1980; Smit & Hertogen, 1980; Sprain et al. 2018). The K-Pg event formed a thin clay layer that has been identified in more than 350 marine and terrestrial sites across the globe (Smit, 1999; Claeys et al. 2002). The layer also contains accretionary lapilli and impact spherules with shocked mineral grains (Gradstein et al. 2012).



## Chapter 6: Conclusion

Detailed petrographic and geochemical investigations of 24 drill core samples from the Doornfontein Conglomerate Member in the Maremane Dome, South Africa, suggest that the Doornfontein Conglomerate Member might be an impact breccia similar to impact breccias in the Stac Fada impact ejecta layer in Scotland. The investigations also suggest that the ca. 15 mm spherical anomalous objects in the samples from the top of the Doornfontein Conglomerate Member are accretionary lapilli and resemble accretionary lapilli formed by impact processes rather than by volcanic processes. The occurrence of the accretionary lapilli at the top of the Doornfontein Conglomerate Member is also analogous to the occurrence of accretionary lapilli at the top of the impact breccias in the Stac Fada impact ejecta layer.

Based on impact ejecta modelling, the samples are  $<5R_C$  from the centre of the Vredefort structure and occur within an expected distance for Vredefort proximal impact ejecta. Based on radiometric age constraints, the samples are confined between the 1.93 Ga andesitic lavas of the Hartley Formation and 2.22 Ga  $\pm$  13 Ga Ongeluk Formation. Therefore, this study suggests that the Doornfontein Conglomerate Member and anomalous objects are associated with the Vredefort impact structure (2.02 Ga), occurring within the expected distance of  $<5R_C$  from the Vredefort structure for Vredefort proximal impact ejecta. Due to the sample's absence of sediment reworking, varying thickness, continuous intergradation without a grain size change and similarity to the impact breccias in the Stac Fada impact ejecta layer, the Doornfontein Conglomerate Member is suggested to have been emplaced as a ground-hugging density current ejecta that propagated outwards from the Vredefort impact site.

The Wolhaarkop Breccia underlying the Doornfontein Conglomerate Member in the Maremane Dome, South Africa, was also investigated by direct observations of outcrops in the field and drill cores. The investigation mainly analysed and examined the sedimentological characteristics of the Wolhaarkop Breccia. The investigation results suggest that the Wolhaarkop Breccia is similar to ballistically emplaced continuous impact ejecta blankets underlying ground-hugging impact ejecta layers. The results specifically suggest that the Wolhaarkop Breccia is similar to continuous impact ejecta blankets of the Ries Crater (Bunte Breccia) and Chicxulub structure (polymict breccia). As a result of these similarities, the inclusion of local rocks in the Wolhaarkop Breccia, alteration of the local substrate during the deposition of the Wolhaarkop Breccia and the overlying proposed Vredefort proximal impact ejecta, the Wolhaarkop Breccia is suggested to have formed by ballistic emplacement and be a continuous impact ejecta blanket of the Vredefort structure.

The proposed Vredefort proximal impact ejecta layer and continuous impact ejecta blanket of the Vredefort structure add to the two already discovered Vredefort distal impact ejecta layers occurring in the Zaonega Formation in Russia (Huber et al. 2014) and Grænsesø impact spherule layer in Greenland (Chadwick et al. 2001). The Vredefort proximal impact ejecta layer will also add to the three Precambrian distal impact ejecta layers discovered in the Griqualand West Basin of the Kaapvaal Craton, namely the Kuruman (2.46-2.52 Ga), Monteville (2.60-2.65 Ga) and Reivilo (2.56 Ga) distal impact ejecta layers (Simonson & Harnik, 2000). The Barberton Greenstone Belt, which occurs on the Kaapvaal Craton, contains four Precambrian impact ejecta layers, namely the S1 (3.47 Ga), S2 (3.26 Ga), S3 (3.24 Ga) and S4 (3.34 Ga) impact ejecta layers (Simonson & Harnik, 2000). Thus, the Kaapvaal Craton contains an additional impact ejecta layer and now contains possible impact ejecta layers from 3.47 Ga to 2.02 Ga (Simonson & Harnik, 2000).

The discovery of the proposed Vredefort proximal impact ejecta and continuous impact ejecta blanket of the Vredefort structure will improve our understanding of impact processes and their effects. This can be achieved by using them to study impact cratering mechanics and the

deposition and formation of impact ejecta, especially proximal impact ejecta. The deposits also provide an excellent opportunity to investigate possible atmospheric, environmental, and biosphere changes that may have occurred during their emplacement. This will assist in advancing our understanding of the early geological record of the Earth and allow impact processes to be integrated with the broader geology.

To enhance in proving the existence of the proposed Vredefort proximal impact ejecta and its model of formation, future studies will have to identify precise shock-metamorphic features, namely PDFs and planar fractures in shocked mineral grains of the Doornfontein Conglomerate Member. The studies will also have to find significant abundances of meteorite geochemical signatures, especially Ir, Ni, Co and Cr, in the Doornfontein Conglomerate Member. The Wolhaarkop Breccia will also require identifying the same shock-metamorphic features and meteorite geochemical signatures for it to be further proven as a continuous impact ejecta blanket of the Vredefort structure.





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## 8. Appendix

### 8.1 Appendix A – Khumani Mine

#### Appendix A.1 – Sample photos



A.1.1: Four pieces of ACKS1.



A.1.2: ACKS2.





A.1.3: ACKS3.



A.1.4: ACKS4.



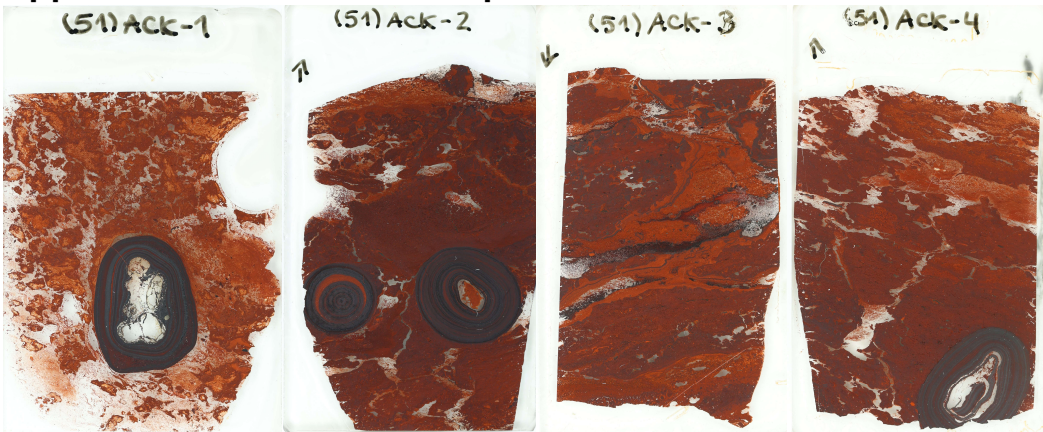
A.1.5: ACKS5.



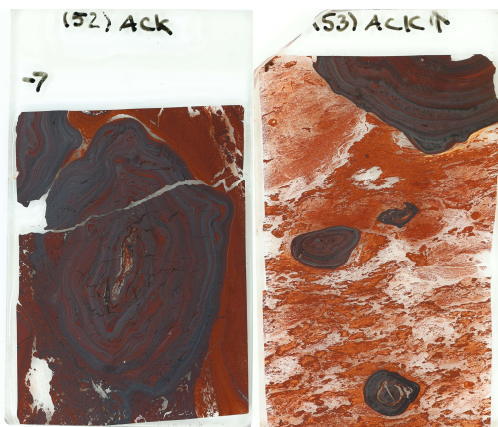


A.1.6: ACKS6.

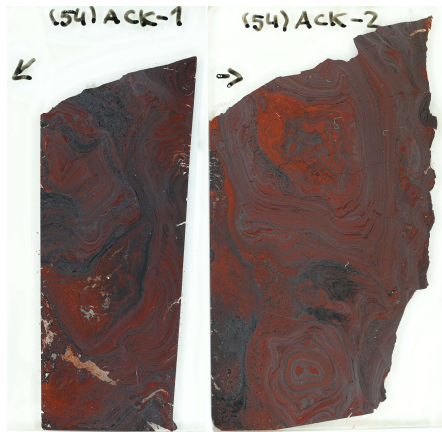
### Appendix A.2 – Thin section photos



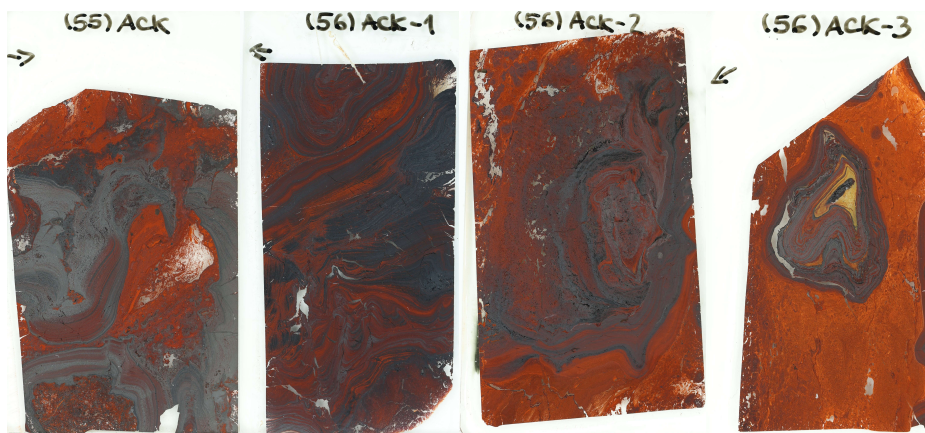
A.2.1: Four thin section photos of the four pieces of ACKS1.



A.2.2: As indicated on the thin sections, these are thin section photos of ACKS2 and ACK3.



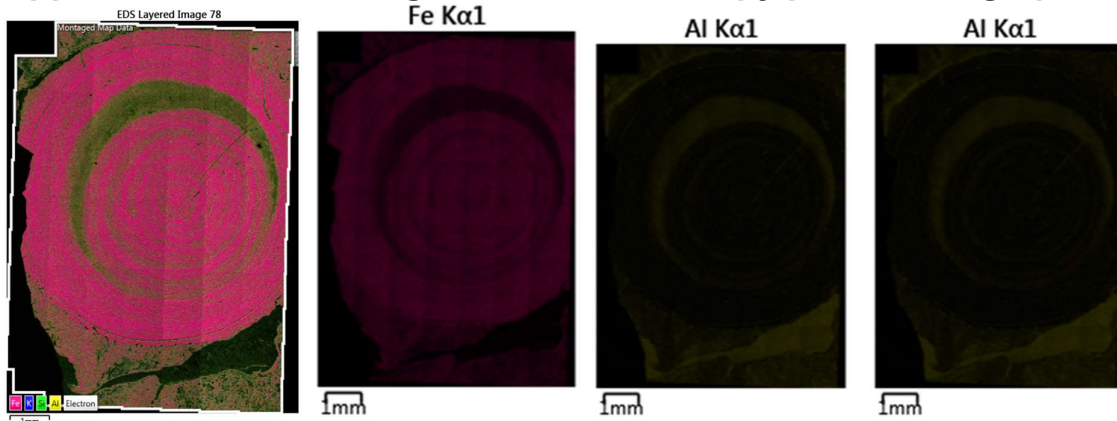
A.2.3: Thin section photos of ACKS4.



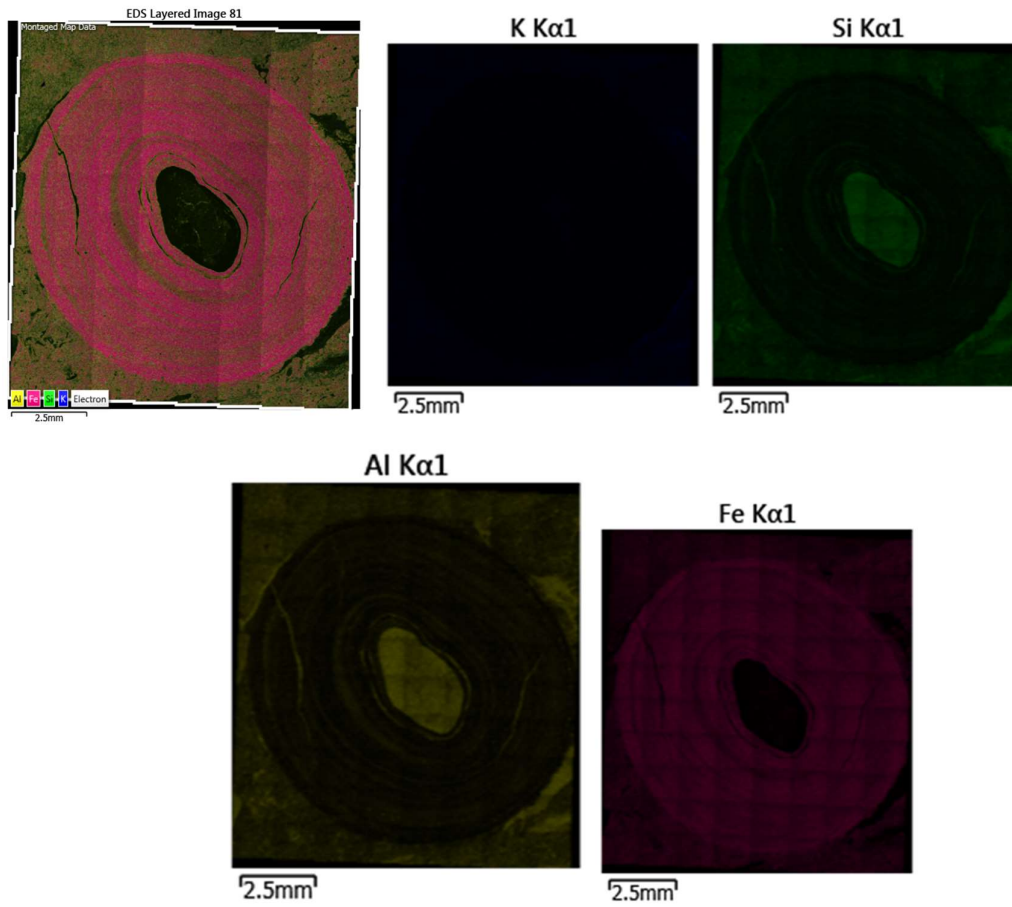
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WESTERN CAPE

A.2.4: As indicated on the thin sections, these are thin section photos of ACKS5 and three sample pieces of ACKS6.

### Appendix A.3 – Scanning electron microscopy photomicrographs



A.3.1: Compositional EDS maps of an accretionary lapillus of ACKS1.



A.3.2: Compositional EDS maps of an accretionary lapillus of ACKS1.

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## 8.2 Appendix B – Turner Exploration Camp

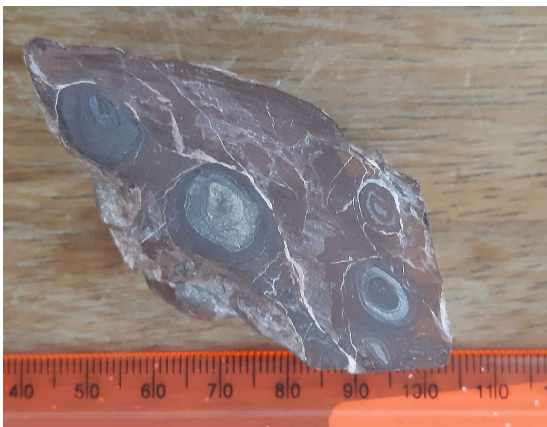
### Appendix B.1 – Sample photos



B.1.1: TNS1



B.1.2: TNS2



B.1.3: TNS3





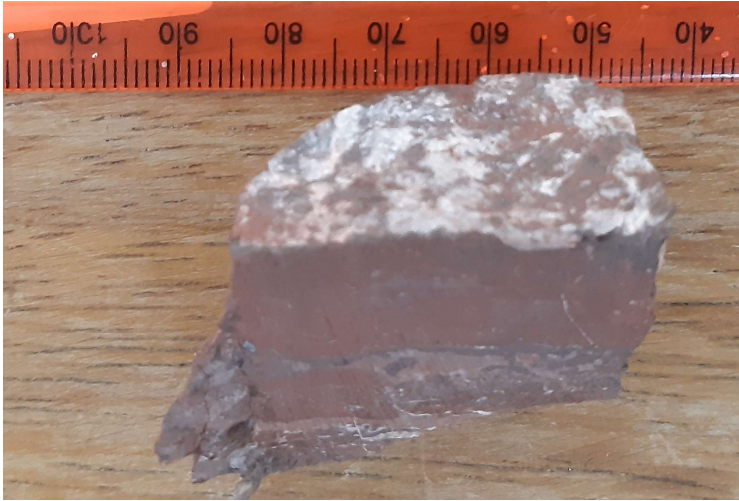
B.1.4: TNS4.



B.1.5: TNS5



B.1.6: TNS6



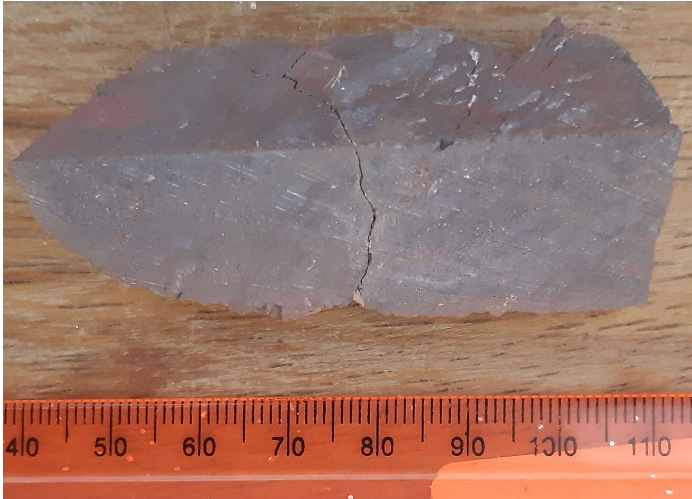
B.1.7: TNS7



B.1.8: TNS8



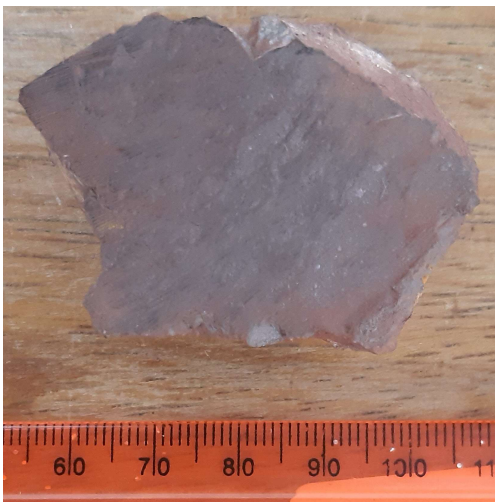
B.1.9: TNS9



B.1.10: TNS10



B.1.11: TNS11



B.1.12: TNS12





B.1.13: TNS13



B.1.14: TNS14



B.1.15: TNS15





B.1.16: TNS16

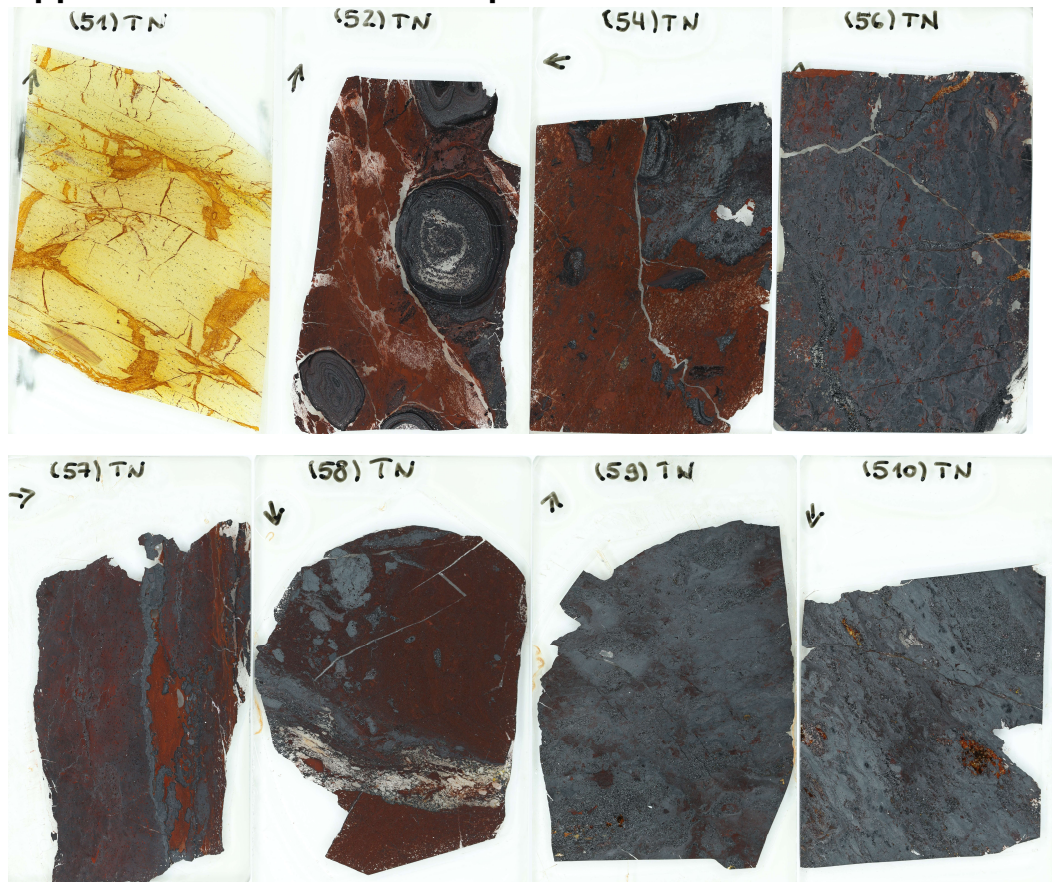


B.1.17: TNS17



B.1.18: TNS18

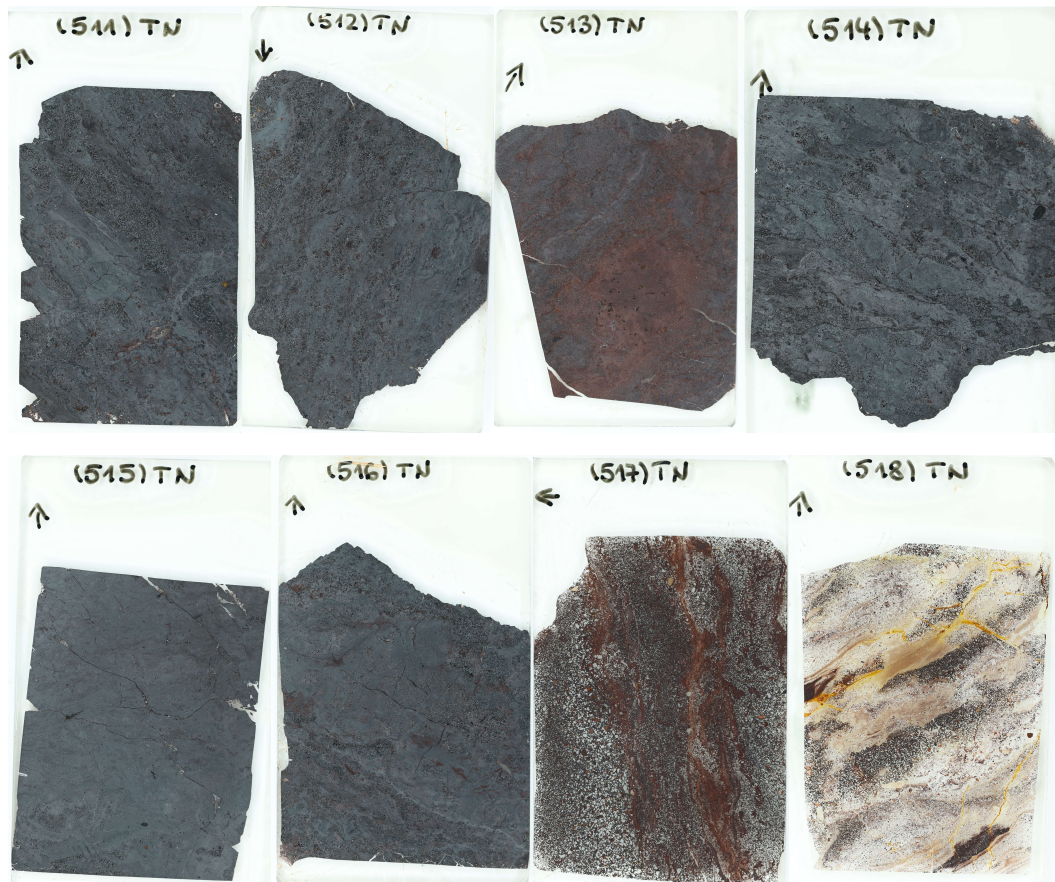
## Appendix B.2 – Thin section photos



B.2.1: As indicated on the thin sections, these are thin section photos of TNS1, TNS2, TNS4, TNS6, TNS7, TNS8, TNS9 and TNS10.

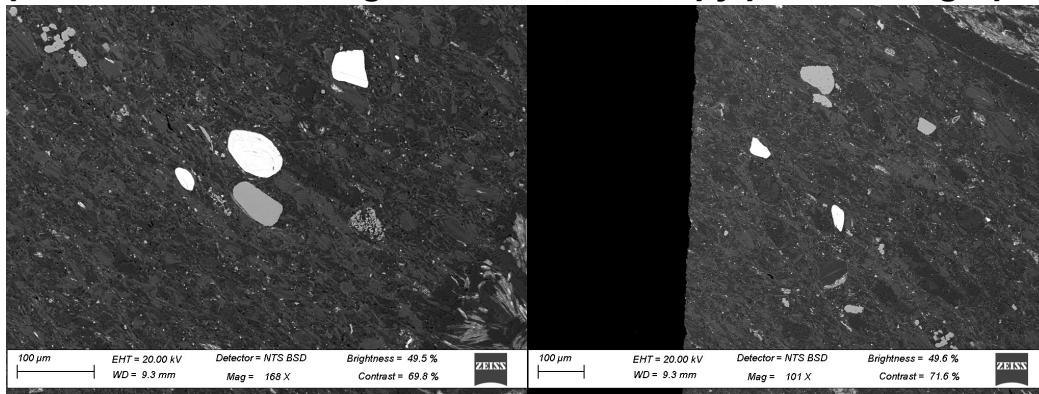
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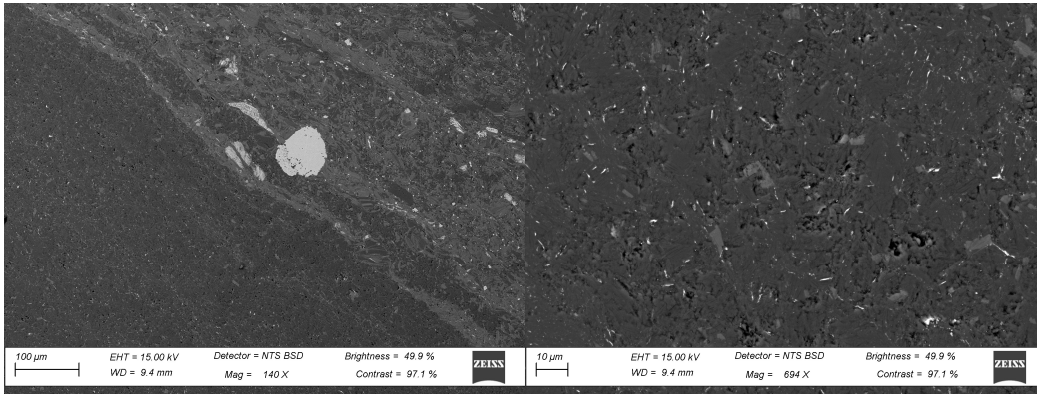




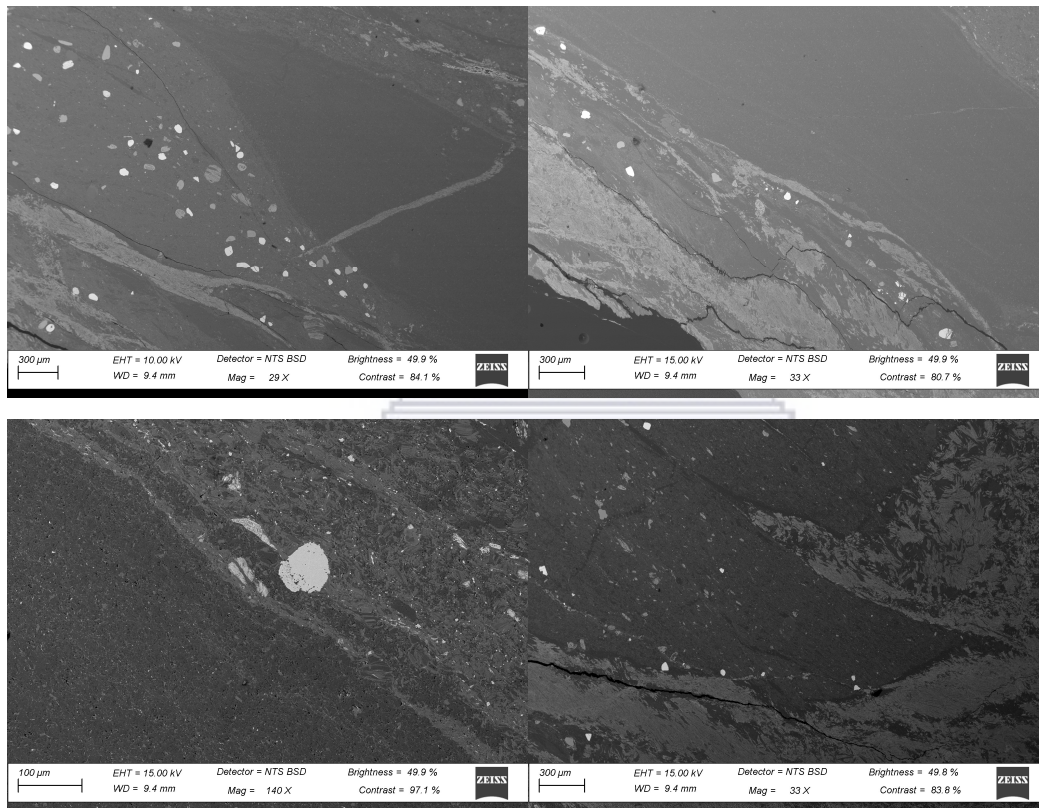
B.2.2: As indicated on the thin sections, these are thin section photos of TNS11, TNS12, TNS14, TNS14, TNS15, TNS16, TNS17 and TNS18.

### Appendix B.3 – Scanning electron microscopy photomicrographs



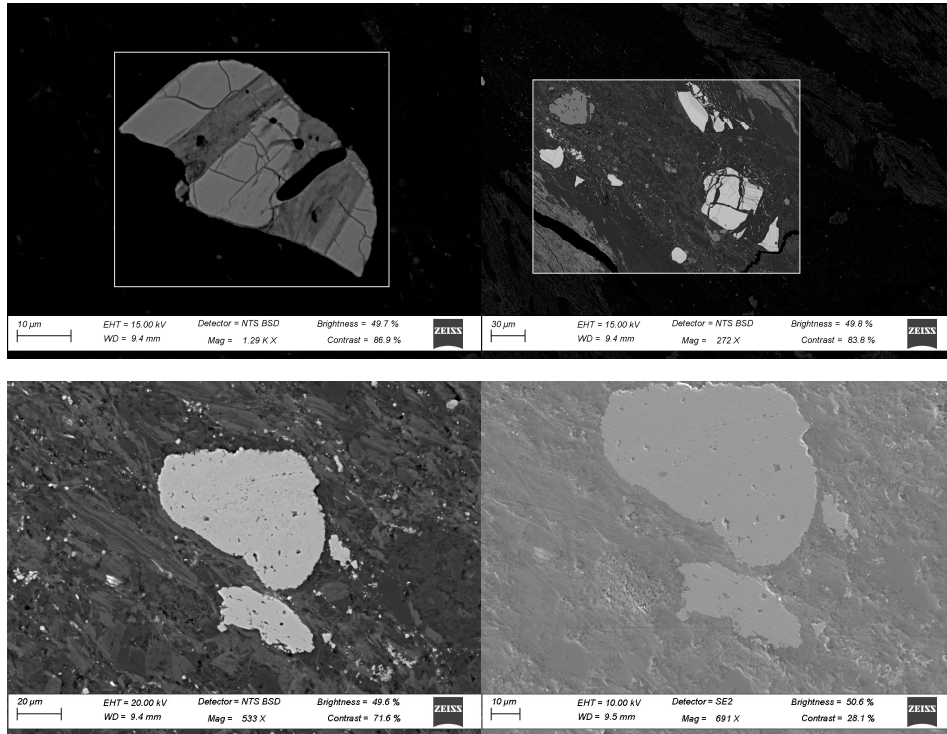


B.3.1: BSE images of zircon, quartz and ilmenite in TNS1.

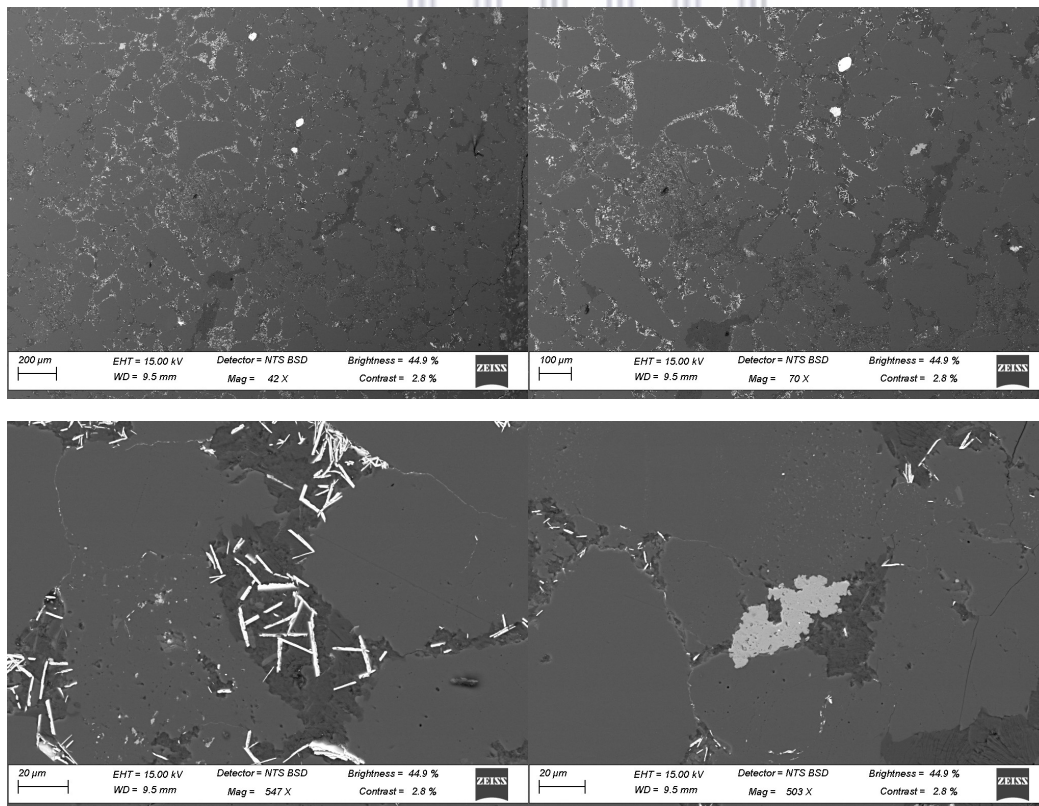


A.3.2: BSE images of quartz, zircon and ilmenite in TNS1. An accretionary lapillus is also depicted.

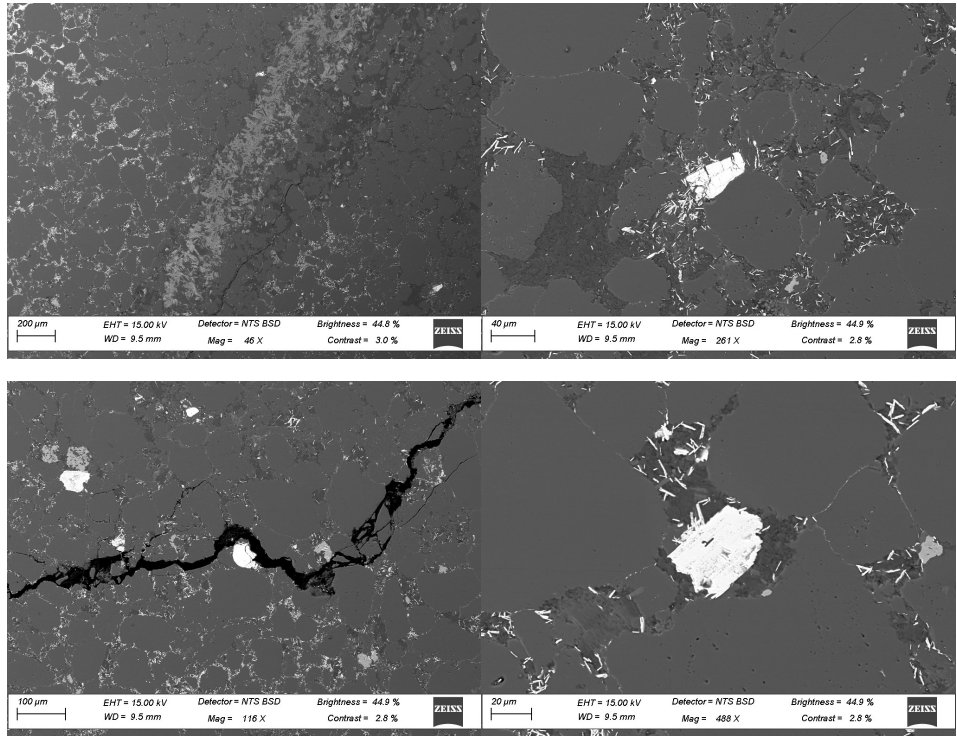




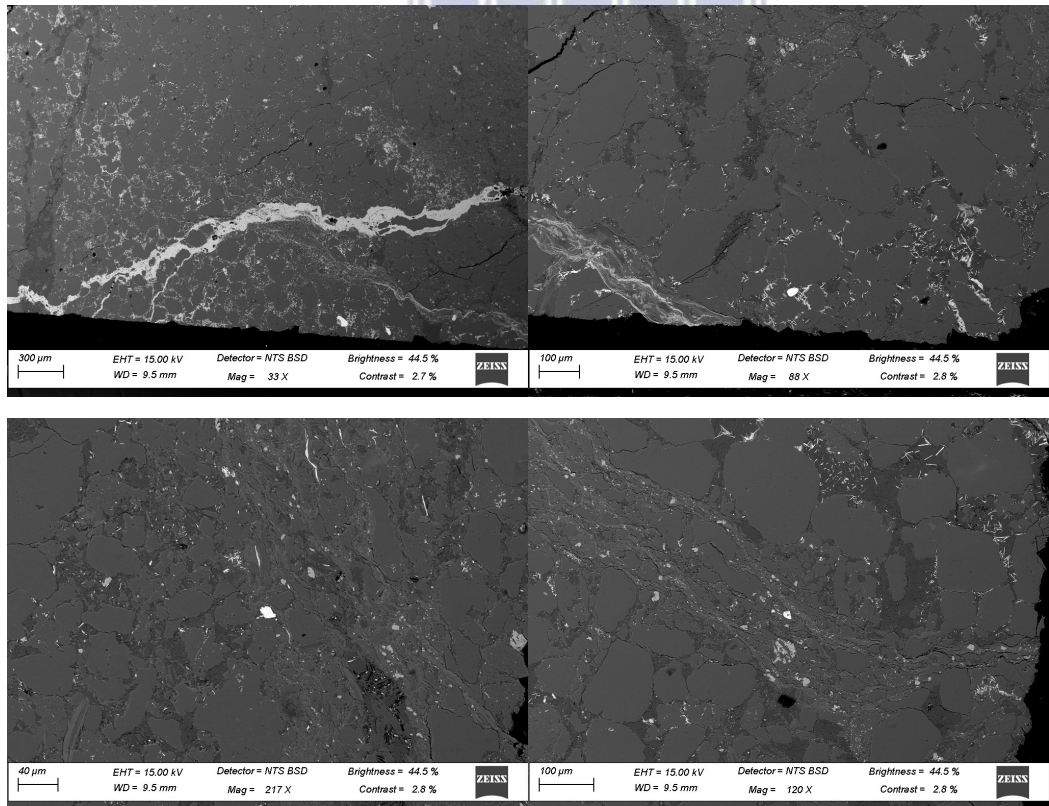
A.3.3: BSE images of zircon grains on the first row and potential rutile grains on the second row in TNS1.



A.3.4: BSE images of quartz and zircon grains in a fine-grained matrix consisting of acicular ilmenite in TNS18.

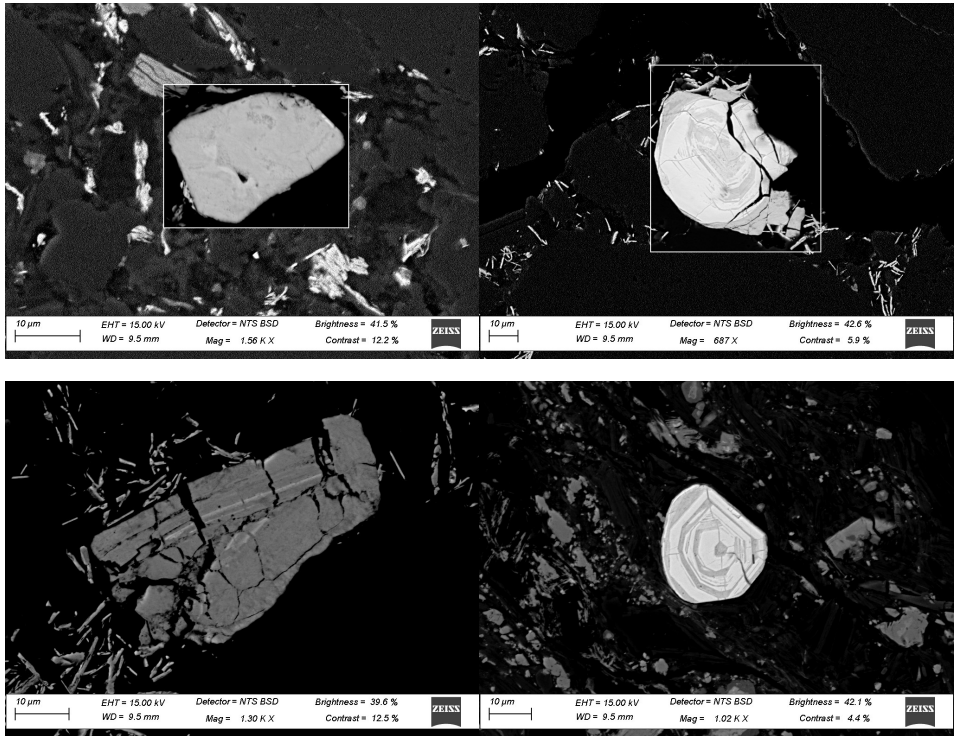


A.3.5: BSE images of the matrix of TNS18.

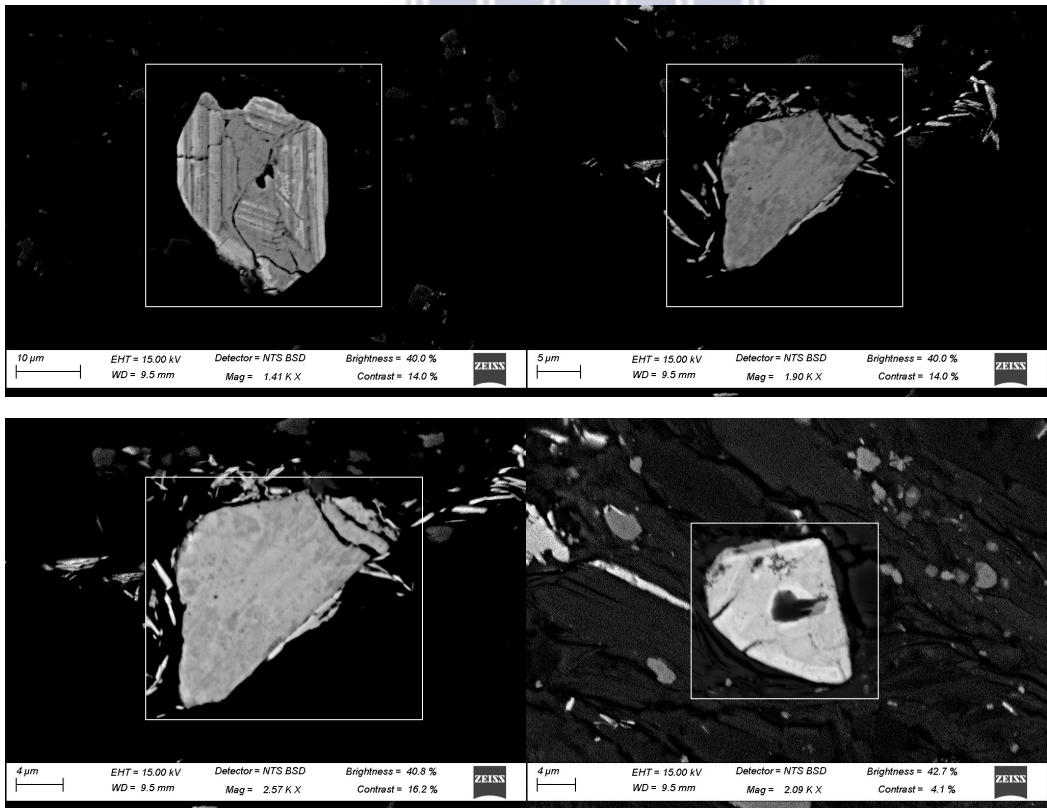


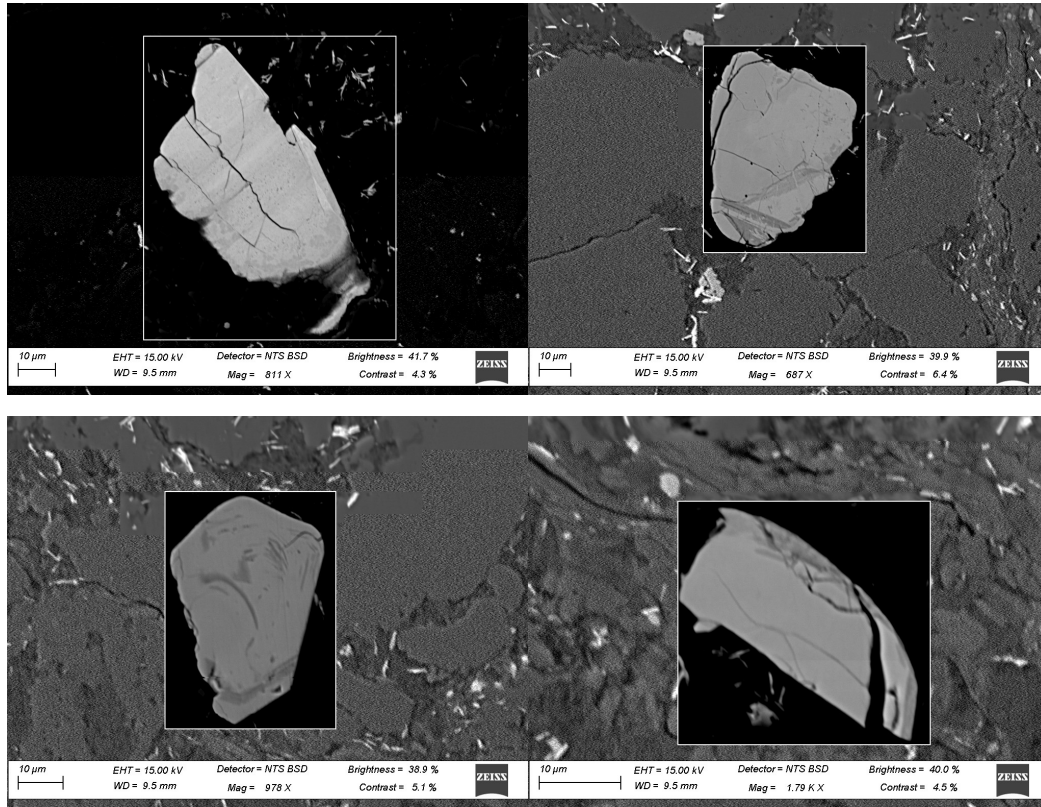
A.3.6: BSE images of matrix of TNS18.



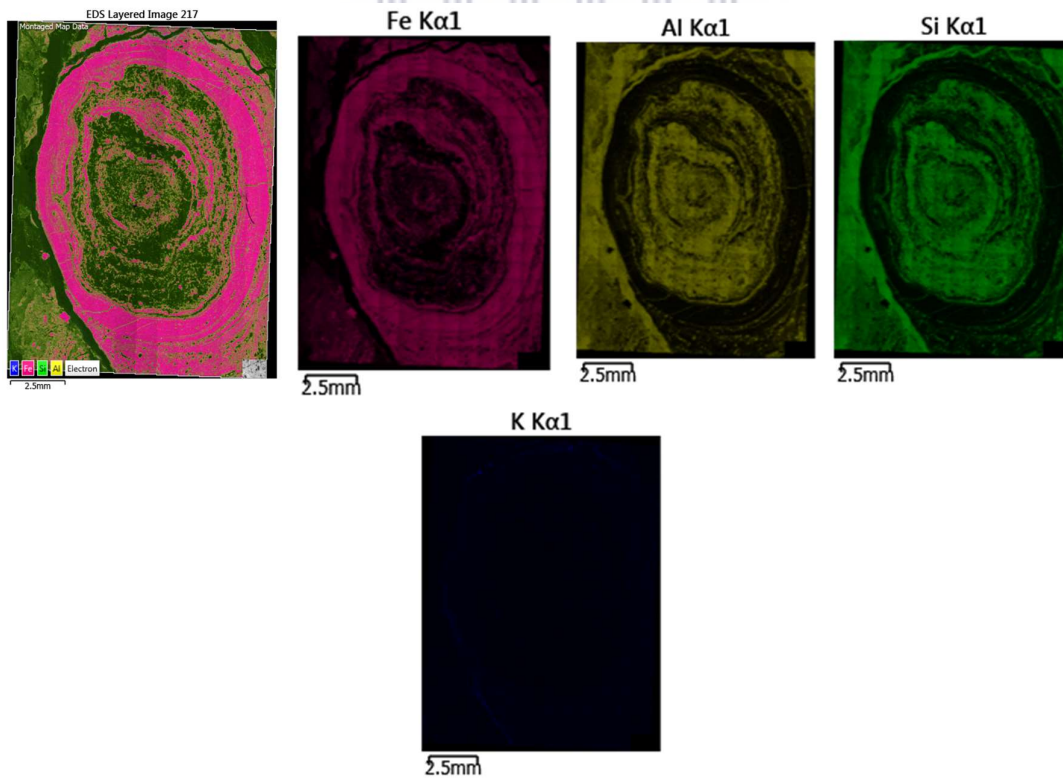


A.3.7: Zircon grain in TNS18.



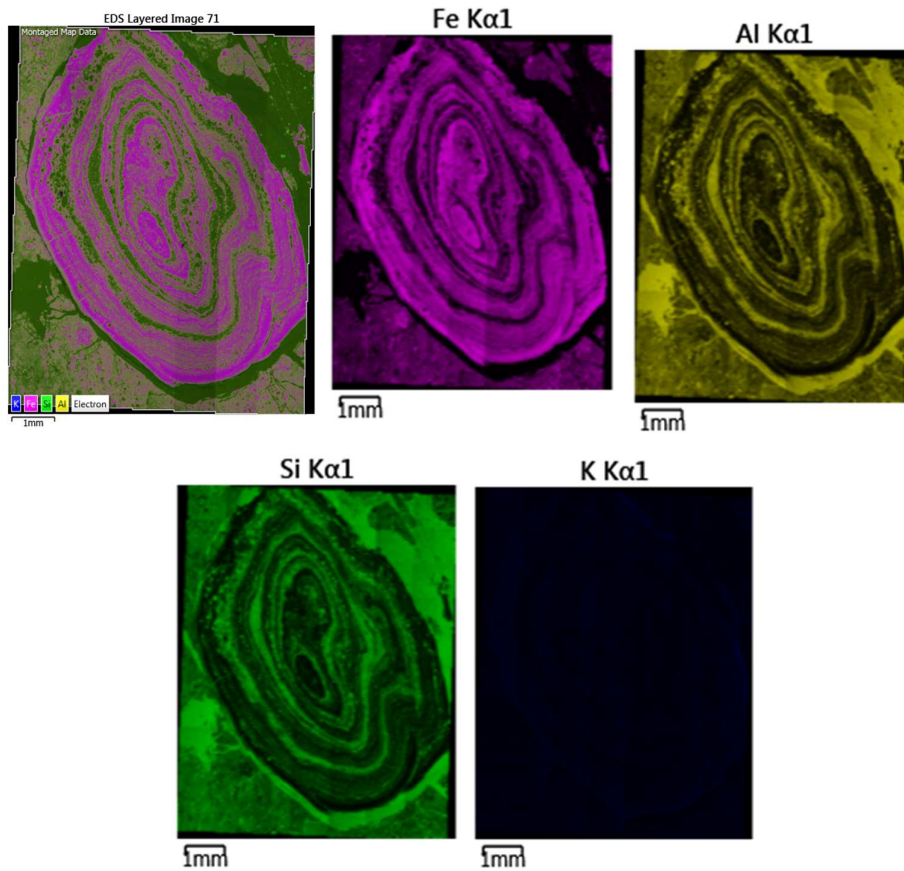


A.3.8: Zircon grains in TNS18.



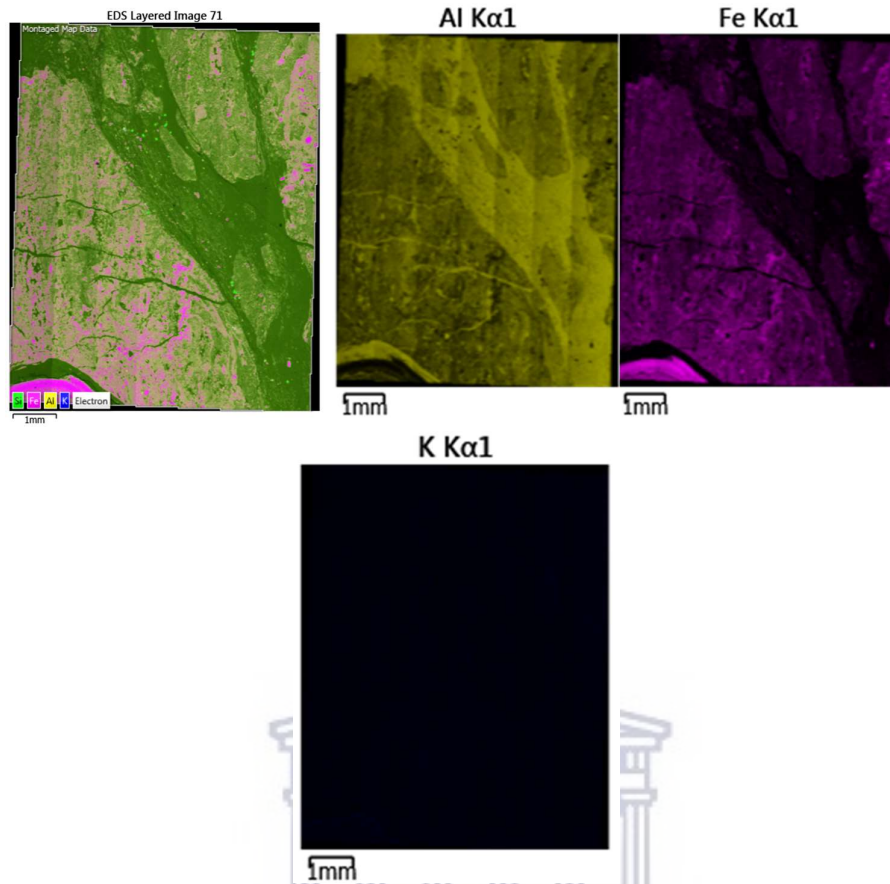
B.3.9: Compositional EDS maps of a nucleated accretionary lapillus in TNS2.





B.3.10: Compositional EDS maps of a nucleated accretory lapillus in TNS2.

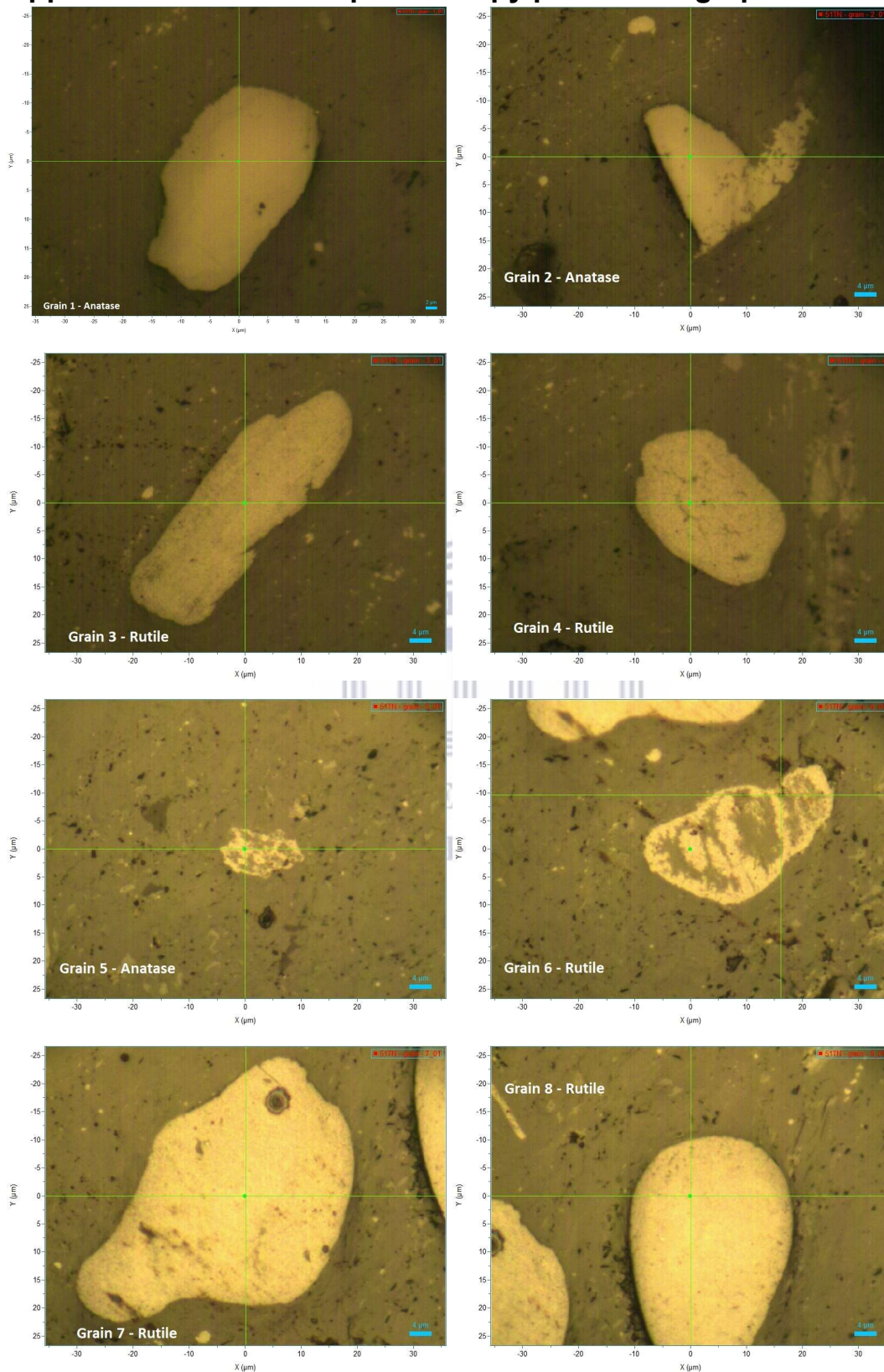
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B.3.11: Compositional EDS maps of part of the matrix in TNS2.

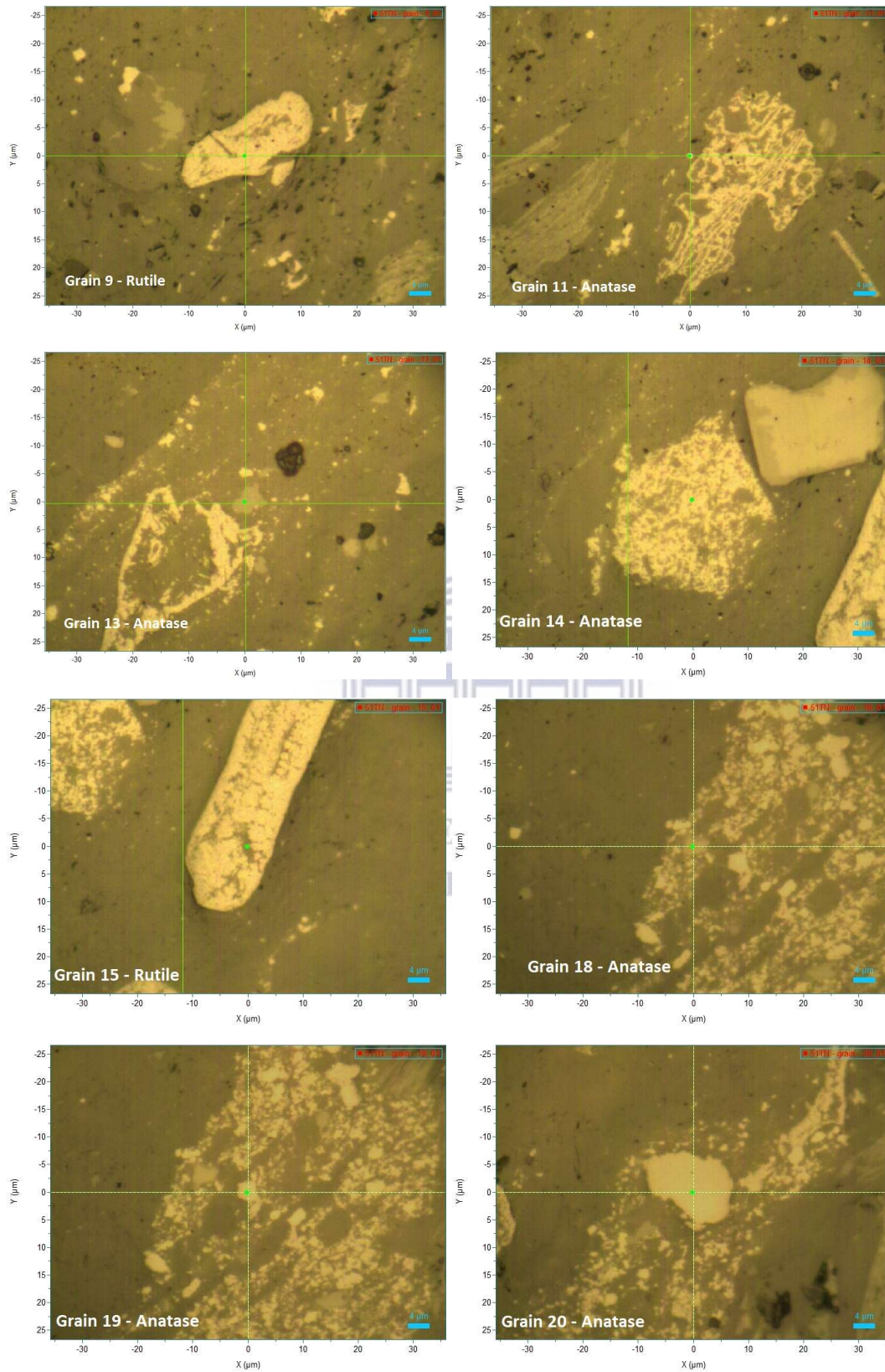
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## Appendix B.4 – Raman spectroscopy photomicrographs and data



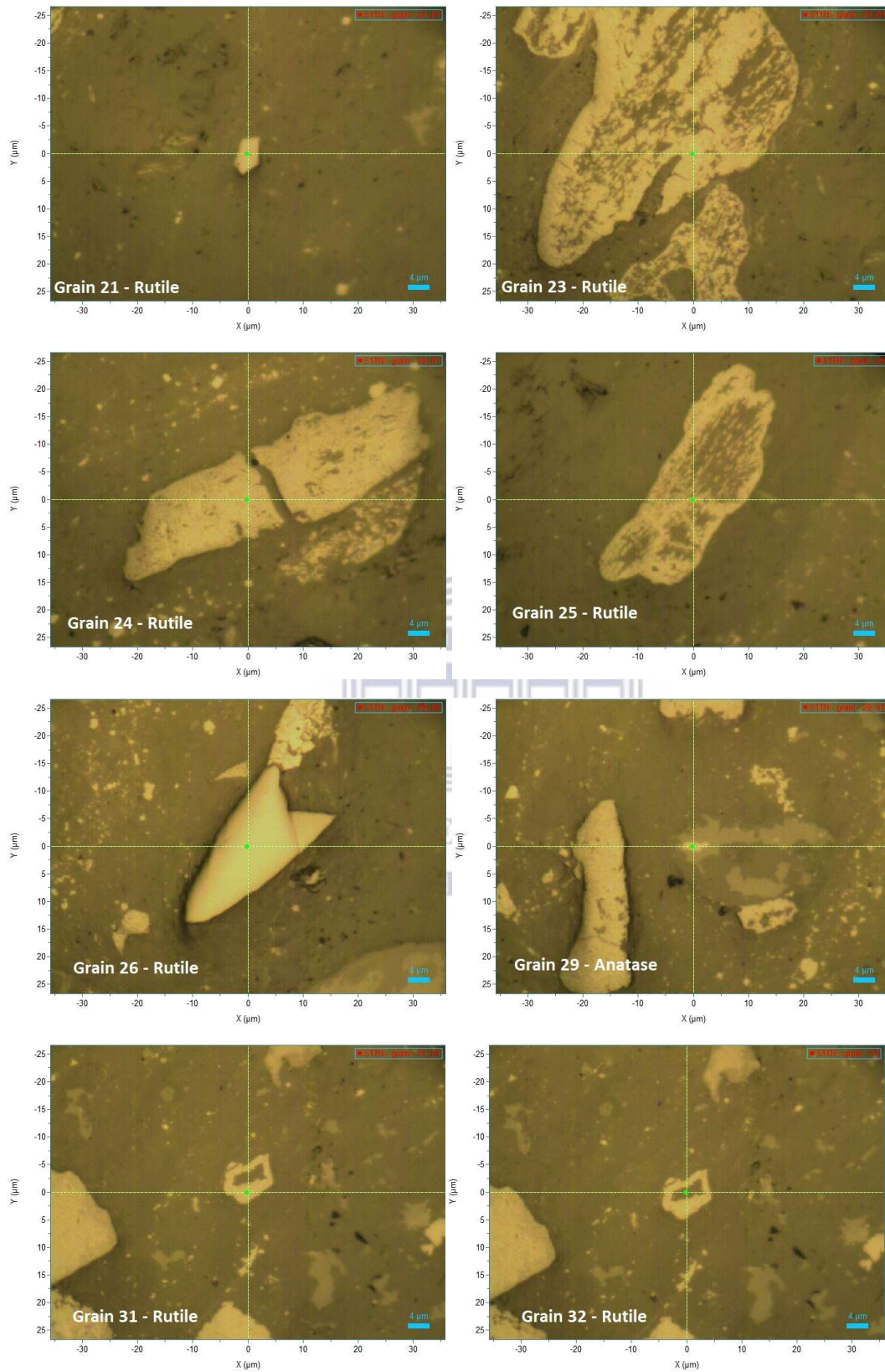
B.4.1: Rutile and anatase grains in TNS1 under reflected light.



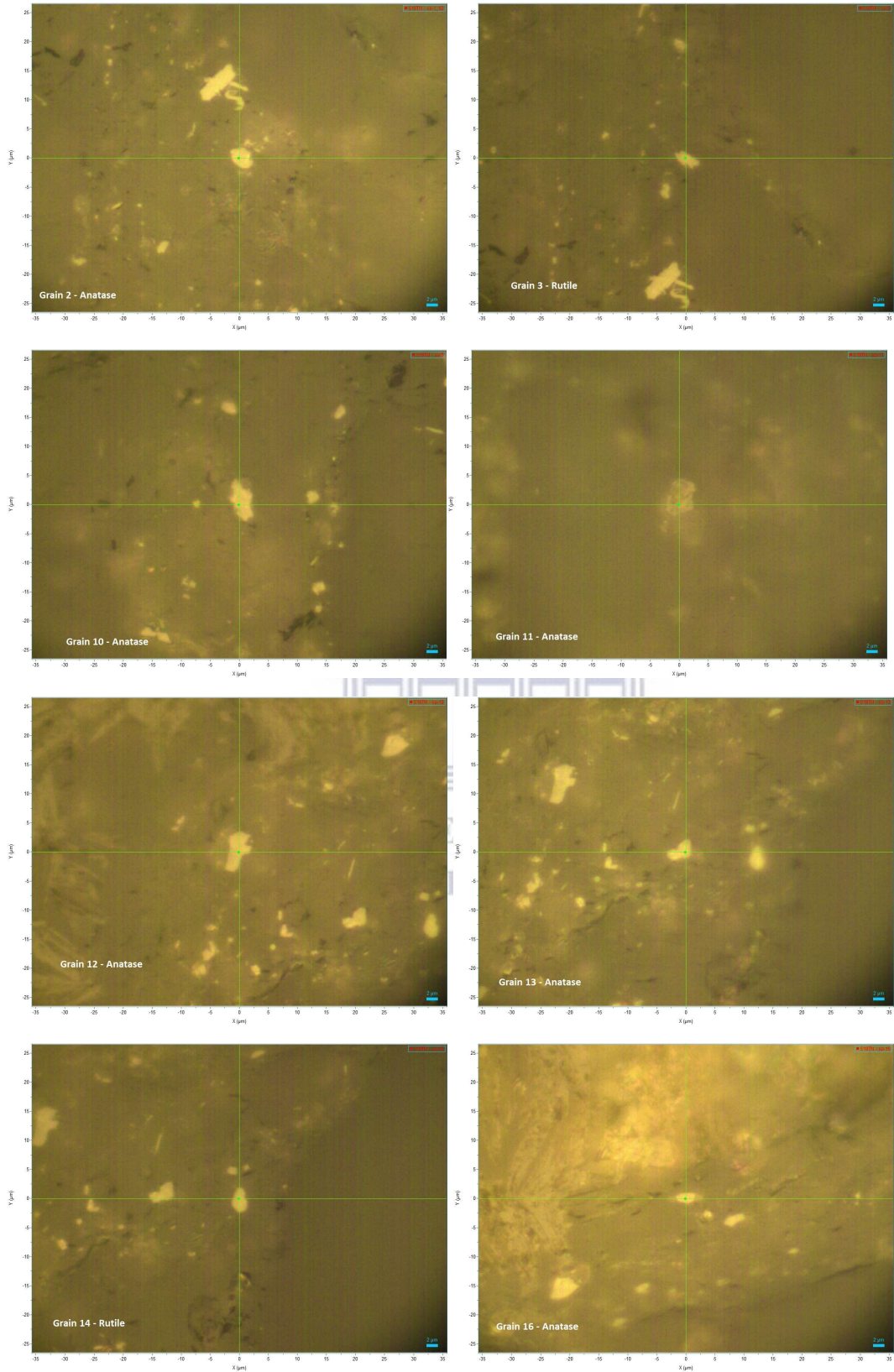


B.4.2: Rutile and anatase grains in TNS1 under reflected light.



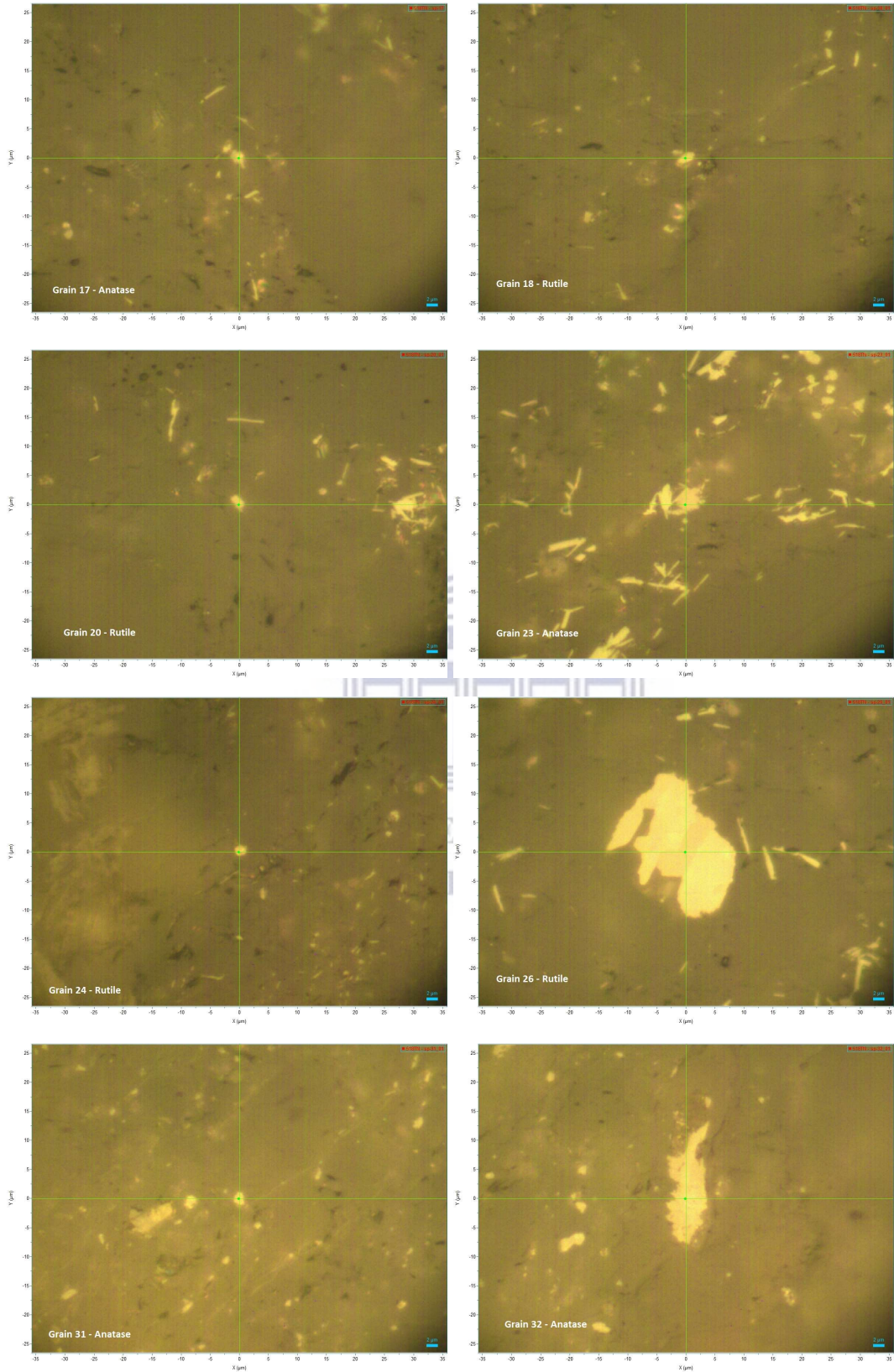


B.4.3: Rutile and anatase grains in TNS1 under reflected light.



B.4.4: Rutile and anatase grains in TNS18 under reflected light.





B.4.5: Rutile and anatase grains in TNS18 under reflected light.



B.4.6: Table showing the Raman shift of the first 15 of 32 analysed grains of TNS1.

TNS1	Turner Exploration Campe															
	Intensity (A.U)	Raman shift (cm <sup>-1</sup> )														
		Grain 1	Grain 2	Grain 3	Grain 4	Grain 5	Grain 6	Grain 7	Grain 8	Grain 9	Grain 10	Grain 11	Grain 12	Grain 13	Grain 14	Grain 15
-38.6	24.0	15.0	31.0	23.0	29.0	25.0	22.0	13.0	21.0	35.0	25.0	24.0	25.0	21.0		
-37.3	24.0	17.0	17.0	21.0	25.0	24.0	15.0	17.0	17.0	13.0	25.0	17.0	20.0	21.0	21.0	
-35.9	21.0	19.0	29.0	27.0	29.0	19.0	29.0	24.0	23.0	27.0	36.0	27.0	25.0	21.0	19.0	
-34.6	27.0	24.0	27.0	25.0	28.0	29.0	27.0	25.0	29.0	21.0	32.0	24.0	29.0	24.0	19.0	
-33.3	20.0	21.0	21.0	24.0	30.0	15.0	33.0	23.0	23.0	26.0	35.0	27.0	24.0	28.0	21.0	
-32.0	21.0	23.0	27.0	21.0	30.0	27.0	28.0	27.0	23.0	26.0	38.0	31.0	26.0	21.0	23.0	
-30.7	21.0	21.0	11.0	23.0	21.0	27.0	23.0	28.0	29.0	25.0	33.0	28.0	23.0	26.0	19.0	
-29.4	27.0	23.0	21.0	23.0	21.0	23.0	23.0	25.0	27.0	19.0	21.0	25.0	28.0	25.0	26.0	
-28.1	25.0	23.0	19.0	23.0	31.0	25.0	29.0	22.0	25.0	22.0	34.0	23.0	24.0	27.0	21.0	
-26.8	22.0	27.0	26.0	25.0	27.0	29.0	19.0	23.0	25.0	25.0	34.0	24.0	22.0	25.0	19.0	
-25.5	15.0	20.0	22.0	24.0	24.0	27.0	24.0	27.0	23.0	21.0	37.0	27.0	29.0	23.0	25.0	
-24.2	21.0	24.0	25.0	26.0	27.0	27.0	23.0	24.0	26.0	27.0	42.0	28.0	27.0	25.0	26.0	
-22.9	25.0	23.0	23.0	23.0	23.0	27.0	24.0	22.0	21.0	24.0	33.0	17.0	19.0	25.0	25.0	
-21.6	25.0	28.0	27.0	19.0	32.0	26.0	27.0	19.0	27.0	19.0	34.0	24.0	28.0	23.0	15.0	
-20.3	21.0	21.0	21.0	18.0	26.0	28.0	21.0	21.0	29.0	16.0	37.0	24.0	27.0	27.0	26.0	
-19.0	25.0	27.0	25.0	29.0	31.0	21.0	25.0	25.0	22.0	25.0	32.0	26.0	21.0	19.0	19.0	
-17.7	28.0	26.0	25.0	21.0	23.0	23.0	27.0	24.0	31.0	23.0	34.0	26.0	34.0	23.0	24.0	
-16.4	22.0	19.0	23.0	31.0	31.0	23.0	25.0	24.0	19.0	25.0	38.0	23.0	31.0	23.0	22.0	
-15.1	26.0	22.0	18.0	23.0	28.0	33.0	27.0	30.0	29.0	24.0	36.0	22.0	26.0	28.0	26.0	
-13.8	24.0	23.0	25.0	30.0	30.0	28.0	25.0	33.0	23.0	21.0	35.0	27.0	27.0	19.0	23.0	
-12.5	17.0	24.0	26.0	27.0	25.0	32.0	21.0	27.0	32.0	23.0	35.0	23.0	25.0	19.0	28.0	
-11.2	27.0	25.0	29.0	23.0	35.0	31.0	31.0	25.0	27.0	24.0	43.0	27.0	25.0	28.0	25.0	
-9.8	23.0	25.0	27.0	25.0	29.0	36.0	24.0	29.0	27.0	30.0	40.0	31.0	27.0	20.0	29.0	
-8.5	21.0	23.0	23.0	25.0	33.0	28.0	31.0	28.0	38.0	29.0	35.0	23.0	25.0	24.0	27.0	
-7.2	29.0	26.0	34.0	23.0	31.0	35.0	29.0	33.0	33.0	39.0	35.0	31.0	28.0	23.0	29.0	
-5.9	33.0	17.0	35.0	39.0	37.0	31.0	45.0	36.0	37.0	30.0	51.0	35.0	37.0	26.0	35.0	
-4.6	31.0	28.0	51.0	47.0	59.0	53.0	47.0	53.0	55.0	52.0	63.0	53.0	55.0	31.0	53.0	
-3.3	67.0	49.0	219.0	227.0	214.0	231.0	239.0	277.0	229.0	234.0	258.0	229.0	245.0	73.0	244.0	
-2.0	156.0	159.0	682.0	671.0	654.0	704.0	677.0	761.0	699.0	665.0	713.0	630.0	628.0	164.0	615.0	
-0.7	285.0	308.0	1247.0	1248.0	1259.0	1280.0	1225.0	1400.0	1282.0	1188.0	1255.0	1119.0	1135.0	266.0	1128.0	
0.6	359.0	405.0	1664.0	1680.0	1775.0	1769.0	1571.0	1795.0	1769.0	1603.0	1527.0	1476.0	1669.0	335.0	1568.0	
1.9	271.0	302.0	1289.0	1320.0	1271.0	1288.0	1239.0	1372.0	1369.0	1220.0	1210.0	1199.0	1231.0	298.0	1166.0	
3.2	195.0	198.0	757.0	903.0	909.0	859.0	715.0	824.0	976.0	865.0	801.0	736.0	811.0	185.0	769.0	
4.5	69.0	83.0	254.0	266.0	275.0	284.0	265.0	251.0	281.0	235.0	239.0	199.0	238.0	58.0	219.0	
5.8	23.0	23.0	43.0	42.0	52.0	51.0	47.0	43.0	41.0	48.0	57.0	37.0	43.0	31.0	47.0	
7.1	25.0	23.0	33.0	38.0	41.0	38.0	42.0	33.0	40.0	32.0	42.0	34.0	37.0	27.0	39.0	
8.4	21.0	25.0	30.0	27.0	36.0	25.0	30.0	31.0	31.0	31.0	46.0	30.0	27.0	28.0	29.0	
9.7	23.0	26.0	31.0	25.0	32.0	29.0	29.0	36.0	38.0	33.0	41.0	33.0	35.0	26.0	34.0	
11.0	23.0	29.0	29.0	31.0	35.0	30.0	35.0	30.0	29.0	25.0	37.0	27.0	35.0	23.0	20.0	
12.3	29.0	28.0	26.0	21.0	31.0	23.0	29.0	27.0	33.0	30.0	44.0	29.0	29.0	26.0	25.0	
13.6	23.0	31.0	21.0	30.0	31.0	29.0	28.0	30.0	25.0	26.0	46.0	27.0	26.0	31.0	24.0	
14.9	15.0	24.0	23.0	29.0	31.0	32.0	27.0	27.0	32.0	27.0	40.0	30.0	26.0	26.0	31.0	
16.2	26.0	25.0	25.0	25.0	33.0	31.0	31.0	27.0	27.0	23.0	46.0	28.0	28.0	24.0	30.0	
17.5	25.0	29.0	29.0	27.0	31.0	31.0	24.0	25.0	28.0	28.0	39.0	27.0	24.0	27.0	33.0	
18.8	23.0	25.0	26.0	30.0	31.0	31.0	27.0	30.0	28.0	26.0	39.0	35.0	23.0	26.0	28.0	
20.1	13.0	25.0	27.0	29.0	41.0	30.0	27.0	29.0	29.0	23.0	37.0	31.0	27.0	28.0	30.0	
21.3	26.0	22.0	27.0	25.0	36.0	21.0	29.0	32.0	25.0	24.0	42.0	19.0	26.0	24.0	28.0	
22.6	25.0	28.0	28.0	23.0	35.0	24.0	29.0	29.0	30.0	23.0	37.0	27.0	24.0	21.0	26.0	
23.9	30.0	23.0	23.0	27.0	29.0	29.0	31.0	29.0	32.0	22.0	45.0	31.0	23.0	26.0	19.0	
25.2	25.0	26.0	28.0	32.0	30.0	30.0	30.0	27.0	32.0	31.0	49.0	25.0	31.0	23.0	23.0	
26.5	26.0	26.0	20.0	22.0	25.0	23.0	27.0	27.0	32.0	23.0	46.0	26.0	33.0	29.0	31.0	
27.8	25.0	27.0	26.0	30.0	33.0	28.0	27.0	25.0	25.0	30.0	39.0	27.0	29.0	33.0	21.0	
29.1	23.0	29.0	21.0	32.0	35.0	33.0	28.0	23.0	36.0	21.0	41.0	29.0	28.0	29.0	25.0	
30.4	19.0	28.0	30.0	29.0	40.0	27.0	27.0	29.0	28.0	32.0	35.0	25.0	31.0	31.0	15.0	
31.7	27.0	25.0	32.0	29.0	25.0	33.0	25.0	27.0	27.0	31.0	55.0	30.0	27.0	28.0	31.0	
33.0	23.0	23.0	23.0	31.0	44.0	35.0	31.0	30.0	27.0	31.0	49.0	29.0	28.0	35.0	32.0	
34.3	21.0	20.0	29.0	28.0	39.0	29.0	25.0	27.0	36.0	27.0	53.0	31.0	30.0	24.0	25.0	
35.6	29.0	26.0	25.0	29.0	44.0	32.0	23.0	34.0	35.0	30.0	61.0	35.0	31.0	29.0	25.0	
36.9	21.0	28.0	31.0	31.0	37.0	31.0	32.0	33.0	38.0	31.0	59.0	38.0	35.0	26.0	29.0	
38.2	30.0	25.0	31.0	38.0	46.0	43.0	45.0	27.0	41.0	24.0	82.0	39.0	39.0	39.0	25.0	
39.5	30.0	34.0	38.0	35.0	58.0	48.0	39.0	43.0	49.0	31.0	93.0	42.0	47.0	40.0	40.0	
40.8	20.0	38.0	40.0	59.0	76.0	74.0	55.0	50.0	71.0	49.0	165.0	65.0	47.0	51.0	40.0	
42.1	29.0	44.0	59.0	82.0	95.0	91.0	66.0	61.0	88.0	62.0	235.0	93.0	81.0	63.0	64.0	
43.4	43.0	51.0	79.0	110.0	155.0	138.0	97.0	88.0	136.0	79.0	346.0	133.0	109.0	81.0	78.0	
44.7	41.0	76.0	107.0	153.0	255.0	195.0	135.0	118.0	185.0	111.0	554.0	185.0	151.0	119.0	111.0	
46.0	60.0	102.0	155.0	235.0	360.0	279.0	189.0	175.0	265.0	153.0	812.0	268.0	217.0	159.0	154.0	
47.2	71.0	130.0	214.0	307.0	498.0	372.0	251.0	224.0	377.0	195.0	1091.0	327.0	283.0	225.0	209.0	
48.5	92.0	162.0	262.0	391.0	622.0	477.0	336.0	282.0	473.0	253.0	1398.0	419.0	392.0	266.0	251.0	
49.8	109.0	195.0	316.0	469.0	752.0	562.0	389.0	335.0	585.0	294.0	1661.0	509.0	452.0	325.0	303.0	
51.1	119.0	212.0	357.0	518.0	858.0	649.0	459.0	403.0	679.0	339.0	1920.0	561.0	505.0	356.0	361.0	
52.4	136.0	244.0	413.0	612.0	966.0	733.0	519.0	450.0	759.0	361.0	2160.0	636.0	587.0	427.0	398.0	
53.7	158.0	277.0	445.0	668.0	1025.0	807.0	535.0	491.0	861.0	403.0	2368.0	685.0	629.0	456.0	417.0	
55.0	164.0	271.0	477.0	697.0	1139.0	869.0	604.0	529.0	898.0	447.0	2554.0	759.0	689.0	490.0	458.0	
56.3	164.0	293.0	512.0	743.0	1193.0	924.0	617.0	563.0	963.0	473.0	2741.0	792.0	740.0	533.0	490.0	
57.6	181.0	324.0	550.0	796.0	1315.0	947.0	653.0	605.0	1010.0	501.0	2822.0	833.0	771.0	541.0	521.0	
58.9	189.0	327.0	571.0	802.0	1309.0	1006.0	678.0	601.0	1014.0	526.0	2899.0	866.0	771.0	589.0	527.0	
60.2	191.0	344.0	591.0	823.0	1355.0	1033.0	718.0	625.0	1033.0	559.0	3041.0	916.0	812.0	610.0	523.0	
61.5	202.0	355.0	584.0	868.0	1422.0	1059.0	698.0	629.0	1088.0	553.0	3109.0	908.0	848.0	599.0	556.0	
62.7	202.0	352.0	549.0	860.0	1409.0											

84.6	627.0	866.0	1559.0	2153.0	3618.0	2615.0	1818.0	1713.0	2575.0	1477.0	6771.0	2176.0	2169.0	1553.0	1452.0
85.9	665.0	892.0	1599.0	2181.0	3715.0	2621.0	1819.0	1791.0	2682.0	1492.0	6903.0	2150.0	2205.0	1578.0	1467.0
87.2	685.0	892.0	1609.0	2214.0	3734.0	2693.0	1865.0	1790.0	2747.0	1501.0	6912.0	2206.0	2248.0	1641.0	1464.0
88.5	722.0	937.0	1619.0	2227.0	3831.0	2739.0	1924.0	1805.0	2752.0	1502.0	7050.0	2234.0	2294.0	1724.0	1491.0
89.8	741.0	942.0	1663.0	2360.0	3880.0	2794.0	1942.0	1853.0	2808.0	1501.0	7045.0	2233.0	2247.0	1705.0	1561.0
91.1	763.0	985.0	1701.0	2365.0	4060.0	2864.0	2012.0	1923.0	2872.0	1459.0	7113.0	2271.0	2370.0	1807.0	1591.0
92.4	813.0	1031.0	1741.0	2414.0	4169.0	2905.0	2105.0	1921.0	2903.0	1521.0	7172.0	2262.0	2472.0	1837.0	1649.0
93.6	831.0	1045.0	1774.0	2513.0	4220.0	3005.0	2139.0	2022.0	2933.0	1528.0	7144.0	2275.0	2451.0	1895.0	1672.0
94.9	892.0	1056.0	1782.0	2518.0	4357.0	2993.0	2139.0	2035.0	3023.0	1478.0	7255.0	2287.0	2527.0	1961.0	1709.0
96.2	903.0	1104.0	1827.0	2593.0	4446.0	3097.0	2135.0	2073.0	3015.0	1496.0	7267.0	2346.0	2591.0	2056.0	1689.0
97.5	957.0	1096.0	1803.0	2615.0	4497.0	3107.0	2198.0	2113.0	3116.0	1456.0	7312.0	2357.0	2625.0	2115.0	1757.0
98.8	1015.0	1157.0	1889.0	2653.0	4721.0	3206.0	2202.0	2160.0	3150.0	1451.0	7388.0	2395.0	2710.0	2188.0	1822.0
100.1	1015.0	1201.0	1920.0	2676.0	4838.0	3249.0	2268.0	2196.0	3212.0	1449.0	7461.0	2456.0	2678.0	2215.0	1815.0
101.3	1065.0	1235.0	1949.0	2795.0	4933.0	3288.0	2301.0	2199.0	3201.0	1434.0	7606.0	2470.0	2751.0	2303.0	1874.0
102.6	1163.0	1264.0	1972.0	2797.0	5050.0	3415.0	2263.0	2240.0	3285.0	1430.0	7484.0	2420.0	2804.0	2441.0	1889.0
103.9	1175.0	1350.0	2029.0	2845.0	5115.0	3428.0	2357.0	2268.0	3314.0	1393.0	7603.0	2437.0	2829.0	2506.0	1923.0
105.2	1255.0	1391.0	2049.0	2853.0	5232.0	3441.0	2391.0	2301.0	3391.0	1452.0	7541.0	2393.0	2909.0	2615.0	1967.0
106.5	1365.0	1411.0	2103.0	2927.0	5451.0	3591.0	2475.0	2368.0	3462.0	1405.0	7700.0	2367.0	2943.0	2754.0	1983.0
107.8	1439.0	1488.0	2105.0	3006.0	5525.0	3567.0	2490.0	2398.0	3467.0	1437.0	7669.0	2385.0	3018.0	2836.0	2034.0
109.0	1485.0	1553.0	2141.0	3082.0	5685.0	3665.0	2577.0	2449.0	3535.0	1425.0	7610.0	2340.0	3074.0	2955.0	2067.0
110.3	1573.0	1622.0	2188.0	3106.0	5817.0	3675.0	2581.0	2493.0	3568.0	1419.0	7713.0	2318.0	3095.0	3139.0	2133.0
111.6	1641.0	1686.0	2199.0	3163.0	6025.0	3779.0	2607.0	2495.0	3575.0	1450.0	7737.0	2325.0	3199.0	3228.0	2144.0
112.9	1756.0	1773.0	2297.0	3231.0	6123.0	3855.0	2663.0	2558.0	3671.0	1385.0	7788.0	2378.0	3251.0	3383.0	2200.0
114.2	1849.0	1863.0	2339.0	3244.0	6397.0	3835.0	2721.0	2592.0	3669.0	1349.0	7797.0	2391.0	3324.0	3545.0	2183.0
115.5	1945.0	1983.0	2336.0	3325.0	6531.0	3979.0	2740.0	2623.0	3736.0	1394.0	7740.0	2422.0	3393.0	3726.0	2273.0
116.7	2093.0	2113.0	2410.0	3374.0	6828.0	3955.0	2792.0	2684.0	3788.0	1424.0	7769.0	2365.0	3449.0	3971.0	2352.0
118.0	2221.0	2221.0	2433.0	3400.0	7023.0	4128.0	2853.0	2744.0	3857.0	1417.0	7825.0	2436.0	3613.0	4221.0	2409.0
119.3	2388.0	2401.0	2445.0	3428.0	7307.0	4131.0	2855.0	2767.0	3884.0	1422.0	7797.0	2486.0	3689.0	4481.0	2431.0
120.6	2647.0	2610.0	2487.0	3499.0	7717.0	4206.0	2905.0	2801.0	3960.0	1411.0	7938.0	2471.0	3784.0	4898.0	2430.0
121.9	2887.0	2814.0	2532.0	3530.0	8028.0	4294.0	2982.0	2818.0	3998.0	1395.0	7953.0	2448.0	3791.0	5256.0	2483.0
123.1	3161.0	3097.0	2546.0	3595.0	8431.0	4291.0	3002.0	2881.0	4035.0	1422.0	8134.0	2460.0	3993.0	5753.0	2512.0
124.4	3534.0	3359.0	2569.0	3575.0	8857.0	4385.0	2992.0	2895.0	4041.0	1420.0	8214.0	2526.0	4112.0	6314.0	2550.0
125.7	3920.0	3833.0	2618.0	3677.0	9435.0	4425.0	3087.0	2877.0	4065.0	1402.0	8333.0	2506.0	4201.0	7060.0	2511.0
127.0	4447.0	4281.0	2644.0	3731.0	10035.0	4449.0	3102.0	2961.0	4082.0	1413.0	8529.0	2503.0	4307.0	7943.0	2552.0
128.2	5104.0	4873.0	2649.0	3745.0	10959.0	4579.0	3110.0	2905.0	4232.0	1406.0	8675.0	2590.0	4533.0	8923.0	2527.0
129.5	5920.0	5613.0	2687.0	3753.0	11924.0	4569.0	3131.0	2963.0	4165.0	1389.0	8784.0	2674.0	4765.0	10203.0	2668.0
130.8	6936.0	6583.0	2648.0	3798.0	13108.0	4635.0	3140.0	2982.0	4187.0	1412.0	9074.0	2822.0	5063.0	11916.0	2709.0
132.1	8278.0	7828.0	2683.0	3841.0	14699.0	4740.0	3190.0	3013.0	4199.0	1416.0	9475.0	2819.0	5413.0	14083.0	2715.0
133.4	10095.0	9523.0	2738.0	3856.0	16475.0	4829.0	3192.0	3048.0	4251.0	1403.0	9958.0	2829.0	5911.0	17054.0	2666.0
134.6	12569.0	12045.0	2739.0	3906.0	19097.0	4961.0	3215.0	3071.0	4261.0	1387.0	10493.0	2780.0	6526.0	20831.0	2671.0
135.9	16047.0	15407.0	2756.0	3876.0	22431.0	5098.0	3237.0	3089.0	4319.0	1408.0	11354.0	2829.0	7137.0	26131.0	2645.0
137.2	21120.0	20209.0	2762.0	3866.0	27116.0	5283.0	3209.0	3131.0	4299.0	1414.0	12455.0	2897.0	8284.0	33419.0	2669.0
138.5	28434.0	27309.0	2701.0	3988.0	33107.0	5551.0	3318.0	3093.0	4369.0	1378.0	14327.0	2907.0	9825.0	43326.0	2615.0
139.7	38033.0	36883.0	2807.0	4024.0	40607.0	5833.0	3337.0	3179.0	4427.0	1437.0	16721.0	3079.0	11792.0	55751.0	2673.0
141.0	50613.0	48167.0	2723.0	4009.0	50461.0	6178.0	3343.0	3251.0	4507.0	1396.0	19873.0	3202.0	14069.0	69490.0	2732.0
142.3	62842.0	58958.0	2833.0	4051.0	60273.0	6566.0	3447.0	3329.0	4499.0	1406.0	23524.0	3210.0	16386.0	64940.0	2697.0
143.6	64940.0	63245.0	2820.0	4143.0	64940.0	6793.0	3459.0	3261.0	4610.0	1406.0	25722.0	3222.0	17885.0	64940.0	2744.0
144.9	64940.0	58717.0	2833.0	4172.0	64940.0	6744.0	3457.0	3309.0	4571.0	1429.0	24949.0	3105.0	17868.0	64940.0	2686.0
146.1	54235.0	47711.0	2870.0	4133.0	64940.0	6449.0	3377.0	3312.0	4629.0	1451.0	21941.0	2935.0	16563.0	64940.0	2727.0
147.4	40896.0	35622.0	2811.0	4109.0	59829.0	6274.0	3437.0	3277.0	4615.0	1447.0	18498.0	2797.0	14146.0	62403.0	2680.0
148.7	29946.0	25885.0	2846.0	4157.0	49990.0	5890.0	3403.0	3316.0	4536.0	1461.0	15578.0	2728.0	11802.0	49997.0	2681.0
150.0	21931.0	18911.0	2853.0	4099.0	40617.0	5613.0	3451.0	3317.0	4517.0	1456.0	13640.0	2620.0	9876.0	38077.0	2676.0
151.2	16584.0	14076.0	2881.0	4094.0	32937.0	5436.0	3411.0	3305.0	4489.0	1440.0	12112.0	2572.0	8395.0	30156.0	2663.0
152.5	12725.0	10912.0	2877.0	4168.0	27087.0	5248.0	3425.0	3337.0	4551.0	1459.0	11145.0	2513.0	7336.0	23992.0	2699.0
153.8	10019.0	8582.0	2837.0	4134.0	22646.0	5163.0	3421.0	3334.0	4507.0	1488.0	10379.0	2527.0	6491.0	19379.0	2617.0
155.1	8025.0	6947.0	2841.0	4140.0	19190.0	5051.0	3429.0	3346.0	4531.0	1501.0	9805.0	2445.0	5967.0	15834.0	2705.0
156.3	6659.0	5691.0	2871.0	4159.0	16491.0	5019.0	3413.0	3401.0	4547.0	1496.0	9420.0	2460.0	5614.0	13159.0	2712.0
157.6	5480.0	4909.0	2913.0	4157.0	14500.0	4978.0	3421.0	3359.0	4490.0	1513.0	9118.0	2434.0	5231.0	11002.0	2668.0
158.9	4618.0	4142.0	2860.0	4091.0	12993.0	4986.0	3457.0	3372.0	4487.0	1541.0	8894.0	2410.0	4964.0	9373.0	2683.0
160.1	3935.0	3598.0	2861.0	4115.0	11629.0	4843.0	3448.0	3385.0	4469.0	1523.0	8730.0	2416.0	4777.0	8073.0	2692.0
161.4	3406.0	3162.0	2851.0	4097.0	10657.0	4921.0	3465.0	3409.0	4501.0	1541.0	8613.0	2445.0	4614.0	7108.0	2708.0
162.7	2977.0	2783.0	2885.0	4172.0	9897.0	4908.0	3453.0	3436.0	4476.0	1536.0	8465.0	2398.0	4465.0	6204.0	2682.0
164.0	2619.0	2508.0	2851.0	4123.0	9125.0	4810.0	3508.0	3375.0	4431.0	1581.0	8333.0	2407.0	4338.0	5535.0	2665.0
165.2	2319.0	2287.0	2809.0	4166.0	8559.0	4814.0	3449.0	3417.0	4479.0	1553.0	8292.0	2409.0	4209.0	4965.0	2621.0
166.5	2071.0	2069.0	2852.0	4148.0	8143.0	4769.0	3403.0	3424.0	4429.0	1530.0	8310.0	2408.0	4125.0	4424.0	2630.0
167.8	1899.0	1899.0	2852.0	4111.0	7739.0	4838.0	3435.0	3445.0	4482.0	1566.0	8194.0	2382.0	4081.0	4025.0	2676.0
169.1	1685.0	1741.0	2856.0	4179.0	7395.0	4791.0	3443.0	3413.0	4477.0	1571.0	8087.0	2390.0	4027.0	3629.0	2643.0
170.3	1573.0	1635.0	2778.0	4195.0	7111.0	4731.0	3468.0	3421.0	4438.0	1552.0	8143.0	2406.0	3921.0	3369.0	2649.0
171.6	1417.0	15													

212.2	383.0	595.0	2513.0	3835.0	4765.0	4586.0	3301.0	2994.0	4227.0	2577.0	8079.0	2608.0	3546.0	984.0	2584.0
213.4	358.0	595.0	2541.0	3911.0	4673.0	4571.0	3305.0	3046.0	4199.0	2656.0	8210.0	2632.0	3551.0	964.0	2621.0
214.7	335.0	617.0	2527.0	3777.0	4753.0	4661.0	3323.0	3005.0	4105.0	2622.0	8072.0	2677.0	3584.0	927.0	2652.0
216.0	346.0	586.0	2551.0	3900.0	4718.0	4683.0	3323.0	2991.0	4163.0	2477.0	8188.0	2577.0	3601.0	912.0	2645.0
217.2	343.0	575.0	2561.0	3936.0	4657.0	4657.0	3381.0	3066.0	4221.0	2506.0	8190.0	2548.0	3529.0	887.0	2631.0
218.5	323.0	582.0	2593.0	3995.0	4659.0	4698.0	3351.0	3064.0	4204.0	2708.0	8185.0	2479.0	3547.0	890.0	2665.0
219.8	315.0	564.0	2565.0	3939.0	4702.0	4734.0	3357.0	3127.0	4201.0	2996.0	8114.0	2499.0	3571.0	839.0	2662.0
221.0	303.0	547.0	2543.0	3941.0	4712.0	4789.0	3465.0	3176.0	4239.0	3430.0	8090.0	2498.0	3611.0	835.0	2681.0
222.3	311.0	541.0	2556.0	3995.0	4754.0	4711.0	3463.0	3134.0	4279.0	4130.0	8072.0	2475.0	3625.0	847.0	2717.0
223.5	296.0	541.0	2641.0	3996.0	4703.0	4839.0	3448.0	3253.0	4278.0	4913.0	8088.0	2572.0	3587.0	809.0	2707.0
224.8	285.0	539.0	2643.0	3955.0	4689.0	4801.0	3467.0	3257.0	4331.0	5533.0	8055.0	2527.0	3641.0	814.0	2705.0
226.1	295.0	539.0	2641.0	4015.0	4719.0	4773.0	3553.0	3281.0	4290.0	4875.0	8140.0	2538.0	3652.0	784.0	2744.0
227.3	285.0	551.0	2601.0	4077.0	4729.0	4847.0	3573.0	3315.0	4324.0	3756.0	8039.0	2541.0	3692.0	771.0	2753.0
228.6	277.0	518.0	2649.0	4074.0	4731.0	4856.0	3561.0	3303.0	4312.0	2947.0	8103.0	2521.0	3677.0	777.0	2728.0
229.8	281.0	535.0	2666.0	4098.0	4728.0	4787.0	3589.0	3246.0	4408.0	2426.0	8088.0	2499.0	3703.0	745.0	2759.0
231.1	265.0	522.0	2645.0	4053.0	4781.0	4880.0	3572.0	3232.0	4423.0	2115.0	8152.0	2481.0	3669.0	737.0	2801.0
232.4	276.0	521.0	2713.0	4102.0	4734.0	4910.0	3591.0	3195.0	4377.0	1931.0	8107.0	2525.0	3689.0	735.0	2755.0
233.6	264.0	500.0	2697.0	4174.0	4791.0	4977.0	3597.0	3219.0	4422.0	1796.0	8119.0	2490.0	3710.0	740.0	2797.0
234.9	265.0	517.0	2715.0	4207.0	4803.0	4973.0	3620.0	3233.0	4410.0	1724.0	8188.0	2592.0	3706.0	729.0	2809.0
236.2	255.0	516.0	2643.0	4179.0	4779.0	4967.0	3590.0	3227.0	4452.0	1657.0	8118.0	2521.0	3762.0	726.0	2843.0
237.4	268.0	531.0	2639.0	4195.0	4697.0	4959.0	3613.0	3213.0	4436.0	1583.0	8168.0	2550.0	3767.0	721.0	2852.0
238.7	255.0	511.0	2709.0	4262.0	4857.0	4995.0	3613.0	3202.0	4504.0	1600.0	8282.0	2570.0	3793.0	738.0	2857.0
239.9	245.0	528.0	2753.0	4225.0	4777.0	5030.0	3615.0	3203.0	4507.0	1509.0	8182.0	2614.0	3787.0	740.0	2909.0
241.2	233.0	517.0	2757.0	4241.0	4847.0	5077.0	3629.0	3226.0	4437.0	1495.0	8210.0	2603.0	3799.0	709.0	2846.0
242.5	246.0	522.0	2721.0	4215.0	4859.0	5076.0	3672.0	3193.0	4446.0	1499.0	8182.0	2590.0	3805.0	710.0	2881.0
243.7	243.0	514.0	2775.0	4264.0	4893.0	4983.0	3601.0	3253.0	4484.0	1465.0	8252.0	2613.0	3742.0	721.0	2905.0
245.0	252.0	501.0	2770.0	4266.0	4939.0	5081.0	3643.0	3258.0	4576.0	1433.0	8198.0	2676.0	3838.0	704.0	2913.0
246.2	237.0	512.0	2751.0	4235.0	4924.0	5077.0	3667.0	3258.0	4514.0	1438.0	8257.0	2659.0	3795.0	699.0	2910.0
247.5	247.0	512.0	2803.0	4267.0	4892.0	5045.0	3667.0	3245.0	4568.0	1413.0	8304.0	2591.0	3685.0	712.0	2887.0
248.7	250.0	508.0	2761.0	4319.0	4925.0	5088.0	3611.0	3272.0	4453.0	1381.0	8357.0	2622.0	3776.0	689.0	2943.0
250.0	243.0	538.0	2749.0	4313.0	4833.0	5107.0	3643.0	3257.0	4562.0	1394.0	8335.0	2631.0	3735.0	685.0	2917.0
251.3	245.0	503.0	2779.0	4301.0	4807.0	4955.0	3638.0	3313.0	4521.0	1363.0	8323.0	2630.0	3804.0	687.0	2871.0
252.5	242.0	530.0	2812.0	4324.0	4803.0	5095.0	3607.0	3276.0	4547.0	1391.0	8365.0	2616.0	3814.0	694.0	2883.0
253.8	253.0	517.0	2817.0	4301.0	4887.0	5047.0	3661.0	3258.0	4582.0	1394.0	8484.0	2628.0	3771.0	719.0	2874.0
255.0	235.0	522.0	2759.0	4282.0	4929.0	5078.0	3695.0	3273.0	4596.0	1372.0	8501.0	2694.0	3763.0	697.0	2855.0
256.3	247.0	519.0	2812.0	4324.0	4913.0	5072.0	3679.0	3255.0	4531.0	1344.0	8443.0	2666.0	3750.0	715.0	2838.0
257.5	245.0	507.0	2775.0	4311.0	4933.0	5003.0	3627.0	3251.0	4459.0	1364.0	8572.0	2699.0	3761.0	689.0	2845.0
258.8	237.0	513.0	2802.0	4255.0	4952.0	5008.0	3624.0	3269.0	4643.0	1321.0	8681.0	2714.0	3730.0	700.0	2819.0
260.1	239.0	549.0	2819.0	4336.0	4869.0	4979.0	3632.0	3223.0	4582.0	1355.0	9006.0	2787.0	3730.0	700.0	2859.0
261.3	239.0	545.0	2851.0	4217.0	4933.0	5007.0	3648.0	3267.0	4617.0	1326.0	9238.0	2828.0	3766.0	719.0	2837.0
262.6	247.0	529.0	2813.0	4284.0	4924.0	5019.0	3667.0	3247.0	4597.0	1343.0	9675.0	2848.0	3791.0	725.0	2833.0
263.8	264.0	541.0	2813.0	4275.0	4938.0	5058.0	3595.0	3256.0	4613.0	1310.0	9618.0	2919.0	3753.0	735.0	2828.0
265.1	265.0	556.0	2787.0	4275.0	4958.0	4999.0	3599.0	3253.0	4591.0	1369.0	9144.0	2910.0	3763.0	719.0	2824.0
266.3	243.0	523.0	2822.0	4237.0	4928.0	5020.0	3611.0	3277.0	4652.0	1384.0	8882.0	2929.0	3788.0	742.0	2858.0
267.6	263.0	560.0	2749.0	4257.0	4968.0	5065.0	3621.0	3259.0	4573.0	1373.0	8766.0	2949.0	3802.0	756.0	2875.0
268.8	250.0	543.0	2821.0	4253.0	4976.0	4973.0	3559.0	3282.0	4660.0	1365.0	8663.0	2960.0	3767.0	693.0	2845.0
270.1	255.0	561.0	2778.0	4171.0	4961.0	4995.0	3543.0	3282.0	4543.0	1359.0	8622.0	2823.0	3799.0	765.0	2851.0
271.4	263.0	558.0	2857.0	4354.0	4957.0	5033.0	3591.0	3293.0	4516.0	1328.0	8554.0	2895.0	3703.0	733.0	2880.0
272.6	247.0	551.0	2855.0	4233.0	4979.0	5011.0	3633.0	3281.0	4633.0	1343.0	8547.0	2844.0	3811.0	735.0	2854.0
273.9	257.0	564.0	2791.0	4265.0	4997.0	5013.0	3613.0	3375.0	4596.0	1358.0	8574.0	2829.0	3798.0	729.0	2847.0
275.1	269.0	569.0	2846.0	4279.0	4954.0	5005.0	3636.0	3329.0	4588.0	1359.0	8592.0	2794.0	3749.0	764.0	2839.0
276.4	267.0	561.0	2865.0	4243.0	4993.0	4922.0	3629.0	3295.0	4558.0	1326.0	8627.0	2764.0	3790.0	754.0	2855.0
277.6	264.0	547.0	2831.0	4245.0	5021.0	4995.0	3632.0	3343.0	4581.0	1355.0	8528.0	2681.0	3761.0	753.0	2871.0
278.9	278.0	559.0	2853.0	4280.0	4999.0	4957.0	3573.0	3335.0	4646.0	1335.0	8505.0	2683.0	3738.0	736.0	2898.0
280.1	269.0	568.0	2842.0	4287.0	4963.0	5031.0	3641.0	3390.0	4649.0	1338.0	8515.0	2645.0	3840.0	745.0	2874.0
281.4	278.0	590.0	2885.0	4251.0	5002.0	4987.0	3653.0	3327.0	4633.0	1311.0	8487.0	2610.0	3779.0	765.0	2827.0
282.6	286.0	579.0	2887.0	4268.0	4961.0	5011.0	3674.0	3366.0	4665.0	1328.0	8522.0	2639.0	3767.0	749.0	2874.0
283.9	297.0	618.0	2903.0	4291.0	4985.0	5003.0	3681.0	3412.0	4608.0	1343.0	8512.0	2593.0	3813.0	763.0	2831.0
285.1	279.0	587.0	2895.0	4332.0	5031.0	5023.0	3635.0	3369.0	4703.0	1334.0	8578.0	2587.0	3816.0	762.0	2827.0
286.4	314.0	611.0	2908.0	4287.0	5046.0	5055.0	3650.0	3446.0	4681.0	1374.0	8609.0	2587.0	3789.0	753.0	2849.0
287.6	313.0	632.0	2939.0	4285.0	5037.0	4963.0	3670.0	3498.0	4632.0	1347.0	8540.0	2591.0	3825.0	785.0	2869.0
288.9	318.0	615.0	2897.0	4334.0	5055.0	4993.0	3641.0	3497.0	4663.0	1366.0	8594.0	2557.0	3803.0	796.0	2894.0
290.1	329.0	605.0	2919.0	4325.0	5114.0	5031.0	3677.0	3614.0	4649.0	1357.0	8665.0	2564.0	3838.0	801.0	2854.0
291.4	335.0	640.0	2940.0	4375.0	5091.0	5050.0	3762.0	3634.0	4661.0	1349.0	8587.0	2555.0	3807.0	816.0	2855.0
292.6	340.0	675.0	2961.0	4395.0	5158.0	5062.0	3745.0	3664.0	4679.0	1349.0	8636.0	2537.0	3818.0	818.0	2949.0
293.9	331.0	669.0	2949.0	4332.0	5095.0	5051.0	3760.0	3727.0	4700.0	1418.0	8724.0	2546.0	3861.0	837.0	2884.0
295.1	323.0	699.0	3006.0	4388.0	5163.0	5001.0	3775.0	3625.0	4745.0	1373.0	8640.0	2586.0	3883.0	824.0	2877.0
296.4	346.0	669.0	2929.0	4422.0	5178.0	5017.0	3779.0	3628.0	4746.0	1349.0	8708.0	2605.0	3900.0	834.0	2851.0
297.6	358.0	681.0	2969.0	4391.0	5099.0	5028.0	3787.0	3634.0	4751.0	1378.0	8630.0	2535.0	3851.0	811.0	2893.0
298.9	359.0	711.0	2999.0	4429.0	5136.0	5001.0	3777.0	3611.0	4724.0	1406.0	8787.0				



337.5	405.0	810.0	3015.0	4548.0	5399.0	5306.0	3922.0	3617.0	4903.0	2081.0	9124.0	3014.0	4174.0	959.0	3105.0
338.8	399.0	805.0	3049.0	4637.0	5436.0	5273.0	3867.0	3622.0	4916.0	2209.0	9121.0	3005.0	4213.0	947.0	3117.0
340.0	409.0	818.0	3042.0	4583.0	5455.0	5357.0	3884.0	3591.0	4857.0	2342.0	9144.0	2915.0	4199.0	967.0	3124.0
341.3	428.0	814.0	3033.0	4519.0	5357.0	5194.0	3920.0	3675.0	4901.0	2485.0	9138.0	2921.0	4209.0	953.0	3083.0
342.5	432.0	820.0	2973.0	4646.0	5349.0	5249.0	3854.0	3543.0	4839.0	2639.0	9120.0	2888.0	4190.0	982.0	3132.0
343.7	421.0	811.0	3015.0	4608.0	5428.0	5337.0	3899.0	3573.0	4801.0	2877.0	9141.0	2892.0	4221.0	989.0	3097.0
345.0	444.0	841.0	3063.0	4550.0	5473.0	5312.0	3901.0	3604.0	4877.0	3145.0	9193.0	2847.0	4157.0	1005.0	3138.0
346.2	433.0	835.0	3008.0	4601.0	5497.0	5307.0	3847.0	3572.0	4854.0	3459.0	9224.0	2861.0	4129.0	992.0	3077.0
347.5	438.0	816.0	3059.0	4613.0	5429.0	5313.0	3881.0	3570.0	4897.0	3917.0	9324.0	2829.0	4182.0	976.0	3077.0
348.7	461.0	847.0	3032.0	4623.0	5431.0	5285.0	3889.0	3552.0	4815.0	4546.0	9312.0	2792.0	4188.0	1011.0	3066.0
349.9	443.0	853.0	3018.0	4565.0	5501.0	5331.0	3892.0	3564.0	4902.0	5359.0	9202.0	2814.0	4160.0	1029.0	3078.0
351.2	480.0	867.0	2978.0	4595.0	5500.0	5299.0	3913.0	3562.0	4841.0	6449.0	9235.0	2834.0	4155.0	1027.0	3051.0
352.4	453.0	884.0	2979.0	4603.0	5485.0	5225.0	3877.0	3535.0	4793.0	7881.0	9314.0	2875.0	4194.0	1049.0	3022.0
353.7	517.0	900.0	3047.0	4573.0	5487.0	5317.0	3897.0	3543.0	4885.0	9468.0	9299.0	2890.0	4140.0	1067.0	3073.0
354.9	483.0	894.0	3042.0	4539.0	5524.0	5312.0	3897.0	3545.0	4862.0	10655.0	9312.0	2951.0	4190.0	1082.0	3085.0
356.2	500.0	942.0	3043.0	4604.0	5580.0	5313.0	3914.0	3493.0	4808.0	10782.0	9287.0	2942.0	4195.0	1088.0	3095.0
357.4	531.0	939.0	3044.0	4501.0	5552.0	5324.0	3904.0	3542.0	4819.0	9755.0	9358.0	2920.0	4185.0	1121.0	3035.0
358.6	551.0	985.0	3010.0	4566.0	5559.0	5197.0	3884.0	3529.0	4837.0	8188.0	9269.0	2874.0	4205.0	1129.0	3097.0
359.9	551.0	986.0	2993.0	4659.0	5570.0	5310.0	3889.0	3541.0	4913.0	6500.0	9343.0	2816.0	4246.0	1176.0	3077.0
361.1	572.0	989.0	2984.0	4537.0	5574.0	5284.0	3967.0	3507.0	4851.0	5243.0	9395.0	2798.0	4255.0	1199.0	3074.0
362.3	587.0	1016.0	2988.0	4594.0	5613.0	5293.0	3805.0	3491.0	4828.0	4388.0	9403.0	2850.0	4266.0	1249.0	3102.0
363.6	617.0	1053.0	2999.0	4571.0	5597.0	5306.0	3917.0	3475.0	4795.0	3687.0	9442.0	2724.0	4204.0	1258.0	3019.0
364.8	642.0	1097.0	2941.0	4511.0	5721.0	5299.0	3927.0	3493.0	4803.0	3307.0	9487.0	2799.0	4234.0	1259.0	3041.0
366.1	694.0	1135.0	2973.0	4573.0	5735.0	5324.0	3913.0	3517.0	4862.0	3001.0	9365.0	2778.0	4213.0	1342.0	3101.0
367.3	710.0	1185.0	2995.0	4591.0	5797.0	5327.0	3918.0	3501.0	4825.0	2715.0	9404.0	2793.0	4165.0	1363.0	3058.0
368.5	735.0	1233.0	3004.0	4546.0	5813.0	5312.0	3873.0	3540.0	4829.0	2501.0	9417.0	2743.0	4250.0	1408.0	3026.0
369.8	741.0	1292.0	2959.0	4556.0	5838.0	5345.0	3957.0	3567.0	4821.0	2351.0	9588.0	2763.0	4275.0	1490.0	3067.0
371.0	821.0	1340.0	2996.0	4533.0	5912.0	5327.0	3901.0	3502.0	4811.0	2247.0	9517.0	2720.0	4327.0	1544.0	3038.0
372.3	865.0	1395.0	3007.0	4562.0	5993.0	5410.0	3881.0	3552.0	4807.0	2129.0	9474.0	2704.0	4287.0	1601.0	3075.0
373.5	926.0	1459.0	3045.0	4555.0	6076.0	5391.0	3901.0	3548.0	4864.0	2048.0	9515.0	2772.0	4376.0	1702.0	3105.0
374.7	975.0	1573.0	2983.0	4619.0	6096.0	5365.0	4020.0	3542.0	4803.0	1993.0	9555.0	2722.0	4352.0	1789.0	3101.0
376.0	1047.0	1685.0	3011.0	4571.0	6232.0	5394.0	3946.0	3569.0	4845.0	1939.0	9497.0	2785.0	4433.0	1905.0	3073.0
377.2	1129.0	1813.0	3027.0	4672.0	6279.0	5410.0	3945.0	3561.0	4851.0	1905.0	9607.0	2728.0	4439.0	2005.0	3084.0
378.4	1245.0	1954.0	3033.0	4593.0	6419.0	5488.0	3935.0	3510.0	4863.0	1869.0	9606.0	2777.0	4460.0	2132.0	3097.0
379.7	1380.0	2087.0	3001.0	4631.0	6573.0	5405.0	3961.0	3612.0	4906.0	1799.0	9715.0	2772.0	4475.0	2287.0	3165.0
380.9	1487.0	2283.0	2991.0	4658.0	6779.0	5459.0	4095.0	3639.0	4865.0	1782.0	9816.0	2792.0	4520.0	2459.0	3155.0
382.1	1643.0	2493.0	2977.0	4701.0	6878.0	5548.0	4070.0	3643.0	4913.0	1728.0	9886.0	2753.0	4637.0	2665.0	3143.0
383.4	1832.0	2716.0	3057.0	4673.0	7047.0	5564.0	4101.0	3662.0	4945.0	1736.0	9781.0	2779.0	4641.0	2853.0	3161.0
384.6	2025.0	2978.0	3077.0	4734.0	7287.0	5551.0	4162.0	3660.0	4945.0	1725.0	9900.0	2744.0	4756.0	3103.0	3191.0
385.8	2182.0	3305.0	3113.0	4805.0	7505.0	5697.0	4197.0	3710.0	4997.0	1708.0	9961.0	2746.0	4797.0	3312.0	3147.0
387.1	2441.0	3629.0	3102.0	4809.0	7662.0	5732.0	4237.0	3735.0	4943.0	1693.0	9953.0	2824.0	4862.0	3556.0	3229.0
388.3	2676.0	3983.0	3093.0	4876.0	7865.0	5735.0	4249.0	3735.0	5029.0	1728.0	10011.0	2800.0	4938.0	3817.0	3313.0
389.5	2916.0	4329.0	3178.0	4880.0	8133.0	5804.0	4284.0	3807.0	5049.0	1725.0	10105.0	2759.0	4944.0	4140.0	3267.0
390.8	3149.0	4717.0	3158.0	4939.0	8269.0	5839.0	4288.0	3829.0	5083.0	1711.0	10186.0	2797.0	5141.0	4364.0	3315.0
392.0	3412.0	5073.0	3218.0	4942.0	8492.0	5811.0	4403.0	3839.0	5155.0	1700.0	10220.0	2821.0	5138.0	4631.0	3366.0
393.3	3675.0	5444.0	3213.0	5022.0	8648.0	5951.0	4419.0	3836.0	5169.0	1668.0	10311.0	2808.0	5220.0	4833.0	3395.0
394.5	3853.0	5729.0	3223.0	5063.0	8883.0	5968.0	4393.0	3922.0	5211.0	1607.0	10409.0	2852.0	5267.0	5040.0	3419.0
395.7	3949.0	5925.0	3233.0	5117.0	9057.0	6035.0	4508.0	4015.0	5303.0	1587.0	10386.0	2831.0	5387.0	5133.0	3401.0
396.9	4056.0	5991.0	3278.0	5220.0	8971.0	6195.0	4576.0	4062.0	5305.0	1588.0	10446.0	2842.0	5381.0	5157.0	3450.0
398.2	3996.0	5951.0	3285.0	5188.0	8974.0	6197.0	4615.0	4083.0	5287.0	1549.0	10556.0	2886.0	5492.0	5049.0	3507.0
399.4	3928.0	5769.0	3373.0	5269.0	8929.0	6202.0	4715.0	4145.0	5335.0	1539.0	10564.0	2861.0	5488.0	4913.0	3485.0
400.6	3632.0	5376.0	3333.0	5295.0	8800.0	6218.0	4684.0	4246.0	5426.0	1548.0	10392.0	2815.0	5462.0	4658.0	3596.0
401.9	3373.0	4955.0	3386.0	5409.0	8631.0	6397.0	4779.0	4283.0	5476.0	1509.0	10450.0	2889.0	5408.0	4354.0	3649.0
403.1	3062.0	4457.0	3398.0	5475.0	8461.0	6411.0	4845.0	4269.0	5539.0	1457.0	10395.0	2828.0	5492.0	4071.0	3678.0
404.3	2764.0	4064.0	3425.0	5525.0	8324.0	6526.0	4853.0	4381.0	5517.0	1528.0	10366.0	2892.0	5413.0	3740.0	3691.0
405.6	2475.0	3617.0	3452.0	5595.0	8107.0	6582.0	4985.0	4425.0	5595.0	1499.0	10281.0	2857.0	5391.0	3392.0	3757.0
406.8	2200.0	3173.0	3436.0	5663.0	8062.0	6631.0	4978.0	4525.0	5693.0	1475.0	10154.0	2861.0	5515.0	3123.0	3754.0
408.0	1952.0	2873.0	3492.0	5693.0	7864.0	6727.0	5057.0	4560.0	5700.0	1468.0	10247.0	2878.0	5473.0	2880.0	3781.0
409.3	1731.0	2623.0	3561.0	5733.0	7623.0	6725.0	5087.0	4639.0	5730.0	1492.0	10209.0	2883.0	5477.0	2619.0	3827.0
410.5	1561.0	2375.0	3505.0	5881.0	7553.0	6817.0	5167.0	4701.0	5757.0	1505.0	10139.0	2891.0	5519.0	2426.0	3887.0
411.7	1434.0	2171.0	3580.0	5857.0	7479.0	6879.0	5213.0	4719.0	5842.0	1491.0	10128.0	2887.0	5490.0	2277.0	3871.0
413.0	1289.0	1931.0	3531.0	5976.0	7407.0	6915.0	5240.0	4761.0	5838.0	1522.0	10053.0	2899.0	5533.0	2102.0	3914.0
414.2	1175.0	1843.0	3594.0	6027.0	7426.0	7003.0	5275.0	4819.0	5851.0	1529.0	10183.0	2891.0	5599.0	1970.0	3964.0
415.4	1093.0	1712.0	3586.0	6073.0	7269.0	7015.0	5321.0	4851.0	5912.0	1480.0	10052.0	2907.0	5611.0	1851.0	4081.0
416.6	1014.0	1571.0	3613.0	6107.0	7196.0	7156.0	5399.0	4785.0	5901.0	1513.0	10063.0	2913.0	5606.0	1760.0	4041.0
417.9	937.0	1497.0	3632.0	6289.0	7203.0	7142.0	5452.0	4928.0	6051.0	1500.0	10054.0	2914.0	5718.0	1667.0	4111.0
419.1	901.0	1408.0	3691.0	6286.0	7224.0	7285.0	5449.0	4951.0	5995.0	1497.0	10022.0	2993.0	5751.0	1606.0	4185.0
420.3	845.0	1369.0	3697.0	6366.0	7212.0	7380.0	5567.0	5025.0	6070.0	1519.0	9988.0	2992.0	5755.0	1533.0	4227.0
421.6	787.0	1273.0	3635.0	6403.0	7237.0	7437.0	5600.0	5033.0	6154.0	1510.0	10041.0	2915			

460.8	423.0	818.0	3287.0	5605.0	6425.0	6835.0	5029.0	4261.0	5589.0	1429.0	10273.0	3206.0	5491.0	1002.0	4008.0
462.0	443.0	816.0	3195.0	5582.0	6333.0	6719.0	4927.0	4189.0	5514.0	1422.0	10343.0	3211.0	5452.0	1012.0	3921.0
463.2	427.0	832.0	3187.0	5425.0	6281.0	6588.0	4865.0	4073.0	5492.0	1428.0	10409.0	3205.0	5273.0	1015.0	3850.0
464.4	446.0	839.0	3156.0	5331.0	6201.0	6499.0	4787.0	4045.0	5419.0	1414.0	10329.0	3209.0	5205.0	1031.0	3770.0
465.7	455.0	811.0	3128.0	5285.0	6171.0	6357.0	4610.0	3937.0	5281.0	1472.0	10450.0	3215.0	5155.0	1038.0	3732.0
466.9	457.0	834.0	3114.0	5107.0	6055.0	6259.0	4534.0	3914.0	5187.0	1437.0	10491.0	3142.0	5070.0	1021.0	3677.0
468.1	463.0	859.0	3065.0	5056.0	6007.0	6124.0	4413.0	3851.0	5252.0	1429.0	10511.0	3147.0	4923.0	1033.0	3598.0
469.3	442.0	844.0	3039.0	4915.0	5977.0	6046.0	4362.0	3755.0	5151.0	1460.0	10546.0	3104.0	4886.0	1027.0	3499.0
470.5	460.0	865.0	3003.0	4841.0	5969.0	5839.0	4301.0	3734.0	5079.0	1409.0	10522.0	3140.0	4803.0	1062.0	3459.0
471.8	451.0	837.0	2995.0	4830.0	5925.0	5768.0	4207.0	3591.0	4982.0	1468.0	10545.0	3125.0	4778.0	1007.0	3422.0
473.0	488.0	869.0	2982.0	4745.0	5786.0	5733.0	4154.0	3619.0	5003.0	1465.0	10516.0	3094.0	4698.0	1072.0	3402.0
474.2	453.0	883.0	2976.0	4645.0	5806.0	5703.0	4074.0	3595.0	4965.0	1440.0	10635.0	3028.0	4637.0	1055.0	3297.0
475.4	500.0	890.0	2955.0	4551.0	5763.0	5509.0	4008.0	3535.0	4923.0	1439.0	10599.0	3082.0	4541.0	1081.0	3304.0
476.6	494.0	917.0	2883.0	4495.0	5687.0	5503.0	3976.0	3476.0	4877.0	1475.0	10541.0	3068.0	4515.0	1105.0	3260.0
477.9	534.0	916.0	2887.0	4463.0	5666.0	5415.0	3885.0	3408.0	4835.0	1487.0	10666.0	3044.0	4516.0	1107.0	3183.0
479.1	517.0	917.0	2848.0	4473.0	5669.0	5291.0	3823.0	3360.0	4795.0	1489.0	10660.0	3042.0	4419.0	1115.0	3195.0
480.3	527.0	972.0	2864.0	4378.0	5622.0	5372.0	3751.0	3379.0	4743.0	1469.0	10695.0	2980.0	4495.0	1151.0	3143.0
481.5	543.0	957.0	2859.0	4331.0	5549.0	5258.0	3820.0	3344.0	4751.0	1459.0	10678.0	3054.0	4395.0	1158.0	3159.0
482.7	570.0	993.0	2875.0	4307.0	5613.0	5163.0	3763.0	3262.0	4742.0	1448.0	10646.0	3018.0	4428.0	1171.0	3091.0
484.0	573.0	1021.0	2841.0	4226.0	5626.0	5198.0	3663.0	3303.0	4653.0	1461.0	10713.0	3003.0	4265.0	1207.0	3041.0
485.2	587.0	1037.0	2840.0	4147.0	5549.0	5125.0	3652.0	3247.0	4628.0	1469.0	10705.0	3012.0	4351.0	1235.0	3065.0
486.4	608.0	1067.0	2797.0	4120.0	5569.0	5022.0	3623.0	3227.0	4654.0	1462.0	10622.0	2989.0	4336.0	1219.0	3032.0
487.6	625.0	1077.0	2721.0	4125.0	5606.0	4985.0	3595.0	3198.0	4610.0	1438.0	10730.0	3014.0	4257.0	1284.0	3007.0
488.8	633.0	1105.0	2792.0	4069.0	5634.0	4996.0	3611.0	3196.0	4584.0	1442.0	10748.0	2940.0	4206.0	1325.0	2994.0
490.0	672.0	1162.0	2767.0	4078.0	5623.0	5009.0	3509.0	3128.0	4628.0	1441.0	10756.0	2959.0	4200.0	1367.0	2971.0
491.3	723.0	1226.0	2747.0	4000.0	5582.0	4897.0	3500.0	3131.0	4595.0	1450.0	10734.0	2968.0	4234.0	1385.0	2911.0
492.5	725.0	1239.0	2707.0	4023.0	5573.0	4871.0	3431.0	3086.0	4457.0	1460.0	10766.0	2950.0	4153.0	1424.0	2900.0
493.7	797.0	1292.0	2719.0	4003.0	5678.0	4887.0	3454.0	3105.0	4492.0	1411.0	10814.0	2958.0	4207.0	1510.0	2885.0
494.9	813.0	1353.0	2703.0	3965.0	5656.0	4822.0	3379.0	3058.0	4488.0	1414.0	10773.0	2901.0	4121.0	1527.0	2859.0
496.1	857.0	1452.0	2704.0	3956.0	5743.0	4805.0	3410.0	3092.0	4420.0	1427.0	10751.0	2929.0	4176.0	1607.0	2838.0
497.3	907.0	1482.0	2680.0	3946.0	5750.0	4822.0	3341.0	3043.0	4419.0	1409.0	10782.0	2952.0	4214.0	1677.0	2844.0
498.6	973.0	1579.0	2696.0	3919.0	5819.0	4801.0	3335.0	2997.0	4477.0	1403.0	10833.0	2936.0	4213.0	1752.0	2821.0
499.8	1088.0	1749.0	2688.0	3869.0	5978.0	4780.0	3358.0	3026.0	4401.0	1377.0	10929.0	2953.0	4201.0	1910.0	2833.0
501.0	1183.0	1850.0	2681.0	3855.0	6102.0	4803.0	3348.0	3027.0	4415.0	1382.0	10866.0	2881.0	4215.0	2017.0	2805.0
502.2	1253.0	2007.0	2683.0	3867.0	6109.0	4726.0	3299.0	2951.0	4407.0	1430.0	10912.0	2938.0	4199.0	2176.0	2807.0
503.4	1406.0	2202.0	2652.0	3915.0	6279.0	4689.0	3335.0	3011.0	4405.0	1392.0	10987.0	2918.0	4226.0	2338.0	2799.0
504.6	1515.0	2367.0	2679.0	3817.0	6428.0	4723.0	3332.0	2937.0	4369.0	1411.0	11030.0	2908.0	4241.0	2520.0	2821.0
505.9	1747.0	2737.0	2674.0	3804.0	6646.0	4684.0	3357.0	2988.0	4466.0	1395.0	11138.0	2937.0	4346.0	2735.0	2781.0
507.1	1958.0	3034.0	2676.0	3802.0	6787.0	4737.0	3307.0	2943.0	4386.0	1394.0	11146.0	2902.0	4310.0	3031.0	2778.0
508.3	2193.0	3407.0	2625.0	3766.0	7018.0	4723.0	3347.0	3012.0	4372.0	1453.0	11167.0	2955.0	4338.0	3273.0	2799.0
509.5	2499.0	3811.0	2643.0	3743.0	7180.0	4651.0	3224.0	2906.0	4368.0	1373.0	11278.0	2918.0	4436.0	3566.0	2755.0
510.7	2771.0	4234.0	2643.0	3777.0	7435.0	4751.0	3265.0	2942.0	4432.0	1415.0	11412.0	2915.0	4484.0	3835.0	2782.0
511.9	2991.0	4622.0	2611.0	3741.0	7437.0	4743.0	3314.0	2933.0	4384.0	1401.0	11397.0	2920.0	4441.0	4097.0	2802.0
513.1	3173.0	4897.0	2659.0	3781.0	7597.0	4736.0	3318.0	2881.0	4390.0	1392.0	11346.0	2965.0	4540.0	4234.0	2774.0
514.3	3287.0	5076.0	2635.0	3803.0	7685.0	4697.0	3282.0	2904.0	4384.0	1398.0	11429.0	2940.0	4527.0	4319.0	2781.0
515.6	3367.0	5194.0	2645.0	3805.0	7599.0	4729.0	3287.0	2945.0	4365.0	1406.0	11539.0	2949.0	4578.0	4384.0	2799.0
516.8	3325.0	5185.0	2639.0	3789.0	7555.0	4721.0	3259.0	2972.0	4423.0	1428.0	11443.0	2923.0	4561.0	4285.0	2803.0
518.0	3286.0	5121.0	2647.0	3721.0	7518.0	4727.0	3283.0	2901.0	4438.0	1380.0	11501.0	2893.0	4538.0	4245.0	2811.0
519.2	3175.0	4937.0	2647.0	3754.0	7467.0	4743.0	3297.0	2968.0	4425.0	1390.0	11498.0	2929.0	4535.0	4074.0	2801.0
520.4	3037.0	4703.0	2565.0	3791.0	7299.0	4749.0	3268.0	2915.0	4448.0	1402.0	11481.0	2922.0	4459.0	3949.0	2798.0
521.6	2855.0	4449.0	2630.0	3751.0	7219.0	4763.0	3269.0	2937.0	4425.0	1393.0	11430.0	2937.0	4379.0	3771.0	2796.0
522.8	2689.0	4173.0	2690.0	3810.0	6981.0	4756.0	3283.0	2964.0	4419.0	1414.0	11598.0	2937.0	4438.0	3577.0	2811.0
524.0	2479.0	3911.0	2659.0	3830.0	6965.0	4693.0	3291.0	2962.0	4463.0	1413.0	11559.0	2951.0	4414.0	3358.0	2761.0
525.3	2337.0	3639.0	2662.0	3813.0	6886.0	4709.0	3284.0	2915.0	4453.0	1407.0	11441.0	2948.0	4307.0	3147.0	2796.0
526.5	2176.0	3375.0	2645.0	3809.0	6669.0	4752.0	3317.0	2953.0	4456.0	1402.0	11469.0	2926.0	4333.0	2958.0	2820.0
527.7	2027.0	3157.0	2655.0	3826.0	6517.0	4719.0	3315.0	2935.0	4471.0	1382.0	11328.0	2935.0	4405.0	2779.0	2769.0
528.9	1861.0	2913.0	2686.0	3815.0	6541.0	4709.0	3293.0	2968.0	4430.0	1389.0	11521.0	2939.0	4326.0	2663.0	2853.0
530.1	1764.0	2765.0	2671.0	3838.0	6341.0	4647.0	3340.0	2969.0	4485.0	1412.0	11322.0	2970.0	4291.0	2519.0	2803.0
531.3	1577.0	2578.0	2683.0	3741.0	6264.0	4753.0	3285.0	3001.0	4475.0	1397.0	11293.0	2890.0	4255.0	2393.0	2804.0
532.5	1462.0	2423.0	2655.0	3792.0	6190.0	4718.0	3349.0	3034.0	4491.0	1398.0	11297.0	2899.0	4271.0	2289.0	2831.0
533.7	1399.0	2267.0	2663.0	3891.0	6187.0	4777.0	3361.0	2973.0	4485.0	1376.0	11357.0	2949.0	4306.0	2167.0	2792.0
534.9	1309.0	2129.0	2680.0	3839.0	6057.0	4655.0	3319.0	2960.0	4427.0	1397.0	11269.0	2909.0	4227.0	2072.0	2809.0
536.1	1207.0	2016.0	2678.0	3888.0	6047.0	4740.0	3340.0	2948.0	4474.0	1411.0	11297.0	3002.0	4259.0	1960.0	2765.0
537.4	1158.0	1937.0	2675.0	3877.0	5993.0	4730.0	3343.0	3009.0	4483.0	1397.0	11312.0	2942.0	4245.0	1891.0	2801.0
538.6	1090.0	1821.0	2691.0	3862.0	5984.0	4727.0	3377.0	2969.0	4521.0	1409.0	11292.0	2892.0	4231.0	1757.0	2829.0
539.8	1085.0	1752.0	2736.0	3896.0	5900.0	4783.0	3359.0	3047.0	4515.0	1455.0	11266.0	2876.0	4241.0	1737.0	2821.0
541.0	978.0	1657.0	2711.0	3937.0	5920.0	4756.0	3384.0	3013.0	4550.0	1406.0	11265.0	2913.0	4269.0	1709.0	2855.0
542.2	959.0	1592.0	2682.0	3870.0	5781.0	4759.0	3360.0	3062.0	4465.0	1446.0	11318.0	2964.0	4245.0	1652.0	2893.0
543.4	919.0	1489.0	2710.0	3879.0	5885.0	4825.0	3414.0								

582.0	531.0	914.0	2719.0	4432.0	6029.0	5211.0	3685.0	3235.0	4855.0	1325.0	11728.0	2907.0	4520.0	1133.0	3039.0
583.2	550.0	937.0	2755.0	4393.0	6049.0	5289.0	3699.0	3285.0	4948.0	1326.0	11817.0	2901.0	4549.0	1129.0	3073.0
584.4	535.0	902.0	2744.0	4454.0	6073.0	5254.0	3727.0	3298.0	4874.0	1312.0	11770.0	2911.0	4535.0	1133.0	3140.0
585.6	527.0	918.0	2741.0	4443.0	6129.0	5336.0	3761.0	3322.0	4965.0	1265.0	11827.0	2955.0	4560.0	1130.0	3055.0
586.8	525.0	907.0	2747.0	4399.0	6097.0	5285.0	3759.0	3312.0	4943.0	1329.0	11790.0	2921.0	4642.0	1168.0	3095.0
588.0	551.0	907.0	2751.0	4549.0	6197.0	5328.0	3759.0	3365.0	4971.0	1304.0	11896.0	2932.0	4634.0	1152.0	3123.0
589.2	564.0	914.0	2777.0	4544.0	6258.0	5421.0	3869.0	3336.0	4935.0	1336.0	11887.0	2954.0	4663.0	1179.0	3131.0
590.4	543.0	903.0	2722.0	4587.0	6210.0	5423.0	3841.0	3347.0	5016.0	1302.0	11959.0	2946.0	4676.0	1192.0	3113.0
591.6	561.0	957.0	2739.0	4632.0	6319.0	5521.0	3837.0	3388.0	4992.0	1343.0	12042.0	2954.0	4741.0	1195.0	3188.0
592.8	591.0	924.0	2763.0	4609.0	6406.0	5567.0	3967.0	3424.0	4978.0	1327.0	11889.0	2914.0	4775.0	1212.0	3193.0
594.0	578.0	925.0	2703.0	4716.0	6433.0	5551.0	3907.0	3416.0	5066.0	1316.0	12066.0	2940.0	4831.0	1219.0	3171.0
595.2	582.0	961.0	2759.0	4753.0	6430.0	5623.0	3993.0	3391.0	5106.0	1322.0	11990.0	2965.0	4893.0	1278.0	3246.0
596.4	595.0	954.0	2785.0	4737.0	6534.0	5661.0	4074.0	3479.0	5088.0	1331.0	12073.0	2996.0	4897.0	1280.0	3247.0
597.6	600.0	976.0	2758.0	4799.0	6581.0	5675.0	4077.0	3548.0	5109.0	1334.0	12158.0	2948.0	4907.0	1282.0	3302.0
598.8	619.0	1003.0	2753.0	4890.0	6651.0	5729.0	4190.0	3525.0	5165.0	1320.0	12184.0	2988.0	4929.0	1343.0	3307.0
600.0	631.0	983.0	2743.0	4893.0	6697.0	5777.0	4119.0	3535.0	5159.0	1323.0	12180.0	2969.0	4939.0	1376.0	3337.0
601.2	651.0	1030.0	2712.0	4879.0	6778.0	5838.0	4132.0	3547.0	5207.0	1295.0	12197.0	3024.0	5011.0	1420.0	3329.0
602.4	667.0	1017.0	2784.0	4976.0	6876.0	5922.0	4237.0	3569.0	5219.0	1342.0	12308.0	3005.0	5054.0	1438.0	3393.0
603.6	716.0	1043.0	2809.0	5002.0	6897.0	5927.0	4264.0	3627.0	5263.0	1342.0	12301.0	3029.0	5182.0	1494.0	3394.0
604.8	727.0	1086.0	2739.0	5005.0	7020.0	5999.0	4199.0	3633.0	5207.0	1318.0	12269.0	3005.0	5165.0	1524.0	3440.0
606.0	779.0	1102.0	2771.0	5019.0	7087.0	6070.0	4280.0	3610.0	5327.0	1364.0	12438.0	3022.0	5203.0	1607.0	3469.0
607.2	780.0	1132.0	2890.0	5085.0	7144.0	6056.0	4302.0	3635.0	5246.0	1360.0	12272.0	3035.0	5276.0	1627.0	3441.0
608.3	809.0	1151.0	2899.0	5116.0	7233.0	6049.0	4313.0	3703.0	5352.0	1397.0	12339.0	3025.0	5267.0	1699.0	3425.0
609.5	853.0	1171.0	2803.0	5143.0	7354.0	6077.0	4326.0	3715.0	5289.0	1369.0	12489.0	3030.0	5241.0	1787.0	3479.0
610.7	906.0	1232.0	2799.0	5163.0	7325.0	6047.0	4352.0	3691.0	5297.0	1377.0	12695.0	3081.0	5312.0	1857.0	3459.0
611.9	953.0	1320.0	2771.0	5162.0	7489.0	6086.0	4372.0	3636.0	5336.0	1322.0	12585.0	3044.0	5312.0	1947.0	3481.0
613.1	1033.0	1336.0	2763.0	5154.0	7561.0	6057.0	4329.0	3669.0	5336.0	1342.0	12718.0	3058.0	5247.0	2077.0	3469.0
614.3	1091.0	1380.0	2739.0	5068.0	7635.0	6016.0	4287.0	3645.0	5199.0	1403.0	12676.0	3060.0	5281.0	2163.0	3450.0
615.5	1165.0	1475.0	2729.0	5021.0	7607.0	5949.0	4225.0	3613.0	5195.0	1369.0	12796.0	3088.0	5276.0	2301.0	3399.0
616.7	1279.0	1529.0	2756.0	4994.0	7729.0	5962.0	4187.0	3537.0	5236.0	1375.0	12772.0	3049.0	5253.0	2469.0	3381.0
617.9	1346.0	1635.0	2668.0	4990.0	7847.0	5879.0	4158.0	3505.0	5232.0	1374.0	12824.0	3008.0	5286.0	2612.0	3361.0
619.1	1430.0	1761.0	2703.0	4824.0	8020.0	5815.0	4146.0	3466.0	5142.0	1389.0	12910.0	3059.0	5176.0	2804.0	3360.0
620.3	1547.0	1869.0	2672.0	4836.0	8069.0	5781.0	4051.0	3411.0	5141.0	1389.0	12927.0	3049.0	5216.0	2987.0	3286.0
621.5	1691.0	1998.0	2716.0	4719.0	8252.0	5720.0	3999.0	3406.0	5055.0	1391.0	12957.0	3101.0	5147.0	3273.0	3256.0
622.7	1887.0	2147.0	2649.0	4657.0	8359.0	5655.0	3910.0	3249.0	5022.0	1380.0	13084.0	3096.0	5137.0	3521.0	3227.0
623.9	2060.0	2353.0	2679.0	4580.0	8555.0	5563.0	3795.0	3282.0	4983.0	1399.0	13177.0	3066.0	5157.0	3876.0	3189.0
625.1	2274.0	2559.0	2650.0	4517.0	8847.0	5511.0	3799.0	3262.0	4942.0	1414.0	13237.0	3089.0	5129.0	4259.0	3130.0
626.3	2531.0	2791.0	2581.0	4417.0	9049.0	5431.0	3670.0	3156.0	4906.0	1419.0	13255.0	3125.0	5178.0	4596.0	3077.0
627.5	2811.0	3080.0	2551.0	4357.0	9255.0	5359.0	3667.0	3081.0	4811.0	1401.0	13316.0	3112.0	5181.0	5015.0	3068.0
628.7	3193.0	3337.0	2581.0	4283.0	9594.0	5237.0	3601.0	3081.0	4777.0	1403.0	13511.0	3111.0	5149.0	5522.0	2984.0
629.9	3516.0	3731.0	2584.0	4216.0	9833.0	5213.0	3503.0	2983.0	4731.0	1434.0	13569.0	3150.0	5179.0	5952.0	2953.0
631.1	3881.0	4093.0	2531.0	4108.0	10248.0	5134.0	3466.0	2941.0	4611.0	1398.0	13833.0	3095.0	5237.0	6491.0	2881.0
632.3	4279.0	4516.0	2536.0	4101.0	10541.0	5101.0	3402.0	2947.0	4646.0	1422.0	13841.0	3142.0	5353.0	7066.0	2813.0
633.4	4691.0	4867.0	2534.0	3974.0	10780.0	5086.0	3324.0	2941.0	4628.0	1401.0	13932.0	3113.0	5287.0	7543.0	2844.0
634.6	5053.0	5244.0	2515.0	3933.0	11031.0	4935.0	3269.0	2908.0	4587.0	1431.0	14086.0	3183.0	5320.0	7903.0	2824.0
635.8	5374.0	5509.0	2516.0	3913.0	11101.0	4909.0	3283.0	2823.0	4497.0	1416.0	14185.0	3198.0	5319.0	8175.0	2778.0
637.0	5593.0	5825.0	2453.0	3826.0	10997.0	4867.0	3215.0	2786.0	4485.0	1435.0	14304.0	3184.0	5326.0	8247.0	2752.0
638.2	5710.0	5928.0	2493.0	3786.0	10962.0	4846.0	3190.0	2774.0	4510.0	1444.0	14284.0	3181.0	5265.0	8312.0	2721.0
639.4	5615.0	5994.0	2487.0	3729.0	10861.0	4753.0	3140.0	2763.0	4411.0	1444.0	14274.0	3195.0	5252.0	8157.0	2655.0
640.6	5553.0	5799.0	2467.0	3700.0	10615.0	4763.0	3061.0	2755.0	4437.0	1469.0	14257.0	3142.0	5225.0	7994.0	2708.0
641.8	5318.0	5689.0	2479.0	3646.0	10474.0	4703.0	3083.0	2713.0	4429.0	1428.0	14124.0	3190.0	5154.0	7690.0	2670.0
643.0	5026.0	5347.0	2447.0	3605.0	10125.0	4685.0	3009.0	2706.0	4366.0	1428.0	14156.0	3163.0	5086.0	7375.0	2641.0
644.2	4676.0	4981.0	2448.0	3519.0	9892.0	4649.0	2984.0	2689.0	4312.0	1414.0	14089.0	3121.0	4981.0	6933.0	2636.0
645.4	4351.0	4579.0	2475.0	3538.0	9633.0	4515.0	2970.0	2675.0	4405.0	1400.0	13928.0	3134.0	4924.0	6345.0	2621.0
646.6	4009.0	4319.0	2415.0	3567.0	9227.0	4489.0	2955.0	2630.0	4302.0	1411.0	13849.0	3139.0	4795.0	6038.0	2620.0
647.7	3725.0	3936.0	2437.0	3509.0	9007.0	4503.0	2925.0	2651.0	4347.0	1374.0	13753.0	3107.0	4721.0	5643.0	2619.0
648.9	3325.0	3590.0	2430.0	3482.0	8715.0	4503.0	2937.0	2644.0	4338.0	1391.0	13713.0	3090.0	4704.0	5249.0	2591.0
650.1	3060.0	3287.0	2457.0	3403.0	8318.0	4457.0	2911.0	2636.0	4259.0	1388.0	13751.0	3142.0	4604.0	4862.0	2601.0
651.3	2815.0	3052.0	2511.0	3449.0	8121.0	4444.0	2891.0	2673.0	4238.0	1399.0	13574.0	3085.0	4491.0	4542.0	2623.0
652.5	2541.0	2812.0	2493.0	3435.0	7884.0	4404.0	2833.0	2628.0	4297.0	1385.0	13564.0	3064.0	4457.0	4218.0	2575.0
653.7	2380.0	2591.0	2465.0	3389.0	7669.0	4381.0	2847.0	2612.0	4235.0	1402.0	13463.0	3109.0	4363.0	3935.0	2535.0
654.9	2147.0	2403.0	2493.0	3399.0	7455.0	4301.0	2825.0	2642.0	4294.0	1391.0	13373.0	3092.0	4340.0	3667.0	2577.0
656.1	2015.0	2245.0	2478.0	3374.0	7326.0	4347.0	2849.0	2604.0	4263.0	1431.0	13366.0	3118.0	4311.0	3499.0	2561.0
657.3	1872.0	2118.0	2441.0	3407.0	7129.0	4346.0	2779.0	2621.0	4217.0	1356.0	13472.0	3038.0	4228.0	3281.0	2541.0
658.5	1724.0	1971.0	2464.0	3375.0	6959.0	4305.0	2895.0	2617.0	4245.0	1389.0	13465.0	3027.0	4271.0	3077.0	2566.0
659.6	1613.0	1875.0	2435.0	3307.0	6857.0	4320.0	2835.0	2693.0	4240.0	1373.0	13318.0	3087.0	4215.0	2894.0	2563.0
660.8	1513.0	1787.0	2476.0	3367.0	6711.0	4304.0	2840.0	2583.0	4241.0	1376.0	13303.0	3092.0	4170.0	2743.0	2542.0
662.0	1404.0	1691.0	2494.0	3287.0	6612.0	4330.0	2797.0	2588.0	4252.0	1340.0	13392.0	3070.0	4177.0	2597.0	2555.0
663.2	1303.0	1623.0	2419.0	3364.0	6533.0										



701.1	403.0	772.0	2535.0	3296.0	5443.0	4257.0	2711.0	2463.0	4238.0	1407.0	14313.0	3209.0	3925.0	1005.0	2675.0
702.3	417.0	770.0	2497.0	3348.0	5404.0	4239.0	2746.0	2509.0	4294.0	1415.0	14288.0	3238.0	3917.0	1003.0	2663.0
703.5	387.0	789.0	2546.0	3301.0	5384.0	4278.0	2709.0	2519.0	4253.0	1385.0	14345.0	3320.0	3931.0	983.0	2645.0
704.7	413.0	729.0	2496.0	3297.0	5370.0	4169.0	2701.0	2499.0	4280.0	1389.0	14490.0	3270.0	3918.0	951.0	2601.0
705.8	388.0	741.0	2535.0	3273.0	5351.0	4202.0	2655.0	2483.0	4308.0	1377.0	14503.0	3303.0	3903.0	967.0	2643.0
707.0	405.0	753.0	2513.0	3237.0	5329.0	4149.0	2735.0	2459.0	4238.0	1337.0	14501.0	3267.0	3946.0	957.0	2607.0
708.2	375.0	726.0	2587.0	3257.0	5339.0	4181.0	2693.0	2459.0	4264.0	1385.0	14597.0	3313.0	3940.0	935.0	2637.0
709.4	381.0	717.0	2503.0	3220.0	5292.0	4181.0	2666.0	2493.0	4279.0	1350.0	14479.0	3255.0	3916.0	927.0	2638.0
710.6	361.0	702.0	2533.0	3143.0	5289.0	4115.0	2713.0	2481.0	4214.0	1369.0	14530.0	3305.0	3871.0	930.0	2617.0
711.8	356.0	679.0	2500.0	3148.0	5285.0	4135.0	2674.0	2397.0	4242.0	1354.0	14455.0	3295.0	3872.0	889.0	2627.0
712.9	362.0	686.0	2501.0	3144.0	5246.0	4160.0	2627.0	2421.0	4222.0	1342.0	14455.0	3328.0	3905.0	905.0	2606.0
714.1	331.0	681.0	2477.0	3166.0	5207.0	4136.0	2643.0	2446.0	4231.0	1359.0	14389.0	3250.0	3857.0	889.0	2523.0
715.3	323.0	673.0	2473.0	3171.0	5207.0	4145.0	2603.0	2413.0	4149.0	1362.0	14399.0	3250.0	3897.0	894.0	2563.0
716.5	329.0	674.0	2488.0	3159.0	5210.0	4083.0	2585.0	2405.0	4200.0	1332.0	14486.0	3222.0	3847.0	867.0	2562.0
717.6	322.0	657.0	2491.0	3149.0	5221.0	4133.0	2610.0	2395.0	4112.0	1377.0	14481.0	3243.0	3855.0	848.0	2559.0
718.8	313.0	656.0	2446.0	3095.0	5111.0	4053.0	2596.0	2369.0	4169.0	1363.0	14496.0	3227.0	3894.0	859.0	2560.0
720.0	329.0	655.0	2487.0	3088.0	5159.0	4090.0	2581.0	2343.0	4115.0	1357.0	14368.0	3229.0	3843.0	857.0	2499.0
721.2	307.0	631.0	2450.0	3093.0	5127.0	3991.0	2542.0	2361.0	4165.0	1370.0	14434.0	3238.0	3787.0	832.0	2532.0
722.4	305.0	634.0	2430.0	3050.0	5067.0	3994.0	2569.0	2372.0	4102.0	1350.0	14407.0	3254.0	3814.0	824.0	2523.0
723.5	295.0	630.0	2479.0	3046.0	5083.0	4027.0	2548.0	2323.0	4103.0	1359.0	14305.0	3280.0	3821.0	825.0	2502.0
724.7	295.0	627.0	2405.0	3079.0	5025.0	3976.0	2554.0	2340.0	4112.0	1351.0	14457.0	3259.0	3749.0	821.0	2502.0
725.9	305.0	609.0	2401.0	3025.0	5007.0	3965.0	2527.0	2336.0	4106.0	1321.0	14418.0	3222.0	3801.0	825.0	2471.0
727.1	278.0	618.0	2446.0	2992.0	5003.0	3966.0	2511.0	2299.0	4112.0	1337.0	14503.0	3283.0	3758.0	841.0	2491.0
728.3	283.0	610.0	2381.0	3004.0	5012.0	3958.0	2488.0	2274.0	4087.0	1335.0	14452.0	3255.0	3796.0	809.0	2454.0
729.4	282.0	600.0	2425.0	2977.0	5024.0	3933.0	2461.0	2276.0	4063.0	1342.0	14440.0	3244.0	3703.0	817.0	2465.0
730.6	285.0	589.0	2415.0	2956.0	5009.0	3934.0	2421.0	2256.0	4043.0	1334.0	14475.0	3194.0	3751.0	793.0	2452.0
731.8	286.0	601.0	2389.0	2944.0	4937.0	3896.0	2446.0	2262.0	4021.0	1356.0	14518.0	3231.0	3744.0	786.0	2446.0
733.0	272.0	594.0	2364.0	2878.0	4954.0	3868.0	2430.0	2284.0	4042.0	1348.0	14530.0	3284.0	3710.0	801.0	2459.0
734.1	267.0	601.0	2347.0	2929.0	4950.0	3849.0	2426.0	2237.0	4037.0	1333.0	14550.0	3250.0	3712.0	791.0	2435.0
735.3	275.0	596.0	2404.0	2913.0	4946.0	3794.0	2381.0	2231.0	4053.0	1342.0	14580.0	3274.0	3696.0	804.0	2442.0
736.5	261.0	610.0	2368.0	2899.0	4928.0	3841.0	2414.0	2163.0	3977.0	1299.0	14606.0	3263.0	3752.0	790.0	2396.0
737.7	265.0	588.0	2375.0	2839.0	4861.0	3863.0	2377.0	2240.0	3993.0	1333.0	14579.0	3327.0	3667.0	795.0	2379.0
738.8	256.0	576.0	2362.0	2821.0	4856.0	3793.0	2379.0	2239.0	4009.0	1316.0	14705.0	3348.0	3702.0	778.0	2374.0
740.0	246.0	562.0	2350.0	2884.0	4883.0	3843.0	2372.0	2185.0	3966.0	1332.0	14619.0	3322.0	3718.0	761.0	2369.0
741.2	249.0	596.0	2370.0	2811.0	4838.0	3820.0	2378.0	2193.0	3897.0	1297.0	14665.0	3318.0	3674.0	765.0	2378.0
742.4	260.0	553.0	2361.0	2827.0	4809.0	3719.0	2357.0	2137.0	3943.0	1317.0	14637.0	3336.0	3623.0	757.0	2413.0
743.5	241.0	605.0	2321.0	2859.0	4853.0	3736.0	2341.0	2170.0	3923.0	1292.0	14651.0	3350.0	3698.0	772.0	2369.0
744.7	243.0	594.0	2311.0	2807.0	4787.0	3693.0	2320.0	2175.0	3949.0	1316.0	14730.0	3329.0	3624.0	745.0	2380.0
745.9	257.0	577.0	2340.0	2801.0	4784.0	3737.0	2345.0	2183.0	3945.0	1327.0	14744.0	3403.0	3593.0	758.0	2385.0
747.1	238.0	554.0	2335.0	2747.0	4789.0	3723.0	2357.0	2165.0	3891.0	1312.0	14870.0	3397.0	3647.0	755.0	2353.0
748.2	251.0	588.0	2358.0	2763.0	4783.0	3723.0	2293.0	2156.0	3858.0	1319.0	14823.0	3329.0	3587.0	743.0	2391.0
749.4	249.0	596.0	2327.0	2796.0	4792.0	3725.0	2317.0	2165.0	3902.0	1306.0	14985.0	3419.0	3627.0	753.0	2379.0
750.6	245.0	574.0	2319.0	2761.0	4759.0	3758.0	2333.0	2173.0	3875.0	1283.0	14911.0	3368.0	3624.0	760.0	2346.0
751.8	253.0	576.0	2263.0	2736.0	4808.0	3733.0	2265.0	2157.0	3904.0	1313.0	14972.0	3388.0	3639.0	779.0	2346.0
752.9	251.0	585.0	2255.0	2765.0	4787.0	3723.0	2299.0	2111.0	3880.0	1339.0	14988.0	3381.0	3630.0	760.0	2348.0
754.1	244.0	575.0	2284.0	2730.0	4793.0	3692.0	2286.0	2120.0	3779.0	1299.0	14944.0	3374.0	3620.0	749.0	2323.0
755.3	257.0	579.0	2259.0	2746.0	4703.0	3741.0	2288.0	2128.0	3921.0	1297.0	15084.0	3336.0	3645.0	744.0	2299.0
756.4	229.0	589.0	2308.0	2730.0	4786.0	3733.0	2296.0	2117.0	3876.0	1317.0	15140.0	3313.0	3603.0	763.0	2310.0
757.6	235.0	565.0	2310.0	2709.0	4717.0	3581.0	2261.0	2139.0	3875.0	1286.0	15134.0	3351.0	3585.0	757.0	2295.0
758.8	240.0	587.0	2295.0	2703.0	4765.0	3593.0	2283.0	2137.0	3899.0	1294.0	15206.0	3355.0	3569.0	755.0	2280.0
760.0	249.0	571.0	2293.0	2697.0	4815.0	3664.0	2241.0	2127.0	3829.0	1336.0	15196.0	3308.0	3608.0	765.0	2348.0
761.1	213.0	570.0	2280.0	2703.0	4737.0	3683.0	2241.0	2123.0	3870.0	1281.0	15288.0	3356.0	3570.0	742.0	2285.0
762.3	233.0	575.0	2267.0	2716.0	4709.0	3661.0	2210.0	2127.0	3888.0	1294.0	15320.0	3327.0	3567.0	745.0	2313.0
763.5	255.0	577.0	2241.0	2707.0	4736.0	3653.0	2258.0	2088.0	3849.0	1295.0	15258.0	3301.0	3583.0	768.0	2302.0
764.7	252.0	560.0	2315.0	2697.0	4793.0	3611.0	2240.0	2090.0	3864.0	1315.0	15276.0	3339.0	3579.0	763.0	2317.0
765.8	249.0	609.0	2272.0	2673.0	4814.0	3643.0	2228.0	2069.0	3860.0	1315.0	15420.0	3332.0	3561.0	760.0	2230.0
767.0	238.0	609.0	2311.0	2658.0	4751.0	3625.0	2267.0	2105.0	3867.0	1318.0	15400.0	3314.0	3546.0	783.0	2285.0
768.2	238.0	596.0	2299.0	2665.0	4794.0	3654.0	2203.0	2105.0	3847.0	1332.0	15530.0	3281.0	3541.0	783.0	2288.0
769.3	259.0	618.0	2289.0	2704.0	4846.0	3640.0	2213.0	2075.0	3832.0	1335.0	15458.0	3325.0	3527.0	763.0	2263.0
770.5	267.0	582.0	2327.0	2679.0	4774.0	3598.0	2173.0	2113.0	3855.0	1297.0	15473.0	3316.0	3574.0	725.0	2278.0
771.7	258.0	603.0	2267.0	2640.0	4847.0	3654.0	2233.0	2080.0	3865.0	1301.0	15537.0	3311.0	3555.0	802.0	2271.0
772.8	255.0	613.0	2281.0	2673.0	4798.0	3571.0	2190.0	2145.0	3814.0	1294.0	15585.0	3315.0	3600.0	784.0	2243.0
774.0	246.0	621.0	2290.0	2675.0	4848.0	3652.0	2235.0	2108.0	3835.0	1299.0	15669.0	3361.0	3591.0	777.0	2243.0
775.2	281.0	621.0	2265.0	2671.0	4782.0	3605.0	2212.0	2060.0	3841.0	1360.0	15639.0	3335.0	3543.0	785.0	2255.0
776.4	271.0	608.0	2277.0	2611.0	4800.0	3651.0	2233.0	2090.0	3871.0	1335.0	15563.0	3333.0	3597.0	786.0	2241.0
777.5	277.0	633.0	2300.0	2719.0	4811.0	3595.0	2185.0	2115.0	3835.0	1340.0	15737.0	3356.0	3595.0	801.0	2299.0
778.7	276.0	632.0	2285.0	2636.0	4825.0	3599.0	2199.0	2094.0	3865.0	1345.0	15724.0	3301.0	3575.0	820.0	2197.0
779.9	278.0	642.0	2301.0	2681.0	4822.0	3600.0	2176.0	2085.0	3829.0	1339.0	15730.0	3333.0	3577.0	800.0	2254.0
781.0	288.0	657.0	2292.0	2630.0	4799.0	3565.0	2199.0	2078.0	3805.0	1358.0	15778.0	3379.0	3601.0	801.0	2231.0
782.2	295.0	677.0	2253.0	2654.0	4833.0										

819.5	261.0	607.0	2008.0	2366.0	4431.0	3177.0	1929.0	1894.0	3581.0	1345.0	16508.0	3338.0	3364.0	776.0	2017.0
820.6	251.0	604.0	1989.0	2331.0	4393.0	3181.0	1907.0	1876.0	3541.0	1351.0	16611.0	3360.0	3346.0	770.0	2026.0
821.8	241.0	602.0	1988.0	2342.0	4381.0	3224.0	1910.0	1834.0	3569.0	1363.0	16623.0	3396.0	3377.0	749.0	2025.0
823.0	257.0	599.0	1996.0	2307.0	4313.0	3191.0	1924.0	1821.0	3491.0	1350.0	16640.0	3346.0	3348.0	715.0	2031.0
824.1	235.0	609.0	1968.0	2316.0	4329.0	3142.0	1890.0	1805.0	3563.0	1383.0	16607.0	3338.0	3317.0	738.0	1963.0
825.3	245.0	591.0	1952.0	2268.0	4336.0	3090.0	1876.0	1855.0	3496.0	1374.0	16648.0	3361.0	3294.0	739.0	1936.0
826.4	247.0	605.0	1867.0	2286.0	4325.0	3088.0	1869.0	1818.0	3480.0	1391.0	16817.0	3314.0	3331.0	760.0	1941.0
827.6	258.0	614.0	1891.0	2238.0	4287.0	3066.0	1838.0	1829.0	3441.0	1371.0	16774.0	3307.0	3341.0	723.0	1927.0
828.8	237.0	579.0	1927.0	2237.0	4198.0	3072.0	1821.0	1784.0	3377.0	1346.0	16768.0	3393.0	3306.0	760.0	1932.0
829.9	249.0	592.0	1852.0	2217.0	4241.0	2993.0	1807.0	1786.0	3428.0	1325.0	16894.0	3363.0	3327.0	728.0	1926.0
831.1	249.0	604.0	1869.0	2183.0	4204.0	3050.0	1811.0	1736.0	3382.0	1344.0	16854.0	3391.0	3258.0	735.0	1938.0
832.2	237.0	605.0	1887.0	2161.0	4173.0	2992.0	1768.0	1725.0	3370.0	1350.0	16964.0	3396.0	3281.0	737.0	1881.0
833.4	233.0	607.0	1852.0	2158.0	4143.0	2970.0	1787.0	1714.0	3297.0	1356.0	17062.0	3349.0	3206.0	734.0	1917.0
834.6	221.0	589.0	1827.0	2115.0	4131.0	2947.0	1735.0	1703.0	3353.0	1350.0	17002.0	3408.0	3248.0	731.0	1883.0
835.7	233.0	587.0	1793.0	2041.0	4148.0	2901.0	1715.0	1691.0	3353.0	1352.0	16994.0	3392.0	3207.0	729.0	1828.0
836.9	239.0	600.0	1799.0	2055.0	4089.0	2959.0	1710.0	1693.0	3298.0	1345.0	17242.0	3347.0	3189.0	731.0	1845.0
838.0	218.0	598.0	1786.0	2082.0	4105.0	2876.0	1711.0	1655.0	3264.0	1377.0	17110.0	3388.0	3226.0	723.0	1813.0
839.2	237.0	579.0	1763.0	2030.0	4105.0	2910.0	1687.0	1632.0	3268.0	1353.0	17231.0	3407.0	3171.0	730.0	1811.0
840.4	221.0	599.0	1771.0	2013.0	4009.0	2822.0	1637.0	1628.0	3229.0	1364.0	17436.0	3429.0	3157.0	720.0	1789.0
841.5	219.0	601.0	1754.0	1983.0	4031.0	2848.0	1637.0	1628.0	3151.0	1382.0	17440.0	3405.0	3161.0	728.0	1783.0
842.7	224.0	583.0	1727.0	2016.0	3999.0	2813.0	1647.0	1616.0	3189.0	1360.0	17395.0	3400.0	3177.0	706.0	1767.0
843.8	226.0	592.0	1716.0	1925.0	3967.0	2812.0	1613.0	1591.0	3189.0	1369.0	17370.0	3363.0	3129.0	728.0	1757.0
845.0	223.0	581.0	1704.0	1971.0	3978.0	2739.0	1585.0	1570.0	3124.0	1291.0	17475.0	3392.0	3146.0	721.0	1747.0
846.2	227.0	582.0	1691.0	1942.0	3945.0	2787.0	1559.0	1553.0	3124.0	1330.0	17507.0	3434.0	3119.0	707.0	1763.0
847.3	214.0	592.0	1651.0	1877.0	3866.0	2695.0	1558.0	1542.0	3109.0	1306.0	17500.0	3451.0	3112.0	709.0	1707.0
848.5	216.0	573.0	1649.0	1910.0	3865.0	2742.0	1535.0	1513.0	3114.0	1327.0	17589.0	3414.0	3074.0	705.0	1706.0
849.6	221.0	569.0	1622.0	1867.0	3887.0	2671.0	1513.0	1475.0	3088.0	1341.0	17683.0	3424.0	3073.0	687.0	1671.0
850.8	211.0	586.0	1614.0	1827.0	3834.0	2673.0	1516.0	1491.0	3105.0	1348.0	17716.0	3435.0	3096.0	697.0	1683.0
851.9	209.0	574.0	1587.0	1787.0	3868.0	2648.0	1545.0	1475.0	3035.0	1323.0	17735.0	3447.0	3043.0	685.0	1679.0
853.1	213.0	560.0	1590.0	1819.0	3857.0	2665.0	1478.0	1440.0	2967.0	1327.0	17709.0	3471.0	3072.0	677.0	1670.0
854.3	222.0	569.0	1571.0	1803.0	3734.0	2631.0	1474.0	1427.0	2991.0	1336.0	17676.0	3404.0	3026.0	692.0	1627.0
855.4	213.0	566.0	1548.0	1762.0	3731.0	2546.0	1451.0	1404.0	3030.0	1353.0	17837.0	3456.0	3012.0	702.0	1625.0
856.6	221.0	575.0	1540.0	1727.0	3698.0	2568.0	1427.0	1431.0	3009.0	1321.0	17843.0	3474.0	3051.0	713.0	1627.0
857.7	212.0	551.0	1553.0	1726.0	3727.0	2525.0	1433.0	1388.0	2970.0	1366.0	18038.0	3445.0	2965.0	686.0	1598.0
858.9	213.0	570.0	1519.0	1704.0	3686.0	2488.0	1393.0	1390.0	2910.0	1331.0	18068.0	3501.0	2937.0	680.0	1529.0
860.0	219.0	547.0	1507.0	1685.0	3696.0	2466.0	1390.0	1339.0	2910.0	1341.0	18080.0	3496.0	2951.0	688.0	1559.0
861.2	211.0	564.0	1489.0	1665.0	3629.0	2477.0	1384.0	1332.0	2895.0	1352.0	18044.0	3516.0	2989.0	681.0	1545.0
862.3	201.0	565.0	1493.0	1626.0	3611.0	2458.0	1345.0	1327.0	2916.0	1340.0	17992.0	3465.0	2967.0	687.0	1511.0
863.5	197.0	563.0	1439.0	1626.0	3617.0	2428.0	1305.0	1301.0	2866.0	1355.0	18132.0	3565.0	2919.0	703.0	1523.0
864.7	203.0	559.0	1435.0	1607.0	3601.0	2407.0	1378.0	1278.0	2865.0	1337.0	18237.0	3499.0	2950.0	689.0	1512.0
865.8	207.0	585.0	1440.0	1593.0	3564.0	2355.0	1305.0	1265.0	2885.0	1329.0	18301.0	3522.0	2932.0	674.0	1534.0
867.0	208.0	570.0	1407.0	1556.0	3498.0	2387.0	1287.0	1254.0	2834.0	1377.0	18319.0	3507.0	2899.0	677.0	1483.0
868.1	193.0	557.0	1405.0	1566.0	3531.0	2376.0	1253.0	1243.0	2835.0	1326.0	18250.0	3476.0	2941.0	675.0	1504.0
869.3	203.0	549.0	1391.0	1550.0	3537.0	2333.0	1277.0	1243.0	2813.0	1352.0	18311.0	3551.0	2883.0	673.0	1465.0
870.4	202.0	534.0	1381.0	1545.0	3497.0	2375.0	1271.0	1207.0	2770.0	1362.0	18462.0	3542.0	2867.0	675.0	1447.0
871.6	187.0	554.0	1391.0	1541.0	3519.0	2327.0	1221.0	1213.0	2734.0	1351.0	18446.0	3480.0	2915.0	669.0	1469.0
872.7	204.0	551.0	1347.0	1507.0	3525.0	2314.0	1243.0	1211.0	2709.0	1350.0	18511.0	3497.0	2890.0	647.0	1449.0
873.9	204.0	542.0	1356.0	1484.0	3489.0	2257.0	1193.0	1184.0	2784.0	1361.0	18514.0	3505.0	2909.0	645.0	1461.0
875.0	188.0	539.0	1362.0	1497.0	3469.0	2281.0	1251.0	1183.0	2722.0	1320.0	18548.0	3503.0	2901.0	642.0	1439.0
876.2	185.0	549.0	1324.0	1484.0	3425.0	2253.0	1226.0	1149.0	2747.0	1340.0	18568.0	3544.0	2872.0	657.0	1405.0
877.3	181.0	543.0	1329.0	1439.0	3394.0	2197.0	1197.0	1146.0	2708.0	1330.0	18556.0	3553.0	2839.0	653.0	1425.0
878.5	184.0	545.0	1304.0	1407.0	3371.0	2219.0	1181.0	1135.0	2762.0	1351.0	18437.0	3506.0	2837.0	645.0	1399.0
879.6	189.0	545.0	1283.0	1443.0	3444.0	2219.0	1182.0	1172.0	2676.0	1337.0	18690.0	3574.0	2787.0	639.0	1407.0
880.8	181.0	518.0	1316.0	1454.0	3408.0	2235.0	1136.0	1135.0	2656.0	1341.0	18679.0	3577.0	2778.0	657.0	1395.0
881.9	182.0	547.0	1285.0	1434.0	3375.0	2179.0	1185.0	1127.0	2647.0	1352.0	18758.0	3543.0	2861.0	637.0	1384.0
883.1	183.0	547.0	1297.0	1402.0	3362.0	2159.0	1139.0	1130.0	2614.0	1313.0	18706.0	3489.0	2846.0	645.0	1380.0
884.3	181.0	545.0	1288.0	1375.0	3367.0	2173.0	1143.0	1097.0	2633.0	1301.0	18595.0	3520.0	2810.0	634.0	1346.0
885.4	174.0	526.0	1274.0	1373.0	3287.0	2154.0	1149.0	1113.0	2623.0	1329.0	18652.0	3547.0	2804.0	627.0	1379.0
886.6	172.0	531.0	1263.0	1375.0	3317.0	2155.0	1113.0	1085.0	2614.0	1331.0	18713.0	3520.0	2789.0	634.0	1361.0
887.7	181.0	524.0	1262.0	1375.0	3287.0	2124.0	1095.0	1083.0	2595.0	1346.0	18763.0	3522.0	2750.0	629.0	1376.0
888.9	176.0	516.0	1227.0	1350.0	3321.0	2162.0	1109.0	1085.0	2576.0	1337.0	18897.0	3514.0	2759.0	623.0	1346.0
890.0	179.0	525.0	1257.0	1371.0	3311.0	2130.0	1103.0	1064.0	2608.0	1329.0	18766.0	3525.0	2770.0	627.0	1392.0
891.2	161.0	524.0	1244.0	1307.0	3290.0	2110.0	1101.0	1068.0	2607.0	1336.0	18748.0	3514.0	2787.0	634.0	1329.0
892.3	165.0	514.0	1222.0	1340.0	3237.0	2093.0	1061.0	1059.0	2570.0	1298.0	18850.0	3459.0	2783.0	601.0	1325.0
893.5	168.0	514.0	1216.0	1321.0	3293.0	2110.0	1076.0	1048.0	2593.0	1339.0	18797.0	3564.0	2735.0	638.0	1325.0
894.6	185.0	517.0	1222.0	1307.0	3255.0	2124.0	1040.0	1037.0	2525.0	1327.0	18993.0	3554.0	2765.0	609.0	1356.0
895.8	167.0	519.0	1208.0	1297.0	3214.0	2108.0	1077.0	1015.0	2523.0	1338.0	18818.0	3506.0	2785.0	600.0	1332.0
896.9	172.0	529.0	1206.0	1289.0	3245.0	2084.0	1065.0	1035.0	2582.0	1339.0	18928.0	3519.0	2735.0	607.0	1344.0
898.1	157.0	495.0	1217.0	1289.0	3199.0	2073.0	1051.0	1014.0	2496.0	1311.0	18973.0	3561.0	2731.0	622.0	1299.0
899.2	175.0	522.0	1214.0	1275.0	3230.0</										

934.7	141.0	490.0	1156.0	1232.0	3241.0	1986.0	996.0	971.0	2493.0	1385.0	20440.0	3721.0	2779.0	600.0	1265.0
935.9	150.0	486.0	1139.0	1183.0	3161.0	1993.0	993.0	957.0	2483.0	1403.0	20442.0	3738.0	2794.0	591.0	1294.0
937.0	144.0	517.0	1151.0	1205.0	3189.0	1978.0	964.0	965.0	2491.0	1389.0	20376.0	3721.0	2769.0	584.0	1265.0
938.2	143.0	485.0	1149.0	1179.0	3220.0	1977.0	959.0	957.0	2443.0	1368.0	20535.0	3745.0	2786.0	621.0	1292.0
939.3	146.0	498.0	1155.0	1180.0	3213.0	2009.0	981.0	937.0	2457.0	1369.0	20696.0	3778.0	2795.0	619.0	1275.0
940.4	144.0	501.0	1145.0	1175.0	3222.0	2011.0	976.0	947.0	2473.0	1411.0	20599.0	3777.0	2779.0	587.0	1295.0
941.6	151.0	488.0	1138.0	1217.0	3212.0	2001.0	943.0	968.0	2456.0	1394.0	20715.0	3774.0	2816.0	591.0	1284.0
942.7	153.0	483.0	1124.0	1192.0	3186.0	2005.0	985.0	949.0	2502.0	1421.0	20789.0	3730.0	2785.0	597.0	1263.0
943.9	147.0	492.0	1144.0	1205.0	3231.0	1985.0	975.0	961.0	2472.0	1398.0	20679.0	3727.0	2786.0	590.0	1270.0
945.0	144.0	501.0	1151.0	1200.0	3217.0	1963.0	965.0	934.0	2499.0	1426.0	20690.0	3777.0	2786.0	605.0	1272.0
946.1	137.0	509.0	1135.0	1173.0	3220.0	1989.0	983.0	953.0	2469.0	1411.0	20721.0	3736.0	2799.0	610.0	1273.0
947.3	143.0	509.0	1109.0	1163.0	3187.0	1951.0	953.0	930.0	2484.0	1416.0	20563.0	3777.0	2808.0	586.0	1252.0
948.4	145.0	502.0	1157.0	1173.0	3185.0	1957.0	952.0	933.0	2443.0	1383.0	20679.0	3721.0	2724.0	601.0	1292.0
949.6	149.0	490.0	1115.0	1173.0	3163.0	1967.0	961.0	909.0	2473.0	1447.0	20849.0	3817.0	2749.0	589.0	1285.0
950.7	145.0	481.0	1139.0	1116.0	3208.0	1962.0	955.0	954.0	2422.0	1396.0	20878.0	3750.0	2747.0	598.0	1263.0
951.8	136.0	510.0	1137.0	1165.0	3216.0	1964.0	987.0	955.0	2414.0	1434.0	20757.0	3762.0	2792.0	598.0	1267.0
953.0	136.0	487.0	1112.0	1158.0	3156.0	1979.0	943.0	918.0	2471.0	1407.0	20832.0	3733.0	2780.0	581.0	1279.0
954.1	139.0	498.0	1127.0	1168.0	3185.0	1968.0	953.0	935.0	2463.0	1424.0	20865.0	3802.0	2762.0	601.0	1256.0
955.3	137.0	469.0	1123.0	1192.0	3191.0	1992.0	956.0	936.0	2450.0	1436.0	20842.0	3769.0	2741.0	587.0	1281.0
956.4	143.0	486.0	1121.0	1170.0	3159.0	1951.0	938.0	929.0	2458.0	1416.0	20858.0	3709.0	2771.0	595.0	1271.0
957.5	148.0	472.0	1113.0	1129.0	3170.0	1940.0	931.0	908.0	2423.0	1426.0	20945.0	3750.0	2791.0	602.0	1287.0
958.7	143.0	498.0	1109.0	1151.0	3173.0	1937.0	962.0	931.0	2474.0	1442.0	20953.0	3702.0	2801.0	601.0	1271.0
959.8	129.0	465.0	1145.0	1164.0	3171.0	1983.0	947.0	932.0	2432.0	1411.0	20989.0	3769.0	2771.0	587.0	1262.0
961.0	143.0	495.0	1154.0	1125.0	3190.0	1960.0	915.0	929.0	2497.0	1461.0	20902.0	3744.0	2756.0	595.0	1272.0
962.1	138.0	502.0	1109.0	1133.0	3185.0	1905.0	950.0	931.0	2478.0	1482.0	21122.0	3810.0	2798.0	587.0	1273.0
963.2	135.0	483.0	1109.0	1153.0	3195.0	1957.0	937.0	917.0	2439.0	1507.0	21111.0	3792.0	2785.0	590.0	1225.0
964.4	134.0	477.0	1160.0	1163.0	3234.0	1890.0	941.0	889.0	2421.0	1519.0	21148.0	3720.0	2770.0	593.0	1267.0
965.5	125.0	466.0	1140.0	1135.0	3179.0	1947.0	941.0	918.0	2404.0	1587.0	21400.0	3765.0	2794.0	589.0	1268.0
966.7	141.0	471.0	1109.0	1169.0	3197.0	1970.0	954.0	917.0	2432.0	1608.0	21193.0	3773.0	2808.0	585.0	1263.0
967.8	137.0	467.0	1097.0	1140.0	3182.0	1946.0	946.0	901.0	2421.0	1690.0	21311.0	3740.0	2800.0	578.0	1263.0
968.9	133.0	490.0	1133.0	1132.0	3183.0	1963.0	942.0	903.0	2429.0	1759.0	21157.0	3788.0	2814.0	588.0	1261.0
970.1	136.0	479.0	1106.0	1138.0	3195.0	1922.0	937.0	915.0	2466.0	1915.0	21391.0	3842.0	2799.0	575.0	1267.0
971.2	143.0	495.0	1110.0	1158.0	3164.0	1933.0	930.0	937.0	2459.0	2091.0	21499.0	3895.0	2793.0	569.0	1269.0
972.3	136.0	496.0	1096.0	1150.0	3170.0	1905.0	948.0	904.0	2461.0	2312.0	21549.0	3930.0	2829.0	592.0	1273.0
973.5	135.0	486.0	1133.0	1134.0	3187.0	1919.0	941.0	867.0	2430.0	2269.0	21712.0	4034.0	2791.0	588.0	1245.0
974.6	132.0	483.0	1115.0	1129.0	3151.0	1965.0	933.0	927.0	2471.0	2081.0	21887.0	4039.0	2852.0	601.0	1261.0
975.8	135.0	487.0	1133.0	1167.0	3195.0	1919.0	942.0	911.0	2474.0	1910.0	21969.0	3987.0	2842.0	589.0	1233.0
976.9	136.0	482.0	1113.0	1143.0	3228.0	1972.0	925.0	939.0	2467.0	1831.0	22066.0	4022.0	2884.0	586.0	1282.0
978.0	134.0	466.0	1138.0	1151.0	3227.0	1947.0	922.0	923.0	2462.0	1757.0	22198.0	3992.0	2859.0	591.0	1294.0
979.2	125.0	504.0	1132.0	1163.0	3200.0	2001.0	941.0	920.0	2438.0	1715.0	22354.0	3968.0	2829.0	604.0	1312.0
980.3	135.0	477.0	1134.0	1145.0	3263.0	1957.0	947.0	936.0	2477.0	1688.0	22445.0	3950.0	2873.0	615.0	1296.0
981.4	129.0	491.0	1112.0	1168.0	3219.0	1995.0	944.0	947.0	2461.0	1653.0	22490.0	3980.0	2893.0	590.0	1315.0
982.6	138.0	491.0	1147.0	1163.0	3239.0	1987.0	941.0	927.0	2481.0	1662.0	22541.0	3945.0	2907.0	597.0	1313.0
983.7	134.0	493.0	1157.0	1181.0	3224.0	1950.0	901.0	944.0	2465.0	1617.0	22547.0	3963.0	2888.0	589.0	1293.0
984.8	139.0	485.0	1176.0	1163.0	3293.0	1979.0	942.0	941.0	2491.0	1654.0	22702.0	3985.0	2894.0	580.0	1317.0
986.0	130.0	500.0	1164.0	1173.0	3258.0	1969.0	948.0	971.0	2481.0	1662.0	22737.0	4005.0	2941.0	581.0	1309.0
987.1	146.0	493.0	1138.0	1157.0	3308.0	1993.0	963.0	931.0	2513.0	1711.0	22850.0	3999.0	2908.0	598.0	1315.0
988.2	137.0	516.0	1125.0	1155.0	3320.0	1983.0	963.0	933.0	2517.0	1753.0	22820.0	3966.0	2903.0	603.0	1326.0
989.4	135.0	481.0	1157.0	1169.0	3294.0	1999.0	945.0	929.0	2470.0	1734.0	22926.0	4026.0	2956.0	595.0	1285.0
990.5	134.0	505.0	1109.0	1168.0	3241.0	2004.0	977.0	934.0	2460.0	1788.0	23000.0	4002.0	2898.0	593.0	1294.0
991.6	141.0	499.0	1150.0	1158.0	3293.0	2034.0	964.0	942.0	2522.0	1869.0	22893.0	4037.0	2891.0	626.0	1279.0
992.8	133.0	494.0	1163.0	1128.0	3289.0	2015.0	934.0	938.0	2495.0	1909.0	23222.0	4042.0	2945.0	607.0	1320.0
993.9	129.0	485.0	1170.0	1160.0	3271.0	2015.0	944.0	933.0	2496.0	1987.0	23208.0	4101.0	2916.0	610.0	1299.0
995.0	137.0	490.0	1139.0	1135.0	3297.0	2002.0	939.0	967.0	2493.0	2139.0	23197.0	4119.0	2887.0	605.0	1335.0
996.2	140.0	517.0	1161.0	1184.0	3285.0	1961.0	941.0	921.0	2488.0	2262.0	23241.0	4101.0	2918.0	607.0	1329.0
997.3	131.0	497.0	1174.0	1157.0	3307.0	2012.0	952.0	939.0	2505.0	2479.0	23213.0	4113.0	2906.0	577.0	1329.0
998.4	139.0	490.0	1156.0	1190.0	3287.0	2009.0	927.0	933.0	2492.0	2801.0	23154.0	4153.0	2962.0	609.0	1309.0
999.6	135.0	494.0	1132.0	1179.0	3282.0	1974.0	952.0	938.0	2457.0	3221.0	23276.0	4234.0	2952.0	593.0	1307.0
1000.7	130.0	528.0	1135.0	1195.0	3285.0	2017.0	931.0	905.0	2509.0	3811.0	23373.0	4248.0	2981.0	609.0	1314.0
1001.8	135.0	511.0	1135.0	1167.0	3319.0	1983.0	956.0	926.0	2490.0	4607.0	23485.0	4305.0	2997.0	604.0	1278.0
1003.0	128.0	499.0	1143.0	1174.0	3327.0	1999.0	934.0	919.0	2517.0	5750.0	23674.0	4384.0	2968.0	600.0	1292.0
1004.1	125.0	509.0	1129.0	1190.0	3288.0	1991.0	921.0	935.0	2482.0	6896.0	23725.0	4630.0	2914.0	612.0	1333.0
1005.2	123.0	508.0	1134.0	1181.0	3265.0	1962.0	935.0	894.0	2472.0	7511.0	23607.0	4939.0	2955.0	600.0	1285.0
1006.4	133.0	505.0	1125.0	1180.0	3349.0	2007.0	962.0	947.0	2483.0	6859.0	23734.0	5438.0	2948.0	601.0	1309.0
1007.5	137.0	491.0	1146.0	1145.0	3301.0	2003.0	901.0	929.0	2530.0	5648.0	23717.0	5790.0	2957.0	601.0	1308.0
1008.6	141.0	505.0	1157.0	1151.0	3267.0	1953.0	944.0	917.0	2505.0	4497.0	23834.0	5598.0	2921.0	616.0	1303.0
1009.8	125.0	487.0	1164.0	1160.0	3309.0	1999.0	953.0	931.0	2518.0	3590.0	23966.0	5011.0	2984.0	596.0	1303.0
1010.9	143.0	510.0	1137.0	1181.0	3318.0	2011.0	938.0	930.0	2488.0	3061.0	24128.0	4641.0	2948.0	603.0	1310.0
1012.0	123.0	498.0	1153.0	1177.0	3326.0	2016.0	935.0	951.0	2492.0	2711.0	24090.0	4441.0	2996.0	603.0	1322.0
1013.2	141.0	499.0	1181.0	1173.0	3321.0	2007.0	943.0	927.0	2503.0	2474.0	24404.0	4395.0	3014.0	612.0	1323.0
1014.3															



1048.1	132.0	520.0	1196.0	1193.0	3443.0	2033.0	925.0	960.0	2555.0	1513.0	26802.0	4441.0	3110.0	645.0	1385.0
1049.2	140.0	521.0	1200.0	1161.0	3433.0	2046.0	951.0	971.0	2578.0	1519.0	26807.0	4434.0	3142.0	642.0	1388.0
1050.3	128.0	525.0	1193.0	1186.0	3458.0	2038.0	946.0	969.0	2593.0	1535.0	26980.0	4512.0	3106.0	643.0	1367.0
1051.5	127.0	517.0	1216.0	1200.0	3440.0	2044.0	961.0	947.0	2542.0	1542.0	26905.0	4494.0	3115.0	649.0	1373.0
1052.6	136.0	522.0	1169.0	1208.0	3456.0	2024.0	951.0	951.0	2600.0	1524.0	26958.0	4543.0	3124.0	631.0	1371.0
1053.7	139.0	528.0	1189.0	1172.0	3480.0	2057.0	947.0	988.0	2561.0	1528.0	27307.0	4525.0	3140.0	663.0	1393.0
1054.8	131.0	516.0	1195.0	1191.0	3456.0	2063.0	969.0	973.0	2519.0	1542.0	27185.0	4544.0	3105.0	665.0	1385.0
1056.0	135.0	498.0	1195.0	1193.0	3424.0	2032.0	929.0	976.0	2625.0	1565.0	27385.0	4531.0	3111.0	659.0	1353.0
1057.1	137.0	527.0	1181.0	1199.0	3423.0	2063.0	971.0	976.0	2543.0	1544.0	27415.0	4630.0	3142.0	670.0	1378.0
1058.2	128.0	511.0	1195.0	1198.0	3367.0	2054.0	952.0	943.0	2511.0	1552.0	27519.0	4543.0	3135.0	665.0	1408.0
1059.3	140.0	537.0	1209.0	1187.0	3465.0	2060.0	956.0	967.0	2587.0	1507.0	27626.0	4562.0	3200.0	659.0	1333.0
1060.5	121.0	506.0	1218.0	1215.0	3436.0	2057.0	941.0	973.0	2546.0	1506.0	27658.0	4556.0	3131.0	649.0	1391.0
1061.6	129.0	532.0	1217.0	1206.0	3409.0	2053.0	951.0	980.0	2598.0	1525.0	27753.0	4480.0	3141.0	676.0	1381.0
1062.7	131.0	495.0	1199.0	1223.0	3434.0	2020.0	960.0	941.0	2588.0	1530.0	28018.0	4589.0	3172.0	659.0	1399.0
1063.8	126.0	507.0	1194.0	1201.0	3440.0	2058.0	941.0	969.0	2539.0	1515.0	27930.0	4583.0	3154.0	667.0	1351.0
1064.9	131.0	521.0	1214.0	1209.0	3455.0	2054.0	949.0	988.0	2548.0	1515.0	28040.0	4631.0	3138.0	685.0	1407.0
1066.1	141.0	529.0	1207.0	1185.0	3439.0	2013.0	977.0	1005.0	2581.0	1509.0	28096.0	4628.0	3163.0	668.0	1401.0
1067.2	123.0	519.0	1185.0	1191.0	3420.0	2044.0	962.0	1003.0	2594.0	1529.0	28231.0	4664.0	3170.0	658.0	1393.0
1068.3	125.0	526.0	1208.0	1187.0	3411.0	2043.0	965.0	971.0	2602.0	1494.0	28270.0	4623.0	3183.0	671.0	1390.0
1069.4	127.0	532.0	1205.0	1207.0	3478.0	2041.0	974.0	973.0	2510.0	1570.0	28556.0	4625.0	3169.0	641.0	1401.0
1070.5	135.0	507.0	1197.0	1189.0	3456.0	2093.0	961.0	989.0	2523.0	1544.0	28541.0	4717.0	3139.0	645.0	1395.0
1071.7	129.0	527.0	1208.0	1197.0	3460.0	2011.0	970.0	973.0	2533.0	1542.0	28621.0	4626.0	3171.0	663.0	1394.0
1072.8	135.0	515.0	1193.0	1193.0	3436.0	2011.0	968.0	1005.0	2581.0	1518.0	28727.0	4642.0	3146.0	665.0	1397.0
1073.9	129.0	533.0	1216.0	1225.0	3492.0	2021.0	965.0	981.0	2509.0	1517.0	28990.0	4644.0	3184.0	669.0	1370.0
1075.0	132.0	522.0	1226.0	1183.0	3411.0	2014.0	953.0	969.0	2574.0	1521.0	28910.0	4718.0	3131.0	678.0	1402.0
1076.1	127.0	511.0	1228.0	1193.0	3470.0	2036.0	964.0	974.0	2602.0	1511.0	28942.0	4704.0	3149.0	678.0	1379.0
1077.3	134.0	526.0	1197.0	1218.0	3495.0	2040.0	959.0	994.0	2550.0	1511.0	29052.0	4760.0	3189.0	691.0	1395.0
1078.4	126.0	501.0	1185.0	1190.0	3465.0	2031.0	960.0	965.0	2576.0	1556.0	29175.0	4771.0	3174.0	684.0	1412.0
1079.5	123.0	532.0	1211.0	1194.0	3451.0	2041.0	977.0	974.0	2591.0	1521.0	29407.0	4704.0	3154.0	678.0	1434.0
1080.6	135.0	519.0	1182.0	1214.0	3497.0	2057.0	955.0	996.0	2579.0	1528.0	29491.0	4737.0	3174.0	665.0	1383.0
1081.7	140.0	543.0	1197.0	1215.0	3466.0	2071.0	976.0	974.0	2583.0	1498.0	29614.0	4741.0	3189.0	655.0	1397.0
1082.9	135.0	531.0	1207.0	1216.0	3429.0	2039.0	929.0	980.0	2612.0	1495.0	29678.0	4756.0	3168.0	691.0	1424.0
1084.0	128.0	518.0	1207.0	1219.0	3495.0	2025.0	972.0	971.0	2587.0	1565.0	29736.0	4797.0	3234.0	703.0	1349.0
1085.1	121.0	529.0	1195.0	1197.0	3497.0	2077.0	944.0	1026.0	2570.0	1482.0	29854.0	4848.0	3197.0	702.0	1403.0
1086.2	123.0	542.0	1199.0	1197.0	3500.0	2078.0	949.0	985.0	2559.0	1511.0	29932.0	4774.0	3217.0	697.0	1371.0
1087.3	115.0	533.0	1216.0	1193.0	3489.0	2055.0	964.0	996.0	2575.0	1516.0	30260.0	4821.0	3192.0	691.0	1427.0
1088.5	119.0	526.0	1173.0	1201.0	3470.0	2040.0	975.0	1011.0	2555.0	1543.0	30310.0	4763.0	3204.0	685.0	1404.0
1089.6	115.0	537.0	1208.0	1205.0	3445.0	2071.0	981.0	1006.0	2593.0	1498.0	30423.0	4850.0	3197.0	683.0	1399.0
1090.7	125.0	531.0	1201.0	1219.0	3475.0	2067.0	972.0	997.0	2582.0	1515.0	30630.0	4827.0	3241.0	695.0	1451.0
1091.8	123.0	535.0	1226.0	1224.0	3461.0	2089.0	993.0	1021.0	2565.0	1524.0	30707.0	4858.0	3235.0	729.0	1420.0
1092.9	131.0	549.0	1213.0	1231.0	3444.0	2076.0	972.0	985.0	2561.0	1549.0	30952.0	4806.0	3237.0	677.0	1425.0
1094.0	127.0	526.0	1231.0	1197.0	3511.0	2081.0	941.0	1009.0	2586.0	1541.0	31096.0	4859.0	3213.0	706.0	1436.0
1095.2	128.0	559.0	1241.0	1191.0	3515.0	2045.0	963.0	1005.0	2579.0	1564.0	31104.0	4816.0	3306.0	697.0	1418.0
1096.3	123.0	537.0	1238.0	1225.0	3516.0	2045.0	933.0	1009.0	2657.0	1525.0	31248.0	4949.0	3219.0	717.0	1427.0
1097.4	133.0	546.0	1217.0	1229.0	3520.0	2038.0	967.0	1008.0	2617.0	1538.0	31479.0	4879.0	3229.0	699.0	1436.0
1098.5	124.0	547.0	1213.0	1237.0	3502.0	2072.0	985.0	1016.0	2597.0	1543.0	31538.0	4923.0	3248.0	708.0	1418.0
1099.6	127.0	533.0	1212.0	1213.0	3498.0	2079.0	967.0	1022.0	2607.0	1541.0	31899.0	4964.0	3277.0	733.0	1399.0
1100.7	131.0	543.0	1259.0	1238.0	3503.0	2077.0	965.0	1041.0	2612.0	1523.0	31993.0	4943.0	3296.0	698.0	1448.0
1101.9	129.0	546.0	1228.0	1260.0	3475.0	2079.0	975.0	1020.0	2631.0	1505.0	32151.0	4934.0	3275.0	718.0	1439.0
1103.0	129.0	552.0	1204.0	1249.0	3517.0	2119.0	997.0	1013.0	2610.0	1561.0	32326.0	5029.0	3270.0	710.0	1466.0
1104.1	139.0	526.0	1223.0	1234.0	3493.0	2113.0	948.0	1021.0	2583.0	1536.0	32449.0	5005.0	3313.0	705.0	1449.0
1105.2	127.0	551.0	1210.0	1252.0	3572.0	2099.0	972.0	1010.0	2577.0	1530.0	32574.0	4997.0	3279.0	727.0	1446.0
1106.3	125.0	541.0	1241.0	1219.0	3594.0	2113.0	972.0	1011.0	2615.0	1560.0	32962.0	5044.0	3270.0	704.0	1472.0
1107.4	126.0	538.0	1245.0	1227.0	3579.0	2088.0	968.0	1038.0	2643.0	1555.0	33016.0	5008.0	3305.0	722.0	1487.0
1108.5	128.0	544.0	1241.0	1237.0	3581.0	2116.0	991.0	1041.0	2645.0	1543.0	33226.0	5024.0	3301.0	733.0	1485.0
1109.7	128.0	551.0	1224.0	1260.0	3543.0	2113.0	988.0	1030.0	2669.0	1574.0	33316.0	5051.0	3319.0	732.0	1485.0
1110.8	137.0	534.0	1281.0	1274.0	3551.0	2101.0	991.0	1033.0	2631.0	1568.0	33619.0	5045.0	3327.0	722.0	1484.0
1111.9	131.0	567.0	1233.0	1225.0	3551.0	2117.0	993.0	1041.0	2678.0	1592.0	33778.0	5069.0	3373.0	723.0	1485.0
1113.0	133.0	558.0	1271.0	1263.0	3584.0	2113.0	999.0	1055.0	2709.0	1512.0	33990.0	5090.0	3333.0	733.0	1522.0
1114.1	132.0	540.0	1249.0	1272.0	3611.0	2118.0	981.0	1035.0	2669.0	1588.0	34154.0	5093.0	3361.0	736.0	1473.0
1115.2	117.0	551.0	1234.0	1255.0	3548.0	2127.0	999.0	1039.0	2672.0	1590.0	34284.0	5086.0	3366.0	743.0	1490.0
1116.3	132.0	560.0	1243.0	1270.0	3577.0	2113.0	984.0	1059.0	2626.0	1565.0	34695.0	5139.0	3366.0	731.0	1472.0
1117.5	127.0	548.0	1265.0	1245.0	3613.0	2143.0	969.0	1041.0	2651.0	1505.0	34736.0	5171.0	3415.0	733.0	1481.0
1118.6	123.0	562.0	1293.0	1263.0	3619.0	2143.0	1026.0	1046.0	2677.0	1551.0	34899.0	5158.0	3367.0	715.0	1516.0
1119.7	135.0	572.0	1249.0	1295.0	3619.0	2141.0	1003.0	1040.0	2694.0	1557.0	35010.0	5153.0	3393.0	743.0	1523.0
1120.8	135.0	562.0	1269.0	1293.0	3674.0	2149.0	1009.0	1070.0	2671.0	1550.0	35238.0	5179.0	3424.0	766.0	1509.0
1121.9	139.0	543.0	1299.0	1268.0	3697.0	2151.0	1015.0	1061.0	2690.0	1575.0	35486.0	5243.0	3463.0	749.0	1529.0
1123.0	132.0	563.0	1249.0	1286.0	3628.0	2140.0	1005.0	1059.0	2665.0	1588.0	35709.0	5221.0	3432.0	746.0	1526.0
1124.1	121.0	561.0	1301.0	1284.0	3663.0	2149.0	1019.0	1093.0	2683.0	1575.0	35912.0	5232.0	3423.0	731.0	1496.0
1125.2	129.0	565.0	1283.0	1271.0	3687.0	2167.0	1013.0	1							

1159.6	134.0	581.0	1313.0	1352.0	3852.0	2210.0	1039.0	1103.0	2784.0	1594.0	39603.0	5450.0	3672.0	775.0	1599.0
1160.7	135.0	582.0	1309.0	1343.0	3733.0	2222.0	1047.0	1133.0	2817.0	1590.0	39785.0	5434.0	3641.0	793.0	1605.0
1161.8	143.0	585.0	1355.0	1352.0	3815.0	2217.0	1071.0	1067.0	2772.0	1577.0	39736.0	5491.0	3651.0	776.0	1607.0
1162.9	132.0	581.0	1325.0	1347.0	3821.0	2254.0	1043.0	1126.0	2737.0	1603.0	39904.0	5478.0	3603.0	809.0	1618.0
1164.0	133.0	612.0	1329.0	1393.0	3821.0	2269.0	1061.0	1135.0	2753.0	1610.0	39878.0	5415.0	3652.0	810.0	1650.0
1165.1	123.0	580.0	1343.0	1341.0	3815.0	2189.0	1063.0	1139.0	2807.0	1600.0	40024.0	5467.0	3713.0	794.0	1621.0
1166.3	139.0	587.0	1370.0	1373.0	3857.0	2252.0	1059.0	1099.0	2722.0	1598.0	39958.0	5424.0	3668.0	796.0	1619.0
1167.4	135.0	585.0	1359.0	1398.0	3894.0	2267.0	1059.0	1107.0	2752.0	1583.0	40038.0	5455.0	3691.0	784.0	1635.0
1168.5	130.0	571.0	1374.0	1389.0	3831.0	2285.0	1076.0	1122.0	2779.0	1608.0	40160.0	5403.0	3751.0	774.0	1625.0
1169.6	139.0	592.0	1380.0	1372.0	3836.0	2228.0	1095.0	1134.0	2753.0	1597.0	39997.0	5457.0	3701.0	795.0	1629.0
1170.7	123.0	582.0	1370.0	1361.0	3826.0	2245.0	1051.0	1139.0	2817.0	1620.0	40236.0	5461.0	3698.0	819.0	1649.0
1171.8	136.0	593.0	1349.0	1370.0	3846.0	2267.0	1086.0	1150.0	2748.0	1597.0	40257.0	5437.0	3741.0	821.0	1633.0
1172.9	131.0	590.0	1381.0	1405.0	3845.0	2233.0	1041.0	1117.0	2797.0	1596.0	40153.0	5462.0	3693.0	792.0	1655.0
1174.0	127.0	589.0	1362.0	1359.0	3849.0	2286.0	1083.0	1126.0	2759.0	1565.0	40263.0	5418.0	3648.0	805.0	1623.0
1175.1	127.0	580.0	1349.0	1370.0	3816.0	2295.0	1088.0	1127.0	2773.0	1615.0	40398.0	5459.0	3706.0	781.0	1653.0
1176.2	133.0	599.0	1385.0	1365.0	3875.0	2258.0	1089.0	1117.0	2770.0	1623.0	40238.0	5537.0	3738.0	812.0	1619.0
1177.3	137.0	579.0	1372.0	1393.0	3839.0	2257.0	1090.0	1126.0	2752.0	1620.0	40616.0	5486.0	3719.0	799.0	1623.0
1178.4	136.0	579.0	1366.0	1387.0	3901.0	2262.0	1086.0	1128.0	2825.0	1641.0	40310.0	5452.0	3741.0	819.0	1625.0
1179.5	135.0	586.0	1367.0	1383.0	3937.0	2315.0	1097.0	1105.0	2754.0	1629.0	40484.0	5476.0	3794.0	781.0	1674.0
1180.6	133.0	582.0	1400.0	1375.0	3898.0	2255.0	1105.0	1160.0	2779.0	1620.0	40400.0	5550.0	3763.0	811.0	1635.0
1181.7	130.0	598.0	1383.0	1418.0	3897.0	2320.0	1071.0	1174.0	2772.0	1630.0	40455.0	5539.0	3767.0	815.0	1664.0
1182.8	129.0	591.0	1383.0	1385.0	3935.0	2314.0	1105.0	1136.0	2823.0	1651.0	40635.0	5555.0	3795.0	805.0	1637.0
1183.9	130.0	571.0	1384.0	1414.0	3929.0	2317.0	1109.0	1117.0	2800.0	1633.0	40707.0	5507.0	3749.0	821.0	1638.0
1185.0	132.0	591.0	1353.0	1424.0	3909.0	2303.0	1116.0	1132.0	2805.0	1596.0	40664.0	5560.0	3776.0	808.0	1686.0
1186.1	138.0	594.0	1390.0	1407.0	3968.0	2279.0	1111.0	1151.0	2771.0	1667.0	40746.0	5575.0	3866.0	810.0	1667.0
1187.2	134.0	580.0	1417.0	1451.0	3957.0	2326.0	1105.0	1149.0	2763.0	1661.0	40840.0	5519.0	3858.0	828.0	1651.0
1188.3	133.0	581.0	1382.0	1414.0	3905.0	2315.0	1083.0	1160.0	2791.0	1629.0	40899.0	5578.0	3829.0	787.0	1649.0
1189.4	141.0	565.0	1373.0	1399.0	3949.0	2340.0	1090.0	1165.0	2807.0	1621.0	40872.0	5588.0	3827.0	805.0	1655.0



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B.4.7: Table showing the Raman shift of the last 17 of 32 analysed grains of TNS1.

TNS1	Turner Exploration Campe															
	Intensity (A.U)	Raman shift (cm <sup>-1</sup> )														
		Grain 16	Grain 17	Grain 18	Grain 19	Grain 20	Grain 21	Grain 23	Grain 24	Grain 25	Grain 26	Grain 27	Grain 28	Grain 29	Grain 30	Grain 31
-38.6	26.0	20.0	25.0	27.0	21.0	27.0	22.0	20.5	26.5	22.5	26.0	21.0	25.0	29.0	24.5	23.5
-37.3	19.0	19.0	21.0	26.5	26.0	24.0	22.0	21.5	20.5	21.0	18.5	19.0	21.5	16.5	20.5	20.5
-35.9	23.0	24.0	29.0	26.0	27.0	29.0	20.5	27.0	28.0	24.5	25.0	22.0	25.5	21.5	24.5	27.5
-34.6	27.0	29.0	21.0	26.5	27.5	25.5	28.0	20.5	25.0	24.0	26.5	21.0	24.5	21.5	26.0	20.0
-33.3	25.0	23.0	28.0	30.5	28.5	27.0	23.5	22.0	24.5	19.5	28.0	28.0	23.0	24.0	26.5	27.0
-32.0	24.0	21.0	34.0	27.5	23.5	27.0	23.0	24.0	25.5	27.0	24.0	24.0	25.5	21.5	26.0	25.0
-30.7	18.0	28.0	21.0	24.0	25.0	32.0	21.0	22.0	27.5	25.5	23.0	21.5	26.5	23.5	26.0	26.0
-29.4	28.0	22.0	25.0	27.5	23.0	23.0	20.5	23.0	23.0	24.0	16.0	22.0	26.5	21.0	24.5	20.5
-28.1	27.0	21.0	22.0	26.0	27.0	28.5	28.0	23.0	28.5	27.5	22.5	23.0	25.5	24.0	22.0	19.0
-26.8	23.0	26.0	26.0	32.0	26.5	24.5	32.0	23.5	25.0	27.0	24.5	25.0	27.5	26.0	25.0	24.0
-25.5	26.0	24.0	20.0	25.5	27.5	28.5	26.0	23.5	24.5	24.5	26.5	22.5	25.0	24.0	23.0	23.0
-24.2	20.0	23.0	21.0	26.5	25.0	25.0	27.0	24.0	20.5	25.0	19.0	21.0	23.0	25.0	28.5	24.0
-22.9	17.0	24.0	21.0	33.0	30.5	24.0	19.5	23.5	25.5	25.0	27.0	20.0	22.0	22.5	21.5	23.0
-21.6	28.0	21.0	25.0	27.0	25.0	21.0	25.0	26.0	27.5	26.5	25.0	27.5	26.0	22.5	20.0	26.0
-20.3	21.0	24.0	27.0	26.0	29.5	25.0	25.0	26.0	29.5	29.0	24.5	23.0	20.0	22.5	19.0	21.0
-19.0	26.0	21.0	23.0	32.0	26.0	26.0	25.0	24.0	25.0	23.5	25.5	22.0	26.5	24.5	28.5	26.5
-17.7	24.0	23.0	23.0	31.0	22.5	26.0	25.5	22.5	21.5	28.0	25.0	28.0	25.0	24.5	24.0	21.0
-16.4	24.0	21.0	25.0	28.5	23.0	29.0	20.0	31.0	24.0	25.5	28.0	24.5	25.5	23.5	27.0	24.5
-15.1	29.0	27.0	25.0	27.5	27.5	23.0	25.5	27.5	26.5	29.5	26.0	27.5	25.5	18.0	25.5	26.5
-13.8	27.0	23.0	25.0	22.0	24.5	27.0	26.0	24.0	24.0	24.5	25.5	23.0	26.0	25.0	27.0	28.0
-12.5	33.0	23.0	25.0	28.0	26.0	29.5	28.0	20.0	20.0	28.5	23.5	29.0	28.0	25.0	25.0	23.0
-11.2	33.0	21.0	22.0	26.5	24.5	24.5	28.5	27.0	27.5	29.0	29.0	27.0	26.5	24.5	26.0	26.5
-9.8	23.0	21.0	27.0	31.0	25.0	34.0	30.0	27.0	29.5	30.5	27.0	24.5	26.0	29.5	26.0	33.0
-8.5	25.0	26.0	28.0	32.5	29.5	30.0	32.0	25.5	31.0	27.5	26.5	28.0	26.5	26.0	27.5	26.5
-7.2	30.0	25.0	32.0	26.5	28.0	29.0	31.0	29.5	32.0	33.5	29.0	30.0	34.5	27.0	31.0	29.5
-5.9	32.0	37.0	21.0	28.0	29.0	36.5	35.0	33.5	36.5	32.5	32.5	30.5	37.0	34.5	36.5	36.0
-4.6	58.0	60.0	39.0	42.0	33.5	51.0	55.5	54.0	62.5	55.5	50.0	52.5	56.5	55.0	57.0	52.0
-3.3	268.0	281.0	95.0	107.0	98.0	245.0	284.0	271.5	285.5	281.5	267.0	264.5	310.0	287.5	306.0	278.0
-2.0	720.0	610.0	227.0	254.0	186.0	711.5	698.0	620.0	647.0	727.5	639.5	609.0	730.5	635.5	719.5	654.0
0.7	1311.0	1161.0	390.0	480.5	362.0	1341.0	1290.0	1263.5	1257.0	1345.0	1190.0	1132.0	1349.0	1140.0	1279.0	1205.5
0.6	1790.0	1605.0	503.0	562.5	451.5	1562.5	1705.0	1727.5	1570.0	1752.5	1427.5	1369.5	1689.5	1459.0	1585.0	1434.0
1.9	1285.0	1023.0	406.0	403.0	353.0	1218.0	1291.5	1156.0	1103.0	1192.0	1149.5	1178.5	1260.5	1114.5	1213.0	1108.5
3.2	854.0	749.0	255.0	253.0	234.0	782.0	897.0	833.0	786.5	918.0	758.5	792.0	879.5	741.0	783.0	802.5
4.5	222.0	196.0	78.0	86.0	72.0	190.0	197.5	182.0	180.0	176.0	165.0	157.5	159.0	170.0	168.5	168.5
5.8	42.0	37.0	30.0	39.5	31.5	36.0	49.0	46.5	42.5	35.0	41.5	37.5	44.0	38.5	41.5	39.5
7.1	36.0	37.0	34.0	36.0	31.5	36.0	34.0	29.5	35.5	34.0	32.0	33.5	31.0	31.0	31.0	33.0
8.4	34.0	29.0	26.0	31.5	27.0	28.5	34.0	33.5	31.0	30.0	23.0	27.0	26.0	25.5	32.0	34.5
9.7	23.0	29.0	23.0	33.5	31.0	23.5	33.0	25.5	34.0	29.5	24.0	30.0	33.5	30.5	28.5	25.5
11.0	29.0	25.0	27.0	37.5	28.0	32.0	28.0	30.0	28.0	26.0	29.5	27.5	30.0	27.5	24.0	24.0
12.3	28.0	27.0	31.0	33.5	28.0	26.0	25.5	26.5	29.0	32.0	21.0	28.0	32.0	28.5	27.5	26.5
13.6	28.0	26.0	26.0	33.5	25.5	31.5	29.0	29.5	32.0	29.0	22.5	28.5	28.0	28.5	33.0	24.0
14.9	29.0	24.0	30.0	37.0	24.5	27.0	31.5	25.0	25.5	34.0	23.0	28.0	28.5	23.0	26.0	26.0
16.2	23.0	25.0	29.0	32.0	28.5	32.0	28.0	29.5	28.0	26.0	27.0	23.5	25.0	27.5	28.5	29.0
17.5	31.0	24.0	33.0	35.5	27.0	31.0	30.5	30.0	24.5	31.0	28.0	25.0	28.0	22.0	24.0	27.0
18.8	27.0	23.0	27.0	36.0	28.5	33.0	28.0	27.5	26.0	28.0	28.0	25.0	23.5	30.0	29.5	26.5
20.1	30.0	23.0	27.0	32.5	32.0	23.5	31.0	26.0	27.0	26.5	21.5	27.0	31.0	25.5	28.0	34.0
21.3	27.0	28.0	33.0	34.0	28.5	28.0	28.0	20.0	28.0	25.0	27.5	25.0	20.0	26.0	28.5	25.5
22.6	29.0	25.0	35.0	37.0	30.0	25.0	28.0	30.0	27.0	29.5	25.5	28.5	27.5	24.5	26.5	24.5
23.9	29.0	31.0	33.0	38.0	31.5	29.0	30.5	26.5	27.5	27.0	25.5	25.5	22.5	28.0	28.0	20.0
25.2	24.0	25.0	33.0	35.0	26.0	28.0	26.5	26.5	29.0	26.0	20.0	26.5	31.5	22.0	34.0	29.0
26.5	30.0	25.0	27.0	40.0	36.0	31.0	29.0	21.0	29.0	31.0	20.0	25.5	24.5	23.0	26.5	24.0
27.8	22.0	23.0	33.0	33.5	29.5	31.0	30.5	30.0	28.0	30.5	25.5	26.0	26.0	25.0	25.0	26.0
29.1	27.0	27.0	35.0	39.0	27.0	32.5	25.5	27.5	29.0	30.0	22.5	23.0	30.0	27.0	26.0	27.5
30.4	26.0	27.0	36.0	36.0	30.0	34.0	33.5	29.0	25.5	31.0	26.0	21.0	29.5	30.5	33.5	30.5
31.7	23.0	25.0	32.0	38.0	31.5	28.5	30.0	24.5	30.0	28.5	21.0	27.0	33.0	25.5	23.0	27.0
33.0	25.0	25.0	37.0	45.5	31.0	29.0	32.5	33.0	33.0	30.0	31.5	27.5	26.0	27.0	33.5	29.0
34.3	28.0	31.0	47.0	41.5	33.5	33.0	29.5	30.0	30.5	32.5	24.0	25.0	25.5	23.0	28.0	28.5
35.6	32.0	26.0	39.0	47.0	35.5	36.5	30.5	29.5	35.0	29.5	27.0	27.5	27.5	27.0	31.5	34.5
36.9	25.0	25.0	45.0	51.0	34.0	34.5	32.5	31.0	32.5	37.0	22.5	31.5	34.5	22.5	33.0	30.5
38.2	29.0	32.0	49.0	62.0	39.0	45.0	34.5	34.5	37.0	38.0	29.0	29.5	30.0	29.0	39.0	34.0
39.5	41.0	34.0	70.0	82.0	46.0	47.5	42.5	35.0	49.0	55.5	29.5	32.0	38.5	22.0	46.5	43.5
40.8	51.0	38.0	99.0	123.5	56.0	67.5	57.0	45.5	64.5	68.0	32.0	35.0	40.5	31.5	64.0	53.5
42.1	64.0	45.0	141.0	178.0	70.0	89.0	76.5	62.0	85.5	89.0	30.0	40.0	58.0	30.0	84.5	70.0
43.4	91.0	55.0	227.0	276.5	95.0	135.5	106.5	97.0	130.0	142.0	51.5	45.0	72.5	47.5	119.5	95.5
44.7	135.0	83.0	347.0	396.0	137.0	197.5	164.5	141.5	178.5	201.5	63.5	66.0	103.0	53.5	172.0	135.0
46.0	206.0	115.0	496.0	574.0	190.5	296.0	229.0	205.5	262.5	292.5	77.5	86.0	143.5	76.0	247.5	200.0
47.2	257.0	159.0	659.0	764.0	261.0	392.0	313.5	269.0	353.5	415.0	107.0	109.0	178.0	93.0	340.0	265.0
48.5	353.0	207.0	831.0	972.5	329.5	489.0	394.0	347.5	452.0	507.0	127.5	134.5	219.5	109.0	418.5	318.0
49.8	421.0	247.0	1018.0	1159.0	405.5	591.0	472.0	426.5	550.0	603.5	147.5	159.0	268.5	122.0	514.5	404.5
51.1	489.0	278.0	1139.0	1328.0	464.0	685.5	537.0	481.0	641.0	697.5	165.0	175.5	298.0	144.5	571.0	466.0
52.4	545.0	309.0	1327.0	1525.0	519.5	746.0	620.5	534.0	704.5	798.0	183.0	199.0	330.5	159.5	644.0	490.0
53.7	593.0	341.0	1449.0	1640.0	583.0	841.5	672.5	610.5	792.0	842.5	198.0	221.0	362.5	158.0	679.0	557.0
55.0	625.0	368.0	1586.0	1771.5	637.0	891.5	721.0	651.5	836.5	905.0	213.5	236.5	382.5	182.0	734.5	599.5
56.3	657.0	401.0	1631.0	1886.5	670.0	948.5	792.5	682.5	868.0	967.0	221.0	236.0	416.0	196.0	796.0	634.5
57.6	689.0															



85.9	2145.0	1576.0	4414.0	5224.0	2149.0	2610.0	2268.5	1977.0	2557.5	2860.5	1449.5	1667.0	1743.5	1389.0	2312.0	1783.0
87.2	2189.0	1563.0	4430.0	5342.0	2191.0	2631.5	2294.5	2005.5	2581.5	2893.5	1496.5	1692.5	1787.0	1430.0	2378.0	1825.0
88.5	2241.0	1571.0	4531.0	5338.5	2245.0	2663.5	2318.0	2010.0	2635.5	2938.5	1528.5	1720.0	1823.0	1446.0	2396.5	1832.0
89.8	2294.0	1583.0	4539.0	5475.0	2314.0	2714.0	2352.0	2047.5	2677.0	2962.5	1570.5	1766.0	1828.0	1474.5	2448.5	1904.5
91.1	2341.0	1625.0	4643.0	5633.5	2375.0	2747.5	2425.0	2124.5	2736.5	3007.0	1560.0	1803.5	1895.5	1531.0	2487.0	1939.0
92.4	2415.0	1661.0	4688.0	5677.0	2442.0	2758.5	2516.0	2155.5	2787.5	3067.5	1614.0	1863.5	1921.0	1562.5	2530.5	1999.0
93.6	2457.0	1701.0	4736.0	5815.5	2510.5	2829.5	2532.0	2180.5	2871.5	3062.0	1658.5	1894.0	1967.0	1600.5	2633.0	2037.0
94.9	2504.0	1742.0	4761.0	5926.0	2603.5	2893.0	2578.5	2214.0	2907.0	3124.5	1676.0	1917.0	2022.0	1633.0	2652.5	2063.0
96.2	2496.0	1789.0	4825.0	6054.0	2653.0	2915.5	2634.0	2243.0	2973.0	3146.0	1697.5	1943.5	2061.0	1667.0	2691.0	2059.5
97.5	2567.0	1795.0	4903.0	6157.5	2762.0	2936.5	2672.5	2276.5	3029.5	3172.5	1777.0	1991.0	2132.0	1673.5	2703.0	2093.0
98.8	2535.0	1825.0	4908.0	6321.5	2851.5	2966.0	2750.0	2293.0	3065.5	3130.0	1789.5	2045.5	2164.5	1730.5	2772.0	2158.0
100.1	2586.0	1843.0	5043.0	6399.5	2936.0	3017.0	2750.0	2332.5	3113.5	3226.0	1843.5	2126.5	2206.0	1774.0	2792.5	2192.5
101.3	2628.0	1911.0	5048.0	6544.0	3049.5	3074.5	2810.5	2368.0	3220.5	3224.0	1836.5	2119.5	2262.5	1781.0	2872.0	2212.0
102.6	2629.0	1969.0	5189.0	6743.0	3142.5	3095.0	2851.0	2424.0	3283.5	3249.5	1870.0	2149.0	2299.5	1830.5	2843.5	2276.5
103.9	2631.0	1980.0	5137.0	6821.5	3250.0	3057.5	2865.0	2420.0	3285.5	3272.5	1896.5	2193.0	2344.5	1840.5	2920.5	2293.0
105.2	2656.0	2034.0	5290.0	7003.0	3398.0	3028.0	2995.0	2454.5	3353.0	3285.5	1915.5	2216.5	2400.0	1844.5	2946.0	2307.0
106.5	2685.0	2013.0	5439.0	7235.0	3476.0	3050.5	3013.5	2520.5	3427.5	3268.5	1931.0	2209.0	2443.5	1862.0	3013.0	2399.0
107.8	2670.0	1959.0	5397.0	7378.5	3648.0	3035.5	3070.5	2495.0	3485.5	3306.5	1912.5	2244.0	2483.0	1883.0	3067.0	2416.0
109.0	2706.0	2047.0	5560.0	7600.0	3836.5	3023.5	3111.0	2580.0	3564.0	3320.0	1898.0	2248.5	2525.5	1892.0	3135.5	2484.5
110.3	2673.0	2006.0	5573.0	7795.5	3962.5	3018.0	3169.0	2637.0	3590.0	3299.5	1908.5	2228.0	2548.0	1873.5	3176.5	2508.5
111.6	2745.0	2050.0	5680.0	8095.5	4107.0	3042.5	3218.5	2637.0	3673.0	3362.5	1872.0	2211.0	2584.0	1874.5	3243.5	2521.0
112.9	2718.0	2018.0	5842.0	8289.5	4386.0	3036.5	3310.0	2652.0	3703.0	3361.5	1951.5	2231.5	2619.5	1841.0	3280.5	2555.0
114.2	2707.0	2021.0	5833.0	8579.0	4573.5	3042.5	3328.5	2726.0	3784.0	3348.0	1927.5	2211.0	2719.0	1867.0	3355.5	2648.5
115.5	2704.0	1993.0	6046.0	8881.5	4810.0	3047.0	3370.0	2762.0	3835.0	3433.5	1942.5	2253.0	2781.5	1889.0	3388.0	2682.5
116.7	2759.0	2074.0	6083.0	9223.0	5117.0	3092.0	3452.0	2782.0	3884.0	3456.0	1967.0	2295.0	2840.0	1881.0	3463.0	2764.0
118.0	2677.0	2014.0	6323.0	9703.0	5427.0	3101.5	3472.5	2805.5	3979.5	3468.5	1989.0	2279.0	2908.0	1922.5	3511.0	2794.5
119.3	2722.0	2017.0	6547.0	10156.5	5846.5	3077.5	3501.0	2863.5	4033.5	3555.5	1986.0	2279.0	3049.0	1926.0	3553.5	2853.5
120.6	2709.0	2061.0	6683.0	10715.5	6260.5	3082.0	3551.5	2862.5	4102.0	3548.0	1995.5	2305.5	3118.0	1912.0	3578.0	2892.5
121.9	2653.0	2117.0	6910.0	11403.0	6765.0	3071.5	3599.0	2929.5	4100.0	3577.0	1880.0	2283.0	3268.0	1914.0	3653.5	2950.5
123.1	2636.0	2109.0	7281.0	12278.0	7394.5	3066.5	3619.5	2986.0	4172.0	3635.0	1977.0	2339.0	3410.0	1924.5	3763.5	2992.0
124.4	2569.0	2105.0	7588.0	13144.5	8189.0	3118.5	3655.5	2949.0	4210.0	3658.5	1996.0	2334.5	3634.0	1945.0	3765.5	3059.0
125.7	2563.0	2112.0	8039.0	14380.0	9095.0	3098.0	3731.5	2988.5	4264.0	3644.0	2001.0	2327.5	3807.0	1933.5	3849.0	3091.0
127.0	2590.0	2127.0	8421.0	15825.0	10242.5	3118.5	3759.5	3025.5	4257.5	3742.5	2015.0	2343.0	4090.0	1942.0	3911.0	3187.0
128.2	2550.0	2148.0	9125.0	17583.0	11519.5	3108.0	3789.0	3050.5	4302.0	3803.0	2025.0	2348.5	4409.5	1941.5	4024.5	3222.0
129.5	2559.0	2146.0	9836.0	19753.0	13352.0	3154.0	3824.0	3071.0	4393.0	3895.5	1988.5	2356.5	4765.5	1962.0	4119.0	3368.0
130.8	2495.0	2139.0	10780.0	22529.5	15425.0	3201.0	3871.5	3092.0	4390.0	4021.0	2087.5	2362.5	5311.0	1991.5	4193.5	3482.0
132.1	2512.0	2171.0	12041.0	26224.5	18402.0	3214.0	3909.0	3053.0	4459.0	4073.0	2070.5	2459.0	5919.5	1980.0	4323.5	3575.5
133.4	2458.0	2189.0	13653.0	30969.0	22302.5	3241.5	3863.5	3072.0	4475.0	4208.0	2080.0	2458.0	6734.0	2021.0	4467.0	3665.0
134.6	2495.0	2193.0	15921.0	37635.0	27527.5	3187.0	3914.0	3114.5	4450.5	4400.5	2113.0	2479.5	7818.5	2004.5	4648.0	3842.0
135.9	2451.0	2177.0	18788.0	46834.5	35141.0	3169.0	3944.5	3139.0	4501.0	4507.0	2146.5	2555.0	9244.5	2027.0	4913.0	4020.0
137.2	2506.0	2224.0	22842.0	59543.0	45387.0	3188.0	3964.0	3113.5	4493.0	4806.5	2163.0	2624.0	11345.0	2063.0	5219.0	4312.5
138.5	2448.0	2246.0	28214.0	64940.0	60529.0	3242.5	3988.0	3170.0	4559.5	5245.0	2223.5	2677.5	14110.5	2080.5	5689.0	4728.5
139.7	2535.0	2275.0	35304.0	64940.0	64940.0	3304.0	4031.5	3243.5	4546.5	5851.0	2281.5	2765.5	17677.5	2083.5	6307.5	5205.5
141.0	2797.0	2271.0	43121.0	64940.0	64940.0	3481.0	4056.0	3231.0	4637.0	6634.5	2364.5	2887.0	21807.5	2092.5	6881.0	5773.5
142.3	3351.0	2248.0	50415.0	64940.0	64940.0	3902.5	4103.5	3275.0	4649.0	7466.0	2370.0	2958.0	25769.0	2109.0	7541.0	6228.5
143.6	3793.0	2272.0	54819.0	64940.0	64940.0	4194.0	4195.5	3338.5	4684.0	7898.0	2399.5	3090.0	28235.0	2123.0	8011.0	6442.0
144.9	3353.0	2292.0	54216.0	64940.0	64940.0	3761.5	4191.0	3313.0	4695.5	7420.5	2389.5	3135.5	28317.0	2095.5	7980.0	6360.5
146.1	2778.0	2265.0	48991.0	64940.0	64940.0	3455.5	4136.0	3321.5	4656.0	6558.0	2375.5	3161.5	25766.0	2112.5	7630.0	5954.5
147.4	2521.0	2317.0	41371.0	64940.0	64940.0	3231.0	4180.0	3283.0	4683.5	5768.5	2306.0	3091.5	2736.0	2108.5	7083.0	5512.0
148.7	2414.0	2299.0	33659.0	64940.0	64940.0	3128.0	4157.0	3273.5	4630.0	5091.5	2287.5	2919.5	17756.5	2107.5	6484.0	4948.0
150.0	2325.0	2277.0	27293.0	62608.0	49953.5	3068.5	4123.5	3247.0	4658.0	4640.0	2227.0	2840.5	14344.5	2112.5	5908.0	4540.0
151.2	2294.0	2271.0	22412.0	48924.5	37419.0	2985.0	4126.0	3236.0	4593.0	4278.5	2218.0	2782.5	11608.5	2093.0	5491.0	4286.0
152.5	2293.0	2290.0	18546.0	39022.5	28796.5	2950.5	4134.5	3250.0	4632.5	4057.0	2219.0	2724.5	9595.5	2088.5	5216.0	4061.0
153.8	2283.0	2268.0	15637.0	31709.0	22720.0	2898.0	4175.0	3234.0	4670.5	3890.5	2179.5	2648.0	8074.5	2110.0	4982.0	3820.0
155.1	2223.0	2309.0	13609.0	26392.5	18397.0	2906.5	4175.0	3244.5	4647.0	3871.5	2157.5	2596.0	6894.0	2060.0	4770.5	3750.0
156.3	2235.0	2320.0	11909.0	22395.0	15107.5	2888.5	4133.0	3270.5	4680.0	3577.5	2180.0	2573.0	6037.5	2101.0	4679.5	3581.0
157.6	2217.0	2318.0	10712.0	19307.5	12732.0	2873.0	4165.0	3280.5	4665.0	3539.0	2137.0	2555.5	5345.0	2101.5	4561.5	3559.0
158.9	2195.0	2310.0	9725.0	16960.5	10845.0	2840.0	4205.5	3251.5	4610.0	3469.5	2149.5	2536.0	4798.0	2102.0	4471.0	3468.5
160.1	2111.0	2229.0	8906.0	15126.5	9395.0	2864.0	4223.0	3256.5	4624.5	3423.5	2122.5	2505.5	4361.5	2089.0	4453.0	3454.5
161.4	2185.0	2294.0	8199.0	13525.5	8155.0	2866.5	4178.0	3208.5	4669.5	3383.5	2141.5	2514.0	4024.0	2095.0	4338.0	3432.0
162.7	2215.0	2314.0	7719.0	12203.0	7222.5	2899.0	4172.0	3244.5	4641.0	3363.0	2140.5	2525.5	3768.0	2086.5	4294.0	3376.5
164.0	2224.0	2276.0	7363.0	11224.5	6449.0	2875.0	4174.5	3242.5	4616.5	3341.5	2169.5	2426.0	3539.0	2101.5	4345.0	3360.0
165.2	2254.0	2334.0	6979.0	10428.0	5805.0	2864.0	4133.0	3208.0	4587.0	3269.0	2137.5	2481.5	3334.0	2109.5	4257.0	3308.0
166.5	2245.0	2308.0	6741.0	9673.0	5263.0	2899.5	4182.5	3177.0	4599.5	3286.5	2126.5	2440.0	3186.0	2090.5	4253.5	3332.5
167.8	2277.0	2326.0														

213.4	3890.0	1980.0	4803.0	4886.0	1574.5	4300.0	3957.0	3165.0	4394.5	4424.0	1759.0	2041.0	1773.5	1701.5	3856.0	3114.0
214.7	3912.0	1961.0	4895.0	4846.0	1537.0	4337.0	3956.0	3177.0	4415.5	4491.0	1785.0	2014.0	1770.0	1710.5	3916.5	3121.0
216.0	3943.0	1930.0	4882.0	4831.5	1516.5	4347.5	4015.5	3182.5	4399.0	4527.0	1760.0	2003.5	1762.0	1709.5	3908.5	3148.5
217.2	4009.0	1942.0	4825.0	4797.0	1511.5	4401.5	3942.0	3212.0	4431.5	4575.0	1739.0	1966.5	1695.5	1690.5	3849.5	3148.5
218.5	4039.0	1909.0	4821.0	4752.5	1460.5	4467.5	4041.5	3236.5	4489.0	4561.0	1720.0	1970.5	1743.0	1673.0	3906.0	3159.5
219.8	4111.0	1905.0	4776.0	4746.5	1447.5	4447.5	4079.5	3277.0	4519.5	4597.0	1732.5	1954.0	1708.5	1665.0	3927.5	3155.5
221.0	4081.0	1869.0	4822.0	4688.5	1482.0	4538.5	4070.5	3309.5	4543.0	4639.5	1721.0	1920.0	1708.0	1671.0	3901.0	3166.0
222.3	4160.0	1907.0	4786.0	4744.5	1450.5	4541.0	4069.0	3346.5	4553.5	4673.0	1685.5	1921.0	1673.0	1639.0	3936.0	3165.0
223.5	4213.0	1885.0	4791.0	4662.5	1438.5	4531.5	4124.0	3412.0	4557.5	4685.5	1667.5	1900.5	1663.5	1625.0	3991.0	3161.0
224.8	4283.0	1857.0	4807.0	4639.5	1412.5	4580.0	4076.0	3450.5	4514.0	4749.5	1671.5	1880.0	1632.5	1588.5	3966.0	3175.5
226.1	4264.0	1845.0	4794.0	4675.0	1395.0	4625.5	4135.5	3520.5	4590.5	4717.0	1658.5	1876.0	1614.0	1595.0	4008.5	3228.0
227.3	4301.0	1819.0	4853.0	4674.0	1405.5	4623.5	4141.5	3505.0	4592.5	4799.5	1644.0	1868.0	1605.0	1600.0	3989.5	3254.0
228.6	4381.0	1842.0	4809.0	4630.0	1374.0	4673.0	4139.5	3473.0	4621.5	4802.5	1639.0	1868.0	1621.5	1571.5	3990.0	3230.5
229.8	4385.0	1796.0	4707.0	4635.0	1375.0	4683.5	4148.0	3440.5	4616.5	4827.5	1627.0	1815.0	1608.0	1592.0	4043.0	3247.5
231.1	4425.0	1837.0	4762.0	4620.0	1354.5	4705.5	4219.5	3468.5	4659.5	4872.0	1645.0	1824.0	1606.0	1566.5	4033.0	3262.5
232.4	4461.0	1809.0	4778.0	4615.5	1365.5	4732.5	4215.5	3388.0	4682.0	4849.5	1601.0	1857.0	1589.0	1574.5	4058.5	3248.0
233.6	4477.0	1811.0	4775.0	4627.0	1363.5	4756.5	4238.0	3463.5	4687.0	4881.0	1595.5	1811.5	1573.0	1526.5	4051.5	3265.5
234.9	4525.0	1780.0	4800.0	4587.0	1340.0	4772.0	4216.0	3430.0	4723.5	4934.5	1614.5	1833.5	1621.5	1565.0	4091.0	3337.0
236.2	4547.0	1770.0	4776.0	4620.0	1344.5	4813.5	4261.5	3400.0	4763.5	4941.0	1597.0	1822.5	1574.0	1563.0	4104.0	3316.5
237.4	4559.0	1761.0	4851.0	4605.5	1304.5	4740.0	4246.0	3377.0	4787.0	4981.5	1609.5	1815.0	1571.0	1537.5	4108.0	3306.5
238.7	4531.0	1717.0	4708.0	4592.5	1354.0	4806.0	4300.0	3430.0	4811.5	4929.0	1613.0	1786.0	1554.5	1542.0	4129.0	3358.0
239.9	4547.0	1761.0	4773.0	4605.0	1330.0	4806.5	4303.0	3438.5	4832.5	4947.0	1579.0	1773.5	1539.0	1551.5	4095.0	3347.0
241.2	4471.0	1719.0	4829.0	4633.5	1308.0	4818.0	4294.0	3452.5	4827.0	4984.0	1576.0	1756.0	1561.5	1544.5	4130.5	3346.0
242.5	4543.0	1791.0	4791.0	4614.5	1328.0	4806.5	4295.5	3464.5	4864.5	4956.0	1594.0	1769.0	1525.5	1538.0	4138.0	3386.0
243.7	4535.0	1775.0	4809.0	4588.5	1323.0	4785.0	4300.0	3498.5	4835.5	4967.0	1586.5	1777.5	1560.5	1496.5	4116.5	3412.0
245.0	4531.0	1726.0	4863.0	4606.0	1285.0	4746.0	4321.0	3453.5	4854.5	4915.0	1587.0	1783.0	1532.0	1510.5	4169.5	3364.5
246.2	4437.0	1737.0	4885.0	4600.0	1319.5	4768.0	4310.5	3504.0	4868.0	4921.0	1581.0	1740.5	1504.0	1508.5	4140.0	3366.0
247.5	4398.0	1781.0	4846.0	4602.0	1309.5	4708.0	4348.5	3466.5	4899.5	4842.5	1557.0	1791.0	1533.0	1499.0	4135.5	3375.0
248.7	4368.0	1711.0	4808.0	4618.5	1309.5	4676.0	4358.5	3474.5	4833.0	4851.0	1557.0	1757.5	1549.5	1428.5	4148.5	3381.0
250.0	4267.0	1729.0	4777.0	4605.5	1296.0	4642.0	4362.0	3463.5	4863.0	4797.0	1572.0	1751.0	1511.5	1482.0	4124.5	3336.0
251.3	4224.0	1723.0	4843.0	4657.0	1299.0	4616.5	4417.5	3497.0	4942.5	4755.0	1547.5	1756.5	1520.5	1516.0	4176.5	3390.0
252.5	4125.0	1773.0	4872.0	4645.0	1339.0	4631.5	4340.5	3466.0	4897.0	4738.0	1545.0	1746.0	1539.5	1480.0	4166.5	3352.0
253.8	4097.0	1717.0	4829.0	4617.5	1307.0	4612.0	4328.0	3495.5	4893.0	4726.0	1567.5	1709.0	1502.5	1481.0	4160.5	3356.0
255.0	3997.0	1728.0	4851.0	4599.5	1315.0	4561.0	4353.0	3462.5	4878.5	4638.0	1550.5	1739.0	1515.0	1472.0	4169.5	3382.0
256.3	3999.0	1738.0	4843.0	4659.0	1305.0	4527.0	4344.5	3471.5	4899.0	4648.5	1560.5	1703.0	1509.5	1493.5	4144.0	3339.0
257.5	3941.0	1730.0	4875.0	4646.0	1319.5	4535.0	4349.0	3506.5	4885.0	4639.0	1533.0	1739.0	1541.5	1454.0	4147.0	3355.0
258.8	3897.0	1728.0	4801.0	4646.0	1330.0	4520.0	4379.5	3472.5	4900.0	4581.0	1529.5	1688.5	1519.0	1446.0	4199.0	3322.0
260.1	3801.0	1715.0	4827.0	4666.5	1306.5	4498.0	4329.0	3469.5	4849.5	4614.0	1534.0	1728.0	1530.5	1482.0	4193.5	3353.5
261.3	3754.0	1767.0	4841.0	4695.5	1319.0	4553.5	4339.5	3524.5	4836.0	4589.0	1532.0	1706.0	1508.0	1460.5	4164.0	3382.5
262.6	3734.0	1715.0	4873.0	4704.0	1319.0	4588.5	4370.0	3455.5	4867.0	4608.5	1530.0	1765.0	1487.0	1463.5	4142.5	3357.0
263.8	3656.0	1741.0	4858.0	4659.0	1340.0	4583.0	4376.0	3482.0	4878.0	4619.0	1552.5	1706.0	1516.0	1476.0	4161.5	3395.0
265.1	3637.0	1705.0	4865.0	4740.5	1317.5	4517.5	4324.5	3497.5	4874.0	4668.5	1540.5	1744.0	1533.5	1453.5	4234.0	3439.0
266.3	3605.0	1739.0	4884.0	4695.0	1327.5	4487.0	4359.0	3486.0	4936.5	4704.0	1524.0	1702.0	1515.0	1465.5	4168.0	3419.5
267.6	3573.0	1760.0	4893.0	4715.0	1338.0	4471.0	4375.5	3444.0	4885.0	4642.0	1556.5	1748.0	1537.5	1478.5	4185.0	3420.0
268.8	3563.0	1760.0	4898.0	4676.0	1355.5	4427.0	4385.5	3485.0	4892.5	4649.0	1531.5	1742.0	1534.5	1483.0	4190.5	3429.5
270.1	3497.0	1729.0	4850.0	4702.5	1318.0	4304.0	4315.5	3431.5	4920.0	4461.5	1542.0	1716.0	1497.5	1483.5	4186.0	3402.0
271.4	3439.0	1685.0	4881.0	4750.5	1360.5	4309.0	4409.0	3434.0	4895.5	4415.0	1514.0	1717.0	1549.0	1485.5	4224.0	3424.0
272.6	3435.0	1703.0	4837.0	4752.5	1340.5	4221.0	4338.0	3485.5	4873.0	4360.5	1531.0	1727.0	1504.0	1497.5	4211.5	3420.0
273.9	3437.0	1747.0	4891.0	4757.0	1355.0	4159.5	4377.5	3494.0	4916.5	4318.0	1515.5	1702.5	1543.5	1469.0	4179.0	3380.0
275.1	3379.0	1719.0	4917.0	4722.0	1335.5	4150.5	4388.5	3548.5	4901.5	4279.0	1534.5	1724.5	1502.5	1459.0	4196.5	3378.5
276.4	3377.0	1741.0	4931.0	4765.0	1351.0	4069.0	4362.0	3461.0	4883.5	4212.0	1550.5	1726.0	1536.5	1445.0	4207.5	3355.0
277.6	3318.0	1735.0	4929.0	4771.5	1354.5	4076.0	4404.0	3518.5	4900.5	4165.0	1547.0	1717.0	1540.5	1473.5	4193.0	3381.5
278.9	3263.0	1763.0	4914.0	4804.0	1350.0	3986.5	4418.0	3547.5	4911.0	4152.0	1515.5	1715.0	1548.0	1473.0	4197.5	3381.5
280.1	3266.0	1714.0	4923.0	4820.5	1362.5	3935.5	4347.0	3524.5	4918.0	4073.5	1527.0	1708.0	1542.5	1467.0	4295.0	3389.5
281.4	3203.0	1749.0	4890.0	4799.5	1335.0	3926.5	4403.0	3522.5	4876.0	4045.0	1552.0	1690.0	1569.0	1471.0	4263.0	3309.0
282.6	3191.0	1738.0	4936.0	4803.5	1345.0	3888.5	4396.5	3562.0	4893.0	4062.5	1512.0	1697.5	1540.0	1457.5	4240.0	3409.0
283.9	3175.0	1762.0	4951.0	4803.0	1383.5	3837.0	4401.5	3548.0	4922.5	3984.0	1554.0	1712.5	1534.0	1457.5	4232.0	3387.0
285.1	3145.0	1759.0	4964.0	4855.0	1374.0	3807.5	4433.5	3546.5	4968.0	3949.0	1542.0	1726.0	1557.0	1480.0	4273.0	3406.5
286.4	3093.0	1773.0	4997.0	4890.5	1375.5	3786.0	4415.5	3564.5	4947.0	3930.5	1520.0	1711.0	1539.5	1486.0	4308.5	3389.5
287.6	3063.0	1773.0	4974.0	4912.0	1390.5	3747.5	4415.5	3594.5	4911.0	3897.5	1515.0	1714.0	1564.0	1509.5	4262.5	3422.0
288.9	3077.0	1738.0	4967.0	4899.5	1392.0	3724.5	4464.5	3609.5	4960.0	3892.0	1568.0	1717.5	1556.5	1476.0	4333.0	3420.5
290.1	3061.0	1721.0	4977.0	4875.0	1406.5	3719.5	4423.0	3624.0	4893.5	3870.0	1556.0	1746.0	1566.0	1481.0	4360.5	3420.5
291.4	3026.0	1761.0	5052.0	4969.0	1409.0	3678.5	4449.5	3631.0	4991.0	3812.5	1555.0	1744.5	1597.5	1483.0	4365.5	3447.0
292.6	2975.0	1801.0	4999.0	4988.0	1402.0	3646.5	4423.0	3663.5	4930.0	3771.5	1518.5	1732.0	1549.5	1473.0	4355.5	3456.0
293.9	2959.0	1779.0	5035.0	4965.5	1436.0	3633.0	4489.0	3684.0	4945.0	3761.5						

338.8	3007.0	1911.0	5310.0	5384.0	1554.5	3966.5	4759.0	3568.0	5202.0	4074.5	1655.5	1854.0	1718.0	1590.5	4668.0	3771.0
340.0	3031.0	1912.0	5283.0	5374.0	1566.0	3895.5	4698.5	3599.0	5204.5	4045.5	1632.0	1856.5	1726.0	1580.0	4661.5	3757.5
341.3	3031.0	1914.0	5327.0	5401.0	1539.5	3899.5	4756.0	3598.0	5147.5	4046.5	1657.0	1858.5	1761.0	1603.5	4666.5	3761.0
342.5	3026.0	1938.0	5348.0	5434.0	1565.5	3890.0	4750.0	3567.0	5203.0	3957.5	1678.5	1840.5	1761.5	1561.0	4630.0	3707.0
343.7	3044.0	1951.0	5306.0	5402.0	1555.0	3891.5	4763.5	3592.5	5226.5	3946.0	1671.5	1860.5	1749.0	1608.5	4672.0	3703.5
345.0	3051.0	1945.0	5342.0	5469.5	1547.0	3871.5	4692.0	3631.5	5198.0	3950.0	1683.0	1871.0	1761.0	1581.0	4638.5	3715.5
346.2	3040.0	1919.0	5388.0	5476.5	1530.0	3940.0	4723.5	3640.5	5208.0	3979.0	1674.0	1915.5	1765.5	1626.5	4594.0	3716.5
347.5	3083.0	1939.0	5342.0	5523.5	1568.0	3884.0	4765.0	3579.5	5218.0	3962.0	1664.5	1862.0	1772.0	1587.0	4599.0	3701.5
348.7	3096.0	1931.0	5368.0	5479.0	1561.0	3952.5	4719.0	3595.0	5244.5	4014.5	1670.5	1880.0	1758.5	1614.0	4627.0	3688.0
349.9	3067.0	1953.0	5453.0	5556.0	1623.5	3902.5	4704.5	3623.0	5261.0	3934.5	1638.0	1848.0	1776.0	1601.0	4636.5	3683.5
351.2	3029.0	1945.0	5359.0	5529.5	1602.0	3955.0	4695.5	3609.5	5183.0	3987.5	1648.0	1860.0	1772.5	1600.0	4599.0	3695.5
352.4	3125.0	1929.0	5424.0	5614.5	1598.0	3944.0	4691.0	3592.0	5223.0	4010.5	1667.5	1876.0	1757.5	1611.5	4620.0	3717.0
353.7	3098.0	1871.0	5483.0	5576.5	1614.0	3945.0	4748.5	3618.0	5214.5	4031.5	1690.5	1881.0	1784.0	1609.0	4618.0	3651.5
354.9	3119.0	1961.0	5431.0	5666.0	1627.5	3970.0	4722.0	3583.0	5199.5	3992.5	1665.5	1880.0	1785.5	1609.0	4609.0	3665.5
356.2	3132.0	1920.0	5431.0	5673.0	1621.0	3975.0	4755.5	3570.5	5205.5	4024.0	1686.5	1892.5	1838.0	1603.5	4569.0	3640.0
357.4	3161.0	1935.0	5470.0	5754.0	1648.5	3999.0	4761.0	3600.0	5230.0	4008.5	1691.0	1880.0	1850.5	1612.5	4637.0	3705.0
358.6	3181.0	1959.0	5373.0	5830.5	1669.0	4022.0	4751.0	3608.5	5185.0	4098.5	1691.0	1884.0	1827.5	1629.0	4594.0	3701.0
359.9	3194.0	1953.0	5507.0	5782.0	1686.5	4014.0	4708.0	3584.0	5238.5	4066.5	1682.5	1910.0	1865.0	1615.0	4567.0	3691.0
361.1	3128.0	1980.0	5513.0	5892.5	1699.5	4010.5	4737.5	3582.5	5275.5	4087.0	1685.0	1918.0	1861.0	1619.0	4616.0	3724.5
362.3	3179.0	1955.0	5536.0	5955.5	1685.0	4064.0	4728.0	3606.0	5217.5	4067.0	1678.5	1901.5	1893.5	1629.5	4597.0	3671.0
363.6	3221.0	1935.0	5592.0	6028.0	1706.0	4049.0	4674.0	3617.0	5200.0	4103.5	1698.0	1894.5	1862.5	1621.0	4629.5	3691.5
364.8	3173.0	1953.0	5593.0	6024.5	1739.0	4051.5	4687.0	3593.5	5230.0	4083.0	1693.0	1878.5	1892.5	1643.0	4602.0	3745.0
366.1	3212.0	1974.0	5618.0	6156.0	1750.0	4045.5	4725.5	3607.5	5236.5	4062.0	1713.0	1908.0	1900.0	1624.5	4640.5	3712.0
367.3	3221.0	1981.0	5626.0	6206.0	1814.0	4079.0	4726.5	3627.0	5214.0	4128.5	1694.5	1910.0	1955.5	1639.0	4658.5	3736.5
368.5	3189.0	1980.0	5697.0	6342.0	1833.5	4051.5	4736.5	3586.0	5256.0	4108.5	1691.5	1915.0	1968.5	1614.0	4638.5	3771.0
369.8	3216.0	1993.0	5641.0	6470.0	1855.5	4072.5	4770.0	3639.0	5271.5	4097.0	1698.5	1942.0	1974.0	1660.5	4687.5	3707.0
371.0	3221.0	1939.0	5755.0	6550.0	1878.5	4092.0	4710.0	3632.0	5279.0	4096.0	1708.0	1930.5	2026.0	1634.0	4639.0	3742.0
372.3	3181.0	2003.0	5753.0	6751.0	1935.0	4134.5	4727.0	3625.0	5284.0	4159.5	1665.5	1932.5	2062.0	1616.0	4654.0	3740.0
373.5	3171.0	1929.0	5711.0	6907.5	1976.0	4096.0	4778.0	3685.0	5276.0	4116.0	1674.0	1918.0	2098.5	1615.5	4607.0	3743.0
374.7	3171.0	1963.0	5870.0	7120.5	2008.0	4136.0	4729.0	3600.5	5286.0	4128.0	1679.5	1932.0	2083.5	1614.0	4722.5	3734.0
376.0	3183.0	1986.0	5852.0	7259.5	2070.0	4096.5	4764.5	3634.5	5301.5	4184.5	1677.0	1890.0	2116.5	1619.5	4692.5	3739.5
377.2	3189.0	1925.0	6040.0	7545.5	2145.0	4147.5	4803.0	3662.0	5270.0	4160.0	1682.0	1899.5	2152.5	1601.0	4700.0	3784.0
378.4	3194.0	1946.0	6048.0	7817.0	2201.5	4191.0	4820.0	3677.0	5316.0	4143.0	1653.0	1877.0	2231.0	1604.0	4769.5	3842.0
379.7	3230.0	1976.0	6139.0	8103.0	2308.0	4173.0	4835.5	3684.0	5312.5	4172.5	1663.5	1855.0	2251.0	1587.0	4786.0	3831.0
380.9	3137.0	1962.0	6227.0	8525.5	2402.5	4143.0	4825.5	3671.5	5373.0	4216.5	1667.0	1876.0	2343.0	1595.5	4828.5	3889.0
382.1	3215.0	1996.0	6317.0	8914.0	2545.5	4153.0	4884.0	3705.0	5400.5	4252.5	1643.5	1865.5	2396.0	1598.0	4818.5	3877.5
383.4	3200.0	1943.0	6398.0	9246.5	2671.0	4203.0	4917.5	3707.0	5407.5	4231.0	1651.0	1879.0	2510.5	1568.5	4906.5	3923.5
384.6	3231.0	1950.0	6511.0	9771.0	2825.0	4261.5	4961.0	3736.5	5427.0	4312.5	1625.0	1868.5	2541.0	1584.5	4894.0	3982.0
385.8	3265.0	1947.0	6684.0	10266.0	2990.5	4280.5	4945.5	3729.0	5475.0	4327.5	1652.0	1838.0	2614.0	1582.0	4977.0	3996.0
387.1	3256.0	1921.0	6809.0	10847.5	3155.5	4267.5	5016.5	3791.0	5541.5	4354.0	1630.0	1853.5	2694.0	1594.5	4962.0	3980.0
388.3	3306.0	1937.0	7041.0	11403.5	3316.5	4309.5	5058.0	3762.0	5586.0	4438.0	1647.0	1862.0	2798.0	1571.0	5046.5	4060.0
389.5	3288.0	1956.0	7200.0	11972.5	3538.5	4315.0	5085.5	3786.5	5590.0	4422.0	1626.0	1852.5	2884.0	1581.0	5047.0	4120.5
390.8	3281.0	1947.0	7296.0	12631.5	3716.0	4375.0	5119.5	3785.0	5607.0	4479.5	1643.0	1843.5	2964.5	1574.0	5168.5	4121.0
392.0	3295.0	1913.0	7508.0	13130.0	3921.0	4380.5	5190.5	3862.0	5646.5	4510.0	1654.0	1836.5	3072.5	1568.5	5213.5	4180.0
393.3	3341.0	1909.0	7606.0	13609.0	4079.5	4383.0	5210.0	3858.5	5711.0	4564.5	1646.5	1819.0	3143.5	1567.0	5276.0	4234.0
394.5	3365.0	1961.0	7722.0	13935.5	4281.0	4457.0	5294.0	3875.5	5785.0	4599.0	1611.0	1816.0	3176.5	1555.0	5314.0	4258.0
395.7	3425.0	1913.0	7799.0	14121.5	4360.5	4494.5	5253.0	3939.5	5802.0	4686.5	1641.0	1859.5	3193.0	1549.5	5367.5	4329.0
396.9	3402.0	1937.0	7732.0	14175.0	4372.0	4586.0	5377.0	3953.5	5849.0	4737.5	1641.0	1829.5	3219.5	1572.0	5410.0	4363.0
398.2	3427.0	1939.0	7689.0	13954.5	4309.5	4601.0	5416.5	3975.5	5870.5	4720.5	1629.5	1837.5	3295.5	1563.0	5438.5	4403.0
399.4	3431.0	1921.0	7664.0	13652.0	4247.5	4663.0	5544.0	4004.0	5992.0	4787.5	1631.0	1856.5	3093.5	1543.0	5529.0	4409.0
400.6	3474.0	1944.0	7532.0	13038.5	4041.0	4715.0	5461.5	4044.0	6077.0	4830.0	1637.5	1834.0	3349.5	1548.5	5576.0	4476.0
401.9	3552.0	1916.0	7299.0	12400.5	3841.0	4733.5	5561.0	4064.0	6096.0	4863.5	1605.5	1852.5	2956.5	1555.0	5637.5	4497.5
403.1	3604.0	1947.0	7117.0	11742.5	3616.0	4857.5	5593.5	4094.5	6190.0	4917.0	1634.0	1845.5	2815.0	1549.5	5651.0	4517.5
404.3	3559.0	1924.0	6989.0	11034.0	3360.5	4877.0	5718.0	4127.0	6263.0	4990.0	1645.0	1851.0	2688.0	1543.0	5695.0	4571.0
405.6	3673.0	1954.0	6838.0	10358.0	3163.5	4968.5	5787.5	4188.5	6258.5	5019.0	1614.0	1825.5	2589.5	1571.0	5779.5	4649.5
406.8	3758.0	1927.0	6733.0	9900.0	2940.0	4988.5	5869.5	4193.5	6329.0	5091.5	1609.0	1825.5	2516.0	1543.5	5745.0	4631.0
408.0	3785.0	1941.0	6658.0	9300.5	2776.5	5151.5	5873.0	4239.5	6387.5	5215.5	1618.0	1832.5	2406.5	1551.0	5874.0	4710.5
409.3	3881.0	1911.0	6503.0	8868.0	2574.0	5197.5	5940.5	4246.5	6441.0	5220.5	1632.5	1832.0	2318.0	1563.0	5902.0	4724.5
410.5	3948.0	1930.0	6356.0	8450.0	2461.0	5294.0	5964.0	4291.0	6539.0	5356.5	1645.0	1837.0	2247.5	1543.0	5894.5	4755.0
411.7	4042.0	1911.0	6280.0	8049.5	2319.0	5409.0	6023.5	4345.5	6569.0	5413.0	1640.5	1845.0	2207.0	1568.0	5957.5	4782.5
413.0	4093.0	1910.0	6250.0	7829.5	2236.5	5537.5	6131.0	4349.5	6626.0	5492.0	1587.0	1817.5	2141.5	1557.5	5977.5	4820.5
414.2	4151.0	1909.0	6145.0	7531.0	2164.0	5601.5	6169.5	4365.5	6682.5	5560.5	1648.5	1854.5	2105.0	1581.5	6031.0	4842.0
415.4	4274.0	1949.0	6097.0	7357.5	2076.5	5742.0	6192.0	4375.0	6651.0	5708.5	1632.5	1820.0	2064.0	1563.0	6098.5	4944.5
416.6	4373.0	1920.0	6072.0	7166.5	2001.5	5873.5	6310.0	4446.0	6822.5	5822.0	1666.0	1808.0	2033.5	1558.5	6101.5	4933.0
417.9	4421.0	1899.0	6023.0	6913.5	1959.0	6014.5	6351.0	4461.5	68							

462.0	5682.0	1903.0	5815.0	5840.5	1594.5	7944.0	5838.5	4253.5	6309.0	7771.0	1583.5	1803.0	1758.0	1544.5	5610.5	4777.0
463.2	5538.0	1921.0	5872.0	5831.5	1600.0	7688.5	5687.0	4178.0	6263.5	7384.0	1610.5	1791.5	1739.0	1554.0	5472.0	4743.0
464.4	5288.0	1887.0	5807.0	5806.0	1587.0	7313.5	5653.5	4135.0	6099.5	7083.0	1607.5	1806.0	1778.0	1556.5	5384.0	4613.0
465.7	5060.0	1929.0	5779.0	5876.5	1593.5	6961.0	5527.0	4092.5	6002.0	6733.0	1591.0	1776.0	1760.0	1562.0	5348.0	4543.0
466.9	4850.0	1944.0	5817.0	5846.0	1625.0	6706.5	5458.0	4087.0	5968.0	6551.0	1597.0	1804.0	1777.5	1539.5	5206.5	4434.5
468.1	4683.0	1958.0	5793.0	5841.0	1595.0	6422.5	5342.0	4008.5	5893.0	6249.0	1618.5	1826.5	1770.5	1582.5	5171.5	4383.5
469.3	4490.0	1921.0	5754.0	5848.5	1620.0	6134.0	5277.5	3961.0	5787.5	5988.0	1631.0	1834.0	1782.5	1571.0	5071.5	4304.5
470.5	4304.0	1914.0	5795.0	5899.5	1606.0	5907.5	5224.0	3928.0	5658.5	5710.5	1622.0	1821.0	1823.0	1571.0	4978.5	4253.5
471.8	4123.0	1953.0	5720.0	5889.0	1600.0	5717.5	5126.5	3917.0	5620.5	5524.0	1627.0	1823.5	1820.5	1586.5	4947.0	4180.0
473.0	3973.0	1943.0	5714.0	5894.5	1635.5	5447.5	5079.0	3807.0	5565.0	5344.5	1620.0	1807.5	1828.0	1554.5	4872.0	4103.5
474.2	3839.0	1975.0	5800.0	5930.5	1633.5	5292.0	5017.0	3821.0	5478.0	5123.5	1618.0	1810.5	1796.0	1554.0	4846.5	4073.0
475.4	3757.0	1959.0	5750.0	5965.0	1666.0	5142.0	4944.0	3783.5	5447.0	4990.0	1642.5	1854.0	1843.5	1586.5	4792.0	3983.5
476.6	3657.0	1951.0	5773.0	5946.5	1639.0	4979.0	4908.5	3728.0	5384.5	4862.5	1591.5	1852.0	1836.5	1585.0	4743.5	3988.5
477.9	3508.0	2003.0	5867.0	5974.5	1648.0	4861.0	4871.5	3712.5	5357.0	4773.5	1629.0	1820.0	1843.0	1568.0	4683.0	3905.0
479.1	3404.0	1994.0	5795.0	6061.0	1652.5	4714.0	4817.0	3698.0	5304.0	4624.0	1644.0	1817.5	1850.0	1590.5	4647.0	3880.0
480.3	3360.0	1929.0	5754.0	6032.0	1682.0	4644.5	4717.5	3634.0	5282.0	4486.0	1635.0	1857.0	1857.0	1590.5	4631.5	3875.5
481.5	3288.0	1971.0	5725.0	6103.5	1683.0	4550.5	4705.0	3660.0	5239.0	4458.0	1640.5	1807.5	1853.5	1601.0	4539.5	3855.5
482.7	3188.0	1979.0	5797.0	6170.0	1692.5	4464.0	4722.5	3614.0	5206.5	4372.5	1641.5	1868.5	1855.0	1593.0	4570.5	3756.5
484.0	3155.0	1925.0	5796.0	6162.5	1691.5	4377.0	4655.0	3601.0	5138.5	4228.5	1654.5	1833.0	1886.5	1587.0	4501.0	3762.5
485.2	3093.0	2026.0	5809.0	6155.0	1696.0	4314.5	4592.5	3611.5	5109.5	4158.5	1633.0	1836.0	1906.0	1608.0	4457.5	3709.5
486.4	2985.0	1990.0	5842.0	6226.0	1697.5	4221.0	4562.5	3564.5	5038.5	4106.5	1664.0	1870.5	1910.0	1591.0	4402.0	3660.5
487.6	2957.0	2009.0	5857.0	6289.5	1746.0	4144.5	4551.5	3552.5	5015.0	4025.0	1644.0	1884.0	1926.0	1597.5	4411.0	3654.5
488.8	2926.0	2021.0	5835.0	6372.0	1728.0	4071.5	4496.5	3570.0	5009.0	4014.0	1674.0	1886.5	1950.0	1608.5	4413.5	3658.5
490.0	2893.0	1973.0	5895.0	6463.0	1772.0	4058.5	4505.5	3523.5	4994.0	3962.0	1680.0	1873.0	1956.5	1598.0	4397.5	3639.0
491.3	2863.0	2035.0	5851.0	6529.5	1792.5	3986.5	4451.0	3532.0	4959.5	3884.0	1665.5	1907.0	1970.5	1602.5	4322.0	3588.0
492.5	2796.0	2042.0	5913.0	6648.0	1803.5	3971.5	4407.5	3514.0	4934.0	3883.5	1686.5	1876.0	2010.0	1623.0	4362.5	3605.0
493.7	2795.0	2045.0	5942.0	6741.0	1841.0	3919.0	4460.0	3491.0	4959.5	3863.0	1685.0	1914.0	2010.0	1631.0	4335.0	3522.0
494.9	2697.0	2040.0	6035.0	6841.0	1851.5	3891.5	4400.0	3511.5	4981.5	3808.5	1685.5	1877.0	2057.5	1594.5	4321.0	3602.0
496.1	2677.0	2067.0	6012.0	6938.5	1908.0	3842.5	4390.0	3486.0	4881.0	3769.0	1656.0	1907.0	2084.5	1621.5	4263.0	3590.5
497.3	2723.0	2042.0	6031.0	7126.0	1910.5	3819.0	4328.5	3483.5	4855.5	3765.0	1672.0	1917.5	2114.0	1652.0	4290.5	3549.5
498.6	2697.0	2035.0	6053.0	7225.0	1966.0	3823.0	4361.0	3423.5	4853.5	3784.0	1679.0	1901.5	2188.5	1629.0	4280.5	3544.5
499.8	2693.0	2027.0	6149.0	7488.5	2028.5	3768.5	4313.0	3459.0	4775.0	3745.0	1696.5	1927.5	2200.5	1656.0	4238.0	3517.0
501.0	2689.0	2057.0	6206.0	7761.5	2075.5	3772.5	4303.5	3474.0	4829.5	3749.5	1682.5	1917.0	2269.0	1679.5	4262.0	3511.0
502.2	2696.0	2036.0	6304.0	8053.0	2118.0	3762.5	4282.5	3443.0	4799.5	3719.5	1703.5	1905.0	2322.5	1642.5	4264.5	3537.5
503.4	2693.0	2086.0	6370.0	8381.5	2225.0	3739.0	4328.0	3405.0	4777.0	3719.0	1706.0	1920.5	2360.5	1667.0	4259.5	3486.5
504.6	2649.0	2069.0	6473.0	8780.0	2323.5	3704.0	4303.0	3454.5	4767.0	3703.5	1732.0	1954.5	2465.5	1662.0	4250.0	3508.5
505.9	2627.0	2094.0	6640.0	9274.5	2476.0	3713.5	4233.0	3400.0	4753.5	3705.0	1709.0	1943.0	2568.0	1640.0	4261.5	3530.5
507.1	2687.0	2057.0	6752.0	9800.5	2642.5	3761.5	4263.5	3438.5	4769.0	3724.5	1719.5	1944.5	2664.0	1657.0	4233.0	3531.5
508.3	2691.0	2075.0	6953.0	10297.5	2787.0	3734.0	4261.5	3410.0	4785.0	3708.0	1735.0	1941.0	2763.5	1668.5	4243.5	3548.0
509.5	2731.0	2051.0	7111.0	11048.5	2928.0	3763.0	4263.0	3417.0	4768.0	3766.0	1699.5	1946.0	2819.5	1636.5	4300.0	3574.0
510.7	2693.0	2057.0	7177.0	11550.0	3122.0	3747.5	4268.0	3469.0	4773.5	3756.0	1730.0	1959.0	2941.5	1672.0	4277.0	3550.0
511.9	2718.0	2040.0	7357.0	11984.5	3295.5	3718.0	4254.0	3446.5	4778.0	3778.5	1732.0	1972.0	2961.0	1691.5	4280.5	3534.5
513.1	2709.0	2100.0	7434.0	12346.0	3425.5	3771.0	4277.0	3396.0	4789.5	3751.0	1725.5	1980.5	3036.5	1654.5	4283.0	3569.0
514.3	2696.0	2093.0	7497.0	12587.0	3478.0	3734.0	4236.0	3404.5	4788.0	3798.0	1742.5	1960.5	3052.0	1679.0	4319.5	3521.5
515.6	2704.0	2059.0	7504.0	12520.5	3460.5	3743.5	4241.5	3406.5	4774.0	3802.0	1734.5	1982.5	3051.0	1660.5	4334.5	3570.0
516.8	2731.0	2109.0	7461.0	12403.5	3411.0	3747.5	4274.0	3463.0	4774.5	3786.0	1732.0	1964.0	3020.0	1682.0	4311.0	3591.5
518.0	2730.0	2076.0	7491.0	12306.0	3401.0	3746.0	4314.5	3438.5	4776.5	3777.0	1733.5	1976.5	3004.0	1663.0	4311.5	3579.0
519.2	2735.0	2078.0	7370.0	12023.0	3339.5	3706.5	4316.0	3459.0	4809.5	3789.0	1735.5	1982.5	2926.5	1673.5	4339.0	3575.0
520.4	2735.0	2060.0	7353.0	11652.5	3230.5	3752.0	4258.0	3451.0	4760.5	3807.5	1735.0	1998.0	2901.0	1676.0	4292.5	3563.5
521.6	2771.0	2101.0	7244.0	11317.0	3125.0	3741.5	4321.0	3436.0	4806.5	3767.5	1733.0	1983.5	2843.0	1714.5	4283.5	3564.0
522.8	2758.0	2111.0	7119.0	10920.0	2974.0	3706.0	4296.0	3468.5	4765.5	3787.0	1756.0	1981.5	2788.0	1699.0	4324.0	3567.0
524.0	2757.0	2087.0	7040.0	10491.0	2910.0	3708.0	4358.0	3472.0	4813.5	3764.0	1747.5	1974.0	2687.0	1715.0	4308.0	3552.5
525.3	2739.0	2095.0	6924.0	10113.0	2799.5	3720.0	4337.5	3484.5	4829.0	3776.5	1749.5	2003.0	2685.0	1732.0	4306.5	3593.5
526.5	2760.0	2087.0	6843.0	9736.0	2694.5	3690.0	4322.5	3508.0	4848.0	3733.0	1751.0	1970.0	2609.0	1690.5	4330.5	3562.0
527.7	2757.0	2065.0	6715.0	9460.0	2602.0	3720.0	4343.0	3472.0	4833.0	3741.5	1733.0	2042.5	2530.0	1698.5	4275.5	3547.0
528.9	2747.0	2117.0	6624.0	9117.5	2505.0	3721.5	4319.0	3510.0	4816.5	3727.0	1761.5	2037.0	2527.5	1714.0	4318.0	3541.5
530.1	2781.0	2071.0	6594.0	8806.5	2413.5	3727.0	4326.5	3487.0	4797.0	3727.5	1743.0	2016.0	2419.0	1711.5	4275.5	3558.5
531.3	2786.0	2089.0	6456.0	8560.0	2328.0	3721.5	4317.0	3521.0	4803.5	3677.5	1763.5	1991.0	2416.5	1750.0	4344.5	3551.0
532.5	2799.0	2134.0	6423.0	8297.0	2296.5	3724.0	4317.0	3489.0	4814.5	3697.0	1740.5	1988.5	2398.0	1720.5	4309.0	3529.5
533.7	2808.0	2015.0	6330.0	8083.5	2220.5	3677.5	4351.0	3549.5	4853.0	3633.0	1742.0	1989.0	2356.0	1704.0	4258.0	3536.5
534.9	2823.0	2115.0	6195.0	7844.5	2159.5	3709.5	4342.0	3507.0	4864.0	3666.5	1761.0	2016.5	2329.0	1727.5	4267.0	3577.5
536.1	2856.0	2097.0	6251.0	7745.0	2160.0	3733.0	4384.0	3550.0	4837.0	3685.5	1788.5	2009.5	2304.5	1707.5	4300.5	3535.0
537.4	2867.0	2137.0	6145.0	7573.5	2042.0	3706.5	4355.0	3516.0	4792.5	3683.5	1771.0	2029.0	2247.0	1744.5	4310.0	3538.0
538.6	2887.0	2099.0	6197.0	7417.5	2055.0	3720.5	4348.0	3529.0	4879.0	3689.5	1751.0	2027.0	2233.0	1727.0	4303.0	3515.5
539.8	2875.0	2113.0	6171.0	7306.0	2023.0	3721.0	4379.5	3563.5	4918							



583.2	6753.0	1992.0	5952.0	6175.0	1855.0	5704.0	4827.0	4155.0	5234.0	5109.5	1658.5	1888.0	1945.0	1604.0	4788.0	3918.0
584.4	6965.0	1991.0	5981.0	6156.5	1843.5	5846.5	4875.0	4129.0	5283.5	5238.0	1661.0	1901.5	1920.0	1607.0	4782.0	3915.5
585.6	7214.0	2006.0	5946.0	6152.5	1840.0	5998.5	4864.5	4181.5	5285.0	5351.0	1667.0	1896.0	1916.0	1612.5	4814.5	3899.0
586.8	7484.0	1971.0	5980.0	6207.5	1900.0	6104.0	4920.0	4171.5	5280.0	5472.5	1632.5	1892.0	1927.0	1588.0	4839.0	3987.0
588.0	7743.0	1965.0	5978.0	6151.0	1880.5	6280.5	4938.0	4194.0	5334.0	5531.0	1667.0	1877.0	1920.0	1603.0	4875.0	3948.0
589.2	8018.0	1957.0	5985.0	6228.0	1921.5	6393.5	4904.0	4252.0	5283.5	5722.0	1664.5	1861.5	1940.5	1613.5	4866.5	3977.5
590.4	8447.0	1973.0	5995.0	6248.0	1923.5	6594.5	5000.0	4257.5	5384.0	5793.0	1638.5	1890.5	1931.5	1612.5	4904.5	3983.0
591.6	8661.0	1951.0	6074.0	6327.0	1935.0	6755.0	4984.0	4299.0	5369.5	5925.0	1664.0	1882.0	1898.5	1591.0	4930.5	4032.0
592.8	8984.0	1971.0	6060.0	6322.0	1958.5	6920.0	5000.0	4333.0	5390.5	6131.5	1625.0	1896.0	1948.0	1597.0	4911.0	4038.5
594.0	9366.0	1981.0	6093.0	6360.5	1998.0	7159.5	5068.0	4341.0	5458.5	6260.5	1642.0	1874.5	1931.0	1589.0	4969.0	4090.0
595.2	9730.0	1995.0	6071.0	6375.5	2051.0	7318.0	5073.0	4444.5	5451.5	6425.0	1656.5	1880.0	1938.5	1589.5	5021.0	4069.0
596.4	10095.0	2033.0	6090.0	6433.0	2080.0	7528.0	5145.5	4446.5	5554.0	6614.0	1639.0	1898.0	1944.0	1587.0	5053.0	4144.0
597.6	10521.0	1985.0	6107.0	6526.0	2093.5	7790.5	5180.0	4421.0	5560.0	6774.0	1658.0	1890.5	1948.0	1570.0	5066.5	4186.0
598.8	10925.0	1979.0	6185.0	6517.5	2140.5	8019.5	5215.5	4534.5	5576.5	6929.5	1638.5	1881.0	1971.0	1572.0	5159.5	4199.5
600.0	11417.0	1983.0	6211.0	6575.0	2180.0	8231.5	5265.5	4530.0	5626.5	7099.0	1633.5	1895.0	1990.5	1614.5	5188.5	4253.0
601.2	11805.0	2001.0	6251.0	6754.5	2212.5	8508.0	5280.0	4589.5	5643.5	7289.0	1658.5	1891.5	1997.0	1589.5	5238.0	4269.5
602.4	12246.0	1975.0	6217.0	6771.0	2292.0	8701.5	5309.0	4649.0	5682.0	7479.0	1635.0	1899.0	1979.0	1591.5	5226.0	4336.5
603.6	12549.0	2029.0	6353.0	6770.5	2295.0	8896.5	5395.0	4696.5	5733.5	7662.0	1612.5	1894.0	1971.0	1589.5	5325.5	4365.0
604.8	12975.0	1972.0	6382.0	6909.0	2395.0	9079.0	5401.0	4691.0	5727.5	7806.0	1656.0	1900.0	2057.0	1574.0	5319.5	4406.5
606.0	13399.0	1965.0	6449.0	6950.5	2460.0	9242.0	5456.5	4768.0	5755.5	7922.5	1672.5	1880.5	2061.5	1616.0	5375.5	4420.0
607.2	13725.0	2023.0	6469.0	7100.5	2532.5	9460.0	5452.5	4796.0	5792.0	8089.0	1655.5	1878.0	2051.5	1598.0	5392.0	4450.5
608.3	13969.0	1974.0	6530.0	7162.5	2583.0	9593.5	5452.0	4748.0	5745.5	8198.0	1643.5	1884.5	2072.5	1604.5	5400.5	4467.5
609.5	14331.0	2021.0	6541.0	7308.0	2691.5	9733.5	5482.0	4783.0	5738.0	8274.0	1641.5	1866.5	2141.0	1579.0	5359.0	4451.5
610.7	14541.0	2002.0	6631.0	7502.0	2802.5	9802.0	5442.0	4803.0	5758.0	8310.0	1653.0	1922.5	2129.0	1595.0	5387.0	4465.0
611.9	14675.0	1985.0	6656.0	7621.0	2909.0	9824.0	5408.5	4812.0	5786.0	8306.0	1658.0	1896.0	2157.0	1622.0	5358.0	4449.0
613.1	14667.0	2006.0	6787.0	7782.5	3036.0	9850.0	5447.0	4783.0	5737.5	8236.5	1655.5	1883.5	2218.5	1604.0	5345.0	4453.0
614.3	14530.0	1993.0	6765.0	7987.0	3183.0	9786.0	5453.5	4780.0	5704.0	8200.5	1643.0	1898.5	2235.0	1620.0	5355.0	4446.0
615.5	14493.0	1995.0	6922.0	8187.0	3360.5	9584.5	5391.5	4731.5	5683.0	8095.5	1650.0	1920.0	2288.0	1576.5	5350.5	4387.0
616.7	14291.0	2029.0	6983.0	8400.0	3539.5	9521.5	5364.0	4757.5	5683.0	7981.5	1665.0	1889.0	2399.0	1599.0	5318.5	4354.0
617.9	13995.0	2025.0	7096.0	8699.0	3772.0	9282.5	5225.0	4706.5	5635.0	7775.0	1643.0	1896.5	2361.0	1595.5	5232.5	4311.5
619.1	13629.0	2025.0	7161.0	8941.5	4026.5	9147.5	5202.0	4656.0	5584.5	7580.0	1645.0	1908.5	2417.5	1583.5	5189.5	4266.0
620.3	13283.0	1974.0	7301.0	9442.5	4282.0	8928.0	5123.5	4641.5	5440.0	7412.5	1667.0	1914.0	2534.5	1598.0	5130.5	4223.0
621.5	12872.0	2005.0	7425.0	9736.5	4589.5	8629.0	5125.0	4617.0	5495.0	7238.5	1634.0	1900.0	2608.5	1620.5	5088.0	4202.0
622.7	12399.0	2009.0	7597.0	10226.0	4954.0	8364.5	5052.0	4578.0	5378.0	6996.0	1673.5	1918.0	2698.5	1621.0	5011.0	4138.5
623.9	12023.0	2000.0	7819.0	10769.0	5384.5	8153.5	4983.0	4490.0	5371.0	6812.5	1678.5	1876.0	2775.5	1623.5	5039.0	4117.5
625.1	11427.0	2001.0	7942.0	11301.5	5825.5	7893.5	4871.0	4442.5	5289.5	6575.5	1651.5	1938.0	2874.5	1599.0	4991.0	4059.5
626.3	11080.0	1999.0	8184.0	12052.5	6436.5	7635.5	4832.5	4386.0	5202.0	6360.0	1687.0	1928.5	2996.5	1623.0	4949.5	4050.5
627.5	10612.0	2037.0	8474.0	12716.5	7009.0	7385.0	4785.5	4309.5	5144.5	6169.5	1665.0	1934.0	3079.5	1632.0	4841.5	4027.0
628.7	10079.0	1983.0	8676.0	13563.5	7739.5	7096.5	4717.0	4283.0	5129.5	5957.5	1675.5	1922.0	3271.0	1637.5	4862.0	3946.5
629.9	9685.0	2023.0	8997.0	14373.0	8529.5	6853.0	4645.0	4246.5	5007.5	5786.5	1688.0	1946.5	3410.5	1618.0	4736.5	3937.5
631.1	9167.0	2015.0	9322.0	15293.5	9353.0	6593.5	4579.0	4191.5	5007.0	5683.0	1683.0	1950.0	3512.5	1628.5	4718.5	3942.5
632.3	8818.0	1965.0	9531.0	16228.5	10208.0	6496.0	4529.0	4097.5	4969.0	5524.5	1685.5	1952.5	3679.5	1638.5	4778.0	3883.5
633.4	8389.0	2021.0	9674.0	17024.0	11077.0	6297.5	4521.5	4104.0	4920.5	5351.5	1700.5	1952.0	3792.0	1618.5	4728.0	3895.0
634.6	8131.0	2020.0	10058.0	17854.5	11916.0	6120.0	4462.5	4064.5	4891.0	5197.0	1648.0	1916.0	3909.0	1598.0	4697.0	3890.5
635.8	7737.0	1991.0	10242.0	18352.5	12610.0	5959.5	4428.0	4019.0	4820.5	5119.5	1701.0	1939.5	3945.5	1649.5	4655.5	3854.0
637.0	7447.0	2010.0	10285.0	18678.5	13141.5	5780.5	4409.5	3994.5	4800.0	4956.5	1690.5	1937.0	4031.5	1636.5	4602.0	3804.5
638.2	7067.0	1981.0	10267.0	18788.5	13314.0	5594.0	4364.5	3925.5	4765.5	4888.5	1672.0	1928.0	3998.0	1642.0	4619.0	3820.0
639.4	6859.0	1981.0	10199.0	18641.5	13433.0	5523.0	4307.0	3948.5	4821.5	4754.0	1681.5	1933.0	3972.0	1610.5	4560.5	3771.5
640.6	6585.0	2002.0	10065.0	18272.5	13157.5	5342.0	4276.0	3882.5	4738.0	4670.5	1687.0	1923.5	3907.0	1625.5	4548.0	3743.0
641.8	6227.0	1973.0	9943.0	17629.5	12683.0	5228.0	4237.5	3903.0	4694.0	4556.0	1656.0	1931.0	3823.5	1597.0	4522.5	3667.0
643.0	6089.0	1998.0	9606.0	17046.5	12006.0	5132.5	4191.5	3851.5	4647.5	4422.5	1656.0	1946.0	3691.5	1598.0	4448.5	3656.0
644.2	5866.0	1985.0	9313.0	16221.5	11255.0	4991.5	4214.0	3823.5	4653.0	4332.5	1672.5	1965.0	3557.5	1611.0	4426.0	3639.5
645.4	5690.0	2037.0	9186.0	15320.0	10479.0	4911.5	4166.5	3836.0	4624.0	4213.0	1681.5	1940.5	3453.0	1606.0	4366.0	3598.0
646.6	5456.0	1988.0	8908.0	14597.5	9711.5	4802.0	4139.0	3777.0	4629.0	4092.5	1640.0	1880.0	3380.0	1575.0	4314.5	3566.0
647.7	5265.0	1967.0	8659.0	13805.0	8991.0	4714.5	4165.5	3788.0	4578.0	4056.0	1643.0	1903.5	3228.0	1599.5	4310.5	3505.5
648.9	5071.0	1979.0	8489.0	13071.0	8309.0	4687.5	4156.0	3770.5	4555.0	3971.5	1623.5	1899.0	3104.0	1568.0	4281.5	3529.5
650.1	5046.0	1949.0	8214.0	12529.0	7696.5	4552.5	4178.5	3738.0	4554.5	3860.5	1620.0	1882.0	3007.0	1594.5	4259.5	3529.0
651.3	4907.0	2017.0	8046.0	11895.5	7048.0	4540.5	4112.5	3681.5	4541.0	3782.0	1655.0	1898.0	2981.5	1582.0	4215.5	3484.5
652.5	4739.0	1994.0	7712.0	11329.5	6557.5	4452.5	4117.0	3710.0	4584.0	3709.0	1620.0	1878.5	2819.0	1562.0	4180.5	3419.0
653.7	4712.0	1937.0	7627.0	10857.5	6074.0	4414.5	4079.5	3703.5	4575.0	3656.0	1636.5	1835.0	2724.0	1565.0	4185.5	3396.0
654.9	4598.0	1967.0	7507.0	10398.0	5688.0	4331.5	4114.0	3714.5	4553.0	3623.5	1631.5	1852.5	2617.5	1572.0	4152.0	3394.0
656.1	4509.0	1992.0	7306.0	10014.5	5291.5	4310.5	4105.0	3662.5	4578.0	3666.5	1618.5	1845.5	2589.0	1547.5	4144.0	3431.0
657.3	4402.0	1943.0	7202.0	9602.5	4991.0	4269.0	4094.5	3689.5	4596.0	3535.0	1614.5	1884.0	2517.0	1578.0	4108.5	3392.0
658.5	4311.0	1961.0	7150.0	9284.5	4678.5	4260.5	4105.5	3662.0	4538.0	3538.5	1576.5	1863.5	2447.5	1551.0	4080.5	3391.0
659.6	4239.0	1962.0	6964.0	90												

702.3	2934.0	2027.0	6044.0	6077.0	1881.0	3778.0	4117.5	3656.0	4661.5	3193.0	1597.0	1835.5	1873.5	1571.0	3966.0	3280.0
703.5	2887.0	2047.0	5980.0	6031.5	1879.0	3732.0	4134.0	3612.0	4664.5	3133.0	1628.0	1848.5	1855.0	1575.0	3979.0	3298.0
704.7	2859.0	2049.0	5990.0	6048.0	1841.5	3712.0	4111.5	3562.0	4590.0	3125.0	1621.0	1842.5	1890.5	1597.0	4003.5	3329.0
705.8	2801.0	2034.0	5947.0	6048.0	1843.0	3749.5	4090.5	3617.5	4721.0	3130.5	1610.5	1846.5	1878.0	1582.0	3978.5	3293.0
707.0	2735.0	2048.0	6001.0	5975.0	1814.0	3710.5	4094.0	3995.0	4652.0	3167.5	1615.5	1846.5	1876.0	1573.0	3993.0	3288.5
708.2	2766.0	2055.0	6041.0	5943.0	1802.5	3685.5	4047.0	3584.5	4624.0	3128.5	1601.0	1820.5	1877.5	1580.0	3956.5	3298.0
709.4	2708.0	2052.0	5965.0	5915.0	1806.0	3688.5	4061.5	3564.0	4625.0	3077.0	1602.5	1842.0	1874.0	1567.0	3957.0	3273.0
710.6	2641.0	2066.0	5981.0	5937.5	1799.5	3694.5	4100.5	3586.0	4601.0	3083.5	1629.5	1826.5	1860.5	1583.0	3928.5	3287.0
711.8	2649.0	2053.0	6018.0	5930.0	1764.5	3583.5	4034.5	3563.5	4628.0	3047.0	1624.0	1859.5	1861.0	1593.0	3917.0	3309.0
712.9	2612.0	2044.0	5976.0	5873.0	1741.0	3570.0	4062.0	3538.0	4553.0	3072.5	1610.5	1846.0	1855.0	1572.0	3940.0	3291.5
714.1	2523.0	2067.0	5900.0	5900.0	1735.0	3572.0	4049.0	3561.0	4591.0	3053.5	1595.0	1825.0	1841.5	1567.0	3902.5	3246.0
715.3	2525.0	2057.0	5910.0	5786.5	1729.5	3545.5	4028.0	3551.0	4555.5	2998.5	1595.0	1853.5	1871.5	1569.0	3879.5	3255.0
716.5	2474.0	2038.0	5979.0	5821.5	1722.0	3530.5	4054.0	3524.0	4580.5	2981.0	1597.0	1829.0	1856.5	1576.5	3862.5	3253.0
717.6	2459.0	2045.0	5921.0	5856.0	1709.5	3504.5	4008.5	3524.5	4570.5	2950.5	1583.0	1815.0	1852.0	1579.0	3861.5	3211.0
718.8	2427.0	2079.0	5937.0	5776.0	1709.0	3480.5	3960.5	3500.5	4548.5	2973.5	1587.5	1839.5	1835.0	1535.0	3870.5	3230.5
720.0	2396.0	2048.0	5997.0	5859.0	1683.5	3488.5	3988.0	3452.0	4542.5	2931.0	1599.5	1833.0	1822.0	1550.5	3873.0	3209.5
721.2	2315.0	2055.0	5807.0	5771.0	1656.5	3453.5	3959.5	3459.5	4493.0	2898.0	1585.0	1863.0	1833.0	1563.0	3874.5	3229.5
722.4	2290.0	2033.0	5891.0	5784.5	1692.5	3407.5	3962.5	3526.0	4507.0	2935.5	1606.0	1832.5	1847.0	1538.0	3825.5	3183.0
723.5	2273.0	2073.0	5930.0	5755.0	1641.5	3417.0	3922.0	3467.0	4473.0	2844.0	1605.0	1838.0	1809.0	1566.0	3795.5	3188.5
724.7	2267.0	2078.0	5871.0	5755.0	1650.5	3398.5	3934.5	3467.5	4450.0	2886.5	1560.0	1821.5	1807.0	1548.0	3837.5	3191.0
725.9	2193.0	2073.0	5890.0	5754.0	1663.5	3353.5	3917.5	3461.0	4459.0	2871.0	1607.0	1842.0	1798.0	1553.5	3790.0	3158.5
727.1	2152.0	2040.0	5880.0	5735.0	1635.0	3378.0	3916.0	3427.0	4452.5	2849.5	1593.0	1821.5	1813.5	1555.0	3775.0	3151.5
728.3	2121.0	2057.0	5857.0	5711.0	1623.5	3368.0	3887.0	3390.5	4416.5	2812.0	1574.5	1846.0	1815.5	1526.0	3795.5	3186.5
729.4	2093.0	2043.0	5827.0	5724.5	1639.0	3363.0	3871.0	3416.5	4387.5	2806.0	1589.5	1819.5	1791.5	1545.5	3757.5	3084.0
730.6	2082.0	2063.0	5815.0	5673.5	1636.5	3355.0	3871.5	3412.5	4439.0	2779.5	1598.5	1800.5	1813.0	1545.5	3761.0	3095.0
731.8	2017.0	2034.0	5841.0	5669.5	1597.0	3306.0	3827.0	3373.5	4320.0	2778.5	1568.0	1810.5	1792.0	1554.0	3758.0	3096.5
733.0	2049.0	2023.0	5781.0	5661.5	1605.5	3256.5	3873.5	3386.5	4387.5	2793.5	1564.0	1827.5	1803.0	1559.0	3701.5	3087.0
734.1	2006.0	2041.0	5798.0	5679.5	1606.5	3293.5	3827.0	3340.0	4362.0	2795.5	1591.0	1804.0	1806.5	1518.0	3705.5	3102.0
735.3	1962.0	2054.0	5814.0	5643.5	1591.0	3259.5	3836.0	3325.5	4320.0	2780.0	1566.0	1830.5	1800.0	1524.5	3759.0	3098.5
736.5	1961.0	2073.0	5769.0	5655.0	1596.0	3233.5	3801.5	3329.5	4316.0	2725.0	1564.5	1823.0	1792.0	1539.5	3702.5	3090.0
737.7	1926.0	2026.0	5837.0	5611.0	1620.5	3273.5	3793.0	3325.5	4304.5	2740.0	1560.0	1802.5	1790.0	1534.5	3675.0	3109.5
738.8	1903.0	2013.0	5802.0	5649.0	1588.5	3219.5	3820.0	3333.0	4320.0	2788.0	1550.5	1817.5	1797.5	1545.5	3728.5	3090.0
740.0	1863.0	2055.0	5823.0	5623.5	1575.5	3234.5	3791.0	3308.0	4319.5	2742.0	1548.5	1839.0	1774.0	1526.0	3659.5	3086.0
741.2	1860.0	2069.0	5805.0	5605.5	1584.5	3228.0	3813.5	3303.0	4273.0	2750.0	1575.0	1836.0	1786.0	1526.0	3646.0	3045.0
742.4	1834.0	2033.0	5820.0	5638.0	1575.5	3243.0	3779.0	3307.5	4285.0	2750.0	1570.0	1809.0	1810.5	1548.0	3645.5	3053.0
743.5	1815.0	1989.0	5771.0	5594.5	1568.0	3201.0	3784.5	3290.0	4303.0	2732.5	1568.5	1778.5	1798.0	1536.0	3628.5	3027.5
744.7	1775.0	2045.0	5792.0	5589.0	1565.5	3201.5	3775.0	3290.5	4301.0	2726.5	1547.0	1810.0	1789.0	1521.0	3585.0	3080.0
745.9	1763.0	2015.0	5797.0	5614.0	1577.5	3233.0	3731.5	3310.0	4240.0	2730.0	1576.0	1828.5	1797.0	1559.5	3642.5	3078.5
747.1	1733.0	2003.0	5856.0	5603.0	1577.0	3216.5	3737.5	3309.5	4237.5	2713.5	1580.5	1836.5	1798.5	1565.5	3622.5	3061.5
748.2	1773.0	2072.0	5790.0	5598.0	1558.0	3206.5	3707.5	3232.0	4277.0	2678.0	1572.5	1828.0	1811.0	1530.0	3564.0	3041.0
749.4	1725.0	2021.0	5813.0	5650.0	1571.5	3217.0	3706.5	3211.0	4225.0	2695.0	1557.0	1808.5	1806.0	1558.0	3571.0	3048.5
750.6	1723.0	1993.0	5827.0	5614.0	1573.0	3219.5	3722.0	3277.0	4249.5	2713.5	1588.0	1808.5	1807.5	1547.0	3626.5	3051.0
751.8	1663.0	2020.0	5848.0	5595.5	1563.5	3198.5	3692.0	3261.0	4249.5	2680.5	1600.0	1812.5	1824.0	1556.0	3623.5	3024.5
752.9	1677.0	2033.0	5798.0	5673.5	1584.5	3176.5	3713.5	3241.5	4199.5	2639.0	1588.5	1820.5	1800.5	1550.0	3569.0	2987.5
754.1	1667.0	2011.0	5808.0	5617.5	1575.5	3186.0	3708.5	3269.0	4223.0	2622.5	1580.0	1841.5	1793.0	1560.0	3557.5	3018.5
755.3	1623.0	2013.0	5854.0	5614.5	1570.5	3182.0	3684.0	3240.0	4161.5	2650.0	1567.0	1849.5	1814.5	1570.5	3588.5	3020.0
756.4	1632.0	2013.0	5787.0	5650.0	1576.5	3167.0	3703.5	3200.5	4164.0	2626.0	1581.0	1848.5	1804.0	1524.0	3561.5	2996.0
757.6	1611.0	2032.0	5849.0	5650.0	1553.0	3187.0	3729.0	3230.0	4184.0	2640.0	1560.0	1831.0	1782.5	1558.0	3551.5	2976.5
758.8	1617.0	1990.0	5835.0	5698.5	1569.0	3141.5	3646.0	3237.0	4200.5	2595.5	1566.0	1825.0	1778.0	1556.5	3585.5	2983.0
760.0	1569.0	2001.0	5879.0	5648.5	1550.5	3142.0	3672.0	3234.0	4194.5	2588.5	1582.0	1827.0	1812.0	1532.0	3564.5	2955.0
761.1	1622.0	2041.0	5796.0	5659.0	1568.0	3145.5	3706.0	3256.0	4173.0	2572.0	1579.0	1814.0	1788.5	1544.5	3537.0	3019.0
762.3	1605.0	2041.0	5865.0	5697.5	1567.0	3153.0	3655.5	3201.0	4133.0	2617.0	1572.5	1821.0	1820.0	1543.5	3548.0	2960.0
763.5	1589.0	2003.0	5911.0	5641.0	1581.0	3160.5	3643.5	3205.5	4189.0	2546.0	1572.5	1822.5	1797.0	1549.0	3586.5	2992.0
764.7	1593.0	2031.0	5855.0	5678.5	1560.5	3121.0	3719.5	3254.5	4180.5	2555.5	1541.0	1822.0	1809.0	1505.5	3544.0	2982.0
765.8	1575.0	2040.0	5857.0	5669.0	1592.0	3143.0	3644.0	3188.0	4163.0	2573.0	1536.5	1811.5	1809.5	1544.0	3591.0	3002.0
767.0	1549.0	2034.0	5835.0	5664.0	1572.0	3113.0	3656.0	3222.5	4174.0	2561.5	1537.5	1808.5	1786.5	1545.0	3571.5	2978.0
768.2	1569.0	1975.0	5869.0	5716.0	1584.5	3117.0	3692.0	3185.0	4161.5	2606.0	1541.5	1797.0	1809.0	1519.5	3542.0	2945.0
769.3	1502.0	2025.0	5938.0	5698.5	1583.0	3146.0	3650.0	3233.5	4191.0	2577.5	1569.0	1816.5	1771.0	1529.0	3569.5	2983.5
770.5	1549.0	2001.0	5919.0	5734.0	1580.5	3124.5	3677.5	3221.0	4169.5	2525.0	1548.5	1816.0	1843.0	1535.5	3567.0	2957.5
771.7	1553.0	2025.0	5901.0	5699.5	1579.5	3119.5	3667.5	3202.5	4201.5	2545.5	1553.0	1819.5	1835.0	1522.0	3576.5	2932.5
772.8	1538.0	2031.0	5832.0	5668.5	1598.5	3132.0	3631.0	3201.0	4191.5	2576.0	1560.5	1825.5	1814.5	1548.5	3577.5	2945.5
774.0	1523.0	2021.0	5902.0	5760.5	1587.5	3092.0	3664.0	3198.0	4175.5	2667.0	1572.0	1829.5	1829.0	1520.5	3531.0	3006.0
775.2	1496.0	2017.0	5965.0	5747.0	1606.0	3106.5	3640.0	3208.5	4210.0	2587.5	1545.0	1831.5	1856.0	1521.0	3532.0	2959.5
776.4	1507.0	2047.0	5928.0	5791.0	1590.0	3140.0	3688.0	3199.0	4186.5	2586.5	1553.5	1815.5	1817.5	1521.0	3541.0	2953.0
777.5	1501.0	2016.0	5906.0	5770.5	1619.0	3124.5	3678.0	3217.0	4192.0	2558.5						

819.5	1328.0	2021.0	5889.0	5747.5	1537.5	3042.0	3373.5	2931.5	3740.0	2398.0	1468.5	1736.0	1780.0	1469.0	3309.5	2742.5
820.6	1345.0	1993.0	5849.0	5699.5	1566.0	3039.0	3299.0	2953.0	3721.0	2390.5	1483.0	1703.0	1769.0	1463.0	3322.0	2762.5
821.8	1331.0	2013.0	5924.0	5702.0	1564.0	3037.0	3342.0	2949.5	3675.0	2403.0	1476.0	1722.0	1783.5	1463.0	3262.0	2715.0
823.0	1333.0	2002.0	5866.0	5695.0	1571.0	3009.0	3275.0	2906.5	3648.0	2358.0	1478.0	1709.5	1767.0	1465.0	3285.5	2738.5
824.1	1310.0	2014.0	5862.0	5704.0	1555.5	3019.0	3310.5	2906.0	3687.5	2337.5	1478.0	1743.0	1784.5	1461.0	3227.5	2733.5
825.3	1319.0	2034.0	5875.0	5699.5	1559.0	3002.0	3314.5	2906.0	3599.5	2359.0	1494.0	1712.0	1771.5	1457.0	3231.0	2701.5
826.4	1273.0	2018.0	5795.0	5652.5	1566.0	3038.0	3236.5	2854.5	3553.0	2347.0	1470.0	1753.0	1804.5	1460.0	3234.5	2661.5
827.6	1303.0	2037.0	5838.0	5714.5	1565.5	3013.5	3251.5	2853.0	3597.5	2261.0	1460.0	1724.5	1773.0	1443.5	3215.0	2686.5
828.8	1261.0	2021.0	5823.0	5658.0	1560.0	3009.0	3207.5	2850.0	3570.5	2285.0	1489.5	1698.5	1770.0	1435.0	3196.0	2625.0
829.9	1277.0	2040.0	5936.0	5693.0	1552.5	2956.5	3170.5	2844.0	3557.0	2266.5	1478.0	1708.5	1790.5	1462.5	3177.0	2636.5
831.1	1289.0	2054.0	5860.0	5688.0	1512.5	3006.5	3222.0	2838.5	3515.0	2258.5	1479.5	1700.5	1790.0	1465.5	3175.0	2632.5
832.2	1295.0	2036.0	5876.0	5689.5	1527.0	2993.0	3145.0	2812.5	3478.0	2266.0	1484.0	1685.5	1770.0	1464.5	3169.5	2605.5
833.4	1267.0	1991.0	5844.0	5716.0	1530.0	2972.0	3155.5	2803.0	3500.5	2226.0	1479.0	1727.5	1787.0	1455.0	3133.0	2661.5
834.6	1267.0	2016.0	5878.0	5657.5	1543.0	2954.5	3111.5	2796.0	3479.0	2227.0	1459.5	1714.0	1782.5	1443.5	3126.0	2590.0
835.7	1210.0	2041.0	5871.0	5653.0	1543.5	2947.5	3124.0	2747.5	3415.0	2208.5	1490.0	1714.5	1777.0	1468.5	3130.5	2590.0
836.9	1191.0	2045.0	5858.0	5697.5	1521.5	2987.0	3141.5	2769.0	3425.0	2213.0	1486.5	1727.5	1799.5	1451.0	3097.5	2589.0
838.0	1181.0	2035.0	5902.0	5740.5	1536.5	2973.5	3059.0	2774.0	3403.0	2177.5	1474.5	1719.5	1769.0	1441.5	3077.5	2554.0
839.2	1170.0	2063.0	5904.0	5648.5	1527.0	2967.0	3098.0	2744.0	3347.5	2194.5	1479.0	1734.0	1794.5	1460.0	3083.0	2568.0
840.4	1156.0	2023.0	5904.0	5736.5	1548.5	2933.0	3050.0	2721.0	3313.0	2163.0	1464.5	1745.0	1783.0	1473.5	3042.0	2520.0
841.5	1158.0	2013.0	5827.0	5653.0	1535.0	2943.5	3049.5	2712.5	3316.0	2166.0	1477.0	1693.0	1796.0	1440.5	3053.0	2548.5
842.7	1146.0	2076.0	5904.0	5705.0	1543.0	2963.0	3062.5	2689.0	3326.5	2156.5	1475.5	1741.0	1798.0	1468.5	3035.5	2517.5
843.8	1090.0	2057.0	5803.0	5673.5	1554.0	2935.5	2990.5	2686.5	3245.0	2147.5	1504.0	1756.5	1791.5	1455.5	3030.0	2477.0
845.0	1085.0	2025.0	5881.0	5715.0	1543.0	2932.5	2982.0	2694.0	3274.5	2137.0	1490.5	1755.0	1814.0	1466.0	3010.5	2507.5
846.2	1063.0	2035.0	5938.0	5691.0	1554.5	2922.0	2990.5	2655.0	3239.5	2118.0	1492.0	1733.0	1770.0	1492.5	2977.0	2493.5
847.3	1051.0	2059.0	5897.0	5657.0	1549.0	2943.0	2991.0	2645.0	3208.0	2117.5	1486.0	1739.0	1797.0	1448.5	2947.0	2479.0
848.5	1055.0	2053.0	5885.0	5700.0	1540.0	2935.5	2932.5	2672.5	3222.0	2108.0	1506.0	1734.0	1795.0	1474.0	2921.0	2484.0
849.6	1039.0	2097.0	5926.0	5678.5	1570.5	2923.5	2901.5	2622.5	3136.5	2119.0	1491.0	1736.0	1819.5	1477.0	2949.0	2456.0
850.8	1037.0	2081.0	5886.0	5685.5	1531.0	2932.5	2910.0	2599.5	3168.0	2110.5	1492.5	1744.0	1807.5	1432.5	2940.0	2449.0
851.9	1013.0	2091.0	5912.0	5714.5	1545.5	2951.5	2903.0	2588.5	3148.5	2080.0	1492.0	1747.5	1811.5	1477.0	2908.0	2449.5
853.1	1003.0	2103.0	5931.0	5711.5	1540.5	2964.0	2842.0	2637.5	3142.5	2091.5	1492.5	1750.5	1808.5	1462.5	2904.0	2386.5
854.3	970.0	2053.0	5915.0	5694.5	1523.5	2938.0	2854.0	2599.5	3106.0	2070.5	1507.0	1719.0	1806.5	1473.0	2868.0	2384.0
855.4	957.0	2082.0	5955.0	5720.5	1539.0	2932.5	2833.0	2574.0	3051.5	2082.0	1513.0	1758.0	1832.5	1489.5	2841.5	2366.0
856.6	974.0	2137.0	5891.0	5729.0	1529.0	2905.0	2849.5	2560.0	3055.0	2060.0	1514.0	1714.5	1818.5	1490.5	2879.0	2349.0
857.7	922.0	2081.0	5961.0	5698.0	1512.5	2920.0	2798.5	2556.0	2993.0	2073.0	1510.0	1760.0	1834.5	1495.0	2825.5	2364.0
858.9	921.0	2015.0	5969.0	5700.0	1543.5	2956.0	2762.5	2526.5	2959.0	2042.5	1499.0	1747.5	1816.5	1483.0	2831.0	2353.0
860.0	939.0	2063.0	5992.0	5667.0	1523.5	2919.0	2725.5	2526.0	3011.5	2035.0	1500.5	1764.5	1806.5	1502.0	2835.5	2352.5
861.2	927.0	2150.0	6012.0	5672.5	1548.0	2908.0	2727.0	2502.5	2962.0	2053.0	1518.5	1754.5	1837.5	1496.5	2804.5	2310.0
862.3	911.0	2099.0	5955.0	5706.5	1524.5	2942.0	2700.5	2489.5	2959.0	2028.0	1516.5	1745.5	1828.5	1479.0	2787.5	2328.5
863.5	897.0	2125.0	6006.0	5649.0	1532.0	2922.5	2738.0	2491.0	2921.0	2013.0	1515.0	1779.5	1830.5	1496.0	2777.5	2313.5
864.7	882.0	2127.0	5990.0	5735.5	1534.0	2886.0	2675.0	2492.5	2877.5	2056.5	1498.0	1775.0	1831.0	1515.5	2752.0	2296.5
865.8	869.0	2137.0	5932.0	5687.0	1524.5	2951.5	2683.0	2461.5	2916.0	2024.0	1526.0	1768.0	1826.5	1499.5	2739.5	2306.0
867.0	866.0	2122.0	5892.0	5701.0	1522.0	2927.5	2676.0	2469.0	2856.5	2036.0	1499.5	1769.5	1835.0	1490.5	2725.0	2284.0
868.1	854.0	2069.0	5926.0	5689.5	1532.5	2918.5	2683.0	2418.5	2858.5	2008.0	1525.5	1772.5	1834.0	1506.0	2722.0	2243.5
869.3	865.0	2137.0	5976.0	5691.0	1536.0	2958.0	2658.5	2435.5	2841.0	2042.0	1538.0	1795.5	1855.5	1506.5	2694.0	2246.5
870.4	848.0	2131.0	5959.0	5685.5	1521.0	2946.0	2661.5	2410.0	2801.5	2030.0	1516.0	1762.0	1815.5	1505.5	2702.5	2243.0
871.6	833.0	2114.0	5896.0	5618.5	1516.5	2962.0	2608.5	2419.0	2798.0	2021.0	1519.0	1780.0	1859.5	1515.0	2674.0	2246.5
872.7	852.0	2126.0	5986.0	5641.0	1512.0	2940.5	2618.5	2420.5	2773.0	1978.0	1531.5	1778.0	1853.5	1488.5	2706.5	2225.0
873.9	813.0	2134.0	5922.0	5714.5	1532.5	2906.0	2570.0	2373.5	2766.0	2023.0	1507.5	1765.0	1829.0	1498.0	2673.0	2177.0
875.0	805.0	2118.0	5927.0	5643.0	1546.0	2941.0	2575.0	2394.0	2760.0	2010.5	1510.0	1783.5	1841.5	1497.0	2650.0	2241.0
876.2	808.0	2145.0	5978.0	5655.0	1548.5	2941.5	2583.5	2389.0	2721.0	1998.5	1549.5	1783.0	1843.0	1501.0	2652.5	2224.5
877.3	823.0	2165.0	5880.0	5650.5	1527.5	2927.5	2533.0	2363.5	2724.0	2012.5	1512.5	1767.0	1846.5	1510.5	2631.5	2196.0
878.5	803.0	2159.0	5945.0	5665.5	1496.0	2943.0	2545.0	2365.0	2715.0	2022.5	1528.0	1776.5	1834.0	1530.0	2633.5	2151.0
879.6	801.0	2142.0	5905.0	5668.0	1547.5	2937.5	2542.5	2370.5	2732.5	2018.5	1525.5	1746.0	1849.0	1507.5	2618.0	2173.5
880.8	795.0	2113.0	5902.0	5649.5	1536.0	2922.0	2532.0	2332.5	2681.5	1996.5	1535.0	1779.0	1852.5	1506.0	2596.5	2188.0
881.9	794.0	2124.0	5974.0	5627.5	1504.0	2911.5	2509.0	2292.0	2708.5	1990.0	1517.5	1786.0	1841.5	1493.5	2618.5	2141.0
883.1	803.0	2117.0	5912.0	5638.0	1497.5	2894.5	2495.5	2336.5	2675.0	1981.5	1513.0	1791.5	1829.5	1495.5	2583.5	2135.5
884.3	809.0	2111.0	5936.0	5631.5	1482.0	2907.0	2534.5	2317.5	2659.5	1978.5	1527.0	1761.0	1838.0	1502.0	2617.0	2160.0
885.4	769.0	2144.0	5877.0	5595.5	1486.0	2922.0	2484.0	2290.0	2640.5	1995.5	1501.5	1765.0	1838.0	1515.0	2613.5	2141.5
886.6	759.0	2123.0	5920.0	5619.0	1509.5	2931.0	2470.0	2298.5	2655.5	1997.0	1521.0	1799.5	1810.5	1488.0	2563.0	2143.5
887.7	761.0	2163.0	5880.0	5563.5	1514.0	2914.5	2464.5	2305.5	2629.5	1979.0	1525.0	1785.0	1851.5	1503.5	2564.0	2128.5
888.9	760.0	2127.0	5844.0	5590.5	1481.5	2918.0	2449.5	2320.5	2636.5	1951.0	1499.5	1813.0	1866.5	1536.0	2556.0	2115.5
890.0	745.0	2113.0	5878.0	5585.5	1497.5	2939.5	2460.5	2316.5	2605.0	1956.0	1523.0	1781.0	1845.0	1504.5	2571.0	2131.0
891.2	721.0	2128.0	5868.0	5555.0	1502.5	2935.5	2437.5	2247.5	2592.0	1959.0	1509.5	1794.5	1832.0	1504.5	2554.5	2121.0
892.3	743.0	2128.0	5879.0	5566.5	1476.0	2886.5	2463.0	2289.0	2605.0	1948.5	1512.0	1781.5	1856.5	1508.5	2528.5	2123.0
893.5	723.0	2153.0	5859.0	5588.0	1504.5	2913.0	2469.0	2266.5	2628.5	1948.5	1521.0	1740.0	1845.5			

934.7	645.0	2270.0	5871.0	5559.0	1442.0	3030.0	2407.5	2203.0	2541.0	1941.0	1546.5	1804.5	1915.5	1550.0	2480.0	2078.5
935.9	625.0	2213.0	5906.0	5622.5	1478.5	3065.5	2406.0	2214.0	2516.0	1967.0	1552.0	1855.0	1927.5	1569.0	2491.5	2104.0
937.0	632.0	2235.0	5921.0	5567.5	1472.5	3062.0	2378.5	2261.5	2509.0	1933.0	1571.0	1837.5	1908.0	1565.0	2487.5	2107.5
938.2	633.0	2233.0	5974.0	5542.0	1497.0	3050.0	2422.0	2231.0	2516.0	1974.0	1580.0	1828.5	1922.0	1567.0	2507.5	2141.0
939.3	625.0	2268.0	5927.0	5623.0	1484.0	3092.5	2398.5	2206.0	2512.0	1988.5	1586.5	1811.5	1905.0	1562.0	2465.5	2103.0
940.4	633.0	2253.0	5955.0	5608.5	1476.0	3067.5	2401.0	2238.0	2537.5	1954.5	1586.0	1857.5	1910.0	1566.5	2549.5	2062.0
941.6	648.0	2267.0	5969.0	5536.0	1480.0	3101.0	2374.5	2238.0	2483.5	1965.5	1586.5	1835.5	1933.0	1583.0	2501.5	2129.0
942.7	631.0	2265.0	5913.0	5612.0	1483.0	3082.0	2399.5	2232.0	2512.0	1970.5	1574.5	1850.5	1933.0	1578.0	2459.5	2105.5
943.9	641.0	2273.0	5957.0	5585.5	1481.0	3114.5	2398.0	2214.0	2517.0	1970.5	1570.5	1860.5	1943.0	1579.0	2484.5	2115.5
945.0	607.0	2277.0	5854.0	5516.5	1492.0	3102.5	2407.0	2240.0	2508.5	1977.0	1567.5	1837.5	1945.0	1537.5	2485.5	2088.0
946.1	621.0	2241.0	5919.0	5579.0	1468.0	3115.0	2376.5	2254.5	2534.0	1951.0	1567.5	1836.0	1938.0	1578.5	2487.0	2121.5
947.3	592.0	2275.0	5930.0	5539.0	1474.5	3060.0	2394.5	2226.0	2531.0	1953.0	1594.0	1846.5	1940.0	1588.0	2478.5	2115.0
948.4	609.0	2283.0	5931.0	5523.5	1447.5	3070.0	2341.5	2222.0	2521.5	1940.5	1598.0	1828.0	1951.5	1583.5	2511.5	2095.5
949.6	621.0	2237.0	5945.0	5544.0	1463.5	3105.5	2383.5	2201.0	2482.5	1945.5	1577.0	1858.0	1928.5	1584.0	2476.5	2112.0
950.7	620.0	2259.0	5891.0	5544.5	1458.0	3089.0	2434.5	2255.0	2467.0	1933.5	1588.0	1871.5	1925.0	1573.5	2497.0	2108.5
951.8	602.0	2277.0	5811.0	5552.5	1472.0	3074.5	2417.5	2228.5	2502.0	1960.5	1570.5	1851.0	1949.0	1572.5	2499.0	2103.0
953.0	623.0	2274.0	5881.0	5512.5	1476.5	3054.0	2389.5	2216.5	2520.0	1939.5	1556.5	1854.5	1941.0	1600.0	2453.5	2102.5
954.1	613.0	2272.0	5907.0	5523.5	1470.0	3065.0	2410.5	2237.0	2541.0	1979.0	1585.5	1862.5	1924.5	1578.5	2498.0	2090.0
955.3	594.0	2276.0	5890.0	5526.5	1453.0	3055.5	2429.5	2200.0	2498.0	1930.0	1570.0	1848.5	1958.0	1585.5	2518.5	2097.5
956.4	611.0	2245.0	5883.0	5518.0	1454.0	3078.0	2372.0	2243.0	2520.0	1948.5	1602.5	1872.5	1965.5	1604.5	2473.0	2090.0
957.5	612.0	2291.0	5971.0	5537.0	1457.5	3104.0	2410.0	2234.5	2500.0	1967.0	1590.5	1860.0	1962.5	1581.0	2476.0	2109.5
958.7	573.0	2276.0	5904.0	5513.5	1452.5	3090.5	2393.5	2191.0	2511.0	1956.0	1579.0	1873.5	1946.0	1574.0	2508.5	2087.5
959.8	603.0	2299.0	5837.0	5512.0	1482.5	3084.5	2391.0	2256.5	2524.5	1919.0	1615.5	1862.0	1961.5	1601.0	2519.5	2118.0
961.0	602.0	2324.0	5857.0	5503.0	1457.0	3080.5	2416.0	2220.0	2551.5	1929.0	1614.5	1896.5	1975.5	1594.0	2467.0	2077.0
962.1	603.0	2275.0	5961.0	5501.5	1473.0	3083.0	2389.5	2224.0	2520.0	1911.0	1606.0	1892.0	1966.0	1575.0	2492.0	2132.0
963.2	588.0	2261.0	5840.0	5509.0	1470.0	3119.5	2395.5	2198.5	2499.5	1912.5	1630.0	1867.0	1949.5	1597.0	2472.0	2146.5
964.4	589.0	2289.0	5860.0	5490.0	1482.0	3078.5	2371.0	2266.0	2521.0	1911.5	1607.5	1864.5	1947.5	1592.5	2487.0	2082.0
965.5	574.0	2263.0	5918.0	5490.5	1490.5	3101.5	2390.0	2235.0	2498.0	1942.0	1580.5	1880.0	1983.0	1589.0	2467.5	2091.5
966.7	586.0	2336.0	5914.0	5470.5	1469.0	3124.0	2396.5	2223.5	2518.0	1928.0	1616.0	1873.5	1998.5	1600.0	2508.0	2102.5
967.8	575.0	2299.0	5840.0	5534.5	1445.5	3093.0	2405.5	2215.5	2450.0	1941.0	1620.5	1862.0	1971.0	1593.0	2476.5	2125.5
968.9	579.0	2305.0	5859.0	5472.5	1458.0	3126.5	2388.0	2213.0	2481.0	1898.0	1594.0	1893.0	1991.5	1605.5	2503.0	2082.5
970.1	602.0	2315.0	5843.0	5519.5	1460.5	3139.5	2400.5	2234.0	2507.0	1916.5	1598.5	1897.0	1995.0	1595.0	2460.5	2094.5
971.2	590.0	2303.0	5816.0	5473.0	1487.5	3196.5	2371.5	2209.0	2524.0	1920.0	1603.5	1889.5	1982.5	1614.0	2504.0	2113.5
972.3	573.0	2326.0	5899.0	5485.5	1469.5	3187.5	2341.0	2249.5	2525.5	1923.5	1621.5	1905.5	2013.0	1629.0	2478.0	2098.0
973.5	589.0	2328.0	5889.0	5517.0	1500.5	3228.0	2412.5	2241.0	2519.0	1934.0	1627.5	1913.5	1970.0	1643.0	2515.0	2107.5
974.6	599.0	2356.0	5909.0	5540.0	1474.0	3244.0	2425.0	2258.0	2508.5	1947.0	1646.5	1926.0	2042.5	1634.0	2485.5	2147.0
975.8	581.0	2339.0	5999.0	5574.5	1475.5	3232.5	2409.0	2278.0	2499.5	1962.5	1656.0	1941.0	2032.5	1631.0	2534.0	2124.5
976.9	578.0	2378.0	5984.0	5596.5	1500.0	3241.5	2416.5	2263.5	2556.0	1956.0	1671.5	1924.0	2058.0	1676.0	2565.5	2156.0
978.0	557.0	2379.0	6011.0	5603.5	1501.5	3292.0	2422.5	2294.0	2562.0	1945.0	1661.5	1989.5	2035.0	1685.0	2555.5	2176.5
979.2	579.0	2401.0	6028.0	5603.5	1518.5	3222.0	2395.0	2266.5	2597.0	2003.5	1663.5	1991.0	2057.0	1671.0	2546.0	2157.5
980.3	579.0	2401.0	6013.0	5607.5	1500.5	3261.5	2471.5	2306.0	2574.0	1997.0	1693.0	1983.0	2067.0	1698.0	2547.5	2167.5
981.4	565.0	2413.0	6039.0	5702.5	1486.0	3270.5	2444.0	2313.0	2553.5	1982.0	1709.5	1996.0	2079.0	1690.5	2555.0	2169.0
982.6	587.0	2411.0	6027.0	5605.0	1502.5	3259.5	2471.0	2316.5	2595.5	2002.0	1699.5	1961.5	2078.5	1679.0	2541.0	2204.5
983.7	576.0	2437.0	6014.0	5665.5	1498.5	3259.0	2481.5	2273.5	2561.5	1980.0	1701.0	1989.0	2086.0	1677.5	2574.5	2184.5
984.8	582.0	2441.0	6042.0	5604.5	1514.0	3294.0	2476.5	2318.5	2570.0	2001.0	1703.5	2006.0	2108.0	1692.5	2578.5	2189.0
986.0	579.0	2483.0	6087.0	5686.5	1507.0	3321.0	2475.0	2287.0	2584.5	2007.5	1701.5	1981.5	2104.5	1678.0	2603.5	2166.5
987.1	578.0	2431.0	6015.0	5683.5	1522.0	3286.5	2484.0	2304.0	2596.0	1975.5	1685.0	1996.0	2084.5	1702.5	2525.0	2186.5
988.2	585.0	2482.0	6047.0	5637.5	1474.0	3252.0	2490.0	2296.5	2633.5	1987.0	1715.0	1976.0	2082.5	1692.5	2536.0	2166.5
989.4	571.0	2427.0	6052.0	5673.0	1518.0	3257.5	2469.0	2305.0	2575.0	2007.5	1687.5	2012.0	2114.0	1699.0	2535.5	2201.0
990.5	555.0	2486.0	6087.0	5681.0	1491.5	3315.0	2471.5	2327.0	2576.5	1988.0	1694.0	1993.0	2092.0	1715.0	2567.5	2198.0
991.6	561.0	2447.0	6096.0	5678.5	1512.0	3302.5	2503.5	2323.0	2621.0	1993.0	1719.5	2005.0	2099.0	1718.0	2562.5	2214.0
992.8	564.0	2475.0	6081.0	5717.0	1506.0	3334.5	2491.0	2324.0	2589.0	1991.0	1718.0	2001.0	2116.0	1702.0	2613.0	2224.0
993.9	559.0	2512.0	6110.0	5708.0	1506.5	3317.0	2469.0	2334.5	2572.0	2014.5	1724.5	2019.0	2116.5	1702.0	2575.5	2193.5
995.0	543.0	2465.0	6172.0	5630.0	1511.5	3356.0	2481.0	2345.0	2610.5	1985.0	1700.5	2001.0	2120.5	1695.0	2598.0	2205.0
996.2	568.0	2483.0	6091.0	5620.5	1504.5	3333.5	2497.0	2336.5	2596.0	2012.0	1723.5	2006.5	2105.0	1706.0	2499.0	2199.0
997.3	552.0	2499.0	6121.0	5688.0	1511.0	3380.5	2508.0	2323.5	2587.0	1991.0	1709.0	1998.5	2107.5	1725.5	2562.0	2213.0
998.4	561.0	2475.0	6068.0	5700.5	1500.0	3358.5	2463.5	2321.5	2631.0	2018.0	1705.5	2007.5	2121.5	1716.0	2580.0	2221.0
999.6	562.0	2482.0	6083.0	5636.5	1503.0	3359.0	2483.0	2362.5	2615.0	2024.0	1732.0	2029.0	2140.5	1699.5	2619.5	2199.0
1000.7	536.0	2487.0	6128.0	5715.5	1518.5	3370.0	2534.0	2363.0	2620.0	2011.0	1697.0	2029.0	2132.0	1715.5	2588.5	2237.5
1001.8	555.0	2477.0	6096.0	5708.0	1491.0	3363.5	2500.0	2364.5	2619.0	2024.0	1713.0	2036.0	2131.5	1715.0	2581.5	2234.0
1003.0	561.0	2482.0	6138.0	5702.5	1510.0	3416.5	2502.5	2338.0	2604.0	2024.5	1713.5	2055.0	2166.5	1742.5	2572.5	2213.0
1004.1	540.0	2470.0	6060.0	5713.5	1503.0	3399.0	2495.5	2344.5	2630.0	2033.0	1731.5	2028.0	2122.0	1734.0	2578.0	2248.0
1005.2	541.0	2490.0	6154.0	5704.0	1491.0	3442.5	2500.0	2351.0	2607.5	2028.0	1719.0	1986.0	2135.5	1728.0	2589.0	2218.0
1006.4	573.0	2519.0	6109.0	5652.0	1533.0	3439.0	2514.0	2374.5	2613.0	2016.5	1681.0	2025.5	2148.0	1706.0	2616.0	2209.0
1007.5	552.0	2518.0	6104.0	5737.5	1509.0	3431.5	2517.0	2342.0	2600.0	2042.5	1702.5	2021.0	2147.5	1710.5	2653.5	



1048.1	522.0	2635.0	6279.0	5811.0	1565.0	3958.0	2604.5	2429.0	2782.0	2159.0	1843.5	2123.5	2293.0	1810.5	2708.5	2334.0
1049.2	527.0	2579.0	6257.0	5864.0	1570.5	3986.0	2572.5	2470.5	2714.0	2205.0	1826.0	2109.0	2262.0	1800.0	2714.0	2323.0
1050.3	497.0	2627.0	6235.0	5848.0	1538.0	4001.5	2584.5	2420.5	2726.0	2193.0	1823.5	2139.5	2252.0	1814.5	2730.0	2327.0
1051.5	525.0	2684.0	6253.0	5817.0	1576.0	3988.5	2606.0	2422.0	2751.5	2175.0	1831.0	2148.0	2280.5	1797.5	2720.5	2343.0
1052.6	538.0	2687.0	6269.0	5833.0	1548.0	4048.5	2609.0	2464.5	2735.0	2169.0	1831.0	2149.0	2263.0	1812.5	2692.0	2334.5
1053.7	515.0	2645.0	6263.0	5877.0	1583.0	4015.0	2597.0	2415.0	2748.5	2172.5	1863.0	2131.0	2297.0	1793.5	2746.5	2338.5
1054.8	510.0	2671.0	6235.0	5825.0	1554.0	4036.5	2607.0	2442.5	2722.5	2182.0	1803.5	2110.0	2253.0	1814.0	2695.5	2328.0
1056.0	518.0	2670.0	6246.0	5812.5	1546.0	4028.0	2623.5	2442.5	2716.5	2152.5	1860.5	2141.0	2258.5	1849.0	2705.0	2325.0
1057.1	527.0	2675.0	6215.0	5824.5	1555.5	4113.0	2597.5	2447.5	2762.0	2171.0	1839.0	2135.5	2286.0	1808.0	2686.5	2351.0
1058.2	513.0	2694.0	6235.0	5849.0	1568.0	4135.5	2627.5	2491.5	2770.5	2187.5	1846.5	2132.0	2278.5	1813.0	2721.0	2325.5
1059.3	526.0	2685.0	6266.0	5882.0	1569.5	4097.5	2614.0	2463.5	2728.0	2211.5	1810.0	2149.0	2301.5	1813.5	2713.0	2352.0
1060.5	508.0	2639.0	6185.0	5822.5	1545.5	4138.0	2647.0	2456.0	2738.5	2197.5	1826.0	2136.0	2309.5	1834.0	2733.5	2337.0
1061.6	511.0	2695.0	6239.0	5796.0	1556.0	4117.5	2607.5	2461.5	2756.0	2199.0	1817.0	2142.0	2314.0	1818.5	2721.0	2361.5
1062.7	521.0	2689.0	6201.0	5846.5	1579.5	4159.5	2626.0	2453.0	2746.0	2191.0	1831.0	2146.0	2333.5	1825.0	2724.0	2308.0
1063.8	515.0	2683.0	6171.0	5851.0	1552.0	4214.5	2623.0	2457.5	2709.5	2199.0	1833.0	2156.0	2304.5	1827.5	2770.5	2332.0
1064.9	518.0	2705.0	6253.0	5840.0	1557.0	4171.0	2583.5	2436.5	2749.5	2215.0	1800.0	2154.0	2304.5	1847.5	2745.5	2330.0
1066.1	493.0	2736.0	6252.0	5876.0	1546.5	4211.5	2632.0	2470.0	2756.0	2200.5	1848.5	2147.5	2299.0	1807.0	2705.0	2346.0
1067.2	491.0	2717.0	6160.0	5809.0	1558.0	4224.5	2636.0	2467.0	2746.0	2203.0	1856.0	2128.5	2319.5	1838.5	2732.0	2371.0
1068.3	508.0	2730.0	6232.0	5846.5	1555.0	4246.5	2653.5	2469.0	2777.5	2201.0	1845.5	2168.5	2312.0	1837.5	2708.5	2370.0
1069.4	507.0	2705.0	6249.0	5809.5	1559.0	4297.0	2617.0	2434.5	2784.0	2205.5	1845.0	2166.5	2297.0	1841.0	2729.5	2401.5
1070.5	495.0	2743.0	6209.0	5845.5	1600.5	4311.5	2635.5	2456.5	2800.0	2205.5	1822.5	2123.0	2311.0	1853.5	2742.5	2384.5
1071.7	518.0	2758.0	6260.0	5813.0	1585.5	4272.5	2627.0	2483.5	2742.0	2249.0	1853.0	2145.5	2316.5	1843.0	2760.0	2347.5
1072.8	507.0	2695.0	6261.0	5805.0	1547.0	4330.5	2653.0	2462.5	2744.0	2231.0	1858.5	2137.0	2324.5	1837.0	2760.0	2346.5
1073.9	515.0	2807.0	6176.0	5842.0	1585.5	4331.0	2627.5	2477.5	2799.0	2213.0	1858.5	2148.5	2328.5	1825.5	2727.5	2396.0
1075.0	499.0	2800.0	6313.0	5823.0	1573.5	4349.0	2620.0	2438.0	2774.0	2222.0	1879.5	2139.5	2335.5	1821.0	2730.0	2355.5
1076.1	500.0	2794.0	6244.0	5808.5	1532.5	4382.0	2610.0	2464.0	2765.0	2234.5	1852.0	2154.0	2310.0	1822.0	2733.0	2361.5
1077.3	493.0	2747.0	6244.0	5829.0	1585.5	4401.0	2647.5	2479.0	2776.5	2239.5	1836.5	2149.0	2325.0	1830.0	2728.0	2407.0
1078.4	512.0	2859.0	6218.0	5858.5	1579.5	4366.0	2651.5	2459.5	2808.5	2235.0	1847.0	2168.0	2278.0	1840.0	2735.0	2335.0
1079.5	495.0	2800.0	6185.0	5858.5	1561.0	4443.0	2637.5	2487.0	2760.0	2257.0	1877.0	2148.0	2334.0	1851.0	2735.0	2365.0
1080.6	507.0	2832.0	6223.0	5846.0	1566.0	4449.0	2653.0	2478.0	2749.0	2238.0	1868.5	2163.5	2356.5	1858.5	2712.0	2375.5
1081.7	498.0	2854.0	6231.0	5808.0	1569.0	4390.0	2653.0	2455.5	2753.5	2274.0	1866.0	2172.5	2346.0	1852.5	2733.0	2379.5
1082.9	509.0	2861.0	6228.0	5822.5	1572.5	4469.5	2661.0	2497.0	2770.0	2268.5	1872.0	2156.5	2330.0	1861.0	2768.5	2377.5
1084.0	503.0	2858.0	6225.0	5829.5	1577.5	4491.0	2614.0	2493.5	2790.5	2215.5	1877.0	2178.0	2329.5	1833.0	2748.0	2388.5
1085.1	492.0	2875.0	6205.0	5864.0	1566.0	4510.5	2641.0	2520.5	2798.0	2285.5	1871.5	2192.5	2321.0	1868.5	2760.0	2383.0
1086.2	501.0	2915.0	6253.0	5858.0	1564.0	4515.5	2632.5	2473.0	2752.5	2267.0	1881.0	2180.0	2333.0	1855.0	2799.5	2396.0
1087.3	491.0	2914.0	6283.0	5836.5	1570.0	4554.0	2637.0	2497.5	2791.0	2244.0	1875.5	2171.5	2336.0	1847.5	2760.5	2413.0
1088.5	497.0	2925.0	6270.0	5847.0	1550.5	4517.5	2668.0	2462.5	2794.0	2285.5	1878.0	2182.0	2353.0	1877.5	2754.5	2382.5
1089.6	490.0	2931.0	6270.0	5827.0	1554.0	4596.0	2705.0	2483.0	2794.0	2263.5	1921.5	2192.0	2337.0	1877.0	2782.5	2367.5
1090.7	488.0	2981.0	6275.0	5868.0	1572.0	4575.0	2676.5	2503.5	2796.5	2274.5	1886.0	2195.5	2388.0	1883.5	2746.0	2393.0
1091.8	496.0	2987.0	6286.0	5892.0	1600.0	4605.0	2662.5	2489.5	2758.0	2261.0	1899.0	2214.0	2400.0	1894.5	2735.5	2406.5
1092.9	502.0	3003.0	6295.0	5847.5	1564.5	4607.0	2662.0	2480.0	2806.0	2250.0	1890.5	2229.0	2385.5	1903.0	2749.5	2392.0
1094.0	490.0	2983.0	6238.0	5873.0	1582.5	4615.0	2658.0	2522.0	2845.0	2291.5	1905.0	2212.5	2398.5	1884.0	2754.0	2430.0
1095.2	490.0	3075.0	6332.0	5839.0	1608.5	4603.0	2652.5	2541.0	2836.0	2279.5	1901.5	2228.0	2437.0	1898.5	2767.0	2423.5
1096.3	465.0	3029.0	6268.0	5839.0	1589.5	4685.5	2633.5	2511.0	2811.5	2303.0	1906.0	2212.5	2403.0	1915.5	2782.0	2403.0
1097.4	488.0	3061.0	6349.0	5912.5	1584.0	4665.5	2672.0	2520.0	2828.0	2291.5	1916.0	2210.5	2427.5	1920.0	2792.5	2435.0
1098.5	482.0	3069.0	6336.0	5871.5	1597.5	4726.0	2673.5	2501.5	2801.0	2277.5	1952.5	2225.0	2419.5	1942.5	2799.0	2431.5
1099.6	481.0	3089.0	6303.0	5839.5	1594.5	4739.5	2677.5	2526.0	2805.0	2330.0	1955.0	2240.0	2411.0	1930.5	2751.0	2431.0
1100.7	495.0	3111.0	6293.0	5920.0	1598.0	4728.5	2685.5	2554.0	2826.0	2318.0	1949.5	2283.5	2464.0	1956.0	2809.0	2448.0
1101.9	491.0	3133.0	6333.0	5904.0	1594.5	4713.5	2686.5	2541.5	2843.5	2340.5	1937.0	2281.0	2441.5	1942.0	2826.5	2446.0
1103.0	504.0	3160.0	6276.0	5891.0	1577.0	4776.5	2676.5	2528.0	2811.5	2320.5	1971.0	2259.0	2486.0	1941.5	2787.5	2464.0
1104.1	485.0	3188.0	6332.0	5915.0	1573.5	4765.0	2724.0	2524.5	2859.0	2330.5	1936.5	2270.5	2494.5	1971.0	2800.0	2446.0
1105.2	516.0	3155.0	6385.0	5976.0	1629.0	4839.0	2718.0	2579.0	2858.5	2361.5	1943.0	2311.5	2438.5	1972.0	2798.0	2435.5
1106.3	478.0	3209.0	6389.0	5898.0	1608.0	4811.5	2733.5	2548.0	2836.0	2367.0	1980.0	2292.5	2452.0	1968.5	2833.5	2494.0
1107.4	485.0	3222.0	6350.0	5955.0	1620.5	4816.5	2745.0	2555.5	2838.0	2345.5	1964.5	2301.0	2456.0	1977.0	2810.5	2447.5
1108.5	510.0	3227.0	6367.0	5960.0	1603.5	4899.5	2726.0	2588.0	2864.0	2345.5	1961.5	2351.5	2516.0	1979.5	2808.0	2499.0
1109.7	524.0	3221.0	6421.0	5924.0	1607.0	4830.5	2752.0	2568.0	2901.5	2337.5	1994.5	2353.0	2528.0	2019.0	2853.5	2479.5
1110.8	463.0	3291.0	6394.0	6008.5	1639.0	4853.5	2719.5	2554.5	2882.0	2385.5	1983.0	2369.5	2547.5	1981.0	2877.0	2505.0
1111.9	500.0	3228.0	6390.0	5989.0	1601.0	4839.0	2735.5	2569.5	2896.0	2368.5	2022.0	2349.0	2560.5	2046.5	2839.0	2483.0
1113.0	481.0	3307.0	6467.0	5972.5	1630.5	4925.0	2734.5	2577.0	2897.0	2375.5	2010.5	2361.5	2563.0	2035.0	2850.5	2499.0
1114.1	503.0	3373.0	6448.0	5978.0	1616.0	4913.5	2765.0	2567.0	2892.0	2400.0	2010.5	2349.0	2603.5	2017.0	2864.0	2523.0
1115.2	502.0	3377.0	6414.0	5990.5	1626.0	4966.0	2747.0	2560.5	2912.5	2382.0	2042.0	2409.5	2616.0	2033.0	2868.5	2493.5
1116.3	486.0	3415.0	6425.0	6004.0	1637.5	4946.0	2793.5	2587.0	2930.5	2395.0	2053.0	2492.0	2604.0	2014.5	2852.0	2500.5
1117.5	473.0	3395.0	6435.0	6014.5	1651.0	4980.0	2773.0	2618.5	2923.0	2404.5	2061.5	2397.0	2634.5	2072.0	2848.0	2482.0
1118.6	511.0	3455.0	6477.0	6024.0	1648.0	4958.5	2793.5	2633.5	2941.0	2407.0	2054.5	2418.5	2669.0	2060.0	2864.5	2534.0
1119.7	493.0	3429.0	6486.0	6024.0	1630.5	4995.5	2800.0	2615.5	2894.0	2411.5						

1159.6	508.0	4089.0	6673.0	6174.5	1704.0	5260.5	2940.0	2733.5	3126.5	2519.0	2368.0	2710.5	3090.0	2369.5	3074.0	2724.0
1160.7	504.0	4163.0	6713.0	6137.5	1765.5	5272.5	2982.0	2759.5	3112.0	2520.0	2330.5	2762.5	3122.0	2341.0	3061.0	2709.5
1161.8	513.0	4205.0	6633.0	6161.5	1746.5	5250.0	2908.0	2764.0	3111.0	2515.0	2341.0	2771.0	3119.5	2370.0	3039.0	2698.5
1162.9	511.0	4229.0	6677.0	6168.0	1733.0	5268.0	2962.0	2759.5	3123.5	2518.0	2334.5	2758.5	3137.5	2377.0	3024.5	2729.0
1164.0	533.0	4145.0	6696.0	6128.0	1756.0	5305.0	2975.0	2768.5	3140.0	2540.5	2360.5	2763.0	3127.0	2356.0	3084.5	2753.5
1165.1	522.0	4197.0	6686.0	6184.5	1712.0	5289.0	2993.0	2796.5	3119.0	2488.0	2340.5	2803.0	3132.5	2386.0	3067.0	2711.0
1166.3	514.0	4231.0	6658.0	6149.0	1756.5	5295.0	2965.0	2728.0	3121.0	2491.0	2369.5	2779.0	3197.0	2356.0	3069.0	2707.5
1167.4	495.0	4279.0	6631.0	6139.0	1745.5	5311.0	2943.5	2785.0	3167.5	2489.0	2342.0	2765.0	3176.0	2371.5	3071.0	2738.5
1168.5	508.0	4266.0	6670.0	6209.0	1743.0	5258.0	2948.0	2799.5	3143.5	2505.0	2372.0	2799.5	3171.5	2406.0	3070.0	2719.5
1169.6	465.0	4304.0	6647.0	6177.0	1751.5	5316.0	2977.5	2781.0	3110.0	2531.5	2357.5	2765.5	3207.0	2384.5	3082.5	2743.0
1170.7	501.0	4253.0	6668.0	6148.5	1751.0	5341.0	3011.5	2767.5	3125.0	2499.0	2378.0	2781.5	3225.0	2410.5	3099.0	2758.0
1171.8	510.0	4315.0	6640.0	6225.5	1749.0	5318.0	2955.0	2798.0	3144.0	2516.0	2361.5	2811.0	3223.5	2417.5	3084.5	2735.5
1172.9	497.0	4308.0	6716.0	6186.5	1743.0	5273.5	2995.0	2805.0	3145.0	2547.5	2406.5	2866.5	3210.5	2392.0	3131.0	2748.0
1174.0	524.0	4273.0	6624.0	6234.0	1737.0	5304.5	3013.0	2792.5	3167.5	2542.5	2392.0	2830.0	3225.0	2412.0	3115.5	2784.0
1175.1	505.0	4319.0	6732.0	6187.0	1742.5	5352.5	2991.0	2778.5	3132.5	2531.5	2414.0	2852.0	3273.5	2416.0	3113.0	2775.5
1176.2	503.0	4342.0	6645.0	6179.5	1777.0	5349.0	2979.5	2804.5	3191.5	2556.0	2423.0	2842.0	3267.0	2453.0	3111.5	2786.5
1177.3	493.0	4293.0	6734.0	6174.0	1764.0	5353.0	3000.0	2807.0	3159.0	2515.0	2407.5	2868.0	3265.5	2462.0	3111.0	2792.0
1178.4	513.0	4344.0	6682.0	6233.0	1754.0	5317.0	3004.0	2778.5	3198.0	2513.0	2443.5	2871.0	3273.0	2450.0	3124.5	2766.0
1179.5	514.0	4387.0	6777.0	6188.5	1745.0	5337.5	3041.5	2800.5	3185.5	2516.5	2450.0	2860.5	3265.0	2439.0	3138.5	2782.0
1180.6	513.0	4383.0	6668.0	6192.5	1758.0	5373.0	2986.0	2827.0	3224.5	2576.5	2457.0	2899.0	3285.0	2438.0	3173.0	2816.5
1181.7	495.0	4390.0	6765.0	6234.5	1766.5	5421.5	3038.0	2813.5	3201.0	2559.0	2447.5	2916.0	3333.5	2457.0	3130.0	2797.5
1182.8	508.0	4386.0	6735.0	6248.0	1789.0	5404.5	3058.0	2826.0	3266.5	2545.5	2439.0	2873.0	3296.0	2437.0	3194.5	2838.0
1183.9	514.0	4398.0	6711.0	6206.5	1746.0	5340.5	3073.0	2849.5	3230.0	2561.0	2469.0	2910.5	3331.0	2477.0	3149.0	2819.5
1185.0	504.0	4365.0	6685.0	6212.5	1773.5	5374.0	3072.5	2834.0	3213.0	2589.0	2481.5	2907.0	3374.0	2453.5	3140.5	2838.0
1186.1	529.0	4419.0	6747.0	6244.0	1759.5	5429.0	3078.0	2858.5	3242.5	2557.5	2488.0	2900.0	3371.5	2492.0	3159.0	2813.0
1187.2	534.0	4467.0	6766.0	6209.5	1772.0	5341.0	3092.5	2863.0	3239.0	2534.0	2470.5	2915.0	3351.0	2485.5	3185.5	2841.5
1188.3	519.0	4409.0	6807.0	6253.5	1772.0	5412.0	3066.0	2883.5	3240.0	2572.5	2484.0	2938.0	3381.5	2522.0	3214.0	2829.5
1189.4	515.0	4435.0	6759.0	6197.5	1775.0	5368.0	3086.5	2863.0	3262.5	2613.5	2457.0	2925.0	3404.5	2497.5	3194.5	2853.5



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B.4.8: Table showing the Raman shifts of the first 15 of 32 analysed grains of TNS18.

TNS18	Turner Exploration Campe															
	Intensity (A.U)	Raman shift (cm <sup>-1</sup> )														
		Grain 1	Grain 2	Grain 3	Grain 4	Grain 5	Grain 6	Grain 7	Grain 8	Grain 9	Grain 10	Grain 11	Grain 12	Grain 13	Grain 14	Grain 15
-38.6	21.0	25.0	19.0	30.0	26.0	28.0	24.0	27.0	23.0	22.0	23.0	21.0	25.0	17.0	22.0	
-37.3	26.0	17.0	24.0	26.0	20.0	21.0	17.0	24.0	21.0	15.0	25.0	17.0	19.0	21.0	19.0	
-35.9	26.0	28.0	23.0	25.0	24.0	25.0	17.0	31.0	29.0	32.0	24.0	28.0	32.0	25.0	26.0	
-34.6	29.0	28.0	28.0	25.0	33.0	21.0	29.0	28.0	30.0	29.0	25.0	24.0	27.0	19.0	24.0	
-33.3	17.0	21.0	21.0	25.0	26.0	20.0	27.0	28.0	24.0	29.0	24.0	31.0	23.0	22.0	28.0	
-32.0	30.0	23.0	25.0	27.0	21.0	23.0	25.0	26.0	23.0	28.0	31.0	23.0	25.0	23.0	21.0	
-30.7	19.0	22.0	23.0	31.0	22.0	23.0	29.0	31.0	27.0	23.0	23.0	30.0	25.0	28.0	23.0	
-29.4	25.0	33.0	26.0	27.0	23.0	15.0	32.0	25.0	24.0	23.0	21.0	27.0	22.0	19.0	27.0	
-28.1	19.0	24.0	21.0	30.0	26.0	22.0	26.0	32.0	21.0	24.0	27.0	23.0	27.0	24.0	25.0	
-26.8	23.0	27.0	26.0	25.0	23.0	23.0	23.0	21.0	17.0	21.0	27.0	22.0	28.0	21.0	22.0	
-25.5	28.0	24.0	25.0	31.0	22.0	25.0	30.0	25.0	23.0	28.0	21.0	21.0	26.0	29.0	25.0	
-24.2	19.0	25.0	28.0	32.0	26.0	17.0	25.0	27.0	21.0	25.0	23.0	23.0	25.0	18.0	26.0	
-22.9	24.0	23.0	26.0	23.0	26.0	26.0	29.0	29.0	25.0	28.0	24.0	25.0	23.0	26.0	23.0	
-21.6	17.0	27.0	24.0	22.0	26.0	25.0	29.0	26.0	21.0	27.0	26.0	9.0	23.0	26.0	26.0	
-20.3	25.0	24.0	23.0	22.0	21.0	26.0	25.0	26.0	27.0	29.0	21.0	25.0	27.0	25.0	26.0	
-19.0	15.0	29.0	26.0	20.0	31.0	25.0	21.0	30.0	27.0	27.0	24.0	23.0	29.0	23.0	27.0	
-17.7	23.0	25.0	21.0	28.0	23.0	21.0	29.0	29.0	19.0	27.0	25.0	22.0	25.0	20.0	29.0	
-16.4	27.0	30.0	28.0	23.0	22.0	19.0	25.0	23.0	21.0	25.0	27.0	27.0	25.0	25.0	29.0	
-15.1	28.0	21.0	28.0	31.0	21.0	21.0	29.0	23.0	23.0	20.0	23.0	26.0	22.0	28.0	23.0	
-13.8	24.0	33.0	27.0	29.0	20.0	24.0	21.0	21.0	21.0	28.0	23.0	24.0	29.0	23.0	29.0	
-12.5	27.0	24.0	27.0	27.0	28.0	26.0	33.0	28.0	29.0	23.0	23.0	27.0	26.0	23.0	27.0	
-11.2	23.0	29.0	27.0	27.0	26.0	21.0	30.0	33.0	22.0	27.0	30.0	27.0	31.0	26.0	33.0	
-9.8	25.0	28.0	28.0	28.0	25.0	23.0	31.0	26.0	27.0	21.0	23.0	24.0	25.0	26.0	23.0	
-8.5	24.0	31.0	25.0	31.0	22.0	29.0	29.0	31.0	23.0	30.0	27.0	29.0	25.0	27.0	30.0	
-7.2	27.0	34.0	31.0	25.0	30.0	27.0	27.0	31.0	32.0	23.0	26.0	29.0	29.0	30.0	32.0	
-5.9	21.0	30.0	32.0	25.0	29.0	32.0	31.0	36.0	35.0	35.0	33.0	31.0	33.0	31.0	36.0	
-4.6	60.0	59.0	47.0	52.0	51.0	39.0	41.0	47.0	42.0	43.0	43.0	31.0	37.0	38.0	45.0	
-3.3	179.0	181.0	153.0	139.0	121.0	121.0	132.0	133.0	121.0	119.0	117.0	134.0	131.0	141.0	145.0	
-2.0	386.0	368.0	353.0	331.0	338.0	309.0	340.0	354.0	329.0	343.0	309.0	331.0	324.0	305.0	355.0	
-0.7	615.0	633.0	609.0	628.0	581.0	549.0	565.0	573.0	552.0	605.0	515.0	569.0	563.0	546.0	588.0	
0.6	728.0	785.0	785.0	795.0	767.0	739.0	733.0	729.0	690.0	743.0	759.0	770.0	826.0	769.0	819.0	
1.9	545.0	581.0	625.0	595.0	575.0	589.0	579.0	614.0	539.0	581.0	567.0	629.0	643.0	644.0	663.0	
3.2	307.0	331.0	336.0	338.0	350.0	340.0	333.0	335.0	312.0	365.0	337.0	379.0	362.0	368.0	395.0	
4.5	81.0	98.0	119.0	116.0	104.0	96.0	110.0	111.0	103.0	109.0	114.0	132.0	142.0	131.0	145.0	
5.8	27.0	36.0	28.0	29.0	35.0	32.0	32.0	38.0	29.0	33.0	34.0	35.0	37.0	28.0	43.0	
7.1	31.0	27.0	37.0	29.0	29.0	29.0	29.0	35.0	31.0	23.0	36.0	27.0	29.0	29.0	33.0	
8.4	22.0	23.0	28.0	30.0	31.0	27.0	24.0	31.0	25.0	32.0	22.0	32.0	30.0	26.0	28.0	
9.7	25.0	19.0	26.0	25.0	21.0	28.0	32.0	34.0	27.0	28.0	19.0	28.0	25.0	23.0	32.0	
11.0	22.0	29.0	23.0	23.0	26.0	24.0	31.0	33.0	27.0	34.0	26.0	30.0	31.0	24.0	27.0	
12.3	32.0	23.0	24.0	33.0	23.0	26.0	32.0	30.0	25.0	29.0	25.0	21.0	27.0	23.0	31.0	
13.6	22.0	26.0	23.0	32.0	28.0	25.0	29.0	24.0	31.0	27.0	36.0	30.0	27.0	25.0	25.0	
14.9	23.0	27.0	24.0	27.0	23.0	21.0	25.0	27.0	23.0	27.0	28.0	31.0	28.0	21.0	26.0	
16.2	25.0	29.0	27.0	28.0	26.0	22.0	32.0	32.0	21.0	28.0	28.0	25.0	26.0	25.0	33.0	
17.5	25.0	25.0	27.0	29.0	25.0	19.0	22.0	28.0	13.0	23.0	22.0	25.0	20.0	27.0	21.0	
18.8	22.0	24.0	27.0	27.0	26.0	27.0	28.0	33.0	24.0	34.0	22.0	30.0	34.0	29.0	29.0	
20.1	27.0	29.0	31.0	19.0	29.0	19.0	25.0	35.0	25.0	25.0	29.0	26.0	31.0	24.0	29.0	
21.3	17.0	19.0	27.0	27.0	32.0	27.0	31.0	30.0	27.0	33.0	28.0	29.0	31.0	27.0	36.0	
22.6	17.0	31.0	27.0	25.0	25.0	22.0	29.0	27.0	27.0	30.0	27.0	15.0	23.0	23.0	25.0	
23.9	25.0	27.0	27.0	33.0	27.0	27.0	29.0	26.0	19.0	31.0	27.0	28.0	30.0	23.0	35.0	
25.2	21.0	27.0	31.0	27.0	27.0	21.0	31.0	33.0	29.0	27.0	28.0	33.0	31.0	19.0	25.0	
26.5	25.0	30.0	17.0	26.0	25.0	26.0	36.0	31.0	21.0	27.0	31.0	27.0	27.0	25.0	34.0	
27.8	19.0	31.0	25.0	25.0	28.0	19.0	29.0	28.0	19.0	31.0	29.0	25.0	27.0	27.0	34.0	
29.1	31.0	27.0	29.0	33.0	21.0	21.0	33.0	33.0	25.0	21.0	17.0	23.0	27.0	25.0	31.0	
30.4	20.0	29.0	26.0	26.0	25.0	19.0	31.0	29.0	27.0	26.0	24.0	29.0	36.0	25.0	27.0	
31.7	31.0	25.0	29.0	29.0	26.0	25.0	33.0	37.0	23.0	30.0	23.0	30.0	27.0	29.0	29.0	
33.0	23.0	31.0	25.0	25.0	29.0	27.0	34.0	35.0	22.0	27.0	28.0	31.0	33.0	23.0	33.0	
34.3	31.0	24.0	25.0	31.0	23.0	24.0	29.0	31.0	25.0	31.0	29.0	21.0	33.0	25.0	30.0	
35.6	23.0	25.0	27.0	32.0	24.0	29.0	32.0	29.0	30.0	31.0	26.0	34.0	37.0	23.0	33.0	
36.9	25.0	23.0	29.0	29.0	27.0	21.0	40.0	38.0	25.0	32.0	31.0	25.0	27.0	29.0	35.0	
38.2	21.0	29.0	29.0	33.0	32.0	27.0	42.0	43.0	27.0	35.0	37.0	33.0	39.0	37.0	41.0	
39.5	30.0	37.0	32.0	36.0	33.0	23.0	41.0	41.0	23.0	33.0	33.0	34.0	41.0	35.0	41.0	
40.8	33.0	37.0	43.0	44.0	35.0	32.0	47.0	47.0	29.0	47.0	37.0	46.0	49.0	41.0	55.0	
42.1	35.0	53.0	43.0	45.0	41.0	35.0	75.0	65.0	41.0	63.0	51.0	61.0	62.0	56.0	76.0	
43.4	46.0	59.0	63.0	58.0	47.0	31.0	105.0	97.0	51.0	87.0	69.0	87.0	85.0	82.0	99.0	
44.7	49.0	75.0	89.0	78.0	69.0	40.0	128.0	140.0	74.0	115.0	97.0	113.0	119.0	117.0	157.0	
46.0	70.0	98.0	123.0	104.0	87.0	63.0	194.0	183.0	97.0	151.0	113.0	150.0	164.0	157.0	209.0	
47.2	87.0	120.0	158.0	134.0	105.0	73.0	250.0	227.0	107.0	212.0	157.0	201.0	227.0	213.0	276.0	
48.5	101.0	150.0	186.0	162.0	131.0	89.0	332.0	289.0	139.0	260.0	195.0	260.0	283.0	287.0	341.0	
49.8	121.0	189.0	231.0	184.0	154.0	98.0	389.0	354.0	160.0	321.0	232.0	314.0	341.0	309.0	399.0	
51.1	136.0	193.0	235.0	218.0	181.0	117.0	453.0	389.0	185.0	350.0	267.0	353.0	404.0	370.0	486.0	
52.4	143.0	230.0	272.0	253.0	193.0	117.0	493.0	449.0	208.0	410.0	281.0	399.0	438.0	413.0	515.0	
53.7	163.0	239.0	295.0	266.0	213.0	139.0	531.0	481.0	227.0	439.0	326.0	441.0	483.0	459.0	603.0	
55.0	174.0	267.0	310.0	290.0	217.0	134.0	590.0	536.0	250.0	474.0	332.0	484.0	539.0	497.0	617.0	
56.3	182.0	282.0	322.0	309.0	215.0	141.0	638.0	571.0	271.0	498.0	381.0	523.0	573.0	550.0	685.0	
57.6	195.0	292.0	346.0	324.0	241.0	147.0	667.0	553.0	272.0	539.0	379.0	556.0	609.0	550.0	703.0	
58.9	197.0	291.0	353.0	341.0	263.0	160.0	682.0	604.0	267.0	562.0	372.0	579.0	622.0	581.0	721.0	
60.2	218.0	306.0	356.0	351.0	269.0	164.0	717.0	641.0	287.0	561.0	414.0	615.0	654.0	589.0	749.0	
61.5	209.0	322.0	366.0	357.0	280.0	159.0	736.0	645.0	273.0	586.0	400.0	597.0	651.0	630.0	770.0	
62.7	208.0	303.0	371.0	362.0	287.0	168.0	718.0	667.0	301.0	596.0	394.0	626.0				

87.2	489.0	868.0	857.0	983.0	809.0	385.0	1 869.0	2 028.0	758.0	1 531.0	1 038.0	1 476.0	1 776.0	1 494.0	1 927.0
88.5	471.0	888.0	862.0	1 038.0	826.0	369.0	1 880.0	2 135.0	756.0	1 551.0	1 006.0	1 545.0	1 779.0	1 505.0	1 967.0
89.8	471.0	902.0	877.0	1 069.0	841.0	394.0	1 934.0	2 216.0	769.0	1 605.0	1 027.0	1 558.0	1 859.0	1 536.0	2 014.0
91.1	492.0	943.0	878.0	1 039.0	855.0	396.0	1 960.0	2 227.0	764.0	1 693.0	1 044.0	1 635.0	1 881.0	1 541.0	2 035.0
92.4	493.0	919.0	876.0	1 092.0	843.0	402.0	1 991.0	2 326.0	783.0	1 702.0	1 061.0	1 662.0	1 926.0	1 612.0	2 120.0
93.6	490.0	988.0	895.0	1 147.0	895.0	405.0	2 036.0	2 338.0	768.0	1 746.0	1 085.0	1 700.0	1 982.0	1 619.0	2 171.0
94.9	489.0	1 001.0	935.0	1 167.0	899.0	406.0	2 128.0	2 422.0	798.0	1 746.0	1 088.0	1 706.0	2 049.0	1 638.0	2 181.0
96.2	489.0	1 004.0	940.0	1 205.0	939.0	411.0	2 187.0	2 509.0	809.0	1 828.0	1 120.0	1 775.0	2 074.0	1 670.0	2 281.0
97.5	492.0	1 039.0	930.0	1 230.0	941.0	389.0	2 265.0	2 599.0	789.0	1 868.0	1 172.0	1 813.0	2 137.0	1 669.0	2 347.0
98.8	475.0	1 085.0	962.0	1 287.0	971.0	392.0	2 339.0	2 645.0	797.0	1 924.0	1 153.0	1 879.0	2 194.0	1 694.0	2 365.0
100.1	507.0	1 091.0	957.0	1 358.0	1 003.0	400.0	2 405.0	2 745.0	812.0	1 937.0	1 179.0	1 853.0	2 287.0	1 692.0	2 448.0
101.3	497.0	1 151.0	984.0	1 383.0	1 070.0	398.0	2 467.0	2 872.0	811.0	2 046.0	1 173.0	1 925.0	2 338.0	1 717.0	2 531.0
102.6	507.0	1 174.0	962.0	1 425.0	1 061.0	400.0	2 522.0	2 923.0	798.0	2 060.0	1 243.0	1 990.0	2 409.0	1 728.0	2 613.0
103.9	498.0	1 187.0	969.0	1 453.0	1 089.0	395.0	2 605.0	3 079.0	822.0	2 101.0	1 257.0	2 073.0	2 462.0	1 679.0	2 660.0
105.2	501.0	1 238.0	954.0	1 479.0	1 131.0	413.0	2 689.0	3 241.0	810.0	2 164.0	1 287.0	2 107.0	2 496.0	1 734.0	2 735.0
106.5	499.0	1 272.0	958.0	1 569.0	1 157.0	406.0	2 823.0	3 339.0	828.0	2 212.0	1 299.0	2 187.0	2 625.0	1 751.0	2 807.0
107.8	479.0	1 316.0	975.0	1 617.0	1 207.0	409.0	2 908.0	3 476.0	808.0	2 300.0	1 332.0	2 222.0	2 733.0	1 692.0	2 902.0
109.0	513.0	1 338.0	979.0	1 689.0	1 259.0	406.0	2 968.0	3 642.0	805.0	2 382.0	1 328.0	2 305.0	2 833.0	1 757.0	3 032.0
110.3	507.0	1 386.0	981.0	1 735.0	1 271.0	407.0	3 147.0	3 805.0	804.0	2 425.0	1 443.0	2 407.0	2 940.0	1 744.0	3 136.0
111.6	520.0	1 473.0	1 003.0	1 830.0	1 350.0	415.0	3 245.0	4 012.0	821.0	2 545.0	1 470.0	2 503.0	3 031.0	1 757.0	3 272.0
112.9	499.0	1 507.0	969.0	1 880.0	1 407.0	405.0	3 361.0	4 217.0	832.0	2 670.0	1 520.0	2 583.0	3 117.0	1 765.0	3 377.0
114.2	533.0	1 565.0	979.0	2 007.0	1 475.0	417.0	3 522.0	4 423.0	829.0	2 761.0	1 568.0	2 662.0	3 272.0	1 772.0	3 519.0
115.5	487.0	1 669.0	1 015.0	2 064.0	1 525.0	397.0	3 710.0	4 754.0	840.0	2 823.0	1 635.0	2 756.0	3 491.0	1 749.0	3 670.0
116.7	512.0	1 745.0	999.0	2 233.0	1 669.0	432.0	3 848.0	5 010.0	832.0	2 965.0	1 704.0	2 911.0	3 673.0	1 779.0	3 865.0
118.0	493.0	1 845.0	1 002.0	2 363.0	1 707.0	421.0	4 116.0	5 368.0	824.0	3 202.0	1 770.0	3 002.0	3 838.0	1 758.0	4 103.0
119.3	530.0	2 016.0	985.0	2 522.0	1 795.0	418.0	4 413.0	5 728.0	843.0	3 377.0	1 875.0	3 295.0	4 099.0	1 814.0	4 375.0
120.6	529.0	2 154.0	1 009.0	2 763.0	1 977.0	431.0	4 659.0	6 296.0	868.0	3 629.0	1 978.0	3 469.0	4 349.0	1 770.0	4 692.0
121.9	518.0	2 333.0	1 023.0	2 967.0	2 067.0	441.0	5 039.0	6 707.0	872.0	3 863.0	2 123.0	3 706.0	4 727.0	1 783.0	5 098.0
123.1	535.0	2 534.0	1 022.0	3 178.0	2 318.0	443.0	5 455.0	7 506.0	847.0	4 210.0	2 249.0	3 984.0	5 118.0	1 799.0	5 531.0
124.4	537.0	2 761.0	1 033.0	3 539.0	2 531.0	433.0	5 987.0	8 356.0	869.0	4 537.0	2 460.0	4 347.0	5 575.0	1 758.0	5 996.0
125.7	528.0	3 095.0	1 033.0	3 867.0	2 767.0	461.0	6 611.0	9 231.0	893.0	4 956.0	2 681.0	4 799.0	6 194.0	1 800.0	6 630.0
127.0	533.0	3 489.0	1 032.0	4 334.0	3 081.0	474.0	7 380.0	10 509.0	926.0	5 501.0	2 961.0	5 353.0	6 938.0	1 802.0	7 436.0
128.2	549.0	3 905.0	1 053.0	4 977.0	3 555.0	484.0	8 198.0	12 013.0	904.0	6 261.0	3 307.0	6 041.0	7 693.0	1 812.0	8 403.0
129.5	571.0	4 503.0	1 096.0	5 693.0	4 047.0	475.0	9 443.0	13 969.0	933.0	6 988.0	3 805.0	6 901.0	8 799.0	1 773.0	9 582.0
130.8	555.0	5 172.0	1 054.0	6 610.0	4 625.0	495.0	10 961.0	16 369.0	946.0	8 121.0	4 314.0	8 004.0	10 215.0	1 785.0	11 097.0
132.1	545.0	6 186.0	1 068.0	7 816.0	5 479.0	521.0	12 954.0	19 694.0	975.0	9 461.0	5 149.0	9 300.0	11 947.0	1 818.0	13 148.0
133.4	585.0	7 570.0	1 079.0	9 383.0	6 537.0	531.0	15 607.0	24 186.0	973.0	11 402.0	6 195.0	11 172.0	14 172.0	1 827.0	15 857.0
134.6	589.0	9 311.0	1 095.0	11 549.0	7 925.0	560.0	19 169.0	30 532.0	1 016.0	13 985.0	7 669.0	13 816.0	17 359.0	1 882.0	19 561.0
135.9	617.0	11 966.0	1 069.0	14 537.0	9 985.0	623.0	24 144.0	39 527.0	1 002.0	17 577.0	9 853.0	17 479.0	21 563.0	1 866.0	24 825.0
137.2	661.0	15 692.0	1 097.0	19 102.0	13 034.0	680.0	31 237.0	52 531.0	1 061.0	22 637.0	12 870.0	22 463.0	27 734.0	1 899.0	32 568.0
138.5	703.0	21 001.0	1 175.0	25 508.0	17 187.0	771.0	40 982.0	64 940.0	1 146.0	29 903.0	17 188.0	29 567.0	36 580.0	1 992.0	43 501.0
139.7	765.0	28 315.0	1 224.0	34 665.0	23 113.0	870.0	54 247.0	64 940.0	1 249.0	39 403.0	22 486.0	38 921.0	48 369.0	2 082.0	58 324.0
141.0	862.0	36 473.0	1 348.0	46 048.0	30 975.0	964.0	64 940.0	64 940.0	1 322.0	50 672.0	27 285.0	49 599.0	63 485.0	2 265.0	64 940.0
142.3	891.0	42 907.0	1 429.0	57 307.0	38 917.0	1 087.0	64 940.0	64 940.0	1 415.0	61 424.0	30 445.0	59 662.0	64 940.0	2 422.0	64 940.0
143.6	881.0	44 607.0	1 462.0	62 965.0	42 843.0	1 144.0	64 940.0	64 940.0	1 446.0	64 940.0	29 987.0	64 899.0	64 940.0	2 547.0	64 940.0
144.9	861.0	40 919.0	1 359.0	58 831.0	40 101.0	1 092.0	64 940.0	64 940.0	1 425.0	64 940.0	26 259.0	63 200.0	64 940.0	2 430.0	64 940.0
146.1	785.0	32 827.0	1 233.0	47 874.0	32 837.0	1 002.0	64 940.0	64 940.0	1 337.0	57 600.0	20 845.0	54 359.0	64 940.0	2 303.0	64 940.0
147.4	735.0	24 873.0	1 144.0	35 949.0	24 597.0	909.0	63 507.0	64 940.0	1 193.0	45 863.0	15 570.0	42 487.0	62 101.0	2 029.0	61 599.0
148.7	689.0	18 193.0	1 085.0	26 353.0	17 896.0	763.0	48 161.0	58 757.0	1 099.0	34 977.0	11 569.0	32 128.0	47 177.0	1 942.0	45 477.0
150.0	647.0	13 485.0	1 064.0	19 292.0	13 299.0	707.0	36 033.0	43 231.0	1 051.0	26 251.0	8 819.0	23 997.0	35 367.0	1 835.0	33 429.0
151.2	637.0	10 219.0	1 038.0	14 678.0	9 981.0	653.0	27 295.0	32 343.0	979.0	19 976.0	6 827.0	18 269.0	26 652.0	1 797.0	25 087.0
152.5	583.0	7 938.0	983.0	11 584.0	7 865.0	589.0	21 159.0	25 030.0	950.0	15 537.0	5 567.0	14 360.0	20 567.0	1 737.0	19 516.0
153.8	577.0	6 361.0	1 011.0	9 076.0	6 203.0	567.0	16 779.0	19 941.0	921.0	12 357.0	4 570.0	11 417.0	16 209.0	1 744.0	15 341.0
155.1	593.0	5 235.0	981.0	7 403.0	5 122.0	543.0	13 561.0	16 138.0	911.0	10 074.0	3 875.0	9 290.0	13 097.0	1 731.0	12 446.0
156.3	557.0	4 331.0	954.0	6 148.0	4 320.0	521.0	11 245.0	13 352.0	896.0	8 274.0	3 261.0	7 793.0	10 791.0	1 717.0	10 349.0
157.6	545.0	3 669.0	957.0	5 139.0	3 595.0	507.0	9 522.0	11 261.0	930.0	7 080.0	2 938.0	6 568.0	9 026.0	1 671.0	8 758.0
158.9	552.0	3 188.0	982.0	4 426.0	3 134.0	484.0	8 059.0	9 601.0	875.0	6 131.0	2 619.0	5 712.0	7 792.0	1 707.0	7 490.0
160.1	547.0	2 754.0	985.0	3 831.0	2 693.0	487.0	7 022.0	8 301.0	898.0	5 265.0	2 367.0	4 964.0	6 707.0	1 686.0	6 544.0
161.4	548.0	2 480.0	968.0	3 392.0	2 419.0	477.0	6 181.0	7 309.0	875.0	4 674.0	2 090.0	4 381.0	5 826.0	1 658.0	5 743.0
162.7	541.0	2 201.0	988.0	3 033.0	2 109.0	473.0	5 500.0	6 398.0	872.0	4 177.0	1 913.0	3 907.0	5 247.0	1 644.0	5 095.0
164.0	540.0	1 989.0	989.0	2 661.0	1 946.0	459.0	4 930.0	5 802.0	849.0	3 820.0	1 789.0	3 540.0	4 631.0	1 669.0	4 649.0
165.2	541.0	1 824.0	956.0	2 414.0	1 760.0	471.0	4 421.0	5 166.0	883.0	3 481.0	1 687.0	3 225.0	4 220.0	1 671.0	4 162.0
166.5	543.0	1 697.0	986.0	2 233.0	1 589.0	467.0	4 014.0	4 692.0	871.0	3 142.0	1 614.0	2 973.0	3 873.0	1 704.0	3 876.0
167.8	545.0	1 555.0	964.0	2 058.0	1 511.0	455.0	3 775.0	4 295.0	866.0	2 931.0	1 543.0	2 782.0	3 469.0	1 675.0	3 537.0
169.1	550.0	1 417.0	979.0	1 852.0	1 387.0	454.0	3 489.0	3 976.0	865.0	2 732.0	1 460.0	2 600.0	3 247.0	1 692.0	3 343.0
170.3	534.0	1 381.0	989.0												



214.7	564.0	673.0	1 350.0	715.0	631.0	463.0	1 408.0	1 337.0	886.0	1 245.0	903.0	1 237.0	1 329.0	2 508.0	1 409.0
216.0	561.0	689.0	1 386.0	687.0	619.0	515.0	1 404.0	1 289.0	896.0	1 219.0	929.0	1 215.0	1 285.0	2 561.0	1 446.0
217.2	569.0	681.0	1 386.0	677.0	629.0	529.0	1 329.0	1 290.0	860.0	1 231.0	911.0	1 184.0	1 280.0	2 589.0	1 385.0
218.5	561.0	624.0	1 348.0	665.0	600.0	580.0	1 338.0	1 260.0	878.0	1 217.0	930.0	1 175.0	1 260.0	2 557.0	1 411.0
219.8	606.0	641.0	1 375.0	658.0	612.0	631.0	1 321.0	1 279.0	909.0	1 234.0	912.0	1 175.0	1 280.0	2 582.0	1 380.0
221.0	615.0	634.0	1 407.0	649.0	649.0	717.0	1 330.0	1 245.0	880.0	1 222.0	908.0	1 191.0	1 202.0	2 612.0	1 353.0
222.3	697.0	603.0	1 424.0	632.0	651.0	906.0	1 308.0	1 243.0	938.0	1 189.0	937.0	1 152.0	1 238.0	2 642.0	1 379.0
223.5	802.0	637.0	1 449.0	636.0	673.0	1 145.0	1 287.0	1 199.0	999.0	1 194.0	942.0	1 161.0	1 221.0	2 659.0	1 360.0
224.8	906.0	627.0	1 415.0	672.0	720.0	1 553.0	1 261.0	1 199.0	1 000.0	1 120.0	973.0	1 157.0	1 248.0	2 668.0	1 341.0
226.1	983.0	615.0	1 417.0	626.0	805.0	1 853.0	1 269.0	1 200.0	1 089.0	1 181.0	994.0	1 171.0	1 221.0	2 664.0	1 332.0
227.3	1 009.0	604.0	1 486.0	640.0	870.0	1 928.0	1 286.0	1 220.0	1 138.0	1 173.0	977.0	1 133.0	1 224.0	2 690.0	1 328.0
228.6	911.0	618.0	1 444.0	627.0	821.0	1 605.0	1 276.0	1 179.0	1 059.0	1 189.0	978.0	1 126.0	1 217.0	2 742.0	1 324.0
229.8	799.0	579.0	1 444.0	635.0	729.0	1 225.0	1 269.0	1 196.0	1 002.0	1 161.0	954.0	1 138.0	1 218.0	2 734.0	1 329.0
231.1	708.0	606.0	1 449.0	614.0	670.0	956.0	1 239.0	1 163.0	959.0	1 137.0	917.0	1 120.0	1 208.0	2 708.0	1 269.0
232.4	673.0	588.0	1 420.0	597.0	587.0	783.0	1 240.0	1 165.0	907.0	1 134.0	878.0	1 116.0	1 183.0	2 711.0	1 326.0
233.6	609.0	586.0	1 433.0	583.0	593.0	673.0	1 262.0	1 157.0	946.0	1 167.0	914.0	1 091.0	1 169.0	2 760.0	1 263.0
234.9	618.0	609.0	1 437.0	603.0	594.0	599.0	1 267.0	1 137.0	930.0	1 158.0	898.0	1 112.0	1 177.0	2 799.0	1 290.0
236.2	634.0	600.0	1 448.0	627.0	584.0	591.0	1 237.0	1 146.0	896.0	1 161.0	898.0	1 118.0	1 199.0	2 707.0	1 268.0
237.4	595.0	573.0	1 443.0	621.0	567.0	569.0	1 240.0	1 139.0	917.0	1 136.0	882.0	1 107.0	1 146.0	2 771.0	1 303.0
238.7	620.0	595.0	1 452.0	620.0	594.0	579.0	1 212.0	1 116.0	902.0	1 152.0	909.0	1 090.0	1 168.0	2 718.0	1 285.0
239.9	643.0	586.0	1 452.0	599.0	569.0	553.0	1 234.0	1 144.0	923.0	1 126.0	926.0	1 094.0	1 149.0	2 752.0	1 276.0
241.2	645.0	580.0	1 450.0	585.0	584.0	577.0	1 236.0	1 137.0	947.0	1 154.0	874.0	1 114.0	1 184.0	2 733.0	1 249.0
242.5	695.0	594.0	1 459.0	607.0	601.0	627.0	1 227.0	1 146.0	966.0	1 155.0	938.0	1 095.0	1 157.0	2 761.0	1 283.0
243.7	713.0	571.0	1 467.0	608.0	594.0	676.0	1 237.0	1 121.0	988.0	1 173.0	977.0	1 110.0	1 183.0	2 749.0	1 316.0
245.0	778.0	595.0	1 450.0	639.0	649.0	728.0	1 222.0	1 155.0	1 008.0	1 126.0	1 024.0	1 106.0	1 178.0	2 721.0	1 300.0
246.2	753.0	582.0	1 426.0	605.0	615.0	737.0	1 227.0	1 142.0	1 046.0	1 132.0	1 037.0	1 100.0	1 161.0	2 747.0	1 293.0
247.5	794.0	572.0	1 414.0	594.0	630.0	699.0	1 239.0	1 121.0	1 053.0	1 152.0	1 062.0	1 108.0	1 138.0	2 741.0	1 311.0
248.7	699.0	594.0	1 438.0	581.0	609.0	630.0	1 218.0	1 117.0	995.0	1 179.0	1 011.0	1 096.0	1 166.0	2 719.0	1 283.0
250.0	673.0	587.0	1 427.0	579.0	583.0	581.0	1 216.0	1 081.0	954.0	1 131.0	965.0	1 108.0	1 152.0	2 663.0	1 287.0
251.3	649.0	577.0	1 406.0	598.0	567.0	547.0	1 217.0	1 139.0	947.0	1 144.0	941.0	1 093.0	1 179.0	2 646.0	1 267.0
252.5	607.0	593.0	1 391.0	595.0	569.0	541.0	1 222.0	1 092.0	899.0	1 128.0	930.0	1 091.0	1 157.0	2 665.0	1 243.0
253.8	593.0	574.0	1 342.0	593.0	554.0	493.0	1 224.0	1 106.0	891.0	1 120.0	887.0	1 094.0	1 148.0	2 597.0	1 310.0
255.0	605.0	596.0	1 369.0	624.0	570.0	498.0	1 224.0	1 089.0	912.0	1 160.0	880.0	1 124.0	1 183.0	2 511.0	1 274.0
256.3	610.0	583.0	1 411.0	607.0	575.0	515.0	1 224.0	1 106.0	902.0	1 168.0	885.0	1 109.0	1 156.0	2 523.0	1 323.0
257.5	585.0	585.0	1 373.0	616.0	569.0	499.0	1 236.0	1 113.0	899.0	1 165.0	873.0	1 119.0	1 147.0	2 496.0	1 320.0
258.8	599.0	610.0	1 361.0	577.0	586.0	508.0	1 248.0	1 139.0	887.0	1 155.0	887.0	1 123.0	1 152.0	2 527.0	1 320.0
260.1	563.0	613.0	1 351.0	638.0	591.0	473.0	1 282.0	1 126.0	926.0	1 189.0	868.0	1 105.0	1 184.0	2 534.0	1 315.0
261.3	601.0	623.0	1 388.0	623.0	583.0	519.0	1 271.0	1 126.0	933.0	1 214.0	903.0	1 154.0	1 164.0	2 466.0	1 381.0
262.6	599.0	571.0	1 343.0	632.0	583.0	489.0	1 273.0	1 114.0	926.0	1 244.0	882.0	1 144.0	1 188.0	2 512.0	1 367.0
263.8	587.0	630.0	1 351.0	623.0	604.0	493.0	1 284.0	1 113.0	945.0	1 207.0	887.0	1 144.0	1 198.0	2 476.0	1 380.0
265.1	603.0	630.0	1 354.0	634.0	575.0	506.0	1 300.0	1 123.0	947.0	1 186.0	901.0	1 155.0	1 187.0	2 410.0	1 344.0
266.3	598.0	638.0	1 363.0	659.0	587.0	510.0	1 310.0	1 155.0	961.0	1 216.0	889.0	1 157.0	1 176.0	2 406.0	1 381.0
267.6	619.0	585.0	1 360.0	636.0	617.0	505.0	1 269.0	1 144.0	946.0	1 226.0	912.0	1 163.0	1 200.0	2 429.0	1 340.0
268.8	623.0	622.0	1 345.0	618.0	598.0	535.0	1 307.0	1 132.0	945.0	1 204.0	908.0	1 144.0	1 188.0	2 397.0	1 331.0
270.1	613.0	608.0	1 327.0	650.0	585.0	539.0	1 289.0	1 170.0	929.0	1 193.0	900.0	1 180.0	1 155.0	2 437.0	1 330.0
271.4	617.0	609.0	1 304.0	641.0	623.0	537.0	1 264.0	1 147.0	941.0	1 170.0	896.0	1 148.0	1 183.0	2 372.0	1 332.0
272.6	639.0	625.0	1 318.0	634.0	594.0	557.0	1 280.0	1 160.0	949.0	1 183.0	888.0	1 136.0	1 188.0	2 364.0	1 376.0
273.9	641.0	612.0	1 305.0	632.0	581.0	575.0	1 251.0	1 147.0	926.0	1 159.0	899.0	1 145.0	1 167.0	2 307.0	1 382.0
275.1	645.0	591.0	1 306.0	615.0	600.0	605.0	1 257.0	1 146.0	932.0	1 160.0	895.0	1 132.0	1 160.0	2 347.0	1 358.0
276.4	661.0	601.0	1 265.0	631.0	583.0	599.0	1 281.0	1 137.0	946.0	1 170.0	930.0	1 136.0	1 144.0	2 297.0	1 370.0
277.6	695.0	604.0	1 269.0	656.0	604.0	619.0	1 265.0	1 164.0	977.0	1 176.0	921.0	1 199.0	1 164.0	2 273.0	1 371.0
278.9	715.0	619.0	1 260.0	621.0	589.0	700.0	1 301.0	1 162.0	939.0	1 193.0	921.0	1 173.0	1 171.0	2 300.0	1 359.0
280.1	721.0	613.0	1 272.0	628.0	598.0	711.0	1 271.0	1 184.0	945.0	1 201.0	937.0	1 165.0	1 170.0	2 208.0	1 382.0
281.4	762.0	628.0	1 218.0	635.0	597.0	774.0	1 264.0	1 152.0	1 004.0	1 204.0	971.0	1 187.0	1 160.0	2 222.0	1 369.0
282.6	787.0	631.0	1 217.0	627.0	623.0	811.0	1 308.0	1 169.0	990.0	1 215.0	964.0	1 168.0	1 170.0	2 218.0	1 394.0
283.9	838.0	616.0	1 218.0	642.0	607.0	885.0	1 296.0	1 216.0	1 025.0	1 204.0	980.0	1 180.0	1 202.0	2 231.0	1 395.0
285.1	890.0	613.0	1 202.0	649.0	637.0	985.0	1 284.0	1 220.0	1 037.0	1 186.0	1 002.0	1 171.0	1 198.0	2 221.0	1 396.0
286.4	979.0	625.0	1 197.0	637.0	641.0	1 140.0	1 297.0	1 211.0	1 051.0	1 217.0	1 059.0	1 194.0	1 188.0	2 216.0	1 407.0
287.6	1 124.0	633.0	1 232.0	653.0	655.0	1 339.0	1 335.0	1 224.0	1 140.0	1 197.0	1 057.0	1 208.0	1 184.0	2 201.0	1 427.0
288.9	1 274.0	651.0	1 213.0	679.0	713.0	1 541.0	1 328.0	1 256.0	1 245.0	1 203.0	1 133.0	1 189.0	1 225.0	2 199.0	1 478.0
290.1	1 446.0	665.0	1 204.0	661.0	782.0	1 968.0	1 354.0	1 313.0	1 326.0	1 225.0	1 243.0	1 231.0	1 236.0	2 171.0	1 472.0
291.4	1 690.0	647.0	1 177.0	685.0	845.0	2 271.0	1 356.0	1 312.0	1 443.0	1 266.0	1 350.0	1 232.0	1 253.0	2 146.0	1 502.0
292.6	1 807.0	670.0	1 214.0	691.0	942.0	2 599.0	1 369.0	1 334.0	1 561.0	1 265.0	1 506.0	1 268.0	1 281.0	2 204.0	1 459.0
293.9	1 829.0	678.0	1 240.0	703.0	964.0	2 591.0	1 412.0	1 313.0	1 656.0	1 250.0	1 547.0	1 275.0	1 293.0	2 197.0	1 557.0
295.1	1 788.0	685.0	1 189.0	732.0	937.0	2 433.0	1 386.0	1 344.0	1 579.0	1 273.0	1 548.0	1 271.0	1 279.0	2 169.0	1 525.0
296.4	1 622.0	668.0	1 165.0	723.0	905.0	2 163.0	1 437.0	1 361.0	1 547.0	1 251.0	1 488.0	1 296.0	1 263.0	2 150.0	1 581.0
297.6	1 505.0	699.0	1 171.0	732.0	861.0	1 947.0	1 418.0	1 336.0	1 465.0	1 306.0	1 495.0	1 299.0	1 303.0	2 165.0	1 602.0
298.9	1 447.0	693.0	1 182.0	724.0	847.0	1 825.0	1 433.0	1							

340.0	576.0	754.0	1 249.0	817.0	656.0	463.0	1 574.0	1 441.0	937.0	1 412.0	940.0	1 404.0	1 282.0	2 097.0	1 708.0
341.3	589.0	786.0	1 234.0	793.0	643.0	465.0	1 585.0	1 478.0	934.0	1 365.0	964.0	1 421.0	1 292.0	2 184.0	1 766.0
342.5	588.0	797.0	1 215.0	808.0	605.0	455.0	1 541.0	1 478.0	936.0	1 400.0	946.0	1 422.0	1 319.0	2 165.0	1 758.0
343.7	589.0	768.0	1 230.0	796.0	653.0	457.0	1 569.0	1 457.0	931.0	1 400.0	948.0	1 430.0	1 301.0	2 187.0	1 777.0
345.0	602.0	765.0	1 230.0	807.0	650.0	481.0	1 578.0	1 478.0	942.0	1 411.0	964.0	1 431.0	1 312.0	2 196.0	1 775.0
346.2	575.0	783.0	1 237.0	810.0	666.0	456.0	1 571.0	1 468.0	910.0	1 400.0	927.0	1 431.0	1 317.0	2 222.0	1 834.0
347.5	567.0	804.0	1 252.0	831.0	633.0	450.0	1 560.0	1 485.0	911.0	1 398.0	950.0	1 467.0	1 320.0	2 248.0	1 758.0
348.7	591.0	819.0	1 227.0	817.0	657.0	467.0	1 614.0	1 539.0	940.0	1 420.0	943.0	1 451.0	1 322.0	2 199.0	1 848.0
349.9	604.0	798.0	1 258.0	816.0	676.0	471.0	1 643.0	1 520.0	912.0	1 424.0	954.0	1 485.0	1 310.0	2 230.0	1 891.0
351.2	597.0	790.0	1 229.0	843.0	631.0	459.0	1 615.0	1 537.0	919.0	1 439.0	969.0	1 504.0	1 324.0	2 272.0	1 874.0
352.4	599.0	831.0	1 255.0	863.0	645.0	477.0	1 602.0	1 547.0	920.0	1 453.0	967.0	1 550.0	1 361.0	2 236.0	1 892.0
353.7	593.0	856.0	1 245.0	845.0	666.0	478.0	1 669.0	1 591.0	928.0	1 469.0	983.0	1 531.0	1 364.0	2 233.0	1 918.0
354.9	608.0	883.0	1 257.0	873.0	670.0	489.0	1 670.0	1 573.0	925.0	1 476.0	991.0	1 572.0	1 359.0	2 267.0	1 957.0
356.2	610.0	871.0	1 292.0	912.0	690.0	485.0	1 675.0	1 593.0	915.0	1 482.0	1 018.0	1 588.0	1 362.0	2 265.0	2 010.0
357.4	592.0	879.0	1 298.0	908.0	695.0	464.0	1 699.0	1 649.0	938.0	1 519.0	993.0	1 602.0	1 398.0	2 299.0	2 060.0
358.6	593.0	879.0	1 251.0	913.0	697.0	459.0	1 742.0	1 651.0	920.0	1 530.0	995.0	1 597.0	1 384.0	2 302.0	2 059.0
359.9	613.0	904.0	1 269.0	943.0	722.0	496.0	1 747.0	1 682.0	936.0	1 548.0	1 015.0	1 625.0	1 401.0	2 345.0	2 114.0
361.1	594.0	939.0	1 288.0	919.0	697.0	459.0	1 756.0	1 758.0	910.0	1 551.0	1 046.0	1 678.0	1 410.0	2 313.0	2 112.0
362.3	612.0	936.0	1 261.0	922.0	687.0	476.0	1 767.0	1 775.0	936.0	1 536.0	1 026.0	1 696.0	1 429.0	2 325.0	2 134.0
363.6	610.0	943.0	1 277.0	957.0	717.0	476.0	1 848.0	1 788.0	907.0	1 624.0	1 041.0	1 720.0	1 413.0	2 260.0	2 206.0
364.8	603.0	996.0	1 275.0	1 005.0	715.0	485.0	1 895.0	1 840.0	930.0	1 618.0	1 049.0	1 777.0	1 418.0	2 303.0	2 291.0
366.1	607.0	1 003.0	1 279.0	1 021.0	717.0	496.0	1 925.0	1 863.0	920.0	1 656.0	1 059.0	1 805.0	1 427.0	2 330.0	2 341.0
367.3	616.0	1 063.0	1 277.0	1 076.0	731.0	497.0	1 979.0	1 977.0	928.0	1 682.0	1 088.0	1 877.0	1 413.0	2 332.0	2 411.0
368.5	623.0	1 064.0	1 281.0	1 086.0	743.0	501.0	2 023.0	1 963.0	953.0	1 722.0	1 062.0	1 918.0	1 471.0	2 315.0	2 483.0
369.8	621.0	1 130.0	1 277.0	1 131.0	793.0	489.0	2 092.0	2 046.0	956.0	1 766.0	1 092.0	2 030.0	1 497.0	2 372.0	2 612.0
371.0	619.0	1 179.0	1 284.0	1 176.0	797.0	515.0	2 157.0	2 132.0	943.0	1 813.0	1 093.0	2 109.0	1 544.0	2 335.0	2 692.0
372.3	639.0	1 242.0	1 276.0	1 231.0	777.0	509.0	2 204.0	2 255.0	949.0	1 864.0	1 129.0	2 135.0	1 554.0	2 298.0	2 867.0
373.5	635.0	1 240.0	1 301.0	1 285.0	815.0	512.0	2 301.0	2 301.0	939.0	1 918.0	1 139.0	2 290.0	1 553.0	2 330.0	2 951.0
374.7	668.0	1 337.0	1 287.0	1 343.0	844.0	519.0	2 428.0	2 449.0	964.0	2 003.0	1 222.0	2 402.0	1 625.0	2 347.0	3 162.0
376.0	653.0	1 406.0	1 325.0	1 422.0	897.0	537.0	2 501.0	2 605.0	956.0	2 090.0	1 224.0	2 518.0	1 690.0	2 384.0	3 291.0
377.2	651.0	1 489.0	1 311.0	1 462.0	907.0	537.0	2 601.0	2 727.0	942.0	2 158.0	1 281.0	2 693.0	1 674.0	2 316.0	3 555.0
378.4	647.0	1 616.0	1 281.0	1 587.0	919.0	517.0	2 804.0	2 891.0	978.0	2 241.0	1 353.0	2 744.0	1 715.0	2 377.0	3 792.0
379.7	673.0	1 719.0	1 323.0	1 723.0	965.0	544.0	2 955.0	3 132.0	963.0	2 377.0	1 374.0	2 969.0	1 817.0	2 362.0	4 092.0
380.9	683.0	1 821.0	1 315.0	1 818.0	1 015.0	553.0	3 177.0	3 331.0	964.0	2 493.0	1 441.0	3 164.0	1 859.0	2 414.0	4 375.0
382.1	671.0	1 973.0	1 303.0	1 947.0	1 071.0	565.0	3 350.0	3 634.0	986.0	2 634.0	1 493.0	3 396.0	1 958.0	2 436.0	4 802.0
383.4	688.0	2 187.0	1 318.0	2 139.0	1 139.0	553.0	3 541.0	3 845.0	965.0	2 821.0	1 592.0	3 641.0	2 048.0	2 459.0	5 153.0
384.6	682.0	2 343.0	1 315.0	2 301.0	1 169.0	565.0	3 882.0	4 195.0	957.0	3 009.0	1 624.0	3 908.0	2 129.0	2 428.0	5 537.0
385.8	702.0	2 574.0	1 334.0	2 514.0	1 274.0	577.0	4 120.0	4 572.0	1 002.0	3 270.0	1 749.0	4 130.0	2 265.0	2 447.0	6 013.0
387.1	721.0	2 813.0	1 353.0	2 646.0	1 355.0	581.0	4 444.0	4 944.0	986.0	3 467.0	1 816.0	4 511.0	2 366.0	2 501.0	6 646.0
388.3	719.0	2 999.0	1 352.0	2 919.0	1 402.0	585.0	4 860.0	5 397.0	970.0	3 719.0	1 931.0	4 905.0	2 471.0	2 528.0	7 219.0
389.5	701.0	3 287.0	1 360.0	3 147.0	1 528.0	604.0	5 187.0	5 827.0	992.0	4 001.0	2 027.0	5 265.0	2 608.0	2 486.0	7 776.0
390.8	717.0	3 482.0	1 358.0	3 405.0	1 569.0	622.0	5 534.0	6 184.0	1 006.0	4 269.0	2 117.0	5 557.0	2 747.0	2 579.0	8 446.0
392.0	725.0	3 677.0	1 398.0	3 675.0	1 703.0	614.0	5 917.0	6 627.0	1 010.0	4 533.0	2 196.0	5 969.0	2 880.0	2 563.0	9 079.0
393.3	729.0	3 925.0	1 388.0	3 932.0	1 779.0	642.0	6 239.0	7 052.0	1 014.0	4 743.0	2 310.0	6 267.0	2 980.0	2 564.0	9 525.0
394.5	756.0	4 165.0	1 396.0	4 001.0	1 816.0	647.0	6 579.0	7 261.0	1 030.0	4 955.0	2 377.0	6 549.0	3 043.0	2 587.0	10 084.0
395.7	762.0	4 288.0	1 420.0	4 191.0	1 901.0	676.0	6 760.0	7 393.0	1 052.0	5 069.0	2 393.0	6 719.0	3 153.0	2 635.0	10 367.0
396.9	827.0	4 235.0	1 418.0	4 207.0	1 871.0	704.0	6 776.0	7 411.0	1 066.0	5 121.0	2 409.0	6 791.0	3 168.0	2 690.0	10 397.0
398.2	831.0	4 202.0	1 435.0	4 158.0	1 893.0	725.0	6 759.0	7 307.0	1 036.0	5 096.0	2 334.0	6 788.0	3 168.0	2 667.0	10 446.0
399.4	873.0	4 065.0	1 479.0	4 076.0	1 837.0	778.0	6 617.0	7 012.0	1 095.0	4 982.0	2 317.0	6 547.0	3 053.0	2 760.0	10 083.0
400.6	905.0	3 795.0	1 489.0	3 824.0	1 773.0	785.0	6 199.0	6 585.0	1 089.0	4 738.0	2 248.0	6 247.0	3 005.0	2 690.0	9 572.0
401.9	966.0	3 523.0	1 512.0	3 610.0	1 667.0	883.0	5 904.0	6 154.0	1 121.0	4 509.0	2 167.0	5 815.0	2 841.0	2 817.0	8 823.0
403.1	1 046.0	3 210.0	1 540.0	3 241.0	1 539.0	963.0	5 556.0	5 591.0	1 181.0	4 235.0	2 094.0	5 331.0	2 664.0	2 884.0	8 235.0
404.3	1 086.0	2 907.0	1 539.0	2 952.0	1 557.0	1 054.0	5 052.0	5 125.0	1 230.0	3 844.0	2 036.0	4 941.0	2 574.0	2 931.0	7 427.0
405.6	1 194.0	2 667.0	1 543.0	2 684.0	1 415.0	1 116.0	4 581.0	4 593.0	1 299.0	3 539.0	2 016.0	4 559.0	2 376.0	2 993.0	6 670.0
406.8	1 277.0	2 397.0	1 566.0	2 451.0	1 377.0	1 233.0	4 232.0	4 202.0	1 358.0	3 293.0	1 999.0	4 051.0	2 261.0	3 024.0	6 133.0
408.0	1 386.0	2 153.0	1 585.0	2 228.0	1 329.0	1 351.0	3 869.0	3 801.0	1 414.0	3 006.0	1 995.0	3 753.0	2 178.0	3 048.0	5 401.0
409.3	1 447.0	1 961.0	1 676.0	2 013.0	1 292.0	1 477.0	3 578.0	3 487.0	1 476.0	2 837.0	2 029.0	3 465.0	2 063.0	3 166.0	4 996.0
410.5	1 542.0	1 827.0	1 659.0	1 869.0	1 271.0	1 525.0	3 318.0	3 218.0	1 579.0	2 601.0	2 045.0	3 135.0	1 967.0	3 197.0	4 578.0
411.7	1 503.0	1 709.0	1 634.0	1 742.0	1 229.0	1 550.0	3 030.0	2 993.0	1 592.0	2 458.0	2 059.0	3 011.0	1 877.0	3 246.0	4 203.0
413.0	1 483.0	1 557.0	1 687.0	1 623.0	1 214.0	1 477.0	2 855.0	2 773.0	1 560.0	2 362.0	2 043.0	2 793.0	1 821.0	3 357.0	3 896.0
414.2	1 392.0	1 493.0	1 737.0	1 519.0	1 153.0	1 414.0	2 726.0	2 641.0	1 531.0	2 239.0	1 920.0	2 609.0	1 784.0	3 430.0	3 626.0
415.4	1 291.0	1 379.0	1 752.0	1 399.0	1 116.0	1 301.0	2 572.0	2 509.0	1 496.0	2 128.0	1 850.0	2 476.0	1 730.0	3 504.0	3 390.0
416.6	1 209.0	1 327.0	1 825.0	1 349.0	1 051.0	1 170.0	2 429.0	2 356.0	1 395.0	2 035.0	1 712.0	2 375.0	1 663.0	3 586.0	3 222.0
417.9	1 131.0	1 264.0	1 828.0	1 288.0	978.0	1 069.0	2 367.0	2 218.0	1 303.0	1 949.0	1 601.0	2 264.0	1 626.0	3 678.0	3 085.0
419.1	1 042.0	1 206.0	1 834.0	1 236.0	896.0	968.0	2 252.0	2 162.0	1 221.0	1 911.0	1 473.0	2 186.0	1 581.0	3 746.0	2 997.0
420.3	976.0	1 161.0	1 885.0	1 192.0	909.0	900.0	2 165.0	2 062.0	1 182.0	1 834.0	1 420.0				

463.2	667.0	1028.0	2 196.0	886.0	748.0	545.0	1 640.0	1 463.0	1 041.0	1 459.0	1 139.0	1 536.0	1 412.0	4 477.0	1 868.0
464.4	661.0	1 056.0	2 086.0	900.0	756.0	562.0	1 660.0	1 490.0	1 115.0	1 464.0	1 238.0	1 544.0	1 435.0	4 297.0	1 805.0
465.7	653.0	1 058.0	2 060.0	889.0	741.0	501.0	1 612.0	1 509.0	1 100.0	1 461.0	1 241.0	1 531.0	1 436.0	4 070.0	1 845.0
466.9	673.0	1 037.0	1 961.0	897.0	733.0	529.0	1 635.0	1 514.0	1 102.0	1 462.0	1 210.0	1 573.0	1 446.0	3 809.0	1 892.0
468.1	666.0	995.0	1 878.0	880.0	754.0	537.0	1 644.0	1 526.0	1 100.0	1 484.0	1 186.0	1 535.0	1 438.0	3 749.0	1 862.0
469.3	667.0	951.0	1 826.0	864.0	718.0	521.0	1 638.0	1 539.0	1 093.0	1 454.0	1 173.0	1 565.0	1 404.0	3 544.0	1 875.0
470.5	687.0	933.0	1 721.0	829.0	704.0	523.0	1 637.0	1 549.0	1 036.0	1 483.0	1 121.0	1 549.0	1 381.0	3 426.0	1 920.0
471.8	680.0	914.0	1 692.0	862.0	708.0	542.0	1 664.0	1 563.0	1 003.0	1 469.0	1 094.0	1 502.0	1 401.0	3 279.0	1 906.0
473.0	667.0	904.0	1 594.0	887.0	701.0	537.0	1 664.0	1 564.0	1 000.0	1 511.0	1 068.0	1 567.0	1 345.0	3 149.0	1 926.0
474.2	673.0	890.0	1 563.0	879.0	720.0	513.0	1 674.0	1 556.0	1 021.0	1 479.0	1 052.0	1 552.0	1 379.0	3 045.0	1 912.0
475.4	629.0	891.0	1 535.0	892.0	718.0	541.0	1 708.0	1 560.0	1 003.0	1 511.0	1 067.0	1 555.0	1 367.0	2 949.0	1 947.0
476.6	649.0	882.0	1 493.0	894.0	711.0	513.0	1 756.0	1 588.0	1 000.0	1 468.0	1 036.0	1 597.0	1 399.0	2 835.0	1 954.0
477.9	681.0	894.0	1 450.0	897.0	703.0	546.0	1 707.0	1 583.0	980.0	1 517.0	1 063.0	1 586.0	1 393.0	2 786.0	1 939.0
479.1	666.0	882.0	1 427.0	895.0	715.0	549.0	1 743.0	1 667.0	967.0	1 514.0	1 025.0	1 635.0	1 389.0	2 665.0	1 983.0
480.3	677.0	907.0	1 405.0	924.0	696.0	559.0	1 745.0	1 629.0	1 009.0	1 524.0	1 059.0	1 598.0	1 394.0	2 621.0	2 016.0
481.5	707.0	923.0	1 391.0	915.0	723.0	539.0	1 785.0	1 650.0	1 013.0	1 544.0	1 040.0	1 626.0	1 415.0	2 512.0	2 064.0
482.7	673.0	923.0	1 336.0	961.0	741.0	580.0	1 793.0	1 697.0	999.0	1 529.0	1 068.0	1 700.0	1 426.0	2 510.0	2 064.0
484.0	705.0	917.0	1 334.0	931.0	714.0	573.0	1 822.0	1 730.0	998.0	1 559.0	1 074.0	1 706.0	1 417.0	2 451.0	2 139.0
485.2	689.0	954.0	1 295.0	944.0	744.0	580.0	1 857.0	1 757.0	1 003.0	1 610.0	1 063.0	1 716.0	1 451.0	2 391.0	2 189.0
486.4	691.0	937.0	1 273.0	968.0	757.0	589.0	1 898.0	1 740.0	982.0	1 627.0	1 068.0	1 727.0	1 444.0	2 331.0	2 198.0
487.6	731.0	983.0	1 296.0	992.0	733.0	596.0	1 866.0	1 813.0	996.0	1 629.0	1 077.0	1 730.0	1 423.0	2 338.0	2 280.0
488.8	695.0	998.0	1 229.0	1 020.0	736.0	595.0	1 950.0	1 808.0	997.0	1 651.0	1 126.0	1 816.0	1 445.0	2 265.0	2 324.0
490.0	734.0	1 008.0	1 261.0	1 022.0	756.0	623.0	1 971.0	1 847.0	1 006.0	1 691.0	1 134.0	1 857.0	1 489.0	2 256.0	2 379.0
491.3	719.0	1 040.0	1 233.0	1 036.0	794.0	650.0	2 049.0	1 961.0	998.0	1 733.0	1 154.0	1 875.0	1 470.0	2 227.0	2 405.0
492.5	745.0	1 042.0	1 215.0	1 102.0	790.0	668.0	2 107.0	1 995.0	1 042.0	1 770.0	1 141.0	1 981.0	1 491.0	2 179.0	2 483.0
493.7	753.0	1 076.0	1 229.0	1 114.0	813.0	649.0	2 122.0	2 047.0	1 028.0	1 796.0	1 154.0	2 009.0	1 531.0	2 127.0	2 577.0
494.9	765.0	1 135.0	1 205.0	1 165.0	850.0	698.0	2 266.0	2 177.0	1 044.0	1 857.0	1 173.0	2 072.0	1 488.0	2 141.0	2 679.0
496.1	759.0	1 203.0	1 223.0	1 189.0	855.0	705.0	2 292.0	2 215.0	1 031.0	1 877.0	1 242.0	2 127.0	1 548.0	2 145.0	2 802.0
497.3	760.0	1 232.0	1 201.0	1 288.0	827.0	708.0	2 356.0	2 289.0	996.0	1 965.0	1 228.0	2 209.0	1 611.0	2 107.0	2 937.0
498.6	752.0	1 272.0	1 193.0	1 307.0	897.0	711.0	2 547.0	2 422.0	1 022.0	2 061.0	1 246.0	2 338.0	1 617.0	2 116.0	3 122.0
499.8	744.0	1 363.0	1 236.0	1 374.0	901.0	709.0	2 599.0	2 553.0	1 023.0	2 114.0	1 286.0	2 465.0	1 643.0	2 099.0	3 251.0
501.0	744.0	1 451.0	1 182.0	1 465.0	925.0	689.0	2 772.0	2 734.0	999.0	2 192.0	1 332.0	2 579.0	1 690.0	2 116.0	3 458.0
502.2	759.0	1 550.0	1 169.0	1 567.0	959.0	664.0	2 952.0	2 915.0	1 011.0	2 315.0	1 342.0	2 735.0	1 738.0	2 085.0	3 721.0
503.4	733.0	1 681.0	1 174.0	1 715.0	996.0	672.0	3 112.0	3 149.0	1 012.0	2 514.0	1 397.0	2 875.0	1 815.0	2 081.0	4 045.0
504.6	691.0	1 833.0	1 187.0	1 820.0	1 011.0	663.0	3 412.0	3 383.0	993.0	2 645.0	1 462.0	3 110.0	1 878.0	2 075.0	4 412.0
505.9	733.0	1 993.0	1 199.0	1 983.0	1 110.0	635.0	3 669.0	3 732.0	995.0	2 841.0	1 529.0	3 464.0	2 002.0	2 043.0	4 821.0
507.1	681.0	2 210.0	1 150.0	2 186.0	1 157.0	627.0	3 999.0	4 017.0	991.0	3 052.0	1 602.0	3 711.0	2 083.0	2 057.0	5 313.0
508.3	700.0	2 425.0	1 198.0	2 423.0	1 219.0	619.0	4 375.0	4 528.0	959.0	3 284.0	1 719.0	4 088.0	2 205.0	2 013.0	5 921.0
509.5	698.0	2 652.0	1 165.0	2 691.0	1 346.0	589.0	4 825.0	4 951.0	974.0	3 603.0	1 817.0	4 464.0	2 320.0	2 004.0	6 497.0
510.7	690.0	2 919.0	1 171.0	2 976.0	1 421.0	589.0	5 180.0	5 425.0	993.0	3 863.0	1 883.0	4 872.0	2 431.0	2 035.0	7 170.0
511.9	675.0	3 092.0	1 133.0	3 177.0	1 471.0	581.0	5 597.0	5 749.0	972.0	4 149.0	1 939.0	5 280.0	2 543.0	2 021.0	7 777.0
513.1	670.0	3 266.0	1 172.0	3 330.0	1 531.0	588.0	5 949.0	5 992.0	984.0	4 357.0	1 998.0	5 535.0	2 603.0	2 043.0	8 143.0
514.3	666.0	3 333.0	1 155.0	3 507.0	1 541.0	577.0	6 102.0	6 166.0	973.0	4 514.0	1 972.0	5 710.0	2 662.0	2 042.0	8 471.0
515.6	681.0	3 358.0	1 164.0	3 482.0	1 537.0	576.0	6 211.0	6 105.0	950.0	4 626.0	2 003.0	5 797.0	2 668.0	2 015.0	8 675.0
516.8	681.0	3 350.0	1 171.0	3 427.0	1 507.0	563.0	6 347.0	6 153.0	949.0	4 553.0	1 973.0	5 832.0	2 660.0	2 031.0	8 547.0
518.0	679.0	3 255.0	1 194.0	3 380.0	1 544.0	558.0	6 177.0	6 040.0	981.0	4 566.0	1 955.0	5 737.0	2 621.0	2 021.0	8 491.0
519.2	669.0	3 115.0	1 190.0	3 297.0	1 504.0	559.0	6 104.0	5 858.0	957.0	4 412.0	1 888.0	5 645.0	2 591.0	2 008.0	8 203.0
520.4	672.0	3 019.0	1 164.0	3 143.0	1 421.0	543.0	5 834.0	5 551.0	970.0	4 335.0	1 855.0	5 352.0	2 523.0	2 002.0	7 919.0
521.6	677.0	2 892.0	1 174.0	2 965.0	1 369.0	541.0	5 663.0	5 344.0	973.0	4 163.0	1 769.0	5 185.0	2 440.0	2 043.0	7 445.0
522.8	673.0	2 679.0	1 150.0	2 848.0	1 331.0	554.0	5 375.0	5 045.0	976.0	3 971.0	1 702.0	4 969.0	2 387.0	1 985.0	7 162.0
524.0	651.0	2 536.0	1 139.0	2 681.0	1 277.0	533.0	5 100.0	4 717.0	968.0	3 765.0	1 644.0	4 653.0	2 223.0	2 018.0	6 654.0
525.3	673.0	2 398.0	1 168.0	2 523.0	1 214.0	548.0	4 761.0	4 445.0	955.0	3 556.0	1 608.0	4 390.0	2 203.0	2 012.0	6 276.0
526.5	653.0	2 266.0	1 161.0	2 339.0	1 163.0	555.0	4 508.0	4 182.0	960.0	3 407.0	1 603.0	4 115.0	2 122.0	2 012.0	5 830.0
527.7	671.0	2 137.0	1 140.0	2 258.0	1 093.0	522.0	4 204.0	3 920.0	952.0	3 254.0	1 521.0	3 868.0	2 079.0	1 977.0	5 415.0
528.9	675.0	1 956.0	1 132.0	2 104.0	1 071.0	522.0	4 031.0	3 681.0	954.0	3 063.0	1 463.0	3 638.0	1 974.0	2 025.0	5 185.0
530.1	676.0	1 906.0	1 163.0	1 949.0	1 021.0	544.0	3 750.0	3 455.0	944.0	2 960.0	1 362.0	3 473.0	2 120.0	1 971.0	4 792.0
531.3	642.0	1 761.0	1 127.0	1 852.0	1 017.0	505.0	3 587.0	3 306.0	940.0	2 730.0	1 367.0	3 245.0	1 887.0	2 003.0	4 560.0
532.5	641.0	1 675.0	1 158.0	1 741.0	982.0	509.0	3 364.0	3 123.0	926.0	2 636.0	1 284.0	3 151.0	1 829.0	1 971.0	4 286.0
533.7	649.0	1 563.0	1 141.0	1 675.0	917.0	527.0	3 244.0	2 999.0	955.0	2 539.0	1 277.0	2 980.0	1 775.0	1 987.0	4 109.0
534.9	660.0	1 525.0	1 127.0	1 577.0	901.0	503.0	3 106.0	2 827.0	948.0	2 453.0	1 249.0	2 851.0	1 774.0	1 979.0	3 758.0
536.1	625.0	1 452.0	1 128.0	1 544.0	893.0	545.0	2 980.0	2 725.0	954.0	2 372.0	1 220.0	2 691.0	1 704.0	1 990.0	3 411.0
537.4	647.0	1 403.0	1 149.0	1 463.0	857.0	513.0	2 846.0	2 587.0	930.0	2 303.0	1 217.0	2 619.0	1 681.0	1 975.0	3 541.0
538.6	651.0	1 337.0	1 148.0	1 421.0	858.0	521.0	2 733.0	2 547.0	953.0	2 191.0	1 191.0	2 504.0	1 657.0	1 998.0	3 343.0
539.8	655.0	1 307.0	1 165.0	1 383.0	839.0	525.0	2 667.0	2 424.0	968.0	2 144.0	1 160.0	2 402.0	1 652.0	1 983.0	3 227.0
541.0	651.0	1 257.0	1 134.0	1 313.0	829.0	529.0	2 565.0	2 359.0	927.0	2 090.0	1 142.0	2 372.0	1 588.0	1 959.0	3 128.0
542.2	654.0	1 211.0	1 139.0	1 265.0	797.0	535.0	2 479.0	2 278.0	909.0	2 041.0	1 157.0	2 294.0	1 552.0	1 944.0	3

584.4	761.0	847.0	1 563.0	890.0	727.0	629.0	1 726.0	1 662.0	970.0	1 519.0	1 067.0	1 565.0	1 464.0	3 007.0	1 932.0
585.6	760.0	857.0	1 572.0	877.0	739.0	629.0	1 748.0	1 661.0	963.0	1 530.0	1 073.0	1 537.0	1 464.0	3 038.0	1 933.0
586.8	782.0	830.0	1 577.0	853.0	716.0	651.0	1 774.0	1 702.0	991.0	1 509.0	1 090.0	1 553.0	1 476.0	3 112.0	1 943.0
588.0	760.0	861.0	1 625.0	912.0	717.0	641.0	1 732.0	1 687.0	970.0	1 564.0	1 092.0	1 551.0	1 494.0	3 237.0	1 924.0
589.2	787.0	821.0	1 651.0	895.0	740.0	653.0	1 758.0	1 689.0	996.0	1 541.0	1 071.0	1 582.0	1 484.0	3 229.0	1 942.0
590.4	791.0	840.0	1 697.0	892.0	738.0	665.0	1 770.0	1 725.0	1 017.0	1 556.0	1 074.0	1 579.0	1 499.0	3 365.0	1 930.0
591.6	789.0	817.0	1 756.0	910.0	761.0	676.0	1 764.0	1 732.0	1 021.0	1 573.0	1 097.0	1 545.0	1 495.0	3 409.0	1 971.0
592.8	802.0	885.0	1 773.0	924.0	766.0	678.0	1 791.0	1 762.0	1 032.0	1 592.0	1 111.0	1 566.0	1 543.0	3 500.0	2 035.0
594.0	811.0	870.0	1 806.0	937.0	786.0	701.0	1 805.0	1 767.0	1 026.0	1 580.0	1 137.0	1 601.0	1 557.0	3 580.0	1 997.0
595.2	838.0	867.0	1 843.0	933.0	785.0	730.0	1 804.0	1 782.0	1 012.0	1 612.0	1 175.0	1 624.0	1 553.0	3 696.0	1 947.0
596.4	868.0	880.0	1 875.0	950.0	808.0	769.0	1 813.0	1 815.0	1 049.0	1 588.0	1 160.0	1 587.0	1 589.0	3 811.0	1 986.0
597.6	875.0	901.0	1 950.0	973.0	815.0	761.0	1 834.0	1 871.0	1 048.0	1 620.0	1 174.0	1 626.0	1 623.0	3 891.0	2 015.0
598.8	901.0	896.0	1 961.0	974.0	843.0	790.0	1 887.0	1 914.0	1 071.0	1 623.0	1 220.0	1 653.0	1 649.0	4 017.0	2 006.0
600.0	941.0	907.0	2 016.0	1 000.0	832.0	797.0	1 941.0	1 979.0	1 093.0	1 631.0	1 226.0	1 681.0	1 637.0	4 191.0	2 045.0
601.2	951.0	912.0	2 074.0	1 012.0	883.0	858.0	1 946.0	1 949.0	1 096.0	1 670.0	1 241.0	1 724.0	1 707.0	4 273.0	2 117.0
602.4	983.0	944.0	2 137.0	1 031.0	901.0	911.0	1 960.0	2 041.0	1 108.0	1 672.0	1 288.0	1 703.0	1 728.0	4 403.0	2 127.0
603.6	1 038.0	973.0	2 131.0	1 063.0	915.0	931.0	1 964.0	2 097.0	1 110.0	1 733.0	1 308.0	1 737.0	1 744.0	4 434.0	2 119.0
604.8	1 050.0	964.0	2 189.0	1 091.0	939.0	965.0	2 017.0	2 158.0	1 164.0	1 745.0	1 349.0	1 764.0	1 804.0	4 610.0	2 204.0
606.0	1 110.0	999.0	2 219.0	1 109.0	981.0	1 019.0	2 097.0	2 214.0	1 192.0	1 751.0	1 416.0	1 792.0	1 885.0	4 643.0	2 238.0
607.2	1 182.0	1 003.0	2 274.0	1 095.0	1 009.0	1 079.0	2 116.0	2 246.0	1 207.0	1 831.0	1 466.0	1 798.0	1 880.0	4 763.0	2 308.0
608.3	1 199.0	1 026.0	2 305.0	1 123.0	1 041.0	1 120.0	2 160.0	2 372.0	1 247.0	1 845.0	1 577.0	1 882.0	1 972.0	4 778.0	2 375.0
609.5	1 240.0	1 076.0	2 266.0	1 198.0	1 055.0	1 172.0	2 233.0	2 435.0	1 280.0	1 891.0	1 585.0	1 870.0	1 975.0	4 904.0	2 369.0
610.7	1 262.0	1 091.0	2 314.0	1 239.0	1 119.0	1 206.0	2 300.0	2 567.0	1 311.0	1 943.0	1 618.0	1 980.0	2 075.0	4 909.0	2 536.0
611.9	1 267.0	1 159.0	2 296.0	1 290.0	1 137.0	1 241.0	2 344.0	2 669.0	1 314.0	1 991.0	1 699.0	2 002.0	2 113.0	4 943.0	2 604.0
613.1	1 263.0	1 199.0	2 289.0	1 347.0	1 208.0	1 252.0	2 463.0	2 809.0	1 334.0	2 069.0	1 721.0	2 056.0	2 215.0	4 915.0	2 657.0
614.3	1 241.0	1 245.0	2 283.0	1 379.0	1 231.0	1 210.0	2 561.0	2 967.0	1 324.0	2 114.0	1 755.0	2 120.0	2 355.0	4 860.0	2 708.0
615.5	1 195.0	1 281.0	2 250.0	1 466.0	1 285.0	1 171.0	2 663.0	3 085.0	1 307.0	2 206.0	1 800.0	2 221.0	2 447.0	4 824.0	2 853.0
616.7	1 195.0	1 345.0	2 227.0	1 562.0	1 327.0	1 124.0	2 757.0	3 306.0	1 267.0	2 335.0	1 804.0	2 294.0	2 488.0	4 754.0	2 970.0
617.9	1 145.0	1 386.0	2 135.0	1 630.0	1 351.0	1 094.0	2 960.0	3 554.0	1 226.0	2 402.0	1 825.0	2 396.0	2 673.0	4 583.0	3 135.0
619.1	1 085.0	1 485.0	2 117.0	1 729.0	1 438.0	1 041.0	3 051.0	3 725.0	1 219.0	2 519.0	1 859.0	2 475.0	2 828.0	4 521.0	3 316.0
620.3	1 073.0	1 571.0	2 090.0	1 830.0	1 488.0	989.0	3 273.0	4 114.0	1 169.0	2 597.0	1 870.0	2 644.0	2 970.0	4 422.0	3 478.0
621.5	1 065.0	1 682.0	2 003.0	1 980.0	1 570.0	967.0	3 434.0	4 407.0	1 166.0	2 796.0	1 909.0	2 757.0	3 162.0	4 359.0	3 696.0
622.7	1 052.0	1 818.0	1 982.0	2 151.0	1 672.0	934.0	3 713.0	4 785.0	1 128.0	2 968.0	1 948.0	2 944.0	3 426.0	4 181.0	3 918.0
623.9	1 029.0	1 949.0	1 907.0	2 271.0	1 791.0	918.0	3 982.0	5 168.0	1 143.0	3 158.0	2 057.0	3 133.0	3 639.0	4 060.0	4 249.0
625.1	1 016.0	2 055.0	1 825.0	2 484.0	1 938.0	889.0	4 306.0	5 736.0	1 112.0	3 394.0	2 145.0	3 313.0	4 005.0	3 907.0	4 589.0
626.3	990.0	2 282.0	1 823.0	2 751.0	2 083.0	884.0	4 671.0	6 342.0	1 155.0	3 689.0	2 320.0	3 602.0	4 281.0	3 760.0	4 959.0
627.5	967.0	2 462.0	1 752.0	3 001.0	2 185.0	901.0	5 004.0	6 972.0	1 117.0	3 934.0	2 482.0	3 903.0	4 660.0	3 598.0	5 403.0
628.7	966.0	2 663.0	1 705.0	3 272.0	2 444.0	866.0	5 497.0	7 804.0	1 137.0	4 280.0	2 625.0	4 214.0	5 090.0	3 550.0	5 763.0
629.9	973.0	2 987.0	1 645.0	3 579.0	2 617.0	855.0	5 963.0	8 507.0	1 112.0	4 664.0	2 819.0	4 552.0	5 565.0	3 400.0	6 337.0
631.1	971.0	3 167.0	1 618.0	3 982.0	2 865.0	864.0	6 415.0	9 335.0	1 117.0	5 017.0	2 963.0	4 965.0	6 088.0	3 284.0	6 941.0
632.3	990.0	3 481.0	1 553.0	4 344.0	3 228.0	883.0	7 034.0	10 251.0	1 094.0	5 367.0	3 176.0	5 432.0	6 571.0	3 188.0	7 524.0
633.4	983.0	3 822.0	1 520.0	4 714.0	3 391.0	861.0	7 611.0	11 196.0	1 146.0	5 823.0	3 408.0	5 682.0	7 038.0	3 111.0	8 158.0
634.6	974.0	4 017.0	1 483.0	5 029.0	3 611.0	885.0	8 111.0	11 984.0	1 119.0	6 173.0	3 578.0	6 131.0	7 458.0	2 999.0	8 679.0
635.8	977.0	4 229.0	1 472.0	5 302.0	3 809.0	870.0	8 573.0	12 535.0	1 145.0	6 512.0	3 639.0	6 346.0	7 969.0	2 902.0	9 177.0
637.0	981.0	4 368.0	1 436.0	5 559.0	3 957.0	873.0	8 799.0	13 063.0	1 157.0	6 767.0	3 808.0	6 600.0	8 205.0	2 853.0	9 521.0
638.2	1 000.0	4 481.0	1 395.0	5 743.0	3 969.0	855.0	9 041.0	13 251.0	1 110.0	6 917.0	3 821.0	6 768.0	8 283.0	2 725.0	9 697.0
639.4	931.0	4 417.0	1 369.0	5 885.0	4 055.0	899.0	9 088.0	13 191.0	1 128.0	6 877.0	3 787.0	6 753.0	8 361.0	2 694.0	9 640.0
640.6	1 000.0	4 299.0	1 344.0	5 499.0	3 959.0	875.0	8 967.0	12 840.0	1 146.0	6 851.0	3 730.0	6 592.0	8 259.0	2 640.0	9 481.0
641.8	1 012.0	4 103.0	1 291.0	5 292.0	3 787.0	909.0	8 535.0	12 321.0	1 118.0	6 601.0	3 555.0	6 491.0	7 964.0	2 546.0	9 109.0
643.0	1 002.0	3 881.0	1 283.0	5 013.0	3 619.0	901.0	8 263.0	11 657.0	1 140.0	6 353.0	3 397.0	6 185.0	7 610.0	2 515.0	8 722.0
644.2	1 049.0	3 703.0	1 247.0	4 729.0	3 397.0	914.0	7 850.0	10 778.0	1 129.0	6 023.0	3 197.0	5 813.0	7 165.0	2 442.0	8 086.0
645.4	1 003.0	3 400.0	1 232.0	4 388.0	3 190.0	924.0	7 354.0	10 005.0	1 125.0	5 653.0	3 060.0	5 529.0	6 717.0	2 346.0	7 529.0
646.6	1 041.0	3 179.0	1 230.0	4 050.0	2 988.0	915.0	6 789.0	9 277.0	1 159.0	5 334.0	2 860.0	5 136.0	6 277.0	2 308.0	6 964.0
647.7	1 039.0	2 968.0	1 217.0	3 783.0	2 783.0	935.0	6 334.0	8 499.0	1 119.0	4 899.0	2 719.0	4 796.0	5 579.0	2 322.0	6 485.0
648.9	1 031.0	2 751.0	1 208.0	3 495.0	2 529.0	947.0	5 929.0	7 762.0	1 122.0	4 557.0	2 583.0	4 544.0	5 430.0	2 261.0	6 032.0
650.1	1 074.0	2 523.0	1 162.0	3 233.0	2 392.0	926.0	5 507.0	7 186.0	1 152.0	4 302.0	2 414.0	4 151.0	5 037.0	2 199.0	5 609.0
651.3	1 055.0	2 341.0	1 129.0	2 983.0	2 185.0	983.0	5 139.0	6 582.0	1 143.0	3 987.0	2 334.0	3 960.0	4 700.0	2 211.0	5 251.0
652.5	1 093.0	2 197.0	1 139.0	2 740.0	2 069.0	966.0	4 809.0	6 113.0	1 133.0	3 735.0	2 200.0	3 664.0	4 374.0	2 167.0	4 730.0
653.7	1 111.0	2 048.0	1 149.0	2 600.0	1 997.0	982.0	4 435.0	5 619.0	1 147.0	3 581.0	2 065.0	3 465.0	4 118.0	2 129.0	4 484.0
654.9	1 085.0	1 945.0	1 125.0	2 395.0	1 857.0	979.0	4 210.0	5 215.0	1 193.0	3 346.0	2 028.0	3 273.0	3 810.0	2 083.0	4 216.0
656.1	1 065.0	1 785.0	1 129.0	2 242.0	1 787.0	987.0	3 929.0	4 877.0	1 158.0	3 202.0	1 946.0	3 072.0	3 674.0	2 081.0	3 959.0
657.3	1 084.0	1 707.0	1 125.0	2 091.0	1 643.0	979.0	3 737.0	4 573.0	1 166.0	2 973.0	1 863.0	2 927.0	3 429.0	2 050.0	3 750.0
658.5	1 099.0	1 619.0	1 094.0	2 016.0	1 621.0	999.0	3 533.0	4 280.0	1 160.0	2 825.0	1 831.0	2 743.0	3 265.0	2 055.0	3 557.0
659.6	1 100.0	1 531.0	1 086.0	1 893.0	1 519.0	984.0	3 336.0	4 047.0	1 147.0	2 712.0	1 776.0	2 656.0	3 035.0	2 023.0	3 346.0
660.8	1 098.0	1 441.0	1 082.0	1 798.0	1 448.0	991.0	3 178.0	3 820.0	1 150.0	2 636.					



703.5	649.0	712.0	1007.0	805.0	706.0	509.0	1581.0	1506.0	921.0	1399.0	957.0	1325.0	1464.0	1748.0	1645.0
704.7	656.0	759.0	999.0	800.0	714.0	495.0	1591.0	1504.0	935.0	1419.0	911.0	1342.0	1442.0	1720.0	1610.0
705.8	643.0	741.0	971.0	795.0	684.0	491.0	1581.0	1454.0	927.0	1460.0	933.0	1331.0	1422.0	1748.0	1640.0
707.0	627.0	723.0	981.0	768.0	677.0	498.0	1557.0	1438.0	942.0	1425.0	923.0	1301.0	1428.0	1715.0	1609.0
708.2	666.0	715.0	990.0	790.0	677.0	455.0	1553.0	1398.0	939.0	1388.0	895.0	1304.0	1396.0	1680.0	1554.0
709.4	656.0	701.0	1013.0	755.0	633.0	471.0	1505.0	1394.0	942.0	1387.0	907.0	1315.0	1430.0	1680.0	1562.0
710.6	642.0	701.0	985.0	755.0	652.0	476.0	1513.0	1393.0	908.0	1364.0	932.0	1312.0	1401.0	1659.0	1564.0
711.8	635.0	706.0	979.0	742.0	656.0	486.0	1496.0	1408.0	928.0	1361.0	904.0	1281.0	1375.0	1633.0	1530.0
712.9	659.0	699.0	984.0	727.0	656.0	457.0	1490.0	1374.0	924.0	1361.0	913.0	1278.0	1350.0	1641.0	1503.0
714.1	621.0	675.0	951.0	718.0	646.0	462.0	1490.0	1369.0	938.0	1343.0	885.0	1278.0	1371.0	1636.0	1512.0
715.3	610.0	678.0	999.0	718.0	639.0	463.0	1490.0	1335.0	917.0	1347.0	902.0	1257.0	1333.0	1646.0	1486.0
716.5	634.0	693.0	971.0	719.0	629.0	459.0	1457.0	1303.0	908.0	1327.0	859.0	1237.0	1362.0	1602.0	1451.0
717.6	646.0	661.0	966.0	729.0	617.0	438.0	1443.0	1315.0	914.0	1308.0	846.0	1262.0	1310.0	1634.0	1476.0
718.8	615.0	670.0	935.0	699.0	595.0	431.0	1420.0	1280.0	907.0	1319.0	866.0	1256.0	1347.0	1561.0	1478.0
720.0	613.0	656.0	961.0	707.0	609.0	453.0	1409.0	1308.0	925.0	1299.0	851.0	1260.0	1327.0	1580.0	1440.0
721.2	595.0	667.0	940.0	679.0	635.0	429.0	1412.0	1273.0	885.0	1330.0	871.0	1224.0	1324.0	1562.0	1407.0
722.4	611.0	648.0	919.0	688.0	611.0	415.0	1392.0	1287.0	893.0	1274.0	861.0	1195.0	1295.0	1533.0	1433.0
723.5	607.0	635.0	937.0	697.0	611.0	434.0	1380.0	1257.0	903.0	1301.0	880.0	1210.0	1308.0	1551.0	1394.0
724.7	608.0	663.0	907.0	686.0	592.0	419.0	1366.0	1279.0	893.0	1287.0	852.0	1184.0	1317.0	1530.0	1440.0
725.9	600.0	622.0	898.0	668.0	610.0	405.0	1384.0	1266.0	875.0	1279.0	870.0	1199.0	1316.0	1484.0	1418.0
727.1	591.0	641.0	901.0	675.0	598.0	427.0	1375.0	1225.0	915.0	1285.0	834.0	1175.0	1288.0	1494.0	1359.0
728.3	579.0	644.0	912.0	681.0	575.0	407.0	1370.0	1220.0	899.0	1274.0	872.0	1161.0	1305.0	1509.0	1423.0
729.4	604.0	640.0	911.0	660.0	589.0	397.0	1398.0	1230.0	887.0	1266.0	849.0	1157.0	1266.0	1477.0	1372.0
730.6	607.0	627.0	909.0	655.0	597.0	410.0	1359.0	1222.0	893.0	1256.0	840.0	1148.0	1253.0	1464.0	1378.0
731.8	584.0	625.0	887.0	657.0	579.0	395.0	1323.0	1222.0	887.0	1245.0	832.0	1149.0	1275.0	1467.0	1364.0
733.0	594.0	610.0	909.0	652.0	595.0	383.0	1355.0	1203.0	887.0	1247.0	824.0	1164.0	1279.0	1445.0	1380.0
734.1	592.0	643.0	889.0	679.0	572.0	414.0	1349.0	1212.0	869.0	1251.0	819.0	1148.0	1266.0	1397.0	1317.0
735.3	561.0	625.0	870.0	668.0	574.0	404.0	1318.0	1179.0	873.0	1238.0	830.0	1136.0	1261.0	1404.0	1345.0
736.5	583.0	637.0	877.0	641.0	572.0	393.0	1312.0	1174.0	892.0	1253.0	809.0	1153.0	1248.0	1406.0	1334.0
737.7	579.0	627.0	900.0	641.0	566.0	397.0	1337.0	1177.0	878.0	1228.0	842.0	1145.0	1240.0	1426.0	1353.0
738.8	593.0	610.0	854.0	674.0	564.0	383.0	1338.0	1175.0	894.0	1239.0	831.0	1130.0	1258.0	1393.0	1350.0
740.0	575.0	617.0	879.0	643.0	564.0	400.0	1327.0	1157.0	879.0	1251.0	803.0	1121.0	1227.0	1401.0	1327.0
741.2	587.0	611.0	844.0	650.0	573.0	380.0	1319.0	1159.0	893.0	1262.0	821.0	1161.0	1254.0	1394.0	1320.0
742.4	585.0	617.0	863.0	643.0	560.0	377.0	1327.0	1163.0	881.0	1232.0	805.0	1139.0	1245.0	1348.0	1311.0
743.5	565.0	613.0	836.0	644.0	569.0	389.0	1283.0	1173.0	897.0	1224.0	834.0	1133.0	1240.0	1348.0	1326.0
744.7	571.0	627.0	871.0	630.0	567.0	408.0	1300.0	1156.0	879.0	1196.0	826.0	1151.0	1218.0	1331.0	1311.0
745.9	553.0	604.0	857.0	650.0	569.0	391.0	1298.0	1165.0	892.0	1235.0	815.0	1103.0	1243.0	1370.0	1322.0
747.1	566.0	584.0	887.0	639.0	583.0	397.0	1281.0	1146.0	881.0	1222.0	817.0	1151.0	1208.0	1327.0	1303.0
748.2	581.0	614.0	854.0	643.0	575.0	375.0	1331.0	1109.0	849.0	1207.0	815.0	1129.0	1232.0	1354.0	1284.0
749.4	563.0	601.0	844.0	631.0	554.0	371.0	1328.0	1150.0	889.0	1255.0	809.0	1107.0	1250.0	1331.0	1318.0
750.6	557.0	607.0	857.0	628.0	558.0	389.0	1291.0	1161.0	888.0	1221.0	819.0	1105.0	1253.0	1312.0	1304.0
751.8	564.0	595.0	851.0	645.0	583.0	388.0	1304.0	1121.0	856.0	1237.0	811.0	1155.0	1206.0	1303.0	1328.0
752.9	586.0	589.0	844.0	647.0	551.0	380.0	1327.0	1139.0	896.0	1238.0	818.0	1135.0	1240.0	1340.0	1300.0
754.1	579.0	571.0	857.0	639.0	547.0	383.0	1264.0	1163.0	903.0	1197.0	800.0	1121.0	1196.0	1320.0	1315.0
755.3	561.0	585.0	825.0	636.0	550.0	361.0	1303.0	1124.0	880.0	1214.0	795.0	1128.0	1186.0	1312.0	1320.0
756.4	568.0	607.0	839.0	633.0	566.0	388.0	1292.0	1164.0	882.0	1221.0	771.0	1135.0	1216.0	1328.0	1303.0
757.6	577.0	597.0	835.0	632.0	561.0	394.0	1313.0	1151.0	875.0	1231.0	794.0	1137.0	1230.0	1318.0	1307.0
758.8	545.0	594.0	821.0	614.0	563.0	355.0	1340.0	1152.0	857.0	1229.0	797.0	1113.0	1262.0	1319.0	1345.0
760.0	572.0	632.0	825.0	626.0	564.0	365.0	1296.0	1146.0	859.0	1243.0	818.0	1112.0	1209.0	1291.0	1329.0
761.1	569.0	594.0	779.0	641.0	559.0	379.0	1321.0	1120.0	865.0	1251.0	790.0	1154.0	1237.0	1301.0	1311.0
762.3	557.0	625.0	819.0	648.0	553.0	387.0	1323.0	1117.0	851.0	1237.0	764.0	1133.0	1240.0	1278.0	1339.0
763.5	573.0	597.0	815.0	629.0	552.0	381.0	1343.0	1143.0	887.0	1244.0	813.0	1146.0	1220.0	1315.0	1321.0
764.7	567.0	592.0	834.0	637.0	541.0	381.0	1297.0	1131.0	848.0	1239.0	817.0	1142.0	1209.0	1283.0	1351.0
765.8	571.0	611.0	821.0	637.0	571.0	349.0	1317.0	1152.0	892.0	1248.0	786.0	1162.0	1222.0	1276.0	1355.0
767.0	575.0	615.0	815.0	625.0	553.0	369.0	1340.0	1119.0	864.0	1216.0	828.0	1156.0	1232.0	1268.0	1327.0
768.2	569.0	617.0	805.0	625.0	564.0	383.0	1323.0	1145.0	855.0	1253.0	793.0	1157.0	1191.0	1275.0	1353.0
769.3	562.0	633.0	811.0	660.0	529.0	363.0	1347.0	1148.0	852.0	1229.0	804.0	1147.0	1244.0	1273.0	1352.0
770.5	557.0	613.0	800.0	631.0	554.0	373.0	1341.0	1161.0	880.0	1260.0	834.0	1140.0	1217.0	1282.0	1340.0
771.7	567.0	601.0	816.0	636.0	544.0	381.0	1324.0	1185.0	861.0	1259.0	788.0	1170.0	1241.0	1285.0	1357.0
772.8	567.0	626.0	805.0	658.0	551.0	364.0	1356.0	1185.0	882.0	1240.0	780.0	1197.0	1216.0	1248.0	1368.0
774.0	570.0	628.0	775.0	640.0	546.0	365.0	1353.0	1152.0	873.0	1241.0	805.0	1158.0	1205.0	1247.0	1370.0
775.2	543.0	621.0	839.0	645.0	530.0	363.0	1348.0	1170.0	847.0	1265.0	790.0	1196.0	1209.0	1279.0	1426.0
776.4	581.0	601.0	791.0	662.0	544.0	375.0	1371.0	1178.0	865.0	1250.0	800.0	1177.0	1228.0	1250.0	1394.0
777.5	569.0	623.0	814.0	655.0	556.0	370.0	1392.0	1186.0	851.0	1284.0	817.0	1182.0	1223.0	1233.0	1423.0
778.7	571.0	611.0	787.0	666.0	570.0	375.0	1375.0	1184.0	854.0	1266.0	814.0	1214.0	1214.0	1256.0	1404.0
779.9	573.0	643.0	787.0	674.0	536.0	376.0	1368.0	1197.0	859.0	1277.0	814.0	1190.0	1228.0	1242.0	1458.0
781.0	574.0	639.0	820.0	666.0	580.0	365.0	1376.0	1214.0	877.0	1284.0	807.0	1199.0	1234.0	1275.0	1466.0
782.2	569.0	644.0	795.0	689.0	546.0	359.0	1373.0	1200.0	844.0	1284.0	816.0	1205.0	1267.0	1249.0	1438.0
783.4	567.0	633.0	799.0	665.0	551.0	364.0	1393.0	1205.0	847.0	1265.0	837.0	1196.0	1247.0	1231.0	1436.0
784.5	569.0	656.0	807.0	688.0	558.0	377.0	1360.0	1219.0	881.0	1275.0	807.0	1184.0	1245.0	1285.0	1458.0
785.7	583.0	663.0	822.0	665.0	563.0	384.0	1402.0	1256.0	893.0	1282.0	813.0	1251.0	1251.0	1258.0	1446.0
786.9	573.0	645.0	824.0	686.0	572.0	389.0	1398.0	1245.0	892.0	1304.0	813.0	1205			

820,6	585,0	598,0	735,0	617,0	538,0	395,0	1 307,0	1 112,0	854,0	1 230,0	810,0	1 178,0	1 204,0	1 175,0	1 353,0
821,8	581,0	617,0	750,0	601,0	537,0	387,0	1 325,0	1 138,0	866,0	1 237,0	794,0	1 160,0	1 208,0	1 160,0	1 336,0
823,0	588,0	620,0	739,0	635,0	519,0	402,0	1 340,0	1 139,0	832,0	1 215,0	796,0	1 158,0	1 217,0	1 161,0	1 364,0
824,1	595,0	589,0	730,0	633,0	524,0	351,0	1 308,0	1 134,0	855,0	1 208,0	778,0	1 154,0	1 191,0	1 156,0	1 359,0
825,3	585,0	589,0	742,0	622,0	509,0	373,0	1 292,0	1 114,0	893,0	1 215,0	781,0	1 131,0	1 206,0	1 145,0	1 323,0
826,4	594,0	605,0	726,0	620,0	551,0	375,0	1 267,0	1 150,0	825,0	1 210,0	796,0	1 164,0	1 199,0	1 156,0	1 359,0
827,6	609,0	596,0	730,0	655,0	527,0	379,0	1 305,0	1 096,0	837,0	1 227,0	820,0	1 127,0	1 197,0	1 132,0	1 383,0
828,8	585,0	609,0	756,0	593,0	496,0	394,0	1 283,0	1 105,0	849,0	1 249,0	820,0	1 102,0	1 202,0	1 160,0	1 308,0
829,9	585,0	607,0	746,0	610,0	540,0	367,0	1 285,0	1 117,0	845,0	1 192,0	787,0	1 155,0	1 191,0	1 122,0	1 299,0
831,1	567,0	609,0	721,0	595,0	556,0	380,0	1 293,0	1 123,0	849,0	1 225,0	763,0	1 128,0	1 187,0	1 124,0	1 308,0
832,2	569,0	587,0	718,0	613,0	531,0	373,0	1 332,0	1 103,0	830,0	1 221,0	770,0	1 126,0	1 195,0	1 122,0	1 322,0
833,4	577,0	602,0	729,0	617,0	511,0	378,0	1 281,0	1 115,0	833,0	1 216,0	779,0	1 136,0	1 165,0	1 130,0	1 304,0
834,6	567,0	570,0	734,0	633,0	524,0	353,0	1 260,0	1 100,0	842,0	1 220,0	777,0	1 137,0	1 184,0	1 107,0	1 299,0
835,7	570,0	597,0	720,0	587,0	524,0	371,0	1 286,0	1 108,0	856,0	1 195,0	794,0	1 129,0	1 200,0	1 109,0	1 328,0
836,9	565,0	608,0	697,0	596,0	525,0	375,0	1 301,0	1 108,0	850,0	1 209,0	779,0	1 126,0	1 173,0	1 094,0	1 314,0
838,0	563,0	587,0	710,0	610,0	523,0	375,0	1 266,0	1 092,0	858,0	1 204,0	780,0	1 144,0	1 201,0	1 083,0	1 283,0
839,2	547,0	553,0	698,0	593,0	541,0	347,0	1 301,0	1 109,0	865,0	1 204,0	800,0	1 123,0	1 176,0	1 068,0	1 289,0
840,4	569,0	594,0	709,0	621,0	533,0	362,0	1 264,0	1 103,0	841,0	1 231,0	767,0	1 109,0	1 181,0	1 075,0	1 288,0
841,5	572,0	585,0	708,0	617,0	524,0	360,0	1 304,0	1 093,0	846,0	1 193,0	780,0	1 131,0	1 177,0	1 079,0	1 283,0
842,7	571,0	584,0	705,0	597,0	503,0	362,0	1 268,0	1 113,0	850,0	1 206,0	773,0	1 121,0	1 223,0	1 076,0	1 314,0
843,8	559,0	583,0	682,0	606,0	523,0	366,0	1 298,0	1 084,0	829,0	1 189,0	810,0	1 105,0	1 178,0	1 083,0	1 282,0
845,0	557,0	575,0	732,0	584,0	515,0	354,0	1 265,0	1 107,0	820,0	1 168,0	782,0	1 109,0	1 183,0	1 067,0	1 288,0
846,2	584,0	576,0	746,0	592,0	523,0	353,0	1 274,0	1 090,0	853,0	1 193,0	798,0	1 107,0	1 197,0	1 056,0	1 315,0
847,3	553,0	565,0	750,0	584,0	518,0	355,0	1 260,0	1 082,0	828,0	1 197,0	787,0	1 119,0	1 192,0	1 079,0	1 299,0
848,5	567,0	583,0	681,0	567,0	514,0	357,0	1 250,0	1 077,0	848,0	1 188,0	759,0	1 111,0	1 200,0	1 060,0	1 282,0
849,6	550,0	561,0	701,0	589,0	536,0	348,0	1 265,0	1 075,0	861,0	1 204,0	794,0	1 096,0	1 164,0	1 027,0	1 287,0
850,8	570,0	574,0	707,0	606,0	534,0	339,0	1 282,0	1 086,0	836,0	1 207,0	790,0	1 115,0	1 171,0	1 039,0	1 263,0
851,9	537,0	575,0	715,0	588,0	505,0	315,0	1 268,0	1 076,0	846,0	1 216,0	772,0	1 104,0	1 196,0	1 044,0	1 263,0
853,1	546,0	583,0	698,0	596,0	517,0	345,0	1 280,0	1 069,0	839,0	1 244,0	757,0	1 111,0	1 176,0	1 050,0	1 288,0
854,3	564,0	545,0	719,0	606,0	515,0	349,0	1 281,0	1 059,0	847,0	1 195,0	768,0	1 092,0	1 159,0	1 050,0	1 277,0
855,4	564,0	561,0	683,0	603,0	497,0	352,0	1 264,0	1 100,0	854,0	1 190,0	764,0	1 105,0	1 176,0	1 015,0	1 287,0
856,6	567,0	559,0	689,0	575,0	512,0	336,0	1 268,0	1 026,0	840,0	1 199,0	773,0	1 087,0	1 166,0	1 009,0	1 281,0
857,7	553,0	578,0	667,0	596,0	507,0	340,0	1 281,0	1 067,0	836,0	1 203,0	775,0	1 080,0	1 187,0	1 059,0	1 274,0
858,9	561,0	554,0	691,0	580,0	492,0	347,0	1 264,0	1 061,0	852,0	1 197,0	777,0	1 110,0	1 194,0	1 024,0	1 273,0
860,0	561,0	560,0	693,0	608,0	526,0	357,0	1 272,0	1 058,0	825,0	1 176,0	767,0	1 102,0	1 172,0	997,0	1 246,0
861,2	550,0	574,0	691,0	591,0	519,0	355,0	1 277,0	1 077,0	827,0	1 221,0	786,0	1 120,0	1 193,0	1 028,0	1 297,0
862,3	557,0	576,0	687,0	589,0	509,0	360,0	1 246,0	1 044,0	843,0	1 169,0	775,0	1 108,0	1 224,0	1 023,0	1 237,0
863,5	547,0	566,0	689,0	582,0	517,0	343,0	1 238,0	1 065,0	849,0	1 181,0	779,0	1 082,0	1 179,0	1 029,0	1 269,0
864,7	568,0	571,0	701,0	561,0	504,0	355,0	1 248,0	1 081,0	844,0	1 198,0	772,0	1 092,0	1 216,0	992,0	1 268,0
865,8	537,0	557,0	695,0	555,0	507,0	341,0	1 240,0	1 045,0	860,0	1 193,0	780,0	1 083,0	1 169,0	981,0	1 279,0
867,0	558,0	574,0	701,0	580,0	487,0	344,0	1 226,0	1 062,0	838,0	1 200,0	771,0	1 078,0	1 195,0	1 011,0	1 230,0
868,1	547,0	531,0	680,0	593,0	495,0	339,0	1 233,0	1 067,0	857,0	1 214,0	751,0	1 064,0	1 150,0	987,0	1 248,0
869,3	561,0	542,0	696,0	598,0	530,0	355,0	1 237,0	1 057,0	852,0	1 175,0	767,0	1 119,0	1 181,0	972,0	1 271,0
870,4	563,0	560,0	688,0	575,0	517,0	321,0	1 234,0	1 051,0	850,0	1 176,0	766,0	1 066,0	1 195,0	981,0	1 245,0
871,6	570,0	548,0	666,0	597,0	518,0	349,0	1 236,0	1 059,0	839,0	1 181,0	759,0	1 101,0	1 177,0	1 000,0	1 262,0
872,7	561,0	557,0	677,0	582,0	528,0	353,0	1 246,0	1 059,0	840,0	1 159,0	770,0	1 056,0	1 155,0	969,0	1 222,0
873,9	553,0	544,0	673,0	557,0	503,0	343,0	1 224,0	1 025,0	832,0	1 172,0	761,0	1 094,0	1 184,0	986,0	1 251,0
875,0	541,0	560,0	677,0	577,0	503,0	341,0	1 226,0	1 043,0	839,0	1 159,0	758,0	1 069,0	1 197,0	976,0	1 244,0
876,2	545,0	536,0	682,0	574,0	525,0	323,0	1 253,0	1 039,0	855,0	1 147,0	765,0	1 065,0	1 165,0	989,0	1 216,0
877,3	550,0	544,0	685,0	569,0	501,0	351,0	1 260,0	1 029,0	851,0	1 172,0	767,0	1 054,0	1 136,0	1 002,0	1 245,0
878,5	551,0	555,0	680,0	586,0	495,0	339,0	1 230,0	1 037,0	832,0	1 174,0	762,0	1 086,0	1 160,0	983,0	1 241,0
879,6	554,0	573,0	651,0	567,0	500,0	340,0	1 225,0	1 014,0	847,0	1 166,0	758,0	1 052,0	1 182,0	991,0	1 219,0
880,8	570,0	546,0	674,0	568,0	479,0	356,0	1 247,0	1 026,0	830,0	1 152,0	753,0	1 046,0	1 169,0	966,0	1 228,0
881,9	573,0	542,0	679,0	543,0	494,0	339,0	1 184,0	1 017,0	835,0	1 179,0	761,0	1 028,0	1 167,0	957,0	1 207,0
883,1	562,0	539,0	636,0	555,0	473,0	337,0	1 225,0	1 013,0	845,0	1 156,0	771,0	1 031,0	1 161,0	946,0	1 163,0
884,3	581,0	523,0	664,0	566,0	511,0	347,0	1 203,0	1 026,0	839,0	1 143,0	745,0	1 048,0	1 191,0	942,0	1 201,0
885,4	556,0	539,0	682,0	567,0	497,0	325,0	1 218,0	1 027,0	824,0	1 125,0	764,0	1 038,0	1 157,0	957,0	1 180,0
886,6	546,0	547,0	657,0	521,0	513,0	342,0	1 191,0	1 000,0	831,0	1 169,0	744,0	1 053,0	1 150,0	979,0	1 197,0
887,7	560,0	565,0	665,0	539,0	489,0	323,0	1 190,0	1 000,0	808,0	1 172,0	736,0	1 047,0	1 157,0	917,0	1 179,0
888,9	553,0	546,0	656,0	541,0	506,0	327,0	1 190,0	980,0	847,0	1 170,0	773,0	1 041,0	1 159,0	966,0	1 174,0
890,0	546,0	529,0	646,0	489,0	325,0	325,0	1 208,0	1 006,0	830,0	1 143,0	754,0	1 017,0	1 150,0	952,0	1 174,0
891,2	571,0	520,0	663,0	537,0	488,0	345,0	1 219,0	995,0	812,0	1 121,0	727,0	1 036,0	1 155,0	978,0	1 199,0
892,3	551,0	535,0	647,0	552,0	510,0	341,0	1 164,0	988,0	833,0	1 151,0	746,0	995,0	1 159,0	933,0	1 182,0
893,5	538,0	539,0	659,0	576,0	472,0	346,0	1 189,0	985,0	813,0	1 135,0	725,0	1 033,0	1 155,0	974,0	1 156,0
894,6	550,0	537,0	657,0	569,0	502,0	324,0	1 172,0	995,0	818,0	1 137,0	728,0	1 040,0	1 104,0	941,0	1 190,0
895,8	558,0	512,0	653,0	553,0	505,0	334,0	1 180,0	972,0	835,0	1 129,0	736,0	1 047,0	1 125,0	946,0	1 177,0
896,9	550,0	525,0	656,0	541,0	521,0	345,0	1 164,0	976,0	828,0	1 110,0	759,0	1 005,0	1 138,0	916,0	1 172,0
898,1	539,0	536,0	658,0	544,0	492,0	338,0	1 181,0	986,0	818,0	1 115,0	723,0	1 019,0	1 116,0	941,0	1 175,0
899,2	535,0	535,0	644,0	556,0	480,0	331,0	1 179,0	990,0	841,0	1 110,0	711,0	1 039,0	1 164,0	936,0	1 145,0
900,4	550,0	524,0	625,0	518,0	491,0	329,0									

935.9	535.0	495.0	633.0	529.0	472.0	309.0	1 135.0	941.0	823.0	1 112.0	720.0	989.0	1 103.0	898.0	1 134.0
937.0	544.0	512.0	663.0	538.0	462.0	326.0	1 154.0	937.0	830.0	1 113.0	734.0	960.0	1 111.0	899.0	1 101.0
938.2	534.0	523.0	627.0	528.0	487.0	299.0	1 136.0	989.0	797.0	1 108.0	757.0	986.0	1 141.0	897.0	1 148.0
938.3	517.0	494.0	630.0	517.0	466.0	317.0	1 135.0	958.0	816.0	1 097.0	717.0	943.0	1 114.0	927.0	1 124.0
940.4	541.0	513.0	639.0	540.0	485.0	326.0	1 138.0	949.0	833.0	1 102.0	720.0	967.0	1 153.0	925.0	1 128.0
941.6	547.0	529.0	636.0	517.0	466.0	313.0	1 155.0	937.0	823.0	1 107.0	713.0	951.0	1 103.0	909.0	1 075.0
942.7	531.0	528.0	645.0	530.0	481.0	328.0	1 157.0	946.0	833.0	1 116.0	753.0	982.0	1 096.0	901.0	1 099.0
943.9	550.0	524.0	627.0	523.0	485.0	299.0	1 156.0	942.0	812.0	1 118.0	717.0	964.0	1 131.0	888.0	1 079.0
945.0	535.0	511.0	642.0	517.0	490.0	316.0	1 144.0	948.0	787.0	1 100.0	730.0	973.0	1 123.0	909.0	1 097.0
946.1	536.0	521.0	630.0	530.0	464.0	324.0	1 164.0	960.0	815.0	1 100.0	721.0	975.0	1 118.0	867.0	1 097.0
947.3	541.0	517.0	629.0	528.0	483.0	324.0	1 142.0	951.0	811.0	1 099.0	710.0	980.0	1 120.0	884.0	1 085.0
948.4	551.0	513.0	625.0	510.0	483.0	326.0	1 126.0	950.0	821.0	1 091.0	719.0	974.0	1 128.0	903.0	1 113.0
949.6	551.0	488.0	621.0	523.0	468.0	318.0	1 142.0	945.0	802.0	1 092.0	710.0	954.0	1 130.0	867.0	1 103.0
950.7	530.0	507.0	625.0	540.0	458.0	309.0	1 119.0	932.0	819.0	1 089.0	696.0	991.0	1 126.0	896.0	1 117.0
951.8	515.0	493.0	628.0	518.0	475.0	307.0	1 148.0	976.0	814.0	1 118.0	697.0	977.0	1 114.0	893.0	1 086.0
953.0	551.0	508.0	644.0	505.0	483.0	312.0	1 139.0	959.0	804.0	1 080.0	712.0	975.0	1 116.0	888.0	1 112.0
954.1	547.0	505.0	643.0	529.0	487.0	327.0	1 132.0	955.0	840.0	1 089.0	710.0	962.0	1 087.0	893.0	1 077.0
955.3	527.0	527.0	632.0	514.0	464.0	325.0	1 126.0	962.0	796.0	1 088.0	725.0	972.0	1 098.0	861.0	1 074.0
956.4	513.0	504.0	622.0	510.0	480.0	323.0	1 132.0	930.0	803.0	1 095.0	711.0	952.0	1 078.0	878.0	1 085.0
957.5	538.0	488.0	635.0	522.0	489.0	320.0	1 114.0	933.0	782.0	1 113.0	719.0	952.0	1 116.0	869.0	1 078.0
958.7	539.0	513.0	617.0	493.0	465.0	334.0	1 138.0	930.0	782.0	1 061.0	714.0	971.0	1 130.0	895.0	1 074.0
959.8	537.0	477.0	640.0	519.0	483.0	323.0	1 112.0	926.0	812.0	1 107.0	702.0	953.0	1 123.0	897.0	1 078.0
961.0	528.0	497.0	645.0	514.0	490.0	328.0	1 098.0	911.0	791.0	1 035.0	711.0	972.0	1 089.0	873.0	1 078.0
962.1	544.0	499.0	623.0	526.0	460.0	317.0	1 113.0	943.0	811.0	1 097.0	703.0	922.0	1 122.0	865.0	1 082.0
963.2	547.0	492.0	639.0	508.0	485.0	319.0	1 140.0	932.0	807.0	1 087.0	697.0	935.0	1 121.0	874.0	1 057.0
964.4	543.0	493.0	621.0	504.0	473.0	320.0	1 115.0	929.0	791.0	1 075.0	717.0	929.0	1 099.0	875.0	1 058.0
965.5	526.0	500.0	639.0	503.0	481.0	305.0	1 106.0	929.0	815.0	1 094.0	705.0	911.0	1 100.0	848.0	1 068.0
966.7	515.0	491.0	640.0	522.0	456.0	315.0	1 109.0	902.0	801.0	1 101.0	713.0	955.0	1 104.0	866.0	1 082.0
967.8	532.0	510.0	628.0	532.0	465.0	301.0	1 118.0	893.0	829.0	1 091.0	715.0	954.0	1 108.0	859.0	1 070.0
968.9	540.0	492.0	645.0	519.0	462.0	324.0	1 118.0	936.0	807.0	1 092.0	703.0	952.0	1 103.0	839.0	1 093.0
970.1	540.0	495.0	615.0	507.0	475.0	315.0	1 094.0	900.0	815.0	1 066.0	698.0	926.0	1 118.0	843.0	1 084.0
971.2	540.0	492.0	627.0	521.0	467.0	304.0	1 105.0	917.0	821.0	1 073.0	703.0	936.0	1 115.0	874.0	1 061.0
972.3	542.0	518.0	612.0	521.0	500.0	324.0	1 112.0	924.0	823.0	1 090.0	697.0	956.0	1 091.0	861.0	1 084.0
973.5	541.0	506.0	625.0	531.0	487.0	318.0	1 145.0	926.0	800.0	1 084.0	725.0	952.0	1 129.0	875.0	1 078.0
974.6	559.0	507.0	622.0	514.0	473.0	317.0	1 138.0	920.0	791.0	1 097.0	694.0	950.0	1 116.0	867.0	1 073.0
975.8	555.0	511.0	627.0	515.0	468.0	310.0	1 094.0	922.0	817.0	1 098.0	707.0	950.0	1 106.0	863.0	1 063.0
976.9	531.0	499.0	619.0	511.0	494.0	319.0	1 141.0	938.0	833.0	1 096.0	709.0	934.0	1 122.0	869.0	1 098.0
978.0	541.0	500.0	622.0	515.0	473.0	337.0	1 154.0	933.0	853.0	1 098.0	730.0	945.0	1 101.0	866.0	1 119.0
979.2	537.0	507.0	654.0	513.0	478.0	323.0	1 138.0	912.0	795.0	1 117.0	700.0	972.0	1 103.0	865.0	1 092.0
980.3	549.0	479.0	658.0	531.0	498.0	326.0	1 150.0	952.0	817.0	1 102.0	731.0	961.0	1 129.0	889.0	1 084.0
981.4	537.0	505.0	619.0	525.0	506.0	333.0	1 131.0	965.0	808.0	1 107.0	731.0	978.0	1 138.0	876.0	1 070.0
982.6	531.0	497.0	651.0	514.0	488.0	317.0	1 157.0	925.0	849.0	1 086.0	720.0	937.0	1 113.0	870.0	1 091.0
983.7	545.0	523.0	636.0	539.0	484.0	327.0	1 155.0	941.0	819.0	1 115.0	727.0	983.0	1 128.0	879.0	1 087.0
984.8	527.0	512.0	659.0	509.0	498.0	325.0	1 139.0	927.0	841.0	1 117.0	739.0	963.0	1 114.0	879.0	1 102.0
986.0	547.0	487.0	632.0	537.0	479.0	315.0	1 151.0	918.0	797.0	1 083.0	723.0	991.0	1 139.0	867.0	1 083.0
987.1	549.0	525.0	662.0	522.0	494.0	328.0	1 160.0	917.0	855.0	1 111.0	733.0	949.0	1 125.0	891.0	1 084.0
988.2	543.0	535.0	656.0	541.0	484.0	317.0	1 128.0	902.0	857.0	1 121.0	723.0	959.0	1 108.0	897.0	1 117.0
989.4	541.0	521.0	654.0	511.0	497.0	309.0	1 136.0	945.0	840.0	1 110.0	711.0	967.0	1 116.0	873.0	1 095.0
990.5	549.0	515.0	650.0	547.0	489.0	329.0	1 135.0	935.0	835.0	1 105.0	707.0	985.0	1 116.0	890.0	1 109.0
991.6	552.0	515.0	671.0	537.0	472.0	322.0	1 147.0	942.0	830.0	1 110.0	744.0	966.0	1 158.0	869.0	1 111.0
992.8	555.0	505.0	645.0	514.0	475.0	333.0	1 141.0	937.0	826.0	1 085.0	736.0	950.0	1 138.0	923.0	1 100.0
993.9	541.0	517.0	658.0	523.0	507.0	320.0	1 156.0	950.0	835.0	1 119.0	707.0	973.0	1 141.0	889.0	1 097.0
995.0	549.0	535.0	652.0	509.0	506.0	320.0	1 136.0	931.0	826.0	1 111.0	709.0	967.0	1 157.0	915.0	1 109.0
996.2	560.0	530.0	637.0	535.0	515.0	311.0	1 171.0	936.0	851.0	1 137.0	728.0	961.0	1 139.0	889.0	1 113.0
997.3	541.0	510.0	645.0	551.0	488.0	321.0	1 161.0	947.0	851.0	1 113.0	728.0	989.0	1 135.0	877.0	1 089.0
998.4	529.0	537.0	673.0	523.0	488.0	337.0	1 148.0	952.0	847.0	1 121.0	731.0	948.0	1 143.0	866.0	1 093.0
999.6	533.0	531.0	645.0	532.0	505.0	322.0	1 142.0	931.0	837.0	1 152.0	727.0	966.0	1 147.0	898.0	1 066.0
1000.7	545.0	522.0	659.0	540.0	517.0	313.0	1 133.0	935.0	850.0	1 132.0	748.0	974.0	1 140.0	874.0	1 086.0
1001.8	535.0	535.0	653.0	541.0	499.0	330.0	1 144.0	949.0	835.0	1 115.0	718.0	980.0	1 142.0	875.0	1 087.0
1003.0	551.0	523.0	640.0	527.0	509.0	331.0	1 126.0	948.0	851.0	1 092.0	730.0	959.0	1 140.0	882.0	1 116.0
1004.1	558.0	530.0	667.0	526.0	509.0	319.0	1 156.0	965.0	811.0	1 127.0	727.0	958.0	1 120.0	856.0	1 109.0
1005.2	559.0	525.0	650.0	533.0	512.0	331.0	1 157.0	940.0	824.0	1 134.0	747.0	960.0	1 142.0	880.0	1 081.0
1006.4	564.0	515.0	671.0	535.0	502.0	341.0	1 180.0	954.0	840.0	1 128.0	726.0	975.0	1 176.0	888.0	1 113.0
1007.5	539.0	513.0	655.0	525.0	487.0	335.0	1 167.0	961.0	844.0	1 127.0	739.0	935.0	1 127.0	880.0	1 083.0
1008.6	545.0	531.0	658.0	537.0	485.0	331.0	1 142.0	944.0	842.0	1 120.0	739.0	965.0	1 159.0	884.0	1 108.0
1009.8	533.0	523.0	655.0	549.0	489.0	325.0	1 153.0	930.0	855.0	1 112.0	739.0	970.0	1 139.0	888.0	1 113.0
1010.9	551.0	530.0	648.0	508.0	509.0	323.0	1 137.0	928.0	854.0	1 143.0	727.0	983.0	1 176.0	889.0	1 113.0
1012.0	565.0	534.0	668.0	543.0	512.0	340.0	1 194.0	950.0	858.0	1 128.0	734.0	981.0	1 154.0	890.0	1 100.0
1013.2	567.0	537.0	662.0	530.0	499.0	335.0	1 158.0	934.0	854.0	1 119.0	732.0	979.0	1 121.0	885.0	1 090.0
1014.3	541.0	533.0	673.0	536.0	506.0	337.0	1 186.0	938.0	841.0	1 140.0	720.0	975.0	1 152.0	889.0	1 110.0
1015.4	573.0	528.0	677.0	551.0	507.0	345.0	1 167.0	925.0	839.0	1 113.0	720.0	930.0	1 153.0	892.0	1 094.0
1016.5	559.0	517.0	659.0	551											

1049.2	610.0	543.0	703.0	567.0	558.0	406.0	1 169.0	956.0	879.0	1 186.0	746.0	953.0	1 188.0	881.0	1 100.0
1050.3	621.0	541.0	687.0	549.0	534.0	389.0	1 220.0	981.0	868.0	1 156.0	761.0	985.0	1 205.0	888.0	1 135.0
1051.5	618.0	543.0	686.0	568.0	545.0	401.0	1 187.0	972.0	914.0	1 149.0	760.0	992.0	1 200.0	893.0	1 124.0
1052.6	627.0	540.0	684.0	545.0	539.0	401.0	1 194.0	967.0	910.0	1 180.0	754.0	993.0	1 155.0	893.0	1 125.0
1053.7	630.0	545.0	695.0	546.0	538.0	397.0	1 202.0	957.0	900.0	1 178.0	769.0	988.0	1 186.0	883.0	1 147.0
1054.8	615.0	525.0	709.0	564.0	526.0	394.0	1 196.0	977.0	889.0	1 131.0	762.0	998.0	1 194.0	891.0	1 142.0
1056.0	612.0	553.0	686.0	571.0	561.0	391.0	1 180.0	965.0	900.0	1 151.0	761.0	1 000.0	1 187.0	889.0	1 127.0
1057.1	604.0	556.0	696.0	569.0	534.0	401.0	1 177.0	954.0	897.0	1 153.0	781.0	979.0	1 181.0	883.0	1 116.0
1058.2	621.0	552.0	723.0	549.0	555.0	411.0	1 183.0	952.0	916.0	1 163.0	775.0	964.0	1 211.0	887.0	1 124.0
1059.3	605.0	550.0	702.0	577.0	553.0	417.0	1 219.0	964.0	885.0	1 167.0	774.0	1 007.0	1 203.0	898.0	1 112.0
1060.5	615.0	550.0	689.0	569.0	553.0	399.0	1 208.0	952.0	908.0	1 168.0	784.0	993.0	1 190.0	898.0	1 116.0
1061.6	597.0	562.0	710.0	543.0	545.0	413.0	1 215.0	960.0	891.0	1 186.0	748.0	989.0	1 172.0	854.0	1 150.0
1062.7	633.0	560.0	692.0	584.0	539.0	403.0	1 199.0	961.0	883.0	1 135.0	749.0	944.0	1 221.0	892.0	1 126.0
1063.8	607.0	553.0	712.0	560.0	567.0	417.0	1 194.0	957.0	865.0	1 144.0	767.0	973.0	1 184.0	906.0	1 092.0
1064.9	616.0	548.0	713.0	565.0	556.0	379.0	1 236.0	974.0	914.0	1 142.0	781.0	996.0	1 235.0	885.0	1 101.0
1066.1	618.0	541.0	712.0	563.0	549.0	409.0	1 122.0	957.0	898.0	1 145.0	764.0	979.0	1 196.0	884.0	1 117.0
1067.2	615.0	549.0	693.0	571.0	554.0	403.0	1 192.0	969.0	935.0	1 159.0	793.0	969.0	1 201.0	912.0	1 107.0
1068.3	608.0	565.0	715.0	583.0	545.0	411.0	1 211.0	944.0	907.0	1 139.0	774.0	992.0	1 218.0	889.0	1 100.0
1069.4	619.0	554.0	731.0	560.0	546.0	414.0	1 210.0	959.0	902.0	1 143.0	772.0	976.0	1 206.0	873.0	1 132.0
1070.5	589.0	557.0	699.0	560.0	560.0	417.0	1 215.0	996.0	902.0	1 151.0	770.0	988.0	1 203.0	872.0	1 105.0
1071.7	625.0	542.0	709.0	550.0	579.0	411.0	1 192.0	969.0	918.0	1 186.0	751.0	986.0	1 200.0	886.0	1 120.0
1072.8	612.0	552.0	681.0	565.0	572.0	409.0	1 191.0	970.0	877.0	1 166.0	752.0	975.0	1 162.0	893.0	1 098.0
1073.9	619.0	538.0	686.0	555.0	562.0	409.0	1 232.0	981.0	925.0	1 161.0	793.0	1 018.0	1 171.0	884.0	1 114.0
1075.0	615.0	569.0	692.0	580.0	552.0	401.0	1 206.0	973.0	888.0	1 146.0	761.0	971.0	1 185.0	889.0	1 109.0
1076.1	626.0	550.0	694.0	590.0	577.0	403.0	1 193.0	988.0	909.0	1 157.0	800.0	973.0	1 205.0	910.0	1 117.0
1077.3	597.0	576.0	708.0	577.0	554.0	415.0	1 213.0	951.0	903.0	1 143.0	782.0	987.0	1 197.0	859.0	1 097.0
1078.4	617.0	562.0	703.0	580.0	543.0	384.0	1 199.0	964.0	910.0	1 140.0	766.0	981.0	1 223.0	902.0	1 107.0
1079.5	609.0	539.0	711.0	556.0	545.0	420.0	1 194.0	934.0	906.0	1 152.0	768.0	989.0	1 195.0	910.0	1 105.0
1080.6	567.0	566.0	713.0	580.0	552.0	399.0	1 200.0	973.0	891.0	1 148.0	759.0	977.0	1 188.0	884.0	1 112.0
1081.7	607.0	560.0	698.0	567.0	556.0	408.0	1 205.0	947.0	908.0	1 170.0	755.0	975.0	1 190.0	874.0	1 099.0
1082.9	621.0	556.0	714.0	565.0	563.0	401.0	1 197.0	971.0	908.0	1 202.0	751.0	992.0	1 205.0	893.0	1 107.0
1084.0	617.0	574.0	715.0	552.0	565.0	404.0	1 199.0	981.0	894.0	1 147.0	749.0	1 003.0	1 196.0	866.0	1 101.0
1085.1	611.0	557.0	742.0	573.0	576.0	419.0	1 226.0	969.0	910.0	1 167.0	783.0	976.0	1 208.0	912.0	1 133.0
1086.2	599.0	557.0	725.0	576.0	576.0	412.0	1 202.0	976.0	924.0	1 147.0	748.0	948.0	1 233.0	888.0	1 089.0
1087.3	633.0	545.0	719.0	564.0	547.0	400.0	1 223.0	941.0	881.0	1 149.0	749.0	988.0	1 175.0	876.0	1 085.0
1088.5	631.0	557.0	706.0	590.0	561.0	397.0	1 203.0	959.0	910.0	1 181.0	754.0	988.0	1 214.0	912.0	1 103.0
1089.6	619.0	551.0	710.0	578.0	575.0	397.0	1 203.0	975.0	887.0	1 138.0	775.0	968.0	1 193.0	880.0	1 121.0
1090.7	618.0	559.0	692.0	559.0	564.0	403.0	1 214.0	982.0	921.0	1 195.0	774.0	989.0	1 195.0	889.0	1 125.0
1091.8	624.0	551.0	738.0	564.0	545.0	396.0	1 219.0	942.0	938.0	1 165.0	761.0	990.0	1 197.0	878.0	1 111.0
1092.9	614.0	529.0	707.0	582.0	571.0	399.0	1 221.0	964.0	916.0	1 156.0	773.0	968.0	1 220.0	896.0	1 116.0
1094.0	605.0	549.0	720.0	568.0	568.0	409.0	1 220.0	971.0	914.0	1 175.0	769.0	970.0	1 223.0	883.0	1 121.0
1095.2	619.0	571.0	734.0	603.0	571.0	411.0	1 209.0	993.0	904.0	1 159.0	755.0	960.0	1 177.0	900.0	1 100.0
1096.3	639.0	583.0	721.0	554.0	563.0	394.0	1 215.0	948.0	931.0	1 166.0	758.0	996.0	1 240.0	895.0	1 129.0
1097.4	650.0	565.0	721.0	568.0	576.0	411.0	1 204.0	955.0	907.0	1 149.0	759.0	982.0	1 200.0	854.0	1 120.0
1098.5	622.0	570.0	726.0	569.0	570.0	405.0	1 220.0	961.0	905.0	1 162.0	747.0	1 002.0	1 222.0	897.0	1 122.0
1099.6	610.0	573.0	724.0	595.0	574.0	407.0	1 205.0	976.0	891.0	1 173.0	777.0	971.0	1 186.0	902.0	1 100.0
1100.7	633.0	584.0	721.0	575.0	582.0	397.0	1 214.0	987.0	927.0	1 185.0	735.0	997.0	1 209.0	869.0	1 103.0
1101.9	614.0	587.0	716.0	558.0	572.0	419.0	1 240.0	955.0	921.0	1 142.0	773.0	989.0	1 202.0	899.0	1 106.0
1103.0	633.0	571.0	741.0	575.0	589.0	401.0	1 231.0	1 006.0	924.0	1 194.0	785.0	976.0	1 209.0	873.0	1 118.0
1104.1	643.0	568.0	736.0	598.0	588.0	403.0	1 208.0	984.0	939.0	1 168.0	744.0	995.0	1 225.0	884.0	1 130.0
1105.2	629.0	579.0	719.0	577.0	575.0	426.0	1 198.0	980.0	924.0	1 186.0	773.0	977.0	1 196.0	908.0	1 105.0
1106.3	642.0	564.0	729.0	579.0	577.0	417.0	1 215.0	980.0	923.0	1 190.0	770.0	1 002.0	1 215.0	892.0	1 126.0
1107.4	636.0	567.0	737.0	556.0	587.0	411.0	1 212.0	963.0	937.0	1 179.0	763.0	992.0	1 229.0	890.0	1 106.0
1108.5	623.0	554.0	746.0	587.0	594.0	410.0	1 254.0	977.0	930.0	1 191.0	778.0	987.0	1 229.0	896.0	1 110.0
1109.7	599.0	584.0	719.0	581.0	604.0	419.0	1 208.0	984.0	920.0	1 159.0	787.0	968.0	1 247.0	899.0	1 115.0
1110.8	627.0	557.0	733.0	581.0	582.0	435.0	1 234.0	997.0	898.0	1 149.0	767.0	975.0	1 233.0	907.0	1 150.0
1111.9	618.0	567.0	730.0	587.0	625.0	425.0	1 223.0	986.0	914.0	1 190.0	761.0	997.0	1 234.0	909.0	1 132.0
1113.0	639.0	585.0	745.0	591.0	583.0	391.0	1 239.0	1 000.0	929.0	1 184.0	803.0	997.0	1 208.0	922.0	1 127.0
1114.1	635.0	585.0	747.0	588.0	584.0	419.0	1 247.0	968.0	909.0	1 188.0	760.0	1 006.0	1 232.0	903.0	1 126.0
1115.2	617.0	568.0	750.0	610.0	590.0	419.0	1 255.0	1 007.0	958.0	1 180.0	757.0	1 004.0	1 250.0	893.0	1 116.0
1116.3	638.0	572.0	769.0	573.0	603.0	418.0	1 260.0	1 006.0	956.0	1 163.0	783.0	991.0	1 245.0	898.0	1 113.0
1117.5	623.0	582.0	746.0	571.0	592.0	410.0	1 271.0	970.0	937.0	1 220.0	784.0	992.0	1 234.0	876.0	1 143.0
1118.6	643.0	571.0	758.0	592.0	594.0	414.0	1 247.0	986.0	924.0	1 189.0	769.0	993.0	1 242.0	875.0	1 121.0
1119.7	625.0	578.0	753.0	604.0	594.0	412.0	1 223.0	988.0	943.0	1 194.0	774.0	997.0	1 224.0	891.0	1 146.0
1120.8	631.0	582.0	734.0	598.0	589.0	406.0	1 264.0	965.0	937.0	1 188.0	778.0	1 010.0	1 238.0	913.0	1 152.0
1121.9	625.0	572.0	747.0	609.0	593.0	401.0	1 234.0	1 007.0	968.0	1 193.0	790.0	1 019.0	1 271.0	892.0	1 133.0
1123.0	607.0	597.0	772.0	605.0	596.0	423.0	1 265.0	1 033.0	918.0	1 207.0	782.0	993.0	1 228.0	890.0	1 132.0
1124.1	629.0	599.0	760.0	587.0	621.0	420.0	1 245.0	1 007.0	924.0	1 191.0	776.0	1 006.0	1 229.0	912.0	1 122.0
1125.2	638.0	595.0	735.0	598.0	590.0	407.0	1 227.0	980.0	953.0	1 206.0	769.0	1 005.0	1 223.0	919.0	1 170.0
1126.4	609.0	592.0	759.0	595.0	615.0	403.0	1 253.0	969.0	955.0	1 237.0	771.0	985.0	1 240.0	887.0	1 138.0
1127.5	622.0	569.0	770.0	608.0	596.0	393.0	1 236.0	1 008.0	955.0	1 210.0	779.0</				



1160.7	615,0	595,0	789,0	616,0	622,0	428,0	1 261,0	1 000,0	973,0	1 232,0	799,0	994,0	1 243,0	913,0	1 147,0
1161.8	632,0	599,0	813,0	591,0	641,0	400,0	1 280,0	1 033,0	945,0	1 238,0	781,0	1 042,0	1 306,0	929,0	1 131,0
1162.9	619,0	630,0	810,0	633,0	636,0	411,0	1 268,0	1 011,0	964,0	1 197,0	791,0	999,0	1 283,0	910,0	1 164,0
1164.0	630,0	605,0	814,0	631,0	615,0	418,0	1 256,0	1 006,0	952,0	1 231,0	809,0	1 017,0	1 285,0	918,0	1 133,0
1165.1	627,0	608,0	817,0	616,0	637,0	410,0	1 262,0	981,0	970,0	1 260,0	777,0	1 005,0	1 263,0	889,0	1 132,0
1166.3	638,0	631,0	809,0	616,0	632,0	403,0	1 263,0	1 042,0	996,0	1 242,0	790,0	1 006,0	1 266,0	907,0	1 176,0
1167.4	627,0	626,0	816,0	621,0	647,0	409,0	1 273,0	1 013,0	989,0	1 235,0	764,0	1 008,0	1 266,0	915,0	1 146,0
1168.5	653,0	607,0	773,0	621,0	631,0	423,0	1 279,0	1 023,0	974,0	1 236,0	759,0	1 001,0	1 261,0	948,0	1 142,0
1169.6	605,0	610,0	798,0	611,0	647,0	431,0	1 318,0	1 023,0	952,0	1 236,0	772,0	1 032,0	1 250,0	886,0	1 164,0
1170.7	639,0	614,0	817,0	610,0	641,0	440,0	1 280,0	989,0	982,0	1 232,0	791,0	1 040,0	1 276,0	923,0	1 109,0
1171.8	617,0	605,0	779,0	603,0	650,0	403,0	1 265,0	1 010,0	967,0	1 250,0	784,0	1 014,0	1 297,0	919,0	1 121,0
1172.9	640,0	598,0	764,0	606,0	664,0	418,0	1 288,0	1 028,0	961,0	1 213,0	779,0	1 033,0	1 263,0	912,0	1 145,0
1174.0	625,0	624,0	821,0	617,0	640,0	427,0	1 300,0	1 009,0	984,0	1 232,0	775,0	1 012,0	1 287,0	908,0	1 133,0
1175.1	639,0	597,0	803,0	631,0	643,0	426,0	1 259,0	1 018,0	985,0	1 237,0	793,0	1 002,0	1 253,0	906,0	1 100,0
1176.2	653,0	607,0	808,0	601,0	642,0	415,0	1 252,0	1 017,0	983,0	1 180,0	782,0	1 002,0	1 313,0	902,0	1 124,0
1177.3	639,0	614,0	797,0	628,0	615,0	429,0	1 279,0	1 008,0	970,0	1 237,0	784,0	1 005,0	1 300,0	910,0	1 148,0
1178.4	649,0	619,0	815,0	601,0	633,0	423,0	1 266,0	988,0	930,0	1 225,0	783,0	1 029,0	1 255,0	901,0	1 140,0
1179.5	633,0	605,0	837,0	627,0	646,0	436,0	1 276,0	1 049,0	998,0	1 251,0	788,0	1 008,0	1 307,0	911,0	1 118,0
1180.6	638,0	628,0	808,0	637,0	626,0	428,0	1 283,0	1 008,0	979,0	1 227,0	772,0	997,0	1 283,0	903,0	1 159,0
1181.7	623,0	611,0	816,0	632,0	653,0	433,0	1 297,0	1 043,0	966,0	1 238,0	778,0	1 017,0	1 279,0	900,0	1 140,0
1182.8	623,0	645,0	810,0	621,0	670,0	436,0	1 280,0	1 012,0	969,0	1 247,0	786,0	1 044,0	1 277,0	939,0	1 102,0
1183.9	625,0	615,0	806,0	621,0	651,0	443,0	1 261,0	1 022,0	980,0	1 241,0	792,0	1 018,0	1 266,0	924,0	1 160,0
1185.0	629,0	640,0	814,0	633,0	631,0	437,0	1 307,0	1 016,0	964,0	1 248,0	776,0	1 019,0	1 295,0	934,0	1 161,0
1186.1	663,0	629,0	808,0	637,0	633,0	457,0	1 302,0	1 005,0	985,0	1 207,0	778,0	1 006,0	1 296,0	922,0	1 143,0
1187.2	649,0	628,0	805,0	649,0	645,0	432,0	1 319,0	1 004,0	961,0	1 224,0	806,0	1 021,0	1 265,0	922,0	1 150,0
1188.3	641,0	631,0	825,0	640,0	654,0	454,0	1 275,0	1 017,0	1 009,0	1 225,0	779,0	1 002,0	1 270,0	913,0	1 149,0
1189.4	654,0	619,0	858,0	624,0	650,0	429,0	1 299,0	1 007,0	979,0	1 228,0	811,0	1 004,0	1 322,0	937,0	1 145,0



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WESTERN CAPE

B.4.9: Table showing the Raman shifts of the last 17 of 32 analysed grains of TNS18.

		Turner Exploration Camp																
TNS18	Intensity (A.U)	Raman shift (cm <sup>-1</sup> )																
		Grain 16	Grain 17	Grain 18	Grain 19	Grain 20	Grain 21	Grain 22	Grain 23	Grain 24-01	Grain 24-02	Grain 26	Grain 28	Grain 29	Grain 30	Grain 31	Grain 32	
-38.6	19	24	24	24	25	23	22	21	22	25	20	19	21	23	24	21	21	
-37.3	23	24	21	17	17	24	17	21	19	19	17	15	17	19	25	22	22	
-35.9	30	27	25	26	24	19	25	27	19	26	27	21	25	23	31	21	21	
-34.6	23	33	23	27	23	23	21	21	22	25	29	27	24	28	23	21	21	
-33.3	27	22	25	28	22	22	27	25	21	22	26	25	21	33	24	23	23	
-32.0	31	27	23	23	25	21	23	25	26	23	27	23	21	21	24	24	24	
-30.7	30	22	20	21	25	21	17	27	17	25	27	23	22	19	24	17	17	
-29.4	23	28	28	17	20	25	18	25	21	25	27	23	25	19	26	21	21	
-28.1	26	21	26	22	22	24	23	26	21	25	25	17	19	25	19	24	24	
-26.8	23	19	27	26	21	27	22	23	21	28	21	23	22	19	22	19	22	
-25.5	33	23	24	26	23	24	26	25	17	17	21	23	21	21	25	25	25	
-24.2	23	25	25	21	23	24	20	25	24	28	28	25	20	16	26	18	18	
-22.9	29	19	25	22	20	23	22	26	19	28	21	24	17	21	23	19	19	
-21.6	25	29	17	24	25	25	24	17	29	23	22	17	20	22	24	27	27	
-20.3	26	26	25	23	21	17	25	23	21	21	28	19	19	23	25	22	22	
-19.0	23	28	29	23	21	22	19	27	25	24	24	27	17	26	25	25	25	
-17.7	25	23	23	21	27	20	27	21	22	27	29	25	22	27	23	22	22	
-16.4	21	29	29	23	27	26	19	25	24	25	21	21	21	26	16	27	27	
-15.1	30	24	24	23	23	24	24	23	19	21	30	23	25	21	27	22	22	
-13.8	31	26	32	23	23	19	17	28	26	22	21	19	23	19	23	23	23	
-12.5	23	27	27	25	19	25	28	24	19	19	23	25	25	21	23	20	20	
-11.2	25	22	23	26	26	25	23	27	29	27	27	23	21	25	21	31	31	
-9.8	32	29	29	24	25	23	24	25	27	25	26	25	29	21	27	19	19	
-8.5	31	22	23	26	25	18	25	28	21	28	21	26	23	24	23	27	27	
-7.2	31	33	29	17	17	25	31	27	23	31	25	25	24	21	23	21	21	
-5.9	31	31	29	27	21	27	25	29	28	28	25	28	24	27	19	32	32	
-4.6	41	51	39	35	33	33	37	39	42	38	38	41	35	41	38	37	37	
-3.3	129	125	118	112	116	99	103	115	103	110	119	131	121	125	136	129	129	
-2.0	333	319	298	291	313	284	285	286	279	287	291	299	320	292	323	332	332	
-0.7	529	503	515	541	541	485	542	544	509	536	576	556	623	540	557	619	619	
0.6	801	781	732	757	803	825	815	771	801	825	827	787	869	732	805	903	903	
1.9	688	635	623	643	631	653	689	683	717	745	733	659	828	641	725	611	611	
3.2	349	363	341	368	355	335	385	360	387	375	385	380	443	411	449	441	441	
4.5	150	145	157	138	162	144	176	169	184	174	155	171	183	153	153	121	121	
5.8	35	41	29	33	38	35	34	27	36	37	34	37	29	30	35	36	36	
7.1	32	29	29	23	21	32	28	23	29	29	29	29	29	27	25	27	27	
8.4	33	28	26	27	25	26	24	30	27	22	30	28	25	29	22	23	23	
9.7	30	35	29	28	26	27	28	25	22	26	26	23	24	25	19	27	27	
11.0	31	27	28	27	25	23	30	24	31	25	25	29	19	25	22	27	27	
12.3	29	31	23	24	23	26	24	26	26	21	24	27	25	26	21	25	25	
13.6	33	30	24	23	27	16	21	31	21	21	25	25	23	25	25	25	25	
14.9	35	31	29	29	19	29	29	26	23	29	24	23	24	21	28	20	20	
16.2	26	28	28	22	22	24	19	24	23	24	26	16	21	25	23	27	27	
17.5	24	29	22	27	23	22	26	21	25	23	24	23	26	23	30	27	27	
18.8	40	23	24	26	25	17	16	33	22	21	24	25	21	21	25	19	19	
20.1	29	32	24	19	19	21	24	27	27	25	29	21	26	23	25	21	21	
21.3	31	28	21	25	27	19	25	25	22	29	21	17	28	19	23	26	26	
22.6	31	34	23	26	25	24	19	15	28	26	23	27	25	29	25	25	25	
23.9	34	31	25	22	30	19	27	29	25	19	30	25	24	19	29	25	25	
25.2	26	31	27	26	25	25	21	30	31	27	27	29	25	27	29	28	28	
26.5	27	34	28	23	24	21	21	28	24	27	31	24	21	21	19	25	25	
27.8	28	32	26	25	27	23	21	33	28	27	25	21	24	27	26	25	25	
29.1	39	25	27	26	24	23	22	30	23	21	25	21	25	21	25	26	26	
30.4	35	31	28	25	25	22	21	26	27	23	26	24	24	19	24	21	21	
31.7	40	29	27	17	20	24	25	31	17	27	27	17	21	23	21	14	14	
33.0	36	34	24	28	26	29	27	31	27	34	25	27	23	25	32	35	35	
34.3	38	33	27	21	21	26	23	19	24	23	28	25	22	29	27	28	28	
35.6	38	35	31	27	31	23	21	33	23	31	21	23	19	23	25	29	29	
36.9	38	41	19	21	23	17	29	24	24	31	32	30	28	29	29	25	25	
38.2	41	43	30	25	30	21	25	33	30	30	33	26	22	34	31	30	30	
39.5	51	56	25	27	31	22	23	29	32	31	31	25	29	29	34	32	32	
40.8	72	69	41	34	41	24	25	40	35	36	35	27	25	37	51	37	37	
42.1	94	107	47	39	43	30	29	39	46	43	52	35	35	46	65	48	48	
43.4	143	165	67	45	56	31	35	55	53	58	63	44	27	68	93	63	63	
44.7	199	247	95	56	84	39	42	68	65	83	77	51	38	92	124	90	90	
46.0	285	329	136	74	109	50	43	95	95	110	123	63	37	141	194	116	116	
47.2	401	400	190	93	144	61	54	115	121	159	162	83	49	193	235	156	156	
48.5	512	517	203	109	183	79	73	153	155	199	183	101	61	245	281	194	194	
49.8	631	625	261	123	224	89	86	175	197	230	223	133	62	296	372	230	230	
51.1	722	698	286	139	252	96	99	205	210	272	249	139	76	345	417	248	248	
52.4	805	761	331	173	274	105	105	240	245	292	286	174	71	387	452	278	278	
53.7	910	823	363	175	308	93	109	257	259	311	315	187	85	414	495	308	308	
55.0	987	876	373	183	331	120	120	267	274	351	311	199	83	451	544	333	333	
56.3	1057	942	401	193	354	121	134	284	307	378	344	220	91	465	560	332	332	
57.6	1112	986	411	207	351	121	125	333	318	380	353	225	83	484	592	353	353	
58.9	1130	993	429	211	368	126	135	319	331	405	371	229	105	493	609	361	361	
60.2	1183	1051	448	228	371	134	132	355	340	413	371	257	92	507	659	385	385	
61.5	1213	1034	449	215	391	141	130	354	345	425	375	229	108	516	636	379	379	
62.7	1217	1056	460	232	400	135	143	358	352	423	383	247	107	523	666	383	383	
64.0	1226	1103	463	229	391	144	141	350	345	431	398	242	100	520	651	386	386	
65.3	1247	1093	465	240	398	137	129	343	353	413	394	233	108	524	687	398	398	
66.6	1287	1135	494	257	426	140	136	379	382	447	414	259	111	546	706	401	401	
67.9	1380	1174	477	260	431	135	145	397	407	478	428	265	111	605	763	447	447	
69.2	1446	1317	548	288	469	165	155	421	440	494	465	286	111	627	812	463	463	
70.5	1579	1386	593	322	537	163	178	458	463	537	487	301	134	715	865	527	527	
71.8	1738	1459	673	362	559	187	196	520	522	580	539	337	143	839	964	581	581	
73.1	1911	1569	710	377	664	206	205	549	591	640	588							

85.9	3005	2319	1069	607	1108	320	299	892	889	943	984	519	243	1919	1640	1019
87.2	3049	2307	1095	615	1097	307	313	885	919	1011	993	523	252	1917	1691	1066
88.5	3090	2397	1134	591	1135	308	317	955	923	986	1005	519	243	1981	1695	1063
89.8	3179	2398	1137	618	1145	313	304	953	919	1036	1029	516	240	2005	1696	1071
91.1	3215	2457	1125	625	1176	321	313	997	913	1035	1055	553	255	2031	1768	1110
92.4	3244	2484	1163	623	1163	311	316	1011	911	1052	1068	530	247	1997	1807	1151
93.6	3382	2494	1191	646	1221	330	303	1039	929	1093	1093	537	243	2043	1827	1138
94.9	3392	2549	1210	639	1247	319	301	1075	933	1075	1111	545	249	2069	1879	1157
96.2	3521	2598	1231	649	1269	321	317	1105	939	1080	1119	529	257	2015	1863	1192
97.5	3532	2674	1205	661	1260	310	327	1134	917	1111	1145	543	251	2053	1927	1191
98.8	3602	2692	1254	635	1294	319	312	1163	956	1107	1126	555	258	1976	1929	1231
100.1	3708	2689	1289	661	1305	315	306	1200	956	1104	1147	527	259	1939	1974	1254
101.3	3795	2769	1314	647	1348	307	311	1237	951	1122	1166	551	265	1937	1996	1252
102.6	3869	2843	1305	688	1302	289	323	1282	933	1134	1171	547	252	1934	1991	1289
103.9	3938	2884	1287	692	1359	317	319	1327	948	1142	1149	557	249	1890	2070	1323
105.2	4061	2955	1293	679	1349	317	309	1349	972	1168	1161	569	253	1883	2052	1321
106.5	4153	2984	1312	687	1335	313	285	1407	967	1126	1163	568	269	1861	2033	1315
107.8	4218	2995	1330	681	1325	323	315	1502	952	1168	1192	561	277	1838	2110	1374
109.0	4306	3146	1299	688	1354	311	330	1567	969	1151	1195	551	259	1831	2145	1401
110.3	4463	3222	1267	693	1368	313	314	1595	980	1175	1185	557	260	1848	2227	1442
111.6	4607	3287	1346	704	1363	301	325	1741	981	1187	1198	556	265	1799	2274	1455
112.9	4732	3445	1292	710	1384	314	317	1764	975	1169	1200	568	258	1808	2302	1476
114.2	4926	3528	1291	724	1367	285	318	1865	1013	1151	1202	559	273	1825	2343	1497
115.5	5160	3594	1336	737	1351	320	332	1991	995	1164	1205	551	274	1804	2435	1543
116.7	5330	3718	1355	742	1390	330	320	2041	983	1159	1180	581	259	1785	2494	1604
118.0	5561	3860	1307	765	1337	333	330	2187	1003	1180	1206	578	264	1741	2564	1638
119.3	5868	4042	1360	784	1337	310	319	2356	1026	1167	1213	605	262	1725	2679	1670
120.6	6210	4254	1321	781	1370	325	335	2546	1025	1179	1221	611	275	1742	2745	1764
121.9	6554	4441	1361	821	1363	323	347	2702	1041	1173	1207	583	268	1704	2841	1832
123.1	7096	4789	1369	843	1376	301	323	2987	1037	1149	1237	593	259	1749	3033	1857
124.4	7626	5074	1373	879	1397	319	313	3275	1060	1196	1223	615	281	1682	3251	1973
125.7	8276	5430	1354	949	1373	334	323	3653	1073	1174	1207	608	293	1709	3389	2115
127.0	9135	6020	1367	1005	1387	316	326	4067	1125	1180	1203	627	311	1751	3660	2255
128.2	10192	6537	1407	1125	1392	315	352	4558	1181	1199	1237	637	325	1710	3971	2365
129.5	11400	7260	1411	1195	1381	332	338	5223	1167	1184	1199	627	313	1749	4376	2661
130.8	12974	8171	1443	1233	1363	325	346	5941	1173	1211	1227	667	309	1687	4893	2932
132.1	14953	9353	1464	1271	1391	327	348	6957	1208	1197	1210	649	294	1647	5590	3268
133.4	17718	10911	1503	1374	1363	327	364	8359	1186	1197	1205	695	271	1597	6512	3725
134.6	21398	13070	1521	1559	1391	336	338	10145	1253	1190	1200	733	275	1549	7759	4303
135.9	26493	16001	1591	1775	1405	323	360	12665	1312	1209	1201	775	275	1552	9587	5313
137.2	33690	20062	1701	2151	1451	324	365	16091	1397	1245	1173	830	261	1524	12105	6651
138.5	44643	25592	1833	2654	1509	334	362	21264	1527	1243	1209	899	275	1522	15771	8411
139.7	59959	32528	2009	3429	1600	341	383	27951	1764	1295	1246	1035	287	1537	20848	10866
141.0	64940	40871	2383	4375	1752	319	385	37065	1975	1333	1355	1144	295	1525	26561	13359
142.3	64940	48671	2738	5419	2030	338	405	46929	2153	1475	1534	1263	292	1542	30962	15663
143.6	64940	54207	2915	5873	2263	335	409	54331	2272	1594	1624	1333	303	1546	32393	16855
144.9	64940	54468	2739	5489	2095	347	406	55181	2151	1556	1470	1339	297	1556	29761	16411
146.1	64940	49135	2401	4600	1705	339	401	49523	1965	1399	1321	1305	294	1547	24551	14494
147.4	64940	40634	2051	3509	1520	351	416	39901	1747	1337	1198	1158	287	1562	19075	11633
148.7	59031	31911	1813	2765	1418	355	386	30305	1521	1245	1186	1025	296	1588	14467	9124
150.0	43473	24740	1671	2143	1378	341	393	22564	1393	1217	1147	907	271	1516	11053	7091
151.2	32453	19414	1593	1723	1279	350	381	17105	1291	1193	1151	849	288	1510	8511	5652
152.5	25214	15551	1468	1509	1276	351	395	13071	1242	1158	1123	761	282	1501	7049	4529
153.8	19967	12765	1413	1309	1233	353	373	10255	1189	1143	1130	709	277	1465	5841	3833
155.1	16269	10497	1353	1167	1263	345	363	8258	1093	1149	1143	704	283	1481	5041	3267
156.3	13623	8919	1315	1074	1227	359	375	6679	1135	1156	1123	689	294	1462	4355	2825
157.6	11635	7744	1328	968	1231	345	361	5615	1116	1143	1147	663	298	1431	3918	2568
158.9	9980	6727	1293	938	1216	347	361	4851	1079	1132	1141	679	285	1430	3487	2295
160.1	8870	6032	1288	911	1229	359	361	4061	1077	1133	1105	631	267	1389	3221	2137
161.4	7954	5448	1290	837	1214	356	359	3573	1046	1117	1145	652	269	1410	2994	1986
162.7	7103	4962	1277	844	1202	339	382	3117	1057	1121	1155	623	288	1351	2802	1865
164.0	6476	4522	1306	781	1214	345	352	2818	1024	1130	1143	595	277	1384	2658	1766
165.2	5902	4227	1274	777	1220	332	369	2491	1045	1166	1124	615	273	1355	2536	1707
166.5	5481	3936	1291	763	1238	329	348	2269	1056	1117	1145	608	274	1307	2421	1609
167.8	5139	3730	1243	733	1205	331	356	2085	1021	1126	1125	616	261	1347	2353	1607
169.1	4874	3498	1279	723	1238	353	366	1921	1044	1138	1133	600	292	1321	2273	1566
170.3	4612	3366	1268	697	1238	338	354	1734	1021	1141	1179	599	281	1313	2207	1541
171.6	4412	3224	1295	739	1270	335	344	1628	1013	1147	1189	601	275	1293	2117	1482
172.9	4220	3080	1290	711	1265	344	333	1530	1044	1167	1216	591	283	1315	2084	1483
174.1	4034	3013	1314	711	1263	332	327	1423	1032	1179	1211	583	279	1293	2027	1475
175.4	3890	2926	1348	699	1285	328	324	1275	1017	1195	1253	557	288	1273	2071	1437
176.7	3786	2811	1314	696	1335	319	327	1243	1036	1185	1251	575	282	1264	2006	1419
178.0	3616	2672	1371	679	1360	317	325	1115	1009	1191	1320	569	271	1256	2002	1468
179.2	3480	2672	1371	679	1360	317	325	1115	1009	1191	1320	569	271	1256	2002	1468
180.5	3431	2614	1347	663	1375	327	316	1059	1033	1232	1340	551	278	1260	1948	1428
181.8	3294	2516	1382	651	1395	314	321	1005	1018	1221	1363	553	275	1236	1928	1464
183.0	3248	2478	1397	679	1371	327	317	974	1033	1228	1374	580	274	1250	1934	1451
184.3	3176	2409	1451	665	1449	318	321	937	1038	1267	1427	555	272	1263	1909	1489
185.6	3101	2409	1429	688	1450	308	313	889	1027	1284	1439	560	281	1240	1917	1471
186.8	3108	2369	1461	659	1528	309	328	869	1014	1291	1483	555	2			

213.4	2613	2109	1909	679	1893	351	349	649	1109	1572	2001	567	325	1290	2098	1923
214.7	2637	2146	1887	693	1939	339	359	639	1122	1605	2025	593	330	1274	2138	1966
216.0	2629	2128	1927	651	1971	360	351	643	1099	1615	2055	582	334	1237	2123	1955
217.2	2603	2078	1931	675	1953	365	361	628	1050	1603	2059	573	333	1221	2096	1987
218.5	2603	2085	1951	664	2003	382	367	641	1092	1661	2111	577	341	1224	2101	2025
219.8	2575	2139	1961	658	1995	412	385	641	1074	1656	2057	591	349	1225	2087	2045
221.0	2564	2139	1996	663	1980	452	393	665	1085	1674	2125	633	357	1201	2130	2057
222.3	2540	2167	2019	670	2049	495	477	722	1078	1704	2121	666	395	1201	2105	2043
223.5	2547	2232	2066	666	2050	608	537	815	1073	1729	2161	705	468	1175	2107	2091
224.8	2559	2329	2089	657	2057	754	651	990	1105	1731	2159	771	559	1182	2126	2095
226.1	2536	2471	2097	647	2030	852	727	1119	1111	1765	2193	855	726	1151	2146	2101
227.3	2529	2437	2061	664	2122	872	781	1257	1126	1796	2157	899	837	1153	2140	2135
228.6	2526	2425	2107	665	2109	786	690	1164	1149	1817	2218	889	818	1122	2125	2142
229.8	2500	2247	2082	646	2109	631	607	1011	1115	1775	2248	775	635	1138	2169	2141
231.1	2517	2123	2051	639	2118	539	493	815	1104	1756	2237	704	498	1134	2137	2118
232.4	2503	2063	2031	661	2156	451	437	717	1078	1739	2233	653	398	1113	2181	2121
233.6	2533	2106	2066	623	2144	431	415	666	1066	1739	2238	649	386	1102	2154	2154
234.9	2486	2031	2110	660	2167	425	399	612	1059	1741	2283	632	335	1089	2151	2127
236.2	2459	1990	2061	621	2195	391	393	595	1040	1720	2283	626	330	1083	2167	2079
237.4	2458	2027	2099	667	2135	408	391	589	1049	1794	2260	627	309	1103	2203	2133
238.7	2516	1990	2065	657	2184	419	403	602	1020	1729	2261	655	305	1061	2173	2094
239.9	2507	2026	2101	659	2129	437	409	601	1053	1717	2272	677	319	1099	2161	2095
241.2	2422	2084	2088	687	2161	461	440	611	1087	1773	2245	680	326	1077	2191	2131
242.5	2495	2072	2097	627	2167	501	479	644	1077	1801	2270	733	335	1063	2162	2101
243.7	2517	2096	2059	641	2133	543	521	689	1043	1795	2244	790	351	1078	2164	2109
245.0	2466	2163	2064	665	2131	578	588	727	1085	1763	2247	859	393	1051	2139	2075
246.2	2472	2177	2039	653	2105	602	590	784	1081	1788	2251	907	406	1073	2146	2094
247.5	2497	2210	2089	641	2085	588	575	765	1115	1771	2212	884	410	1069	2177	2045
248.7	2479	2106	2050	655	2070	550	525	709	1104	1769	2119	815	376	1053	2157	2053
250.0	2449	2126	1995	641	2047	497	463	643	1121	1695	2122	748	338	1057	2140	2068
251.3	2500	2029	1963	665	2003	445	426	616	1048	1690	2122	659	327	1046	2086	2035
252.5	2486	2014	1965	651	2010	419	407	576	1071	1663	2084	681	310	1039	2119	2034
253.8	2481	2003	1965	650	1959	397	406	584	1084	1648	2027	671	299	1019	2054	1991
255.0	2478	2005	1939	654	1940	393	387	551	1054	1612	2037	645	303	1023	2133	1995
256.3	2490	1992	1963	672	1912	391	395	543	1061	1645	1979	620	279	1030	2115	1978
257.5	2511	1974	1950	669	1916	393	382	557	1085	1621	2013	629	307	1035	2094	2006
258.8	2548	1962	1913	681	1893	382	377	567	1046	1577	1958	617	293	1045	2067	1949
260.1	2508	1991	1906	685	1876	392	378	565	1068	1611	1925	607	307	1037	2091	1993
261.3	2514	2008	1909	703	1837	385	379	575	1071	1603	1945	622	303	1044	2067	1922
262.6	2481	2057	1942	716	1878	400	383	565	1065	1590	1903	633	306	1069	2110	1908
263.8	2510	1987	1885	703	1802	408	387	580	1061	1584	1865	619	307	1021	2083	1900
265.1	2580	2009	1872	683	1863	393	389	584	1095	1565	1859	626	319	1053	2062	1865
266.3	2610	2027	1848	755	1735	390	407	577	1081	1538	1850	641	313	1016	2006	1888
267.6	2533	2022	1851	733	1758	401	381	579	1069	1530	1831	626	310	1040	2070	1849
268.8	2498	2035	1815	724	1759	397	411	589	1061	1530	1825	639	311	1003	2078	1852
270.1	2563	2026	1819	705	1728	395	413	603	1065	1526	1811	638	308	1024	2042	1789
271.4	2538	2044	1810	703	1691	439	401	605	1073	1525	1824	663	318	999	1997	1809
272.6	2516	1992	1783	683	1696	426	414	605	1046	1487	1796	629	329	985	1981	1789
273.9	2525	2017	1773	679	1681	441	432	617	1041	1528	1799	667	329	992	1980	1823
275.1	2512	2064	1741	675	1645	449	453	642	1051	1487	1751	651	315	1027	1946	1794
276.4	2516	2070	1723	675	1620	473	474	647	1030	1491	1771	671	333	998	1950	1767
277.6	2507	2035	1703	661	1613	477	483	641	1068	1454	1713	685	325	1030	1949	1769
278.9	2490	2044	1722	654	1619	487	477	685	1051	1427	1749	693	352	1013	1933	1737
280.1	2501	2098	1705	643	1589	520	509	722	1079	1467	1678	700	357	1006	1955	1721
281.4	2517	2066	1667	658	1613	565	535	734	1073	1445	1677	721	360	999	1919	1712
282.6	2527	2132	1678	629	1567	596	549	783	1089	1467	1698	755	373	1018	1922	1675
283.9	2555	2176	1695	630	1557	629	604	835	1073	1425	1655	790	389	999	1915	1723
285.1	2520	2198	1628	655	1545	677	657	873	1064	1483	1625	835	403	1011	1913	1650
286.4	2554	2283	1681	659	1521	781	723	952	1101	1483	1605	882	459	1005	1881	1647
287.6	2581	2348	1685	663	1567	911	818	1041	1137	1481	1590	985	508	984	1899	1650
288.9	2599	2458	1653	657	1543	1067	955	1221	1131	1521	1588	1101	573	1017	1921	1665
290.1	2612	2650	1688	657	1538	1227	1156	1436	1189	1571	1539	1289	683	997	1878	1651
291.4	2562	2885	1712	632	1540	1505	1357	1725	1172	1539	1553	1467	849	991	1875	1639
292.6	2634	3087	1695	633	1547	1699	1511	1975	1264	1577	1541	1676	1016	993	1886	1666
293.9	2588	3149	1673	630	1527	1781	1595	2094	1290	1616	1524	1765	1110	1000	1889	1638
295.1	2599	3094	1693	638	1525	1664	1553	2123	1309	1604	1525	1732	1103	1012	1878	1616
296.4	2629	2976	1652	671	1528	1589	1468	1957	1271	1581	1543	1649	966	983	1856	1603
297.6	2635	2927	1648	681	1537	1489	1387	1833	1267	1557	1489	1581	837	1007	1861	1589
298.9	2659	2793	1639	668	1537	1402	1315	1729	1254	1547	1487	1481	792	981	1927	1555
300.1	2705	2751	1611	659	1522	1279	1276	1617	1286	1528	1511	1491	761	994	1886	1563
301.4	2684	2657	1607	653	1511	1190	1165	1523	1212	1526	1491	1363	742	982	1858	1533
302.6	2683	2642	1598	655	1445	1067	985	1444	1231	1485	1447	1222	654	990	1851	1545
303.9	2695	2423	1545	649	1503	932	906	1276	1151	1491	1487	1085	567	989	1886	1524
305.1	2711	2343	1535	679	1487	823	790	1153	1142	1444	1475	992	509	1016	1867	1546
306.4	2707	2337	1570	665	1488	734	701	1062	1141	1433	1463	905	453	991	1885	1531
307.6	2688	2244	1567	639	1489	649	646	977	1099	1409	1521	857	423	977	1871	1506
308.9	2708	2189	1529	647	1471	592	575	897	1086	1382	1488	783	403	994	1895	1523
310.1	2740	2173	1561	631	1485	558	527	890	1087	1359	1481	763	363	985	1895	1511
311.4	2710	2153	1545	645	1478	496	496	819	1098	1372	1532	713	371	979	1863	1515
312.6	2731	2113	1552	676	1481	491	475	822	1046	1366	1529	683	338	979	1884	1535
313.9	2734	2125	1567	691	1512	471	455									



338.8	2789	2046	1619	719	1524	355	364	705	1050	1419	1656	614	302	993	1952	1655
340.0	2731	2089	1623	693	1546	370	367	701	1045	1389	1586	613	305	1005	1936	1601
341.3	2748	2053	1628	707	1566	359	341	713	1065	1415	1620	621	285	1017	1995	1626
342.5	2796	2017	1627	694	1546	376	357	723	1057	1459	1599	589	287	999	1960	1650
343.7	2758	2067	1637	685	1546	367	366	704	1032	1423	1629	621	290	987	2008	1638
345.0	2735	2048	1645	679	1543	363	358	725	1081	1399	1636	607	290	1011	1971	1663
346.2	2804	2066	1647	707	1541	357	361	728	1075	1426	1635	612	289	990	1933	1653
347.5	2785	2044	1631	678	1572	377	369	723	1055	1446	1605	617	304	1000	1972	1697
348.7	2823	2081	1689	681	1539	371	373	721	1073	1458	1679	601	289	1006	1975	1702
349.9	2886	2037	1666	703	1579	337	357	776	1063	1426	1702	592	304	1009	1976	1657
351.2	2817	2070	1677	692	1597	378	377	765	1069	1403	1676	606	287	1025	1992	1708
352.4	2810	2017	1691	719	1591	373	393	779	1049	1449	1678	618	295	1035	2052	1721
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354.9	2826	2060	1717	715	1611	388	387	800	1086	1434	1687	581	312	1047	2009	1736
356.2	2875	2108	1699	689	1631	388	381	806	1098	1458	1733	585	308	1055	2031	1746
357.4	2935	2091	1698	700	1610	379	377	809	1087	1447	1727	619	314	1050	2027	1776
358.6	2890	2116	1720	705	1641	378	379	847	1067	1481	1724	635	315	1011	2028	1735
359.9	2942	2104	1679	712	1606	387	379	868	1087	1511	1715	613	309	1041	2046	1751
361.1	2949	2125	1705	701	1622	376	375	880	1089	1481	1714	631	307	1023	2070	1761
362.3	3026	2108	1695	673	1648	378	384	900	1078	1519	1710	611	305	1010	2114	1775
363.6	2980	2109	1726	679	1625	388	373	924	1087	1522	1710	627	297	1035	2052	1733
364.8	3002	2080	1721	701	1631	377	405	919	1083	1487	1713	627	307	1012	2094	1763
366.1	3065	2130	1720	729	1634	392	390	977	1093	1495	1747	631	301	1035	2139	1795
367.3	3130	2176	1725	708	1653	388	396	987	1075	1503	1685	642	299	1037	2125	1812
368.5	3178	2156	1741	709	1627	389	389	1056	1063	1510	1733	637	292	1000	2166	1820
369.8	3174	2187	1752	718	1627	402	410	1085	1089	1499	1746	649	303	985	2225	1810
371.0	3216	2193	1757	719	1636	405	413	1149	1055	1495	1728	646	307	1013	2163	1845
372.3	3270	2244	1790	745	1669	409	408	1178	1087	1497	1746	613	315	1001	2238	1853
373.5	3311	2247	1759	725	1655	420	411	1255	1077	1492	1802	651	308	1006	2256	1842
374.7	3439	2263	1751	731	1644	423	421	1351	1093	1505	1738	627	319	1012	2240	1840
376.0	3498	2306	1780	732	1682	407	425	1373	1079	1540	1761	666	314	1010	2339	1906
377.2	3591	2343	1741	763	1685	417	413	1451	1121	1481	1797	695	305	999	2360	1911
378.4	3687	2369	1801	735	1663	422	436	1561	1107	1534	1715	671	309	993	2413	1957
379.7	3802	2420	1779	754	1680	423	431	1698	1125	1561	1773	693	316	991	2498	1961
380.9	3989	2467	1798	744	1666	435	433	1857	1119	1541	1765	688	316	1014	2523	2000
382.1	4092	2517	1823	765	1718	466	454	1973	1112	1561	1783	694	304	1006	2598	2034
383.4	4335	2522	1815	829	1683	453	461	2114	1097	1542	1815	704	318	1004	2668	2098
384.6	4617	2646	1861	801	1724	456	451	2340	1117	1571	1796	709	328	1029	2731	2095
385.8	4779	2689	1875	817	1699	452	441	2488	1101	1575	1785	727	340	1009	2831	2207
387.1	5064	2793	1841	841	1689	461	472	2683	1111	1570	1848	742	319	1017	2943	2246
388.3	5348	2849	1863	897	1701	461	470	2961	1132	1594	1865	715	321	1038	3011	2298
389.5	5543	2929	1885	914	1739	474	483	3196	1135	1619	1875	748	318	1029	3131	2323
390.8	5895	3040	1918	895	1723	497	501	3367	1167	1618	1876	757	325	1010	3267	2481
392.0	6194	3069	1973	929	1751	491	498	3635	1145	1633	1891	760	347	1021	3341	2485
393.3	6509	3191	1995	963	1767	501	522	3846	1164	1579	1885	790	326	1013	3480	2545
394.5	6822	3211	1993	993	1761	531	517	4044	1152	1621	1910	791	321	998	3558	2561
395.7	6957	3206	2007	1011	1761	555	547	4201	1149	1665	1956	828	359	1022	3612	2626
396.9	7057	3223	2077	1004	1755	582	577	4262	1157	1703	1964	829	357	1021	3609	2655
398.2	7071	3301	2051	973	1817	618	585	4206	1189	1688	1991	890	351	1019	3638	2666
399.4	6937	3242	2041	973	1854	655	629	4183	1200	1712	2014	889	366	1044	3567	2705
400.6	6620	3182	2105	957	1846	681	665	3927	1229	1766	1995	961	379	1038	3476	2607
401.9	6337	3149	2155	944	1848	745	731	3793	1206	1771	2048	997	380	1022	3389	2616
403.1	5974	3090	2165	933	1907	823	791	3609	1228	1812	2116	1037	417	1072	3330	2677
404.3	5674	3118	2194	866	1899	902	864	3381	1224	1830	2140	1141	443	1065	3203	2606
405.6	5285	3089	2240	886	1969	1001	979	3171	1241	1849	2189	1240	468	1036	3087	2622
406.8	4997	3128	2247	838	1989	1141	1109	3077	1239	1877	2245	1390	506	1029	3060	2600
408.0	4643	3201	2297	816	2007	1256	1177	2947	1283	1947	2250	1517	562	1009	2962	2601
409.3	4452	3209	2367	795	2027	1389	1293	2987	1321	2010	2302	1630	605	1005	2931	2639
410.5	4242	3301	2443	784	2068	1433	1411	2849	1331	2035	2352	1781	670	1017	2887	2657
411.7	4019	3250	2475	800	2111	1492	1411	2826	1357	2069	2423	1801	699	1027	2871	2710
413.0	3913	3154	2540	780	2215	1454	1369	2659	1388	2137	2447	1803	717	1025	2789	2684
414.2	3726	3085	2623	759	2235	1419	1307	2565	1351	2141	2550	1715	710	1038	2827	2741
415.4	3582	2950	2637	742	2201	1287	1205	2323	1333	2149	2640	1585	653	999	2785	2745
416.6	3540	2833	2681	759	2319	1138	1071	2106	1291	2239	2723	1439	616	1044	2841	2806
417.9	3462	2704	2755	732	2347	1029	941	1906	1243	2214	2705	1304	536	1044	2873	2859
419.1	3368	2595	2764	731	2430	891	843	1757	1235	2211	2857	1173	506	1015	2924	2918
420.3	3281	2498	2857	737	2455	833	784	1593	1231	2255	2976	1124	459	1029	2890	3021
421.6	3199	2479	2929	725	2551	740	725	1467	1187	2319	2997	1042	450	1019	2929	3068
422.8	3158	2419	2971	742	2580	714	677	1367	1180	2360	3081	919	402	1033	2977	3121
424.0	3174	2305	3042	737	2716	645	645	1291	1148	2387	3213	914	386	1031	3041	3216
425.3	3130	2314	3157	774	2743	612	585	1241	1149	2413	3293	852	348	1040	3080	3320
426.5	3091	2259	3251	739	2803	591	555	1143	1124	2488	3454	827	360	1018	3143	3375
427.7	3046	2266	3287	731	2901	547	547	1104	1125	2565	3550	810	357	1014	3173	3520
428.9	3014	2211	3444	746	2957	542	524	1077	1145	2559	3656	777	339	1034	3261	3588
430.2	2961	2167	3524	744	3084	523	525	1043	1144	2665	3808	776	315	1034	3320	3715
431.4	3006	2177	3672	744	3147	525	486	1009	1124	2761	3881	749	321	1031	3375	3775
432.6	2988	2180	3756	749	3261	497	495	979	1109	2784	4064	733	330	1043	3349	3908
433.8	2944	2153	3922	733	3387	478	489	951	1114	2899	4167	746	309	1031	3441	3979
435.1	2939	2150	3953	725	3421	481	485	903	1130	2897	4343	722	335	1025	3528	4089
436.3	2921	2147	4072	750	3505	462	466	907	1113	3019	4450	713	319	1038	3593	4136
437.5	2901	21														



462.0	2815	2131	3390	868	3003	407	442	837	1325	2655	3775	685	399	1327	3050	3519
463.2	2850	2169	3229	965	2925	415	456	842	1436	2527	3571	694	445	1437	3038	3364
464.4	2782	2173	3085	1047	2871	416	453	829	1520	2460	3451	651	503	1569	2874	3212
465.7	2837	2147	2977	1015	2691	418	450	849	1529	2363	3265	669	507	1593	2841	2986
466.9	2872	2158	2867	1041	2628	421	445	845	1494	2257	3157	673	507	1553	2724	2871
468.1	2793	2146	2683	991	2490	436	451	831	1419	2197	2881	658	482	1493	2653	2769
469.3	2834	2150	2658	925	2349	414	449	853	1331	2094	2745	672	431	1408	2591	2613
470.5	2811	2142	2469	878	2269	414	448	805	1298	2011	2638	673	385	1281	2549	2522
471.8	2857	2082	2437	842	2121	401	421	817	1261	1927	2534	655	373	1245	2475	2474
473.0	2871	2141	2304	811	2115	406	446	809	1186	1882	2430	666	347	1244	2421	2363
474.2	2917	2080	2264	791	2033	415	403	837	1202	1827	2303	647	352	1149	2374	2265
475.4	2837	2083	2172	792	1953	413	423	855	1188	1775	2221	666	355	1131	2331	2211
476.6	2916	2098	2068	771	1921	407	426	846	1164	1747	2140	671	339	1102	2245	2111
477.9	2914	2063	2015	760	1824	428	446	867	1168	1719	2083	671	349	1105	2215	2063
479.1	2948	2167	2014	754	1816	436	435	875	1183	1672	1968	690	337	1106	2248	2003
480.3	2976	2108	1931	752	1753	432	445	872	1149	1626	1950	677	351	1090	2185	1981
481.5	2975	2112	1905	789	1717	443	453	875	1150	1604	1908	673	347	1065	2105	1934
482.7	2945	2151	1849	764	1687	451	442	893	1166	1582	1817	674	321	1107	2079	1875
484.0	2936	2155	1837	747	1667	420	461	923	1135	1530	1783	681	337	1093	2128	1829
485.2	3041	2197	1779	769	1632	435	480	948	1149	1521	1757	681	329	1105	2085	1829
486.4	2968	2158	1715	739	1581	449	461	985	1131	1495	1695	691	354	1119	2095	1775
487.6	3029	2130	1741	752	1599	473	479	1021	1121	1505	1647	698	349	1101	2080	1762
488.8	3045	2206	1714	741	1495	483	487	1059	1127	1457	1639	712	354	1076	2054	1747
490.0	3060	2240	1671	759	1516	479	521	1100	1154	1435	1629	731	341	1095	2068	1694
491.3	3093	2241	1659	742	1497	509	499	1135	1135	1462	1566	717	367	1089	2049	1699
492.5	3145	2232	1635	763	1496	505	524	1205	1135	1450	1573	729	361	1106	2032	1673
493.7	3149	2251	1620	725	1493	505	527	1229	1137	1422	1556	763	373	1106	2028	1703
494.9	3239	2255	1608	774	1497	499	523	1271	1139	1396	1519	751	355	1080	2064	1660
496.1	3258	2249	1615	768	1482	509	540	1326	1156	1443	1538	748	391	1053	2063	1712
497.3	3327	2274	1601	737	1441	520	549	1415	1154	1379	1516	766	355	1078	2079	1651
498.6	3356	2358	1558	753	1470	518	525	1472	1128	1380	1469	770	378	1072	2038	1705
499.8	3459	2324	1599	763	1439	517	520	1547	1140	1394	1508	750	377	1087	2102	1698
501.0	3540	2350	1543	775	1429	515	509	1640	1145	1371	1459	757	372	1067	2149	1680
502.2	3673	2399	1556	758	1430	505	503	1725	1122	1371	1502	760	374	1079	2230	1699
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504.6	3937	2452	1555	793	1417	490	488	1946	1098	1352	1465	733	379	1074	2270	1762
505.9	4160	2528	1537	802	1435	471	469	2093	1118	1356	1440	731	345	1097	2334	1812
507.1	4389	2569	1533	834	1438	459	455	2309	1127	1366	1468	710	342	1102	2401	1852
508.3	4641	2661	1525	824	1390	447	459	2469	1136	1344	1435	689	345	1091	2557	1881
509.5	4883	2694	1577	861	1402	449	451	2743	1139	1360	1465	701	333	1060	2644	1951
510.7	5170	2763	1570	912	1399	441	442	2945	1097	1361	1424	687	321	1135	2683	1973
511.9	5590	2765	1587	927	1425	432	450	3156	1121	1350	1496	701	330	1091	2818	2013
513.1	5806	2813	1547	890	1411	411	415	3316	1151	1336	1445	685	319	1091	2873	2065
514.3	5879	2830	1535	950	1443	415	443	3433	1125	1325	1453	681	325	1075	2882	2033
515.6	6032	2816	1558	920	1493	417	417	3423	1099	1334	1454	695	303	1074	2910	2029
516.8	5944	2791	1539	958	1446	411	433	3427	1135	1331	1486	671	317	1105	2890	2064
518.0	5922	2743	1541	949	1389	414	407	3343	1137	1333	1494	695	303	1085	2862	2026
519.2	5829	2774	1505	941	1383	411	419	3284	1123	1335	1444	638	305	1094	2818	2038
520.4	5638	2701	1547	920	1499	397	436	3107	1148	1361	1482	669	317	1091	2722	1993
521.6	5457	2647	1544	895	1416	418	422	2935	1121	1333	1457	655	315	1082	2665	1943
522.8	5303	2592	1531	898	1421	395	411	2843	1101	1373	1457	667	297	1069	2613	1926
524.0	5081	2585	1555	869	1441	405	412	2649	1150	1340	1445	669	317	1085	2575	1931
525.3	4928	2465	1501	848	1425	424	419	2487	1099	1360	1480	651	310	1115	2515	1839
526.5	4656	2464	1529	841	1433	406	397	2379	1112	1331	1465	637	289	1078	2443	1842
527.7	4535	2436	1507	830	1437	407	421	2256	1103	1347	1471	655	294	1081	2311	1799
528.9	4389	2394	1514	843	1443	409	433	2134	1117	1333	1474	642	307	1105	2331	1804
530.1	4193	2320	1516	809	1449	401	409	2012	1116	1340	1415	682	303	1056	2244	1773
531.3	4097	2337	1520	774	1470	394	434	1867	1114	1340	1463	661	308	1051	2235	1707
532.5	3930	2269	1488	778	1453	405	408	1781	1083	1327	1471	664	306	1075	2196	1667
533.7	3903	2236	1512	793	1439	395	410	1709	1069	1335	1449	655	313	1046	2152	1649
534.9	3761	2264	1532	777	1487	415	424	1619	1097	1350	1426	638	295	1073	2124	1664
536.1	3681	2215	1535	784	1483	397	422	1540	1076	1332	1465	643	303	1047	2102	1646
537.4	3598	2168	1533	754	1462	424	421	1467	1111	1358	1482	632	294	1102	2092	1603
538.6	3545	2163	1527	759	1515	411	408	1441	1103	1332	1456	643	321	1034	2087	1559
539.8	3462	2156	1489	753	1492	406	411	1377	1085	1383	1475	629	295	1074	2011	1569
541.0	3444	2153	1507	709	1505	412	414	1331	1115	1352	1491	651	300	1092	1974	1601
542.2	3401	2134	1523	725	1503	411	431	1280	1069	1370	1500	638	293	1076	2036	1561
543.4	3324	2138	1479	723	1526	427	422	1237	1114	1365	1482	627	299	1066	2005	1553
544.6	3262	2116	1535	722	1518	402	420	1189	1082	1369	1499	645	310	1056	1990	1501
545.8	3207	2112	1521	731	1583	413	423	1153	1077	1413	1535	641	315	1065	1990	1563
547.0	3198	2089	1528	711	1607	432	418	1145	1077	1393	1532	638	316	1052	1975	1563
548.2	3237	2066	1583	713	1602	428	415	1131	1108	1401	1547	627	303	1056	1971	1543
549.4	3173	2061	1549	702	1607	425	422	1105	1077	1419	1576	615	277	1047	1939	1532
550.6	3106	2086	1563	718	1646	406	437	1081	1096	1433	1573	661	301	1085	1983	1532
551.9	3093	2056	1587	716	1651	413	445	1071	1084	1428	1541	635	303	1082	1966	1511
553.1	3067	2072	1587	688	1669	423	437	1040	1077	1435	1632	648	307	1046	1958	1543
554.3	3110	2067	1600	708	1701	422	413	1029	1097	1456	1627	635	297	1071	1984	1537
555.5	3059	2044	1607	715	1723	443	444	991	1108	1501	1661	656	303	1061	1988	1546
556.7	3004	2051	1603	723	1768	445	434	971	1061	1488	1653	674	297	1054	1981	1513
557.9	3001	2058	1639	701	1831	440	442	957	1065	1521	1743	655	312	1080	1943	1555
559.1	3005	2044	1673	723	1833	435	447									

583.2	2933	2141	2354	703	3114	527	517	967	1117	2165	2845	714	303	1050	2359	1967
584.4	2934	2076	2391	711	3189	515	545	963	1101	2247	2905	742	319	1040	2361	1953
585.6	2891	2127	2433	672	3326	536	519	977	1092	2333	3006	739	323	1050	2380	2023
586.8	2977	2131	2536	707	3349	543	528	984	1096	2388	3080	735	330	1013	2487	2044
588.0	2908	2125	2586	729	3523	550	537	988	1103	2416	3193	725	319	1050	2475	2082
589.2	2975	2126	2675	717	3638	553	560	991	1073	2469	3294	775	345	1046	2519	2166
590.4	2999	2189	2682	691	3758	546	553	1019	1099	2593	3411	769	325	1048	2513	2169
591.6	2970	2160	2811	712	3881	573	595	1015	1110	2651	3508	766	345	1065	2644	2262
592.8	3039	2199	2881	703	4037	571	563	1054	1085	2675	3661	776	329	1065	2644	2205
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595.2	3033	2243	3050	702	4315	617	615	1074	1118	2889	3937	831	351	1056	2803	2401
596.4	3109	2272	3154	707	4544	624	639	1118	1109	2971	4069	855	335	1045	2819	2438
597.6	3099	2333	3250	703	4717	621	638	1145	1117	3066	4239	846	361	1062	2789	2493
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600.0	3226	2394	3450	711	5045	697	706	1235	1118	3212	4455	885	365	1025	3007	2650
601.2	3158	2396	3514	722	5153	723	721	1254	1137	3364	4729	924	389	1049	3096	2664
602.4	3280	2479	3638	728	5389	745	753	1275	1140	3455	4827	950	392	1083	3133	2787
603.6	3307	2556	3679	712	5563	823	791	1357	1160	3517	4987	998	398	1043	3153	2815
604.8	3319	2603	3801	744	5686	829	837	1455	1161	3665	5135	1003	417	1061	3308	2843
606.0	3357	2651	3885	719	5881	883	865	1523	1155	3727	5261	1100	435	1047	3313	2907
607.2	3430	2728	3985	699	6008	939	923	1581	1191	3811	5366	1155	459	1081	3406	2920
608.3	3510	2829	3958	740	6145	1025	953	1651	1217	3823	5477	1217	465	1075	3411	2955
609.5	3560	2889	4063	742	6223	1028	963	1747	1246	3941	5549	1242	493	1057	3427	2969
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615.5	4084	3207	3987	754	6280	1039	987	2052	1236	3944	5551	1291	543	1039	3547	2938
616.7	4192	3260	3961	739	6224	1028	971	2057	1226	3899	5454	1228	519	1071	3601	2865
617.9	4410	3278	3891	789	6021	956	927	2117	1208	3833	5251	1183	498	1077	3599	2831
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620.3	4826	3500	3697	790	5706	872	823	2232	1200	3583	4996	1118	413	1041	3547	2743
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622.7	5372	3706	3474	820	5371	807	785	2406	1177	3456	4716	977	409	1069	3584	2621
623.9	5647	3846	3293	833	5131	770	743	2563	1213	3300	4491	1008	405	1058	3651	2647
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626.3	6503	4272	3102	866	4747	725	738	2922	1198	3098	4133	958	391	1035	3730	2603
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632.3	9597	5630	2622	992	3881	669	707	4287	1187	2617	3285	986	377	1044	4280	2715
633.4	10284	5925	2532	1035	3715	673	711	4531	1205	2573	3171	945	378	1055	4367	2778
634.6	11024	6234	2485	1066	3501	691	699	4859	1209	2479	3028	923	370	1044	4459	2848
635.8	11689	6450	2391	1097	3396	695	701	5069	1226	2379	2885	955	369	1032	4591	2864
637.0	12122	6524	2320	1099	3231	692	695	5285	1264	2301	2780	953	388	1027	4663	2921
638.2	12232	6530	2251	1127	3190	677	717	5381	1249	2242	2609	957	385	1021	4599	2811
639.4	12274	6603	2185	1057	3033	697	719	5349	1261	2189	2556	984	391	1029	4572	2822
640.6	12010	6481	2136	1105	2903	698	708	5271	1228	2126	2442	981	381	1041	4465	2759
641.8	11764	6363	2099	1101	2808	694	705	5084	1241	2075	2387	961	375	1022	4279	2682
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644.2	10644	5725	1959	1054	2649	723	725	4661	1195	1990	2185	973	371	1017	3903	2461
645.4	9961	5489	1895	987	2526	748	745	4343	1226	1913	2203	941	363	1005	3774	2353
646.6	9333	5211	1865	954	2445	736	753	4130	1246	1909	2094	989	382	1009	3638	2253
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648.9	8126	4714	1777	930	2360	743	757	3619	1241	1858	1954	979	383	1023	3251	2035
650.1	7587	4528	1760	886	2284	760	751	3401	1196	1773	1911	1005	379	986	3027	1897
651.3	7011	4317	1699	873	2264	743	792	3169	1178	1811	1892	1009	386	992	2928	1864
652.5	6584	4198	1691	844	2160	774	781	2996	1163	1743	1835	993	384	955	2822	1773
653.7	6325	3996	1666	853	2121	768	809	2826	1158	1756	1809	1003	390	935	2692	1699
654.9	5937	3905	1628	845	2082	765	805	2631	1212	1700	1750	1037	399	988	2590	1671
656.1	5590	3752	1599	827	2062	773	805	2519	1180	1683	1746	1039	385	971	2524	1595
657.3	5309	3602	1581	795	1973	791	820	2431	1146	1662	1707	1022	399	956	2461	1572
658.5	5101	3470	1557	832	1970	811	785	2367	1139	1658	1685	1031	395	955	2381	1508
659.6	4873	3377	1532	763	1919	787	812	2224	1187	1643	1631	1032	388	963	2322	1456
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662.0	4545	3153	1518	769	1887	769	780	2023	1180	1594	1629	987	406	955	2205	1389
663.2	4353	3114	1507	759	1825	761	773	1956	1175	1575	1577	1011	396	949	2153	1389
664.4	4290	2955	1479	763	1813	746	745	1837	1151	1568	1548	985	381	941	2147	1359
665.6	4154	2926	1472	744	1813	737	744	1801	1119	1572	1549	971	353	927	2054	1317
666.8	4000	2862	1458	755	1785	719	721	1719	1179	1522	1503	978	373	946	2043	1322
668.0	3906	2770	1459	744	1790	697	719	1637	1119	1471	1507	929	387	929	2009	1296
669.1	3889	2713	1430	762	1711	667	683	1525	1163	1476	1491	941	377	919	2000	1266
670.3	3746	2684	1424	739	1693	651	656	1495	1062	1461	1449	883	349	951	1974	1246
671.5	3674	2611	1440	747	1703	625	623	1417	1118	1499	1447	861	354	916	1928	1255
672.7	3607	2519	1411	729	1674	634	634	1373	1117	1485	1422	795	345	914	1927	1236
673.9	3513	2536	1381	743	1671	638	604	1310	1098	1437	1407	836	325	939	1936	1206
675.1	3477	2496	1419	719	1659	594	584	1271	1100	1403	1445	811	331	939	1876	1217
676.3	3431	2427	1399	720	1633	574	565	1227	1114	1398	1425	781	338	945	1881	1189
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703.5	2865	2015	1286	721	1416	396	398	721	1082	1199	1231	621	285	911	1664	1063
704.7	2830	1967	1269	717	1346	407	394	722	1105	1275	1226	623	289	918	1664	1071
705.8	2822	1999	1279	727	1359	390	377	694	1067	1265	1192	627	275	956	1668	1040
707.0	2808	1996	1274	712	1346	394	375	690	1091	1239	1217	626	292	949	1631	1051
708.2	2804	1958	1229	718	1331	380	397	664	1057	1252	1177	611	292	984	1689	1041
709.4	2742	1938	1241	750	1315	379	376	676	1071	1240	1181	573	291	929	1624	1029
710.6	2780	1940	1214	731	1301	375	378	658	1086	1231	1146	595	287	944	1644	993
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715.3	2725	1886	1168	717	1231	356	357	605	1075	1190	1116	569	284	923	1570	997
716.5	2735	1873	1186	713	1209	363	342	603	1099	1168	1071	581	283	934	1595	967
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718.8	2681	1853	1153	714	1189	351	339	594	1058	1161	1076	573	274	916	1536	961
720.0	2615	1849	1112	712	1207	351	346	577	1071	1145	1051	559	287	913	1545	940
721.2	2703	1845	1150	709	1161	343	311	560	1079	1147	1057	549	285	902	1523	929
722.4	2620	1845	1119	711	1109	329	343	560	1051	1126	1044	585	283	924	1499	923
723.5	2639	1844	1119	752	1146	333	342	565	1062	1107	1016	563	270	907	1509	918
724.7	2615	1810	1137	692	1163	343	324	556	1052	1100	982	558	278	938	1503	926
725.9	2663	1785	1079	716	1112	319	325	542	1040	1073	999	547	259	900	1509	904
727.1	2601	1791	1106	696	1097	321	338	543	1050	1063	1003	563	271	924	1467	889
728.3	2582	1792	1099	680	1094	330	319	535	1085	1080	979	566	265	922	1469	925
729.4	2581	1838	1099	699	1077	323	337	525	1081	1074	961	555	275	935	1459	885
730.6	2597	1813	1039	693	1096	329	325	535	1023	1059	947	550	274	928	1491	896
731.8	2611	1782	1055	695	1048	324	308	529	1059	1083	914	535	267	908	1462	866
733.0	2580	1791	1055	689	1049	312	311	509	1064	1038	907	528	278	932	1461	846
734.1	2573	1781	1031	676	1034	323	306	497	1075	1037	920	557	272	913	1449	855
735.3	2560	1789	1044	716	989	322	325	502	1083	1026	913	538	268	913	1466	839
736.5	2566	1801	1030	688	1010	315	295	513	1056	1047	893	559	268	912	1397	835
737.7	2512	1747	997	720	997	321	308	509	1031	1022	876	515	262	909	1408	818
738.8	2580	1779	1003	720	988	317	293	498	1063	1025	881	523	259	929	1432	825
740.0	2573	1743	1009	702	985	317	292	498	1064	1030	861	535	261	906	1403	818
741.2	2522	1740	975	701	989	300	275	493	1050	1010	858	531	253	901	1421	789
742.4	2562	1745	963	701	971	299	304	471	1056	986	837	547	249	919	1427	800
743.5	2561	1780	973	724	959	295	299	483	1050	1008	835	521	269	920	1409	788
744.7	2527	1768	991	730	959	305	299	469	1047	957	822	529	262	893	1419	797
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747.1	2518	1748	969	711	932	295	295	482	1019	997	813	551	263	885	1383	780
748.2	2513	1738	957	713	931	295	304	489	1057	989	812	529	252	890	1365	768
749.4	2581	1742	989	697	931	298	301	471	1035	988	810	543	259	879	1393	770
750.6	2497	1740	976	693	928	305	299	488	1060	983	776	535	245	911	1379	749
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752.9	2551	1754	967	719	913	298	295	473	1054	967	806	525	271	901	1390	786
754.1	2531	1750	925	715	897	299	304	455	1039	980	772	499	259	894	1359	739
755.3	2500	1756	924	693	911	306	293	465	1052	959	779	531	266	896	1391	743
756.4	2553	1719	923	703	905	300	289	477	1046	924	771	541	265	918	1354	743
757.6	2492	1758	906	711	901	303	281	455	1021	955	765	524	258	884	1365	745
758.8	2551	1757	925	711	905	287	290	472	1067	938	771	511	271	920	1374	722
760.0	2518	1759	923	709	880	304	299	471	1050	982	754	519	259	885	1359	687
761.1	2546	1723	919	695	867	300	291	474	1030	935	743	521	268	924	1359	719
762.3	2505	1720	905	707	895	296	296	467	1051	924	746	537	275	907	1346	725
763.5	2539	1723	923	695	872	297	289	461	1023	919	693	534	276	908	1355	741
764.7	2525	1754	897	694	855	287	288	459	1041	956	744	525	266	903	1356	724
765.8	2559	1731	908	703	889	277	288	469	1046	927	743	513	255	887	1333	695
767.0	2535	1772	891	693	866	276	257	477	1046	900	743	533	266	897	1351	737
768.2	2513	1753	915	699	869	279	284	452	1069	924	725	515	260	900	1373	723
769.3	2551	1720	905	720	881	293	286	470	1068	927	713	521	270	916	1349	726
770.5	2553	1711	915	683	864	282	283	481	1028	931	730	519	260	875	1363	715
771.7	2575	1716	905	708	859	308	281	500	1063	913	731	517	257	907	1333	701
772.8	2533	1737	894	694	851	295	286	466	1042	896	719	521	247	911	1317	703
774.0	2557	1739	911	705	857	279	265	483	1067	937	697	503	262	889	1333	704
775.2	2623	1738	906	704	870	267	286	474	1044	937	697	517	269	906	1340	687
776.4	2583	1724	891	710	842	285	279	500	1059	917	715	514	258	883	1347	700
777.5	2591	1757	911	712	859	279	277	483	1045	911	731	519	256	908	1341	717
778.7	2586	1736	895	687	849	293	267	496	1013	925	713	536	255	908	1342	701
779.9	2614	1746	907	706	847	273	285	487	1025	925	734	537	243	898	1359	700
781.0	2531	1738	884	715	845	288	285	507	1038	910	728	520	256	909	1324	710
782.2	2577	1724	887	710	843	281	274	479	1047	902	692	539	263	910	1366	710
783.4	2586	1748	888	697	869	285	281	487	1067	894	713	530	261	906	1383	676
784.5	2608	1748	886	705	852	281	268	521	1058	902	679	517	268	913	1348	716
785.7	2597	1758	889	687	831	287	270	512	1057	905	719	518	273	908	1340	703
786.9	2635	1721	886	718	819	277	271	517	1070	928	691	538	258	887	1349	716
788.0	2579	1765	896	718	843	286	290	517	1063	924	717	525	254	934	1321	684
789.2	2584	1758	878	695	836	281	279	485	1066	896	722	522	253	909	1366	710
790.4	2624	1715	899	716	839	299	297	533	1026	920	698	517	259	877	1367	716
791.5	2613	1777	903	691	841	289	273	527	1058	908	685	541	253	919	1366	687
792.7	2612	1780	851	699	827	280	275	520	1018	893	697	526	266	889	1321	702
793.9	2579	1758	903	721	821	297	281	498	1066	903	683	529	255	904	1351	685
795.0	2630	1733	885	718	837	294	279	550	1032	886	699	543	260	891	1359	687
796.2	2619	1716	875	719	865	293	282	542	1064	871	696	530	261	886	1376	697
797.4	2621	1739	871	725	829	300	289	522	1069	895	690	515	261	892	1338	687
798.5	2585	1733	878	713	825	296	285	539	1044	897	696	510	251	903	1339	671
799.7	2613</															



819.5	2504	1726	818	679	788	295	307	493	1050	868	632	559	277	897	1267	631
820.6	2512	1691	799	672	774	299	285	490	1043	854	633	531	246	885	1294	609
821.8	2512	1677	817	692	777	288	299	488	1060	872	634	540	258	881	1255	601
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826.4	2488	1690	801	683	753	302	281	471	1044	844	600	534	255	865	1283	605
827.6	2488	1706	803	688	767	297	283	470	1044	852	597	543	265	873	1224	592
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829.9	2544	1679	807	701	780	293	293	460	1048	859	618	538	225	857	1289	592
831.1	2491	1712	788	679	736	299	265	471	1027	837	587	529	252	907	1254	575
832.2	2485	1707	785	693	749	285	279	463	1047	846	596	521	257	875	1247	601
833.4	2521	1689	773	680	747	292	280	461	1063	826	571	519	258	868	1242	579
834.6	2482	1705	799	673	709	291	285	459	1023	831	573	540	239	868	1221	579
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836.9	2493	1682	801	710	722	277	279	437	1022	841	569	527	255	857	1224	576
838.0	2485	1691	760	667	722	284	269	451	1047	837	567	513	255	877	1249	591
839.2	2450	1697	789	669	719	287	280	431	1025	817	549	543	249	867	1221	561
840.4	2486	1713	763	667	707	271	282	470	1042	827	557	518	249	855	1248	586
841.5	2539	1680	764	700	714	285	277	417	1027	804	539	495	261	869	1211	547
842.7	2463	1661	734	671	694	278	270	441	1048	805	550	508	253	860	1229	554
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845.0	2485	1697	752	688	683	275	279	442	1050	796	544	500	253	859	1237	536
846.2	2499	1729	768	695	678	288	263	432	1025	808	527	511	272	881	1219	549
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848.5	2499	1687	726	682	653	281	247	423	1075	807	513	511	239	900	1207	519
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850.8	2447	1682	741	677	660	281	259	438	1044	805	513	507	250	887	1219	547
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856.6	2457	1686	724	702	666	271	273	439	1054	809	483	514	262	835	1163	522
857.7	2514	1687	741	706	638	276	245	418	1047	805	487	503	233	877	1205	523
858.9	2465	1712	720	681	633	267	261	411	1056	770	476	492	251	897	1196	503
860.0	2466	1688	711	684	628	273	251	409	1035	774	454	511	251	872	1201	511
861.2	2498	1722	696	673	641	267	263	425	1029	789	468	503	245	880	1190	507
862.3	2450	1673	715	703	605	257	266	387	1030	789	473	501	257	890	1201	500
863.5	2442	1701	722	695	626	282	257	405	1051	800	460	505	255	881	1187	481
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865.8	2474	1647	700	671	589	255	243	413	1033	772	457	496	241	873	1165	513
867.0	2490	1669	710	691	612	268	251	412	1050	774	439	521	253	894	1155	498
868.1	2467	1667	697	681	603	263	249	397	1035	775	450	489	242	893	1187	495
869.3	2456	1694	700	678	603	275	253	414	1079	777	452	495	247	903	1182	492
870.4	2430	1672	701	693	577	269	255	379	1050	773	451	511	237	889	1165	501
871.6	2429	1646	703	705	620	263	255	417	1051	772	436	505	247	889	1174	474
872.7	2443	1666	694	705	601	274	255	422	1035	777	454	513	260	879	1161	494
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875.0	2467	1663	675	703	600	264	265	391	1067	757	423	495	245	879	1183	478
876.2	2420	1654	702	677	591	265	260	391	1017	745	425	495	261	871	1157	469
877.3	2422	1638	693	693	573	279	246	379	1047	770	441	500	235	873	1149	502
878.5	2451	1634	687	689	585	253	261	367	1069	764	434	485	243	870	1161	476
879.6	2472	1659	665	690	574	261	256	387	1052	758	430	493	253	861	1155	490
880.8	2423	1642	701	663	571	259	260	393	1041	763	429	495	243	853	1165	481
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883.1	2431	1702	665	673	585	251	249	378	1022	773	417	489	255	863	1130	451
884.3	2428	1651	680	687	571	276	255	379	1010	733	427	488	243	867	1135	468
885.4	2468	1597	684	692	591	251	245	377	1041	744	420	503	246	869	1142	446
886.6	2411	1637	665	674	571	253	264	371	1052	737	420	499	241	869	1157	466
887.7	2437	1658	662	677	574	266	248	351	1038	750	413	487	249	856	1172	446
888.9	2434	1663	674	679	557	267	248	375	1042	723	424	508	229	849	1150	461
890.0	2442	1646	662	691	537	260	241	393	1047	758	405	503	245	866	1165	449
891.2	2437	1619	659	672	554	255	258	378	1039	734	423	502	239	855	1107	460
892.3	2364	1627	654	679	557	261	245	361	1060	743	405	498	235	853	1143	454
893.5	2388	1623	661	663	562	260	249	367	1011	737	409	493	237	880	1138	456
894.6	2418	1646	662	673	561	245	247	375	1060	753	408	501	249	879	1140	470
895.8	2393	1638	669	641	555	259	249	369	1022	724	401	501	226	864	1129	459
896.9	2380	1616	635	682	564	258	245	363	1027	739	393	502	245	865	1140	455
898.1	2375	1644	651	680	563	249	244	370	1043	728	404	480	233	843	1142	433
899.2	2364	1634	657	668	561	252	247	363	1022	737	386	493	231	865	1137	449
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901.5	2405	1583	671	656	564	247	231	359	1012	708	401	500	239	857	1114	433
902.6	2379	1602	641	698	561	262	243	363	1028	714	381	486	246	863	1122	445
903.8	2374	1601	634	679	547	245	242	357	1026	727	387	484	227	833	1135	459
904.9	2360	1592	644	667	572	267	240	345	1051	734	395	524	244	849	1115	442
906.1	2343	1618	673	691	527	247	245	362	1009	726	373	493	242	854	1123	447
907.2	2343	1590	617	679	550	255	239	349	1023	722	389	488	234	845	1121	445
908.4	2349	1611	655	682	535	267	237	355	986	717	384	502	223	850	1119	435
909.5	2406	1602	640	678	539	257	250	364	997	716	389	495	240	847	1130	427
910.7	2360	1568	665	687	535	245	246	357	1025	705	391	481	249	860	1087	441
911.8	2353	1607	639	665	547	251	242	369	1009	716	386	491	255	824	1126	425
913.0	2371	1578	653	675	539	255	238	361	1017	709	355	491	235	848	1127	442
914.1	2308	1622	645	681	536	260	243	349	1025	739	368	501	247	847	1138	452
915.3	2359	1555	643	683	525	257	245	331	995	735	388	503	246	821	1098	435

934.7	2386	1635	627	695	522	261	237	342	1010	712	359	481	239	843	1096	427
935.9	2339	1615	632	662	530	243	238	340	1016	735	377	481	231	854	1090	413
937.0	2388	1586	622	708	507	256	241	347	1033	713	367	476	233	848	1140	411
938.2	2369	1614	627	663	512	239	240	339	1036	711	363	480	249	848	1126	421
939.3	2355	1603	634	679	515	231	252	339	997	741	358	493	247	848	1133	427
940.4	2373	1590	627	712	511	255	250	337	1019	711	363	475	233	841	1095	407
941.6	2350	1592	629	679	537	253	239	331	1011	722	377	483	229	865	1114	413
942.7	2325	1599	658	691	524	250	238	343	1017	705	349	493	225	853	1113	409
943.9	2330	1619	636	691	517	249	254	345	1010	727	356	479	235	867	1121	421
945.0	2362	1596	635	673	528	229	237	335	1025	714	362	466	231	850	1094	409
946.1	2359	1626	635	680	481	241	242	333	1035	725	352	495	238	833	1106	421
947.3	2320	1637	615	676	534	250	239	335	1022	711	333	490	217	857	1100	417
948.4	2331	1622	634	666	522	250	234	339	1026	719	356	487	244	841	1105	411
949.6	2304	1598	644	696	527	251	239	335	1045	706	351	471	232	831	1086	421
950.7	2307	1605	612	677	510	259	217	336	1001	699	358	485	233	830	1101	399
951.8	2294	1588	604	691	501	258	244	337	1034	697	356	487	232	844	1111	415
953.0	2322	1612	624	653	493	248	225	322	1007	716	352	468	243	810	1101	417
954.1	2297	1598	607	674	509	241	237	325	1027	697	349	467	239	819	1063	433
955.3	2276	1562	615	670	512	242	242	327	1001	717	336	461	237	839	1066	413
956.4	2332	1543	615	681	507	251	239	330	1002	712	345	458	236	838	1093	413
957.5	2297	1617	619	680	483	243	236	343	986	712	366	474	225	825	1073	425
958.7	2305	1589	630	677	495	241	234	323	975	715	347	461	244	841	1101	406
959.8	2282	1598	617	669	528	249	225	337	979	720	331	479	228	830	1070	416
961.0	2282	1582	619	690	497	240	239	326	1017	710	333	471	233	829	1091	400
962.1	2266	1577	621	675	508	245	228	327	1006	703	333	469	236	818	1096	395
963.2	2269	1616	613	686	515	249	251	309	975	718	347	481	237	831	1091	390
964.4	2276	1549	619	666	512	252	243	324	981	709	357	453	223	825	1113	407
965.5	2320	1588	612	665	493	245	243	324	1007	711	346	473	220	828	1066	407
966.7	2274	1554	607	657	491	247	235	330	995	704	355	449	242	810	1099	405
967.8	2302	1547	623	683	489	247	235	331	969	715	325	474	238	808	1047	409
968.9	2299	1530	600	687	491	235	231	320	1005	719	338	487	201	809	1079	400
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972.3	2275	1570	625	688	511	243	223	321	1007	700	342	490	249	831	1108	405
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974.6	2309	1633	619	663	493	252	239	307	1014	710	357	495	240	810	1111	397
975.8	2330	1600	624	708	504	246	241	326	1032	719	350	475	229	836	1106	404
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981.4	2371	1602	612	718	511	236	215	327	1024	730	328	488	250	869	1104	414
982.6	2405	1650	619	681	493	243	242	333	983	737	334	495	227	857	1087	407
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984.8	2349	1630	619	686	502	243	238	319	1041	727	351	481	252	865	1099	403
986.0	2331	1631	605	669	503	239	231	334	1041	719	337	484	219	851	1141	393
987.1	2325	1646	635	703	519	245	240	323	1031	737	328	480	246	843	1114	409
988.2	2347	1619	628	723	508	249	243	317	1075	706	340	475	239	833	1102	393
989.4	2338	1657	613	678	512	253	252	332	1035	735	336	498	254	855	1103	404
990.5	2325	1628	619	690	513	238	235	335	1021	740	333	487	240	872	1116	407
991.6	2306	1631	637	713	521	246	243	324	1033	740	325	487	255	848	1124	397
992.8	2333	1625	625	685	499	243	245	330	1027	742	319	477	242	849	1115	397
993.9	2328	1632	640	700	511	254	229	325	1042	724	337	490	237	859	1121	403
995.0	2349	1604	638	698	507	243	234	348	1020	733	327	485	237	831	1104	400
996.2	2323	1583	637	708	484	260	245	337	1047	739	309	510	250	868	1117	418
997.3	2325	1644	628	711	526	243	237	320	1027	738	325	502	245	850	1134	412
998.4	2302	1607	610	683	513	249	251	337	1025	735	339	487	239	827	1105	397
999.6	2279	1639	620	689	497	255	239	329	1037	728	331	475	236	843	1146	394
1000.7	2383	1601	637	704	495	252	240	331	1061	725	313	490	251	849	1117	407
1001.8	2337	1628	621	693	514	258	239	323	1011	723	325	501	243	846	1097	404
1003.0	2340	1621	642	716	504	261	239	329	1033	718	325	492	239	864	1120	419
1004.1	2340	1653	639	693	513	249	237	321	1045	751	331	494	255	866	1135	393
1005.2	2355	1652	645	729	487	268	227	344	1041	740	319	495	239	854	1127	407
1006.4	2328	1662	653	703	513	259	254	323	1000	754	341	514	237	859	1123	411
1007.5	2331	1627	633	713	494	261	245	328	1002	739	319	497	225	855	1135	396
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1012.0	2361	1637	643	698	501	255	251	353	1031	743	327	511	245	867	1093	403
1013.2	2331	1686	640	722	530	256	241	326	1057	743	325	487	245	857	1146	399
1014.3	2338	1631	632	712	493	262	243	341	1021	765	321	491	247	845	1095	383
1015.4	2329	1659	645	711	491	259	256	342	1031	747	325	517	249	851	1100	393
1016.5	2347	1658	651	733	518	264	259	337	1021	732	318	507	251	841	1148	388
1017.7	2347	1636	631	715	501	264	243	336	1061	757	329	493	243	857	1132	398
1018.8	2332	1672	625	717	524	278	237	337	1037	721	319	507	259	855	1142	391
1019.9	2366	1666	647	731	497	271	255	351	1021	759	329	533	255	845	1148	393
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1025.6	2350	1666	651	703	536	284	264	340	1060	763	326	533	262	847	1137	393
1026.7	2336	1694	630	729	526	283	251	353	1009	741	309	511	260	867	1146	401
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1029.0	2348	1676	633	709	501	278	273	365	1049	747	303	519	271	869	1	

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1049.2	2355	1718	659	737	485	311	287	388	1063	773	317	556	269	890	1158	409
1050.3	2378	1726	668	745	507	327	295	389	1061	753	311	527	279	892	1161	365
1051.5	2319	1722	650	733	512	312	296	385	1057	797	311	560	280	876	1154	393
1052.6	2390	1724	665	747	524	313	298	374	1058	778	301	543	277	895	1179	393
1053.7	2338	1744	675	718	521	314	301	403	1061	776	309	558	280	862	1191	397
1054.8	2352	1717	656	715	504	313	315	375	1051	777	295	572	269	883	1184	393
1056.0	2385	1703	659	722	526	316	283	389	1057	778	323	541	283	885	1175	377
1057.1	2381	1714	675	727	529	305	285	395	1053	787	309	561	283	851	1156	367
1058.2	2346	1711	677	773	514	303	282	383	1037	776	319	565	287	883	1141	392
1059.3	2364	1743	663	734	498	301	301	398	1033	799	309	557	276	863	1146	395
1060.5	2368	1720	659	742	520	304	289	383	1041	790	291	575	278	892	1140	393
1061.6	2328	1742	675	745	495	309	296	386	1067	749	304	544	287	876	1137	372
1062.7	2354	1716	687	740	531	315	281	393	1029	781	299	574	280	866	1200	391
1063.8	2348	1752	679	742	526	309	307	383	1035	779	295	551	276	873	1151	383
1064.9	2364	1768	681	738	523	316	292	367	1058	787	289	554	275	871	1160	396
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1067.2	2347	1702	677	727	533	319	292	381	1070	784	293	560	267	872	1126	377
1068.3	2313	1735	693	743	510	295	293	381	1073	802	293	567	288	865	1174	373
1069.4	2314	1706	676	747	530	317	305	403	1082	787	301	535	278	879	1147	393
1070.5	2353	1715	658	761	531	314	287	383	1077	799	305	564	286	856	1178	353
1071.7	2343	1713	669	709	542	297	293	394	1075	777	296	575	263	862	1166	380
1072.8	2353	1738	663	757	510	327	297	397	1053	795	311	558	281	860	1180	399
1073.9	2328	1714	671	778	533	325	293	379	1049	769	299	557	282	896	1130	387
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1076.1	2384	1728	683	731	516	297	296	388	1084	790	305	558	283	865	1193	382
1077.3	2287	1712	682	753	501	324	300	400	1068	779	297	567	273	862	1150	383
1078.4	2314	1748	666	727	525	299	310	381	1056	792	291	549	279	891	1200	379
1079.5	2298	1742	656	749	535	318	287	395	1093	789	296	547	286	887	1146	373
1080.6	2346	1768	667	743	516	319	312	387	1042	766	299	567	297	883	1137	387
1081.7	2271	1722	660	749	521	305	291	382	1082	768	290	565	280	869	1178	379
1082.9	2346	1751	687	758	520	315	304	397	1038	763	307	553	257	891	1177	398
1084.0	2342	1740	669	759	518	309	307	406	1048	790	298	564	287	896	1209	395
1085.1	2321	1751	677	751	523	320	298	396	1069	755	295	570	297	892	1165	372
1086.2	2335	1745	673	762	522	315	293	396	1049	779	299	567	277	853	1155	386
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1088.5	2336	1708	650	741	517	312	291	395	1076	779	295	555	290	868	1177	391
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1090.7	2357	1722	687	749	520	307	279	387	1051	772	291	571	282	870	1160	383
1091.8	2324	1745	665	745	514	315	289	381	1060	791	290	539	280	860	1178	379
1092.9	2308	1730	679	757	504	314	295	399	1031	772	281	540	302	872	1135	378
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1104.1	2347	1763	696	745	537	326	298	399	1039	803	306	561	293	843	1164	369
1105.2	2326	1768	691	762	528	319	309	395	1037	788	287	564	294	853	1221	396
1106.3	2331	1761	664	771	517	317	305	405	1077	822	279	579	282	881	1164	386
1107.4	2362	1769	693	762	538	329	309	393	1054	822	303	559	293	890	1166	384
1108.5	2354	1808	690	741	533	327	311	396	1079	796	290	571	296	883	1178	372
1109.7	2349	1791	701	751	538	325	311	394	1077	795	299	551	295	873	1201	380
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1113.0	2348	1776	688	780	514	330	293	395	1100	785	308	553	299	892	1177	384
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1120.8	2378	1788	695	788	535	324	294	403	1105	832	294	580	302	889	1209	386
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1125.2	2342	1780	697	761	515	319	305	398	1083	811	313	533	306	863	1206	403
1126.4	2401	1804	727	792	537	299	295	397	1111	855	304	555	288	837	1174	382
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1133.0	2433	1851	692	814	545	311	293	381	1103	828	309	564	295	869	1240	399
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1139.7	2371	1858	737	791	531	315	293	387	1095	834	306	573	290	897	1182	403
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1171,8	2371	1822	766	817	567	334	300	393	1092	875	298	591	309	891	1260	403
1172,9	2337	1817	735	836	543	309	311	415	1052	876	311	586	313	907	1207	395
1174,0	2315	1851	744	812	563	343	311	419	1096	852	304	581	315	896	1213	393
1175,1	2349	1864	751	803	577	322	317	408	1101	881	306	585	324	901	1265	388
1176,2	2358	1864	743	840	531	322	317	402	1110	873	312	591	325	891	1222	409
1177,3	2360	1871	751	845	567	339	320	428	1108	865	289	589	328	879	1236	414
1178,4	2341	1826	734	839	561	339	308	425	1070	855	299	587	319	900	1236	403
1179,5	2375	1844	763	809	548	329	310	410	1093	886	295	585	329	877	1236	398
1180,6	2320	1862	738	827	559	343	325	403	1116	871	314	598	328	883	1231	406
1181,7	2368	1852	742	813	577	331	319	420	1103	879	291	590	317	897	1261	413
1182,8	2339	1829	769	818	575	351	335	433	1089	876	289	603	327	907	1248	394
1183,9	2383	1871	741	813	589	331	325	422	1100	903	298	585	324	913	1248	385
1185,0	2349	1855	752	807	564	347	325	425	1093	881	292	584	338	897	1231	422
1186,1	2378	1890	755	830	560	337	327	432	1117	897	313	612	329	893	1260	413
1187,2	2362	1896	759	819	582	346	325	426	1098	910	298	584	337	920	1238	419
1188,3	2337	1865	769	813	545	348	329	435	1063	906	306	605	331	912	1254	413
1189,4	2317	1867	739	822	569	352	342	427	1113	892	297	589	329	888	1262	408



UNIVERSITY of the  
WESTERN CAPE



## Appendix B.5 – Rutile and anatase values

### B.5.1: Anatase values from the RRUFF Database.

Anatase							
Intensity (A.U)	Raman shift (cm <sup>-1</sup> )						
79.8	0.0	272.7	19854.3	465.5	52075.3	658.4	43161.4
81.8	24506.0	274.6	20663.0	467.5	54396.3	660.3	40159.5
83.7	21745.6	276.6	21516.0	469.4	57362.4	662.2	37616.0
85.6	22973.0	278.5	22404.0	471.3	60936.5	664.2	35579.0
87.6	27667.7	280.4	23434.1	473.3	65316.9	666.1	33747.5
89.5	33488.4	282.3	24686.5	475.2	70641.2	668.0	32091.5
91.4	39967.7	284.3	25969.5	477.1	76832.8	670.0	30651.3
93.3	47104.6	286.2	27265.2	479.0	83838.2	671.9	29468.3
95.3	51325.8	288.1	28575.6	481.0	91667.1	673.8	28457.9
97.2	57037.5	290.1	29917.6	482.9	100062.8	675.7	27640.3
99.1	64898.4	292.0	31270.5	484.8	109018.9	677.7	26915.7
101.1	74631.6	293.9	32597.8	486.8	118521.9	679.6	26213.5
103.0	85929.9	295.8	33915.4	488.7	128245.0	681.5	25580.6
104.9	100319.1	297.8	35146.4	490.6	139072.6	683.5	25074.7
106.8	114162.1	299.7	36291.3	492.5	150597.3	685.4	24671.7
108.8	128318.9	301.6	37355.9	494.5	164320.4	687.3	24354.3
110.7	141123.3	303.6	38330.8	496.4	180471.8	689.2	24101.8
112.6	151551.5	305.5	39230.2	498.3	199614.7	691.2	23757.0
114.6	159764.3	307.4	40083.0	500.3	222624.5	693.1	23323.3
116.5	167231.1	309.3	40879.3	502.2	249479.8	695.0	22916.5
118.4	171341.8	311.3	41570.2	504.1	280349.1	697.0	22554.4
120.3	179299.8	313.2	42136.4	506.0	316440.9	698.9	22113.2
122.3	190208.3	315.1	42633.4	508.0	351108.9	700.8	21599.3
124.2	207709.6	317.1	43062.3	509.9	387059.4	702.7	20954.7
126.1	232733.7	319.0	43418.9	511.8	413337.5	704.7	20291.1
128.1	265372.8	320.9	43636.6	513.8	427505.4	706.6	19622.9
130.0	308435.7	322.8	43831.9	515.7	428961.3	708.5	18947.0
131.9	360879.2	324.8	44066.5	517.6	415390.8	710.5	18299.7
133.8	425146.8	326.7	44354.9	519.5	392014.5	712.4	17697.6
135.8	517873.3	328.6	44800.6	521.5	362200.6	714.3	17137.9
137.7	605247.9	330.6	45368.5	523.4	327570.9	716.2	16620.0
139.6	678389.8	332.5	46209.5	525.3	293823.9	718.2	16140.3
141.6	731801.9	334.4	47327.0	527.3	260925.6	720.1	15695.2
143.5	722136.4	336.3	48748.9	529.2	231294.2	722.0	15284.5
145.4	638021.8	338.3	50435.7	531.1	205080.1	724.0	14903.0
147.3	538485.9	340.2	52478.0	533.0	182089.8	725.9	14552.1
149.3	415060.1	342.1	54897.5	535.0	162612.6	727.8	14238.1
151.2	302016.3	344.0	57732.7	536.9	145839.7	729.7	13961.2
153.1	217581.5	346.0	61270.5	538.8	131832.2	731.7	13747.1
155.1	158486.5	347.9	65447.5	540.8	119722.2	733.6	13606.8
157.0	115487.7	349.8	70385.7	542.7	109108.0	735.5	13486.4
158.9	89726.6	351.8	76006.5	544.6	99886.6	737.5	13369.4
160.8	70363.7	353.7	82588.1	546.5	92014.1	739.4	13292.6
162.8	57891.5	355.6	90150.8	548.5	85446.0	741.3	13260.0
164.7	48893.3	357.5	98740.1	550.4	79668.8	743.2	13271.3
166.6	42210.5	359.5	108468.5	552.3	74690.0	745.2	13336.2
168.6	37331.7	361.4	119306.8	554.3	70304.6	747.1	13432.8
170.5	33394.9	363.3	131055.8	556.2	66535.7	749.0	13533.2
172.4	30426.5	365.3	143610.8	558.1	63230.7	751.0	13678.0
174.3	27911.0	367.2	157488.2	560.0	60466.8	752.9	13904.6
176.3	25846.4	369.1	172584.5	562.0	58025.3	754.8	14190.0
178.2	24177.3	371.0	189504.6	563.9	55885.1	756.7	14522.1
180.1	22865.8	373.0	207570.1	565.8	53989.9	758.7	14885.5
182.1	21877.5	374.9	228335.7	567.8	52338.5	760.6	15233.3
184.0	21183.4	376.8	252740.0	569.7	50873.6	762.5	15594.5
185.9	20791.8	378.8	280794.3	571.6	49494.4	764.5	16089.0
187.8	20708.2	380.7	313003.9	573.5	48213.9	766.4	16709.3
189.8	21026.1	382.6	349055.6	575.5	47121.6	768.3	17281.1
191.7	21431.1	384.5	387772.8	577.4	46226.7	770.2	17780.5
193.6	22222.4	386.5	431117.8	579.3	45370.6	772.2	18343.2
195.6	22710.6	388.4	470864.9	581.3	44508.4	774.1	18991.8
197.5	22219.5	390.3	510526.7	583.2	43754.4	776.0	19664.5
199.4	20840.0	392.3	539376.7	585.1	43086.7	778.0	20384.0
201.3	19256.7	394.2	553641.3	587.0	42583.8	779.9	21084.0
203.3	17350.6	396.1	552570.4	589.0	42247.7	781.8	21803.7
205.2	15788.3	398.0	531878.8	590.9	42113.3	783.7	22427.9
207.1	14849.5	400.0	494142.5	592.8	42203.3	785.7	22915.6
209.1	14195.3	401.9	446677.1	594.8	42516.7	787.6	23318.0
211.0	13751.0	403.8	387264.5	596.7	43035.5	789.5	23684.2
212.9	13466.5	405.8	330884.5	598.6	43818.8	791.5	23932.0
214.8	13224.2	407.7	278291.4	600.5	44771.7	793.4	23987.8
216.8	13021.8	409.6	232650.9	602.5	46044.0	795.3	23924.6
218.7	12880.3	411.5	195677.3	604.4	47512.4	797.2	23820.6
220.6	12833.5	413.5	165591.2	606.3	49176.4	799.2	23622.3
222.6	12811.4	415.4	141865.5	608.2	51030.0	801.1	23231.9
224.5	12803.4	417.3	123558.6	610.2	53120.5	803.0	22723.3
226.4	12803.9	419.3	108707.7	612.1	55304.6	805.0	22236.7
228.3	12803.5	421.2	97347.3	614.0	57425.8	806.9	21753.7
230.3	12804.8	423.1	87810.8	616.0	59792.9	808.8	21198.2
232.2	12820.7	425.0	80418.9	617.9	62469.3	810.7	20576.6
234.1	12853.0	427.0	74058.1	619.8	65558.2	812.7	19964.8
236.1	12899.6	428.9	68661.4	621.7	69154.8	814.6	19360.4
238.0	12950.8	430.8	64063.3	623.7	73214.2	816.5	18794.8
239.9	13022.8	432.8	60273.8	625.6	77822.8	818.5	18265.1
241.8	13122.3	434.7	57198.3	627.5	82896.6	820.4	17785.4
243.8	13252.7	436.6	54743.3	629.5	87924.3	822.3	17364.4
245.7	13414.1	438.5	52844.3	631.4	93209.2	824.2	16964.8
247.6	13604.2	440.5	51259.5	633.3	97183.3	826.2	16587.4
249.6	13844.3	442.4	49999.9	635.2	100303.5	828.1	16224.6
251.5	14158.0	444.3	48980.2	637.2	101237.3	830.0	15873.8
253.4	14496.2	446.3	48228.7	639.1	99718.8	832.0	15542.9
255.3	14820.8	448.2	47636.5	641.0	96315.9	833.9	15227.3
257.3	15184.0	450.1	47156.5	643.0	90527.3	835.8	14949.7
259.2	15661.7	452.0	46853.2	644.9	83815.0	837.7	14759.7
261.1	16108.6	454.0	46755.1	646.8	76322.3	839.7	14549.0
263.1	16599.5	455.9	46883.5	648.7	68958.1	841.6	14239.4
265.0	17188.3	457.8	47246.5	650.7	62301.6	843.5	13936.3
266.9	17713.1	459.8	47848.7	652.6	56371.8	845.5	13721.3
268.8	18368.4	461.7	48845.3	654.5	51231.7	847.4	13513.9
270.8	19093.0	463.6	50194.2	656.5	46864.1	849.3	13230.4

851,2	12937,3	1044,1	3170,1
853,2	12716,0	1046,0	3178,6
855,1	12525,9	1047,9	3163,7
857,0	12302,3	1049,9	3096,2
859,0	12066,6	1051,8	3055,1
860,9	11873,8	1053,7	3071,0
862,8	11642,8	1055,7	3059,6
864,7	11479,5	1057,6	3004,8
866,7	11222,6	1059,5	2948,2
868,6	11013,7	1061,4	2884,8
870,5	10840,5	1063,4	2834,2
872,4	10617,0	1065,3	2796,6
874,4	10343,8	1067,2	2775,3
876,3	10074,0	1069,2	2781,8
878,2	9811,1	1071,1	2772,2
880,2	9564,5	1073,0	2736,7
882,1	9334,2	1074,9	2709,2
884,0	9129,8	1076,9	2698,6
885,9	8963,4	1078,8	2667,8
887,9	8780,9	1080,7	2606,5
889,8	8554,5	1082,7	2557,7
891,7	8360,6	1084,6	2522,2
893,7	8232,9	1086,5	2512,1
895,6	8099,4	1088,4	2537,4
897,5	7946,1	1090,4	2526,1
899,4	7792,8	1092,3	2469,4
901,4	7627,9	1094,2	2420,2
903,3	7488,7	1096,2	2380,6
905,2	7420,5	1098,1	2350,2
907,2	7331,5	1100,0	2329,2
909,1	7152,3	1101,9	2320,8
911,0	6984,9	1103,9	2325,7
912,9	6899,0	1105,8	2292,0
914,9	6822,1	1107,7	2284,2
916,8	6698,8	1109,7	2265,0
918,7	6577,6	1111,6	2233,0
920,7	6499,6	1113,5	2219,9
922,6	6434,5	1115,4	2167,3
924,5	6361,5	1117,4	2133,9
926,4	6283,1	1119,3	2117,9
928,4	6207,6	1121,2	2107,3
930,3	6123,6	1123,2	2100,5
932,2	6005,1	1125,1	2094,8
934,2	5880,3	1127,0	2084,5
936,1	5799,1	1128,9	2041,4
938,0	5733,5	1130,9	1980,8
939,9	5618,6	1132,8	1944,1
941,9	5488,6	1134,7	1925,2
943,8	5441,4	1136,7	1917,9
945,7	5321,2	1138,6	1912,4
947,7	5330,2	1140,5	1878,0
949,6	5164,5	1142,4	1841,3
951,5	5082,6	1144,4	1860,2
953,4	5069,2	1146,3	1889,7
955,4	5052,1	1148,2	1862,3
957,3	5029,5	1150,1	1816,0
959,2	4986,2	1152,1	1792,7
961,2	4923,7	1154,0	1777,5
963,1	4865,9	1155,9	1752,8
965,0	4812,2	1157,9	1731,8
966,9	4756,7	1159,8	1731,9
968,9	4699,3	1161,7	1731,7
970,8	4618,9	1163,6	1715,4
972,7	4564,6	1165,6	1694,4
974,7	4508,2	1167,5	1665,1
976,6	4441,6	1169,4	1649,5
978,5	4410,1	1171,4	1679,2
980,4	4357,7	1173,3	1691,5
982,4	4318,2	1175,2	1645,2
984,3	4294,9	1177,1	1605,4
986,2	4236,2	1179,1	1591,2
988,2	4135,9	1181,0	1587,5
990,1	4066,9	1182,9	1593,2
992,0	4038,1	1184,9	1605,4
993,9	4010,0	1186,8	1632,0
995,9	3979,3	1188,7	1647,0
997,8	3928,4	1190,6	1644,0
999,7	3852,0	1192,6	1640,6
1001,7	3789,1	1194,5	1642,5
1003,6	3745,3	1196,4	1626,1
1005,5	3712,6	1198,4	1582,3
1007,4	3691,1	1200,3	1569,9
1009,4	3674,9		
1011,3	3668,1		
1013,2	3637,9		
1015,2	3570,2		
1017,1	3522,1		
1019,0	3505,0		
1020,9	3495,3		
1022,9	3497,8		
1024,8	3480,3		
1026,7	3425,3		
1028,7	3390,8		
1030,6	3395,1		
1032,5	3389,8		
1034,4	3368,5		
1036,4	3342,0		
1038,3	3313,3		
1040,2	3275,1		
1042,2	3211,2		

## B.5.2: Rutile values from the RRUFF Database.

Rutile									
Intensity (A.U)	Raman shift (cm <sup>-1</sup> )								
165,1	1616,1	356,0	1841,5	548,9	2425,2	741,7	2319,9	934,6	2118,8
167,0	1646,8	358,0	1852,0	550,8	2448,5	743,7	2308,7	936,5	2117,1
169,0	1663,3	359,9	1854,7	552,7	2468,8	745,6	2292,3	938,4	2117,9
170,9	1674,9	361,8	1853,2	554,7	2499,0	747,5	2274,9	940,4	2121,0
172,8	1689,1	363,7	1852,0	556,6	2549,3	749,4	2259,0	942,3	2126,5
174,8	1704,9	365,7	1850,0	558,5	2615,3	751,4	2244,0	944,2	2138,7
176,7	1724,5	367,6	1850,0	560,5	2679,9	753,3	2223,1	946,1	2146,9
178,6	1753,1	369,5	1852,9	562,4	2736,2	755,2	2187,5	948,1	2149,1
180,5	1790,4	371,5	1858,7	564,3	2796,3	757,2	2157,3	950,0	2147,1
182,5	1817,0	373,4	1868,1	566,2	2867,4	759,1	2144,9	951,9	2141,9
184,4	1822,3	375,3	1882,0	568,2	2954,3	761,0	2149,9	953,9	2131,0
186,3	1815,4	377,2	1899,5	570,1	3038,5	762,9	2150,2	955,8	2126,4
188,3	1812,6	379,2	1920,2	572,0	3112,6	764,9	2140,1	957,7	2139,3
190,2	1818,2	381,1	1947,3	574,0	3185,7	766,8	2128,2	959,6	2155,8
192,1	1822,9	383,0	1972,7	575,9	3269,5	768,7	2119,1	961,6	2159,5
194,0	1822,3	385,0	1995,7	577,8	3377,5	770,7	2113,8	963,5	2144,6
196,0	1814,2	386,9	2015,9	579,7	3469,7	772,6	2105,9	965,4	2137,1
197,9	1810,0	388,8	2028,6	581,7	3542,4	774,5	2091,3	967,4	2147,1
199,8	1812,9	390,7	2023,8	583,6	3593,2	776,4	2076,7	969,3	2161,8
201,8	1821,9	392,7	2016,7	585,5	3615,9	778,4	2066,5	971,2	2170,3
203,7	1830,4	394,6	2020,2	587,4	3593,0	780,3	2060,9	973,1	2169,5
205,6	1839,9	396,5	2041,5	589,4	3563,3	782,2	2057,1	975,1	2169,4
207,5	1847,7	398,5	2056,3	591,3	3542,2	784,2	2059,8	977,0	2165,8
209,5	1852,6	400,4	2052,7	593,2	3529,8	786,1	2060,8	978,9	2166,1
211,4	1854,7	402,3	2037,3	595,2	3520,8	788,0	2050,8	980,9	2181,2
213,3	1852,4	404,2	2029,8	597,1	3507,4	789,9	2016,2	982,8	2210,6
215,3	1842,9	406,2	2040,4	599,0	3500,7	791,9	1997,3	984,7	2224,2
217,2	1827,2	408,1	2052,1	600,9	3512,8	793,8	2009,1	986,6	2202,4
219,1	1812,8	410,0	2054,6	602,9	3553,3	795,7	2031,4	988,6	2179,2
221,0	1798,9	412,0	2044,5	604,8	3588,2	797,7	2041,1	990,5	2174,6
223,0	1787,7	413,9	2041,3	606,7	3607,5	799,6	2033,8	992,4	2191,5
224,9	1781,2	415,8	2054,7	608,7	3618,9	801,5	2029,8	994,4	2201,6
226,8	1783,4	417,7	2077,0	610,6	3636,0	803,4	2038,0	996,3	2197,7
228,8	1786,8	419,7	2095,0	612,5	3672,5	805,4	2051,4	998,2	2194,8
230,7	1791,6	421,6	2102,2	614,4	3695,9	807,3	2060,0	1000,1	2203,5
232,6	1797,9	423,5	2111,4	616,4	3694,3	809,2	2059,8	1002,1	2222,1
234,5	1802,7	425,5	2127,3	618,3	3668,3	811,2	2059,0	1004,0	2235,1
236,5	1803,9	427,4	2149,9	620,2	3644,4	813,1	2056,6	1005,9	2238,8
238,4	1804,2	429,3	2171,9	622,2	3623,6	815,0	2053,7	1007,9	2241,7
240,3	1807,5	431,2	2194,5	624,1	3603,6	816,9	2051,6	1009,8	2242,9
242,3	1816,5	433,2	2214,6	626,0	3585,4	818,9	2048,3	1011,7	2245,1
244,2	1824,3	435,1	2228,8	627,9	3569,9	820,8	2050,0	1013,6	2257,6
246,1	1828,7	437,0	2224,5	629,9	3544,1	822,7	2064,0	1015,6	2290,6
248,0	1829,5	439,0	2226,5	631,8	3497,5	824,7	2084,1	1017,5	2312,9
250,0	1827,8	440,9	2243,0	633,7	3445,1	826,6	2095,5	1019,4	2310,0
251,9	1821,6	442,8	2270,3	635,7	3401,3	828,5	2089,4	1021,4	2293,4
253,8	1813,3	444,7	2289,2	637,6	3374,3	830,4	2085,0	1023,3	2285,0
255,8	1807,4	446,7	2294,7	639,5	3342,4	832,4	2088,5	1025,2	2296,2
257,7	1805,6	448,6	2293,9	641,4	3299,4	834,3	2096,3	1027,1	2301,9
259,6	1803,7	450,5	2290,8	643,4	3251,2	836,2	2096,1	1029,1	2294,5
261,5	1799,5	452,5	2285,4	645,3	3206,2	838,2	2082,6	1031,0	2285,0
263,5	1791,2	454,4	2278,3	647,2	3163,8	840,1	2070,5	1032,9	2288,1
265,4	1786,8	456,3	2267,0	649,2	3124,9	842,0	2067,2	1034,9	2305,3
267,3	1789,2	458,2	2255,1	651,1	3086,0	843,9	2069,1	1036,8	2320,4
269,3	1795,7	460,2	2248,8	653,0	3047,2	845,9	2066,8	1038,7	2328,4
271,2	1800,2	462,1	2250,8	654,9	3017,7	847,8	2053,6	1040,6	2334,3
273,1	1801,4	464,0	2255,9	656,9	3006,6	849,7	2043,9	1042,6	2343,6
275,0	1802,5	466,0	2263,0	658,8	2994,8	851,6	2042,8	1044,5	2357,5
277,0	1804,3	467,9	2273,7	660,7	2975,8	853,6	2048,9	1046,4	2361,2
278,9	1806,2	469,8	2279,6	662,7	2950,7	855,5	2054,2	1048,4	2341,5
280,8	1810,7	471,7	2273,1	664,6	2917,4	857,4	2062,9	1050,3	2322,7
282,8	1821,5	473,7	2265,5	666,5	2867,7	859,4	2066,3	1052,2	2318,0
284,7	1834,4	475,6	2267,8	668,4	2817,4	861,3	2056,2	1054,1	2327,7
286,6	1841,7	477,5	2283,3	670,4	2777,4	863,2	2037,9	1056,1	2331,1
288,5	1837,6	479,5	2298,8	672,3	2754,2	865,1	2025,7	1058,0	2320,8
290,5	1832,4	481,4	2311,3	674,2	2732,2	867,1	2022,2	1059,9	2313,9
292,4	1830,4	483,3	2320,8	676,2	2706,2	869,0	2022,0	1061,9	2318,2
294,3	1832,8	485,2	2329,0	678,1	2683,0	870,9	2024,6	1063,8	2329,9
296,3	1836,4	487,2	2339,6	680,0	2670,3	872,9	2029,4	1065,7	2338,9
298,2	1844,8	489,1	2346,5	681,9	2672,9	874,8	2030,3	1067,6	2342,6
300,1	1854,0	491,0	2343,5	683,9	2673,0	876,7	2023,1	1069,6	2347,6
302,0	1856,6	493,0	2329,2	685,8	2665,7	878,6	2017,8	1071,5	2357,8
304,0	1844,3	494,9	2323,6	687,7	2651,9	880,6	2019,9	1073,4	2369,4
305,9	1831,1	496,8	2333,9	689,7	2636,2	882,5	2027,0	1075,4	2377,2
307,8	1822,5	498,7	2353,7	691,6	2617,3	884,4	2029,0	1077,3	2379,6
309,8	1819,6	500,7	2375,0	693,5	2598,8	886,4	2018,3	1079,2	2381,5
311,7	1819,2	502,6	2403,8	695,4	2582,6	888,3	2037,5	1081,1	2386,1
313,6	1824,0	504,5	2426,8	697,4	2568,5	890,2	2049,5	1083,1	2388,9
315,5	1831,4	506,5	2437,7	699,3	2553,2	892,1	2054,6	1085,0	2383,6
317,5	1835,5	508,4	2438,8	701,2	2533,7	894,1	2032,2	1086,9	2365,6
319,4	1831,9	510,3	2438,0	703,2	2516,4	896,0	2045,3	1088,9	2359,9
321,3	1827,7	512,2	2433,1	705,1	2506,3	897,9	2044,2	1090,8	2380,8
323,2	1826,7	514,2	2427,8	707,0	2508,6	899,9	2042,5	1092,7	2401,3
325,2	1830,0	516,1	2424,3	708,9	2497,6	901,8	2060,6	1094,6	2405,5
327,1	1828,7	518,0	2426,8	710,9	2458,1	903,7	2042,2	1096,6	2397,0
329,0	1813,8	520,0	2421,3	712,8	2417,1	905,6	2060,0	1098,5	2389,0
331,0	1793,0	521,9	2402,6	714,7	2398,6	907,6	2063,3	1100,4	2381,3
332,9	1782,6	523,8	2377,1	716,7	2404,7	909,5	2073,3	1102,4	2377,2
334,8	1794,3	525,7	2352,6	718,6	2407,9	911,4	2068,9	1104,3	2379,3
336,7	1807,1	527,7	2325,9	720,5	2399,6	913,4	2069,0	1106,2	2385,8
338,7	1812,7	529,6	2307,9	722,4	2387,2	915,3	2083,4	1108,1	2392,2
340,6	1811,0	531,5	2304,2	724,4	2377,3	917,2	2089,8	1110,1	2398,0
342,5	1810,9	533,5	2315,8	726,3	2373,5	919,1	2083,8	1112,0	2403,6
344,5	1816,8	535,4	2326,6	728,2	2366,5	921,1	2079,2	1113,9	2408,6
346,4	1825,4	537,3	2333,9	730,2	2350,1	923,0	2078,5	1115,8	2412,6
348,3	1830,5	539,2	2342,6	732,1	2330,6	924,9	2093,2	1117,8	2413,8
350,2	1825,1	541,2	2354,5	734,0	2321,4	926,9	2106,1	1119,7	2408,9
352,2	1822,1	543,1	2368,8	735,9	2326,5	928,8	2114,8	1121,6	2412,1
354,1	1827,7	545,0	2386,1	737,9	2330,3	930,7	2119,8	1123,6	2436,6
356,0	1841,5	547,0	2404,7	739,8	2327,8	932,6	2121,7	1125,5	2459,1