An investigation of the possible correlations between kimberlite lithophases and their indicator mineral compositions at Finsch Diamond Mine, Northern Cape Province, South Africa

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Dedication

I dedicate this thesis to my parents; namely, my father, Elatotswe Charles Thuntsi and my late mother, Kesekwaemang Mary Thuntsi. I will forever be grateful for their unwavering support, encouragement and unending love. You continue to inspire me!

Acknowledgements

The author would like to extend his sincere gratitude to the Julian Baring Scholarship Fund. This correlation study has elucidated key concepts in the use of heavy minerals, in relation to the descriptive geological nomenclature, in assessing the diamond potential and grade of the Finsch kimberlite. This study would have not been possible without funding from the scholarship. Andrew Rogers, the Principal: Mineral Resource Manager at Petra Diamonds Ltd, is also thanked for initiating this study and, sharing his extensive knowledge on the use of heavy minerals in assessing diamond potential and grade. Dr J. vA Robey is also thanked for his review of this dissertation, especially the explanations regarding the complex nature of kimberlite deposits, from partial melt to kimberlite pipe, through the assessment of various petrographic slides. The Diamond Sorters from Helam Mine and the Geology Assistants from Finsch Diamond Mine are also thanked, for assisting in the QC/QA picking of heavy mineral grains from sample concentrates. Christel Tinguely and Nicholas Laidler are also thanked for their assistance in the operation of the LA ICP-MS and Electron Microprobe facilities, respectively, housed at the University of Cape Town. I would also like to thank Associate Professor Phillip Janney for his constructive assessments, explanations and interpretations on all subjects pertained in this dissertation, especially the analyses approach and interpretation of various petrologic relationships observed in various comparison diagrams. Phillip's extensive knowledge on the geochemical evolution of the crust and mantle significantly contributed to the authors' construction of this dissertation. The author would further like to thank Associate Professor Janneys' contribution in sourcing additional funding which enabled the completion of this thesis. Lastly, I would like to thank my wife, Keitumetse Makume. Your perseverance, unending motivation and love enabled me to complete this study.

Abstract

Kimberlite indicator minerals (KIMs) are distinct mantle-derived minerals such as garnet, clinopyroxene, chromite and ilmenite, which are brought to surface by kimberlite volcanism. Kimberlite indicator minerals are mainly used in assessing the petrogenetic history of kimberlites, however KIMs are also used to infer the diamond potential of kimberlites in exploration programmes. Kimberlite indicator minerals recovered as heavy mineral concentrates show compositional variations in Cr_2O_3, CaO, MgO, FeO and TiO_2 that reflect the chemical, thermal and lithological environments in which they formed, as well as the probability of association with diamond. In this study, the petrogenetic history of the Finsch kimberlite is derived and mineral compositional attributes of heavy mineral concentrates are identified and, correlations (or lack thereof) are noted with the occurrence of diamonds, in association with a revised descriptive geological nomenclature of the Finsch kimberlite. This is achieved through the major and trace element analysis of KIMs separated as heavy mineral concentrates from kimberlite samples using a simplified characterization technique for KIMs. The results of this investigation suggest that the Finsch kimberlite is characterized by lithophase units with three textural types: pyroclastic (unit F1), hypabyssal (units F2 and F4) and transitional (units F2, F3, F5/F6 and F8), with the occurrence of melt segregationary textures in units F1, F2, F3, F5/F6 and F8, indicating emplacement of a volatile-rich magma that effectively transported and retained mantle xenocrystic material during emplacement. The petrological characteristics of the different Finsch kimberlite units are mainly attributed to the emplacement style and melt interaction of each unit. Garnet and clinopyroxene recovered from the various Finsch kimberlite units are particularly useful in associating the occurrence of KIM, to diamondiferous mantle rocks. The lithophase units of the Finsch kimberlite (except for unit F3, which contains very few garnets) are characterized by dominantly peridotitic garnets, with similar compositional ranges in terms of major element and trace element compositions (e.g., with typically low Zr and Y contents and sinusoidal to positively sloped REE patterns, with individual REE contents typically less than 10x chondrites). The diamond potential of the Finsch kimberlite is demonstrated through the occurrence of a significant proportion of the garnets falling in the G10 field as well as eclogitic garnets typically showing characteristics of Group 1 and diamondiferous eclogites. Clinopyroxene is mainly characterized by low Al_2O_3 contents and moderate Cr_2O_3 contents, that overlap in terms of Mg#, Ca# and Na content with lherzolitic clinopyroxene from granular lherzolites from Finsch and other kimberlites on the Kaapvaal craton. Single mineral thermobarometry for garnet and clinopyroxene yields a similar range of temperature and pressure values (800 – 1200°C vs. 850 – 1300°C and 2.2 – 5.5 vs. 2.2 – 6.5 for garnet and clinopyroxene, respectively). The petrological, geochemical and thermobarometric results from this study demonstrate that the Finsch kimberlite was emplaced by moderately to strongly pyroclastic eruptive processes that were effective in sampling and conveying mantle xenolithic material (and diamonds) to the near surface. Further, it sampled a lithologically heterogeneous, but dominantly peridotitic lithospheric mantle with minor eclogitic components. A significant proportion of the sampled KIM have compositions associated with diamonds (e.g., such as G10 garnets or with compositions overlapping with Finsch diamond inclusions) and pressure and temperature values lying within the diamond stability field. However, the majority of KIMs appear to be derived from lherzolitic lithologies and, likely originated from pressures too low to lie in the diamond stability field. Little overall correlation between kimberlite textural type and KIM populations and parageneses is apparent.

Key words: kimberlite indicator mineral, kimberlite phase/lithophase/unit, pyromagmaclast

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Chapter One – Introduction, aims and objectives

1.1 Introduction

Kimberlite is an ultramafic, alkaline, and volcanic to sub-volcanic rock of deep-seated origin that can contain significant quantities of diamond Mitchell (1986). Skinner and Clement (1979) highlight the importance of the relationships that exist between various mineral parageneses, especially those of peridotitic affinity, in relation to their formation and occurrence in kimberlite and, association to diamonds. It has been generally accepted that kimberlite acts as a transporting mechanism for a host of mantle-derived material (Grütter et al., 2004; Nowicki et al., 2007; Field et al., 2008), especially, but rarely, diamonds. Kimberlite Indicator Minerals (KIMs) are a set of distinct mantle-derived minerals, such as garnet, clinopyroxene and chromite, which are brought to surface by kimberlite and can be used to identify kimberlite intrusions and evaluate their diamond potential (Gurney and Zweistra, 1995). KIM are often coarse grained, resistant to weathering, have densities of greater than 3.2 g/cm^3 and are characterised by distinctive colours (Tardif and Crabtree, 2000). Kimberlite indicator minerals are analysed for major and trace element compositions, typically using the electron microprobe and laser ablation ICP-MS, respectively, to establish a mantle origin and to determine whether the mantle sampled by the kimberlite magma was diamond-bearing and, if so, its likely diamond grade.

The understanding of possible correlations between the occurrence of KIM in kimberlite, their compositions and the presence and grade of diamonds has advanced through the development of a number of petrological models (e.g., Gurney, 1984; Grütter et al., 2004; Nowicki et al., 2007). Kimberlite indicator minerals, in general (especially garnets) recovered in diamond exploration programs' show compositional variations in Cr_2O_3, CaO, MgO, FeO and TiO_2 that reflect the chemical, thermal and lithological environments in which they formed, as well as their probability of association with diamond (Grütter et al., 2004). Mantle-derived minerals (e.g., garnet, clinopyroxene, ilmenite and chromite) are minerals of choice used in exploration programs, due to their abundance in kimberlite and the ability of these minerals to survive weathering and dispersion on the Earth's surface (e.g., Griffin and Ryan, 1995; Grütter et al., 2004).

Kimberlite indicator minerals often have compositional characteristics distinct from their crustal equivalents. Peridotitic garnets are Cr-pyropes with compositions that do not overlap with crustal garnet types (Schulze, 2003). Eclogitic garnets are usually Mg- and Cr-poor pyrope-almandine – grossular solid solutions, which are rich in Fe and Ca and overlap with the compositions of certain crustal garnets (Schulze, 2003). Ilmenite, which is commonly of megacrystic origin, is reliably distinguished from non-kimberlitic varieties by its higher MgO and Cr_2O_3 contents (Wyatt et al., 2004). Chromite from kimberlite displays unusually high Cr_2O_3 and low TiO_2 compositions relative to that from layered mafic intrusions (Grütter and Apter, 1998). Clinopyroxene is usually more diopsidic compared to that in crustal ultramafic rocks e.g., augite in layered mafic intrusions (Nimis, 1998). These compositional characteristics of KIM are used in exploration programs to distinguish KIM from other minerals that may be present in a heavy mineral concentrate.

Diamond potential at Finsch was first inferred from the significant population of garnets, recovered from heavy mineral concentrate that plot in the chromium-rich, calcium-poor (i.e., G10) region of the Cr_2O_3 versus CaO plot of Gurney and Switzer (1973), where such compositions were previously only associated with inclusions in diamonds. Furthermore, peridotitic garnets from Finsch generally display low values of Ca# and intermediate Mg# values (Mg# and Ca# are defined by the atomic ratios Mg/[Mg + Fe] and Ca/[Ca + Mg], respectively, each multiplied by 100), therefore plotting approximately half-way between the Mg- and Fe- apices in the Ca-Mg-Fe ternary plot, similar to the Finsch diamond inclusions. The compositional characteristics identified for the Finsch peridotitic garnets, both in kimberlite and as inclusions in diamonds suggest that many garnets in the Finsch kimberlite coexisted with diamond (e.g., Gurney and Switzer, 1973; Gurney et al., 1979; Skinner, 1989) and these authors identified close source rock links between highly depleted peridotite (which implies high Mg#) and diamonds.

It would be very useful to identify and categorize the variety of mineral compositional characteristics of mantle-derived minerals, obtained as heavy mineral concentrates in each lithophase unit of the Finsch kimberlite. This categorization will delineate the temperature and pressure of origin and, the metasomatic grade and affinity (if any) of each mineral category identified. Furthermore, it would be useful to compare the proportion of each categorized mineralogical variety (i.e., mineral type and paragenesis), per lithophase unit, in an attempt to assess the types and proportions of mantle lithologies sampled by each lithophase unit. Such characterization would be beneficial to future mining expansion and production operations, as diamond grades could potentially be estimated and mapped in a kimberlite pipe based on the assemblage and composition of kimberlite indicator minerals sampled from its different lithophase units. Developing a methodology to this hypothesis is possible, for the reason that this study is characterizing KIMs from kimberlite units that have/are being mined with a known diamond grade. The definition of KIM in this study is: alteration-resistant mantle mineral grains that are transported to the surface by kimberlites. These include especially pyrope or pyrope-almandine garnet, clinopyroxene and chromite. In particular, this will include minerals of peridotitic paragenesis (e.g., from garnet harzburgite/dunite/lherzolite and chromite harzburgite), but also include minerals of eclogitic paragenesis (e.g., eclogitic garnet and omphacite) that may display compositional characteristics correlating with diamond potential. Kimberlite indicator minerals in this study have been obtained as heavy mineral concentrates, liberated from mantle xenoliths entrained in kimberlite and/or kimberlite samples. The benefits of using KIM in diamond exploration programmes include, but are not limited to:

- Compositional characteristics of KIM provide information on their source lithology and whether (or not) that lithology is associated with the occurrence of diamond (e.g., garnet harzburgite or Group I eclogite).
- The ability to geochemically discriminate KIM parageneses correlating geochemistry with diamond stability and preservation, such as equilibration temperatures and pressures and the type and extent of metasomatism.

A variety of sampling and laboratory methods are used in quantitatively evaluating the abundance and composition of KIM in kimberlite. These techniques are reviewed by Nowicki et al. (2007), including a summary of the comprehensive Mantle Mapper™ sampling technique developed by Mineral Services (Pty) Ltd, a subsidiary of Mineral Services Group. This approach focuses on robust KIM sampling techniques used for the selection, screening, splitting, visual and geochemical discrimination of the different types of KIM minerals and parageneses for analysis and interpretation. For this study, heavy mineral concentrates are typically generated from the crushing, screening and dense media separation of ≈20 kg kimberlite samples, where KIM are visually picked from the heavy mineral concentrate, with the goal of obtaining 60 grains per KIM type (e.g., 60 grains of purple garnet, 60 grains of pink garnet, 60 grains of chromite etc.), under a binocular microscope. These picked mineral grains are then mounted in epoxy resin discs and analysed for their major and trace element compositions (please see section 3.1) for a detailed description of the sampling and analysis approach for this study).

A number of classification schemes based on the chemical composition of KIM have been proposed and published, and many of these are summarised in the reviews by Nowicki et al. (2007) and Grütter et al. (2004). These provide simple and diagnostic methods of classifying different mineral parageneses and identifying probabilities of association with diamond for prospective diamond explorers. KIM geochemical classification schemes (e.g., Dawson and

Stephens, 1975; Danchin and Wyatt, 1979; Jago and Mitchell, 1989; Schulze, 2003; Grütter et al., 2004) are based on many KIM studies performed on kimberlite localities worldwide. These contributions base their approach on the inference that diamonds occur in kimberlites as xenocrysts derived from disaggregated mantle rocks that pre-date the age of emplacement of the kimberlite. The techniques based on these studies have been successfully applied to kimberlite provinces worldwide to effectively forecast the presence of diamonds in kimberlites.

Lithological units in a kimberlite pipe or diatreme refer to subdivisions of rocks which have characteristics that are distinct from adjacent rocks in the same intrusion. The terms: kimberlite phase (or a phase of kimberlite), kimberlite lithophase or kimberlite unit are equivalent in this study and, refer to a solidified batch of differentiated magma [i.e., solidified magma that has different characteristics from another batch of solidified magma – not to be confused with igneous differentiation] within a kimberlite volcano/diatreme. A differentiated batch of solidified magma represents a distinct lithological unit, based on gross texture (e.g., volcaniclastic versus hypabyssal), mineral content/proportion, macrocryst type, crustal xenolith content/proportion and diamond content/grades. On this basis, no association to other kimberlite magma types within the same kimberlite volcano/diatreme is possible.

1.2 Scope of study and objectives

This study investigates the relationships between kimberlite lithophases and their indicator mineral compositions. An examination of these relationships was carried out on all Finsch kimberlite lithophase units. A reclassification of the various Finsch kimberlite lithophases is also undertaken, using updated kimberlite classification schemes. The following are the key objectives of this work:

1. A reanalysis of the descriptive geological nomenclature and classification of the various Finsch kimberlite lithophases, using the classification and interpretation scheme developed by Scott Smith et al. (2013). This is achieved by a petrographic classification of the various Finsch kimberlite lithophases to identify their textural and petrogenetic characteristics, as little has been published on the petrography of the Finsch kimberlite (e.g., Fraser and Hawkesworth, 1992; Ekkerd et al., 2003). Chemical analysis of KIM, both in thin section and obtained by heavy mineral separation, provides useful constraints on the lithologies sampled by the kimberlite phases.
2. Collection of mineral major and trace element data for the KIM recovered from the various kimberlite lithophases. The major element mineral chemistry data set

generated is compared to published data sets and genetic classification schemes (e.g., Gurney and Switzer, 1973; Shee et al., 1982; Viljoen et al., 1992; Fipke et al., 1995; Griffin et al., 2003; Grütter et al., 2004; Nowicki et al., 2007; Gibson et al., 2008; Kobussen et al., 2009; Lazarov et al., 2009ab; Lazarov et al., 2012ab).

3. Characterization of the major and trace element contents of garnet and clinopyroxene KIM in terms of their paragenesis, metasomatic grade and thermobarometry. In detail, major and trace element contents of peridotitic garnets in the various KIM fractions are compared to those from diamond inclusions and other minerals associated with diamond (e.g., G10 garnets). Further, trace element criteria are used to characterise the melt enrichment or depletion and extent of metasomatism experienced by the garnets. Single mineral thermometry is applied to peridotitic garnet and clinopyroxene (e.g., Ryan et al., 1996; Nimis and Taylor, 2000) to determine the thermal gradients under which they equilibrated and their equilibration conditions relative to the diamond stability field. These findings are further compared to neighbouring kimberlites in the Barkly West cluster.
4. The composition of KIM obtained from every lithophase unit are compared. This statistical examination and comparison of the extent in heterogeneity (if any) of the different depth intervals or different mantle lithologies sampled by the Finsch kimberlite (e.g., harzburgite vs. lherzolite, or peridotite vs. eclogite) is important, as it is generally accepted that different phases of kimberlite in a diatreme should sample the mantle equally.

Chapter Two – The Finsch kimberlite

2.1 Location of the study area

The Finsch kimberlite pipe was discovered in 1960 by Mr Fincham and Mr Schwabel, two prospectors who were prospecting asbestos on the farm Brits, about 12 km from Daniëlskuil, in the Northern Cape Province of South Africa. These prospectors discovered a variety of KIM while in the area, leading to the discovery of the Finsch kimberlite pipe, which they named using the first three letters of each of their surnames (Ekkerd et al., 2003).

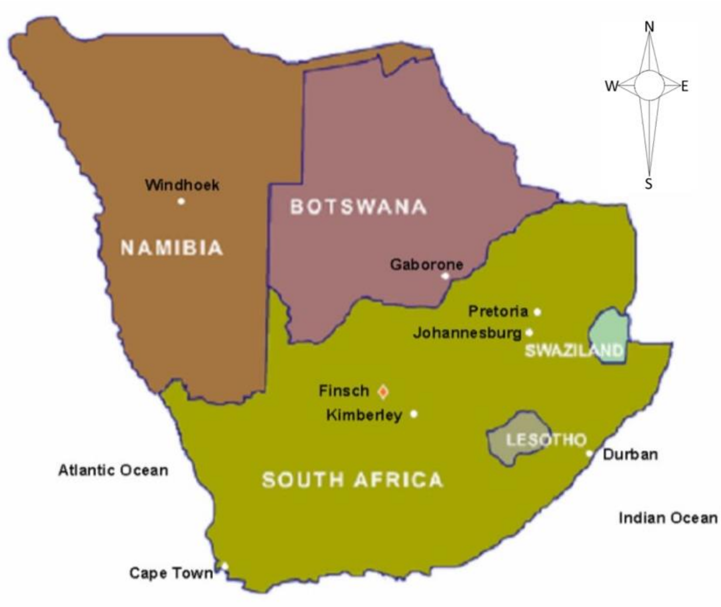


Figure 1: Locality map of Finsch Diamond Mine, Northern Cape Province, South Africa.

Finsch Diamonds was thus established in 1961 (Ekkerd et al., 2003). Finsch Diamond Mine is located about 160 km WNW of the city of Kimberley in the Northern Cape. The Lime Acres kimberlite cluster, comprising of the Finsch, Shone and Bowden kimberlite pipes, occur within the NE-SW striking Smuts Dyke Cluster (Ekkerd et al., 2003). The Smuts Dyke Cluster comprises of three dyke-sets, namely, the Botha, Bonza and Smuts dykes (Ekkerd et al., 2003).

The Shone and Bowden kimberlite pipes are smaller-sized kimberlite pipes discovered in the Lime Acres area and occur in the limestone quarry acquired by PPC Holdings. The Shone kimberlite pipe was the first pipe to be discovered in the area (in 1919). It is located on the Smuts Dyke Cluster and has a surface area of about 1.2 hectares (Skinner, 1985). The

Bowden kimberlite pipe, much smaller than the Shone pipe (0.45 hectares) and with an elongate shape, was discovered shortly afterward (Skinner, 1985). It is also located in the Smuts dyke cluster. The Finsch kimberlite pipe was found much later, but is significantly larger, with a surface area of 17.9 hectares (Ekkerd et al., 2003).

2.2 Local geological setting

The Lime Acres area is mainly underlain by the Ghaap Group of the Transvaal Supergroup (Hornsveld, 1977). The Ghaap Group lithologies form part of the thick Ghaap Plateau sub-basin, which spans about 200 Ma of sedimentary deposition. The basic type of sedimentary rocks that make up the Ghaap Group include predominant dolostone, with lesser limestone, banded iron formation (BIF), shale, chert and mudstone. The Ghaap Group is characterized by sediments that are mostly undeformed, which were deposited in the Griqualand West Basin (Fig. 2) during the late Archean to the early Paleoproterozoic Era (Beukes, 1986). Reviews of the volcanism, sedimentology and stratigraphy of the Griqualand West Basin are provided by Beukes (1986), Eriksson and Altermann (1998), and Moore et al., (2001).

At least two main subgroups of the Ghaap Group have been described by Barnett (1998) through core logging and stratigraphic mapping of the shaft and decline areas at Finsch Diamond Mine. These subgroups are the Asbestos Hills Subgroup and the Campbellrand Subgroup, which are both characterized by carbonate rocks (mainly dolostone and limestone) and chert and can be seen in the stratigraphic column in Figure 3, modified after Barnett (1998). The local country rock geology of the Finsch kimberlite is discussed using the stratigraphic column of Barnett (1998).

The Asbestos Hills Subgroup surrounds the surface outcrop of the Finsch pipe (1504 – 1440 meters above mean sea level – mamsl), is about 64.4 m thick, and consists of the Kuruman Formation and the Finsch Transition Member. The Kuruman Formation is 43.2 m thick and is mainly characterised by banded iron formation (BIF). The Kuruman Formation is conformably underlain by the Finsch Transition Member, which is characterized by chert, mudstone, black shale, jasper and magnetite (Barnett, 1998). These lithologies are about 21.2 m thick and are the lowermost marker beds of the Asbestos Hills Subgroup.

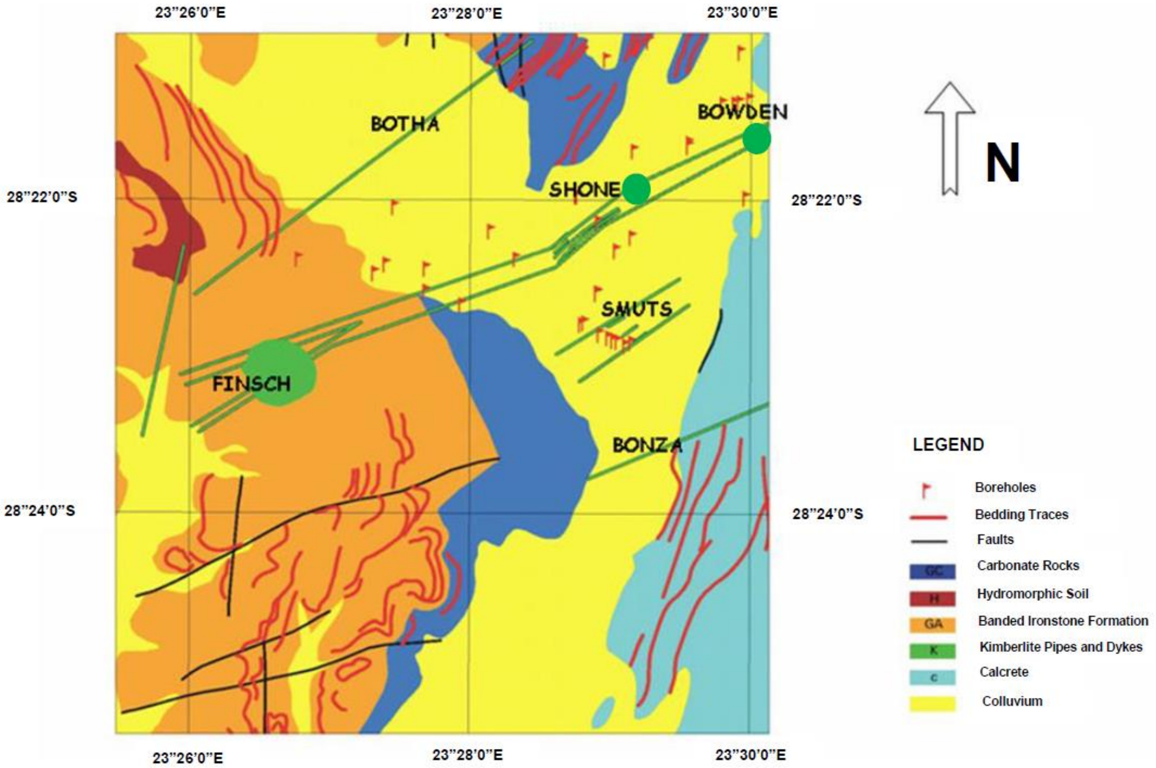


Figure 2: Local Geology of the Lime Acres area, Northern Cape Province, South Africa, modified after Ekkerd et al. (2003).

The Asbestos Hills Subgroup is then unconformably (by strike-slip displacement) underlain by the Campbellrand Subgroup (Barnett, 1998). The Campbellrand Subgroup is approximately 1156 m thick (1440.3 – 284.3 mamsl) and consists of seven formations identified by Barnett (1998). These formations, from top to bottom, are the Gamohaan Formation (145 m thick), the Koegelbeen Formation (388 m thick), the Lower Dolomite Member (258m thick), the Klippan Formation (29 m thick), the Papkuil Formation (263 m thick), the Klipfonteinheuwel Formation (48 m thick) and the Fairfield Formation (25 m thick).

The Gamohaan Formation is mainly characterised by laminated dolomite, carbonaceous shale and limestone, with domal stromatolitic textures. Occasional pyrite nodules have been observed in the mid to upper Gamohaan Formation (Barnett, 1998). The Koegelbeen Formation is mainly characterised by massive limestone, with laminae of carbon-rich shale. Cryptalgal limestone with zones of black chert were observed towards the base of the Koegelbeen formation (Barnett, 1998). The lowermost Kuruman Formation, Gamohaan Formation and Koegelbeen Formation have been subjected to strike slip faulting and normal faulting, striking in a northeast direction. According to Barnett (1998), the Koegelbeen Formation is mainly characterised by cryptalgal dolomites, with predominant thin laminae of carbon-rich dolomite and black chert and, is conformably underlain by the Lower Dolomite Member. The Klippan Formation is characterised by a light grey dolomite, with a stromatolite horizon of approximately 8.4 m thickness occurring at its base and, is conformably underlain by the Papkuil Formation. The Papkuil Formation is also characterised by a light grey dolomite, however with stromatolite zones observed throughout this unit. Several carbon–rich shale laminae are observed towards the base of the Papkuil Formation. The Papkuil Formation is conformably underlain by the Klipfonteinheuwel Formation and the Fairfield Formation, which both have top and bottom contacts characterised by black shale. Several bands of chert, dolomite and domal stromatolites have been observed between the two carbon-rich shale marker beds. The Fairfield Formation underlies the Klipfonteinheuwel Formation and is similar to it in terms of lithology, however with a few bands of chert and domal stromatolite textures present.

2.3 Geology of the Finsch kimberlite

The Finsch kimberlite pipe is the only kimberlite pipe in the immediate vicinity where banded ironstone of the Asbestos Hills Subgroup forms the country rock at surface. The nearby Shone and Bowden kimberlite pipes have dolostone as the country rock at surface (Skinner, 1985). The Finsch kimberlite has been classified as a Group 2 kimberlite (Smith, 1983a; Fraser and Hawkesworth, 1992), an orangeite by the classification of Mitchell (1995) and, a Kaapvaal lamproite by the classification of Scott-Smith et al. (2018). Like all orangeites, it is both ultrabasic (SiO_2 < 42 wt. %) and ultrapotassic (K_2O/Na_2O > 6.9) and has a mineralogy with abundant phlogopite, olivine, serpentine and diopside (Fraser and Hawkesworth, 1992). The Finsch kimberlite has a phlogopite Rb-Sr isochron age of 118 ± 2.8 Ma (Smith et al., 1985) and had a surface area of 17.9 hectares upon discovery. Although no geochemical or petrographic work has been conducted on the NE-SW striking kimberlite dykes (Botha, Smuts and Bonza) or on the Shone and Bowden kimberlite pipes, it is believed that these clusters of kimberlites are also Group 2 variety, due to their proximity to the Finsch kimberlite pipe (Skinner, 1985). Petrologic studies indicate that the Finsch kimberlite originated from a melt of a garnet peridotite mantle source, with evidence of minimal crustal contamination (Fraser and Hawkesworth, 1992). In this study, the term 'Finsch kimberlite' refers to all the kimberlite units forming the diatreme and any associated precursor kimberlite units. This is further divided into two spatial zones: 'the main pipe' refers to the kimberlite units that form the diatreme (Fig. 4) and, the 'precursor' kimberlite units refers to the irregular kimberlite intrusions, along the south-western and north-eastern periphery of the diatreme, that are truncated by the main pipe (Fig. 4).

Griqualand West Sequence (After SACS, 1980)			Transvaal Supergroup, Griqualand West basin (as of 1992; e.g. Beukes, 1987)		
Group	Formation	Member	Formation	Subgroup	Group
~2518 Ma	Ghaap Plateau	Lime Acres	Gamohaan	Nauga, Klein Naute	Ghaap
			Kogelbeen		
			Klippan		
			Papkuil		
			Klipfontein		
~2550 Ma		Fairfield	Fairfield		
		Ulco	Reivilo		
~2560 Ma	Schmidtsdrif	Monteville	Monteville	Schmidtsdrif	
~2590 Ma		Clearwater	Clearwater		
		Boomplaas	Boomplaas		
~2640 Ma	Vryburg	Vryburg			

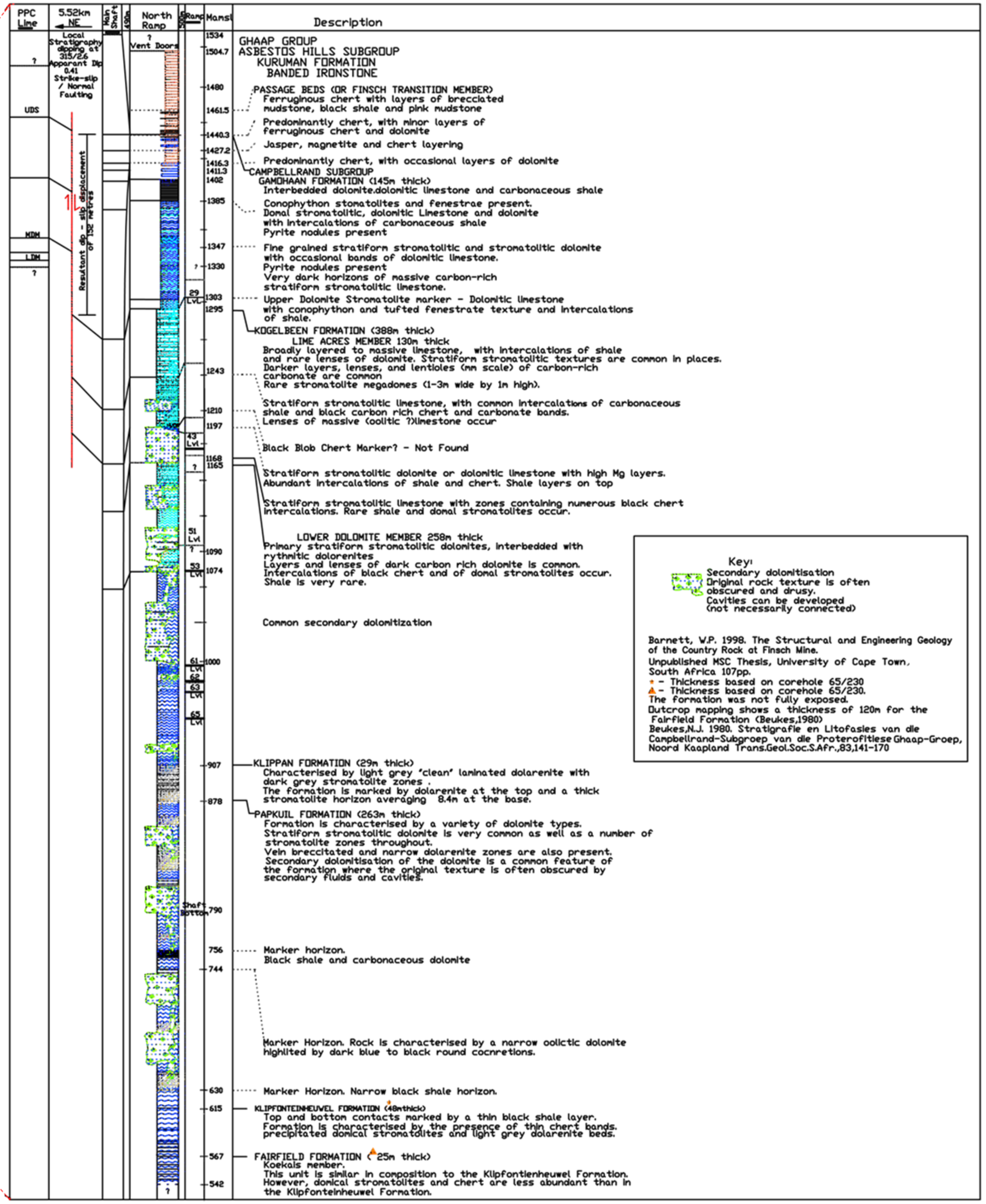


Figure 3: Stratigraphic column of the shaft and decline tunnel, Finsch Diamond Mine, South Africa – KLM Consulting, modified after Barnett (1998).

The main pipe, which is characterised by an elliptical cross section, consists of at least five kimberlite lithophases that are irregularly distributed in the diatreme, all representing volcanic and/or sub-volcanic events during the development and emplacement of the main pipe. At least three other irregular kimberlite intrusions have also been identified adjacent to the main pipe (Fig. 4) and are thought to be precursors (Howarth and Skinner, 2016), thus likely representing earlier irregular kimberlite intrusions. The various kimberlite lithophases identified in the main pipe and the associated precursor intrusions are named F1 to F8, based on the genetic interpretations of the various kimberlite lithophase features, including: the morphology of the intrusion, petrographic classification, volume and diamond grade (Ekkerd, 2003). Delineation of the various Finsch kimberlite phases was achieved by mine geologists through exploration drilling, bench mapping and underground mapping routines. Contacts between kimberlite lithophases are sometimes marked by rock discontinuities (e.g., mostly shear zones and/or faulting mapped between largely volcaniclastic and coherent units) but are mostly sharp (without fault/shear discontinuities) or can be gradational. The different kimberlite lithophases are identified by changes in the rock colour, xenolith content, structural discontinuities, mineral content (and proportions) and gross texture.

The F1 and F8 kimberlite lithophase are the most volumetrically significant units in the main pipe and occur next to each other, with the F8 truncating the F1 kimberlite lithophase (Lawless, 1998). The F1 and F8 kimberlite lithophases were originally thought to represent essentially the same kimberlite phase, based on macroscopic similarities – the F8 lithophase was thought to be a differentiated version of the F1 kimberlite (Ekkerd, 2005). However, recent underground tunnel mapping has indicated sharp lithological contacts and macroscopic differences between the F1 and F8 kimberlite units. The F7 kimberlite lithophase is localised within the F8 kimberlite and has experienced a greater degree of fractional crystallization than the F8 kimberlite lithophase (Ekkerd et al., 2003).

An internal irregular intrusion appears to have formed during the later stages of pipe development, known as the F2 kimberlite phase, as it intrudes at least two of the other Finsch kimberlite lithophases. The F2 kimberlite occurs near the centre of the main pipe and is hosted within the F1 and F8 kimberlite phases (Lawless, 1998). At least two separate ellipsoid-like lobes of the F2 kimberlite phase have been identified near the centre of the main pipe, during recent tunnel mapping routines (see Fig. 4 and 5). Finally, the sub-vertical F4 dykes mark the last intrusive activity in the main pipe, as these dykes crosscut all kimberlite phases in the main pipe (F1, F2 and F8). These dykes, however, pinch-out and transition into sills in some portions of the main pipe.

The irregular intrusive bodies located adjacent to the main pipe (Fig. 4) are known as the precursor kimberlite phases (termed the F5/F6 South-West Precursor (SWPC) and the F3 Precursor). These kimberlite phases are thought to represent the irregular or root-zone complex of a precursor kimberlite due to their complex geology and irregular shape at depth. The units (i.e., the F1, F2, F4, F7 and F8 kimberlite units that form the main part of diatreme) intruded this complex of irregular precursor kimberlites, thus truncating the outer lobes of the F5/F6 and F3 kimberlite phases with the main pipe. The F5/F6 and F3 kimberlite phases are thought to be the same phase of kimberlite (Ekkerd, 2005), however the F3 kimberlite appears to have experienced greater post-emplacement weathering, indicated by the friable nature of this unit. The F5/F6 precursor has a main lobe oriented in a northeast-southwest direction (Fig. 4), however several other lobes of the F5/F6 have become evident with depth through the extensive resource-drilling programme, namely: the south-precursor, the northeast precursor and north-west precursor (Fig. 5). Through drilling, several kimberlite dykes have been observed to crosscut the southwestern lobe of the F5/F6 precursor, thus indicating syn- or post-emplacement dyke intrusion.

The Finsch kimberlite magma, upon emplacement, detached large blocks of the Karoo and Transvaal Supergroup. These initially large 'floating blocks' in the main pipe became brecciated zones (agglomerates of kimberlite and country rock) possibly due to secondary and/or tertiary volcanic or sub-volcanic processes. These brecciated zones are now preserved in the main pipe as agglomerates of mudstone, dolerite, basalt and sandstone, respectively. A recreation of the palaeo-stratigraphy based on the upper crustal xenoliths suggests an estimated post-emplacement erosion of ≈1350 m, which implies an initial pipe surface area of ≈210 ha (Hanson et al., 2009).

In their study of the petrogenesis of the Finsch kimberlite, Fraser and Hawkesworth (1992) noted that the petrography of the Finsch kimberlite is characterised by a groundmass containing abundant phlogopite, diopside and secondary serpentine, with a macroporphyritic texture that is dominated by mainly anhedral xenocrysts and subhedral to euhedral phenocrysts of olivine and phlogopite. Of the textural relationships observed, Fraser and Hawkesworth (1992) noted that phenocrystal olivine and phlogopite were the initial mineral phases to crystallise in the various Finsch kimberlite phases, followed by microphenocrysts of spinel, perovskite and diopside (enclosed poikilitically by late-stage phlogopite laths). Groundmass phlogopite, diopside and apatite were the last mineral phases to crystallise, as these minerals were observed adjacent to post-emplacement calcite and serpentine, without disruption.

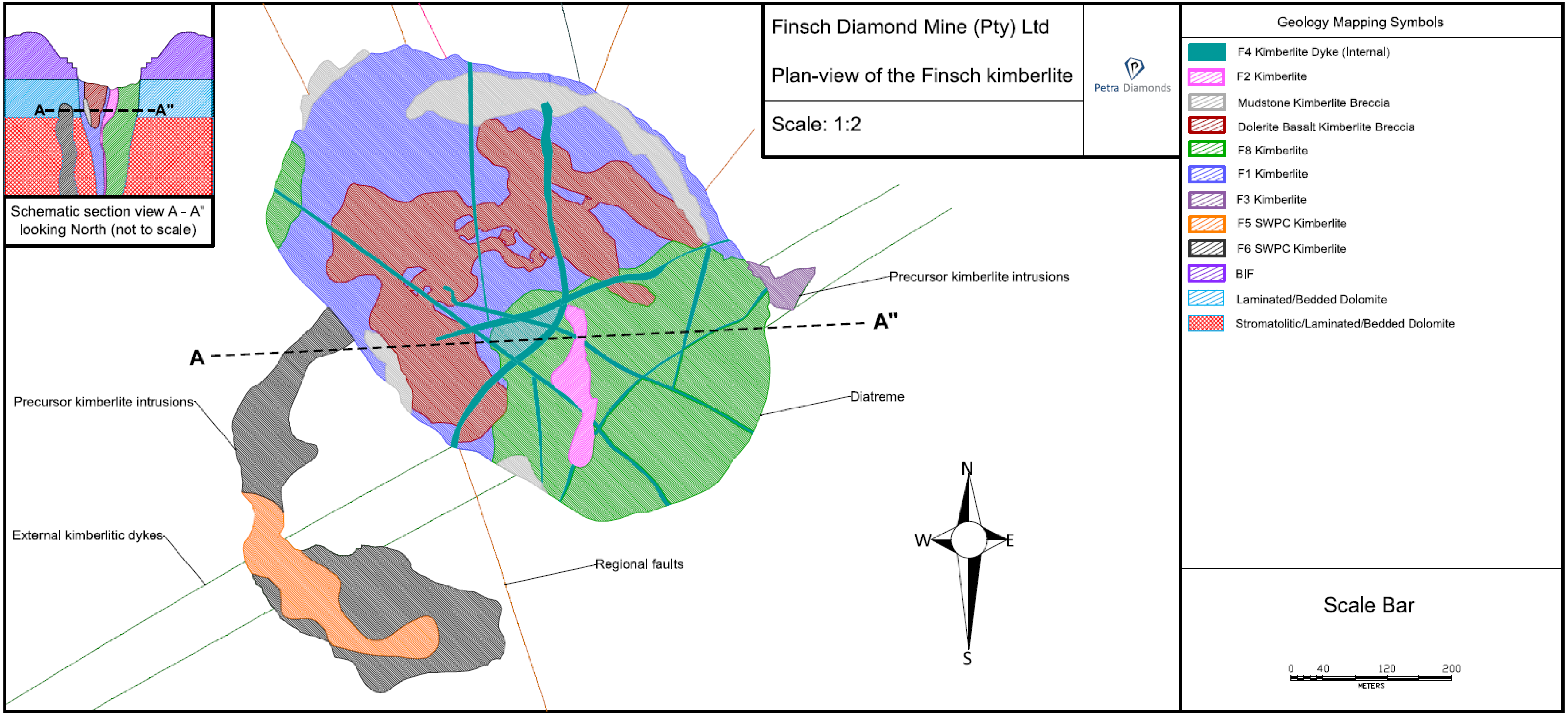


Figure 4: A Plan-view of the GEMCOM™ geological model of the various Finsch kimberlite phases, associated precursor intrusions, local structures and external dykes, 700 meters below the main shaft collar elevation. Section of the Finsch kimberlite (top left-hand corner: A-A", modified after Clement (1982) depicts a cross-section (ENE-WSW) of the Finsch kimberlite.

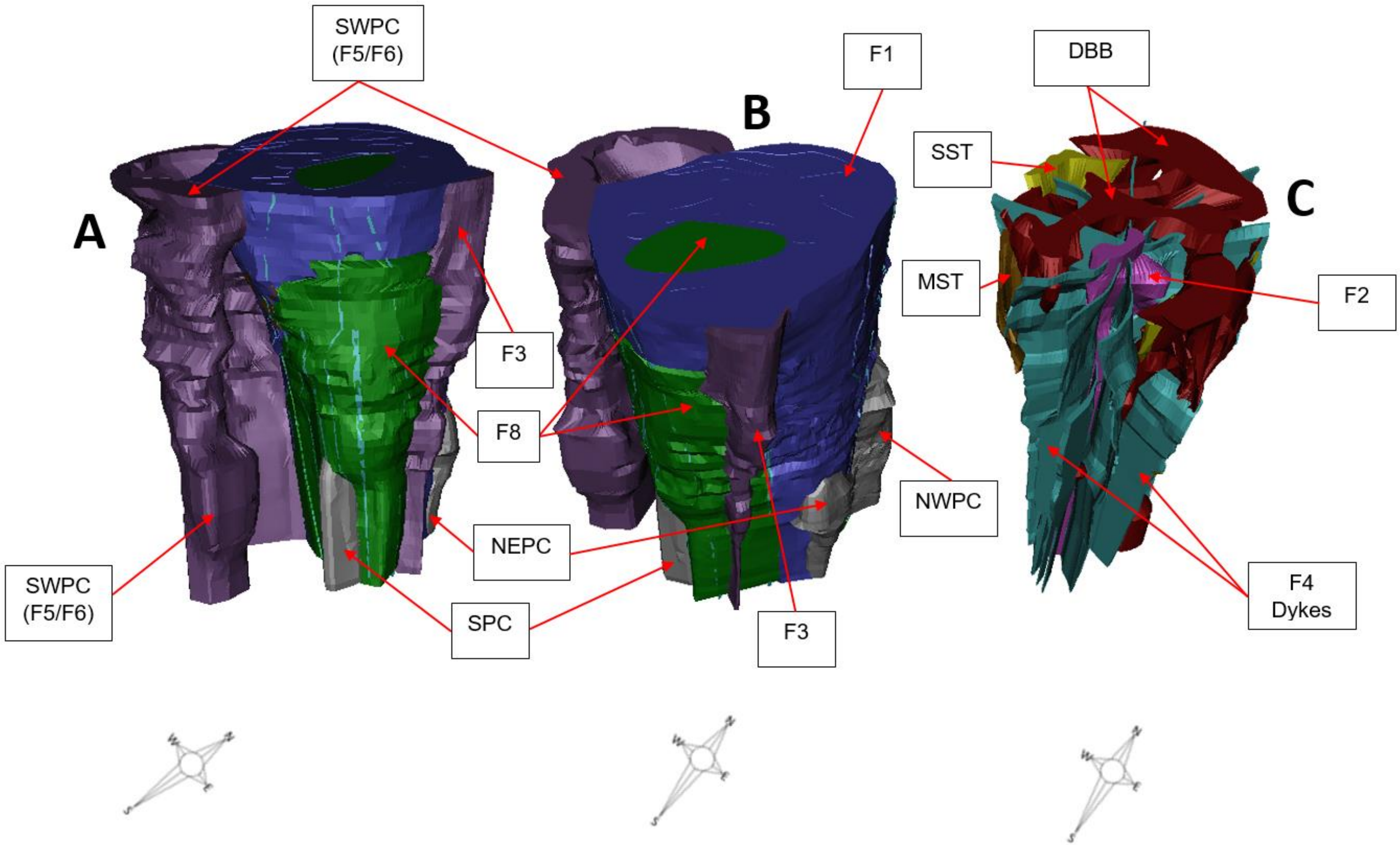


Figure 5: A three-dimensional (3D) view of the GEMCOM™ geological model of the Finsch kimberlite, oriented in different views, namely: panels (A), (B) and (C) representing the geology (not to scale). Panel (A): View of the Finsch kimberlite from the south-eastern periphery; panel (B): View of the Finsch kimberlite from the eastern periphery; panel (C): View of the internal geometry of the F2 kimberlite phase, kimberlite-agglomerates and F4 dyke (excluding the F1, F3, F5/F6 and F8 kimberlite phase) from the south-eastern periphery. SWPC: south-west precursor (i.e., unit F5/F6); SPC: south-precursor; NEPC: Northeast precursor; NWPC: North-west precursor; MST: Mudstone breccia; SST: Sandstone breccia; DBB: Dolerite basalt breccia.

A geological map and, three-dimensional views of the various Finsch kimberlite phases, agglomerate zones and precursor ore bodies are shown in Figure 4 and 5 respectively. A geological description of each kimberlite phase of the Finsch kimberlite is given in Table 1, modified after Ekkerd et al. (2003). It should be noted that the density and grade estimations are based on a 2017 resource estimate, using updated drill core and bulk sampling estimation data in the geological model.

Table 1: Descriptive nomenclature of the Finsch kimberlite phases and the precursor kimberlite phases, modified after Ekkerd et al. (2003)

Generic Kimberlite Phase Name	General Features
F1 kimberlite phase 	F1 kimberlite phase is volumetrically the most abundant (≈60%) unit, however, its proportion relative to others decreases in volume with depth. This is a volcaniclastic kimberlite phase, occupying the centre to the outer northwestern periphery of the main pipe. This kimberlite lithophase contains on average, 15 vol. % crustal xenoliths (mainly Karoo Supergroup lithic xenoliths – which are carbonaceous shale and dolomite). Unit F1 exhibits variations in colour (green to dull grey) with associated high levels of crustal xenolith dilution in places, possibly due to localized sidewall failure. This kimberlite phase is visibly fragmental with a clast-supported texture, characterized by sub-rounded to rounded pyromagmaclasts. The gross texture ranges from massive, to layered. Average density is 2.55 g/cm³. Average measured diamond grade is 59 carats per hundred ton (cpht).
F2 kimberlite phase 	The F2 kimberlite phase is an irregularly shaped intrusion, which occupies a central area in the main pipe and, varies in size and morphology with depth. This is a hypabyssal kimberlite phase, which is dark brown in colour and, is characterised by abundant dolerite, sandstone and chert crustal xenoliths, which together represent a crustal dilution of ≈15 vol. %, although locally this may be as high as 30 vol. %. The crustal xenoliths are highly altered (into calc-silicates) and baked. Average density is 2.80 g/cm³. Average measured diamond grade is 58 cpht.

Table 1 continued

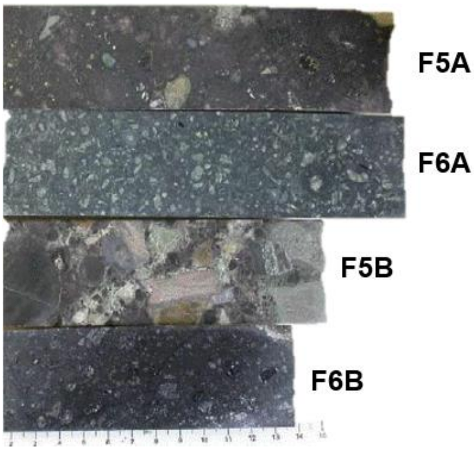
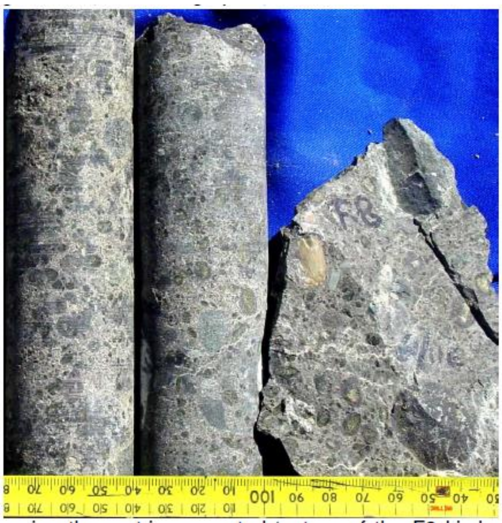
F3 kimberlite phase 	The F3 kimberlite phase occupies the northeast periphery and, is truncated by the main pipe along a sharp to gradational contact. F3 is a hypabyssal kimberlite phase, with a segregationary texture, which can be subdivided into the F3a breccia and F3b dyke. F3a is brownish in colour with prominent white calcite-vein segregations. It typically contains up to 15 vol. % crustal xenoliths (although locally this may be as high as 30 vol. %), representing virtually the entire country rock stratigraphy from the Precambrian upwards. Unit F3b is brownish in colour, with a dyke-like geometry, appears more uniform than F3a in texture, and contains less than 5 vol. % crustal xenoliths, compared to F3a. Lithological contacts between the two units range from sharp to gradational. F3b contains only dolomite, dolerite and chert xenoliths and is volumetrically less abundant than F3a. Average density is 2.70 g/cm³. Average measured diamond grade is 16 cpht.
F4 kimberlite phase 	The F4 kimberlite phase occurs as a system of internal hypabyssal dykes and sills within the main pipe, which represent the final phase of magmatic activity. The F4 kimberlite phase is mostly dark brown in colour with a mostly aphanitic texture. Crustal dilution is low (<5 vol. %) and the xenoliths consist of variably altered dolomite and chert. Average density is 2.81 g/cm³. Average measured diamond grade is 85 cpht.
F5/F6 kimberlite phase 	The F5/F6 kimberlite phase together form the south-west precursor, in the form of an irregular intrusion or root-zone complex, located on the southwestern and northeastern periphery of the main pipe along a sharp to gradational contact. There is little mineralogical difference between units F5 and F6, but they represent distinguishable units of the south-west precursor in terms of having significant differences in crustal xenolith content and pyromagmaclast morphology. Units F5/F6 are similar in appearance to the F3 phase (particularly with regard to having segregationary texture) and contain on average 15 vol. % crustal xenoliths, although locally this may be as high as ≈65 vol. %. At least 4 separate sub-phases have been identified in the south-west precursor. The F6 (i.e., F6A and F6B at left) is dark green to dark brown in colour and contains fewer lithic xenoliths as compared to F5 (F5A and F5B at left), which is mostly dark brown in colour. Average density is 2.80 g/cm³. Average measured diamond grade is 53 cpht.

Table 1 continued

F7 kimberlite phase 	The F7 kimberlite phase occupies an area in the southeastern periphery of the main pipe, immediately adjacent to F8, but with a gradational contact. This transitional (predominantly hypabyssal) kimberlite phase is dark brown to black in colour and has features (e.g., mineral content, lithic xenolith content and general texture) similar to those of unit F8. This suggest that unit F7 could be a differentiated version of unit F8. Crustal dilution in unit F7 is as low as ≈5 vol. % in the coherent areas and may reach ≈30 vol. % in some transitional areas. Crustal xenoliths in this kimberlite phase are mainly dolerite and dolomite. Average density is 2.71 g/cm³. No average diamond grade is determined for the F7 kimberlite phase as a unit on its own, due to the volumetrically irregular and volumetrically insignificant nature of this kimberlite phase, in resource estimation and classification terms. However, for Unit 7 the same diamond grade of unit F8 (i.e., 70 cpht) is assumed for the sake of geological modelling purposes.
F8 kimberlite phase 	The F8 kimberlite phase occupies the central portion to the southeastern periphery of the main pipe. This kimberlite phase is characterized by ≈15 vol. % crustal dilution on average, which increases in some areas that are in close proximity to the F2 kimberlite phase. Unit F8 is characterised by a decrease in Karoo Supergroup xenoliths (relative to unit F1), but with an increased abundance in Precambrian dolomite and chert (relative to unit F1). Unit F8 is a brownish-grey coloured hypabyssal kimberlite, which becomes transitional in some places to volcaniclastic, with a high volume (>30 vol. %) of rounded pyromagmaclasts, which are often large (average diameter of 25mm)' and shows characteristics of both volcanic and sub-volcanic pyromagmaclast formation. Furthermore, this kimberlite exhibits gradational to sharp lithophase contacts with the F1 unit, however the F8 unit clearly truncates the F1. Average density is 2.63 g/cm³. Average measured diamond grade is 70 cpht.

2.4 The Finsch diamonds

The Finsch kimberlite is a major diamond producer, having supplied over 130 million carats in its 50-plus year lifespan to date. Finsch has produced a number of large, +100 carat, gem quality diamonds in its history. In addition, the mine is known for its highly commercial diamond parcels on the +5-diamond sieve (i.e., stones greater than 1.829 mm in diameter) and has a high abundance of fancy coloured gem-quality diamonds.

The Finsch kimberlite is characterised by both peridotitic and eclogitic diamonds, with those of peridotitic paragenesis being dominant (Gurney et al., 1979). The most abundant peridotitic minerals observed as inclusions in diamonds are garnets, orthopyroxene and chromite respectively (Gurney et al., 1979). However, eclogitic diamond inclusions have also been noted and include garnet, clinopyroxene, kyanite (e.g., Gurney et al., 1979; Lowry et al., 1999) and sulphide (Palot et al., 2013). The oldest Sm-Nd isochron ages recorded in Finsch diamond inclusions (up to 3.3 Ga; Richardson et al., 1984) are obtained from harzburgitic garnets, whereas a similar study on eclogitic inclusions yielded a much younger age of 1580 ± 50 Ma (Richardson et al., 1990).

Eclogitic diamonds from Finsch provide evidence of at least two diamond populations (Appleyard et al., 2004). This is based on the range in aggregation states measured, the total nitrogen contents observed and the differing thermobarometry results of the eclogitic diamond inclusions (Appleyard et al., 2004). However, evidence of localised fluid- or melt-related metasomatism is not indicated (e.g., absence of LREE enrichment, no Sr anomalies observed), Viljoen et al. (2014).

At least three diamond growth environments have been inferred and described for the Finsch peridotitic (1) and eclogitic (2) diamonds and include:

- The Finsch peridotitic diamond inclusions are consistent with an origin from substrates formed by high-degree melt extraction at high pressure from the sublithospheric mantle, such as by extraction of komatiite from upwelling sub-lithospheric mantle to generate the cratonic lithosphere (Richardson et al., 1984). Diamond formation (and entrapment of inclusions) occurs in the lithospheric mantle and either follows or is associated with metasomatic enrichment of the lithospheric mantle. This is strongly supported by the Sm-Nd and Rb-Sr model ages (i.e., 3.2 – 3.3 Ga) of sub-calcic garnets in the Finsch kimberlite, as inclusions in diamonds and as heavy mineral concentrates, (Richardson et al., 1984)

- Viljoen et al. (2014) proposes an origin for the Finsch eclogitic diamonds from carbon entrapped (or introduced later) with oceanic crustal protoliths (i.e., low-pressure oceanic protoliths, consisting of basalt and gabbro for eclogitic diamond formation at Finsch).
- Palot et al. (2013) proposed multiple growth events for the eclogitic Finsch diamonds. This multiple diamond growth event is mainly based on nitrogen aggregation in diamond (i.e., N concentration vs. percentage of N in IaB centres) which provides clues to the temperatures to which they have equilibrated, and for how long.

Chapter Three – Sampling and analysis approach

3.1 The quantitative recovery of KIM using the density separation technique.

A simplified flow diagram of the Mantle Mapper™ heavy mineral analysis (HMA) routine procedure used is shown in Figure 6. Kimberlite indicator minerals are recovered from kimberlite samples of approximately 20 kg mass, obtained from various locations within the area of current underground mining activities at Finsch Diamond Mine. One kimberlite sample was collected for each kimberlite lithophase (i.e., F1 – F8). HMA routines (using the Mantle Mapper™ method, Nowicki et al., 2007) for the separation and recovery of KIM were implemented on these kimberlite samples at the Petra Diamonds heavy mineral facility at Helam Mine, North West Province, South Africa. The ≈20 kg kimberlite samples were lightly crushed through a jaw crusher to generate a workable maximum size of crushed material of 2.5mm. The crushed material was then sieved with a +2360 µm metal sieve, thus separating the oversized +2360 µm material from the desired -2360 µm size fraction. The oversized +2360 µm material is then stored temporarily. The -2360 µm material is then re-sieved using a +300 µm sieve, this allows any material finer than 300 µm generated by initial crushing to sink into a sample bucket for temporary storage. The -2360 µm to +300 µm fraction is then stored as one sample set to be used in the HMA routine. The +2360 µm oversized material generated from initial crushing is then re-crushed in an oscillating cone crusher. 1mm is the largest size of material that is allowed to pass through the cone crusher. The cone-crushed material is passed through +300 µm and +2360 µm sieves. A second HMA sample is then generated from this re-crushed sample-set. The -300 µm (initial and re-crush) material are combined, weighed and permanently stored.

The two HMA sample sets (i.e., -2360 µm and +300 µm generated from jaw and cone crushing) are combined, weighed and treated for HMA routines using the tetrabromoethane (TBE; $C_2H_2Br_4$) gravity separation technique. TBE is a halogenated hydrocarbon solution which has a density of ≈ 2.98 g/cm^3, ideal for separating KIM from a sample, due to their density contrast. The samples are introduced to the TBE solution in separatory funnels for a period of about 8 – 10 minutes under a ventilated hood. This is done to allow enough time for the dense material to sink and concentrate at the bottom of the separator funnel, this dense settled material then represents the heavy mineral concentrate (or simply, concentrate). The concentrate is then collected in a beaker through a tap at the bottom of the separator flask.

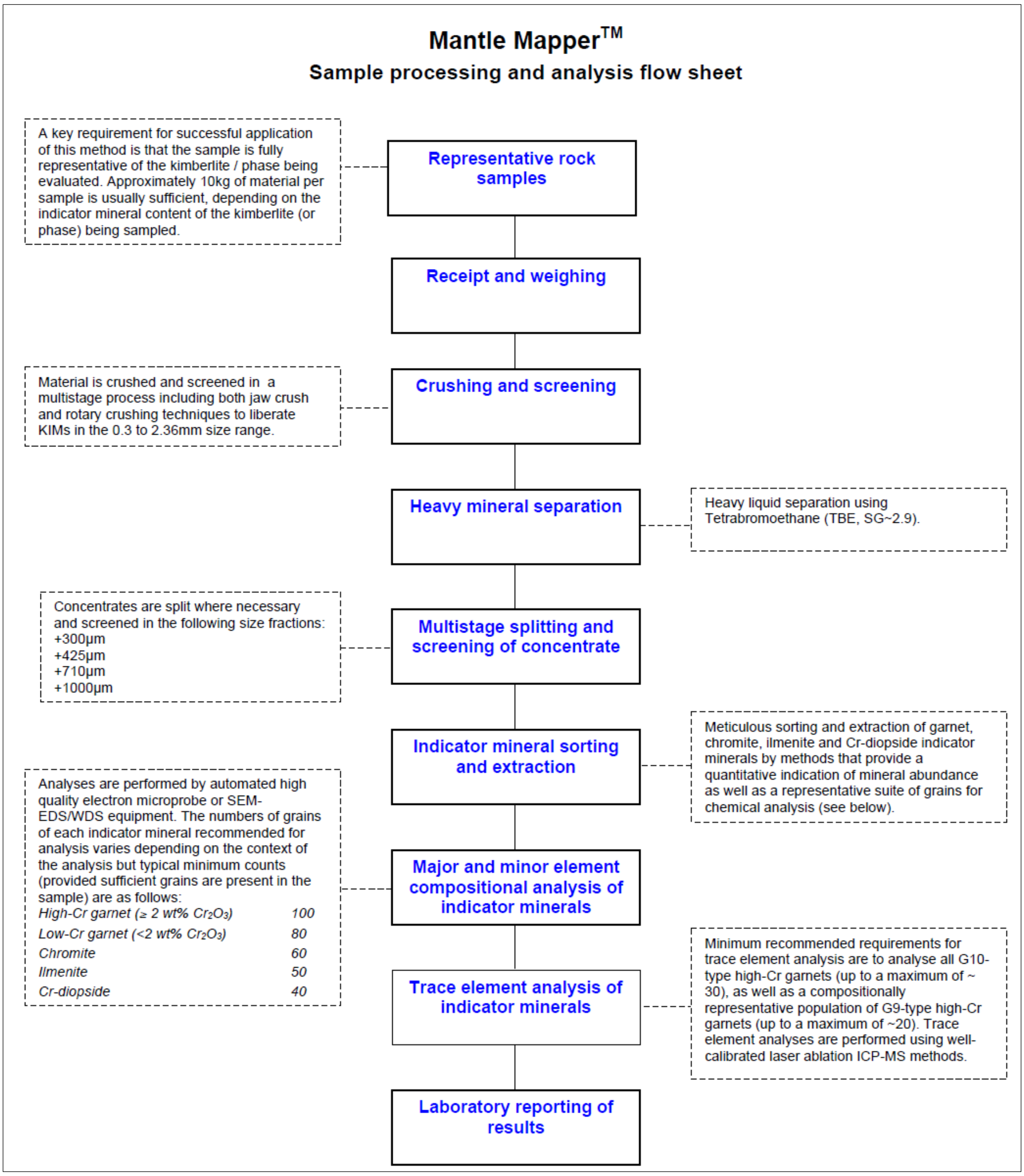


Figure 6: The Mantle Mapper™ HMA routines flow diagram, modified after Nowicki et al. (2007)

The TBE solution is recovered and, the concentrate treated with acetone and left overnight to remove the excess TBE solution. The dried concentrate is then weighed and stored in a jar for sorting. This procedure was followed for all of the kimberlite lithophase samples. The dried heavy mineral concentrate from each sample is then sieved with a nonmagnetic metal sieve to generate four sample size fractions (+300 µm to -425 µm; +425 µm to -710 µm, +710 µm to -1000 µm and +1000µm). These sample size fractions were then split up to 6 times (i.e., up to 1/64 of the original sample), using a nonmagnetic riffler splitter. The splitting of a concentrate sample is ideal for this sampling routine, as it reduces the size of the concentrate sample that needs to be processed for the separation of KIM under a binocular microscope. This is desirable, as some samples can generate high yields of concentrate material. Sample splits of the original concentrate are representative, in the form of a fraction (e.g., 1/2, 1/4, 1/8 etc.) and, therefore create minimal sampling bias during sample splitting routines.

The number of times a concentrate sample is split is based on a visual estimate of the abundance of KIM observed within the finest size fraction (i.e., +300 µm to -425 µm) under a binocular microscope. The observer then estimates how many times a sample needs to be split, so that the requisite 60 grains per KIM type are cumulatively contained in all the estimated splits [e.g., assume the +300 µm to -425 µm size fraction appears to have ≈1000 grains each of most of the KIM categories desired (e.g., clinopyroxene, orange garnet, red garnet, pink-purple garnet etc.) then you might choose to split the sample 4 times (i.e., $^1/_2$ then $^1/_4$ then $^1/_8$ then $^1/_{16}$) to yield a split with ≈60 grains each]. All size fractions (i.e., +300 µm to -425 µm; +425 µm to -710 µm, +710 µm to -1000 µm and +1000µm) of a concentrate sample are split in the same way. KIM (i.e., purple, pink, red and orange garnets, chromite and clinopyroxene) are then recovered under a binocular microscope, based on the unique mineral identification properties of each KIM, such as the colour and cleavage for the oxide mineral grains (streak characteristics are used for oxide mineral grains if the crystal system is not visible). Approximately 60 grains per indicator mineral type, per kimberlite sample are hand-picked from the concentrate, using a non-magnetic tweezer, starting from the highest split of the +300 µm to -425 µm size fraction, advancing in reducing orders of splits, continuing to coarser size fractions, until the requisite combined 60 grains per KIM are obtained. It must however be noted that all KIMs occurring within a split must be taken-out of the concentrate, regardless of whether the requisite 60 grains have been reached (or not).

The 60 grains per KIM represents the number of grains that need to be obtained from a kimberlite sample, this number is an industry standard based on numerous successful indicator mineral evaluations of kimberlites worldwide. It is a compromise between the rapid characterisation of the indicator minerals in a kimberlite lithophase and obtaining sufficient numbers of grains to adequately depict the population of heterogeneous mantle lithologies that can be contained in the lithophase or kimberlite (Nowicki et al., 2007). It should be noted that 60 grains were not always obtainable in a sample. If the required 60 grains of any given mineral, in the highest sample split of the finest size fraction have not been recovered, all minerals of that type must be taken from the next sample split, whether or not the 60 grains have been reached. This routine is continued into coarser size fractions, until the requisite combined total of 60 grains have been recovered. Additional kimberlite samples can be processed through the HMA routine if the required 60 grains per indicator mineral type are not recovered across all concentrate sample splits and sample size fractions (see Table 2). The recovered grains are then mounted on separate epoxy disks for each KIM type, for each kimberlite sample. Kimberlite indicator mineral sorting results can be seen in Appendix D: Kimberlite indicator mineral sorting results.

3.2 Sample collection for thin section preparation

A representative hand-sized sample was collected for each of the Finsch kimberlite lithophases (F1 – F8, excluding the F7 kimberlite phase due to its inaccessibility underground) during underground mapping routines. Polished thin sections on 25 x 45 mm glass slides were made at the University of Cape Town. Four samples were obtained from F1, three from F4, six from F5/F6, two from F3, six from F8, five from F2, and two from a gradational contact between F1 and F8. A description of the thin section petrography is presented and discussed in Chapter 4 of this study.

3.3 Microprobe analysis of kimberlite indicator mineral grains

Of all the KIM grains liberated during the heavy mineral separation process of the Finsch kimberlite samples in the first (primary) run, i.e., 20 kg of each kimberlite type, 2285 KIM grains were selected using the HMA routine, of which all were mounted and analysed with the electron microprobe. Table 2 provides a summary overview of the various KIM mineral grains recovered from the sorting of all kimberlite samples.

Table 3 provides a summary of the various KIM mineral grains recovered from the processing of additional 20kg sets of kimberlite samples through the HMA routine. This additional processing of kimberlite samples is established to make up grain numbers, i.e., ≈ 60 grains per indicator mineral type, as set out in the Mantle Mapper™ sampling procedure (see section 3.1.1). 564 grains were recovered from the processing of additional kimberlite samples, as shown in Table 3.

Table 2: Primary kimberlite indicator mineral sorting results

Kimberlite phase	Purple Garnet	Pink Garnet	Red Garnet	Orange Garnet	Ilmenite	Chromite	Clinopyroxene
F1	58	64	66	62	60	54	50
F2	52	59	117	27	54	61	1
F3	12	2	4	0	51	57	12
F4	1	3	1	0	23	34	7
F5/F6	62	50	75	31	51	54	0
F8	53	57	66	63	53	62	52

Table 3: Kimberlite indicator minerals obtained from additional separations (i.e., obtained from different samples of kimberlite)

Kimberlite phase	Purple Garnet	Pink Garnet	Red Garnet	Orange Garnet	Ilmenite	Chromite	Clinopyroxene
F2	-	-	-	-	-	-	9
F2	-	-	-	29	-	-	42
F3	44	8	6	-	-	-	54
F4	43	30	49	27	-	-	1
F4	15	27	-	15	-	-	27
F4	2	2	2	9	33	17	7
F5/F6	-	-	-	30	-	-	36

The Finsch KIM grains were mounted onto forty-five 25 mm polished epoxy-resin discs at the laboratory facilities of Remote Exploration Services. These epoxy discs were then carbon coated at the University of Cape Town (UCT). Analyses were conducted on a JEOL Superprobe JXA-8100 Electron Probe Microanalyzer at UCT equipped with five wavelength-dispersive spectrometers containing a range of crystals (LDE1, LDE2, PETJ, PETH, TAP, LIF, LIFH), fitted with two gas-flow proportional and two sealed Xenon detectors. The electron beam voltage was set at 15kV, with a beam diameter of 3 microns during all analyses. A current of 15nA was employed for major elements. The peak counting time was 10 seconds and background times (upper and lower) 2 x 5 seconds each. Grain analysis positions were digitized and, samples were analysed using well-characterised industry and in-house standards. Standards were mainly natural silicates and pure oxides and can be seen in Appendix A: Table of standards.

Detection limits on electron microprobe measurements depend on a number of variables. The estimated detection limits, pertaining to the conditions in this study, are as follows, in parts per million (ppm): Garnet: SiO_2 (207 ppm); MgO (122 ppm); MnO (242 ppm); CaO (80 ppm); Al_2O_3

(146 ppm); NaO (156 ppm); Cr_2O_3 (201 ppm); K_2O (69 ppm); TiO_2 (181 ppm), FeO (245 ppm) and NiO (306 ppm). Clinopyroxene (CPx): SiO_2 (236 ppm); MgO (127 ppm); MnO (242 ppm); CaO (85 ppm); Al_2O_3 (147 ppm); NaO (196 ppm); Cr_2O_3 (201 ppm); K_2O (70 ppm); TiO_2 (180 ppm) and FeO (256 ppm). Chromite (CHR): SiO_2 (189 ppm); MgO (162 ppm); MnO (290 ppm); CaO (97 ppm); Al_2O_3 (157 ppm); Cr_2O_3 (254 ppm); TiO_2 (233 ppm) and FeO (269 ppm). Fe_2O_3 is calculated using the stoichiometry of mineral formulae. Analysis concentrations are reported in (wt. %), with analysis sums of 98.50 – 102.50 wt. % being accepted.

3.4 Microprobe analysis of opaque minerals in thin section

Two thin sections were selected, from the F3 and F4 kimberlite phases, to analyse opaque minerals that had been observed in transmitted light through the binocular microscope. These opaque minerals are sulphide and oxide minerals, respectively, based on petrographic observations. These thin sections were then carbon coated and analysed for major elements using the JEOL Superprobe JXA-8100 Electron Probe Microanalyzer at UCT, following the same basic procedure as for the grains in the epoxy disks.

3.5 Laser Ablation ICP-MS analysis of the purple and pink garnets

Table 4 summarises a total of 149 G10 and G9 garnet grains (i.e., 78 G10 and 71 G9 garnet grains) across all Finsch kimberlite phases, which were selected for trace element analysis by LA-ICP-MS. The selection of each garnet type (i.e., G10 or G9) is based on the CaO vs. Cr_2O_3 garnet classification diagram of Grutter et al. (2004), which is used to define and categorize all garnet mineral parageneses. These analyses were performed on a subset of grains, mounted on polished 25 mm epoxy discs used for EPMA major element analysis. Calibration was performed using NIST 610 and 612 synthetic glasses and precision and accuracy were monitored with a well-characterized, in-house garnet standard (from JJG 1424 Thaba Putsoa garnet websterite). The LA-ICP-MS instrument used to analyse the silicate minerals is a Thermo-Fisher X-Series II quadrupole ICP-MS interfaced with a New Wave UP213 solid-state laser ablation system at UCT. The spot size of the laser was set to 100 microns, with the laser repetition rate at 10Hz and the laser power at ≈12 J/cm^2 for all analyses. Helium was used as the carrier gas to transport the ablated material to the mass spectrometer, which was mixed with argon prior to injection into the plasma. The standards NIST 610 and NIST 612, as well as in-house standard JJG-1424 garnet were run as an unknown to monitor precision of the instrument and were run after each 10-12 spot analyses.

Table 4: Kimberlite indicator minerals selected for trace element analysis.

Kimberlite phase	G10	G9
F4	14	16
F3	13	5
F5/F6	12	11
F2	12	12
F8	13	13
F1	14	14

Chapter Four – Descriptive nomenclature and classification of the Finsch kimberlite

4.1 Petrographic description of kimberlite samples

Thin sections were prepared from 30 hand-sized kimberlite samples (about 5 samples per lithophase) at the University of Cape Town. The samples selected are representative of each kimberlite phase mapped underground (excluding unit F7 – as no samples were available for analysis). Although the samples appear uniform in hand specimen, they exhibit a variety of distinct petrographic characteristics that can be used to classify different phases of kimberlite. The petrographic descriptions of the various kimberlite samples are discussed using the classification and interpretation scheme developed by Scott Smith et al. (2013). "Melt segregationary" or "volcaniclastic" textures in this study refer to the magmatic processes that results in the presence of fluidal-shaped pyroclasts comprised of solidified melt plus any entrained xenoliths/solids (e.g., macrocrysts, xenocrysts or phenocrysts) in kimberlite. The fluidal-shaped bodies of solidified magma are referred to as pyromagmaclasts and mainly form during the eruption of a kimberlite pipe. Additionally, melt segregationary textures can also refer to the presence of rare complex fluidal-shaped bodies characterized by multiple rims/layers of solidified magma, often around a core composed of a macrocryst/xenocryst or phenocryst. The multiple rims/layers of solidified magma represent repetitive deposition/coating of kimberlitic melt in a magma chamber, prior to eruptive breakthrough (Howarth and Skinner, 2016). The multiple rim/layered fluidal-shaped bodies of solidified magma are referred to as "fluidized-pyromagmaclasts" in this study (Howarth and Skinner, 2016). Further, kimberlite units (i.e., units F2, F3, F5/F6 and F8) which display hypabyssal textures in one thin section and volcaniclastic textures in another are referred to as "transitional" in this study. However, none of the thin sections prepared in this study display true transitional textures (i.e., a single kimberlite unit displaying both magmaclastic and hypabyssal textures/characteristics within a single thin section). Table 5 summarises the petrography of the Finsch kimberlite phases observed in thin section, in reference to Figure 7 – 12. Modal abundances of minerals were not determined in hand specimen or thin section, due to the inequigranular texture of the Finsch kimberlite phases, which are variable on a scale far larger than a single thin section.

Table 5: Overview of the petrographic description observed in the Finsch kimberlite phases.

F1 kimberlite phase	A greenish – grey, volcaniclastic, crustal xenolith-bearing (<15%), fine to coarse grained (0.5 – 8mm), olivine-rich (average of 35%), serpentine kimberlite phase (Fig. 7A - D) An inequigranular, melt segregationary textured kimberlite phase, with elliptically shaped pyromagmaclasts (5 – 20 mm) characterised by cores of country rock xenoliths (X_c) of dolerite/basalt, limestone and olivine macrocrysts (distinguished by anhedral fractured grains, which are commonly yellowish to colourless in plane polarised light, i.e., fresh to replaced by yellowish serpentine and clays). Olivine macrocrysts (1 – 10 mm) are mostly replaced by serpentine and calcite. Phenocrystic olivine (<0.5mm) is common in unit F1. Sub-angular to sub-rounded chromite mineral grains (0.1 – 0.3 mm) are also common in this unit. This kimberlite phase has portions that are both clast and matrix supported. Average crustal xenolith content is 8%. The groundmass is characterised by ultrafine to fine grained grains (0.125 – 1 mm) of serpentine, phlogopite and diopside.
F2 kimberlite phase	A brownish grey, transitional, crustal xenolith-bearing (<15%), fine to coarse grained (0.5 – 8mm), olivine-rich (25 – 30%), phlogopite-clinopyroxene kimberlite phase (Fig. 8A - D) A transitional, melt segregationary and inequigranular textured kimberlite phase. Olivine macrocrysts (1 – 6 mm) are mostly rounded to sub-rounded. However, sub-angular olivine macrocrysts are not uncommon. Olivine macrocrysts are generally pale yellowish green in colour, due to calcite and/or serpentinite replacement and are mostly fractured. Other olivine macrocrysts are black in colour (Fe oxides replacing olivine), especially along fractures. Phenocrystic olivine (0.1 – 0.5mm) is common. Opaque mineral grains are also common in unit F1 and, represent chromite mineral grains (0.1 – 0.5 mm). Average crustal xenolith content is 12% and includes rounded dolerite, shale, dolomite and chert (not shown in Figure 8A – D). The groundmass is primarily characterised by very fine to fine grained (0.5 – 1mm) phlogopite.
F3 kimberlite phase	A brownish grey, highly altered, transitional, crustal xenolith-bearing (<15%), fine to coarse grained (0.5 – 8mm), olivine-bearing (average of 25%) serpentine-phlogopite kimberlite phase (Fig. 9A - F) A transitional, inequigranular and melt segregationary textured kimberlite phase. Although unit F3 is described as a transitional textured kimberlite phase, it is characterized by a dominant (>70%) hypabyssal texture, with a lesser (<30%) melt segregationary texture. The length and scale of the textural variation of unit F3 varies between 5m and 25m. Pyromagmaclasts (4 – 15 mm) are mostly elliptically shaped and have cores composed of altered, sub-rounded olivine, with occasional sub-angular to sub-rounded limestone and sub-rounded pyrite minerals. Olivine cores (2 – 5 mm) in some pyromagmaclasts are serpentinized or converted to calcite. Deuteric/secondary calcite veins are a common feature in in unit F3, often seen cross-cutting macrocrystic minerals. Phenocrystic olivine (0.1 – 0.5mm) is common in unit F3, most of which has been converted to calcite. Average crustal xenolith content is 11%. The groundmass is mainly characterised by ultrafine to fine grained (0.125 – 1mm) serpentine, phlogopite, calcite and diopside.

Table 5 continued

F4 kimberlite phase	A greenish grey, hypabyssal, crustal xenolith-bearing (<15%), fine to fine grained (0.5 – 2mm), olivine-rich (average of 40%), phlogopite-clinopyroxene kimberlite phase (Fig. 10A - D) A homogeneous, hypabyssal kimberlitic dyke with an inequigranular texture. Anhedral olivine macrocrysts (1 – 5 mm) are common and, range from mainly rounded and sub-rounded to occasionally sub-angular. Most olivine macrocrysts are fractured and are pale greenish yellow in colour due to partial replacement by serpentine. Phenocrystic olivine (0.01 – 0.5mm) is common in unit F4. Opaque sub-rounded chromite mineral grains (0.1 – 0.8 mm) are also common in unit F4. This kimberlite phase is characterized with a groundmass dominated by phlogopite and clinopyroxene. Average crustal xenolith content is 2%.
F5 kimberlite phase	A brownish, transitional, crustal xenolith bearing (<15%), fine to coarse grained (0.5 – 8mm), olivine-rich (average of 30%), phlogopite kimberlite phase (Fig. 11A - B) A transitional kimberlite phase, with a 50 – 50% proportioned hypabyssal/pyroclastic texture and, a dominant melt-segregationary texture, which occasionally becomes fragmental. The length and scale of the textural variation of unit F5 varies between 5 and 10m. Olivine macrocrysts (1 – 8mm) are mostly fractured and appear yellowish green in colour due to serpentinite replacement. Some olivine macrocrysts are black in colour, especially along fractures (Fe oxide replacement). Phenocrystic olivine (<0.5mm) is common in unit F5. Unit F5 is the only Finsch kimberlite unit characterized by the fluidized pyromagmaclast variant (most dominant when compared to normal standard pyromagmaclasts). Several of the fluidized pyromagmaclasts (2 – 15 mm) are elliptically shaped and, are characterised by thin rims (<1mm) of ultrafine to very-fine grained kimberlite groundmass (<0.125 – 0.5mm) dominated by phenocrystic olivine. The cores of the fluidized pyromagmaclasts are mainly composed of sub-rounded olivine, with few sub-angular clasts of country rock xenoliths also observed as cores of fluidized pyromagmaclasts. Most of the rims of the fluidized pyromagmaclasts observed are very-fine grained (0.5 – 1mm), however others are characterised by fine to medium grained rims (1 – 4mm). Average crustal xenolith content is 13%.
F6 kimberlite phase	A brownish grey, transitional, crustal xenolith-bearing (<15%), fine to coarse grained (0.5 – 8mm), olivine-bearing (average of 25%), phlogopite kimberlite phase (Fig. 11C - D) A transitional kimberlite phase, characterized by a dominant hypabyssal, inequigranular and macrocrystic texture. Anhedral, mainly rounded to sub-rounded but occasionally angular olivine macrocrysts (1 – 8 mm) are common in unit F6. Olivine macrocrysts are mostly fractured and partially serpentinized. Some olivine macrocrysts are black in colour, especially along fractures (Fe oxide replacement). Phenocrystic olivine (0.1 – 0.5mm) is common in thin section. Pyromagmaclasts (i.e., both variants defined) are rare in unit F6. The groundmass (<0.125 – 0.5mm) is characterised by predominant phlogopite, with minor calcite, serpentine, apatite and perovskite. Average crustal xenolith content is 5%.

Table 5 Continued

F8 kimberlite phase	A transitional, crustal xenolith-bearing (<15%), fine to coarse grained (0.5 – 8mm), olivine-rich (35 – 40%), phlogopite kimberlite phase (Fig. 12A - D) A transitional kimberlite phase, characterized by a dominant hypabyssal, inequigranular and melt segregationary texture. Pyromagmaclasts have cores mainly composed of sub-rounded olivine macrocrysts, however sub-angular to angular olivine cores in pyromagmaclasts are also common in unit F8. Pyromagmaclasts with sub-angular to angular cores of olivine are often characterised by thin melt segregationary rims, when compared to those with rounded to sub-rounded cores. Olivine macrocrysts (2 – 6 mm) are commonly fractured and are yellowish green to black in colour. Phenocrystic olivine (<0.5mm) is also common in unit F8. The groundmass is characterised by fine grained (0.125 – 1mm) phlogopite, calcite and serpentine. Crustal xenoliths observed include sub-rounded dolerite and sub-angular chert xenoliths (not shown in Figure 12A – D). Average crustal xenolith content is 8%.

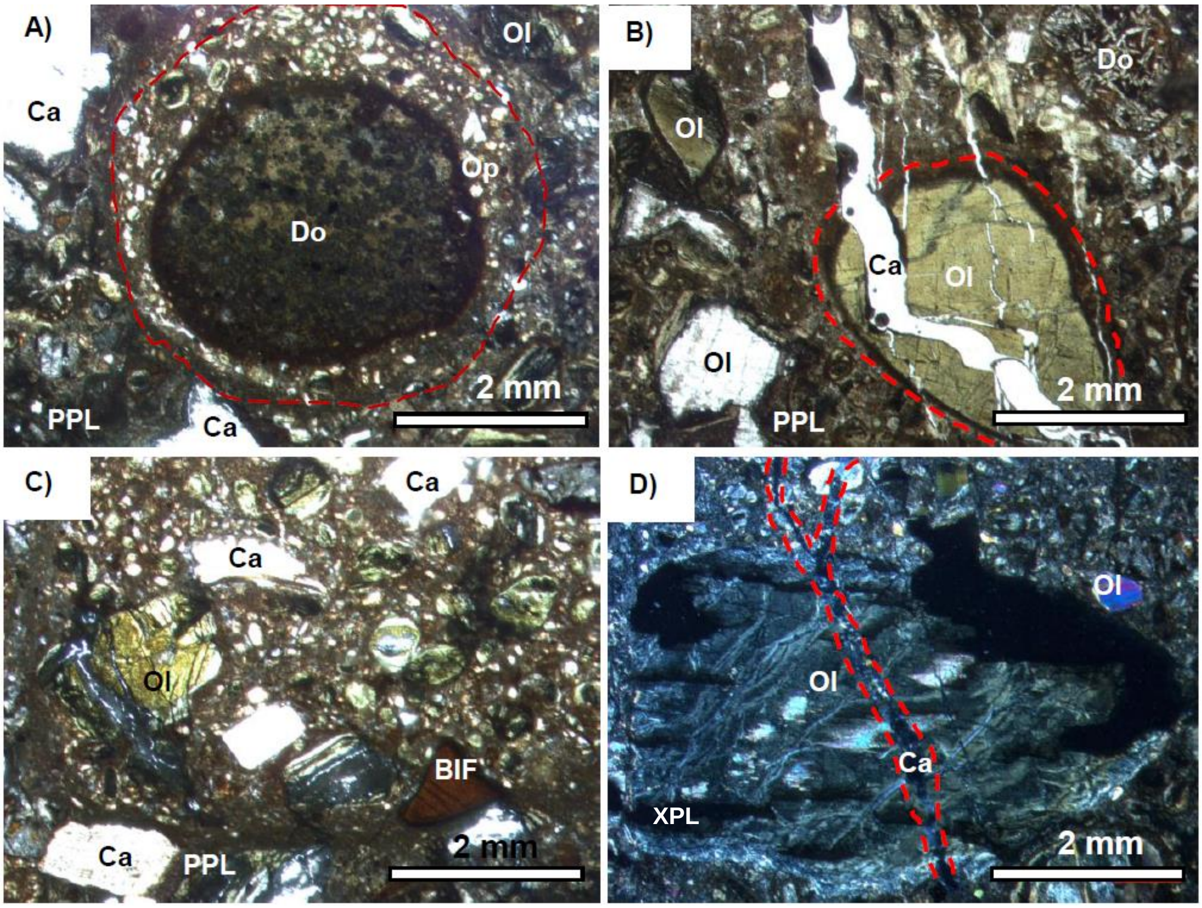


Figure 7: (A-D) Photomicrographs of volcaniclastic-textured kimberlite from the F1 kimberlite phase. Panel (A) is characterised by altered macrocrystic olivine (Ol) minerals replaced by calcite (Ca) and a rounded dolerite (Do) country rock xenolith, forming the core of a pyromagmaclast (outline in red dashed lines), set in a fine grained phlogopite- and serpentine-rich matrix. Panel (B) has a rounded olivine macrocryst forming the core of a thinly rimmed pyromagmaclast, with a late-stage calcite vein cross-cutting the olivine macrocryst (outline in red dashed lines). Panel (C) displays altered olivine macrocrysts replaced by calcite, with country rock xenoliths of banded ironstone (BIF). Panel (D) shows a large, altered olivine macrocryst, replaced by calcite and serpentine, with a vein of very-fine grained kimberlite groundmass cross-cutting the olivine macrocryst (outline in red dashed lines). The yellow-brown olivine in panels B, C and D is serpentinised. Abbreviations: PPL (plane-polarized light) and XPL (cross-polarized light). Field of view of panels (A) – (D) is 6.2mm across the horizontal.

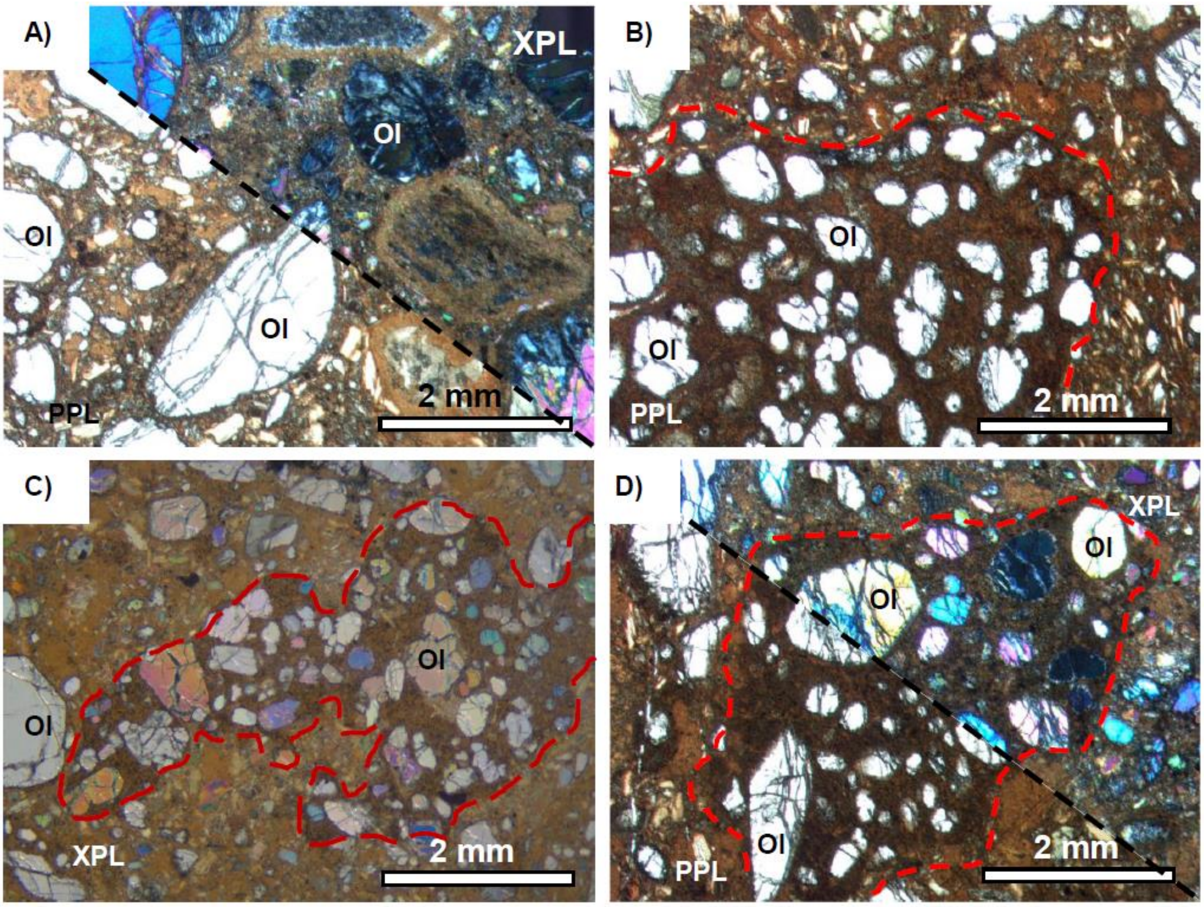


Figure 8: Photomicrographs of textures of transitional kimberlite from the F2 kimberlite phase. Panel (A) is characterised by fresh to altered olivine (Ol) macrocrysts, some replaced by calcite and/or serpentine, set in a fine grained phlogopite-rich matrix. Most olivine macrocrysts in unit F2 are fractured, where some are black in colour due to Fe oxide replacement. Panels (B) is characterised by sub-rounded olivine macrocrysts, forming the core of a pyromagmaclast (outline in red dashed lines), set in a fine to very-fine grained phlogopite-rich matrix. Panels (C) and (D) are characterised by fresh to altered, sub-rounded to sub-angular olivine macrocrysts, forming the core of pyromagmaclasts (outline in red dashed lines), and set in a fine to very-fine grained phlogopite-rich matrix. Abbreviations as in Figure 7. Field of view of panels (A) – (D) is 6.2mm across the horizontal.

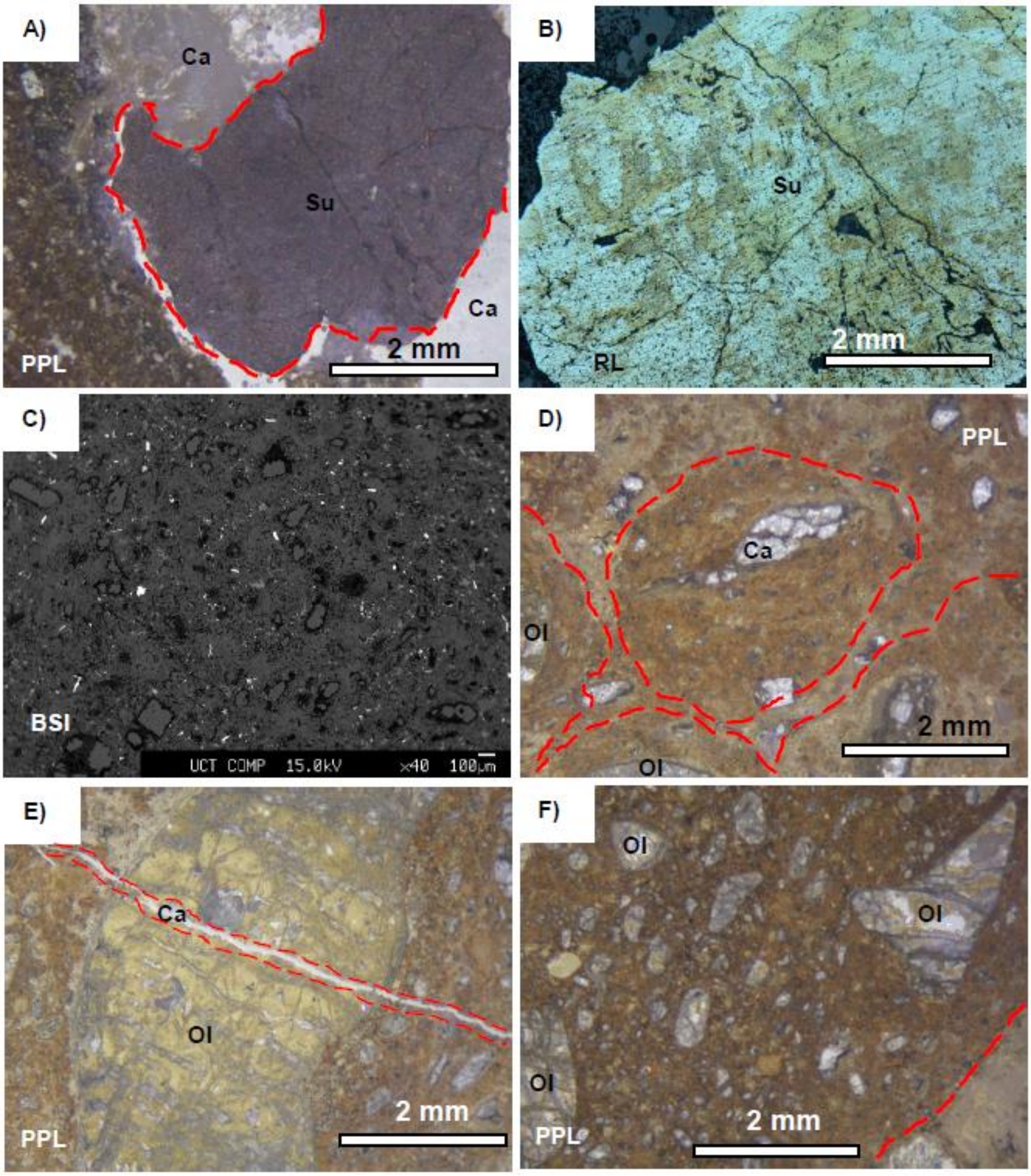


Figure 9: Photomicrographs of textures of transitional kimberlite from the F3 kimberlite phase. Panels (A), (D), (E) and (F) display pyromagmaclast textured kimberlites. Panel (A) is characterised by a large sulphide/pyrite (Su) xenocryst (outline in red dashed lines), with minerals replaced by calcite (Ca), together forming the core of a pyromagmaclast, set in a fine grained phlogopite-rich matrix. Panel (B) displays a large sulphide/pyrite xenocryst (same xenocryst observed in panel (A)), under reflected light. The sulphide/pyrite xenocryst observed in panels (A) and (B) are so large in extent that they must be crustal xenocrysts. Panel (C) displays a backscatter image from the electron microprobe, note the contrast between the sulphide and oxide mineral grains (white specks) and silicate minerals (shades of grey to black – larger mineral grains are olivine). Panel (D) displays one typical F3 kimberlite texture showing several coalescing magmaclasts (outlined in red) containing cores of olivine or olivine replaced by calcite. Panels (E) and (F), display altered, sub-angular to sub-rounded olivine macrocrysts. Note that panel (E) has a late-stage calcite vein which crosscuts a serpentinised olivine macrocryst (outline in red) and panel (F) displays several olivine macrocrysts, which are partially replaced by calcite and serpentine, which, together with macrocrystic kimberlite, make up a large pyromagmaclast (outlined in red). Abbreviations as in Figure 7, except for: RL (reflected light) and BSI (back scatter image). Field of view of panels (A), (B), (D), (E) and (F), is 6.2mm across the length, with panel (C) approximately 2mm across the horizontal.

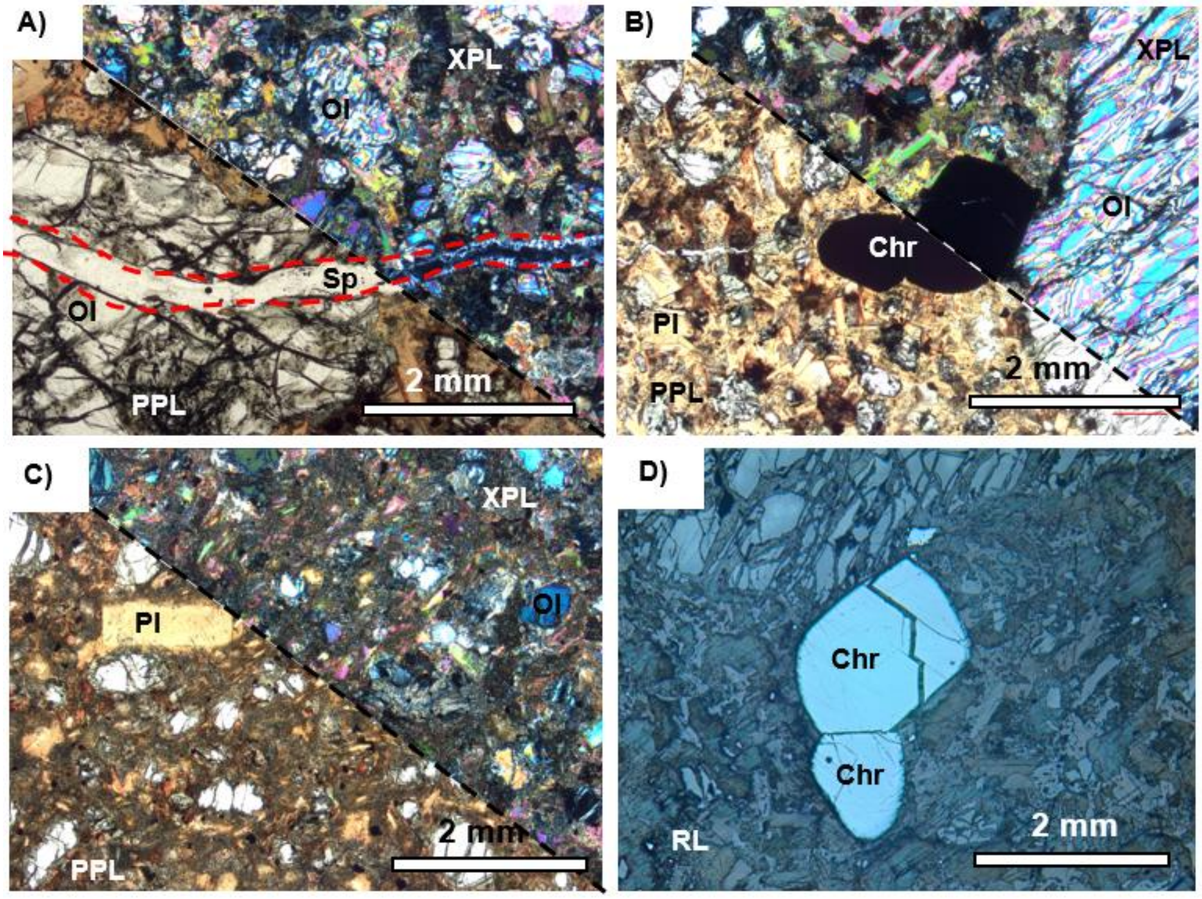


Figure 10: Photomicrographs of hypabyssal-textured kimberlites from the F4 internal dyke kimberlite phase. Panels (A) and (B) display hypabyssal textured kimberlite, with fresh olivine (Ol) macrocrysts, set in a fine grained phlogopite (Pl) -rich matrix. Note panel (A) has a late stage, pale yellow serpentine (Sp) vein (outlined in red) cross cutting an olivine macrocryst and, panel (B) has two opaque chromite (Chr) macrocrysts located adjacent to a large olivine macrocryst. Panel (C) displays a phlogopite (Pl) macrocryst, with several fresh to altered (replaced by calcite) olivine macrocrysts, set in a bright orange coloured, fine grained phlogopite-rich matrix. Panels (C) and (D), display two of the same chromite (Chr) macrocrysts, with the larger chromite cut by a late-stage calcite vein. Abbreviations as in Figure 7, except for: RL (reflected light). Field of view of panels (A) – (D) is 6.2mm across the horizontal.

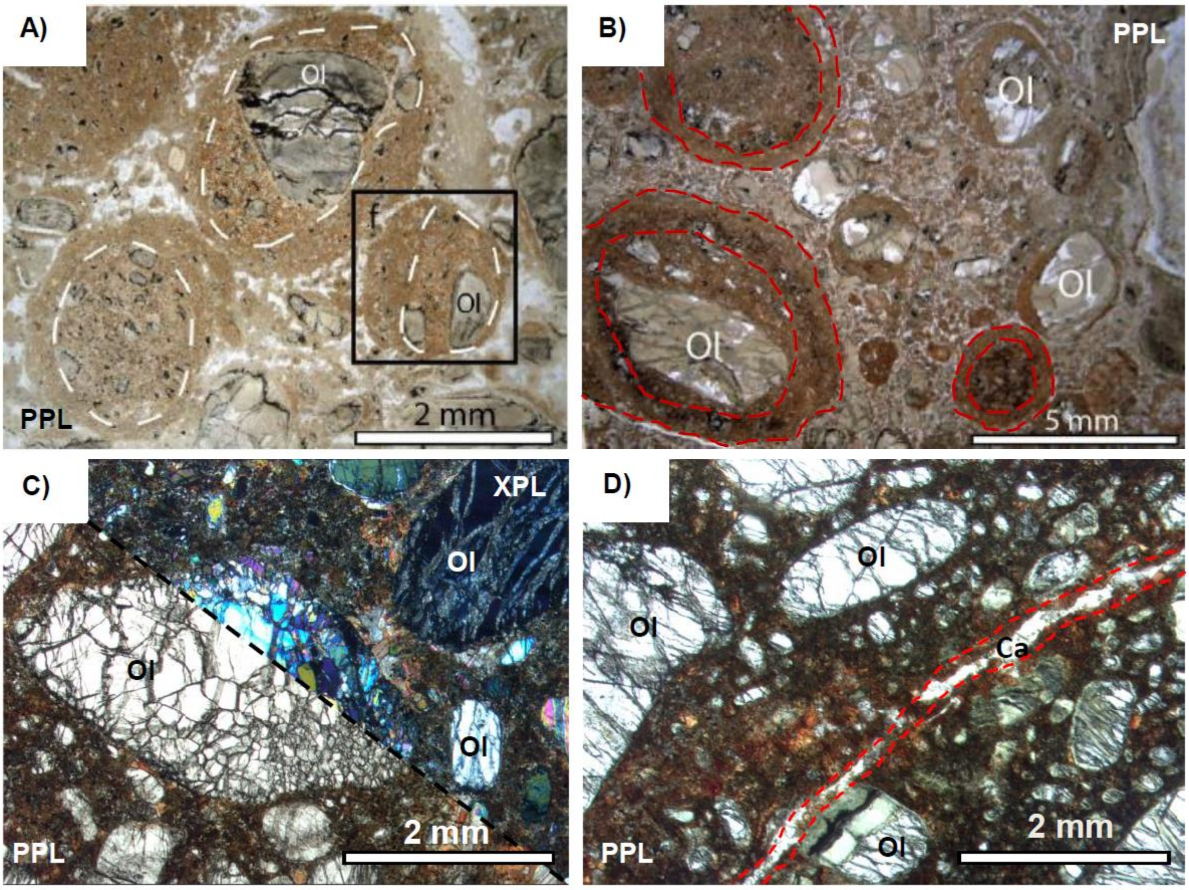


Figure 11: Photomicrographs of textures of transitional kimberlite from the F5/F6 south-west precursor kimberlite phase. Panels A and B, display kimberlite samples from unit F5, with largely altered olivine (Ol) macrocrysts forming the cores of most of the elliptically shaped fluidized pyromagmaclasts (outlined in white and red dashed lines and in the box in panel A), which are set in a phlogopite- and secondary calcite-rich matrix. Note the coarse and fine grained layered pyromagmaclasts in panel (B). Panels (C) and (D) are hypabyssal textured kimberlites from unit F6, displaying sub-rounded olivine macrocrysts set in a fine-grained matrix, which is dominated by phlogopite. Note the partial recrystallization of the large olivine macrocryst in panel (C), representing the response of olivine to solid-state strain. Note panel (D) has late-stage calcite (Ca) vein (outlined in red). Almost all olivine in PPL images (A) and (B) are not colourless and appears to be replaced by serpentine, whereas olivine in (C) and (D) are fresh (i.e., colourless). Abbreviations as in Figure 7.

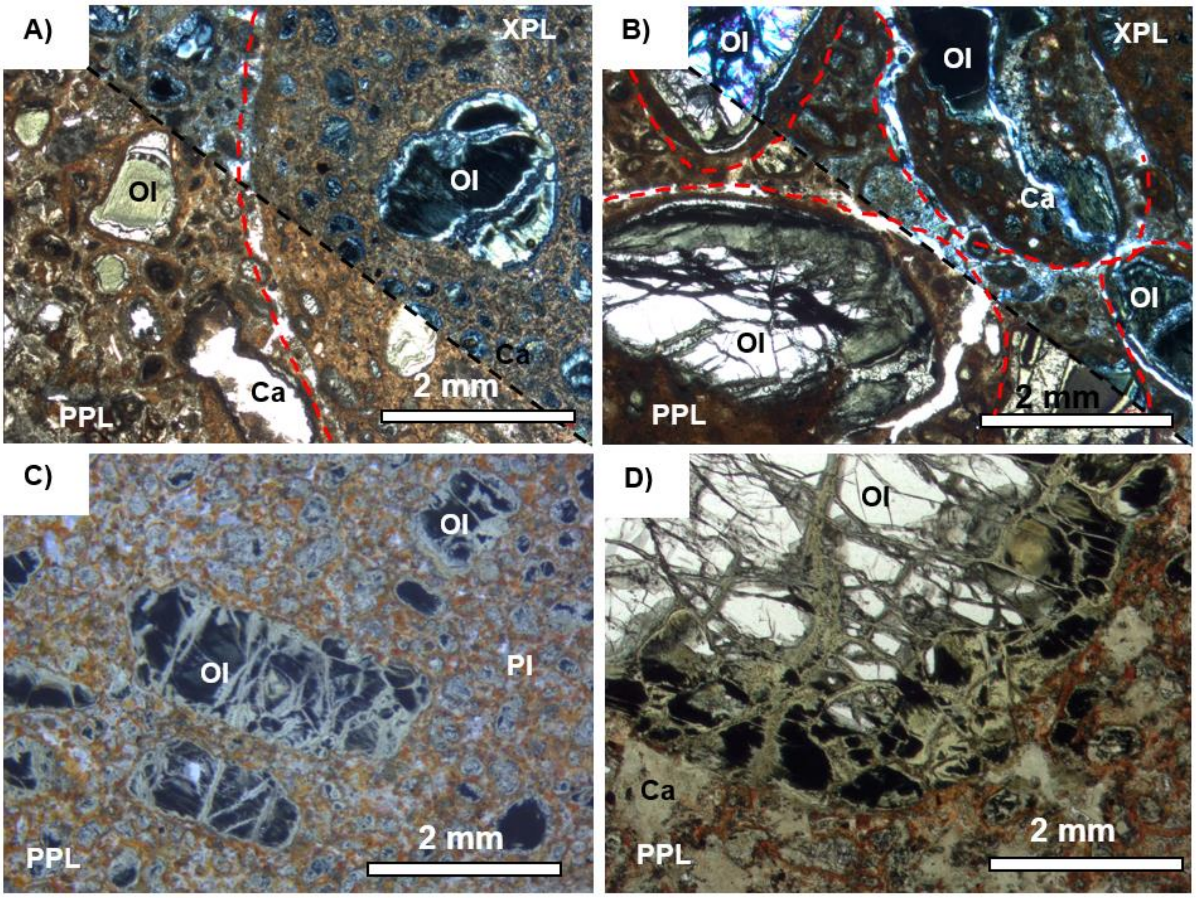


Figure 12: Photomicrographs of textures of transitional kimberlite from the F8 kimberlite phase. Panels (A) and B) display pyroclastic melt segregationary textured portions of the unit, set in a phlogopite-rich matrix, with secondary calcite (Ca) minerals and altered olivine (Ol). Olivine macrocrysts and phenocrysts form as the cores of the rounded pyromagmaclast (outlined in red dashed lines) in panel (A), where panel (B) is mostly characterised by elliptically shaped pyromagmaclasts (outlined in red dashed lines). Panels (C) and (D) are hypabyssal textured portions of the unit, characterised by variably altered and sub-rounded olivine macrocrysts, set in a fine-grained matrix, dominated by phlogopite and secondary carbonate minerals. Note the olivine macrocrysts in panels (A) to (D) are characterised by rims and fractures composed of serpentine and dark-coloured Fe oxide minerals. Abbreviations as in Figure 7. Field of view of panels (A) – (D) is 6.2mm across the horizontal.

4.2 Alteration and abrasion characteristics of the Finsch indicator minerals

Kimberlite indicator minerals can experience alteration (e.g., kelyphitization of garnet, in the mantle or during exhumation), in which the primary minerals are replaced by secondary minerals. The alteration minerals are generally soft and, therefore often experience mechanical abrasion during the kimberlite transport and emplacement (Afanas'ev et al., 2008).

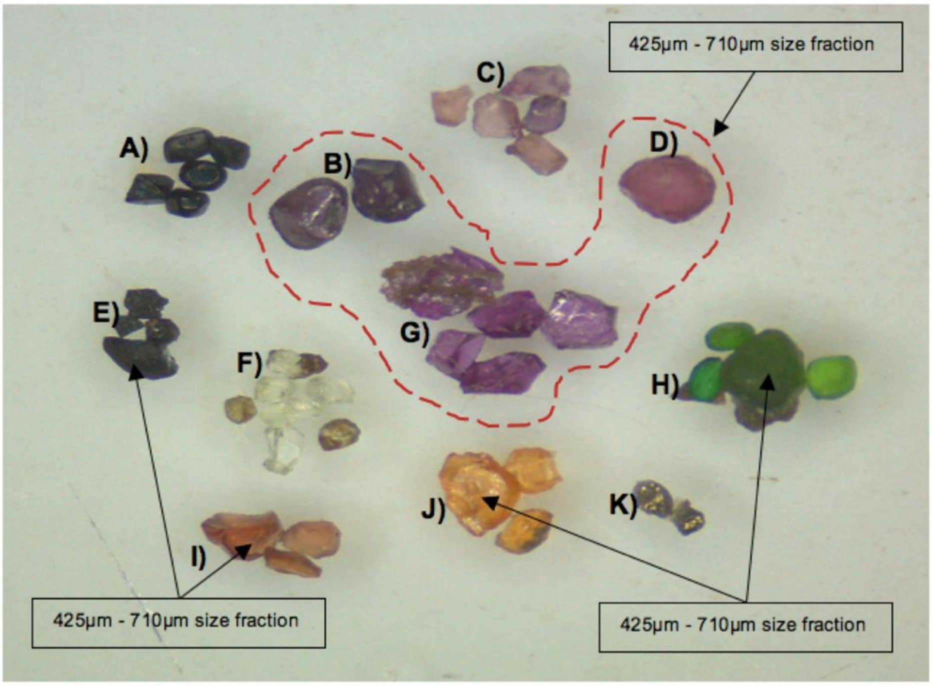


Figure 13: Photomicrograph of some of the kimberlite indicator mineral grains recovered from the heavy mineral separation of the various Finsch kimberlite phases. (A) kimberlitic chromite grains from the F8 kimberlite phase, 300µm-425µm size aperture. (B), (G) and (D) – outlined in red) mauve (likely G10) garnets of various colour intensity from the F1 kimberlite phase, 425µm-710µm size fraction. (C) pink (likely G9) garnets from the F2 kimberlite phase, 300µm-425µm size fraction. (E) Chromite grains from the F3 kimberlite phase, 300µm-425µm size fraction. (F) microdiamonds from the F4 kimberlite phase, 300µm-425µm size fraction. (H) clinopyroxene grains from the F8 kimberlite phase, 300µm-425µm size fraction unless indicated otherwise. (I) and (J) peach and orange (likely eclogitic) garnets from the South West Precursor kimberlite phase, 300µm-425µm size fraction, unless indicated otherwise on actual image. (K) iron sulphide mineral grains from the F3 kimberlite phase, 300µm-425µm size fraction. The above image is 85mm across the horizontal.

The alteration and abrasive processes that affect KIM in the mantle or during exhumation are important in this study, as these processes can contribute to a sampling bias in the recovery KIM from kimberlite samples (Stiefenhofer et al., 2016). This sampling bias can, furthermore, affect potential mineral associations to be investigated in this study (e.g., Ferreira, 2013; Stiefenhofer et al., 2016). Figure 13 – 14 depict some of the abrasion and/or alteration textures observed on some of the KIM, obtained as heavy mineral concentrates from the various Finsch kimberlite units.

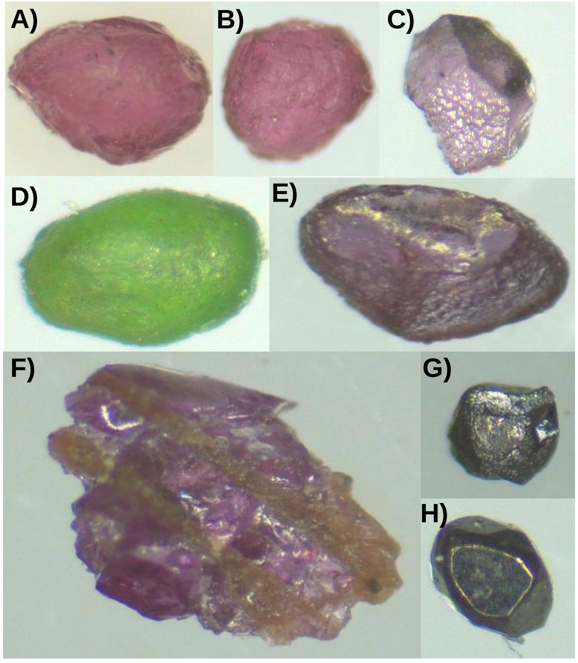


Figure 14: Photomicrographs of the various textural and abrasion characteristics from a select set of kimberlite indicator minerals recovered from the various Finsch kimberlite phases. Photos show 300µm - 425µm size aperture grains on different focus levels on a binocular microscope. Panels (A) and (B) mauve (likely G10) garnet, with a 'sculpted' surface texture. Panel (C) mauve dodecahedral (likely G10) garnet with an etched surface texture. Panel (D) clinopyroxene mineral grain displaying a finely frosted surface texture. Panels (E) and (F) mauve (likely G10) garnets. Note panel (F) represents melt veins along a parallel fracture network in garnet. Panels (G) and (H) oxide mineral grains. Panel (G) anhedral chromite with a lustrous surface texture and panel (H) subhedral chromite mineral grain, with a glossy/lustrous texture.

In addition, oxide mineral grains recovered from unit F1 and F3 were imaged using back-scatter electron scanning on the electron microprobe, to observe any compositional alteration characteristics, as opposed to mineralogical alteration. Deuteric alteration is known to have affected the Finsch kimberlite (Fraser and Hawkesworth, 1992) and evidence of this alteration is observed in the widespread serpentinization of olivine macrocrysts. Figure 15 depicts back-scatter electron images of altered oxide grains from Finsch kimberlite. These grains display various types of alteration zones observed on some of the oxide mineral grains from the F3 and F1 Finsch kimberlite phases. It is important to note that all of the ilmenite minerals grains recovered as heavy mineral concentrates are completely altered and provided no useful mineral compositional data.

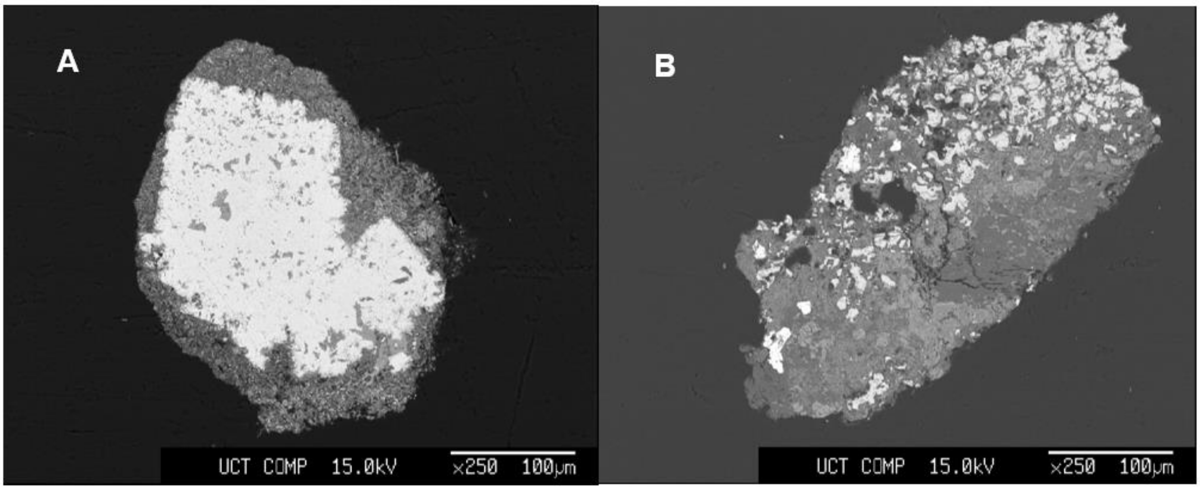


Figure 15: Photomicrographs of the various alteration characteristics observed from a select set of kimberlite indicator minerals recovered from the various Finsch kimberlite phases. (A) Chromite mineral grain from the F3 kimberlite lithophase, with alteration zones of Mg oxide apparently replacing Fe oxide. (B) A nearly completely altered ilmenite mineral grain from the F3 kimberlite lithophase. The alteration of ilmenite involves oxidation (into titanomagnetite or haematite, along with Ti oxide - rutile or pseudobrookite). It must be noted that all of the ilmenite minerals grain recovered as heavy mineral concentrates were either nearly completely altered or provided unreliable mineral compositional contents.

4.3 Resorption characteristics of the Finsch microdiamonds

Diamond can be destroyed by resorption, where elemental carbon is oxidized to carbonate and dissolved in the magma, during kimberlite transport and emplacement. This phenomenon can result in surface textures such as trigons, hexagons, shield-shaped laminae, tetragons, hillocks and terraces, (Fedortchouk and Zhang 2011). Figure 16 depicts various micro-diamonds (i.e., < 1 mm in size) recovered from the F4 kimberlite dyke. The F4 kimberlite dyke is the only unit to have yielded diamonds during heavy mineral separation routines of the different kimberlite phases sampled in this study.

Several diamond resorption textures are visible in Figure 16, suggesting that the host kimberlite magma acted on the diamonds as an oxidizing agent. The oxidation state of the host magma has been suggested as a key controlling factor in the preservation and/or resorption of diamonds (Fedortchouk et al., 2007). Diamond preservation in kimberlite has been correlated to the concentrations of ferric iron in megacrystic ilmenite (Horwood, 1998), however a recent oxygen barometer, based on the ferric iron content of perovskite has provided more direct estimates of oxygen fugacity in kimberlites (Nowicki et al., 2008). It must however be noted that no perovskite mineral grains were identified in heavy mineral concentrate samples or in any thin sections of all samples analysed in this study.

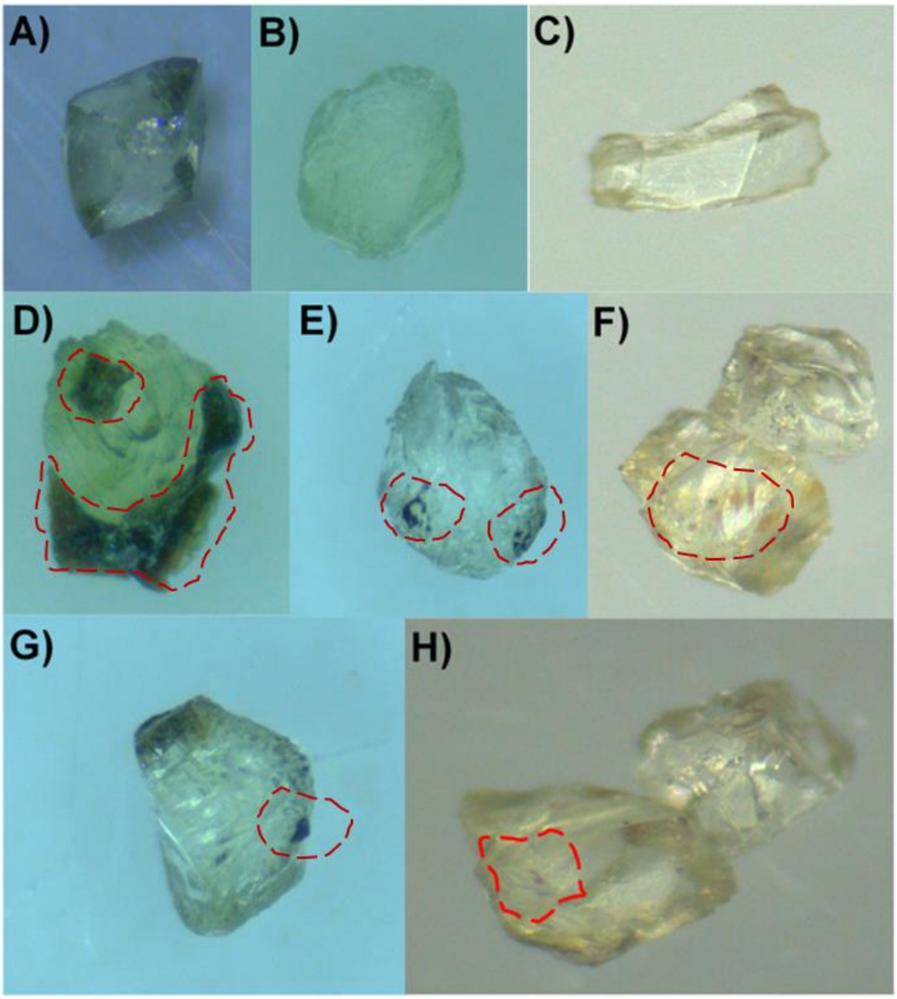


Figure 16: Microdiamonds recovered from the F4 dyke during KIM selection. Panels (A) to (H) have horizontal fields of view of 300µm to 425µm. Images were taken using different focus levels on a binocular microscope. Panel (A) flat-faced colourless octahedron, with resorption-terraces developed at the connecting apex of the crystal. Panel (B) colourless resorbed and frosted octahedron/dodecahedron. Panel (C) dodecahedron fragment with fresh fractured edges possibly due to primary and secondary sample preparation crushing. Panels (D), (E), and (G) resorbed, colourless octahedrons/dodecahedron with residual kimberlite matrix (outlined in red) attached to the diamond. Panels (F) and (H) inclusions (outlined in red) in colourless dodecahedrons: Panels (F) and (H) diamonds containing likely peridotitic garnet and sulphide inclusions.

Resorption reduces diamond size and cause changes in the shape and surface texture of diamonds. This can significantly reduce the total diamond content of any kimberlite, affecting the economic value of kimberlite-hosted diamond deposits. The process(es) behind diamond resorption may also be responsible for a lack of correspondence between KIM populations (e.g., the proportion of diamond indicating G10 garnets sampled in kimberlite which indicate the potential for diamond association, etc.) and the occurrence of diamonds, either in particular kimberlite phases or overall.

Chapter Five – Chemistry of kimberlite indicator minerals

5.1 Major element results

Garnet, clinopyroxene, chromite and ilmenite mineral grains recovered as heavy mineral concentrates from the Finsch kimberlite phases, were classified first by colour, lustre, crystal system and other mineral properties, using the approach outlined in Chapter 3. Then the grains were classified by chemical composition using classification schemes. These classification schemes are used to classify the various minerals recovered from the Finsch kimberlite phases into different parageneses, therefore determining which mineral groups are most likely associated with diamond', e.g., CaO-Cr_2O_3 to distinguish G10/harzburgitic compositions; Na_2O in garnet to distinguish Group1 (i.e., potentially diamondiferous) from Group 2 eclogites and Al_2O_3 in clinopyroxene to discern an origin from garnet peridotite versus eclogitic, megacrystic or phenocrystic. It must be noted that all of the ilmenite mineral grains recovered as heavy mineral concentrates were either nearly completely altered or provided unreliable mineral compositional contents (i.e., >50 wt. % of Fe_2O_3 or MgO contents). For these reasons, all ilmenite compositional data is excluded from interpretation in this study.

5.1.1 Garnet results

Average major element data for each colour category of garnet are presented in Table 6. Schulze (2003) classifies mantle-derived garnets first by their Mg# and Ca#, to differentiate mantle from crustal garnets. Next, the Mg# and Cr_2O_3 (wt. %) contents are used to distinguish peridotitic from eclogitic garnets (Schulze 2003). For red and orange garnets with Mg# greater than 0.65, a TiO_2 (wt. %) vs. Ca/(Ca + Mg + Fe) plot is used to distinguish eclogitic garnets from megacrystic varieties (Schulze, 2003). Next, a CaO (wt. %) vs. Cr_2O_3 (wt. %) plot is used to distinguish the G10, G9, G5 and other compositional garnet lithological groups. Some of these mantle lithologies, particularly harzburgitic, are associated with diamond. Lastly, the Mg# is plotted versus TiO_2 (wt. %) and Cr_2O_3 (wt. %) contents to identify the extent of melt-depletion in garnet and, to distinguish megacrystic from all other garnets. The data presented are compared with literature data for Finsch garnet diamond inclusions (Gurney and Switzer, 1973; Appleyard et al., 2003; Viljoen et al., 2014) and xenolithic garnet (Shee et al., 1982; Skinner, 1986; Viljoen et al., 1992; Griffin et al., 2003; Gibson et al., 2008; Lazarov et al., 2009ab; Lazarov et al., 2012ab) to see how similar or different the population of KIMs sampled by kimberlites are to the minerals as xenoliths and diamond inclusions.

Table 6: Average mineral major element data for peridotitic and eclogitic garnet groups from the F1, F2, F3, F4, F5/F6 and F8 Finsch kimberlite phases. See footnote[1] for further explanations.

	F1				F2				F3				F4				F5/F6				F8			
	Purple	Pink	Red	Orange	Purple	Pink	Red	Orange	Purple	Pink	Red	Orange	Purple	Pink	Red	Orange	Purple	Pink	Red	Orange	Purple	Pink	Red	Orange
SiO_2	39.99	41.63	42.27	41.75	41.47	42.37	41.30	40.66	40.89	-	-	-	41.47	42.37	41.30	40.66	41.95	42.35	43.22	41.82	42.10	42.50	42.24	41.91
TiO_2	0.08	0.07	0.44	0.50	0.11	0.16	0.34	0.41	0.18	-	-	-	0.11	0.16	0.34	0.41	0.10	0.21	0.34	0.50	0.14	0.13	0.44	0.39
Al_2O_3	19.81	21.72	22.53	22.93	20.39	21.53	21.80	22.62	17.73	-	-	-	20.39	21.53	21.80	22.62	20.09	21.46	21.49	22.42	19.68	22.21	22.16	22.53
Cr_2O_3	4.64	2.97	1.69	0.84	5.20	2.90	2.59	0.80	7.52	-	-	-	5.20	2.90	2.59	0.80	5.55	3.52	2.82	1.70	5.85	2.82	2.06	0.51
FeO	6.38	7.32	8.60	10.46	6.71	8.76	9.42	9.99	6.96	-	-	-	6.71	8.76	9.42	9.99	6.18	6.97	7.09	8.07	6.64	7.49	7.72	10.00
MnO	0.33	0.34	0.31	0.31	0.38	0.39	0.40	0.34	0.38	-	-	-	0.38	0.39	0.40	0.34	0.35	0.33	0.31	0.30	0.34	0.35	0.32	0.32
MgO	19.54	20.06	20.16	19.50	20.52	19.67	19.52	19.14	18.56	-	-	-	20.52	19.67	19.52	19.14	21.38	20.57	20.27	20.08	20.30	20.28	20.36	20.33
CaO	3.98	4.45	4.16	4.05	4.42	4.22	4.32	4.79	5.96	-	-	-	4.42	4.22	4.32	4.79	3.47	4.52	4.30	4.18	4.93	4.46	4.19	3.85
Na_2O	0.07	0.06	0.09	0.10	0.06	0.06	0.09	0.11	0.13	-	-	-	0.06	0.06	0.09	0.11	0.11	0.10	0.09	0.08	0.06	0.07	0.10	0.10
K_2O	0.02	0.02	0.01	0.01	0.01	0.03	0.02	0.01	0.03	-	-	-	0.01	0.03	0.02	0.01	0.03	0.02	0.02	0.01	0.02	0.01	0.01	0.01
Total	99.81	98.63	100.27	100.44	99.27	100.07	99.81	98.87	98.59	-	-	-	99.27	100.07	99.81	98.87	99.22	100.06	99.95	99.17	100.07	100.31	99.61	99.96
n	49	61	66	58	60	57	47	49	3	-	-	-	60	57	47	49	61	51	72	30	52	59	115	26

Table 7: Average mineral major element data for clinopyroxene and chromite mineral groups from the F1, F2, F3, F4, F5/F6 and F8Finsch kimberlite phases. See footnote[1] for further explanations.

	F1		F2		F3		F4		F5/F6		F8	
	CPX	CHR	CPX	CHR	CPX	CHR	CPX	CHR	CPX	CHR	CPX	CHR
SiO_2	54.36	0.05	54.69	0.05	54.40	0.03	55.01	0.06	53.47	0.06	53.26	0.07
TiO_2	0.13	2.92	0.17	0.60	0.20	7.41	0.14	3.39	0.15	6.65	0.12	0.48
Al_2O_3	3.19	7.15	2.60	9.38	2.04	7.27	1.89	7.12	3.07	7.11	4.76	8.09
Cr_2O_3	1.53	58.10	1.91	59.02	2.43	50.44	1.66	57.12	3.20	52.11	2.27	59.83
FeO	2.66	17.95	2.25	16.70	2.37	21.22	0.44	17.69	2.49	20.66	3.07	16.68
Fe_2O_3	-	19.95	-	18.56	-	23.58	-	19.65	-	22.95	-	18.53
MnO	0.09	0.48	0.08	0.48	0.09	0.71	0.10	0.47	0.11	0.49	0.12	0.48
MgO	16.35	12.96	16.59	13.48	16.65	11.96	3.97	13.61	16.86	12.22	16.47	13.29
CaO	19.23	0.00	19.41	0.00	19.40	0.00	19.74	0.00	18.59	0.01	18.12	0.00
Na_2O	1.44	-	1.61	-	2.13	-	14.70	-	1.90	-	1.22	-
K_2O	0.02	-	0.03	-	0.03	-	2.03	-	0.03	-	0.03	-
Total	99.00	99.60	99.33	99.69	99.74	99.03	99.67	99.45	99.86	99.29	99.44	98.92
n	37	44	51	42	66	31	42	30	32	49	46	35

[1] All results in Table 6 and 7 are the means of the number of grains analysed (given in the bottom row) in each category, in parts per million (ppm), expressed in wt. %. Abbreviations: CPX: clinopyroxene; CHR: chromite.

a) Paragenesis

Magnesium-number (Mg#) is indicative of the extent of melt-depletion in mantle-derived peridotitic garnets, where highly depleted rocks are characterized by high Mg#. Only 0.7% to 7% of garnet data from the various Finsch kimberlite phases plot in the crustal field of Schulze (2003), as shown in Figure 17. It is noted that several garnet data overlap the fields of peridotite xenolith garnets (from all kimberlite units) and peridotitic diamond inclusions (only units F1, F4, F5/F6 and F8), with only few garnet data overlapping (or plotting near/along the boundary) of eclogitic diamond inclusions, however.

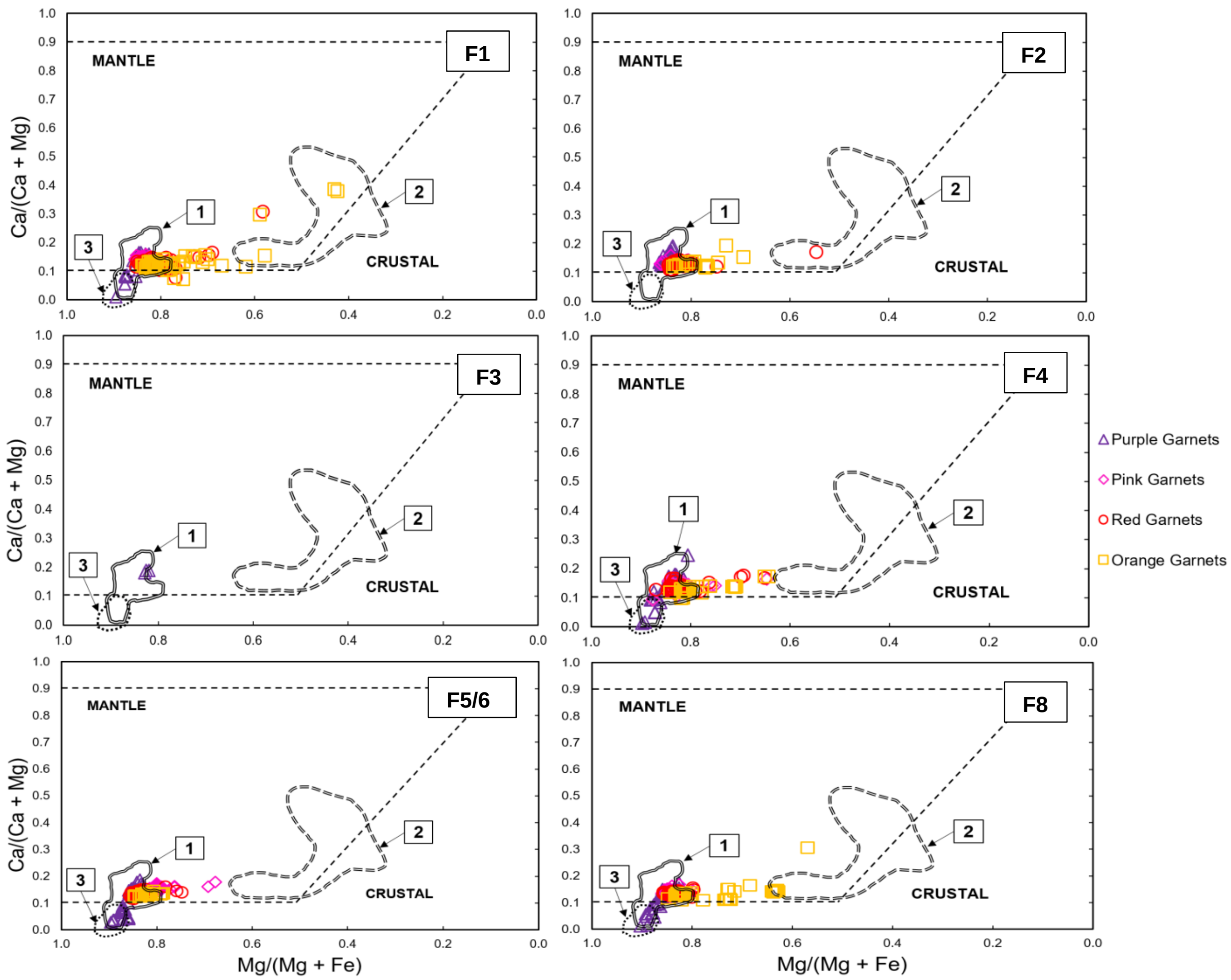


Figure 17: Mg/(Mg+Fe) vs. Ca/(Ca+Mg) crust/mantle garnet classification diagram of Schulze (2003), depicting the predominantly mantle origin of garnets from the various Finsch kimberlite phases. Garnets that fall into the crustal field on these diagrams (except purple, red and orange garnets with very low Ca#) are excluded from further interpretation in this study (see Figure 23). The fields as labelled are: 1: Peridotite xenolith garnets (Shee et al., 1982; Skinner, 1986; Viljoen et al., 1992; Griffin et al., 2003; Gibson et al., 2008; Lazarov et al., 2009ab; and Lazarov et al., 2012ab); 2: Eclogitic diamond inclusions from Appleyard et al. (2004); 3: Peridotitic diamond inclusions from Gurney and Switzer (1973) and Viljoen et al. (2014). Note that Mg/(Mg + Fe) values on X-axis are shown in reverse order.

All of the garnets that fall outside (especially those with very low Ca#) or along the mantle boundaries of the Schulze (2003) diagram (see Figure 17, panels for unit F1, F4, F5/6 and F8) indeed appear to be mantle garnets and are considered as such in this study.

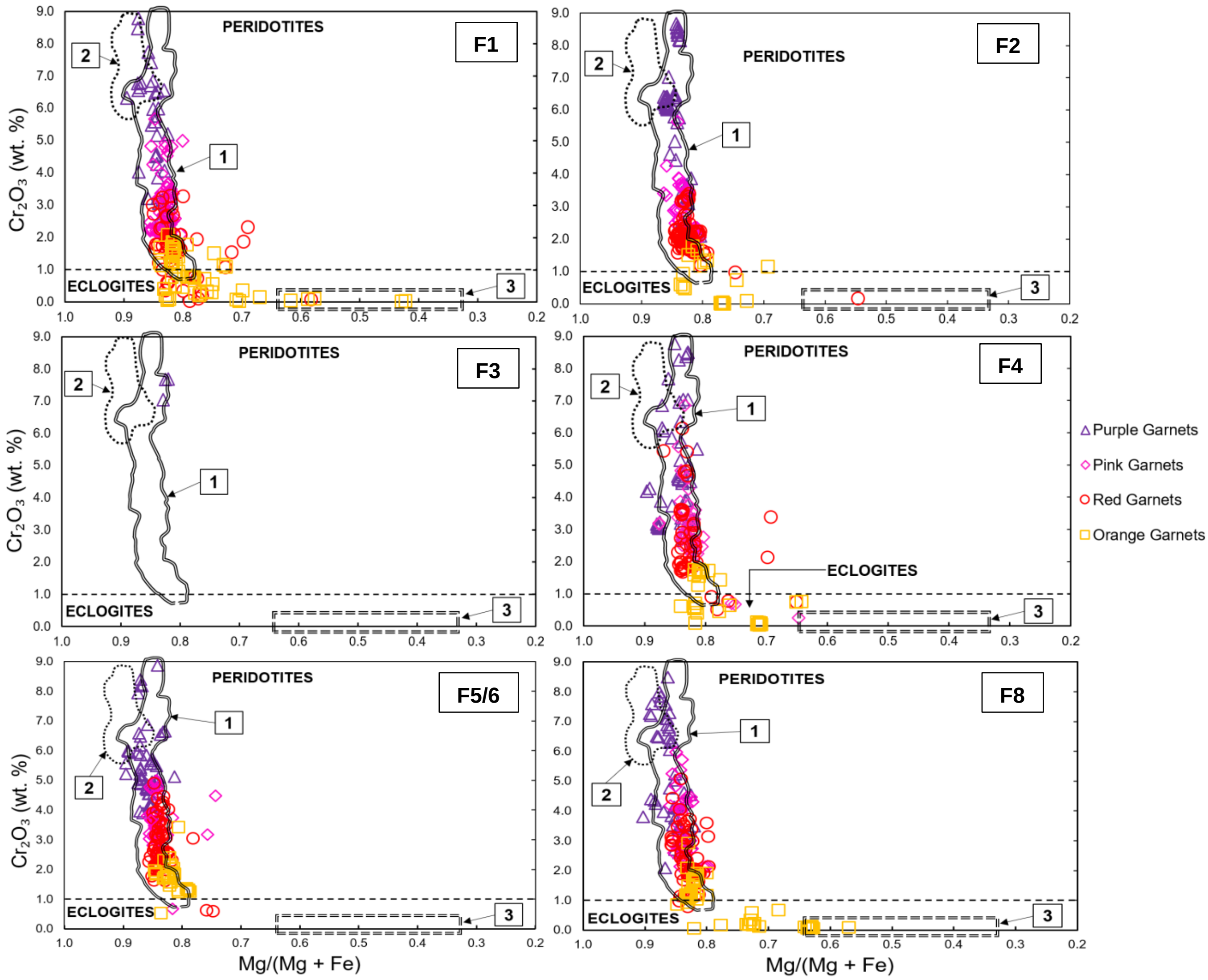


Figure 18: Mg/(Mg + Fe) vs. Cr_2O_3 garnet classification diagram, with fields for eclogites and peridotites from Schulze (2003). Most of the garnets obtained from the various Finsch kimberlite phases plot within the peridotitic field. It should however be noted that megacrystic garnets are not distinguished in this diagram. The fields as labelled are: 1: Peridotite xenolith garnets (see data sources Figure 17); 2: Peridotitic diamond inclusions from Gurney and Switzer (1973) and Viljoen et al. (2014); 3: Eclogitic diamond inclusions from Appleyard et al. (2004).

The Mg# vs. Cr_2O_3 garnet classification diagram (Fig. 18), is used to distinguish between peridotitic and eclogitic garnet parageneses, with the peridotites and eclogites fields reproduced from Schulze (2003). The majority of the garnets represented in Figure 18 are of peridotitic paragenesis (F2, F3, F4, F5/F6 and F8). Unit F1 has the largest proportion (>25%)

of garnets of eclogitic paragenesis and unit F5/F6 is characterized by the lowest proportion of eclogitic garnets. Several garnet data in Figure 18 overlap the xenolithic garnet field (all kimberlite units), whereas units F1, F2, F4 and F8 are the only kimberlite units which have garnet data which approaches and/or overlaps the eclogitic diamond inclusion field of Appleyard et al. (2004)

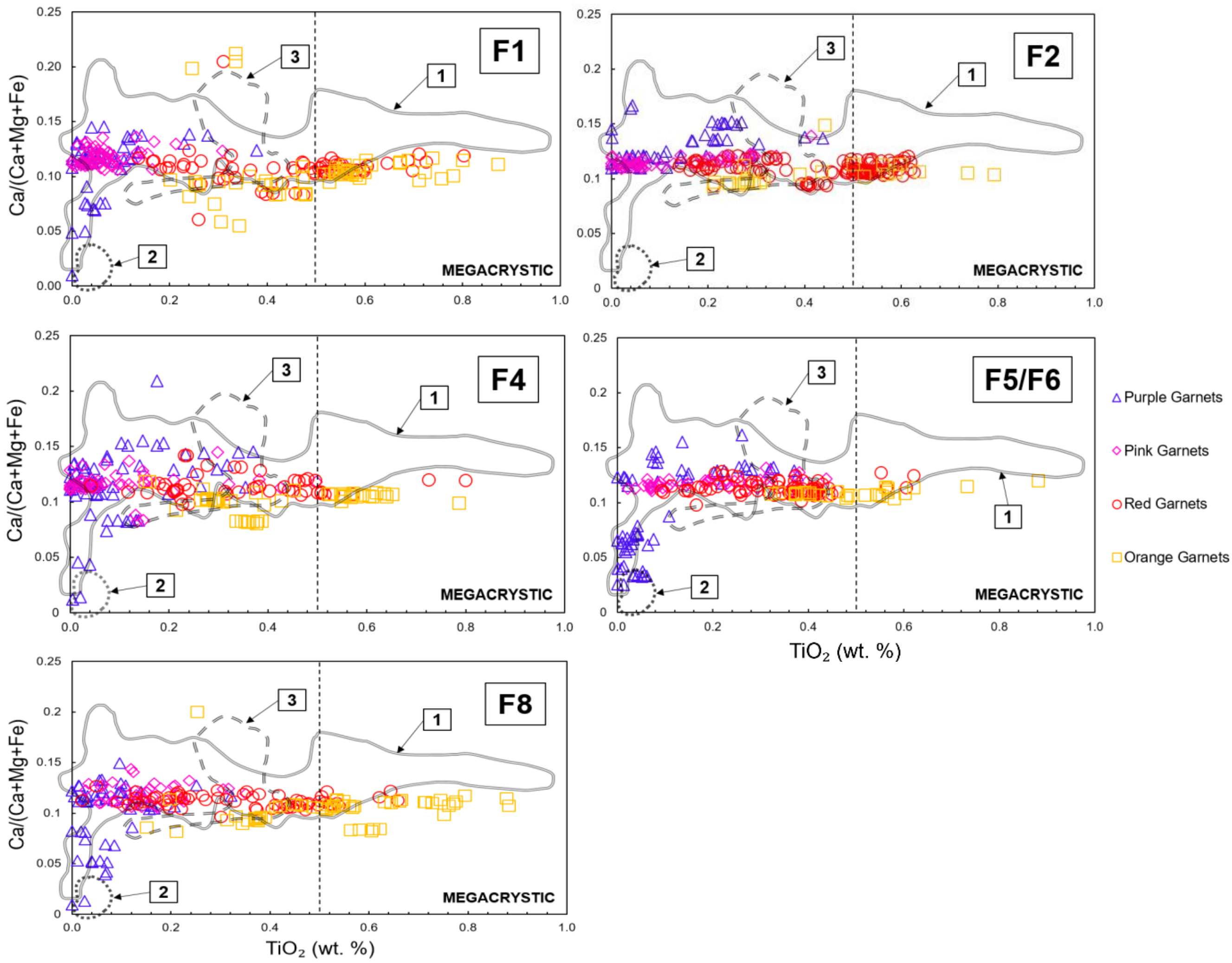


Figure 19: Variation diagram of TiO_2 (wt. %) vs. Ca/(Ca + Mg + Fe) of Schulze (2003) for distinguishing megacrystic and non-megacrystic garnets from all Finsch units. Garnets with TiO_2 < 0.5 wt. % are considered to be either peridotitic or eclogitic, based on the Cr_2O_3 composition of each garnet. The fields of comparison data are as shown as in Figure 17, including all associated data sources.

The TiO_2 vs. Ca/(Ca + Mg + Fe) diagram in Figure 19, is used to distinguish the Finsch garnets of likely megacrystic paragenesis, with the megacrystic field reproduced from Schulze (2003). This diagram is applied to all Finsch garnets to differentiate megacrysts [with Cr_2O_3 <1 wt. %, based on the classification of Schulze (2003)] and megacrysts (with Cr_2O_3 < 4 wt. %, based on the G1 garnet classification of Grütter et al. (2004)). The Cr_2O_3 contents of these garnets were categorized into the Cr_2O_3 concentration groups denoted above before being applied to the TiO_2 vs. Ca/(Ca + Mg + Fe) diagram. Figure 19 is dominated by garnet data which overlaps the xenolithic mantle garnet field, followed by garnet data which overlaps the eclogitic diamond inclusion field (to a lesser extent), with very few purple garnet data approaching or overlapping the peridotitic diamond inclusion field. It should however be noted that eclogitic garnets with TiO_2 contents at least as high as 0.9 wt.% have been reported (Viljoen et al., 2005), therefore not every garnet that falls in the megacrystic field on this diagram is necessarily a megacryst.

The CaO vs. Cr_2O_3 garnet classification diagram (Fig. 20), is probably the most used diagram for distinguishing the different compositional groups of mantle garnet. These groups are associated with different mantle lithologies, of which some (e.g., harzburgite) have an association with diamond. The fields shown in Figure 20, after Grütter et al. (2004), are G10 (harzburgitic), G9 (lherzolitic), G12 (wehrlitic), G0 (garnets derived from unclassified mantle lithologies), G1 (megacrystic – not shown), G3 (eclogitic, 6 – 32 wt. % CaO), G4 (eclogitic, 2 – 6 wt. % CaO) and G5 (pyroxenitic). For units F1, F2, F3, F4 and F8, fewer than 20% of all garnet data plot in the G10 field in Figure 20. For unit F5/F6, more than 25% of garnet data plot in the G10 field (Fig. 20). For each unit, the percentage of peridotitic garnets (i.e., G9+G10+G12) that are G10 is: F1 (7.2%), F2 (17.5%), F3 (0%), F4 (15.9%), F5/F6 (26.7%) and F8 (17.1%).

Purple garnets are, by far, the dominant garnet type plotting in the G10 field. Some of the G10 garnets in Figure 20 fall at low CaO values (less than ≈3 wt. %), plotting near the main concentration of diamond inclusion data from Gurney and Switzer (1973) and Viljoen et al. (2014), (e.g. mostly purple garnets from units F1, F4, F5/F6 and F8). However, for all units except F3 (Fig. 20), the garnet population is dominated by an elongated grouping of data that lies along the Ca-rich side of the G10-G9 field boundary, with a smaller population of data that lies well within the G10 field. The F1 and F8 phases are the only two units that are characterized by garnets that plot in the low Cr_2O_3, high CaO G3 (i.e., "eclogitic") field in Figure 20. Furthermore, the elongated grouping of Finsch garnets along the G10-G9 boundary (Fig. 21) plot near or overlap data for garnets from many Finsch mantle xenoliths, including garnet lherzolite xenoliths (i.e., Shee et al., 1982; Skinner, 1986; Gibson et al., 2008; Lazarov et al., 2009ab) and garnet harzburgite xenoliths (i.e., Skinner, 1986; Viljoen et al., 1992).

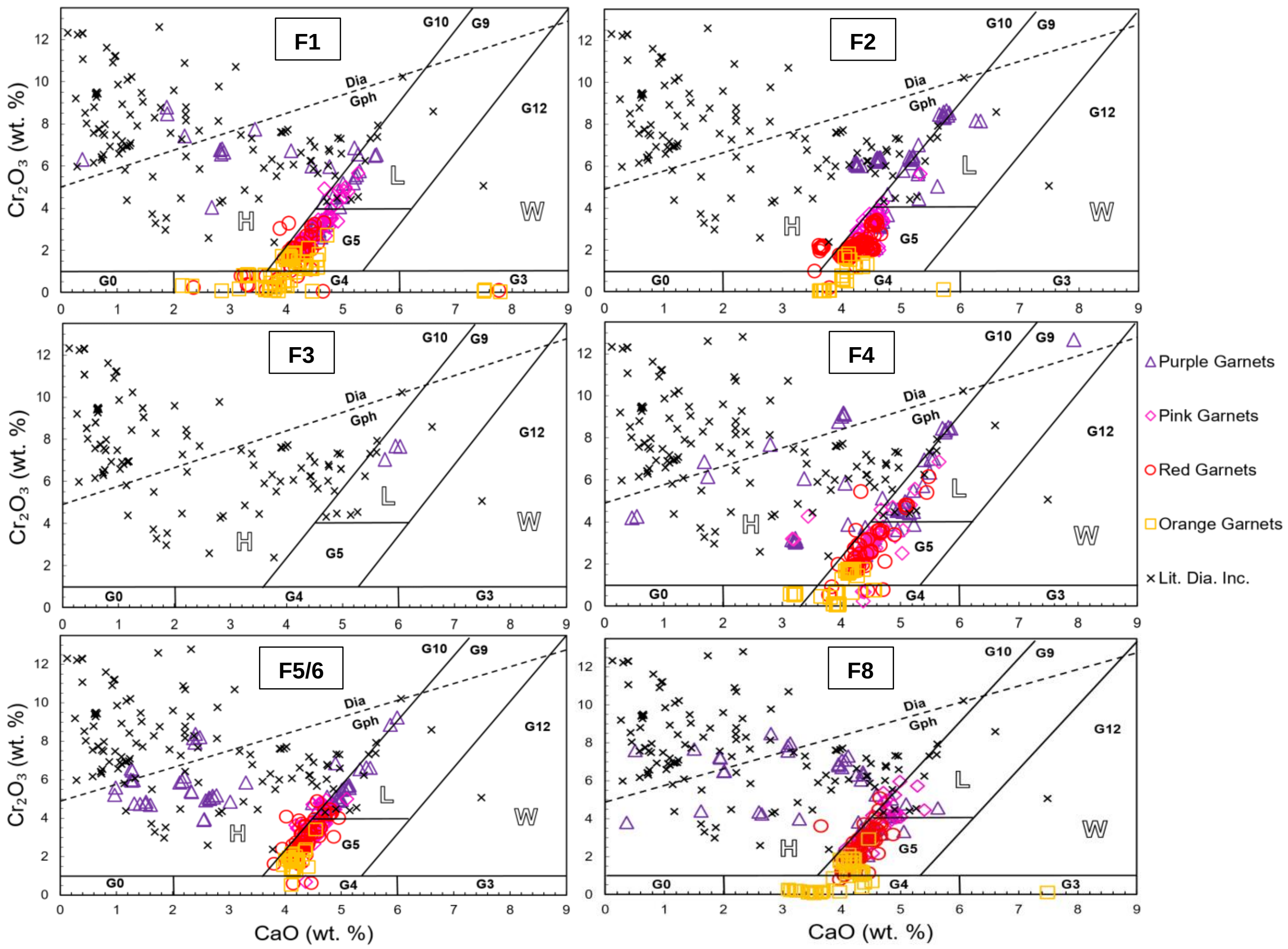


Figure 20: CaO vs. Cr_2O_3 garnet classification diagram, with compositional fields and graphite-diamond transition, shown after Grütter et al. (2004). Note that the G5 field entirely and the G4 field partially overlies the G9 field (which extends to Cr_2O_3 = 0 wt. %), with the G5 and G4 categories being distinguished from G9 on the basis of Mg#. The literature data for peridotitic garnet diamond inclusions (i.e., Lit. Dia. Inc.) is denoted by "X" symbols and includes diamond inclusion data from Gurney and Switzer (1973) and Viljoen et al. (2014).

The Na_2O vs. TiO_2 eclogitic garnet classification diagram (Fig. 22), is used to classify eclogitic garnets on the basis of Na_2O content and distinguish them from megacrystic garnets. Eclogitic garnets with elevated Na_2O (i.e., Na_2O >0.07 wt. %) are considered significant in diamond exploration programs, because diamond-bearing eclogites are associated with the Group 1 eclogite type and all diamond-bearing eclogites are of this type (e.g., MacGregor and Carter, 1970; Robinson et al., 1984), although not all Group 1 eclogites are diamondiferous. Conversely, eclogitic garnets with low TiO_2 and low Na_2O (i.e., Na_2O < 0.07 wt. %) are associated with Group 2 eclogites, whereas those low-Cr garnets with relatively high TiO_2 and low Na_2O tend to be megacrystic.

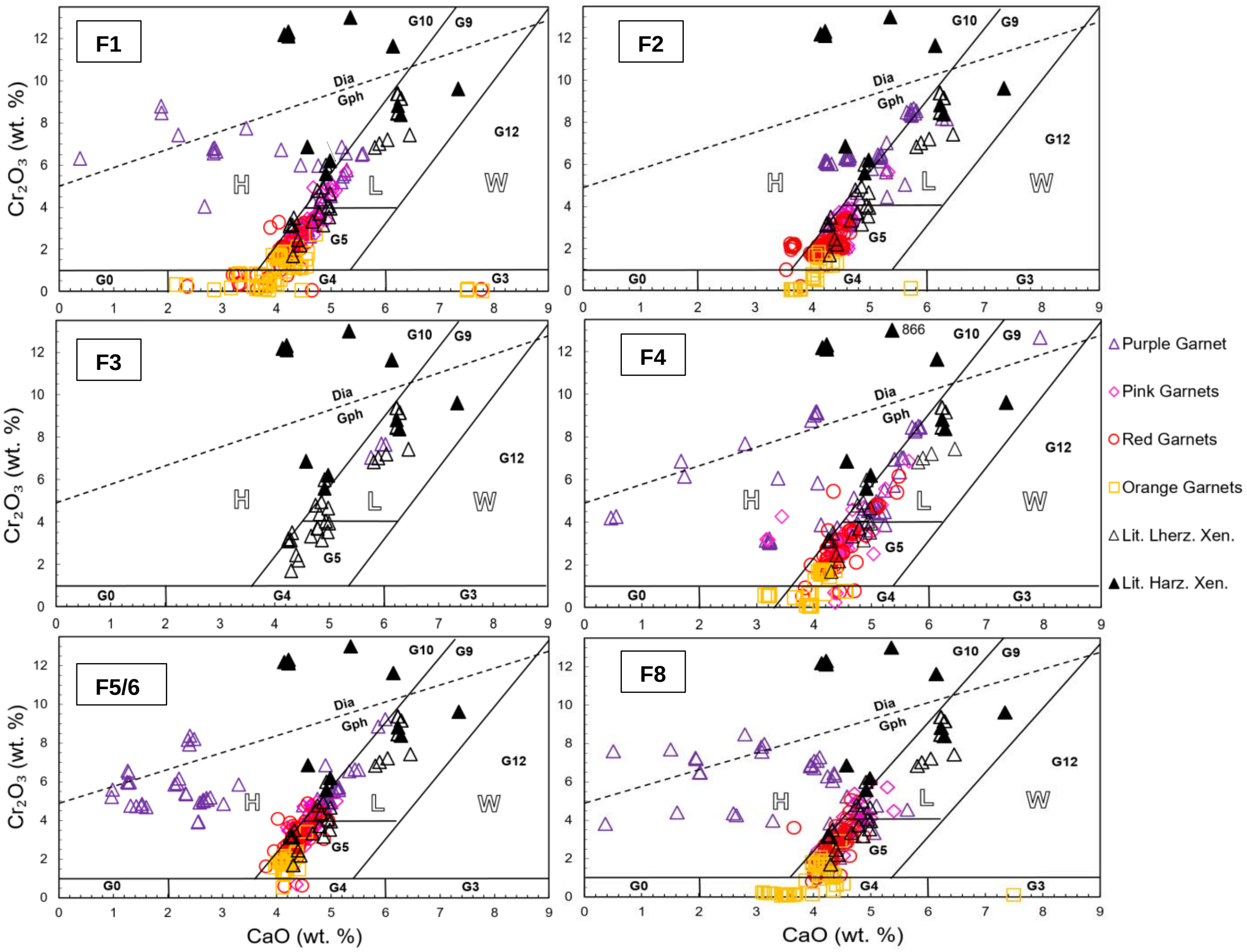


Figure 21: CaO vs. Cr_2O_3 garnet classification diagram, with compositional fields and graphite-diamond transition shown after Grütter et al. (2004) and garnet data, obtained from Finsch mantle xenoliths. Data for garnets from Finsch garnet lherzolite and garnet harzburgite xenoliths (i.e., Lit. Lherz. Xen., and Lit. Harz. Xen., respectively) are denoted by open and closed "Δ" symbols, respectively (data from Shee et al., 1982; Skinner, 1986; Viljoen et al., 1992; Gibson et al., 2008; Lazarov et al., 2009ab).

For those kimberlite phases with significant numbers (≥5) of garnets with Cr_2O_3 contents of less than 1 wt. % (i.e., F1, F2, F4 and F8), more than 80% of these low-Cr_2O_3 garnets have Na_2O contents in excess of 0.07 wt. % (Fig. 22), which also approach and/or overlap the eclogitic garnet diamond inclusion field of Appleyard et al. (2004), especially for units F2 and F4. The Group 2 field (Fig. 22) contains less than 10% of garnet data for units F4 and F8, and approximately 15% of garnet data for unit F1, with no garnets falling in the Group 2 field for units F2 or F5/F6 (Fig. 22). The F5/F6 kimberlite has only four garnets with <1 wt. % Cr_2O_3 and these all fall in the megacrystic field, with half having Na_2O greater and half less than 0.07 wt. %. No Cr-poor garnets were obtained from unit F3. Note the small proportion of garnets that fall in the "M" field in Figure 22. This strongly suggests that many of the garnets identified as "megacrystic " in Figure 19 are actually eclogitic.

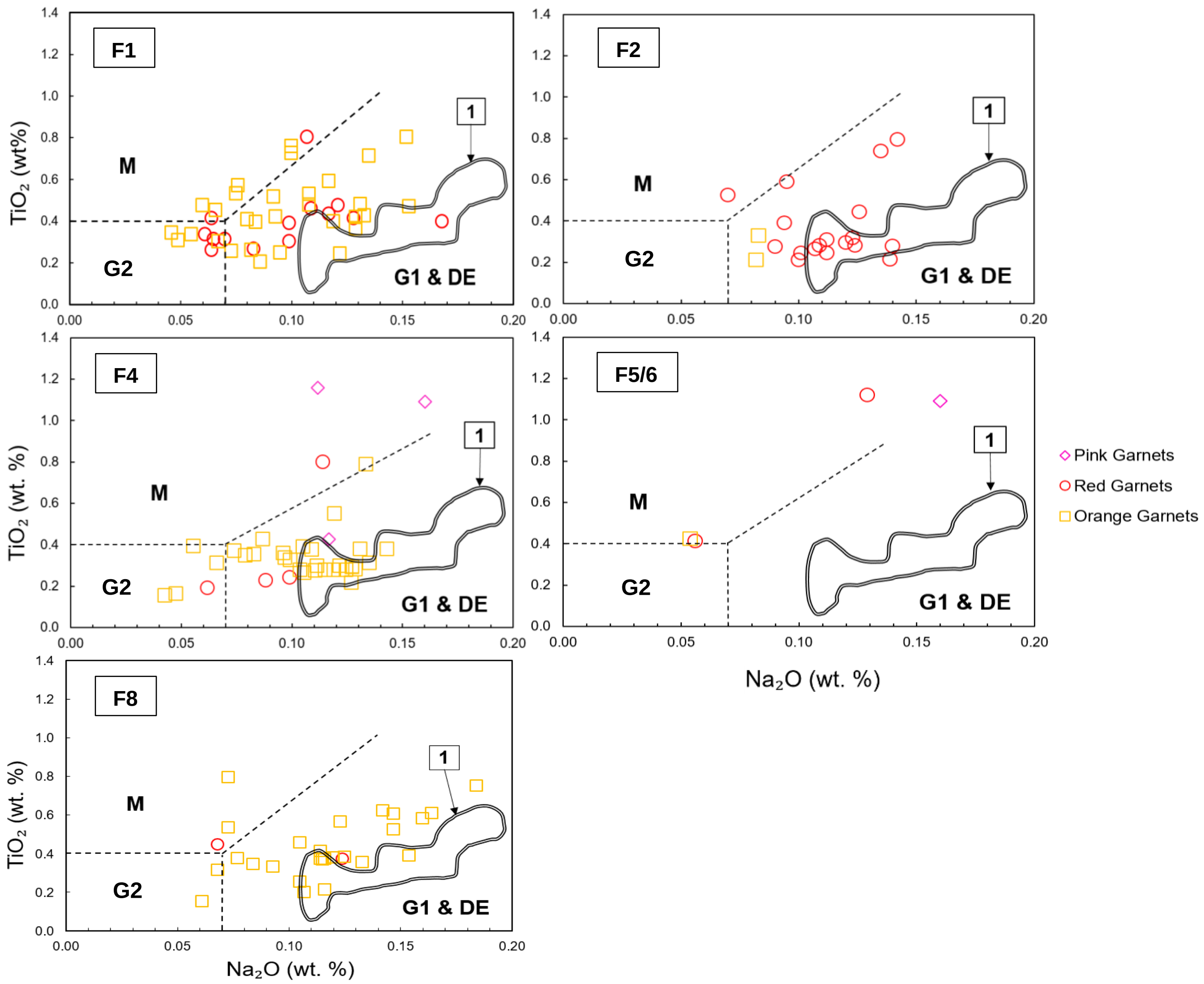


Figure 22: Na_2O vs. TiO_2 eclogitic garnet diagram for the various Finsch kimberlite phases. This diagram only shows garnets having <1 wt. % of Cr_2O_3. The 0.07 wt. % Na_2O and 0.4 wt. % TiO_2 divisions are from Cookenboo and Grütter (2010). Field definitions are: 1: Finsch eclogitic garnet diamond inclusion field from Appleyard et al. (2004); M: Cr-poor megacrysts; G2: Group 2 eclogite; G1 & DE: Group 1 (including diamondiferous) eclogite. Note that unit F3 has no low-Cr garnets and so data for this unit are not shown.

The stacked bar graph diagram in Figure 23, represents a summary of the results of differently coloured garnet mineral grains from the various Finsch units, sorted into harzburgitic, lherzolitic, wehrlitic, megacrystic or eclogitic paragenesis groups, mainly using classification schemes of Schulze (2003) and Grütter et al. (2004). In detail, the CaO vs. Cr_2O_3 garnet classification diagram (Fig. 20) was used to differentiate harzburgitic, lherzolitic and wehrlitic paragenesis. Further, the Mg# vs. Cr_2O_3 garnet classification diagram (Fig. 18) was used to distinguish between peridotitic and eclogitic garnet parageneses. This is done for the reason that many of the eclogitic garnets fall in the G4 and G5 (pyroxenite) fields of Grutter et al. (2004) diagram in Figure 20, where similarly, many megacrystic garnets also fall (e.g., eclogitic). For this reason, the chemical composition, rather than colour, must be used as the primary means of classifying garnets and their parageneses. Lastly, Figure 19 was used to distinguish the Finsch garnets of likely megacrystic paragenesis. It is clear from Figure 23 that garnets of a certain colour (e.g., orange) are often not classified as being of the paragenesis that a given colour is typically associated with (e.g., orange garnets may be lherzolitic rather than eclogitic).

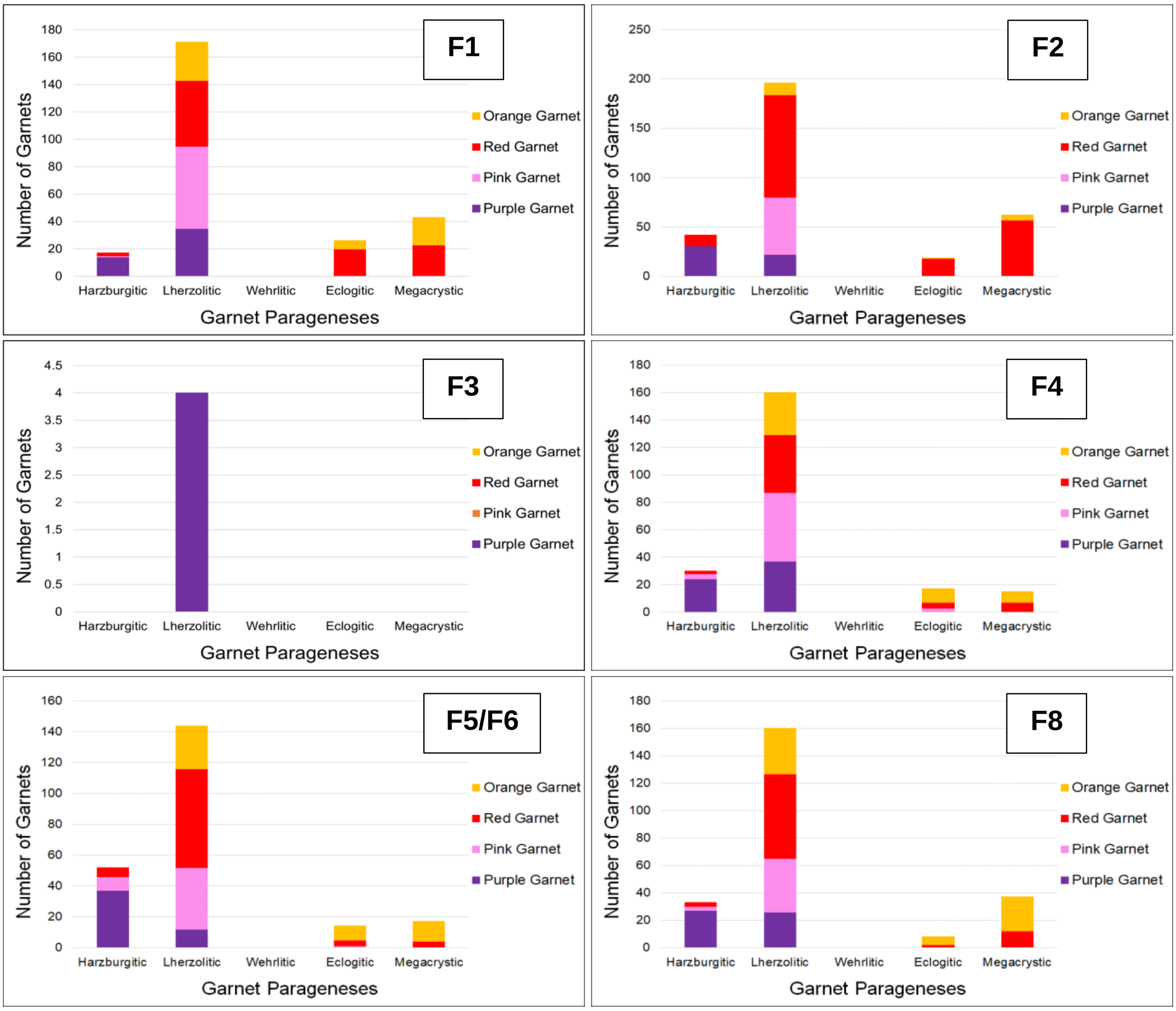


Figure 23: Stacked bar graphs, showing the results of the garnet minerals obtained from the various Finsch kimberlite phases, sorted according to their parageneses (harzburgitic, lherzolitic, wehrlitic, megacrystic or eclogitic), mainly using classification schemes of Schulze (2003) and Grütter et al. (2004). The different colour stacks show the different coloured garnet grains that constitute each paragenesis group.

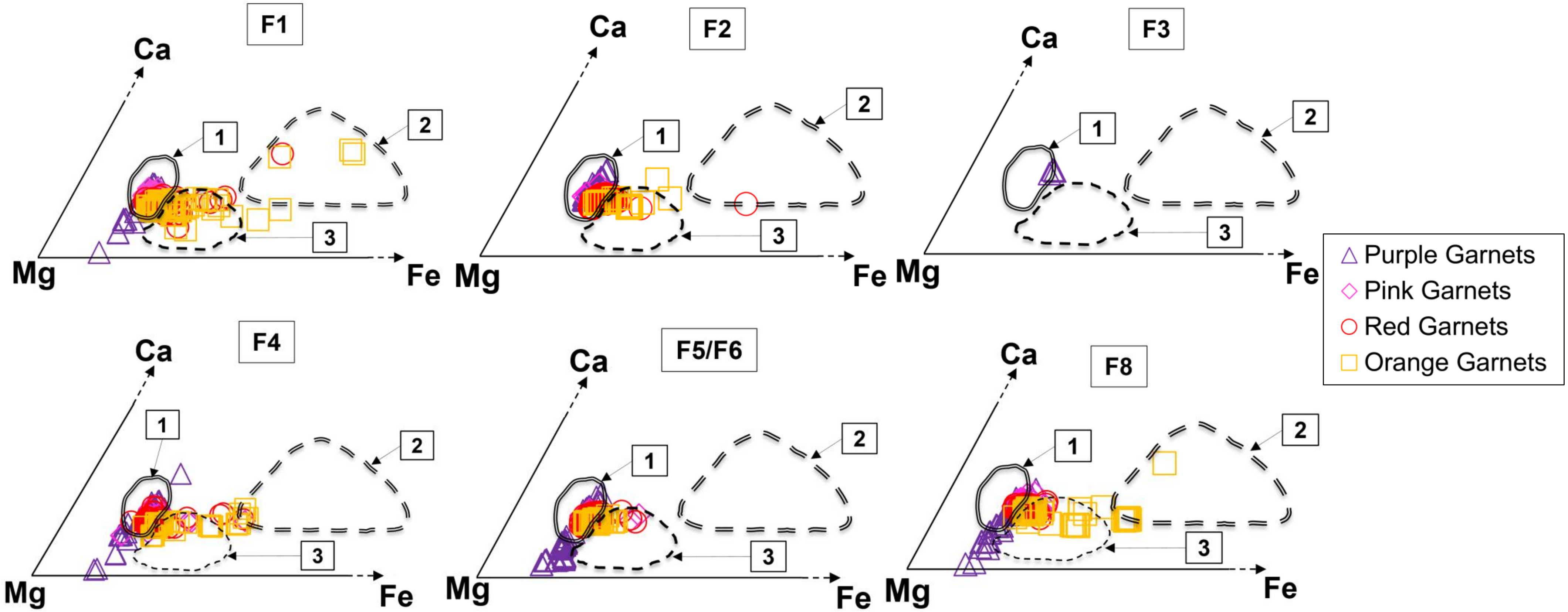


Figure 24: Bottom right-hand apex of the Ca-Mg-Fe ternary diagram (atomic proportions) for garnets recovered from the Finsch kimberlite phases. The fields shown are as follows: 1: peridotitic xenolithic garnet (double black solid lines, data from Shee et al., 1982; Skinner, 1986, Gibson et al., 2008, Lazarov et al., 2009a, 2009b); 2: the eclogitic garnet diamond inclusion field (double black dashed lines, data from Appleyard et al., 2004) and 3: the peridotitic garnet diamond inclusions field (single black dashed-lines, data from Gurney and Switzer, 1973).

The ternary diagrams in Figure 24 are used to compare the Ca-Mg-Fe composition of kimberlitic concentrate garnets with those of garnet inclusions in diamonds in terms of their main chemical components. The vast majority of the garnet data have compositions falling within or on the edge of the Finsch peridotitic diamond inclusion field, and only relatively few fall within the eclogitic garnet diamond inclusion field for Finsch (Fig. 24). In detail, the compositions of many garnets plot near or along the boundary of the peridotitic garnet diamond inclusions and peridotitic garnet field for units F5/F6 and F8, while only few garnets from units F1, F2 and F4 overlap the field of peridotitic garnet diamond inclusions (Fig. 24). Garnets from unit F3 only approach (but do not overlap) the peridotitic garnet diamond inclusion field. In addition, the composition of only few garnets overlap the eclogitic garnet diamond inclusion field in Figure 24. Unit F2 is characterized by the highest proportion of garnet data in Figure 24 that overlap the peridotitic garnet field, followed by unit F1, unit F4, unit F5/F6 and unit F8.

5.1.2 Clinopyroxene results

Average clinopyroxene major element data for each kimberlite unit are presented in Table 7. The CaO vs. Cr_2O_3 clinopyroxene classification diagram (Fig. 25) compares the compositions of KIM clinopyroxene obtained from the Finsch kimberlite units with those occurring worldwide as inclusions in diamonds. The compositions of clinopyroxenes in Figure 25 predominantly (>80%) plot within the diamond inclusion field for all Finsch kimberlite units. It is further observed that the percentage of clinopyroxene data that plot outside the inclusions in diamond field in Figure 25 are: 5% for unit F3, 9% for unit F5/F6 and 7% for unit F8.

The Al_2O_3 vs. Cr_2O_3 clinopyroxene classification diagram (Fig. 26) is used to classify the likely lithology of origin of the clinopyroxene grains recovered from the various Finsch kimberlite units. Clinopyroxenes from the Finsch kimberlite units display two predominant clusters of data in Figure 26, that plot in the garnet peridotites and spinel- & off-craton peridotites source rock fields. A circular-grouping of data observed in Figure 26 depicts an uncorrelated cluster of data plotting in the garnet-peridotite field, with an approximate range of 0 – 4 wt. % of Al_2O_3 and 0.5 – 4.25 wt. % of Cr_2O_3. A smaller, elongate and mildly anticorrelated data cluster, in contrast to the larger uncorrelated cluster described above is observed to plot in the spinel- & off-craton peridotites field, with an approximate range of 5 – 8 wt. % of Al_2O_3 and 0.5 – 1.25 wt. % of Cr_2O_3 (Fig. 26).

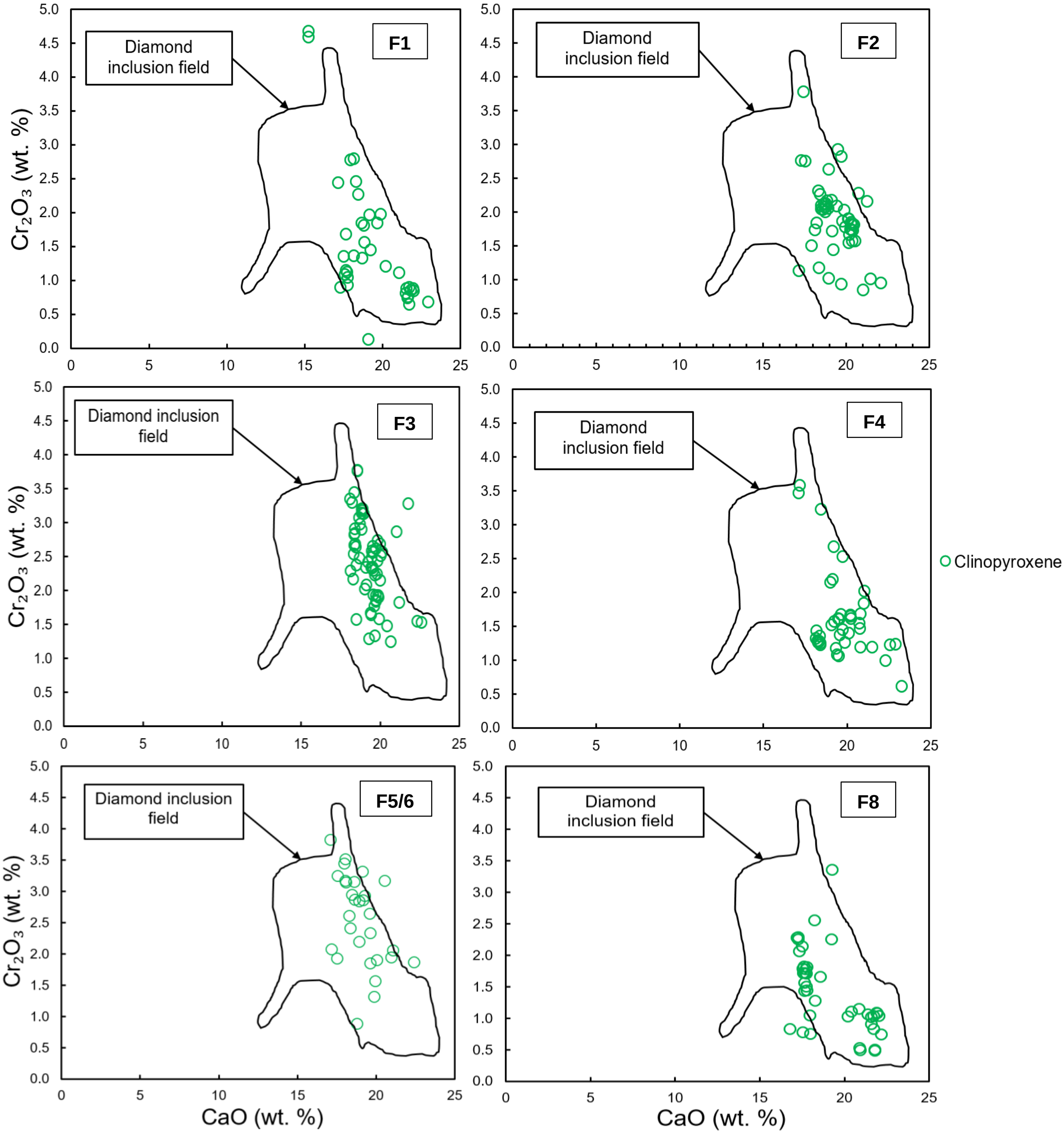


Figure 25: CaO vs. Cr_2O_3 diagram, comparing the composition of the clinopyroxene grains obtained as heavy mineral concentrates in this study, to the composition of worldwide peridotitic clinopyroxene diamond inclusions (from Fipke et al.,1989).

The clinopyroxene data from the Finsch kimberlite units dominantly fall within the garnet peridotite field in Figure 26, except those from units F1 and F8, which have significant percentages of clinopyroxene data (e.g., 20% and 50%, respectively) with Al_2O_3 values greater than 4 wt.%. The field of clinopyroxene data from Finsch peridotite xenoliths in Figure 26 falls at a similar range of Al_2O_3 but slightly lower Cr_2O_3 values (0.5 – 2.25 wt. %) than the main cluster of Finsch KIM data presented here, but at least some data for all Finsch kimberlite units do fall within this field.

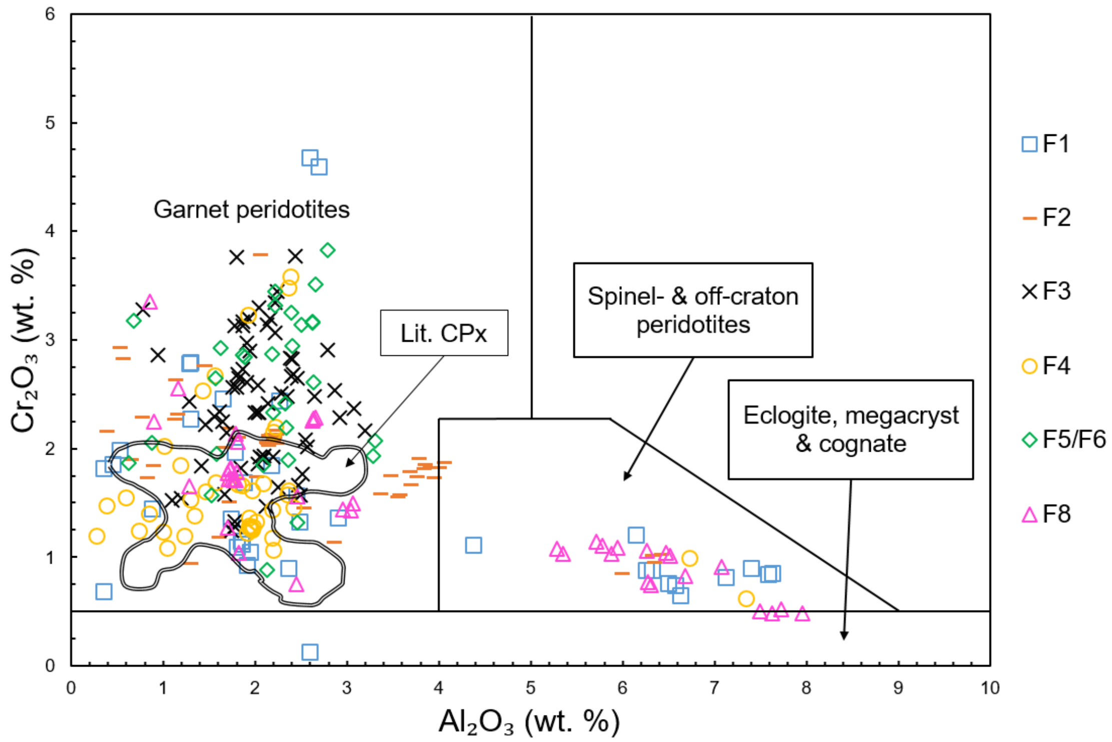


Figure 26: Major element classification diagram for clinopyroxene, modified after Nimis (1998). Al_2O_3 (wt. %) vs. Cr_2O_3 (wt. %) displaying the fields for clinopyroxene from garnet peridotite, spinel- & off-craton peridotite and eclogite and megacrysts. The double outlined field "Lit. CPX" shows the compositions of clinopyroxene from Finsch peridotite xenoliths (data from Shee et al., 1982; Skinner, 1986; Skinner, 1989; Gibson et al., 2008).

Two main clusters of data are also observed in the MgO vs. Al_2O_3 clinopyroxene classification diagram in Figure 27. Most clinopyroxene data from the Finsch kimberlite units fall near the boundary between the garnet-bearing/garnet-free peridotites field in Figure 27. In detail, the clinopyroxene data from units F3, F4 and F5/F6 essentially fall entirely in the main data cluster lying adjacent to this boundary (though mostly in the garnet-bearing peridotites field; Fig. 27). Whereas the data from units F1, F2 and F8 have more variable compositions, with some data falling in the garnet-free peridotite field, but most of the data falling in the garnet peridotite field at relatively high Al_2O_3 values (4.5 to 8 wt. %). For example, approximately 50% of clinopyroxene data from units F1 and F8 plot in the main data cluster along the garnet-bearing/ garnet-free peridotites field boundary, while the remaining half of the data plot at high Al_2O_3 values (4 - 8 wt. %) in the garnet-bearing peridotites field (Fig. 27). The main units whose clinopyroxene data overlaps with the Lit. CPx (Finsch xenolithic CPx) field in Figure 27 are F5/F6 and F8 (approximately 30 – 40%) with only a few data from units F1, F2, F3 and F4 falling within this field.

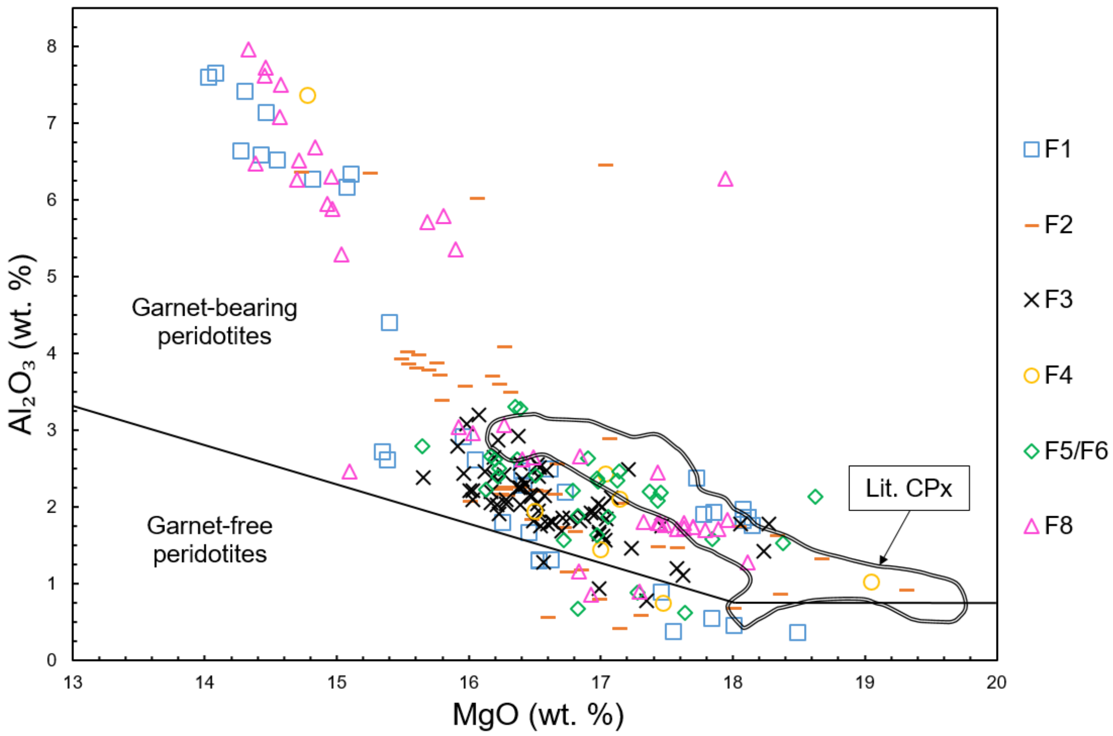


Figure 27: Major element classification diagrams for clinopyroxenes, modified after Nimis (1998). MgO (wt. %) vs. Al_2O_3 (wt. %) diagram, showing fields for clinopyroxenes from garnet-bearing and garnet-free peridotites. This diagram is based on work done by Ramsay (1995). Data for the Lit. CPx field are from Shee et al. (1982), Skinner (1986), Skinner (1989) and Gibson et al. (2008).

Clinopyroxene is further differentiated using Ca# vs. Na_2O (to distinguish peridotitic from eclogitic clinopyroxene), Cr# vs. Mg# (to distinguish eclogitic, websteritic and lherzolitic clinopyroxene) and MgO vs. Na_2O (to distinguish the different groups of eclogitic clinopyroxene) and the ternary diagram of Al-Cr-Na for mantle equilibrated clinopyroxenes (Fig. 28A – D). Clinopyroxene data for units F1 – F8 dominantly (>90%) overlap the clinopyroxene field for kimberlite xenoliths and xenocrysts, reproduced from Morris et al. (2002) in Figure 28A, with few clinopyroxene data from units F1, F4 and F8 overlapping with eclogitic clinopyroxene data after Fipke et al. (1989).

Clinopyroxene data further dominantly overlap the peridotitic clinopyroxene field in the Cr# vs. Mg# diagram (Fig. 28B), with less than 5% of clinopyroxene data from units F1 and F8 falling on the peridotitic – eclogitic transition zone at Cr# 0.07 – 0.10 (Fig. 28B). Further, the majority of clinopyroxene data from units F2, F3, F4 and F5/F6 overlap the lherzolitic field reproduced from Kalugina and Zedgenizov (2020), with ≈50% of clinopyroxene data from unit F1 and F8 plotting within the websteritic field (Fig. 28B).

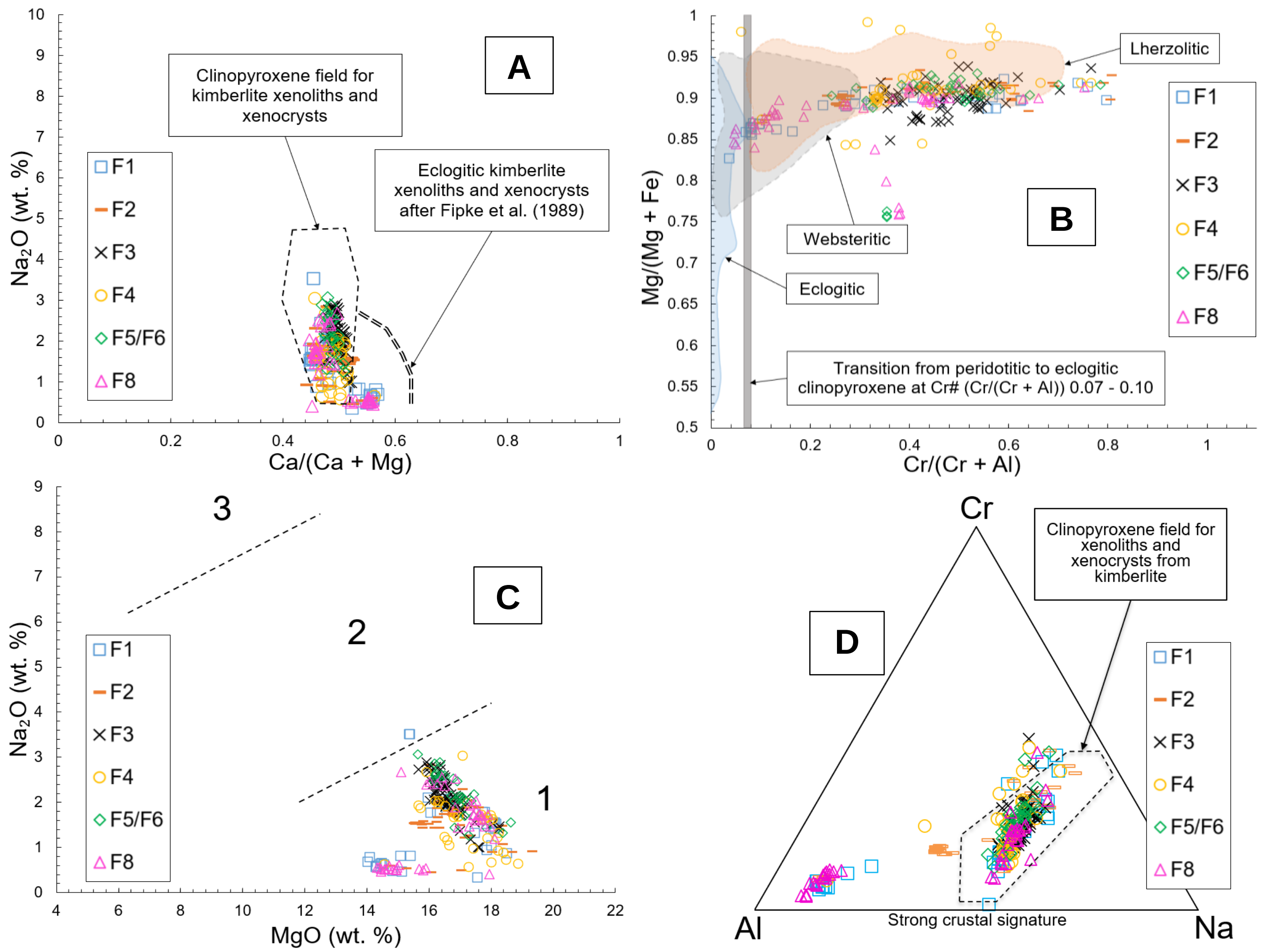


Figure 28: Clinopyroxene classification diagrams, differentiating the paragenesis of clinopyroxene minerals sampled by the Finsch kimberlite, panels (A) – (D). Panel (A): Ca# vs. Na_2O, showing the field of clinopyroxene minerals from kimberlite xenoliths and xenocrysts reproduced from Morris et al. (2002) and, eclogitic clinopyroxene data after Fipke et al. (1989) (double dashed lines). Panel (B): Cr# (i.e., Cr/(Cr + Al)) vs. Mg#, showing the fields of lherzolitic, websteritic and eclogitic clinopyroxene reproduced from Kalugina and Zedgenizov (2020). Panel (C): MgO vs. Na_2O, showing compositional fields (groups) 1 – 3 of Taylor and Neal (1989). Panel (D): Ternary diagram of Al-Cr-Na for mantle equilibrated clinopyroxenes derived from kimberlite, with the clinopyroxene field for xenoliths and xenocrysts from kimberlite reproduced from Morris et al. (2002).

Taylor and Neal (1989) used jadeite components to subdivide clinopyroxene into three groups, as part of their scheme for classifying eclogite xenoliths: clinopyroxenes from Group 1 eclogites [not to be confused with Group I eclogites of MacGregor and Carter (1970)] have low jadeite contents, which they interpreted as resulting from formation as high-pressure igneous cumulates within the upper mantle; Group 2 eclogite clinopyroxenes have moderate jadeite contents (which they interpreted as metamorphic products of a subducted oceanic crustal protolith); and Group 3 eclogite clinopyroxenes have the highest jadeite contents (which they interpreted as a relic of the Earth's primary differentiation shortly after accretion). The majority (>99%) of clinopyroxene data from units F1 – F8 overlap the Group 1 eclogites field in Figure 28C, largely overlapping with xenolithic clinopyroxene data (i.e., diamond inclusions) after Appleyard et al. (2004) and Kalugina and Zedgenizov (2020). It must however be noted that the Group 1 field in Figure 28C also includes non-eclogitic mantle clinopyroxene.

At least two groups of clinopyroxene data are observed in the Al-Cr-Na ternary diagram (Fig. 28D). In detail, a predominant vertical data grouping is observed near the centre of the ternary diagram, with a second data grouping observed near the Al-saturated apex of the Al-Cr-Na ternary diagram respectively (Fig. 28D). The vertical data group is dominated (>75%) by clinopyroxene data from all Finch kimberlite units, which dominantly overlap the clinopyroxene field for xenoliths/xenocrysts from kimberlite (Fig. 28D). Further, the Al-saturated vertex in Figure 28D is characterized by clinopyroxene data from units F1 and F8.

5.1.3 Chromite results

Average chromite major element data are presented in Table 7. The MgO vs. Cr_2O_3 chromite classification diagram (Fig. 29) is used to compare chromite obtained as heavy mineral concentrates in kimberlite with chromite occurring as inclusions in diamond. The MgO and Cr_2O_3 compositions of chromite grains in the F1, F2, F4, F5/F6 and F8 kimberlite units predominantly (>85%) plot within the diamond inclusion field, whereas in the F3 kimberlite unit, less than 50% of chromite grains plot within this field. Additionally, in the each of the F1 and F3 kimberlite units, two chromite grains fall well outside the field of chromite from kimberlite heavy mineral concentrates, as does one grain in unit F5/F6.

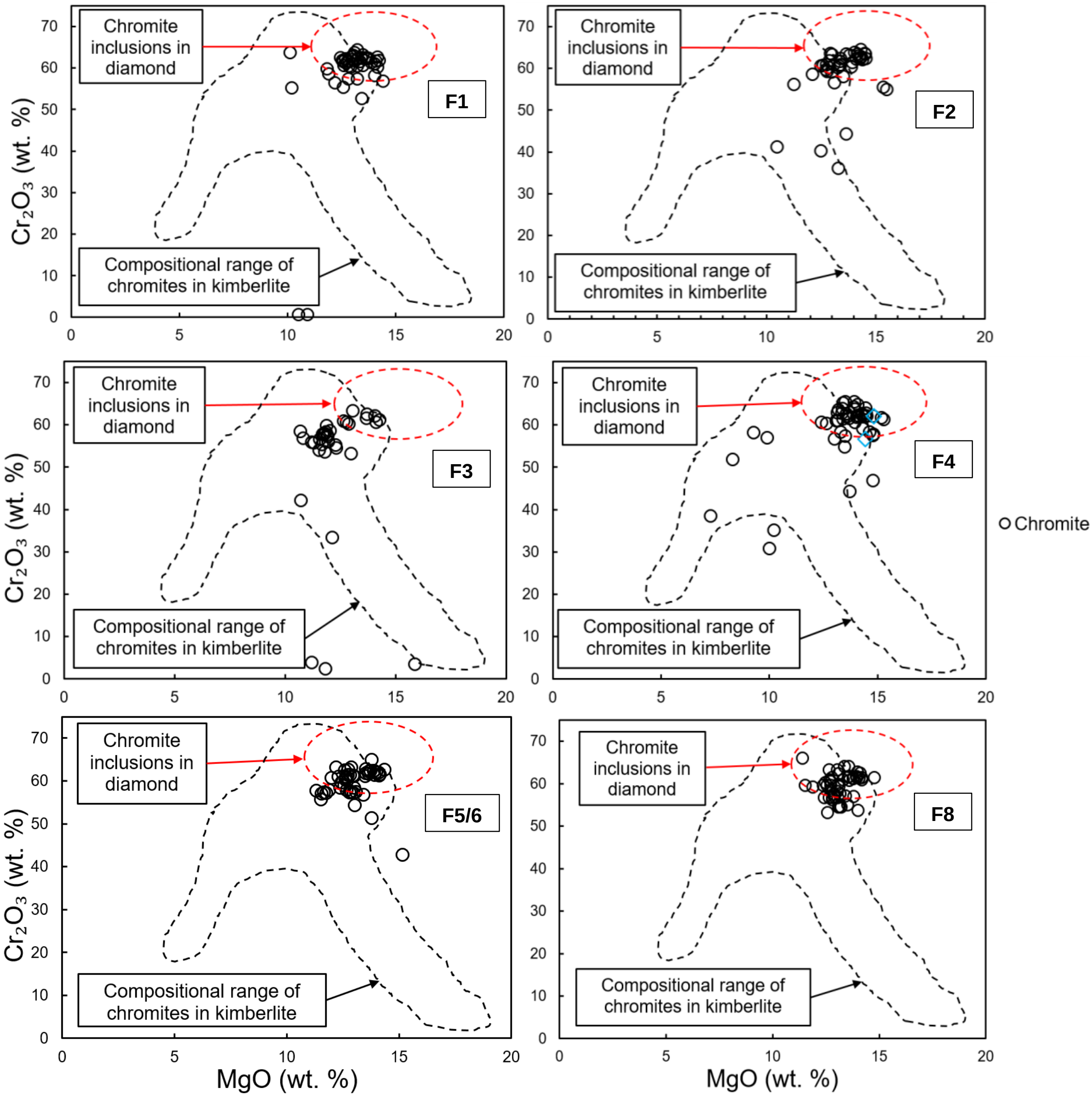


Figure 29: MgO vs. Cr_2O_3 diagram, which compares the composition of chromite obtained as heavy mineral concentrates in kimberlite to the composition of world-wide chromite inclusions in diamond. The kimberlitic and diamond inclusion fields, as labelled, are modified after Fipke et al. (1989). The blue coloured diamond symbols on the panel for unit F4 represents data of chromite minerals observed in thin sections from unit F4, analysed by the electron microprobe.

5.2 Trace element chemistry of G10 and G9 garnet minerals

Trace element data for G10 and G9 peridotitic garnets are presented in Table 8. G10 and G9 garnets were selected from each Finsch kimberlite unit for trace element analysis by LA ICP-MS. Trace element data collected in this study are shown in Figure 30 – 33. REE and incompatible element patterns (shown in Figure 30 – 31) are shown for the selected G10 and G9 garnets of the various Finsch kimberlite phases, based on the average trace element composition of each garnet type (G10 and/or G9 garnets), per kimberlite phase. In contrast, the element-element trace element diagrams (Figure 32 – 33) display the composition of each garnet mineral type analysed.

5.2.1 Rare earth element patterns

The rare earth elements are 14 trace elements of the lanthanide series, with atomic numbers from 57 to 71. Most REE have a valence of 3+, except for Eu (which can have a valence of 2+) and Ce (which can have a valence of 4+). Significant variations in composition are observed in the trace element data obtained from the various Finsch garnets analysed. The Finsch garnets are generally characterised by REE with concentrations less than 10 times that of chondrites.

G9 garnets are characterized by more sloped patterns (i.e., the "hump" in the middle rare earth elements (MREE) is mild or non-existent and the patterns from MREE to heavy rare earth elements (HREE) have a clear, linear positive slope) whereas the G10 garnets are more traditionally sinusoidal (i.e., strong hump in the MREE and the patterns show more of a U-shape from the MREE to HREE), (Fig. 30). In detail, G10 garnets from all the Finsch kimberlite phases are generally characterized by a sinusoidal REE pattern (similar to 'high-Cr' (i.e., 8 – 10 wt. % Cr_2O_3) harzburgitic and lherzolitic garnets, after Gibson et al. (2008) and Lazarov et al. (2012a)), where an increase in light rare earth elements (LREE), compared to the middle REE, is observed, with maxima at Nd, Sm, or Eu, relative minima at Gd, Tb, Dy or Ho and, a gradual increase toward the heaviest rare earth elements (HREE; Fig. 30).

Table 8: Average trace element data (in ppm) for the G10 and G9 garnets analysed from the various Finsch kimberlite phases (F1, F2, F3, F4, F5/F6 and F8). See footnote[2] for further explanations.

		F1		**F2**		**F3**		**F4**		**F5/F6**		**F8**	
	LOD (ppm)	G10	G9	G10	G9	G10	G9	G10	G9	G10	G9	G10	G9
Sc	0.26	97.76	80.75	80.43	80.13	111.54	76.34	89.06	69.20	89.16	76.96	88.06	81.64
Ti	0.66	502.48	300.18	480.93	589.88	857.85	843.10	320.95	305.55	405.27	779.28	313.47	632.85
V	0.34	214.55	156.73	242.40	167.55	244.45	184.07	200.31	148.43	219.21	198.61	213.85	197.50
Co	0.16	39.63	41.53	40.07	43.00	36.73	39.39	37.42	39.41	38.67	40.50	39.02	41.72
Ni	0.21	49.27	40.97	54.33	36.11	44.99	44.03	40.18	36.32	47.88	56.96	48.82	55.77
Rb	0.18	0.09	0.14	0.09	0.09	0.15	0.08	0.05	0.10	0.10	0.07	0.10	0.07
Sr	0.13	1.17	0.10	0.26	0.14	0.54	1.02	1.12	0.21	1.75	0.15	1.15	0.23
Y	0.09	5.75	5.41	3.59	8.97	9.91	10.30	3.42	4.93	2.23	6.70	3.30	7.58
Zr	0.15	23.41	11.18	13.12	10.39	84.99	54.23	16.90	16.75	13.13	10.76	24.56	16.61
Nb	0.10	0.13	0.32	<d.l.	<d.l.	0.44	0.25	0.61	0.42	<d.l.	<d.l.	<d.l.	0.28
La	0.10	0.13	0.03	0.04	0.02	0.05	0.08	0.16	0.05	0.14	0.02	0.10	0.02
Ce	0.21	1.71	0.20	0.36	0.27	0.54	1.18	1.57	0.46	1.80	0.25	1.33	0.29
Pr	0.10	0.52	0.06	0.12	0.08	0.19	0.30	0.49	0.12	0.53	0.08	0.35	0.12
Nd	0.19	4.43	0.55	1.11	0.73	2.17	2.79	4.22	1.10	3.86	0.82	3.00	1.25
Sm	0.21	1.53	0.31	0.52	0.36	2.20	0.88	0.97	0.53	0.78	0.46	1.20	0.74
Eu	0.22	0.51	0.15	0.20	0.17	0.94	0.36	0.26	0.21	0.24	0.20	0.40	0.29
Tb	0.09	0.19	0.10	0.09	0.14	0.35	0.25	0.09	0.10	0.07	0.14	0.12	0.17
Gd	0.19	1.25	0.45	0.53	0.60	2.73	1.22	0.58	0.56	0.54	0.66	1.00	0.89
Dy	0.21	1.12	0.76	0.59	1.26	2.16	1.83	0.58	0.70	0.43	1.05	0.61	1.23
Ho	0.09	0.23	0.20	0.13	0.35	0.44	0.42	0.13	0.18	0.09	0.26	0.13	0.30
Er	0.21	0.60	0.70	0.42	1.16	1.15	1.22	0.42	0.64	0.25	0.83	0.39	0.95
Tm	0.09	0.09	0.12	0.08	0.20	0.15	0.18	0.07	0.11	0.04	0.14	0.07	0.16
Yb	0.25	0.65	1.09	0.63	1.64	1.12	1.41	0.62	1.00	0.35	1.10	0.56	1.34
Lu	0.09	0.11	0.18	0.11	0.27	0.16	0.21	0.11	0.16	0.06	0.18	0.10	0.22
Hf	0.09	0.52	0.25	0.29	0.21	1.37	1.00	0.33	0.32	0.28	0.25	0.51	0.32
Ta	0.08	0.02	0.02	0.02	0.01	0.03	0.01	0.02	0.02	0.02	0.02	0.02	0.03
Pb	0.13	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Th	0.09	0.04	0.06	0.02	0.02	0.02	0.03	0.07	0.04	0.03	0.02	0.04	0.01
U	0.10	0.08	0.06	0.04	0.05	0.03	0.05	0.12	0.08	0.07	0.05	0.06	0.02
n	-	12	12	12	11	13	5	13	13	12	11	12	13

[2] All results in Table 8 are the means of the number of grains analysed (given in the bottom row) in each category, in parts per million (ppm). Abbreviations: PPM: parts per million; LOD: limit of detection and <d.l.: below detection limit

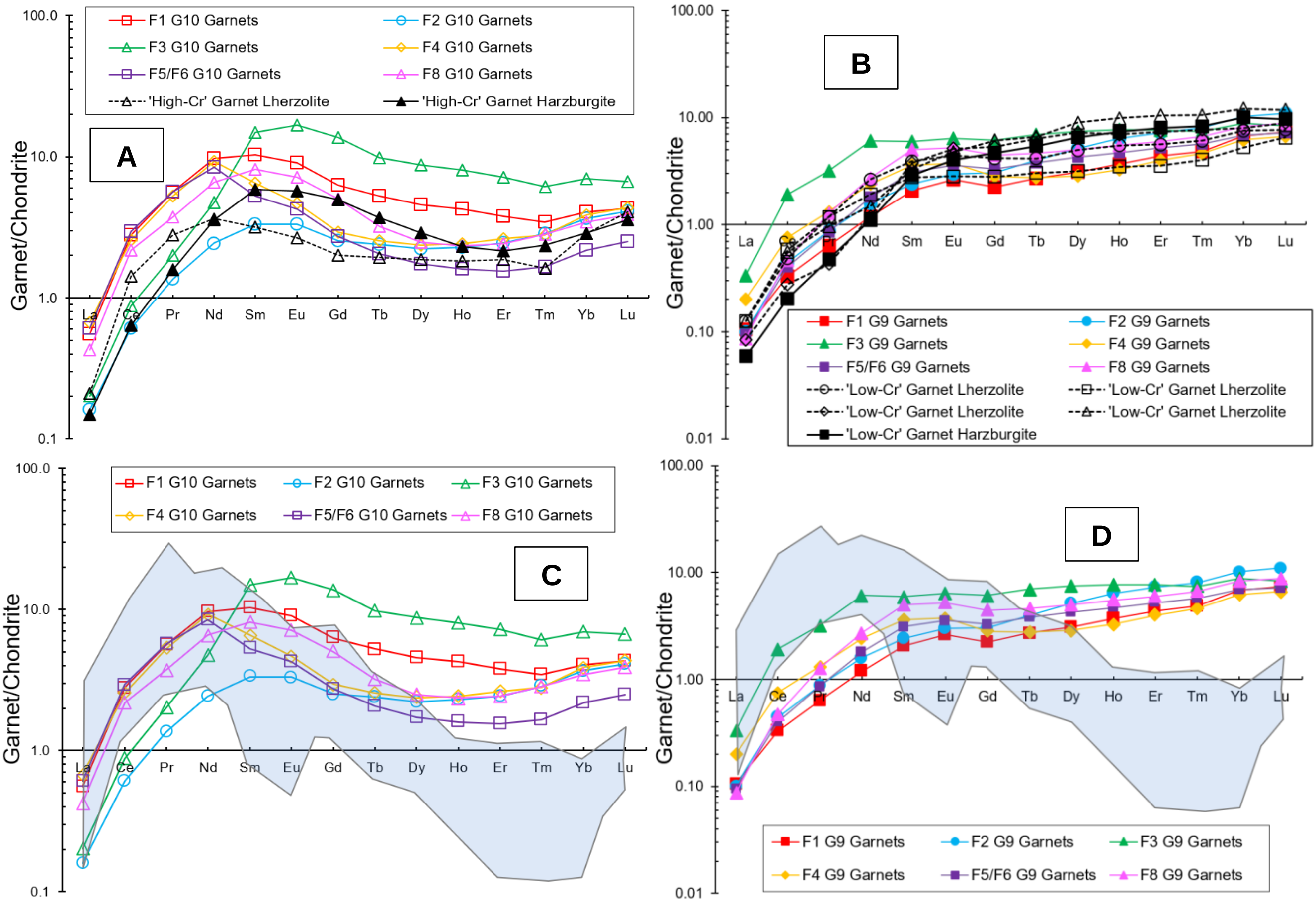


Figure 30: Panels (A) – (D), chondrite-normalized REE compositions of Finsch G10 and G9 garnets. Chondrite normalization values used are from McDonough and Sun (1995). Panels (A) and (C) show mean G10 garnet compositions from all kimberlite units and Panels (B) and (D) show mean G9 garnet compositions from all Finsch kimberlite units as denoted in the legends. Also shown are average 'High- and Low-Cr' garnet lherzolite data (from Gibson et al., 2008) and average 'High- and Low-Cr' garnet harzburgite data (from Lazarov et al., 2012a) in panels (A) and (B) for comparison. The blue shaded area in panels (C) and (D) represents the range of REE contents for Finsch peridotitic garnet diamond inclusions from Viljoen et al. (2014). Open and closed symbols are used for G10 and G9 garnets, respectively and lherzolites and harzburgites, respectively.

Conversely, G9 garnets from the various Finsch kimberlite phases generally do not display sinusoidal REE patterns (or very slightly sinusoidal, e.g., F4 G9 garnets), but are far more commonly characterized by relatively straight, mildly positively sloped patterns in the MREE to HREE, similar to 'low-Cr' (i.e., 3 – 8 wt. % Cr_2O_3) harzburgitic and lherzolitic garnets, after Gibson et al. (2008) and Lazarov et al. (2012a; Fig. 30). The concentrations of LREE and MREE in G10 garnets are slightly elevated in comparison to those in G9 garnets, whereas the concentration of HREEs in G9 garnets is slightly elevated in comparison to those in the G10 garnets (Fig. 30). Additionally, the delineated minimum and maximum peridotitic garnet diamond inclusion field from Viljoen et al. (2014) also displays sinusoidal patterns, however the MREE and HREE concentrations of the Finsch garnets are more enriched when compared to those of Viljoen et al. (2014) in Figure 30.

5.2.2 Primitive mantle-normalised incompatible element patterns

Incompatible trace elements are elements that are unsuitable, due to their size and/or charge, to substitute into the crystal structure of a rock forming mineral. During partial melting and fractional crystallization, incompatible trace elements are concentrated in the melt phase and their preference for the melt phase is indicated by their low partition coefficients. As a result, incompatible trace elements are often depleted in mantle rocks due to their preference for being in the melt phase. However, the concentration of incompatible trace elements in mantle rocks is controlled by their petrologic history, particularly melt depletion and metasomatic enrichment events (i.e., involving interaction of melts or volatile-rich fluids with solid mantle rock). The primitive mantle-normalised incompatible element patterns of the garnets (Fig. 31) are characterized by negative anomalies at Rb, La, Sr and Ti, with positive anomalies at U and Sc. The positive Sc anomalies are much more apparent in G10 garnets, compared to G9 garnets. Further, G10 and G9 garnets from all the Finsch kimberlite units are enriched in U compared to other incompatible elements (e.g., Th and Nb), resulting in positive U anomalies and low Th/U ratios (Fig. 31). G10 garnets from unit F1 are the only data with depletions in Nb relative to La (Fig. 31). Furthermore, G9 and G10 garnets from the Finsch kimberlite units are characterized by similar ranges of Nb/La ratios and G9 and G10 garnets from unit F3 are characterized by enrichments in Zr and Hf relative to the similarly incompatible MREE (Fig. 31). Incompatible element data for garnets from Finsch peridotite xenoliths [i.e. 'high-Cr' (i.e., 8 – 10 wt. % Cr_2O_3) harzburgitic and lherzolitic garnets and 'low-Cr' (i.e., 3 – 8 wt. % Cr_2O_3) harzburgitic and lherzolitic garnets], from Gibson et al. (2008) and peridotitic concentrate garnets from Lazarov et al. (2012a), are included in Figure 31 for comparison.

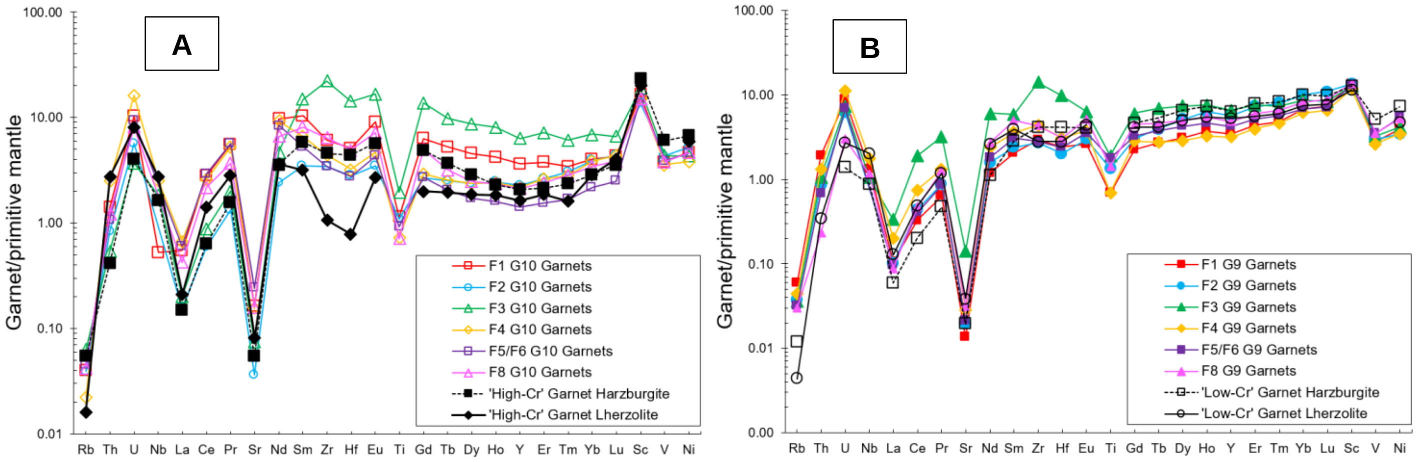


Figure 31: Primitive mantle-normalized mean trace element compositions of G10 (panel A) and G9 Finsch pyrope garnets (panel B), from the various Finsch kimberlite phases. Elements are plotted in order of decreasing incompatibility/increasing compatibility during mantle melt generation. Normalising values used are from McDonough and Sun (1995). Open and closed symbols are used for G10 and G9 garnets and, lherzolites and harzburgites respectively. 'High- and Low-Cr' Garnet lherzolite data (after Gibson et al., 2008) and 'High- and Low-Cr' Garnet harzburgite data (after Lazarov et al., 2012a) is shown for comparison.

5.2.3 Trace element covariations

Variations of CaO content in garnet are plotted against La (a LREE) and Lu (a HREE) in Figure 32. An increase in variability in the concentration of Lu is observed between 2 and 6 wt. % CaO (i.e., an increase in the maximum and average Lu contents is observed, however there are also many data with low Lu contents in this range of CaO, Fig. 32C). La concentrations show increasing variability and increasing average values with increasing Cr_2O_3 content (Fig. 32B), where the opposite pattern for Lu is observed (i.e., most variable and highest average Lu contents are at low Cr_2O_3, with the average value decreasing with increasing Cr_2O_3), (Fig. 32D). Garnet data from Gibson et al. (2008) and Lazarov et al. (2009ab) is included in Figure 32, panel A, B & D for comparison.

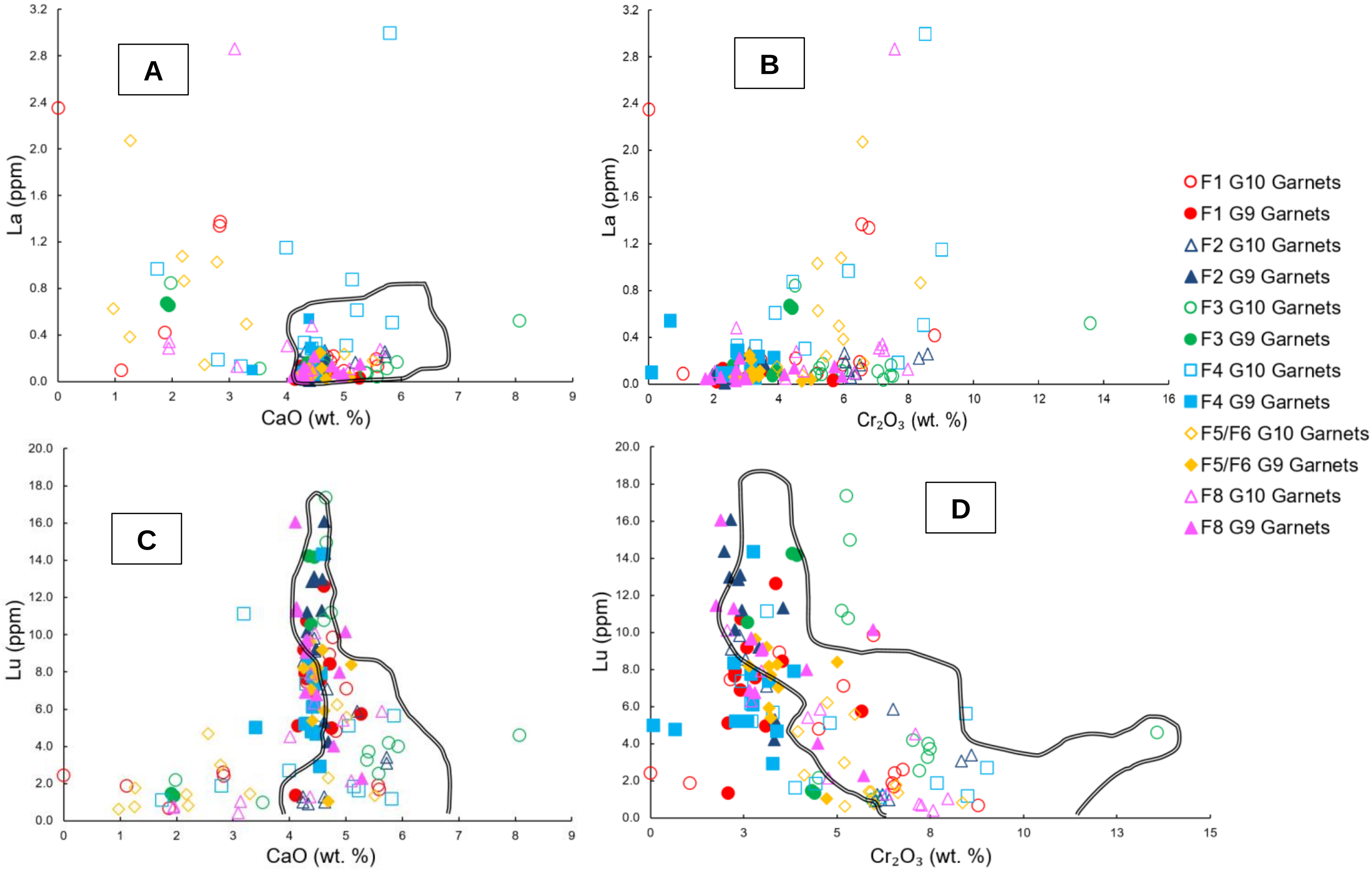


Figure 32: Variation of CaO (wt. %) contents, panels (A) and (C), and Cr_2O_3 (wt. %) contents panels (B) and (D), versus LREE element La (ppm) and, HREE element Lu (ppm), respectively, in Finsch peridotitic garnets. Open and closed symbols are used for G10 and G9 garnets respectively. The field with double solid lines outlines peridotitic garnet data from Gibson et al. (2008) and Lazarov et al. (2009a; 2009b), for comparison.

In Figure 33, panels (A) and (B), more than 50% of G10 and G9 garnets from units F1 – F8 are observed to plot in the field for depleted peridotites. In Figure 33, panels (C) and (D), plots of Ti vs. Zr and Zr vs. Y are used to infer the source rock characteristics and style of metasomatism, respectively, of the garnet KIMs, (Griffin and Ryan, 1995). Metasomatism of garnet by mafic silicate melts is characterized by an increase in Ti, Zr, and Y, whereas hydrous, phlogopite-forming metasomatism is characterized by addition of Zr while retaining low Ti and relatively low Y (Kobussen et al., 2009).

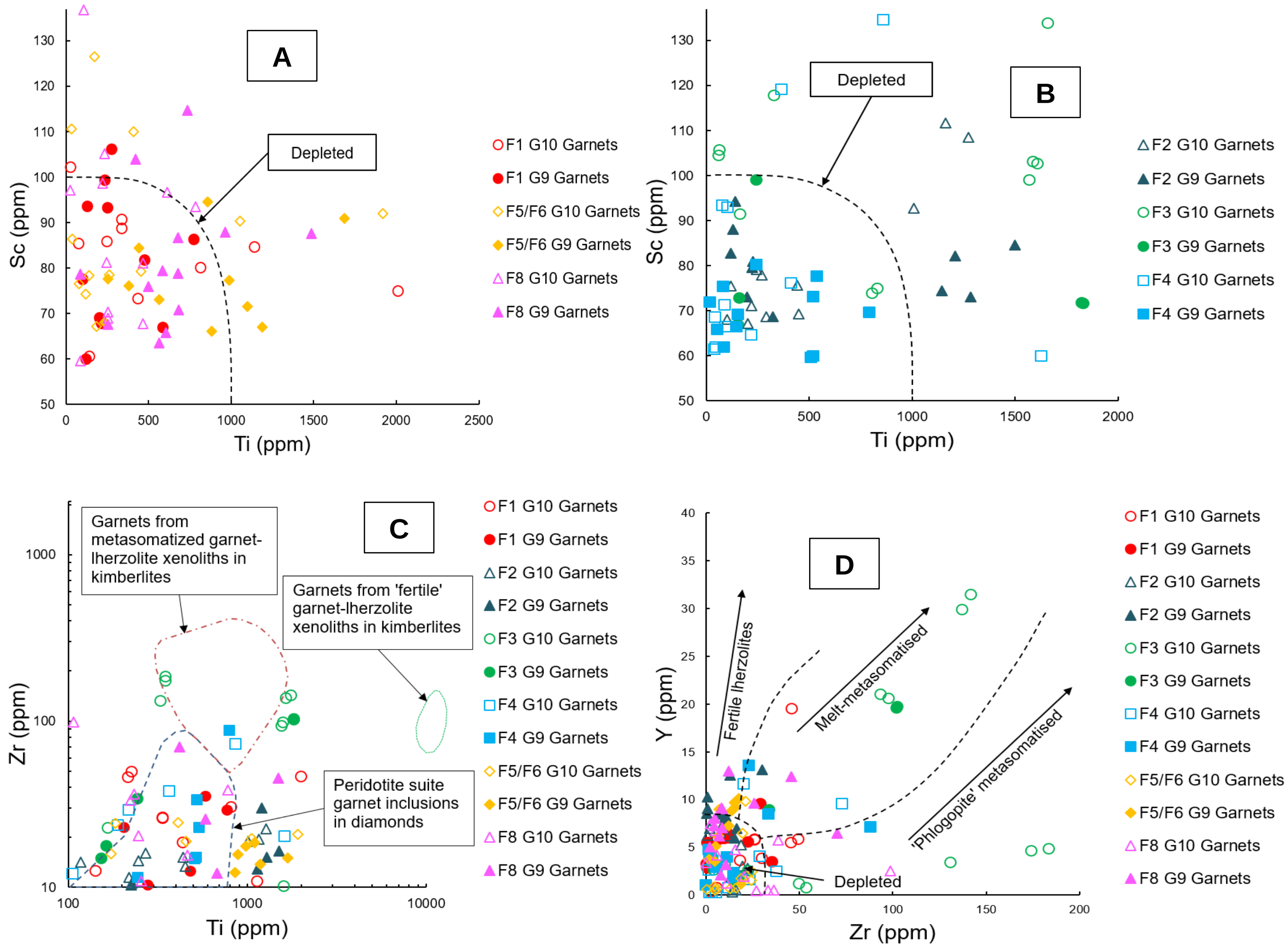


Figure 33: Panel (A) and (B), Ti (ppm) vs. Sc (ppm) diagram for G10 and G9 garnet data (open and closed symbols respectively) from the various Finsch kimberlite units (fields in panel (A) and (B) are from Shimizu and Richardson (1987). Panel (C): Ti (ppm) vs. Zr (ppm) diagram, the fields as labelled are modified after Shimizu and Richardson (1987). Panel (D): Zr (ppm) vs. Y (ppm) diagram, with the various fields as labelled, modified after Griffin and Ryan. (1995).

In Figure 33C, approximately 50% of the G10 and G9 garnets from the various Finsch kimberlite phases plot in the 'peridotite suite garnet diamond inclusions' field of Shimizu and Richardson (1987), with a further 15 – 20% of the garnets plotting near or along the boundary of this field at slightly lower or higher Ti contents. Further, the vast majority (i.e., >90%) of Finsch garnets measured in this study have Y and Zr concentrations falling in the depleted field of Figure 33D, with less than 15% of the garnets displaying "melt" and "phlogopite" metasomatic signatures. Of the garnets that appear to have experienced metasomatism in this panel, the largest group are G10 garnets from unit F3, which appear to have either undergone melt- or phlogopite-metasomatism, with approximately half the number of G10 garnet data from unit F3 plotting in either metasomatic field.

5.3 Garnet and clinopyroxene thermobarometry

5.3.1 Garnet thermobarometer

Nickel contents of peridotitic garnets can be used to estimate their equilibration temperature , based on the temperature-dependence of Ni partitioning into garnet in equilibrium with olivine. Two such thermometers have been developed, by Ryan et al. (1996) and Canil (1999) and are the most widely used in estimating the equilibration temperature of garnets. The Ni in garnet thermometer used in this study is based on the Ryan et al. (1996) thermometer modified from Griffin et al. (1989). These thermometers assume that garnet was in equilibrium with olivine of uniform Ni content (Ryan et al., 1996). The Ni contents in garnets from the different Finsch kimberlite units are used to estimate their equilibration temperatures, using the equation below, where Ni_{garnet} is the Ni concentration in garnet measured in units of parts per million by weight:

$$T_{Ni}(°C) = \frac{1000}{1.506\text{-}0.189\ln\left(Ni_{garnet}\right)}\text{-}273$$

Additionally, Cr contents in peridotitic garnet can be used to estimate equilibration pressures (P_{Cr}), by means of a modified barometer after Nickel (1989), that is based on partitioning of Cr between an orthopyroxene composition calculated to be in equilibrium with garnet and chromite. The composition of the orthopyroxene is estimated by inverting the geothermometry equations of Harley (1984), Gasparik (1987) and Brey and Köhler (1990). However, it is important to note that this barometer is based on the assumption that garnet coexists with chromite, which, though possible (Klemme, 2004), is unlikely to always be the case. The average of maximum and minimum estimated pressure values are applied in this study, using the below equation:

$$P_{Ni^*} = \{-RT\ln(K_D - 14412(K_{Ca^{gnt}})^2 + (49782 - 23.5T)[X_{Ca^{gnt}}(X_{Al^{gnt}} - X_{Cr^{gnt}})] \\ + 23900(X_{Ca^{opx}})^2 - 2873 - 3.94T\} / [146(X_{Ca^{gnt}})^2 - 397]$$

The Ryan et al. (1996) T_{Ni} thermometer and P_{Cr} barometer were applied to major element data for all peridotitic garnet mineral grains from the various Finsch kimberlite units. Most of the Finsch garnet temperature and pressure estimates in Figure 34 overlap the data for Finsch concentrate garnets from Griffin et al. (2003) and Kobussen et al. (2009) and, xenolithic garnet data from Gibson et al. (2008) and Lazarov et al. (2009ab). In detail, more than 85% of garnet data from units F1, F4, F5/F6 and F8 plot in the graphite stability field, whereas all garnet data from units F2 and F3 plot in the graphite stability field (Fig. 34). The remaining <15% garnet data from units F1, F4, F5/F6 and F8 plot in the diamond stability field. 55% of garnet data from all the Finsch kimberlite units plot between the 35 and 45 mW/m² geotherms (characteristic of thick, cool cratonic regions), with the remaining half plotting above the 45 mW/m² geotherm after Pollack and Chapman (1977; Fig. 34).

The estimated temperatures of garnets from the various Finsch kimberlite units range from 817 to 1157°C with a mean of 1001 ± 83°C (1σ), (Fig. 34 and 35), where all units have average T_{Ni} values well within 1σ of each other. Further, estimated garnet pressure data from all the Finsch kimberlite units (Fig. 34) range from 23 – 54kb with a mean of 36 ± 8kb (1σ). In detail, G9 garnet data from all Finsch units shows the largest range as well as the lowest average pressures calculated, whereas. G10 garnets are characterised by higher average pressures calculated and, are the only paragenesis which plot within the diamond stability field with in Figure 34.

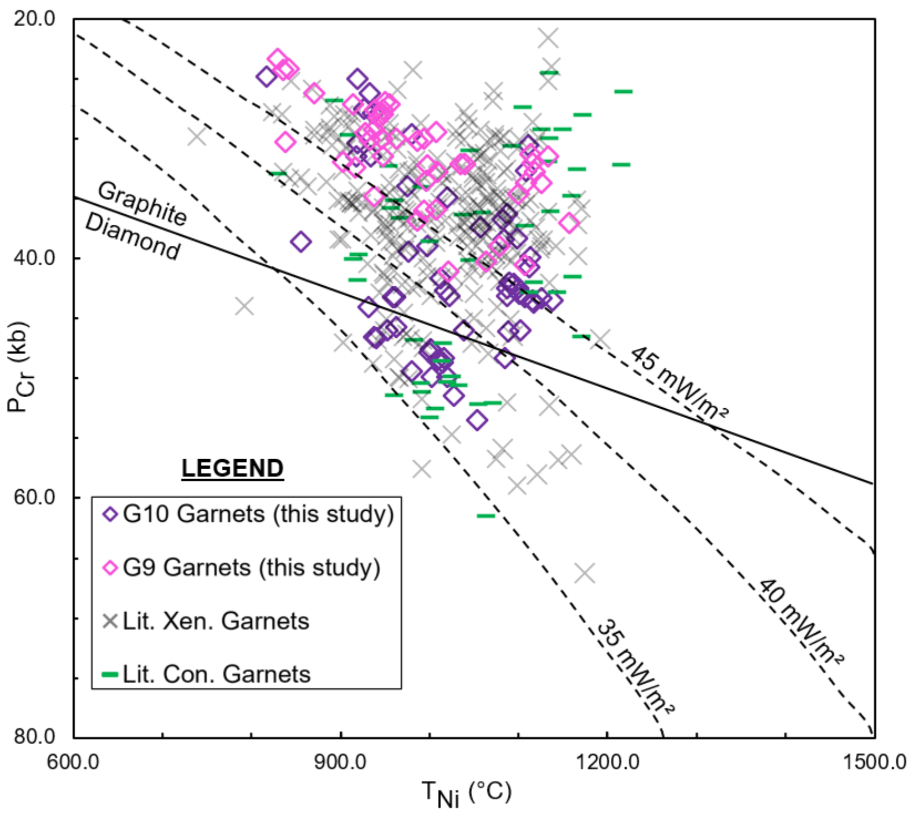


Figure 34: Temperature vs. pressure diagram for G10 and G9 (open and closed diamond symbols respectively) garnet minerals obtained from the Finsch kimberlite units. Temperature and pressure data were calculated using the Ryan et al. (1996) thermometer and P(Cr) barometer. Solid black line indicates the diamond/graphite boundary after Kennedy and Kennedy (1976) and, the black dashed curves are geotherms of 35, 40, and 45 mW/m² heat flow values, after Pollack and Chapman (1977). Finsch garnet concentrate data (i.e., Lit. Con. Garnets data marked by a '–' symbol) from Griffin et al. (2003) and Kobussen et al. (2009) and Finsch mantle xenolithic data (i.e., Lit. Xen. Garnets data marked by a 'X' symbol) from Gibson et al. (2008) and Lazarov et al. (2009a; 2009b) is presented for comparison. Values on the y-axis are shown increasing downward.

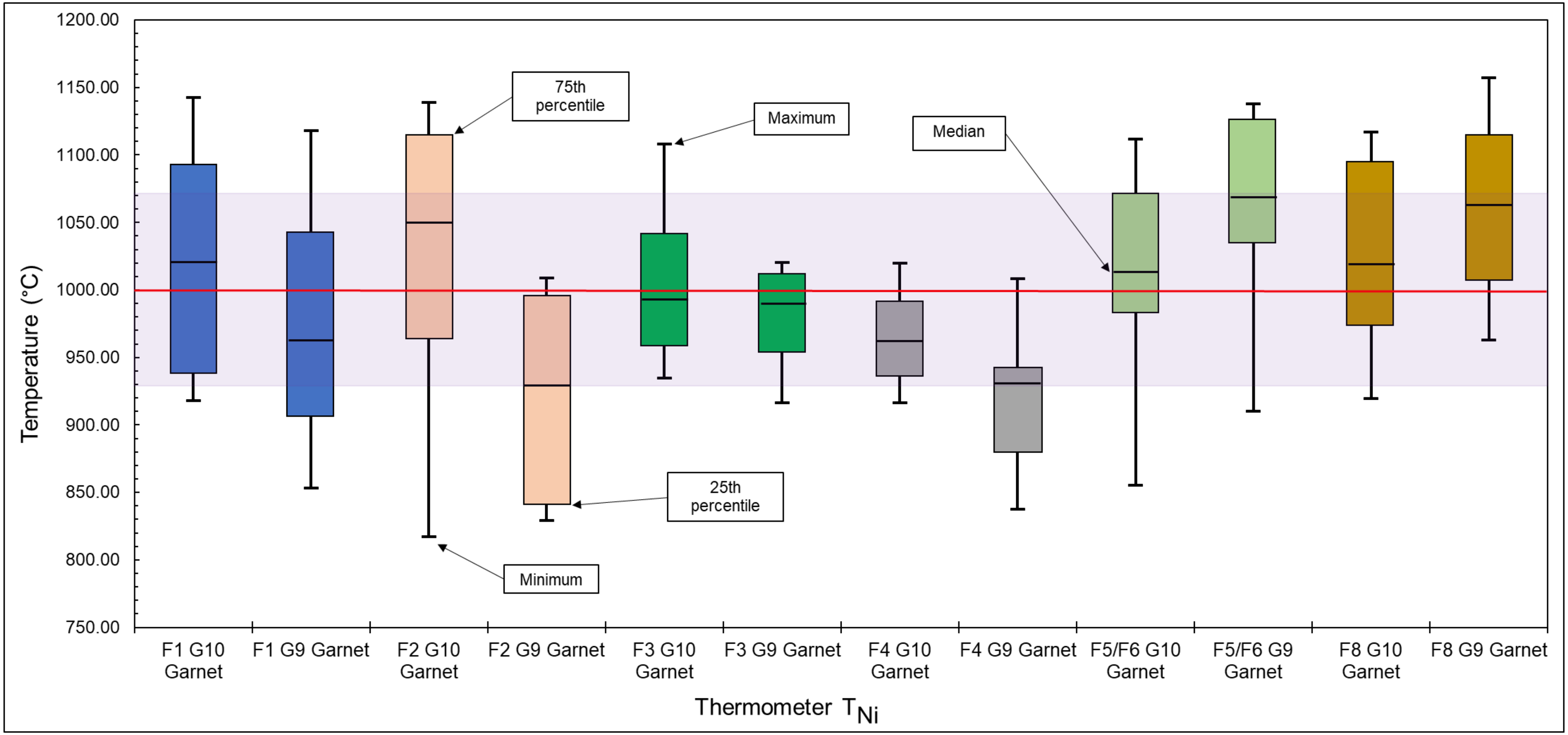


Figure 35: Box and whisker diagrams for G10 and G9 garnet data (i.e., garnets which are classified as G10 and G9 based on their chemical composition) obtained from the various Finsch kimberlite units. This diagram compares temperatures obtained by Ni-in-garnet thermometry [T_{Ni}, Ryan et al. (1996)] for G10 and G9 garnets obtained from all the Finsch kimberlite units. The red line within the purple shaded zone represents the median value of the entire data set, with the purple shaded zone representing 1σ (standard deviation) of the entire data set.

5.3.2 Clinopyroxene thermobarometry

Major element compositions of peridotitic clinopyroxene can also be used to estimate the temperature and pressure conditions of equilibration of mantle-derived minerals. The temperature estimations are based on the equilibria and exchange of Mg-Ca between clinopyroxene and orthopyroxene and the pressure estimations are based on the Al-Cr exchange between clinopyroxene and garnet, where Al is negatively correlated with pressure (i.e., at high pressures, clinopyroxenes have higher Cr/(Cr + Al) ratios; Nimis and Taylor, 2000). The Nimis and Taylor (2000) thermobarometer assumes that clinopyroxene was in equilibrium with both garnet and orthopyroxene.

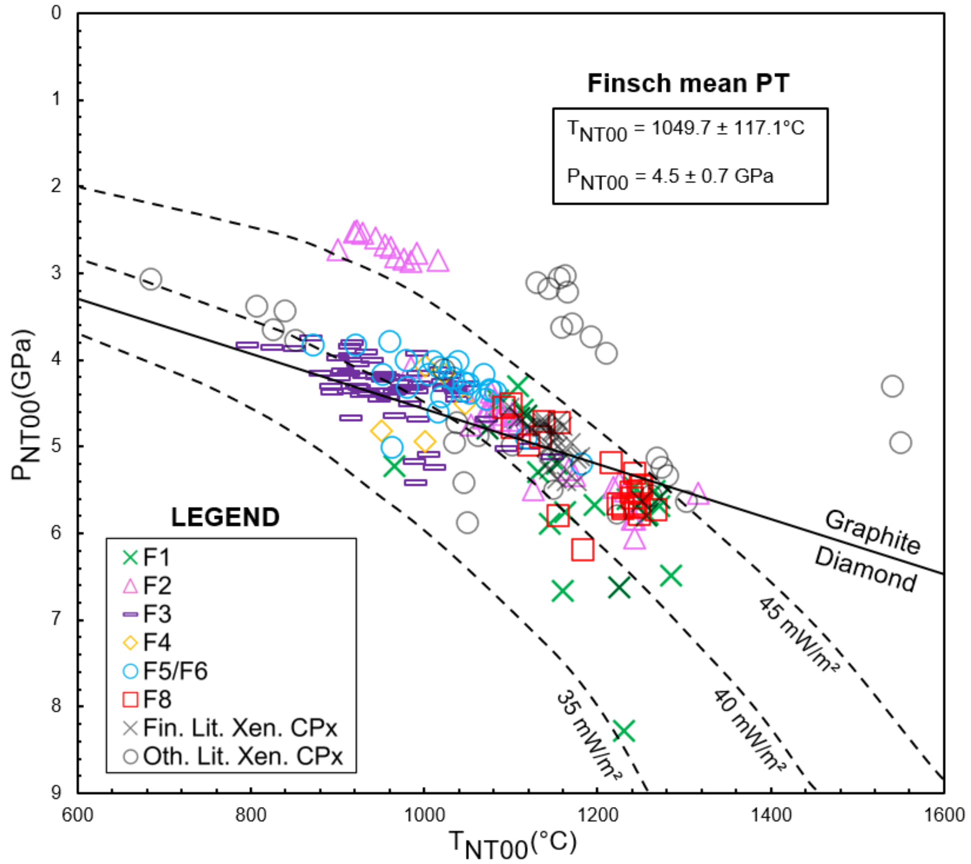


Figure 36: Temperature vs. pressure diagram for clinopyroxene data from the Finsch kimberlite units. Temperature and pressure data were calculated using the Nimis and Taylor (2000) thermobarometer. The black dashed curves are geotherms of 35, 40, and 45 mW/m² heat flow values (Pollack and Chapman, 1977). Solid black line indicates the diamond/graphite boundary (Kennedy and Kennedy, 1976). Clinopyroxene data from Finsch peridotite xenoliths (i.e., Fin. Lit. Xen. CPx data marked by an 'X' symbol) are from Shee et al. (1982); Skinner (1986) and Gibson et al. (2008). P & T values for clinopyroxene data from peridotite xenoliths and kimberlite concentrate from Group 2 kimberlite pipes in the Barkly West cluster near the Finsch kimberlite (denoted by the grouping Oth. Lit. Xen. CPx, marked by an 'O' symbol, from Boyd, 1974; Griffin et al., 2003; Ivanič, 2007; Ivanič et al., 2012 and Nkere et al., 2021) are shown for comparison. Values on the y-axis are shown increasing downward.

The Nimis and Taylor (2000) thermobarometer was applied to major element data for all applicable clinopyroxene mineral grains from the various Finsch kimberlite units. Clinopyroxene temperature and pressure values from units F1, F2, F5/F6 and F8 are the only ones to slightly overlap with the T and P values of clinopyroxenes from Finsch xenoliths and concentrates in Figure 36. Less than half of the clinopyroxene data from each kimberlite unit plot in the diamond stability field, with the remaining data plotting in the graphite stability field, (Fig. 36). However, a large proportion of data falls close to (i.e., within ±1.5 GPa) the graphite-diamond boundary (Fig. 36). More than 85% of clinopyroxene data from the Finsch kimberlite units F1, F3, F4, F5/6 and F8 fall in a region between the 35 – 45mW/m² geotherms in Figure 36 (with a temperature range of between 850 – 1350°C), similar to some clinopyroxene pressure and temperature values for clinopyroxene from Finsch peridotite xenoliths of Shee et al. (1982), Skinner (1986) and Gibson et al. (2008) as well as from Bellsbank and Frank Smith kimberlites. Geotherms of 35 – 45mW/m² are characteristic of thick, cool cratonic regions (Pollack and Chapman, 1977). In contrast, clinopyroxene data from unit F2 show two groupings of data in Figure 36. The first grouping shows nearly half of clinopyroxene data from unit F2 (Fig. 36) plotting slightly above the 45mW/m² geotherm (at a temperature range of 850 - 1050°C), with the remaining data plotting between the 35 – 45mW/m² geotherms (with a temperature range of between 850 – 1350°C).

There is a significant amount of overlap between the T and P estimates from Finsch garnet and clinopyroxene calculated in this study, although garnet tends to show less variable values for both. Similarities between garnet and clinopyroxene single mineral thermobarometry data are observed for units F2 and F5/F6 (Fig. 37), which have largely overlapping T and P values. Unit F2 is characterized by a bimodal distribution for both garnet and clinopyroxene, with data plotting at the low- and high-ends of the P & T ranges (Fig. 37), where. Units F3 and F8 overlap the diamond-graphite boundary in both garnet and clinopyroxene thermometry. The main difference observed in Figure 37 is that the main concentration of clinopyroxene data falls between the 35 and 40 mW/m² geotherms, whereas most garnet data fall between the 40 and 45 mW/m² geotherms, suggesting warmer lithospheric conditions. However, it is important to note that for garnet, there are a significant population of data falling significantly above the 45 mW/m² geotherm (i.e., with similar T but low P values) whereas such data are largely absent in the clinopyroxene data set.

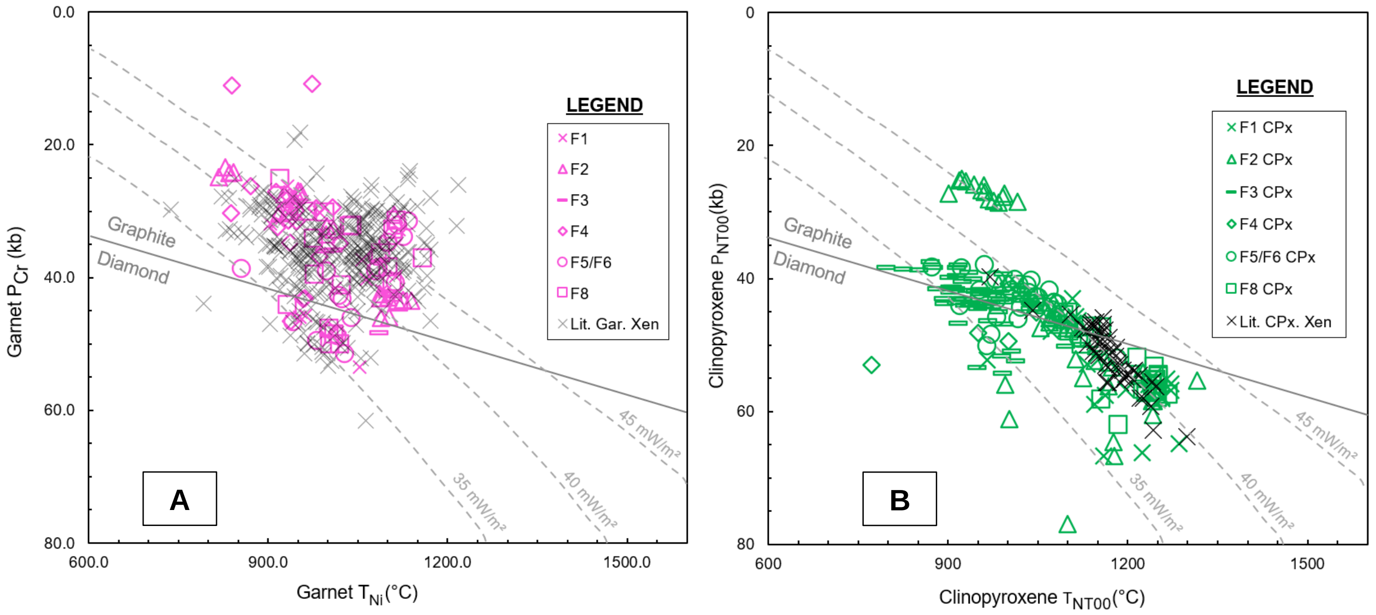


Figure 37: Temperature vs. pressure diagram, comparing garnet and clinopyroxene thermobarometry data from all Finsch kimberlite units. This diagram compares the thermobarometry data of garnets obtained using the garnet thermobarometer of Ryan et al. (1996) and the clinopyroxene thermobarometer of Nimis and Taylor (2000). Pink and green coloured symbols represent garnet and clinopyroxene data respectively. Literature garnet data (i.e., Lit. Gar. Xen. data marked by an 'X' symbol in panel A) is obtained from Griffin (2003) and Kobussen et al. (2009). Literature clinopyroxene data (i.e., Lit. CPx. Xen. data marked by an 'X' symbol in panel B) is obtained from Shee et al. (1982); Skinner (1986); Gibson et al. (2008) and Lazarov et al. (2009). Values on the y-axis are in reverse order.

Chapter 6 – Discussion

6.1 Emplacement of the Finsch kimberlite

The emplacement of the Finsch kimberlite can be understood by interpreting the petrographic characteristics observed in hand samples and thin sections, together with the interpretation of the three-dimensional shapes (or erosional truncation) of each lithophase intrusion. These characteristics are key in defining the sequence of emplacement of the units and the possible interaction between different kimberlite units in the Finsch kimberlite during their emplacement. The style of emplacement of the different units may have influenced (or correlate with) the KIM assemblages they carry.

The Finsch kimberlite is characterized by at least three textural variants of kimberlite lithological units, namely: coherent (hypabyssal), volcaniclastic (pyroclastic) and transitional (hypabyssal to pyroclastic). These textures are based on the interpretation of gross macroscopic features observed in hand specimen, as well as petrographic features observed in thin sections of the various Finsch kimberlite samples. From these observations, unit F1 is the only Finsch kimberlite unit characterized entirely by a pyroclastic texture. Likewise, unit F4 is the only Finsch kimberlite units characterized entirely by a hypabyssal texture, whereas units F2, F3, F5/F6 and F8 are all characterized by transitional textures. In addition, there is little evidence for a relationship between kimberlite texture and KIM population (i.e., mineral types and mineral compositions). The textural observations made in Chapter 4 are consistent with the following chronological order of emplacement:

Units F3 and F5/F6 represent a simultaneously emplaced precursory kimberlite complex, which was later intruded by the main pipe. Units F3 and F5/F6 are characterized by an irregular unit morphology, similar to that of a root zone complex or irregular intrusion and consistent with a complex emplacement history. The classification of units F3 and F5/F6 as a root zone complex or an irregular intrusion is supported by the combination of the location (i.e., adjacent to the main pipe) and irregular shape (with depth) of these units and, the transitional texture (i.e., pyroclastic and hypabyssal) of these kimberlite units, together with the co-occurrence of fluidized and non-fluidized pyromagmaclast variants. Further, the occurrence of contrasting types of pyromagmaclasts (i.e., fluidized and non-fluidized) suggests that unit F5 experienced sub-volcanic emplacement processes. In contrast, the rarity of non-fluidized pyromagmaclasts in unit F6 suggests that this unit experienced mainly sub-volcanic emplacement processes, with no repetitive coating of pyromagmaclasts. In addition, unit F3 experienced greater syn- or post-emplacement alteration compared to units F5/F6. The external precursor kimberlitic dykes located adjacent to unit F3 (see Figure 4) likely acted as a potential pathway for ground water seepage, facilitating the alteration. The textures and characteristics of F5/F6 described above support the separation of unit F5 and F6 into individual kimberlite phases.

The observations further suggest that unit F1 is the first extrusive unit. This is mainly based on the erosional truncation of unit F1 by unit F8 (Fig. 4) and the country rock xenolith make-up incorporated into unit F1. Unit F1 is the only kimberlite phase in the Finsch kimberlite that has incorporated the entire country rock stratigraphy present at the time of the initial emplacement, suggesting it was the first eruptive phase. Furthermore, the abundance of pyromagmaclasts and the extent of serpentinization of this unit (unit F1 being the first unit to form the primary diatreme, thus possibly allowing draw-down of ground water into the partial void exhumed, facilitating early ground water interaction with the unit F1 magma) is consistent with the hypothesis of unit F1 being the first eruptive phase.

Unit F8 represents a transitional-textured kimberlite unit, which followed the emplacement of unit F1. This is demonstrated by the erosional truncation of unit F1 by unit F8 (Fig. 4). Similarly, to units F3 and F5/F6, unit F8 is characterized by textural features which are mainly associated with sub-volcanic emplacement processes. This is demonstrated by the occurrence of hypabyssal characteristics in unit F8 (e.g., welded fine grained matrix characterized by dominant phlogopite, the occurrence of a thinly rimmed melt segregationary texture). The emplacement of unit F8 was mainly sub-volcanic. This is demonstrated by the inability of unit F8 to fully erupt and erode unit F1 (see the volume reduction of unit F8 with height in Figure 5B). This also suggests that the emplacement of unit F8 was relatively quiescent.

Unit F2 represents a transitional-textured, plug-like lobe, which occurs in the centre region of the Finsch kimberlite. It appears to have formed as a slow, degassed melt, rising through a molten central region of the Finsch kimberlite, with minimal interaction of the two magmas due to possible varying densities and viscosities. Unit F2 displays no characteristics of an erupted kimberlite and is characterized by a predominant transitional texture. The inclusion of several country rock xenoliths in unit F2 (most of which are altered into calc-silicates) suggests that these country rock xenoliths originate from unstable rocks from the crater zone which were incorporated into unit F2 through a fluidized zone. However, there is no evidence that unit F2 represents a fluidized-zone (i.e., the hot and fluid, central-region of a cooling kimberlite pipe, where large blocks of steep-sided crater material roll down toward, and become incorporated into, a kimberlite phase as exceptionally large country rock xenoliths). Nevertheless, the evidence of a fluidized unit F2 may possibly be eroded, post-emplacement, based on the reconstructed emplacement model of Hanson et al. (2009).

Unit F4 represents a hypabyssal-textured kimberlite dyke, characterized by a largely homogenous texture, with no melt segregationary texture observed. These characteristics suggest that unit F4, similarly to unit F2, was emplaced as a degassed melt, slowly rising through a series of vertical to sub-vertical joints (i.e., structural joints) throughout the Finsch kimberlite pipe. Furthermore, the vertical to sub-vertical dykes of unit F4 occasionally pinch-out in the adjacent country rock, suggesting that unit F4 exploited pre-existing structural joints in the country rock.

6.2 Indicator mineral chemistry for bulk rock assemblages and diamond prospectivity

6.2.1 Mantle lithologies from garnet

The Finsch KIM garnets have four likely origins, or parageneses, from which they are derived. These are inferred from the garnet compositional data in Table 6 and Table *8* and illustrated in Figure 18 – 24. These parageneses are harzburgitic, lherzolitic (both also belonging to the larger peridotitic category), eclogitic and megacrystic. A few garnets analysed in this study belong to a 5^{th} compositional grouping, websteritic (e.g., garnets classified as plotting in the G4 or G5 fields on the CaO vs. Cr_2O_3 diagram of Grutter et al. (2004). The representation in terms of numbers of grains plotting within the websteritic group is so small (i.e., <1%), that it does not merit further analysis. It is important to note that while garnet colour can be a useful general guide (e.g., most purple garnets being harzburgitic, most orange garnets being eclogitic) colour is not entirely reliable as an indicator of the paragenesis affinity of garnets making necessary the classification of garnets on the basis of major element chemistry. Further, there are also instances where different chemical classification schemes obtain different parageneses, such as high Ti eclogitic garnets, which could be classified as megacrystic or eclogitic (e.g., Schulze, 2003; Grütter et al., 2004). In detail, the data suggests that less than 30% of all Finsch garnets are eclogitic, with more than 70% being peridotitic, with more than 80% of these being of lherzolitic (G9) paragenesis. Unit F1 is characterized by the highest proportion (25%) of eclogitic garnets, whereas units F5/F6 are characterized by the lowest proportion of eclogitic garnets (<1%). Eclogitic and megacrystic parageneses were distinguished using the Na_2O vs. TiO_2 classification diagram, where unit F1 is characterized by the highest proportion of megacrystic garnets (Fig. 22), followed by unit F4, whereas units

F5/F6 and F8 are characterized by the lowest proportion of megacrystic garnets. More than 95% of G10 and G9 garnets from the Finsch kimberlite units are characterized by low Cr contents ranging between 0.5 and 6.5 wt. % Cr_2O_3, with very few high-Cr garnets (i.e., >8 wt. % Cr_2O_3). The compositional data further indicates that less than 15% of all Finsch peridotitic garnets from all units (except F5/F6) are harzburgitic (G10) garnets, whereas approximately 84% are lherzolitic (G9) garnets. The remaining 1% are wehrlitic garnets. For unit F5/F6, approximately 25% of peridotitic garnets are harzburgitic. In addition, units F1, F4, F5/F6 and F8 are characterized by G10 garnets with compositions similar to garnet diamond inclusions in terms of their major elements. Similarly, the Ca-Mg-Fe composition of Finsch garnets indicate a potential association with diamonds on the basis of the fact that a large proportion overlap with the fields for diamond inclusions, minerals from diamondiferous peridotites and subcalcic (G10) garnets (Gurney and Switzer, 1973; Shee et al., 1982; Lazarov et al., 2009a), the latter of which are strongly correlated with the presence of diamonds. Generally, the larger the proportion of harzburgitic garnets relative to lherzolitic garnets, the greater the diamond potential of a kimberlite unit or units (Grütter et al., 2004).

Of the few eclogitic garnets (i.e., garnets with <1 wt. % Cr_2O_3) recovered in heavy mineral concentrates from kimberlite, more than 80% of these in (except for units F5/F6) are classified as Group 1 eclogites (i.e., characterized by an elevated Na_2O composition), indicating a potential diamond association. However, only ≈50% of eclogitic garnets from unit F5/F6 are characterized by elevated Na contents and therefore having a Group 1 eclogitic affinity.

6.2.2 Mantle lithologies from clinopyroxene

The Finsch kimberlite is mainly characterized by clinopyroxene of peridotitic mineral assemblage. More than 85% of clinopyroxene minerals from units F1, F2, F4 and F5/F6 plot in the field for worldwide peridotitic clinopyroxene diamond inclusions in the CaO vs. Cr_2O_3 classification diagram (Fig. 25), suggesting a potential correlation with diamond occurrence. However, approximately only 50% of clinopyroxenes from units F3 and F8 plot within the diamond inclusion field in Figure 25. For most Finsch kimberlite units (except units F3 and F5/F6), clinopyroxene grains fall into two groups in the Al_2O_3 vs. Cr_2O_3 and MgO vs Al_2O_3 clinopyroxene source-rock classification diagrams (Fig. 26 and 27). Most units contain high-Cr, low-Al clinopyroxene consistent with garnet peridotite, as well as high-Al low-Cr clinopyroxene possibly consistent with spinel peridotite. Clinopyroxene data from the Finsch kimberlite dominantly (>95%) overlap the kimberlite xenoliths/xenocryst field of Morris et al. (2002) in the Ca# vs. Na_2O classification diagram (Fig. 28), with <5% of clinopyroxene data overlapping the eclogitic clinopyroxene field of Fipke et al. (1989). Similarly, clinopyroxene data from all the Finsch kimberlite units dominantly plot in the clinopyroxene from kimberlite xenoliths/xenocrysts/diamond inclusions field in the Morris et al. (2002) Al-Cr-Na ternary diagram (Fig. 28). This infers a large overlap in clinopyroxene compositions, which are often similar in composition to peridotitic clinopyroxene varieties (i.e., high-Cr and subcalcic).

6.3 Characteristics of the lithospheric mantle beneath the Finsch kimberlite as inferred from garnet trace element concentrations.

6.3.1 Mantle depletion and enrichment

Individual REE in Finsch peridotitic garnets typically have concentrations of less than 10 times chondrites. G10 garnets are generally characterized by sinusoidally shaped REE patterns, with relative enrichments in LREE (with maxima at Nd, Sm or Eu), a decrease in the MREE and a gradual increase in the HREE. These sinuous-shaped REE patterns and low to moderate incompatible element concentrations are characteristic of harzburgitic (subcalcic) garnets (e.g., Nixon et al., 1987; Shimizu & Richardson, 1987; Hoal et al., 1994; Shimizu et al., 1997; Stachel et al., 1998; Gibson et al., 2008; Lazarov et al., 2009ab; Lazarov et al., 2012ab), which experienced a two-stage process of (1) strong melt depletion and (2) later metasomatic enrichment by a strongly LREE-enriched agent. Further, garnets characterized by sinusoidal chondrite normalized REE patterns, with positive HREE slopes are similar to garnets that occur in harzburgite xenoliths from Finsch, which equilibrated at temperatures <1100°C (Gibson et al., 2008).

Conversely, G9 garnets are far more commonly characterized by relatively straight, mildly (positively) sloped patterns, especially in the MREE and HREE (e.g., Shimizu & Richardson, 1987; Hoal et al., 1994; Shimizu et al., 1997; Stachel et al., 1998) and are similar to low-Cr (i.e., 3 – 8 wt. % Cr_2O_3) harzburgitic and lherzolitic garnets from Finsch (Gibson et al., 2008). All Finsch peridotitic garnets are also characterized by primitive mantle-normalised incompatible element patterns with depletions in Rb, the LREE Sr and Ti, have positive U anomalies, low Th/U ratios and similarly high Nb/La ratios.

Several hypotheses have been proposed for the dissimilarity in shape of REE patterns exhibited by lherzolitic and harzburgitic garnets. These hypotheses are summarized into two groups and, mainly focus on the origin of subcalcic harzburgitic garnets, due to their association with diamond formation. These models of formation are, 1: Low-pressure cratonic mantle formation which involves initial melting in a mid-ocean ridge setting, followed by further melting in a subduction zone setting (in both examples, the melting is relatively shallow and dominantly takes place in the spinel stability field). Garnet would only form after the depleted mantle residue from this melting is tectonically thickened and then the metasomatism occurs after this. 2: A second model of formation proposes that the infiltration of a carbonatite melt (Griffin et al., 1992) has leached Ca from an already depleted garnet or that subcalcic garnets were created by the reaction of Si-rich fluids and garnet-free harzburgite at high pressure [e.g., Malkovets et al. (2007); Hill et al. (2015)].

The first model of formation of subcalcic garnets presented above is most likely applicable to subcalcic garnets sampled by the Finsch kimberlite. Gibson et al. (2008) presented evidence that Finsch peridotites were not affected by Si enrichment that most often accompanies metasomatism in a subduction setting. The subcalcic garnets from Finsch indicate that the mantle beneath Finsch is the product of several depletion events, (e.g., as inferred from Sm-Nd and Lu-Hf isotopic systematics; Gibson et al., 2008; Lazarov et al., 2009a), with more than one enrichment event (e.g., positive HREE slopes in subcalcic garnets) that overprinted a depleted mantle. The last partial melting event leading to the formation of cratonic root beneath the Kaapvaal craton occurred around 2.5 Ga (Lazarov et al., 2009). Diamond growth requires precise redox chemical reactions, within specific temperature and pressure ranges. Also, the relatively high pressures for a given temperature required for diamond stability means that a metasomatic origin for diamond is required because diamond would not have been introduced during or soon after melt depletion (the cratonic root needs to have cooled to a much later geotherm).

Trace element covariations define an envelope of increasing average Cr content with increasing concentration of the LREE La and, decreasing concentration of the HREE Lu as observed in the Finsch peridotitic garnet data (Fig. 32). A negative relationship (though not a true correlation) appears to exist between Lu and Cr. This is consistent with the fact that the HREE are mildly incompatible in peridotite overall (and therefore would decrease with increasing melt depletion) and are also resistant to metasomatic enrichment. In contrast, a positive relationship exists between Cr and La, most likely because highly melt-depleted and Cr-enriched peridotites are more likely to be strongly metasomatized. The lack of correlation of CaO with La (Fig. 32) can be attributed to the high susceptibility of La to even mild metasomatism (Lazarov et al., 2012a), which results in a widespread scatter when compared with CaO. This occurs due to a combination of melt extraction and melt metasomatism (i.e., in synthetic systems, REE substitution is dependent on the amount of Ca in the X-cation site of garnets and, the pyrope – grossular garnet ratio; Ballaran et al., 1999).

6.4 Equilibration temperatures and pressures as recorded by garnet and clinopyroxene.

6.4.1 Garnet and clinopyroxene thermobarometry

Clinopyroxene does not occur in harzburgite and therefore has low utility as a diamond-indicating mineral. In addition, the use of Cr_2O_3 contents of clinopyroxene are limited in inferring mantle source-rock characteristics due to the fact that high Cr_2O_3 in clinopyroxene is not necessarily correlative with diamond occurrence or content (Morris et al., 2002). However, clinopyroxene (and garnet) can yield useful temperature and pressure data. Temperature and pressure values obtained from garnet and clinopyroxene minerals from Finsch are fairly similar, with a comparable temperature and pressure ranges of 800 – 1300°C and 25 – 60kb respectively. Most of the Finsch garnet and clinopyroxene thermobarometry data overlap with xenolithic mantle garnets from Finsch and garnet and clinopyroxene thermobarometry data from neighbouring kimberlites in the Barkly West area (e.g., Boyd, 1974; Shee et al., 1982; Skinner, 1986; Griffin et al., 2003; Ivanic, 2007; Gibson et al., 2008; Kobussen et al., 2009; Lazarov et al., 2009a; 2009b; Ivanič et al., 2012; Nkere et al., 2021).

Less than half of garnet and clinopyroxene thermobarometry data from Finsch (Fig. 37) fall within the diamond stability field. In addition, G10 garnets are characterised by higher average pressures, when compared to the G9 garnets. This implies lower lithospheric heat flow in the mantle sampled by some of the G10 garnets compared to the G9 garnets. It must also be noted that Grutter et al. (2006) found that the P(Cr) barometer is sensitive to chromium content and that the barometer is less precise for G9 garnets with low chromium. G9 garnets tend to have lower chromium than G10 and, this could explain the apparent difference in pressures between G9 and G10. Whether this is indicative of a change in the proportion of harzburgitic to lherzolitic mantle with depth (e.g., Griffin et al., 2003), or simply reflects unrepresentative sampling remains unclear. It must however also be noted that the P(Cr) barometer used in the Ryan et al. (1996) thermobarometer requires several assumptions, most especially that garnet coexists with chromite. This is a far less robust assumption than the one for the Ni in garnet thermometry (i.e., that garnet coexists with olivine) and, could result in biased pressure results.

Chapter 7 – Conclusion

The nature and scarcity of economic diamond-bearing kimberlites are such that kimberlite mineral resource classification models might benefit from a closer examination of the possible correlations between individual kimberlite lithophases and their indicator mineral populations (i.e., both in terms of mineral type and mineral composition). This dissertation attempts to provide such an analysis for the economic Finsch kimberlite, to determine whether such studies carried out in other kimberlites could provide useful information that would benefit exploration and development activities. The main conclusions are as follows:

1. The descriptive classification and emplacement sequence of the Finsch kimberlite is defined by the identification and designation of several petrological characteristics described in this study. The difference or similarity in the petrography of each kimberlite unit at Finsch is mainly attributed to the volatility of the kimberlitic magma, combined with the emplacement style of each unit, together with the interaction of the different kimberlite melts (possibly with some variation due to differences in degrees of partial melting and fractionation), during emplacement. The emplacement order of the Finsch kimberlite is summarised as follows:

    a. Units F3 and F5/F6 represent a simultaneously emplaced precursor kimberlite complex, marking the first kimberlite volcanism activity at Finsch. All three units are diamondiferous, however unit F3 is characterised by the lowest diamond grade in the Finsch kimberlite and is also characterized by the lowest proportion of garnet sampled. Although units F5/F6 and F3 represent a distinct sub-volcanic kimberlite body, unit F5/F6 should be unbundled and classified individually, as each unit is characterized by unique textures. This precursory complex was later intruded by the main-pipe.
    b. The main-pipe is characterised by five kimberlite phases (i.e., unit F1, F2, F4, F7 and F8). Unit F1 marks the first extrusive volcanism of the main pipe, followed by unit F8. This sequence is mainly defined by the erosional truncation of unit F1 by unit F8. The emplacement of unit F8 is followed by the emplacement of unit F2, where unit F4 marks the last volcanic activity at Finsch. This sequence of emplacement between units F2 and F4 is mainly defined by cross-cutting relationships within the main-pipe. Lastly, unit F7 is not defined as an independently emplaced unit of the Finsch kimberlite, but rather

a differentiated version of unit F8, due to its volumetrically irregular and insignificant nature.

c. Pyromagmaclasts are common in the Finsch kimberlite and are useful in defining the volcanic or sub-volcanic nature of each kimberlite unit. Units F1 and F8 display evidence of an erupted kimberlite, this is based on the occurrence of melt segregationary textures described in units F1 and F8. The melt segregationary textures described for units F1 and F8 further imply a volatile-rich kimberlite melt for unit F1 and F8, which effectively transported and preserved xenolithic mantle material to the surface. Contrary, units F2 and F4 are not characterized by melt segregationary textures or display evidence of an erupted kimberlite, however both units are diamondiferous and, unit F4 is characterized by the highest average diamond grade in the Finsch kimberlite. This observation supports the ability of non-pyroclastic kimberlite variants, to similarly, effectively transport and preserve mantle xenoliths in kimberlite. Units F1, F2, F4 and F8 approximately characterised by similar mineral proportions of garnet, however unit F4 is characterized by a lower proportion of clinopyroxene compared to units F1, F2 and F8

2. Garnet and clinopyroxene recovered from the various Finsch kimberlite units are particularly useful in associating the occurrence of KIM in kimberlite to different mantle lithologies and, support the following:

   a. The Finsch kimberlite is characterised by having 82% of peridotitic garnets from all units that equilibrated outside the diamond stability field. All lherzolitic (G9) garnets fall into this category as well as most harzburgitic (G10) garnets, with only 8% of all garnets plotting in the diamond stability field. Most (i.e., 91%) of the eclogitic garnets are of Group 1 eclogitic affinity indicating a possible association with diamond.
   b. It is however concluded that diamond potential does not appear to be directly related to the proportions of KIM types and P-T values obtained from this study for any individual unit. Specifically, a kimberlite phase with high diamond potential is not necessarily indicated by the presence of large proportions of G10 harzburgitic garnets (e.g., less than 15% of all garnets obtained as heavy mineral concentrates from units F1, F2, F4 and F8 fall within the G10 field in the CaO vs. Cr_2O_3 garnet classification diagram, however these kimberlite units are characterized by very high diamond grades), or garnets and clinopyroxene minerals with estimated temperatures and/or pressures falling within the

diamond stability field or garnets with depleted REE sinusoidal patterns similar to diamondiferous harzburgites

c. The diamond grade values presented in Table 1 of this study are however not suitable for correlation with compositional indexes (e.g., % of peridotitic garnets that are G10), for the reason that the diamonds have undergone variable (but often significant) resorption and, the values as presented are average values and do not take into account any statistical variations or detailed representative sampling.

3. Representative sampling as done in this study, representing the efforts of a single mine geologist to obtain bulk samples and to separate heavy indicator minerals from them, performed over a number of weeks (not including the time needed to do petrography and collect and analyse geochemical data), shows both the utility and limitations of such an approach. The presence of KIM with strong compositional affinities to diamond inclusions, and other chemical and thermobarometric indications of diamond affinity (e.g., G10 compositions and T and P values falling in the diamond field) are highly consistent with the diamondiferous nature of the Finsch kimberlite. However, the general similarity between units and the limited number of data, along with factors like the variable resorption of Finsch heavy mineral concentrates and diamonds, makes difficult any significant statistical differentiation of units in terms of diamond grade or potential.

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Appendices

Appendix A: Table of standards

Mineral Type	Element	Channel	Crystal	Source Mineral	Smithsonian Standard Number
Garnet	SiO_2	1	TAP	Pyrope (Kakanui)	NMNH 143968
	MnO	3	PETJ	Rhodonite	
	MgO	2	TAP	Pyrope (Kakanui)	NMNH 143968
	CaO	4	PETH	Pyrope (Kakanui)	NMNH 143968
	Cr_2O_3	3	PETJ	Chromite (Stillwater) 52NL11	
	Al_2O_3	1	TAP	Pyrope (Kakanui)	NMNH 143968
	Na_2O	2	TAP	Hornblende (Kakanui)	NMNH 143965
	K_2O	4	PETH	Hornblende (Kakanui)	NMNH 143965
	TiO_2	3	PETJ	Rutile (Synthetic)	
	FeO	4	LIFH	Pyrope (Kakanui)	NMNH 143968
Clinopyroxene	SiO_2	1	TAP	Orthopyroxene (Jagersfontein JJG 1424)	
	Na_2O	2	TAP	Hornblende (Kakanui)	NMNH 143965
	MnO	3	PETJ	Rhodonite	
	CaO	4	PETH	Clinopyroxene (Jagersfontein JJG 1424)	
	Al_2O_3	1	TAP	Pyrope (Kakanui)	NMNH 143968
	MgO	2	TAP	Orthopyroxene (Jagersfontein JJG 1424)	
	Cr_2O_3	3	PETJ	Chromite (Stillwater) 52NL11	
	K_2O	4	PETH	Hornblende (Kakanui)	NMNH 143965
	TiO_2	3	PETJ	Rutile (Synthetic)	
	FeO	4	LIFH	Pyrope (Kakanui)	NMNH 143968
Ilmenite	SiO_2	1	TAP	Pyrope (Kakanui)	NMNH 143968
	MgO	2	TAP	Chromite (Stillwater) 52NL11	
	MnO	3	PETJ	Rhodonite	
	CaO	4	PETH	Pyrope (Kakanui)	NMNH 143968
	Al_2O_3	1	TAP	Chromite (Stillwater) 52NL11	
	Cr_2O_3	3	PETJ	Chromite (Stillwater) 52NL11	
	FeO	4	PETH	Ilmenite (Ilmen)	NMNH 96189
	TiO_2	3	PETJ	Ilmenite (Ilmen)	NMNH 96189
Chromite	SiO_2	1	TAP	Pyrope (Kakanui)	NMNH 143968
	MgO	2	TAP	Chromite (Stillwater) 52NL11	
	MnO	3	PETJ	Rhodonite	
	CaO	4	PETH	Pyrope (Kakanui)	NMNH 143968
	Al_2O_3	1	TAP	Chromite (Stillwater) 52NL11	
	Cr_2O_3	3	PETJ	Chromite (Stillwater) 52NL11	
	FeO	4	LIFH	Chromite (Stillwater) 52NL11	
	TiO_2	3	PETJ	Rutile (Synthetic)	

Appendix B: Major element data for garnet, clinopyroxene and chromite, presented in wt. %

Table 9: Finsch unit F1 garnets.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F1-1	41.77	0.00	17.94	8.79	5.83	0.31	23.07	1.87	0.02	0.02	99.63	Purple Garnet
F1-2	42.03	0.03	17.85	8.47	5.72	0.33	22.68	1.88	0.01	0.01	99.01	Purple Garnet
F1-3	41.82	0.06	19.37	6.81	5.77	0.31	21.97	2.86	0.06	0.01	99.04	Purple Garnet
F1-4	42.56	0.00	20.01	6.32	5.16	0.28	24.73	0.38	0.06	0.01	99.50	Purple Garnet
F1-5	42.48	0.05	21.59	4.04	5.78	0.34	22.65	2.67	0.07	0.01	99.68	Purple Garnet
F1-6	46.66	0.04	21.02	7.43	5.46	0.32	17.85	2.19	0.06	0.02	101.06	Purple Garnet
F1-7	42.13	0.05	21.57	3.41	7.79	0.41	19.91	4.62	0.04	0.02	99.96	Purple Garnet
F1-8	41.70	0.03	18.64	7.74	6.24	0.36	21.27	3.44	0.08	0.02	99.52	Purple Garnet
F1-9	42.07	0.01	21.08	4.55	6.55	0.32	20.11	5.00	0.06	0.02	99.76	Purple Garnet
F1-10	42.04	0.03	20.78	4.56	6.58	0.34	19.93	4.98	0.02	0.01	99.26	Purple Garnet
F1-11	42.05	0.10	19.32	6.72	6.35	0.37	20.90	4.08	0.08	0.02	99.98	Purple Garnet
F1-12	42.47	0.03	22.05	3.25	6.91	0.31	20.69	4.53	0.05	0.02	100.31	Purple Garnet
F1-13	42.49	0.03	19.60	6.56	5.67	0.36	22.38	2.84	0.04	0.02	99.99	Purple Garnet
F1-14	42.03	0.07	19.37	6.77	5.48	0.30	21.76	2.83	0.08	0.02	98.70	Purple Garnet
F1-15	42.37	0.03	19.52	6.66	5.76	0.30	22.11	2.89	0.01	0.02	99.67	Purple Garnet
F1-16	41.56	0.12	19.49	5.48	6.32	0.37	20.61	5.21	0.07	0.03	99.26	Purple Garnet
F1-17	42.14	0.11	22.23	2.86	7.35	0.35	20.27	4.39	0.07	0.02	99.78	Purple Garnet
F1-18	42.38	0.03	22.13	2.78	7.39	0.38	20.23	4.53	0.06	0.01	99.91	Purple Garnet
F1-19	42.55	0.04	22.40	2.37	7.69	0.35	20.38	4.34	0.09	0.03	100.22	Purple Garnet
F1-20	41.97	0.06	21.95	3.14	7.51	0.39	19.94	4.47	0.05	0.02	99.50	Purple Garnet
F1-21	42.69	0.04	22.90	2.15	7.73	0.34	20.18	4.31	0.04	0.03	100.40	Purple Garnet
F1-22	42.11	0.11	20.82	4.52	6.54	0.33	20.20	4.82	0.07	0.01	99.53	Purple Garnet
F1-23	42.42	0.02	21.90	3.17	6.97	0.35	19.74	4.67	0.05	0.01	99.29	Purple Garnet
F1-24	42.38	0.08	20.93	4.28	6.75	0.29	20.48	4.66	0.07	0.02	99.93	Purple Garnet
F1-25	41.90	0.12	19.87	6.00	6.80	0.42	20.29	4.44	0.07	0.02	99.95	Purple Garnet
F1-26	42.09	0.14	21.34	3.22	6.13	0.33	20.96	4.71	0.05	0.02	98.98	Purple Garnet
F1-27	42.45	0.02	22.18	2.75	7.27	0.35	20.26	4.52	0.04	0.02	99.85	Purple Garnet
F1-28	41.92	0.04	21.63	3.45	7.66	0.39	19.62	4.71	0.10	0.02	99.53	Purple Garnet
F1-29	42.34	0.12	22.24	3.07	6.98	0.38	20.67	4.48	0.06	0.00	100.33	Purple Garnet
F1-30	42.56	0.09	22.35	2.95	7.39	0.35	20.22	4.59	0.05	0.00	100.54	Purple Garnet
F1-31	42.26	0.03	22.60	2.43	7.47	0.33	20.39	4.42	0.04	0.03	99.99	Purple Garnet
F1-32	42.38	0.01	21.03	4.07	7.21	0.36	19.87	4.95	0.04	0.02	99.95	Purple Garnet
F1-33	42.60	0.03	22.92	2.16	7.79	0.33	20.30	4.31	0.05	0.02	100.51	Purple Garnet
F1-34	41.97	0.24	19.58	5.77	6.50	0.35	20.03	5.29	0.08	0.00	99.81	Purple Garnet
F1-35	42.27	0.23	20.06	5.17	6.68	0.30	20.29	5.01	0.04	0.02	100.07	Purple Garnet
F1-36	41.80	0.38	19.48	5.98	6.45	0.33	20.59	4.77	0.19	0.01	99.96	Purple Garnet
F1-37	42.43	0.09	22.34	2.67	7.69	0.39	20.11	4.37	0.07	0.02	100.17	Purple Garnet

Table 9 continued.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F1-38	41.67	0.13	20.12	5.20	7.26	0.42	19.32	5.19	0.10	0.03	99.44	Purple Garnet
F1-39	41.69	0.28	18.80	6.56	7.10	0.37	19.77	5.27	0.04	0.02	99.90	Purple Garnet
F1-40	41.52	0.11	18.88	6.85	6.31	0.38	20.12	5.20	0.06	0.03	99.46	Purple Garnet
F1-41	42.09	0.14	19.81	5.59	6.44	0.36	20.06	5.25	0.07	0.01	99.82	Purple Garnet
F1-42	42.53	0.14	21.02	3.86	6.88	0.30	20.62	4.77	0.07	0.02	100.20	Purple Garnet
F1-43	41.53	0.04	19.07	6.54	6.68	0.33	20.01	5.60	0.06	0.02	99.86	Purple Garnet
F1-44	41.67	0.07	18.90	6.49	6.44	0.37	19.92	5.57	0.02	0.02	99.46	Purple Garnet
F1-45	42.58	0.02	22.61	2.47	7.75	0.32	20.33	4.39	0.07	0.02	100.54	Purple Garnet
F1-46	41.03	0.00	22.13	2.44	7.70	0.37	21.55	4.35	0.04	0.02	99.63	Purple Garnet
F1-47	42.33	0.05	22.20	2.86	7.52	0.34	20.27	4.50	0.04	0.02	100.14	Purple Garnet
F1-48	42.34	0.01	22.43	2.62	7.14	0.29	20.69	4.61	0.07	0.02	100.23	Purple Garnet
F1-49	42.36	0.00	22.38	2.38	7.71	0.34	19.80	4.40	0.07	0.01	99.45	Purple Garnet
F1-50	42.44	0.02	22.66	2.42	7.78	0.32	20.61	4.41	0.02	0.02	100.71	Pink Garnet
F1-51	42.47	0.07	22.61	2.50	7.51	0.38	20.20	4.49	0.09	0.02	100.34	Pink Garnet
F1-52	42.41	0.04	21.78	3.55	7.32	0.40	19.89	4.79	0.05	0.00	100.24	Pink Garnet
F1-53	42.73	0.08	23.04	1.90	7.39	0.37	20.74	4.24	0.07	0.01	100.56	Pink Garnet
F1-54	42.76	0.16	22.08	2.70	7.12	0.36	20.60	4.69	0.05	0.01	100.52	Pink Garnet
F1-55	42.46	0.06	22.07	3.25	7.67	0.42	19.77	4.61	0.05	0.02	100.38	Pink Garnet
F1-56	42.35	0.03	21.95	3.06	7.46	0.43	20.07	4.61	0.05	0.03	100.05	Pink Garnet
F1-57	42.79	0.05	21.61	3.10	6.24	0.26	20.67	4.75	0.06	0.03	99.56	Pink Garnet
F1-58	42.34	0.00	22.57	2.26	7.12	0.36	20.84	4.30	0.08	0.02	99.88	Pink Garnet
F1-59	42.81	0.02	22.63	2.19	7.78	0.39	20.32	4.34	0.07	0.02	100.56	Pink Garnet
F1-60	42.90	0.04	21.91	3.15	6.81	0.32	20.38	4.48	0.07	0.02	100.08	Pink Garnet
F1-61	42.71	0.04	21.66	3.21	6.86	0.36	20.79	4.47	0.07	0.02	100.18	Pink Garnet
F1-62	42.31	0.05	22.87	2.16	7.87	0.42	20.24	4.34	0.10	0.01	100.37	Pink Garnet
F1-63	42.70	0.14	21.38	3.51	6.43	0.26	21.31	4.81	0.09	0.01	100.63	Pink Garnet
F1-64	42.45	0.00	22.72	2.48	7.53	0.32	20.51	4.41	0.08	0.01	100.51	Pink Garnet
F1-65	42.89	0.05	22.57	2.42	7.64	0.32	20.43	4.37	0.08	0.02	100.79	Pink Garnet
F1-66	42.32	0.07	21.57	3.54	7.65	0.35	20.13	4.72	0.06	0.01	100.42	Pink Garnet
F1-67	42.58	0.06	22.27	2.81	7.46	0.34	20.57	4.56	0.08	0.01	100.73	Pink Garnet
F1-68	42.64	0.11	22.76	2.06	7.32	0.30	20.93	4.23	0.06	0.00	100.40	Pink Garnet
F1-69	42.48	0.03	21.48	3.98	7.56	0.39	19.58	4.79	0.05	0.02	100.36	Pink Garnet
F1-70	42.37	0.06	21.71	3.45	6.81	0.33	20.80	4.57	0.08	0.02	100.20	Pink Garnet
F1-71	42.74	0.04	22.74	2.22	7.68	0.36	20.44	4.30	0.04	0.01	100.56	Pink Garnet
F1-72	42.44	0.05	21.68	3.64	7.60	0.32	20.25	4.72	0.05	0.01	100.75	Pink Garnet
F1-73	42.54	0.13	22.15	2.72	7.87	0.42	19.96	4.50	0.05	0.02	100.34	Pink Garnet
F1-74	42.83	0.17	20.65	4.81	6.49	0.32	20.22	5.03	0.02	0.03	100.56	Pink Garnet
F1-75	41.78	0.13	19.92	5.66	6.38	0.28	20.49	5.27	0.04	0.03	99.98	Pink Garnet
F1-76	42.32	0.08	22.82	2.25	7.69	0.37	20.47	4.41	0.08	0.02	100.50	Pink Garnet
F1-77	42.13	0.31	20.43	4.67	6.34	0.35	21.04	4.82	0.12	0.01	100.21	Pink Garnet
F1-78	42.61	0.03	22.62	2.21	7.62	0.38	20.73	4.29	0.03	0.02	100.53	Pink Garnet
F1-79	42.65	0.04	22.82	2.26	7.60	0.31	20.43	4.32	0.05	0.01	100.49	Pink Garnet
F1-80	42.26	0.03	20.91	4.53	6.83	0.39	20.25	5.02	0.05	0.01	100.27	Pink Garnet

Table 9 continued.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F1-81	42.44	0.01	22.98	2.16	7.73	0.32	20.59	4.25	0.05	0.01	100.53	Pink Garnet
F1-82	42.45	0.09	22.50	2.65	7.90	0.34	20.14	4.45	0.05	0.01	100.55	Pink Garnet
F1-83	42.04	0.02	22.43	2.18	7.80	0.38	20.46	4.27	0.03	0.01	99.64	Pink Garnet
F1-84	41.33	0.04	22.19	2.24	7.89	0.35	20.77	4.40	0.03	0.00	99.24	Pink Garnet
F1-85	41.87	0.07	21.63	3.66	7.65	0.43	19.80	4.77	0.06	0.03	99.94	Pink Garnet
F1-86	42.19	0.13	21.52	3.42	6.43	0.29	20.54	4.64	0.04	0.01	99.22	Pink Garnet
F1-87	42.20	0.05	21.00	4.27	6.62	0.29	20.40	4.91	0.05	0.00	99.78	Pink Garnet
F1-88	41.91	0.00	22.31	2.37	7.99	0.35	19.86	4.28	0.05	0.00	99.12	Pink Garnet
F1-89	42.01	0.03	22.36	2.53	7.39	0.27	20.27	4.27	0.04	0.00	99.17	Pink Garnet
F1-90	41.78	0.06	20.53	4.80	7.02	0.40	19.41	5.10	0.02	0.02	99.13	Pink Garnet
F1-91	42.22	0.02	22.46	2.43	7.90	0.37	19.79	4.31	0.03	0.01	99.55	Pink Garnet
F1-92	41.37	0.06	21.81	3.37	7.83	0.37	19.85	4.62	0.04	0.00	99.32	Pink Garnet
F1-93	42.27	0.05	22.30	2.52	7.50	0.30	20.52	4.34	0.04	0.01	99.87	Pink Garnet
F1-94	41.79	0.08	20.63	4.92	6.27	0.31	20.59	4.67	0.06	0.02	99.34	Pink Garnet
F1-95	41.92	0.03	20.58	4.84	6.88	0.32	19.61	4.92	0.03	0.03	99.15	Pink Garnet
F1-96	42.08	0.05	21.85	3.31	7.75	0.35	19.96	4.63	0.04	0.01	100.02	Pink Garnet
F1-97	41.85	0.09	22.52	1.94	7.50	0.37	20.66	4.11	0.02	0.02	99.08	Pink Garnet
F1-98	42.01	0.17	22.43	2.06	7.27	0.32	20.87	4.13	0.02	0.00	99.28	Pink Garnet
F1-99	42.28	0.01	21.76	3.37	6.99	0.30	20.02	4.92	0.00	0.02	99.67	Pink Garnet
F1-100	41.50	0.07	22.67	2.09	8.69	0.38	20.01	4.12	0.00	0.01	99.53	Pink Garnet
F1-101	41.94	0.06	23.03	2.10	8.84	0.36	19.88	4.15	0.05	0.00	100.41	Pink Garnet
F1-102	41.21	0.21	19.91	4.99	6.98	0.38	20.44	5.04	0.05	0.02	99.22	Pink Garnet
F1-103	41.74	0.11	22.10	2.77	7.78	0.37	19.91	4.43	0.06	0.00	99.27	Pink Garnet
F1-104	42.14	0.03	22.79	2.07	7.96	0.33	20.26	4.30	0.03	0.01	99.91	Pink Garnet
F1-105	42.07	0.06	21.98	3.22	7.50	0.31	20.43	4.70	0.05	0.01	100.32	Pink Garnet
F1-106	41.88	0.07	22.41	2.48	7.71	0.36	20.17	4.37	0.05	0.00	99.50	Pink Garnet
F1-107	41.59	0.08	22.12	2.55	8.06	0.41	20.31	4.32	0.09	0.03	99.55	Pink Garnet
F1-108	42.18	0.10	22.65	2.04	8.13	0.32	19.83	4.24	0.02	0.02	99.51	Pink Garnet
F1-109	42.10	0.03	22.11	2.59	7.44	0.30	20.63	4.26	0.04	0.00	99.49	Pink Garnet
F1-110	41.98	0.09	21.85	3.09	7.47	0.36	20.08	4.52	0.04	0.02	99.48	Pink Garnet
F1-111	41.96	0.48	21.45	2.68	7.66	0.30	20.59	4.37	0.11	0.01	99.59	Red Garnet
F1-112	42.19	0.54	22.13	1.96	7.69	0.30	20.69	4.31	0.08	0.02	99.91	Red Garnet
F1-113	42.21	0.55	22.05	2.01	7.80	0.33	20.51	4.31	0.11	0.00	99.88	Red Garnet
F1-114	41.86	0.57	22.07	2.08	8.34	0.31	20.64	4.17	0.12	0.01	100.16	Red Garnet
F1-115	42.27	0.52	22.33	1.75	8.24	0.32	20.52	4.05	0.06	0.00	100.05	Red Garnet
F1-116	42.18	0.51	22.45	1.68	6.83	0.29	21.25	4.19	0.08	0.01	99.46	Red Garnet
F1-117	41.78	0.80	23.07	0.03	9.38	0.30	19.60	4.66	0.11	0.00	99.72	Red Garnet
F1-118	41.96	0.58	21.14	3.27	8.80	0.36	19.74	4.05	0.13	0.02	100.06	Red Garnet
F1-119	41.23	0.33	21.62	2.32	13.41	0.46	16.74	4.56	0.08	0.01	100.75	Red Garnet
F1-120	42.08	0.65	22.19	2.01	7.77	0.32	20.64	4.38	0.08	0.00	100.12	Red Garnet
F1-121	42.08	0.52	22.10	2.07	7.90	0.25	20.87	4.33	0.08	0.01	100.21	Red Garnet
F1-122	42.85	0.33	23.31	1.22	7.08	0.30	20.96	4.16	0.05	0.01	100.26	Red Garnet
F1-123	41.68	0.69	21.93	1.08	12.00	0.27	18.01	4.44	0.10	0.02	100.22	Red Garnet

Table 9 continued.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F1-124	41.92	0.56	22.39	1.75	7.72	0.29	20.59	4.14	0.11	0.00	99.48	Red Garnet
F1-125	42.10	0.70	22.72	1.29	7.93	0.33	20.47	4.06	0.16	0.03	99.78	Red Garnet
F1-126	42.25	0.54	22.07	2.02	7.60	0.28	20.00	4.30	0.10	0.00	99.17	Red Garnet
F1-127	42.36	0.39	23.10	0.33	10.59	0.24	19.65	3.34	0.10	0.01	100.11	Red Garnet
F1-128	42.34	0.52	22.59	1.55	8.51	0.37	20.09	4.04	0.11	0.00	100.12	Red Garnet
F1-129	42.24	0.43	23.20	0.77	9.66	0.28	19.94	3.64	0.12	0.01	100.28	Red Garnet
F1-130	42.25	0.56	22.47	1.63	8.86	0.34	20.35	4.04	0.12	0.00	100.62	Red Garnet
F1-131	42.22	0.53	22.41	1.95	7.89	0.28	20.53	4.05	0.06	0.02	99.93	Red Garnet
F1-132	42.10	0.26	23.80	0.21	10.98	0.39	20.35	2.36	0.06	0.00	100.52	Red Garnet
F1-133	42.46	0.46	23.37	0.36	9.20	0.19	20.60	3.31	0.11	0.03	100.08	Red Garnet
F1-134	42.49	0.47	22.23	2.03	7.99	0.34	20.66	4.46	0.10	0.01	100.76	Red Garnet
F1-135	42.23	0.55	22.14	1.90	7.78	0.33	20.43	4.30	0.09	0.02	99.76	Red Garnet
F1-136	42.37	0.60	22.57	1.64	8.54	0.26	20.27	4.07	0.09	0.00	100.40	Red Garnet
F1-137	42.23	0.54	22.56	1.68	8.52	0.31	20.51	4.13	0.08	0.01	100.56	Red Garnet
F1-138	42.48	0.49	22.56	1.78	6.88	0.29	21.19	4.18	0.08	0.00	99.92	Red Garnet
F1-139	42.29	0.73	22.05	1.97	7.80	0.27	20.45	4.39	0.08	0.00	100.04	Red Garnet
F1-140	41.99	0.31	22.45	1.94	9.84	0.36	19.19	4.29	0.08	0.00	100.44	Red Garnet
F1-141	42.75	0.30	23.71	0.61	7.83	0.24	21.00	3.84	0.10	0.01	100.38	Red Garnet
F1-142	42.54	0.27	24.25	0.10	10.36	0.22	19.85	3.65	0.08	0.00	101.32	Red Garnet
F1-143	42.06	0.71	20.82	3.30	7.81	0.33	20.21	4.67	0.08	0.00	100.00	Red Garnet
F1-144	42.84	0.34	23.67	0.61	7.93	0.23	20.98	3.86	0.06	0.01	100.52	Red Garnet
F1-145	42.62	0.50	22.58	1.66	8.59	0.33	20.38	4.00	0.11	0.00	100.77	Red Garnet
F1-146	41.32	0.27	22.03	1.88	13.22	0.43	17.05	4.37	0.06	0.01	100.63	Red Garnet
F1-147	42.56	0.14	22.51	2.73	6.62	0.29	20.98	4.52	0.00	0.03	100.39	Red Garnet
F1-148	42.41	0.41	23.08	0.81	10.10	0.20	20.01	3.30	0.13	0.01	100.45	Red Garnet
F1-149	42.62	0.41	23.23	0.76	9.61	0.29	19.65	4.21	0.06	0.01	100.86	Red Garnet
F1-150	42.30	0.58	22.28	1.76	8.26	0.32	20.27	4.04	0.12	0.01	99.94	Red Garnet
F1-151	40.88	0.31	22.96	0.08	16.17	0.39	12.64	7.78	0.07	0.01	101.28	Red Garnet
F1-152	41.62	0.23	22.45	1.55	12.35	0.49	17.59	4.15	0.07	0.01	100.51	Red Garnet
F1-153	42.89	0.52	22.66	1.78	7.03	0.33	21.07	4.06	0.10	0.00	100.44	Red Garnet
F1-154	42.69	0.48	23.33	0.76	9.96	0.21	19.86	3.20	0.12	0.02	100.62	Red Garnet
F1-155	42.65	0.53	21.13	3.23	7.25	0.32	20.46	4.51	0.08	0.01	100.16	Red Garnet
F1-156	42.59	0.60	22.26	1.87	7.69	0.30	20.71	4.14	0.16	0.00	100.32	Red Garnet
F1-157	42.38	0.61	22.31	1.78	7.73	0.25	20.57	4.25	0.10	0.02	99.99	Red Garnet
F1-158	42.63	0.46	23.01	1.01	7.41	0.28	20.92	4.08	0.12	0.00	99.91	Red Garnet
F1-159	42.54	0.52	22.26	2.01	7.78	0.31	20.56	4.34	0.04	0.00	100.35	Red Garnet
F1-160	42.65	0.50	22.57	1.72	8.51	0.31	20.16	4.03	0.16	0.01	100.62	Red Garnet
F1-161	42.71	0.51	22.50	1.89	8.03	0.30	20.60	4.23	0.10	0.01	100.88	Red Garnet
F1-162	42.57	0.37	22.77	1.73	7.40	0.29	20.87	4.11	0.06	0.00	100.17	Red Garnet
F1-163	42.21	0.52	22.64	1.60	8.32	0.33	20.03	3.97	0.09	0.02	99.73	Red Garnet
F1-164	42.61	0.40	23.37	0.74	10.25	0.23	19.87	3.25	0.17	0.01	100.89	Red Garnet
F1-165	43.09	0.31	24.19	0.36	7.66	0.31	20.94	3.78	0.07	0.01	100.73	Red Garnet
F1-166	42.66	0.17	21.91	3.10	7.12	0.32	20.85	4.45	0.07	0.02	100.68	Red Garnet

Table 9 continued.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F1-167	42.43	0.17	22.26	2.64	7.68	0.31	20.66	4.44	0.05	0.01	100.63	Red Garnet
F1-168	42.97	0.20	22.74	2.08	7.60	0.27	20.54	4.15	0.06	0.00	100.61	Red Garnet
F1-169	42.24	0.18	22.71	2.10	8.21	0.37	20.25	4.10	0.09	0.02	100.27	Red Garnet
F1-170	42.25	0.23	22.88	2.08	8.69	0.39	19.99	4.31	0.07	0.02	100.91	Red Garnet
F1-171	42.74	0.32	22.20	3.00	6.64	0.31	21.39	3.89	0.06	0.00	100.56	Red Garnet
F1-172	42.18	0.19	22.67	1.39	8.11	0.30	20.86	4.27	0.04	0.00	100.01	Red Garnet
F1-173	41.42	0.20	22.21	2.90	8.01	0.35	20.38	4.45	0.06	0.00	99.98	Red Garnet
F1-174	42.37	0.45	22.28	2.28	7.37	0.33	21.44	4.29	0.11	0.01	100.92	Red Garnet
F1-175	41.85	0.25	22.20	2.31	7.45	0.32	21.22	4.25	0.06	0.01	99.90	Red Garnet
F1-176	41.49	0.24	21.84	2.69	7.90	0.40	19.79	4.73	0.04	0.01	99.13	Red Garnet
F1-177	41.83	0.60	21.88	1.78	9.40	0.27	20.28	4.58	0.10	0.01	100.74	Orange Garnet
F1-178	41.22	0.69	21.64	1.16	12.17	0.32	18.54	4.57	0.10	0.01	100.41	Orange Garnet
F1-179	41.99	0.47	23.18	0.82	10.19	0.18	20.52	3.32	0.15	0.01	100.82	Orange Garnet
F1-180	41.67	0.60	22.36	1.54	8.25	0.33	20.65	4.05	0.10	0.02	99.57	Orange Garnet
F1-181	41.18	0.80	22.94	0.04	13.11	0.34	17.54	4.47	0.15	0.01	100.57	Orange Garnet
F1-182	41.87	0.78	22.10	1.70	7.31	0.29	21.24	3.94	0.14	0.00	99.36	Orange Garnet
F1-183	41.80	0.42	22.88	0.78	9.81	0.21	20.23	3.24	0.13	0.02	99.51	Orange Garnet
F1-184	41.26	0.53	22.99	0.37	13.55	0.31	17.61	3.98	0.08	0.01	100.70	Orange Garnet
F1-185	41.43	0.87	22.11	1.21	8.41	0.29	20.33	4.35	0.12	0.02	99.13	Orange Garnet
F1-186	39.25	0.34	22.66	0.04	21.61	0.58	8.86	7.51	0.16	0.01	101.01	Orange Garnet
F1-187	42.01	0.52	23.24	0.29	10.03	0.31	19.92	4.03	0.09	0.01	100.44	Orange Garnet
F1-188	42.34	0.59	23.07	0.46	9.10	0.26	20.55	3.89	0.12	0.01	100.40	Orange Garnet
F1-189	39.15	0.34	22.58	0.02	21.22	0.62	8.95	7.80	0.16	0.01	100.85	Orange Garnet
F1-190	42.31	0.71	23.45	0.10	8.10	0.31	21.16	3.79	0.14	0.00	100.07	Orange Garnet
F1-191	41.48	0.72	22.60	0.56	11.38	0.26	19.12	4.09	0.10	0.00	100.31	Orange Garnet
F1-192	42.39	0.55	22.91	1.22	7.36	0.34	21.57	4.03	0.09	0.01	100.47	Orange Garnet
F1-193	42.24	0.43	23.25	0.81	10.19	0.24	20.67	3.34	0.13	0.01	101.31	Orange Garnet
F1-194	42.00	0.76	23.68	0.07	7.96	0.30	21.19	3.86	0.10	0.03	99.94	Orange Garnet
F1-195	42.02	0.57	22.89	0.95	8.82	0.31	20.74	4.18	0.08	0.01	100.56	Orange Garnet
F1-196	42.08	0.67	22.37	1.18	8.08	0.36	20.78	4.44	0.08	0.01	100.03	Orange Garnet
F1-197	41.95	0.59	22.31	1.10	8.48	0.28	20.54	4.33	0.16	0.01	99.76	Orange Garnet
F1-198	40.91	0.24	23.52	0.15	15.15	0.50	17.21	3.17	0.12	0.00	100.97	Orange Garnet
F1-199	40.41	0.25	22.92	0.10	16.08	0.27	12.86	7.53	0.10	0.02	100.52	Orange Garnet
F1-200	40.49	0.25	22.91	0.10	18.81	0.45	14.37	3.64	0.10	0.01	101.13	Orange Garnet
F1-201	41.53	0.39	23.82	0.22	10.35	0.26	19.71	3.58	0.08	0.01	99.96	Orange Garnet
F1-202	41.22	0.74	21.82	1.52	11.16	0.29	18.49	4.55	0.09	0.01	99.89	Orange Garnet
F1-203	41.86	0.42	23.16	0.80	9.52	0.28	20.05	3.62	0.09	0.01	99.81	Orange Garnet
F1-204	41.65	0.20	23.15	0.72	10.66	0.22	19.29	3.77	0.09	0.01	99.75	Orange Garnet
F1-205	41.97	0.54	22.10	1.72	8.16	0.31	20.74	4.06	0.08	0.01	99.70	Orange Garnet
F1-206	41.60	0.67	22.11	1.10	12.31	0.30	18.35	4.46	0.09	0.00	100.99	Orange Garnet
F1-207	42.29	0.55	22.64	1.44	8.35	0.28	20.91	4.21	0.05	0.02	100.73	Orange Garnet

Table 9 continued.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F1-208	41.46	0.36	23.48	0.33	10.81	0.42	19.14	3.88	0.13	0.01	100.02	Orange Garnet
F1-209	42.64	0.34	23.97	0.42	7.76	0.26	21.49	3.74	0.06	0.00	100.65	Orange Garnet
F1-210	42.43	0.47	23.45	0.51	8.62	0.29	21.07	3.97	0.06	0.01	100.87	Orange Garnet
F1-211	41.93	0.31	23.77	0.29	11.09	0.40	20.92	2.34	0.05	0.00	101.10	Orange Garnet
F1-212	41.52	0.56	22.44	1.54	8.28	0.30	20.90	4.00	0.12	0.00	99.66	Orange Garnet
F1-213	41.65	0.61	22.52	1.40	8.66	0.36	20.42	4.37	0.06	0.00	100.06	Orange Garnet
F1-214	42.25	0.57	22.38	1.61	8.37	0.27	21.01	4.05	0.11	0.00	100.62	Orange Garnet
F1-215	41.76	0.59	22.39	1.66	8.45	0.33	20.78	4.09	0.12	0.01	100.16	Orange Garnet
F1-216	42.27	0.54	22.64	1.25	8.26	0.32	20.63	4.24	0.08	0.00	100.23	Orange Garnet
F1-217	41.98	0.54	22.32	1.86	8.26	0.27	20.74	4.15	0.07	0.00	100.19	Orange Garnet
F1-218	41.72	0.56	22.26	1.81	8.26	0.28	20.57	4.13	0.11	0.00	99.70	Orange Garnet
F1-219	42.66	0.26	23.80	0.78	8.38	0.30	21.29	3.63	0.07	0.01	101.17	Orange Garnet
F1-220	42.22	0.47	23.14	1.26	8.22	0.30	20.73	4.29	0.10	0.01	100.74	Orange Garnet
F1-221	42.23	0.56	22.14	2.08	7.92	0.32	21.01	4.39	0.09	0.01	100.76	Orange Garnet
F1-222	41.80	0.54	22.26	1.61	8.33	0.31	20.86	4.03	0.10	0.00	99.83	Orange Garnet
F1-223	42.15	0.34	23.47	0.31	11.92	0.33	20.20	2.16	0.05	0.01	100.93	Orange Garnet
F1-224	42.48	0.26	24.20	0.13	7.94	0.32	21.16	3.63	0.08	0.01	100.21	Orange Garnet
F1-225	42.04	0.48	23.14	0.75	10.25	0.20	20.47	3.35	0.13	0.01	100.83	Orange Garnet
F1-226	42.15	0.48	23.30	0.77	10.23	0.20	20.52	3.31	0.11	0.01	101.06	Orange Garnet
F1-227	42.02	0.41	23.82	0.23	10.62	0.28	20.15	3.70	0.08	0.00	101.30	Orange Garnet
F1-228	41.26	0.40	23.42	0.08	13.12	0.28	17.95	3.73	0.12	0.01	100.36	Orange Garnet
F1-229	42.74	0.30	24.39	0.21	7.95	0.28	21.68	3.81	0.07	0.02	101.45	Orange Garnet
F1-230	41.86	0.53	23.26	0.78	9.46	0.23	20.29	3.72	0.11	0.01	100.23	Orange Garnet
F1-231	42.56	0.58	22.79	1.15	7.39	0.32	21.18	3.95	0.15	0.03	100.09	Orange Garnet
F1-232	42.03	0.56	22.56	1.61	8.27	0.34	20.77	4.06	0.08	0.02	100.31	Orange Garnet
F1-233	40.98	0.29	23.50	0.05	17.44	0.33	15.78	2.86	0.09	0.02	101.34	Orange Garnet
F1-234	42.27	0.45	23.54	0.79	9.49	0.27	20.40	3.72	0.07	0.02	101.02	Orange Garnet

Table 10: Finsch unit F2 garnets

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F2-1	42.25	0.03	19.38	6.39	6.06	0.34	21.09	4.63	0.04	0.01	100.23	Purple Garnet
F2-2	41.79	0.22	19.72	6.16	6.26	0.34	20.08	5.18	0.08	0.01	99.84	Purple Garnet
F2-3	41.47	0.04	17.82	8.17	6.61	0.39	19.03	6.34	0.04	0.01	99.93	Purple Garnet
F2-4	42.08	0.09	18.99	6.41	6.18	0.30	21.00	4.63	0.07	0.03	99.78	Purple Garnet
F2-5	42.31	0.00	20.60	5.04	6.53	0.38	20.05	5.61	0.07	0.01	100.61	Purple Garnet
F2-6	42.17	0.04	19.25	6.40	6.07	0.32	20.87	4.65	0.04	0.02	99.84	Purple Garnet
F2-7	42.17	0.14	19.34	6.35	5.98	0.30	20.84	4.59	0.06	0.02	99.79	Purple Garnet
F2-8	41.91	0.17	19.01	6.41	6.59	0.38	20.23	5.20	0.05	0.03	99.97	Purple Garnet
F2-9	42.27	0.11	19.23	6.22	5.87	0.32	20.93	4.62	0.03	0.02	99.61	Purple Garnet
F2-10	42.05	0.21	18.91	6.50	6.51	0.29	20.08	5.20	0.08	0.02	99.84	Purple Garnet
F2-11	41.51	0.24	18.93	6.45	6.53	0.29	19.94	5.14	0.05	0.03	99.12	Purple Garnet
F2-12	41.99	0.44	19.46	5.78	6.90	0.34	20.06	5.29	0.05	0.01	100.32	Purple Garnet
F2-13	41.76	0.19	18.69	7.03	6.02	0.35	20.01	5.29	0.10	0.03	99.48	Purple Garnet
F2-14	42.29	0.06	21.31	3.89	7.85	0.41	19.91	4.63	0.09	0.02	100.45	Purple Garnet
F2-15	42.28	0.06	19.67	6.14	6.36	0.32	21.21	4.25	0.06	0.02	100.37	Purple Garnet
F2-16	42.43	0.11	20.59	4.64	6.30	0.38	20.52	4.77	0.04	0.02	99.79	Purple Garnet
F2-17	42.23	0.07	19.30	6.29	6.03	0.27	20.85	4.58	0.03	0.03	99.67	Purple Garnet
F2-18	41.76	0.24	17.45	8.59	6.62	0.35	19.60	5.72	0.10	0.02	100.44	Purple Garnet
F2-19	42.52	0.00	22.79	2.17	8.45	0.41	20.01	4.45	0.04	0.02	100.86	Purple Garnet
F2-20	42.23	0.29	21.25	3.68	7.54	0.35	20.14	4.77	0.06	0.01	100.34	Purple Garnet
F2-21	42.52	0.02	22.15	3.15	7.66	0.39	20.25	4.62	0.07	0.01	100.85	Purple Garnet
F2-22	42.11	0.00	21.11	4.46	6.66	0.31	20.15	5.30	0.05	0.02	100.16	Purple Garnet
F2-23	41.47	0.23	17.43	8.35	6.62	0.33	19.43	5.73	0.08	0.01	99.68	Purple Garnet
F2-24	41.56	0.04	17.78	8.19	6.62	0.40	19.25	6.26	0.04	0.01	100.14	Purple Garnet
F2-25	42.09	0.10	19.33	6.32	6.05	0.33	20.98	4.57	0.04	0.02	99.81	Purple Garnet
F2-26	42.42	0.05	19.65	6.09	6.12	0.30	21.22	4.27	0.01	0.01	100.13	Purple Garnet
F2-27	42.67	0.04	19.70	6.17	6.05	0.30	21.05	4.24	0.06	0.00	100.27	Purple Garnet
F2-28	42.21	0.00	19.80	6.02	6.14	0.33	20.80	4.33	0.04	0.02	99.68	Purple Garnet
F2-29	41.76	0.21	17.47	8.67	6.44	0.32	19.46	5.76	0.08	0.02	100.18	Purple Garnet
F2-30	42.09	0.07	19.31	6.30	5.95	0.31	20.89	4.65	0.07	0.03	99.65	Purple Garnet
F2-31	41.97	0.17	19.00	6.39	6.46	0.35	20.25	5.16	0.05	0.01	99.81	Purple Garnet
F2-32	42.45	0.21	21.45	3.44	7.19	0.33	20.30	4.50	0.09	0.02	99.98	Purple Garnet
F2-33	42.55	0.31	19.40	5.80	6.55	0.36	20.23	5.03	0.07	0.02	100.33	Purple Garnet
F2-34	41.31	0.20	22.28	3.44	7.33	0.35	20.19	4.64	0.06	0.02	99.80	Purple Garnet
F2-35	42.59	0.04	22.68	2.38	7.51	0.36	20.42	4.44	0.06	0.00	100.47	Purple Garnet
F2-36	42.58	0.03	22.06	3.11	7.67	0.36	20.10	4.66	0.09	0.02	100.68	Purple Garnet
F2-37	42.07	0.40	19.56	5.62	6.69	0.34	19.94	5.29	0.10	0.02	100.03	Purple Garnet
F2-38	42.30	0.07	21.98	3.23	7.51	0.32	20.32	4.66	0.07	0.02	100.48	Purple Garnet
F2-39	41.43	0.25	17.33	8.55	6.55	0.31	19.63	5.81	0.09	0.02	99.98	Purple Garnet
F2-40	42.25	0.00	19.69	6.15	6.20	0.26	21.18	4.22	0.05	0.02	100.01	Purple Garnet
F2-41	42.04	0.22	17.50	8.41	6.59	0.40	19.62	5.70	0.03	0.01	100.53	Purple Garnet
F2-42	42.15	0.01	19.53	6.10	6.29	0.32	21.09	4.27	0.06	0.02	99.82	Purple Garnet

Table 10 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F2-43	41.64	0.26	17.42	8.48	6.52	0.35	19.37	5.64	0.08	0.01	99.77	Purple Garnet
F2-44	42.08	0.12	19.73	6.07	6.19	0.31	21.08	4.24	0.05	0.01	99.87	Purple Garnet
F2-45	42.51	0.06	22.32	2.55	7.28	0.34	20.59	4.25	0.06	0.01	99.96	Purple Garnet
F2-46	41.92	0.27	17.37	8.43	6.59	0.37	19.56	5.79	0.10	0.02	100.41	Purple Garnet
F2-47	42.20	0.29	21.51	3.35	7.65	0.34	20.12	4.69	0.06	0.01	100.21	Purple Garnet
F2-48	42.34	0.27	21.68	3.30	7.62	0.37	20.11	4.61	0.09	0.02	100.41	Purple Garnet
F2-49	42.15	0.21	19.10	6.32	6.54	0.28	20.08	5.16	0.05	0.03	99.91	Purple Garnet
F2-50	42.23	0.02	19.88	6.02	6.30	0.33	21.05	4.27	0.04	0.02	100.16	Purple Garnet
F2-51	42.40	0.14	19.43	6.41	5.96	0.33	21.10	4.60	0.06	0.02	100.44	Purple Garnet
F2-52	41.51	0.23	17.23	8.32	6.57	0.37	19.52	5.72	0.10	0.01	99.60	Purple Garnet
F2-53	42.65	0.04	22.95	2.11	8.53	0.38	19.64	4.58	0.05	0.02	100.95	Purple Garnet
F2-54	42.48	0.24	21.71	3.42	6.04	0.30	21.42	4.55	0.07	0.01	100.24	Pink Garnet
F2-55	42.57	0.06	22.41	2.58	7.08	0.33	20.72	4.34	0.06	0.02	100.16	Pink Garnet
F2-56	42.23	0.03	22.35	2.72	7.52	0.33	20.45	4.59	0.07	0.02	100.28	Pink Garnet
F2-57	42.79	0.08	22.68	2.42	7.64	0.37	20.52	4.36	0.05	0.01	100.91	Pink Garnet
F2-58	42.47	0.23	21.63	3.68	6.98	0.33	20.36	4.62	0.10	0.01	100.41	Pink Garnet
F2-59	42.64	0.00	22.79	1.98	8.35	0.37	19.79	4.63	0.04	0.01	100.58	Pink Garnet
F2-60	42.43	0.04	23.00	2.05	8.53	0.38	19.76	4.54	0.06	0.00	100.78	Pink Garnet
F2-61	42.29	0.04	22.60	2.46	7.62	0.33	20.38	4.31	0.05	0.01	100.07	Pink Garnet
F2-62	42.61	0.02	22.72	2.25	7.81	0.35	20.56	4.24	0.04	0.01	100.61	Pink Garnet
F2-63	42.57	0.00	22.94	2.14	8.44	0.35	19.85	4.39	0.08	0.01	100.77	Pink Garnet
F2-64	42.82	0.06	22.13	3.16	7.08	0.42	20.21	4.37	0.05	0.01	100.30	Pink Garnet
F2-65	42.80	0.06	21.97	2.89	6.75	0.28	20.97	4.25	0.07	0.00	100.03	Pink Garnet
F2-66	42.48	0.20	21.67	3.66	7.19	0.33	20.23	4.53	0.10	0.02	100.40	Pink Garnet
F2-67	42.75	0.06	22.95	2.15	8.39	0.36	19.69	4.48	0.07	0.01	100.90	Pink Garnet
F2-68	42.68	0.03	22.95	2.31	7.59	0.37	20.43	4.26	0.05	0.01	100.68	Pink Garnet
F2-69	42.79	0.05	22.89	2.26	7.61	0.35	20.43	4.31	0.05	0.01	100.75	Pink Garnet
F2-70	42.39	0.20	21.61	3.56	7.26	0.37	20.27	4.57	0.09	0.02	100.33	Pink Garnet
F2-71	42.89	0.03	22.79	2.34	7.54	0.31	20.48	4.38	0.03	0.01	100.78	Pink Garnet
F2-72	42.93	0.11	22.01	2.95	6.94	0.26	20.97	4.30	0.06	0.02	100.53	Pink Garnet
F2-73	42.82	0.10	22.06	2.88	6.94	0.33	20.70	4.34	0.07	0.02	100.27	Pink Garnet
F2-74	42.77	0.13	21.81	2.91	6.77	0.30	20.66	4.37	0.07	0.01	99.79	Pink Garnet
F2-75	42.60	0.30	21.71	3.51	7.68	0.37	19.98	4.68	0.09	0.02	100.93	Pink Garnet
F2-76	42.54	0.06	22.96	2.25	7.70	0.33	20.34	4.34	0.03	0.02	100.56	Pink Garnet
F2-77	42.32	0.30	21.06	3.89	7.02	0.31	20.57	4.69	0.11	0.02	100.27	Pink Garnet
F2-78	42.72	0.02	22.79	2.40	7.61	0.31	20.32	4.44	0.07	0.02	100.69	Pink Garnet
F2-79	42.34	0.22	21.74	3.61	7.23	0.35	20.46	4.52	0.08	0.02	100.56	Pink Garnet
F2-80	42.42	0.24	21.46	3.49	7.39	0.35	20.05	4.62	0.09	0.01	100.12	Pink Garnet
F2-81	42.61	0.24	22.44	2.36	8.11	0.41	19.86	4.43	0.09	0.00	100.54	Pink Garnet
F2-82	42.10	0.26	21.43	3.39	7.66	0.33	19.97	4.36	0.06	0.01	99.57	Pink Garnet
F2-83	42.47	0.29	21.39	3.45	7.61	0.35	20.01	4.58	0.06	0.02	100.23	Pink Garnet
F2-84	43.00	0.28	21.76	3.37	6.18	0.28	21.22	4.42	0.07	0.03	100.60	Pink Garnet

Table 10 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F2-85	42.49	0.25	21.58	3.58	7.56	0.34	19.97	4.59	0.09	0.01	100.45	Pink Garnet
F2-86	42.50	0.17	22.76	2.36	8.13	0.39	19.77	4.40	0.09	0.02	100.58	Pink Garnet
F2-87	42.40	0.24	21.37	3.34	7.57	0.41	20.15	4.61	0.09	0.02	100.21	Pink Garnet
F2-88	42.59	0.19	22.48	2.35	8.17	0.37	19.45	4.40	0.09	0.01	100.10	Pink Garnet
F2-89	42.70	0.23	22.51	2.28	8.33	0.36	19.96	4.51	0.06	0.02	100.95	Pink Garnet
F2-90	42.16	0.22	22.53	2.36	7.96	0.41	19.37	4.39	0.08	0.02	99.50	Pink Garnet
F2-91	42.80	0.17	22.39	2.50	6.84	0.32	20.86	4.34	0.09	0.02	100.33	Pink Garnet
F2-92	42.14	0.29	21.52	3.40	7.62	0.38	20.09	4.70	0.11	0.02	100.27	Pink Garnet
F2-93	42.84	0.07	22.79	2.20	7.79	0.34	20.58	4.35	0.07	0.01	101.05	Pink Garnet
F2-94	42.72	0.03	22.67	2.30	7.69	0.36	20.21	4.24	0.08	0.03	100.31	Pink Garnet
F2-95	42.30	0.21	21.48	3.72	7.21	0.37	20.42	4.47	0.09	0.02	100.29	Pink Garnet
F2-96	42.52	0.00	22.71	2.15	8.34	0.39	19.49	4.62	0.05	0.01	100.29	Pink Garnet
F2-97	42.00	0.29	21.48	3.32	7.40	0.34	19.97	4.69	0.07	0.02	99.57	Pink Garnet
F2-98	41.86	0.41	19.40	5.64	6.72	0.31	19.95	5.32	0.11	0.02	99.74	Pink Garnet
F2-99	42.10	0.34	21.29	3.87	6.97	0.38	20.27	4.61	0.10	0.03	99.96	Pink Garnet
F2-100	42.29	0.02	22.57	2.17	7.42	0.27	20.27	4.31	0.06	0.03	99.39	Pink Garnet
F2-101	42.15	0.05	22.76	2.25	7.64	0.33	20.53	4.33	0.06	0.02	100.11	Pink Garnet
F2-102	42.40	0.00	22.57	2.34	7.58	0.42	20.40	4.28	0.08	0.02	100.08	Pink Garnet
F2-103	42.17	0.02	22.98	2.22	7.64	0.37	20.49	4.29	0.09	0.01	100.29	Pink Garnet
F2-104	42.34	0.02	22.89	2.13	8.31	0.39	19.82	4.41	0.03	0.02	100.36	Pink Garnet
F2-105	42.53	0.07	22.34	2.90	7.07	0.36	20.21	4.47	0.09	0.02	100.06	Pink Garnet
F2-106	42.38	0.01	22.83	2.26	7.55	0.37	20.30	4.30	0.06	0.03	100.09	Pink Garnet
F2-107	42.33	0.14	20.94	4.27	6.15	0.30	20.95	4.69	0.07	0.02	99.85	Pink Garnet
F2-108	42.43	0.05	22.71	2.39	7.52	0.35	20.10	4.35	0.03	0.01	99.94	Pink Garnet
F2-109	42.86	0.06	22.37	2.58	7.08	0.32	20.78	4.27	0.04	0.01	100.36	Pink Garnet
F2-110	42.43	0.03	22.78	2.40	7.63	0.32	20.26	4.37	0.06	0.01	100.27	Pink Garnet
F2-111	42.40	0.05	22.15	2.63	7.07	0.29	20.66	4.25	0.08	0.01	99.59	Pink Garnet
F2-186	42.51	0.41	22.23	1.93	7.11	0.31	21.03	3.64	0.10	0.02	99.28	Red Garnet
F2-187	42.09	0.44	22.46	2.04	7.09	0.25	21.06	3.67	0.12	0.02	99.25	Red Garnet
F2-188	42.33	0.53	22.07	2.10	7.43	0.31	20.24	4.49	0.08	0.02	99.60	Red Garnet
F2-189	42.17	0.31	22.90	1.53	8.97	0.38	19.75	4.06	0.12	0.01	100.20	Red Garnet
F2-190	41.93	0.41	22.34	2.12	7.11	0.29	21.08	3.70	0.09	0.00	99.08	Red Garnet
F2-191	41.99	0.30	22.80	1.72	7.14	0.30	20.84	4.12	0.06	0.02	99.27	Red Garnet
F2-192	42.08	0.27	22.31	1.97	6.79	0.30	20.91	4.24	0.06	0.01	98.92	Red Garnet
F2-193	42.27	0.16	22.70	1.98	7.55	0.30	20.58	4.15	0.05	0.01	99.75	Red Garnet
F2-194	42.03	0.21	22.48	1.89	7.42	0.30	20.51	4.14	0.05	0.01	99.03	Red Garnet
F2-195	42.19	0.20	22.12	1.96	7.40	0.30	20.36	4.23	0.02	0.01	98.78	Red Garnet
F2-196	41.89	0.33	21.22	3.22	7.21	0.29	19.96	4.50	0.09	0.02	98.71	Red Garnet
F2-197	42.16	0.34	21.38	3.33	7.60	0.29	20.25	4.57	0.08	0.00	100.01	Red Garnet
F2-198	42.16	0.43	22.12	2.46	7.88	0.30	20.27	4.29	0.08	0.00	99.99	Red Garnet
F2-199	42.35	0.25	22.60	1.97	7.40	0.28	20.35	4.22	0.03	0.00	99.46	Red Garnet
F2-200	41.87	0.31	22.64	1.58	8.95	0.31	19.16	4.06	0.06	0.02	98.93	Red Garnet

Table 10 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F2-201	41.82	0.33	21.11	3.18	7.33	0.28	20.20	4.60	0.07	0.01	98.94	Red Garnet
F2-202	42.22	0.21	22.56	2.00	7.26	0.33	20.26	4.25	0.06	0.01	99.16	Red Garnet
F2-203	42.15	0.43	22.37	2.16	7.22	0.26	21.03	3.67	0.11	0.01	99.41	Red Garnet
F2-204	41.88	0.59	22.56	1.21	8.61	0.33	19.71	4.24	0.06	0.00	99.18	Red Garnet
F2-205	41.95	0.53	22.47	1.60	8.06	0.29	20.14	4.04	0.07	0.01	99.16	Red Garnet
F2-206	41.95	0.36	21.03	3.20	7.24	0.30	20.07	4.50	0.09	0.02	98.75	Red Garnet
F2-207	41.85	0.33	20.93	3.16	7.48	0.31	20.35	4.55	0.06	0.01	99.03	Red Garnet
F2-208	41.75	0.20	22.46	1.94	7.57	0.29	20.47	4.18	0.05	0.01	98.91	Red Garnet
F2-209	42.07	0.20	22.66	2.03	7.45	0.29	20.41	4.20	0.07	0.01	99.37	Red Garnet
F2-210	42.07	0.28	21.27	3.19	7.19	0.29	20.31	4.51	0.06	0.03	99.20	Red Garnet
F2-211	42.09	0.34	21.01	3.19	7.40	0.30	20.16	4.50	0.04	0.02	99.03	Red Garnet
F2-212	42.07	0.18	22.51	2.31	6.92	0.31	20.94	4.31	0.05	0.01	99.59	Red Garnet
F2-213	41.91	0.18	22.36	2.17	8.19	0.35	19.52	4.35	0.07	0.01	99.10	Red Garnet
F2-214	41.94	0.23	22.68	2.24	8.48	0.33	19.47	4.39	0.06	0.01	99.84	Red Garnet
F2-215	41.83	0.26	22.55	2.15	8.26	0.37	19.77	4.18	0.05	0.01	99.43	Red Garnet
F2-216	41.84	0.18	22.49	2.24	8.28	0.35	19.52	4.43	0.08	0.00	99.40	Red Garnet
F2-217	41.87	0.14	22.41	2.39	7.24	0.31	20.86	4.35	0.04	0.02	99.62	Red Garnet
F2-218	41.53	0.26	21.35	3.41	7.66	0.37	19.84	4.60	0.04	0.00	99.06	Red Garnet
F2-219	41.87	0.18	22.30	2.13	8.41	0.33	19.47	4.44	0.05	0.01	99.18	Red Garnet
F2-220	41.91	0.14	22.47	2.25	8.25	0.33	19.70	4.35	0.05	0.02	99.45	Red Garnet
F2-221	41.62	0.29	21.44	3.31	7.58	0.34	19.87	4.54	0.09	0.02	99.10	Red Garnet
F2-222	42.22	0.19	22.47	2.27	6.82	0.29	20.92	4.18	0.07	0.01	99.43	Red Garnet
F2-223	41.72	0.24	21.35	3.25	7.56	0.37	19.68	4.57	0.05	0.00	98.80	Red Garnet
F2-224	41.73	0.19	22.49	2.24	8.04	0.43	19.75	4.26	0.06	0.02	99.20	Red Garnet
F2-225	42.03	0.17	22.41	2.24	8.36	0.39	19.62	4.39	0.04	0.03	99.66	Red Garnet
F2-226	41.67	0.52	22.08	1.72	8.09	0.35	20.13	4.05	0.11	0.01	98.72	Red Garnet
F2-227	42.15	0.79	23.24	0.53	7.54	0.26	20.99	4.04	0.14	0.00	99.68	Orange Garnet
F2-228	42.01	0.30	23.90	0.04	10.14	0.27	19.19	3.66	0.12	0.02	99.64	Orange Garnet
F2-229	42.40	0.74	23.27	0.49	7.65	0.28	20.76	4.09	0.14	0.00	99.80	Orange Garnet
F2-230	41.95	0.50	22.29	1.35	9.11	0.31	19.54	4.37	0.10	0.01	99.50	Orange Garnet
F2-231	42.11	0.21	24.12	0.00	10.32	0.33	19.08	3.70	0.14	0.02	100.02	Orange Garnet
F2-232	41.89	0.32	23.93	0.03	10.24	0.35	19.25	3.80	0.12	0.00	99.93	Orange Garnet
F2-233	42.03	0.28	23.99	0.05	10.33	0.30	19.13	3.79	0.12	0.00	100.02	Orange Garnet
F2-234	42.05	0.57	22.49	1.66	8.59	0.26	20.33	4.06	0.10	0.02	100.11	Orange Garnet
F2-235	42.04	0.27	24.02	0.02	10.38	0.31	19.24	3.63	0.11	0.02	100.02	Orange Garnet
F2-236	41.81	0.24	23.84	0.04	10.25	0.36	19.21	3.69	0.11	0.00	99.56	Orange Garnet
F2-237	41.75	0.39	23.09	0.74	11.29	0.37	18.48	4.00	0.09	0.02	100.22	Orange Garnet
F2-238	42.07	0.28	24.07	0.03	10.26	0.31	19.08	3.64	0.09	0.01	99.84	Orange Garnet
F2-239	41.85	0.28	23.98	0.03	10.17	0.38	19.26	3.71	0.11	0.02	99.77	Orange Garnet
F2-240	41.81	0.31	23.92	0.03	10.41	0.30	19.31	3.72	0.11	0.01	99.92	Orange Garnet
F2-241	42.90	0.52	23.52	0.60	7.45	0.38	21.30	4.02	0.07	0.00	100.76	Orange Garnet
F2-242	41.81	0.28	24.00	0.00	10.57	0.31	19.27	3.72	0.14	0.02	100.11	Orange Garnet

Table 10 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F2-243	41.94	0.21	23.98	0.00	10.34	0.34	19.49	3.63	0.10	0.01	100.03	Orange Garnet
F2-244	42.26	0.25	23.98	0.00	10.32	0.34	19.06	3.64	0.10	0.00	99.94	Orange Garnet
F2-245	41.59	0.44	23.65	0.09	11.42	0.29	17.16	5.72	0.13	0.00	100.48	Orange Garnet
F2-246	41.98	0.56	22.62	1.18	8.68	0.33	19.95	4.37	0.09	0.00	99.76	Orange Garnet
F2-247	41.44	0.28	22.42	1.15	13.20	0.41	16.78	4.24	0.07	0.02	100.01	Orange Garnet
F2-248	41.93	0.44	22.28	1.79	8.17	0.35	20.35	4.12	0.09	0.02	99.53	Orange Garnet
F2-249	42.64	0.59	23.35	0.94	7.46	0.28	20.76	4.09	0.10	0.01	100.21	Orange Garnet
F2-250	42.24	0.64	22.78	1.51	7.89	0.30	20.69	4.15	0.10	0.01	100.29	Orange Garnet
F2-251	42.27	0.60	22.81	1.30	9.05	0.34	20.03	4.44	0.08	0.01	100.92	Orange Garnet

Table 11: Finsch unit F3 garnets

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F3-1	40.908	0.186	17.691	7.663	7.001	0.398	18.529	6.029	0.129	0.023	98.557	Purple Garnet
F3-2	40.814	0.178	17.842	7.681	7.211	0.393	18.439	5.948	0.12	0.037	98.663	Purple Garnet
F3-3	41.205	0.19	18.161	7.039	6.894	0.377	18.749	5.759	0.135	0.041	98.55	Purple Garnet

Table 12: Finsch unit F4 garnets

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F4-1	40.58	0.18	13.88	12.67	7.44	0.49	17.34	7.93	0.05	0.00	100.55	Purple Garnet
F4-2	42.09	0.02	20.18	6.15	5.98	0.33	22.79	1.74	0.07	0.00	99.35	Purple Garnet
F4-3	40.80	0.23	18.89	6.96	6.47	0.36	19.55	5.40	0.07	0.00	98.74	Purple Garnet
F4-4	40.94	0.06	17.60	9.11	6.39	0.37	20.61	4.05	0.06	0.00	99.19	Purple Garnet
F4-5	40.71	0.03	17.51	9.18	6.34	0.37	20.41	4.04	0.06	0.00	98.66	Purple Garnet
F4-6	41.02	0.14	20.64	4.49	7.41	0.37	19.55	5.04	0.06	0.00	98.72	Purple Garnet
F4-7	40.90	0.27	19.47	6.36	6.62	0.35	19.69	5.49	0.06	0.00	99.20	Purple Garnet
F4-8	41.16	0.01	17.71	8.77	6.35	0.43	20.36	3.95	0.05	0.00	98.79	Purple Garnet
F4-9	41.01	0.06	17.77	9.02	6.15	0.45	20.46	4.00	0.05	0.00	98.96	Purple Garnet
F4-10	41.05	0.07	18.53	7.68	6.23	0.41	21.67	2.80	0.09	0.00	98.53	Purple Garnet
F4-11	41.98	0.04	19.69	6.85	6.04	0.40	22.97	1.68	0.04	0.00	99.68	Purple Garnet
F4-12	42.20	0.01	21.73	4.19	5.04	0.28	24.58	0.46	0.02	0.00	98.51	Purple Garnet
F4-13	41.72	0.05	19.91	5.84	6.30	0.36	20.97	4.06	0.05	0.00	99.26	Purple Garnet
F4-14	41.04	0.09	17.45	9.16	6.26	0.44	20.59	4.03	0.02	0.00	99.08	Purple Garnet
F4-15	41.26	0.07	20.24	5.50	7.73	0.43	18.97	5.22	0.09	0.00	99.52	Purple Garnet
F4-16	41.72	0.21	20.82	4.55	6.66	0.34	20.19	4.94	0.07	0.00	99.51	Purple Garnet
F4-17	42.42	0.14	22.38	3.08	5.45	0.29	22.33	3.22	0.05	0.00	99.35	Purple Garnet
F4-18	40.64	0.15	17.66	8.46	6.92	0.41	19.04	5.85	0.07	0.00	99.19	Purple Garnet
F4-19	41.95	0.03	22.57	2.71	7.23	0.43	20.25	4.44	0.07	0.00	99.68	Purple Garnet
F4-20	41.86	0.02	22.34	2.44	7.62	0.35	19.92	4.41	0.05	0.00	99.01	Purple Garnet
F4-21	41.68	0.12	22.27	3.09	5.61	0.31	22.19	3.24	0.09	0.00	98.60	Purple Garnet
F4-22	41.80	0.08	22.26	3.04	5.57	0.24	22.24	3.22	0.09	0.00	98.53	Purple Garnet

Table 12 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F4-23	40.86	0.19	17.75	8.37	6.86	0.44	19.03	5.76	0.09	0.00	99.35	Purple Garnet
F4-24	41.53	0.30	20.64	4.58	6.65	0.40	20.22	4.95	0.08	0.00	99.35	Purple Garnet
F4-25	42.13	0.13	22.23	3.22	5.66	0.25	22.30	3.22	0.04	0.00	99.19	Purple Garnet
F4-26	41.49	0.01	21.59	3.91	7.20	0.35	19.78	4.77	0.05	0.00	99.15	Purple Garnet
F4-27	41.66	0.06	21.98	3.29	7.65	0.43	19.84	4.51	0.06	0.00	99.49	Purple Garnet
F4-28	41.90	0.01	22.70	2.45	8.02	0.29	20.12	4.30	0.04	0.00	99.82	Purple Garnet
F4-29	40.96	0.03	22.38	2.55	7.69	0.37	20.17	4.41	0.05	0.00	98.62	Purple Garnet
F4-30	41.28	0.05	22.31	2.69	7.78	0.43	19.74	4.30	0.04	0.00	98.63	Purple Garnet
F4-31	41.60	0.26	21.13	3.74	6.32	0.35	20.89	4.40	0.07	0.00	98.77	Purple Garnet
F4-32	42.10	0.10	22.01	3.13	5.49	0.29	22.19	3.20	0.09	0.00	98.60	Purple Garnet
F4-33	41.21	0.00	21.87	3.17	7.43	0.41	20.29	4.49	0.07	0.00	98.94	Purple Garnet
F4-34	42.06	0.11	22.19	3.16	5.41	0.32	22.31	3.16	0.08	0.00	98.80	Purple Garnet
F4-35	42.08	0.00	20.65	5.14	6.81	0.47	20.24	4.69	0.03	0.00	100.11	Purple Garnet
F4-36	42.31	0.05	21.90	3.31	7.63	0.38	19.67	4.52	0.07	0.00	99.84	Purple Garnet
F4-37	41.09	0.10	17.73	8.50	7.03	0.52	19.14	5.81	0.06	0.00	99.98	Purple Garnet
F4-38	40.10	0.12	17.77	8.46	6.95	0.48	19.13	5.71	0.07	0.00	98.79	Purple Garnet
F4-39	42.00	0.25	20.68	4.65	6.61	0.34	20.33	4.88	0.07	0.00	99.81	Purple Garnet
F4-40	41.11	0.32	19.95	4.98	7.29	0.37	19.70	5.08	0.07	0.00	98.88	Purple Garnet
F4-41	42.51	0.02	21.59	4.27	5.30	0.30	24.60	0.55	0.07	0.00	99.22	Purple Garnet
F4-42	41.85	0.04	20.19	6.07	5.82	0.39	21.60	3.37	0.05	0.00	99.38	Purple Garnet
F4-43	41.99	0.36	21.41	3.36	6.98	0.33	20.55	4.35	0.07	0.00	99.40	Purple Garnet
F4-44	41.20	0.03	21.52	3.89	7.16	0.43	20.17	5.23	0.03	0.00	99.66	Purple Garnet
F4-45	41.26	0.06	21.97	3.14	7.70	0.37	20.18	4.46	0.04	0.00	99.18	Purple Garnet
F4-46	41.21	0.05	20.59	4.71	6.96	0.38	20.23	5.02	0.04	0.00	99.19	Purple Garnet
F4-47	41.58	0.03	21.68	3.64	7.02	0.37	20.17	4.95	0.01	0.00	99.44	Purple Garnet
F4-48	41.23	0.03	20.61	4.77	7.01	0.36	20.29	5.08	0.07	0.00	99.45	Purple Garnet
F4-49	41.26	0.07	19.43	5.72	6.73	0.34	19.80	5.38	0.06	0.00	98.80	Purple Garnet
F4-50	41.14	0.37	18.58	7.03	6.81	0.42	19.56	5.52	0.07	0.00	99.50	Purple Garnet
F4-51	41.35	0.04	21.89	3.26	7.25	0.40	20.66	4.56	0.04	0.00	99.45	Purple Garnet
F4-52	41.43	0.11	20.50	4.81	7.13	0.37	20.11	5.05	0.06	0.00	99.57	Purple Garnet
F4-53	41.96	0.00	22.46	2.72	7.17	0.35	20.75	4.31	0.06	0.00	99.78	Purple Garnet
F4-54	40.94	0.34	18.55	7.02	7.21	0.43	19.60	5.56	0.08	0.00	99.74	Purple Garnet
F4-55	41.26	0.01	20.92	4.50	6.96	0.45	20.23	5.22	0.05	0.00	99.60	Purple Garnet
F4-56	41.53	0.01	21.90	3.19	6.95	0.39	20.60	4.54	0.03	0.00	99.14	Purple Garnet
F4-57	41.91	0.05	21.99	3.16	7.68	0.41	20.10	4.52	0.04	0.00	99.86	Purple Garnet
F4-58	41.28	0.01	21.01	4.43	6.89	0.41	20.08	5.15	0.05	0.00	99.30	Purple Garnet
F4-59	41.73	0.18	17.74	8.26	6.46	0.35	19.63	5.75	0.06	0.01	100.16	Purple Garnet
F4-60	42.41	0.20	21.60	3.87	5.55	0.27	21.49	4.12	0.07	0.01	99.59	Purple Garnet
F4-61	42.74	0.09	22.20	2.80	7.15	0.40	20.72	4.43	0.07	0.00	100.59	Purple Garnet
F4-62	42.58	0.13	22.01	2.68	7.15	0.35	20.80	4.40	0.05	0.00	100.14	Pink Garnet
F4-63	42.44	0.05	22.27	2.76	7.12	0.30	20.74	4.36	0.04	0.00	100.09	Pink Garnet
F4-64	40.47	0.43	22.32	0.25	15.56	0.58	16.01	4.37	0.12	0.00	100.10	Pink Garnet

Table 12 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F4-65	41.50	0.00	21.97	3.31	7.72	0.39	19.57	4.91	0.03	0.00	99.40	Pink Garnet
F4-66	41.43	0.01	22.50	2.59	7.95	0.34	19.70	4.43	0.08	0.00	99.03	Pink Garnet
F4-67	41.57	0.09	21.43	3.76	7.31	0.43	19.80	4.70	0.04	0.00	99.13	Pink Garnet
F4-68	41.69	0.02	22.34	2.58	7.88	0.30	20.04	4.39	0.05	0.00	99.30	Pink Garnet
F4-69	42.10	0.14	22.22	3.19	5.59	0.26	22.23	3.17	0.06	0.00	98.96	Pink Garnet
F4-70	41.54	0.05	22.60	2.47	8.01	0.40	19.86	4.37	0.04	0.00	99.33	Pink Garnet
F4-71	41.39	0.02	21.79	3.60	7.74	0.34	19.37	5.04	0.06	0.00	99.36	Pink Garnet
F4-72	41.61	1.09	21.65	0.70	10.81	0.29	18.95	4.35	0.16	0.00	99.61	Pink Garnet
F4-73	42.19	0.11	22.50	2.32	7.79	0.36	20.08	4.44	0.09	0.00	99.88	Pink Garnet
F4-74	42.40	0.21	21.92	2.85	7.27	0.35	20.80	4.24	0.06	0.00	100.10	Pink Garnet
F4-75	41.91	0.01	22.61	2.44	7.98	0.40	20.26	4.36	0.04	0.00	100.00	Pink Garnet
F4-76	42.25	0.06	22.14	3.28	7.51	0.41	19.96	4.54	0.06	0.00	100.21	Pink Garnet
F4-77	41.90	1.16	21.71	0.67	11.26	0.33	19.10	4.39	0.11	0.00	100.63	Pink Garnet
F4-78	42.22	0.15	22.08	3.17	5.58	0.27	22.08	3.20	0.06	0.00	98.81	Pink Garnet
F4-79	42.08	0.12	20.06	5.57	6.60	0.43	20.09	5.24	0.07	0.00	100.27	Pink Garnet
F4-80	41.64	0.00	22.57	2.51	7.07	0.33	20.58	4.29	0.04	0.00	99.03	Pink Garnet
F4-81	41.90	0.03	22.63	2.30	7.65	0.42	20.20	4.28	0.04	0.00	99.45	Pink Garnet
F4-82	41.66	0.17	22.01	2.84	6.99	0.42	20.37	4.50	0.06	0.00	99.03	Pink Garnet
F4-83	41.60	0.12	22.14	2.46	8.41	0.43	19.65	4.44	0.05	0.00	99.30	Pink Garnet
F4-84	42.11	0.15	21.93	2.90	7.11	0.37	20.32	4.48	0.08	0.00	99.45	Pink Garnet
F4-85	42.02	0.38	21.86	2.76	8.45	0.40	19.45	4.59	0.08	0.00	99.99	Pink Garnet
F4-86	41.90	0.15	21.63	3.39	7.24	0.37	19.94	4.48	0.04	0.00	99.14	Pink Garnet
F4-87	42.05	0.16	21.22	3.86	6.85	0.37	20.37	4.56	0.06	0.00	99.50	Pink Garnet
F4-88	42.12	0.05	22.31	2.60	7.94	0.30	19.76	4.34	0.06	0.00	99.47	Pink Garnet
F4-89	41.62	0.06	21.83	3.17	7.69	0.41	20.21	4.46	0.06	0.00	99.51	Pink Garnet
F4-90	41.39	0.04	21.74	3.48	7.79	0.44	19.87	4.61	0.05	0.00	99.42	Pink Garnet
F4-91	41.54	0.07	21.80	3.11	7.57	0.44	20.30	4.52	0.03	0.00	99.38	Pink Garnet
F4-92	41.46	0.04	22.44	2.69	7.74	0.34	20.49	4.41	0.05	0.00	99.66	Pink Garnet
F4-93	41.48	0.01	22.35	2.63	7.78	0.38	20.47	4.44	0.03	0.00	99.57	Pink Garnet
F4-94	40.81	0.05	22.38	2.57	7.83	0.43	20.37	4.36	0.02	0.00	98.81	Pink Garnet
F4-95	41.50	0.02	22.20	3.22	7.37	0.40	20.63	4.60	0.05	0.00	99.99	Pink Garnet
F4-96	41.79	0.05	22.14	3.14	7.86	0.47	20.17	4.46	0.08	0.00	100.16	Pink Garnet
F4-97	40.72	0.04	22.34	2.75	7.68	0.42	20.55	4.42	0.06	0.00	98.98	Pink Garnet
F4-98	41.22	0.02	21.74	3.32	7.40	0.44	20.63	4.66	0.04	0.00	99.47	Pink Garnet
F4-99	41.31	0.07	20.65	4.82	6.86	0.38	20.22	5.17	0.05	0.00	99.53	Pink Garnet
F4-100	42.16	0.00	22.71	2.36	7.85	0.34	20.42	4.38	0.03	0.00	100.25	Pink Garnet
F4-101	41.66	0.01	22.47	2.67	7.98	0.45	20.51	4.55	0.03	0.00	100.32	Pink Garnet
F4-102	40.84	0.21	20.71	4.59	7.46	0.42	20.35	4.67	0.06	0.00	99.31	Pink Garnet
F4-103	41.47	0.13	21.19	4.26	7.82	0.38	21.12	3.44	0.04	0.00	99.85	Pink Garnet
F4-104	41.31	0.03	22.44	2.58	8.05	0.42	20.63	4.49	0.04	0.00	99.99	Pink Garnet
F4-105	41.61	0.00	22.59	2.24	8.30	0.44	20.29	4.34	0.04	0.00	99.84	Pink Garnet
F4-106	41.19	0.15	20.43	4.70	7.18	0.43	20.67	4.87	0.07	0.00	99.69	Pink Garnet

Table 12 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F4-107	41.17	0.10	21.82	3.15	7.84	0.36	20.13	4.48	0.04	0.00	99.09	Pink Garnet
F4-108	41.17	0.04	21.45	3.57	7.30	0.41	20.48	4.56	0.05	0.00	99.03	Pink Garnet
F4-109	41.28	0.02	22.75	2.22	7.90	0.36	20.41	4.37	0.05	0.00	99.36	Pink Garnet
F4-110	41.34	0.03	22.24	2.69	8.01	0.38	20.37	4.49	0.06	0.00	99.62	Pink Garnet
F4-111	41.45	0.04	22.10	3.16	7.78	0.40	20.23	4.53	0.04	0.00	99.73	Pink Garnet
F4-112	41.14	0.00	22.08	2.66	7.60	0.41	20.32	4.45	0.06	0.00	98.71	Pink Garnet
F4-113	41.51	0.03	22.36	2.70	7.71	0.40	20.40	4.42	0.01	0.00	99.54	Pink Garnet
F4-114	41.42	0.02	21.69	3.58	7.32	0.37	20.74	4.69	0.02	0.00	99.85	Pink Garnet
F4-115	41.42	0.30	18.86	6.85	7.07	0.44	20.01	5.65	0.10	0.00	100.69	Pink Garnet
F4-116	41.93	0.32	21.57	3.38	6.78	0.34	20.81	4.50	0.07	0.02	99.72	Pink Garnet
F4-117	42.19	0.15	22.47	2.51	7.85	0.36	20.20	5.03	0.11	0.03	100.89	Pink Garnet
F4-118	40.98	0.50	20.86	3.50	7.18	0.38	20.81	4.63	0.11	0.00	98.95	Pink Garnet
F4-119	41.01	0.33	20.08	4.79	7.31	0.38	20.10	5.09	0.09	0.00	99.18	Red Garnet
F4-120	41.74	0.50	20.96	3.44	7.14	0.32	20.80	4.66	0.10	0.00	99.66	Red Garnet
F4-121	41.28	0.22	22.48	2.46	8.17	0.39	20.33	4.32	0.11	0.00	99.76	Red Garnet
F4-122	42.01	0.47	22.49	1.75	7.36	0.36	21.35	4.21	0.10	0.00	100.10	Red Garnet
F4-123	41.82	0.23	22.11	2.60	8.05	0.39	20.30	4.51	0.10	0.00	100.11	Red Garnet
F4-124	41.60	0.46	21.07	3.60	7.11	0.41	20.88	4.65	0.07	0.00	99.84	Red Garnet
F4-125	42.01	0.16	22.43	2.27	6.97	0.36	21.23	4.23	0.11	0.00	99.76	Red Garnet
F4-126	41.42	0.35	20.12	4.65	7.40	0.38	20.16	5.10	0.08	0.00	99.66	Red Garnet
F4-127	41.55	0.37	22.44	1.97	7.07	0.34	20.88	4.36	0.05	0.00	99.04	Red Garnet
F4-128	41.68	0.38	21.24	3.16	8.04	0.40	20.35	4.45	0.10	0.00	99.81	Red Garnet
F4-129	41.77	0.34	22.41	1.91	7.73	0.33	20.74	4.25	0.13	0.00	99.62	Red Garnet
F4-130	41.67	0.24	23.28	0.89	9.55	0.38	20.14	3.85	0.10	0.00	100.10	Red Garnet
F4-131	41.51	0.12	22.46	2.32	8.18	0.36	20.46	4.25	0.06	0.00	99.72	Red Garnet
F4-132	41.71	0.21	22.62	1.90	7.71	0.28	20.65	4.30	0.07	0.00	99.45	Red Garnet
F4-133	41.47	0.48	20.98	3.48	7.17	0.37	20.78	4.66	0.11	0.00	99.49	Red Garnet
F4-134	40.62	0.24	18.79	6.13	6.89	0.35	19.98	5.48	0.07	0.00	98.55	Red Garnet
F4-135	41.52	0.50	22.56	1.71	7.22	0.34	21.20	4.25	0.11	0.00	99.41	Red Garnet
F4-136	41.16	0.23	20.05	5.39	7.21	0.39	19.75	5.45	0.11	0.00	99.75	Red Garnet
F4-137	42.06	0.19	20.15	5.42	5.83	0.36	21.59	4.34	0.11	0.00	100.04	Red Garnet
F4-138	41.78	0.04	22.31	2.46	7.79	0.40	20.36	4.44	0.07	0.00	99.65	Red Garnet
F4-139	41.55	0.24	21.84	2.87	7.81	0.40	20.52	4.32	0.07	0.00	99.62	Red Garnet
F4-140	41.76	0.45	20.97	3.56	7.14	0.39	20.51	4.62	0.13	0.00	99.54	Red Garnet
F4-141	42.18	0.32	22.19	2.41	7.20	0.34	21.01	4.18	0.09	0.00	99.92	Red Garnet
F4-142	41.52	0.21	21.93	2.89	7.27	0.36	21.01	4.29	0.08	0.00	99.56	Red Garnet
F4-143	41.60	0.48	21.02	3.54	6.99	0.40	20.65	4.70	0.10	0.00	99.48	Red Garnet
F4-144	41.82	0.18	22.03	2.54	7.44	0.43	20.41	4.51	0.08	0.00	99.43	Red Garnet
F4-145	41.44	0.43	21.51	3.11	8.01	0.35	20.27	4.40	0.10	0.00	99.62	Red Garnet
F4-146	41.18	0.80	22.38	0.76	10.66	0.35	19.12	4.71	0.11	0.00	100.07	Red Garnet
F4-147	42.15	0.21	22.60	1.95	7.67	0.38	20.72	4.24	0.08	0.00	100.01	Red Garnet
F4-148	41.20	0.28	20.02	4.77	7.16	0.34	20.11	5.13	0.05	0.00	99.06	Red Garnet

Table 12 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F4-149	41.29	0.44	21.27	3.59	7.17	0.36	20.64	4.25	0.11	0.00	99.13	Red Garnet
F4-150	41.37	0.31	21.86	2.72	7.07	0.43	20.83	4.23	0.10	0.00	98.93	Red Garnet
F4-151	41.66	0.38	22.52	1.90	6.94	0.30	20.88	4.41	0.06	0.00	99.04	Red Garnet
F4-152	41.60	0.51	22.25	1.75	7.47	0.33	20.97	4.22	0.10	0.00	99.20	Red Garnet
F4-153	40.73	0.73	20.97	2.87	8.08	0.39	20.17	4.66	0.17	0.00	98.76	Red Garnet
F4-154	39.83	0.38	20.65	3.37	13.13	0.41	16.58	4.90	0.11	0.00	99.36	Red Garnet
F4-155	40.93	0.23	22.30	1.96	8.29	0.48	20.32	3.95	0.12	0.00	98.57	Red Garnet
F4-156	41.52	0.48	22.30	1.81	7.20	0.32	20.83	4.26	0.07	0.00	98.79	Red Garnet
F4-157	41.96	0.45	22.64	1.67	7.28	0.36	20.91	4.28	0.07	0.00	99.62	Red Garnet
F4-158	41.75	0.53	22.63	1.76	7.54	0.43	21.10	4.22	0.13	0.00	100.09	Red Garnet
F4-159	42.49	0.57	22.33	1.83	8.06	0.40	20.62	4.17	0.07	0.00	100.55	Red Garnet
F4-160	41.90	0.51	22.10	2.08	8.07	0.32	20.52	4.24	0.13	0.00	99.87	Red Garnet
F4-161	41.53	0.23	23.68	0.50	9.90	0.35	19.71	3.80	0.09	0.00	99.79	Red Garnet
F4-162	41.00	0.19	23.06	0.73	15.27	0.41	15.92	4.45	0.06	0.00	101.09	Red Garnet
F4-163	41.82	0.40	22.36	1.97	7.17	0.36	20.93	4.28	0.08	0.00	99.38	Red Garnet
F4-164	40.46	0.26	21.72	2.11	12.91	0.47	16.71	4.74	0.08	0.02	99.47	Red Garnet
F4-165	42.08	0.52	22.64	1.81	7.35	0.37	20.75	4.12	0.10	0.00	99.73	Red Garnet
F4-166	40.95	0.26	23.49	0.08	13.07	0.35	17.80	3.94	0.11	0.00	100.05	Orange Garnet
F4-167	40.26	0.15	22.72	0.74	15.67	0.45	15.76	4.57	0.04	0.00	100.37	Orange Garnet
F4-168	42.09	0.52	22.44	1.57	8.05	0.32	20.33	4.14	0.15	0.00	99.61	Orange Garnet
F4-169	41.26	0.31	23.51	0.08	13.00	0.37	17.79	3.87	0.07	0.00	100.26	Orange Garnet
F4-170	41.11	0.28	23.60	0.10	12.72	0.39	17.87	3.93	0.12	0.00	100.12	Orange Garnet
F4-171	40.53	0.16	22.82	0.73	15.22	0.48	15.87	4.55	0.05	0.00	100.41	Orange Garnet
F4-172	41.39	0.62	22.10	1.73	8.17	0.34	20.49	4.22	0.16	0.00	99.22	Orange Garnet
F4-173	41.46	0.55	22.61	1.26	8.33	0.37	20.16	4.02	0.11	0.00	98.86	Orange Garnet
F4-174	41.03	0.29	23.27	0.05	13.02	0.39	17.96	3.94	0.13	0.00	100.08	Orange Garnet
F4-175	41.19	0.45	22.27	1.42	9.96	0.30	19.30	4.28	0.13	0.00	99.30	Orange Garnet
F4-176	40.75	0.28	23.63	0.02	12.97	0.36	17.86	3.93	0.10	0.00	99.90	Orange Garnet
F4-177	40.51	0.28	23.53	0.03	12.60	0.40	17.70	3.93	0.12	0.00	99.10	Orange Garnet
F4-178	41.10	0.28	23.58	0.10	12.83	0.42	17.73	3.92	0.13	0.00	100.08	Orange Garnet
F4-179	41.02	0.33	23.78	0.03	13.18	0.33	17.89	3.95	0.10	0.00	100.61	Orange Garnet
F4-180	41.71	0.43	23.57	0.59	7.16	0.32	21.08	3.91	0.09	0.00	98.86	Orange Garnet
F4-181	41.85	0.27	22.78	1.71	9.22	0.35	19.93	4.38	0.08	0.00	100.57	Orange Garnet
F4-182	41.48	0.56	22.40	1.53	8.51	0.30	20.39	4.12	0.11	0.00	99.40	Orange Garnet
F4-183	41.13	0.30	23.70	0.06	13.18	0.42	18.00	3.96	0.12	0.00	100.86	Orange Garnet
F4-184	41.21	0.28	23.66	0.04	12.64	0.38	17.50	3.92	0.12	0.00	99.75	Orange Garnet
F4-185	40.80	0.28	23.68	0.03	12.92	0.38	17.93	3.96	0.11	0.00	100.09	Orange Garnet
F4-186	41.09	0.29	23.47	0.05	12.98	0.40	17.83	3.94	0.13	0.00	100.19	Orange Garnet
F4-187	40.49	0.31	23.50	0.07	12.81	0.34	17.67	3.97	0.14	0.00	99.29	Orange Garnet
F4-188	40.69	0.38	22.77	0.63	10.63	0.44	18.86	4.19	0.11	0.00	98.70	Orange Garnet

Table 12 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F4-189	40.33	0.30	23.34	0.04	13.03	0.39	17.85	3.95	0.11	0.00	99.34	Orange Garnet
F4-190	41.66	0.55	23.22	0.68	8.32	0.31	20.74	3.93	0.12	0.00	99.53	Orange Garnet
F4-191	42.52	0.39	23.75	0.39	8.50	0.27	20.76	3.82	0.06	0.00	100.45	Orange Garnet
F4-192	41.70	0.64	22.56	1.65	8.74	0.42	20.30	4.08	0.11	0.00	100.19	Orange Garnet
F4-193	41.63	0.61	22.40	1.74	8.57	0.39	20.47	4.12	0.09	0.00	100.01	Orange Garnet
F4-194	41.94	0.57	22.35	1.63	8.66	0.37	20.63	4.11	0.12	0.00	100.38	Orange Garnet
F4-195	41.81	0.59	22.49	1.68	8.55	0.39	20.51	4.18	0.15	0.00	100.35	Orange Garnet
F4-196	41.78	0.57	22.50	1.67	8.79	0.30	20.30	4.22	0.13	0.00	100.26	Orange Garnet
F4-197	41.44	0.65	22.29	1.68	8.68	0.33	20.38	4.19	0.08	0.00	99.72	Orange Garnet
F4-198	41.57	0.57	22.29	1.70	8.55	0.33	20.39	4.16	0.09	0.00	99.65	Orange Garnet
F4-199	41.66	0.61	22.29	1.68	8.81	0.31	20.42	4.11	0.13	0.00	100.01	Orange Garnet
F4-200	41.92	0.58	22.38	1.69	8.73	0.38	20.47	4.11	0.11	0.00	100.37	Orange Garnet
F4-201	40.95	0.53	22.27	1.71	8.64	0.36	20.29	4.18	0.09	0.00	99.01	Orange Garnet
F4-202	41.22	0.64	22.32	1.70	8.78	0.40	20.35	4.22	0.11	0.00	99.74	Orange Garnet
F4-203	41.35	0.22	23.61	0.44	10.25	0.36	20.06	3.66	0.13	0.00	100.07	Orange Garnet
F4-204	41.68	0.55	22.38	1.66	8.50	0.37	20.36	4.18	0.09	0.00	99.76	Orange Garnet
F4-205	41.77	0.79	23.54	0.08	8.35	0.33	20.82	3.88	0.13	0.00	99.70	Orange Garnet
F4-206	42.84	0.38	23.87	0.55	8.42	0.23	21.11	3.15	0.14	0.04	100.71	Orange Garnet
F4-207	41.87	0.37	23.31	0.58	8.48	0.25	21.22	3.23	0.07	0.02	99.41	Orange Garnet
F4-208	42.47	0.38	23.63	0.56	8.47	0.26	21.21	3.24	0.13	0.02	100.37	Orange Garnet
F4-209	41.96	0.39	23.43	0.52	8.37	0.26	20.94	3.21	0.11	0.00	99.17	Orange Garnet
F4-210	42.45	0.34	23.67	0.56	8.43	0.20	21.20	3.24	0.10	0.02	100.19	Orange Garnet
F4-211	42.08	0.36	23.60	0.52	8.43	0.28	21.27	3.21	0.10	0.02	99.86	Orange Garnet
F4-212	42.39	0.35	23.70	0.54	8.57	0.29	21.02	3.22	0.08	0.01	100.16	Orange Garnet
F4-213	42.29	0.36	23.58	0.57	8.40	0.30	21.21	3.22	0.08	0.01	100.00	Orange Garnet

Table 13: Finsch unit F5/F6 garnets

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F5/F6-1	41.47	0.08	18.89	6.63	6.87	0.48	19.22	5.51	0.13	0.03	99.30	Purple Garnet
F5/F6-2	41.29	0.07	19.10	6.64	7.09	0.46	19.24	5.44	0.15	0.03	99.49	Purple Garnet
F5/F6-3	41.23	0.14	18.83	6.87	5.96	0.32	20.34	4.90	0.14	0.02	98.74	Purple Garnet
F5/F6-4	41.13	0.14	16.99	8.86	6.48	0.36	19.34	5.87	0.17	0.03	99.37	Purple Garnet
F5/F6-5	41.15	0.09	19.26	6.54	6.75	0.47	19.40	5.33	0.14	0.02	99.15	Purple Garnet
F5/F6-6	40.86	0.26	16.71	9.24	6.59	0.41	18.69	5.99	0.17	0.02	98.94	Purple Garnet
F5/F6-7	41.72	0.08	19.78	5.57	6.26	0.36	19.73	5.14	0.12	0.04	98.78	Purple Garnet
F5/F6-8	41.67	0.01	18.33	8.39	5.89	0.37	22.23	2.40	0.07	0.03	99.39	Purple Garnet
F5/F6-9	41.93	0.11	20.14	5.85	6.16	0.32	21.25	3.30	0.10	0.02	99.19	Purple Garnet
F5/F6-10	41.59	0.27	19.62	5.66	6.20	0.29	20.20	5.09	0.10	0.01	99.03	Purple Garnet
F5/F6-11	41.91	0.13	20.85	4.54	6.11	0.35	20.60	4.58	0.10	0.02	99.20	Purple Garnet
F5/F6-12	41.91	0.00	20.95	4.22	6.23	0.32	20.42	4.68	0.10	0.04	98.86	Purple Garnet
F5/F6-13	41.29	0.22	19.90	5.09	6.77	0.38	19.90	4.89	0.12	0.04	98.61	Purple Garnet

Table 13 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F5/F6-14	41.49	0.08	20.07	5.71	6.23	0.35	19.88	5.14	0.11	0.03	99.08	Purple Garnet
F5/F6-15	41.81	0.01	21.04	4.17	6.42	0.27	20.56	4.72	0.11	0.03	99.14	Purple Garnet
F5/F6-16	41.63	0.15	20.52	4.55	6.16	0.35	20.44	4.67	0.14	0.03	98.65	Purple Garnet
F5/F6-17	41.74	0.02	21.04	4.13	6.32	0.34	20.46	4.68	0.09	0.03	98.85	Purple Garnet
F5/F6-18	41.81	0.20	20.42	4.74	6.54	0.33	20.16	4.84	0.16	0.04	99.23	Purple Garnet
F5/F6-19	41.83	0.02	20.94	4.14	6.28	0.33	20.63	4.62	0.14	0.05	98.98	Purple Garnet
F5/F6-20	41.79	0.26	19.56	5.55	6.19	0.32	20.33	5.05	0.14	0.03	99.21	Purple Garnet
F5/F6-21	41.89	0.03	18.99	7.93	5.75	0.33	22.52	2.39	0.11	0.03	99.97	Purple Garnet
F5/F6-22	42.32	0.04	20.77	4.87	5.82	0.33	22.06	3.02	0.11	0.02	99.35	Purple Garnet
F5/F6-23	41.76	0.00	17.94	8.22	5.91	0.38	22.12	2.49	0.10	0.02	98.95	Purple Garnet
F5/F6-24	42.28	0.04	20.58	5.20	5.84	0.30	22.19	2.78	0.10	0.02	99.33	Purple Garnet
F5/F6-25	42.32	0.02	20.05	5.92	5.72	0.28	22.55	2.17	0.07	0.03	99.12	Purple Garnet
F5/F6-26	42.37	0.03	20.69	5.06	6.07	0.30	22.23	2.65	0.08	0.03	99.51	Purple Garnet
F5/F6-27	42.19	0.04	20.51	5.16	6.00	0.33	22.28	2.71	0.12	0.04	99.38	Purple Garnet
F5/F6-28	42.20	0.02	20.45	5.41	5.96	0.32	22.54	2.32	0.11	0.03	99.37	Purple Garnet
F5/F6-29	42.44	0.03	20.09	6.18	5.93	0.34	22.51	2.21	0.10	0.04	99.85	Purple Garnet
F5/F6-30	42.21	0.04	20.65	5.06	5.92	0.28	22.15	2.73	0.10	0.03	99.16	Purple Garnet
F5/F6-31	42.22	0.02	20.87	4.92	5.72	0.35	22.43	2.59	0.07	0.04	99.23	Purple Garnet
F5/F6-32	42.08	0.06	20.29	5.36	5.89	0.30	22.22	2.34	0.10	0.04	98.67	Purple Garnet
F5/F6-33	42.41	0.08	21.56	3.96	5.88	0.31	22.38	2.56	0.12	0.02	99.27	Purple Garnet
F5/F6-34	42.17	0.01	20.76	5.01	6.03	0.29	22.37	2.66	0.06	0.02	99.38	Purple Garnet
F5/F6-35	42.91	0.03	21.71	3.89	6.15	0.30	22.37	2.56	0.11	0.04	100.07	Purple Garnet
F5/F6-36	42.12	0.03	20.99	4.17	6.22	0.36	20.66	4.62	0.11	0.03	99.29	Purple Garnet
F5/F6-37	41.84	0.01	18.39	8.18	5.98	0.33	22.08	2.37	0.11	0.04	99.34	Purple Garnet
F5/F6-38	41.84	0.33	19.57	5.48	6.59	0.39	19.89	5.01	0.13	0.03	99.25	Purple Garnet
F5/F6-39	42.08	0.21	20.31	4.79	6.23	0.33	20.21	4.88	0.11	0.03	99.16	Purple Garnet
F5/F6-40	41.75	0.38	20.38	4.54	6.46	0.38	20.37	4.75	0.10	0.03	99.14	Purple Garnet
F5/F6-41	41.89	0.32	20.18	4.91	6.41	0.40	20.20	4.97	0.15	0.02	99.46	Purple Garnet
F5/F6-42	41.71	0.32	20.21	4.96	6.39	0.37	20.46	4.93	0.17	0.03	99.53	Purple Garnet
F5/F6-43	41.66	0.15	20.39	5.13	7.83	0.56	19.13	4.74	0.13	0.02	99.73	Purple Garnet
F5/F6-44	41.91	0.27	20.16	4.95	6.69	0.33	20.12	5.00	0.13	0.03	99.59	Purple Garnet
F5/F6-45	42.02	0.22	20.52	4.78	6.15	0.32	20.83	4.49	0.11	0.03	99.46	Purple Garnet
F5/F6-46	41.58	0.37	20.29	4.77	6.31	0.36	20.13	4.87	0.15	0.03	98.86	Purple Garnet
F5/F6-47	42.50	0.08	21.56	3.52	6.87	0.32	20.50	4.59	0.11	0.04	100.09	Purple Garnet
F5/F6-48	42.15	0.28	20.16	4.98	6.54	0.31	20.18	4.97	0.11	0.03	99.71	Purple Garnet
F5/F6-49	42.30	0.02	21.75	3.22	6.71	0.28	20.45	4.41	0.11	0.02	99.26	Purple Garnet
F5/F6-50	42.05	0.11	22.37	2.45	6.23	0.33	20.70	4.32	0.12	0.04	98.71	Pink Garnet
F5/F6-51	42.25	0.06	21.70	3.21	6.64	0.33	20.58	4.40	0.12	0.03	99.31	Pink Garnet
F5/F6-52	42.38	0.07	21.70	3.19	6.86	0.35	20.87	4.43	0.11	0.02	99.98	Pink Garnet
F5/F6-53	42.05	0.02	22.53	2.49	7.65	0.38	20.18	4.32	0.10	0.03	99.74	Pink Garnet
F5/F6-54	42.41	0.09	21.92	3.16	7.12	0.27	20.59	4.47	0.07	0.03	100.12	Pink Garnet
F5/F6-55	42.17	0.15	21.37	3.28	6.56	0.35	20.50	4.48	0.13	0.03	99.02	Pink Garnet

Table 13 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F5/F6-56	42.14	0.07	21.78	3.08	6.82	0.31	20.57	4.44	0.13	0.04	99.37	Pink Garnet
F5/F6-57	41.96	0.31	20.01	5.00	6.61	0.27	20.44	5.09	0.12	0.02	99.83	Pink Garnet
F5/F6-58	42.33	0.13	21.46	3.39	6.43	0.34	20.77	4.44	0.09	0.05	99.45	Pink Garnet
F5/F6-59	42.20	0.26	21.34	3.80	6.91	0.33	20.67	4.63	0.15	0.04	100.33	Pink Garnet
F5/F6-60	42.28	0.04	22.17	2.87	7.12	0.27	20.77	4.37	0.13	0.02	100.02	Pink Garnet
F5/F6-61	42.20	0.10	22.17	2.48	7.02	0.35	20.63	4.36	0.12	0.02	99.44	Pink Garnet
F5/F6-62	42.05	0.37	20.58	4.52	6.51	0.34	20.40	4.80	0.14	0.04	99.75	Pink Garnet
F5/F6-63	42.00	0.30	21.12	3.92	6.67	0.33	20.62	4.66	0.13	0.03	99.77	Pink Garnet
F5/F6-64	42.01	0.27	21.70	3.45	6.95	0.32	20.63	4.23	0.12	0.03	99.68	Pink Garnet
F5/F6-65	42.49	0.19	21.40	3.97	6.72	0.34	20.66	4.65	0.09	0.02	100.52	Pink Garnet
F5/F6-66	42.58	0.09	21.64	3.22	6.79	0.28	20.46	4.46	0.09	0.02	99.63	Pink Garnet
F5/F6-67	42.37	0.07	21.96	2.64	6.96	0.27	20.64	4.25	0.14	0.02	99.32	Pink Garnet
F5/F6-68	42.55	0.08	21.73	3.20	6.86	0.30	20.47	4.37	0.14	0.03	99.73	Pink Garnet
F5/F6-69	42.06	0.38	20.63	4.45	6.56	0.32	20.39	4.88	0.11	0.03	99.80	Pink Garnet
F5/F6-70	42.15	0.37	21.64	3.47	6.32	0.33	20.82	4.22	0.14	0.03	99.47	Pink Garnet
F5/F6-71	42.28	0.28	21.09	3.85	6.77	0.33	20.41	4.53	0.11	0.02	99.66	Pink Garnet
F5/F6-72	42.10	0.41	21.42	3.63	6.48	0.33	20.75	4.19	0.14	0.02	99.48	Pink Garnet
F5/F6-73	42.30	0.38	21.39	3.65	6.45	0.33	21.01	4.30	0.14	0.02	99.96	Pink Garnet
F5/F6-74	42.18	0.40	20.37	4.72	6.43	0.32	20.42	4.50	0.16	0.03	99.53	Pink Garnet
F5/F6-75	42.20	0.07	21.89	2.81	6.89	0.32	20.77	4.36	0.12	0.03	99.46	Pink Garnet
F5/F6-76	42.39	0.29	21.72	3.43	6.96	0.32	20.83	4.39	0.10	0.02	100.44	Pink Garnet
F5/F6-77	42.79	0.09	22.37	2.65	7.12	0.27	20.85	4.51	0.04	0.02	100.71	Pink Garnet
F5/F6-78	42.54	0.18	21.33	3.76	6.91	0.31	20.81	4.70	0.07	0.02	100.63	Pink Garnet
F5/F6-79	42.55	0.21	21.38	3.63	7.00	0.34	20.62	4.69	0.05	0.02	100.47	Pink Garnet
F5/F6-80	42.84	0.14	22.21	2.93	6.88	0.31	20.96	4.50	0.04	0.02	100.82	Pink Garnet
F5/F6-81	42.12	0.44	20.30	4.95	6.63	0.31	20.78	4.73	0.09	0.01	100.37	Pink Garnet
F5/F6-82	42.26	0.23	21.66	3.07	6.75	0.34	20.90	4.56	0.07	0.01	99.85	Pink Garnet
F5/F6-83	42.69	0.24	21.85	3.57	7.06	0.30	20.76	4.39	0.08	0.01	100.93	Pink Garnet
F5/F6-84	42.51	0.19	21.94	3.11	7.99	0.44	19.92	4.58	0.08	0.00	100.77	Pink Garnet
F5/F6-85	42.04	1.09	21.94	0.68	10.99	0.30	19.22	4.36	0.16	0.02	100.80	Pink Garnet
F5/F6-86	42.39	0.18	21.71	3.17	7.98	0.40	19.89	4.50	0.03	0.01	100.27	Pink Garnet
F5/F6-87	42.63	0.37	21.53	3.74	6.67	0.34	20.88	4.45	0.09	0.01	100.70	Pink Garnet
F5/F6-88	42.67	0.21	21.08	3.93	6.94	0.38	20.72	4.59	0.08	0.03	100.60	Pink Garnet
F5/F6-89	42.62	0.06	21.64	3.71	7.11	0.33	20.66	4.72	0.05	0.01	100.91	Pink Garnet
F5/F6-90	41.64	0.11	21.34	3.38	11.04	0.41	17.94	4.63	0.09	0.02	100.60	Pink Garnet
F5/F6-91	42.49	0.31	20.49	4.47	6.57	0.38	20.67	4.67	0.10	0.03	100.17	Pink Garnet
F5/F6-92	42.53	0.32	20.71	4.69	6.58	0.35	20.58	4.70	0.08	0.02	100.56	Pink Garnet
F5/F6-93	42.61	0.07	21.76	3.21	6.94	0.30	20.80	4.52	0.10	0.02	100.32	Pink Garnet
F5/F6-94	42.62	0.23	20.61	4.72	6.40	0.30	21.04	4.69	0.06	0.01	100.67	Pink Garnet
F5/F6-95	42.54	0.26	20.58	4.77	6.31	0.29	21.00	4.62	0.07	0.01	100.44	Pink Garnet
F5/F6-96	42.66	0.11	22.04	3.02	7.04	0.33	20.73	4.49	0.04	0.02	100.50	Pink Garnet
F5/F6-97	42.43	0.25	20.54	4.79	6.16	0.34	21.05	4.64	0.07	0.02	100.28	Pink Garnet

Table 13 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F5/F6-98	42.64	0.20	21.10	3.81	6.68	0.38	20.74	4.70	0.06	0.02	100.31	Pink Garnet
F5/F6-99	42.74	0.09	21.94	3.18	6.90	0.31	20.71	4.61	0.05	0.02	100.55	Pink Garnet
F5/F6-100	42.70	0.42	22.47	2.13	6.87	0.30	21.18	4.23	0.10	0.02	100.42	Red Garnet
F5/F6-101	43.10	0.41	22.61	2.09	6.90	0.32	21.09	4.21	0.12	0.02	100.85	Red Garnet
F5/F6-102	42.58	0.42	22.07	2.50	7.49	0.34	20.89	4.31	0.08	0.02	100.71	Red Garnet
F5/F6-103	42.71	0.45	22.47	1.99	6.89	0.25	21.11	4.19	0.09	0.02	100.18	Red Garnet
F5/F6-104	42.58	0.40	22.59	2.21	7.14	0.31	21.01	4.18	0.13	0.01	100.55	Red Garnet
F5/F6-105	42.30	0.55	20.44	4.01	7.73	0.32	20.10	4.95	0.12	0.03	100.54	Red Garnet
F5/F6-106	42.93	0.42	21.29	3.05	7.54	0.29	20.11	4.61	0.07	0.02	100.33	Red Garnet
F5/F6-107	42.75	0.42	22.54	2.08	7.19	0.34	21.01	4.38	0.10	0.01	100.82	Red Garnet
F5/F6-108	42.33	1.12	21.74	0.61	10.83	0.33	19.02	4.47	0.13	0.01	100.57	Red Garnet
F5/F6-109	42.87	0.44	22.10	2.62	6.70	0.34	20.87	4.36	0.09	0.03	100.41	Red Garnet
F5/F6-110	42.68	0.39	22.47	1.99	6.95	0.29	21.28	4.24	0.09	0.02	100.40	Red Garnet
F5/F6-111	43.17	0.36	22.78	1.77	6.69	0.31	21.29	4.19	0.05	0.02	100.63	Red Garnet
F5/F6-112	42.74	0.26	23.14	1.59	7.64	0.38	20.67	4.25	0.04	0.01	100.71	Red Garnet
F5/F6-113	42.56	0.32	22.08	2.73	6.88	0.33	21.23	4.29	0.09	0.02	100.52	Red Garnet
F5/F6-114	42.96	0.36	22.53	2.19	6.98	0.29	21.12	4.26	0.13	0.01	100.83	Red Garnet
F5/F6-115	43.06	0.39	21.68	2.79	6.79	0.31	20.80	4.34	0.11	0.00	100.26	Red Garnet
F5/F6-116	42.75	0.38	21.62	3.13	7.40	0.40	20.47	4.36	0.08	0.01	100.59	Red Garnet
F5/F6-117	42.32	0.62	20.29	4.44	7.36	0.33	20.21	4.80	0.10	0.00	100.47	Red Garnet
F5/F6-118	43.15	0.41	22.62	1.99	7.01	0.27	21.26	4.15	0.10	0.04	101.00	Red Garnet
F5/F6-119	43.08	0.40	22.58	2.02	6.85	0.24	20.98	4.17	0.11	0.02	100.46	Red Garnet
F5/F6-120	42.83	0.26	22.45	2.04	7.43	0.31	20.49	4.10	0.08	0.01	99.99	Red Garnet
F5/F6-121	42.60	0.27	22.21	2.48	7.88	0.35	20.26	4.28	0.08	0.01	100.43	Red Garnet
F5/F6-122	42.87	0.39	22.35	2.41	6.62	0.31	21.52	3.95	0.08	0.02	100.52	Red Garnet
F5/F6-123	42.67	0.41	21.46	3.15	7.03	0.30	20.71	4.35	0.09	0.03	100.18	Red Garnet
F5/F6-124	43.24	0.17	22.97	1.61	6.89	0.31	21.41	3.81	0.13	0.02	100.55	Red Garnet
F5/F6-125	42.88	0.37	21.63	3.27	7.13	0.29	20.25	4.57	0.10	0.01	100.50	Red Garnet
F5/F6-126	42.80	0.37	22.56	2.13	7.21	0.30	20.86	4.26	0.10	0.02	100.60	Red Garnet
F5/F6-127	42.59	0.30	22.26	2.45	6.96	0.34	20.95	4.31	0.06	0.02	100.24	Red Garnet
F5/F6-128	42.35	0.28	20.92	3.79	6.81	0.35	20.23	4.49	0.10	0.01	99.32	Red Garnet
F5/F6-129	42.72	0.41	22.32	2.55	6.95	0.29	20.89	4.38	0.11	0.02	100.63	Red Garnet
F5/F6-130	42.49	0.39	22.48	2.01	7.06	0.32	20.83	4.24	0.09	0.01	99.91	Red Garnet
F5/F6-131	42.62	0.34	21.68	3.04	6.99	0.27	20.77	4.41	0.10	0.03	100.25	Red Garnet
F5/F6-132	43.06	0.46	22.24	2.55	7.01	0.33	21.12	4.28	0.14	0.03	101.21	Red Garnet
F5/F6-133	42.46	0.34	21.35	3.49	7.60	0.34	20.38	4.63	0.06	0.02	100.66	Red Garnet
F5/F6-134	42.39	0.32	21.14	3.51	7.44	0.36	20.52	4.58	0.08	0.02	100.36	Red Garnet
F5/F6-135	42.80	0.44	22.46	2.15	7.04	0.35	20.97	4.11	0.13	0.02	100.48	Red Garnet
F5/F6-136	42.57	0.43	21.47	3.36	6.93	0.29	20.34	4.45	0.10	0.02	99.95	Red Garnet
F5/F6-137	42.75	0.15	22.88	1.71	7.68	0.26	20.71	4.31	0.10	0.02	100.55	Red Garnet
F5/F6-138	42.61	0.37	21.55	3.14	6.98	0.31	21.04	4.30	0.12	0.01	100.44	Red Garnet
F5/F6-139	42.75	0.43	22.03	2.73	7.44	0.31	20.69	4.20	0.11	0.01	100.70	Red Garnet

Table 13 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F5/F6-140	42.44	0.42	21.96	2.60	7.41	0.32	20.58	4.14	0.12	0.01	99.98	Red Garnet
F5/F6-141	42.15	0.61	20.74	3.60	7.08	0.25	20.61	4.37	0.13	0.02	99.56	Red Garnet
F5/F6-142	42.08	0.21	21.73	3.03	7.00	0.34	20.34	4.35	0.06	0.03	99.15	Red Garnet
F5/F6-143	42.42	0.38	21.62	3.16	7.31	0.32	20.52	4.29	0.09	0.02	100.12	Red Garnet
F5/F6-144	42.78	0.35	22.36	2.06	7.07	0.30	20.71	4.15	0.06	0.01	99.84	Red Garnet
F5/F6-145	42.13	0.57	20.87	3.60	7.12	0.26	20.40	4.36	0.14	0.03	99.46	Red Garnet
F5/F6-146	41.82	0.17	22.15	2.57	7.59	0.32	19.81	4.29	0.09	0.03	98.83	Red Garnet
F5/F6-147	42.09	0.19	22.29	2.54	7.68	0.34	20.13	4.25	0.09	0.02	99.61	Red Garnet
F5/F6-148	42.18	0.14	22.32	2.51	7.74	0.35	20.33	4.28	0.08	0.03	99.95	Red Garnet
F5/F6-149	42.48	0.18	22.11	2.58	7.64	0.36	20.24	4.38	0.07	0.01	100.04	Red Garnet
F5/F6-150	42.35	0.22	20.71	4.15	7.12	0.33	20.21	4.79	0.07	0.02	99.98	Red Garnet
F5/F6-151	42.55	0.28	21.80	3.15	6.86	0.31	20.69	4.47	0.04	0.01	100.16	Red Garnet
F5/F6-152	42.44	0.23	21.89	2.65	6.96	0.30	20.38	4.41	0.09	0.02	99.38	Red Garnet
F5/F6-153	41.68	0.22	21.76	3.03	9.30	0.44	18.56	4.87	0.10	0.01	99.96	Red Garnet
F5/F6-154	41.84	0.20	22.38	2.29	7.99	0.34	19.92	4.28	0.10	0.00	99.34	Red Garnet
F5/F6-155	42.20	0.24	20.55	4.19	7.23	0.33	20.23	4.81	0.07	0.02	99.84	Red Garnet
F5/F6-156	42.23	0.42	21.11	3.71	6.56	0.30	20.52	4.31	0.12	0.00	99.27	Red Garnet
F5/F6-157	41.67	0.21	20.57	4.26	7.21	0.37	19.97	4.83	0.01	0.00	99.11	Red Garnet
F5/F6-158	41.79	0.25	20.40	4.18	7.17	0.32	20.08	4.71	0.06	0.03	98.99	Red Garnet
F5/F6-159	41.86	0.29	21.02	3.55	6.91	0.31	20.23	4.35	0.06	0.02	98.58	Red Garnet
F5/F6-160	41.67	0.39	19.94	4.89	6.63	0.33	20.52	4.57	0.10	0.00	99.03	Red Garnet
F5/F6-161	42.34	0.33	20.95	4.07	7.34	0.32	20.12	4.02	0.11	0.01	99.60	Red Garnet
F5/F6-162	42.02	0.37	20.36	4.39	6.75	0.30	20.00	4.70	0.06	0.01	98.95	Red Garnet
F5/F6-163	41.90	0.15	22.18	2.55	7.63	0.37	19.92	4.21	0.08	0.02	99.01	Red Garnet
F5/F6-164	42.32	0.26	22.64	2.25	6.25	0.32	20.79	4.18	0.09	0.02	99.11	Red Garnet
F5/F6-165	42.45	0.10	22.10	2.46	7.05	0.31	20.64	4.19	0.03	0.01	99.34	Red Garnet
F5/F6-166	42.30	0.37	21.07	3.89	6.50	0.28	20.42	4.25	0.15	0.00	99.22	Red Garnet
F5/F6-167	42.33	0.09	21.94	2.41	7.13	0.28	20.39	4.23	0.06	0.02	98.87	Red Garnet
F5/F6-168	42.66	0.11	22.26	2.53	6.98	0.27	20.43	4.40	0.10	0.02	99.75	Red Garnet
F5/F6-169	41.45	0.34	21.22	3.65	6.36	0.29	20.63	4.60	0.06	0.00	98.59	Red Garnet
F5/F6-170	41.48	0.29	20.69	3.95	6.84	0.27	20.47	4.53	0.07	0.01	98.58	Red Garnet
F5/F6-171	41.50	0.41	22.73	0.58	11.13	0.32	18.43	4.14	0.06	0.01	99.31	Red Garnet
F5/F6-172	41.77	0.73	22.33	1.45	7.85	0.28	20.16	4.42	0.10	0.00	99.09	Orange Garnet
F5/F6-173	41.86	0.58	22.54	1.55	8.06	0.34	20.32	3.97	0.12	0.02	99.36	Orange Garnet
F5/F6-174	41.52	0.46	22.42	1.83	8.31	0.26	20.11	4.23	0.08	0.02	99.25	Orange Garnet
F5/F6-175	41.56	0.37	22.68	1.35	9.19	0.28	19.55	4.12	0.06	0.01	99.17	Orange Garnet
F5/F6-176	41.48	0.37	22.67	1.29	9.25	0.33	19.52	4.14	0.06	0.00	99.10	Orange Garnet
F5/F6-177	41.71	0.38	23.05	1.22	8.51	0.27	19.72	4.16	0.08	0.01	99.09	Orange Garnet
F5/F6-178	42.06	0.43	23.67	0.51	7.32	0.34	20.75	4.11	0.05	0.02	99.25	Orange Garnet
F5/F6-179	41.73	0.57	21.91	2.29	7.49	0.33	20.48	4.36	0.08	0.01	99.24	Orange Garnet
F5/F6-180	41.69	0.34	22.95	1.25	9.47	0.27	19.44	4.20	0.06	0.00	99.66	Orange Garnet
F5/F6-181	41.47	0.88	20.72	3.41	8.36	0.31	19.41	4.55	0.11	0.01	99.23	Orange Garnet

Table 13 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F5/F6-182	42.18	0.39	22.55	1.30	9.23	0.31	19.30	4.14	0.09	0.00	99.49	Orange Garnet
F5/F6-183	42.02	0.60	21.92	2.16	7.94	0.31	20.04	4.13	0.09	0.01	99.22	Orange Garnet
F5/F6-184	42.39	0.57	22.67	1.72	7.46	0.24	20.34	4.19	0.08	0.00	99.65	Orange Garnet
F5/F6-185	41.84	0.32	23.19	1.28	8.49	0.38	19.79	4.11	0.05	0.01	99.47	Orange Garnet
F5/F6-186	41.85	0.62	22.27	1.89	8.05	0.27	19.76	4.32	0.10	0.00	99.13	Orange Garnet
F5/F6-187	41.55	0.56	21.89	2.39	7.80	0.33	20.06	4.37	0.08	0.01	99.03	Orange Garnet
F5/F6-188	41.75	0.49	22.42	1.84	7.78	0.31	20.16	4.05	0.13	0.01	98.93	Orange Garnet
F5/F6-189	42.40	0.40	22.61	1.87	6.89	0.28	20.85	4.18	0.09	0.01	99.57	Orange Garnet
F5/F6-190	41.89	0.48	22.22	1.71	7.90	0.33	20.41	4.12	0.10	0.00	99.17	Orange Garnet
F5/F6-191	42.18	0.40	22.62	1.94	6.73	0.31	20.74	4.08	0.10	0.00	99.10	Orange Garnet
F5/F6-192	41.76	0.57	22.45	1.67	7.38	0.25	20.22	4.23	0.07	0.02	98.61	Orange Garnet
F5/F6-193	42.20	0.48	22.55	1.82	6.93	0.30	20.97	4.01	0.05	0.00	99.30	Orange Garnet
F5/F6-194	41.31	0.39	22.28	1.80	8.21	0.30	20.16	4.21	0.09	0.01	98.75	Orange Garnet
F5/F6-195	42.18	0.56	22.44	1.76	7.88	0.32	20.49	4.09	0.07	0.00	99.76	Orange Garnet
F5/F6-196	41.88	0.55	22.56	1.74	7.78	0.25	20.52	4.13	0.09	0.00	99.51	Orange Garnet
F5/F6-197	42.21	0.54	22.37	1.69	7.55	0.30	20.46	4.12	0.10	0.00	99.34	Orange Garnet
F5/F6-198	42.18	0.57	22.01	2.02	7.99	0.31	19.60	4.19	0.12	0.02	99.00	Orange Garnet
F5/F6-199	41.69	0.44	22.54	1.68	7.52	0.28	20.76	4.11	0.09	0.01	99.11	Orange Garnet
F5/F6-200	41.78	0.52	22.34	2.10	8.09	0.29	20.29	4.12	0.09	0.00	99.61	Orange Garnet

Table 14: Finsch unit F8 garnets

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F8-1	41.39	0.02	18.57	7.57	5.94	0.33	21.61	3.09	0.11	0.03	98.67	Purple Garnet
F8-2	41.72	0.07	19.25	6.45	6.05	0.34	20.85	4.36	0.10	0.03	99.21	Purple Garnet
F8-3	41.45	0.03	18.10	8.48	6.15	0.41	21.79	2.80	0.09	0.02	99.32	Purple Garnet
F8-4	41.92	0.06	21.85	3.33	7.30	0.32	19.54	5.05	0.09	0.04	99.49	Purple Garnet
F8-5	42.10	0.06	19.71	6.50	5.50	0.28	22.84	2.02	0.10	0.03	99.14	Purple Garnet
F8-6	41.89	0.01	19.49	6.29	6.08	0.34	20.87	4.24	0.10	0.02	99.33	Purple Garnet
F8-7	41.93	0.00	22.11	3.19	7.13	0.36	20.04	4.67	0.10	0.03	99.55	Purple Garnet
F8-8	41.68	0.21	19.29	6.71	6.02	0.31	20.83	4.01	0.09	0.02	99.15	Purple Garnet
F8-9	41.67	0.00	18.51	7.98	5.52	0.35	22.00	3.14	0.12	0.03	99.30	Purple Garnet
F8-10	42.13	0.02	20.99	4.13	6.27	0.23	20.31	4.82	0.11	0.04	99.05	Purple Garnet
F8-11	42.14	0.11	20.89	4.08	6.50	0.34	20.28	4.87	0.08	0.04	99.34	Purple Garnet
F8-12	41.92	0.16	19.07	6.81	6.07	0.31	21.13	3.95	0.15	0.03	99.59	Purple Garnet
F8-13	41.66	0.25	20.26	5.03	6.33	0.36	20.32	4.84	0.16	0.03	99.24	Purple Garnet
F8-14	42.32	0.06	20.84	4.12	6.40	0.32	20.65	4.81	0.10	0.04	99.67	Purple Garnet
F8-15	42.41	0.12	22.76	2.08	5.80	0.27	21.26	3.97	0.15	0.04	98.86	Purple Garnet
F8-16	42.19	0.13	21.43	3.53	6.30	0.29	20.73	4.43	0.12	0.04	99.19	Purple Garnet
F8-17	42.05	0.10	21.71	3.45	6.67	0.39	20.18	4.58	0.12	0.04	99.29	Purple Garnet
F8-18	42.07	0.06	20.60	4.77	6.00	0.28	20.54	5.09	0.13	0.04	99.56	Purple Garnet
F8-19	42.02	0.11	21.85	2.98	6.78	0.29	20.63	4.37	0.14	0.03	99.20	Purple Garnet

Table 14 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F8-20	42.05	0.04	19.45	6.48	5.64	0.29	22.77	2.01	0.13	0.04	98.89	Purple Garnet
F8-21	42.08	0.02	21.86	3.42	6.63	0.32	20.40	4.33	0.12	0.02	99.20	Purple Garnet
F8-22	41.97	0.09	21.93	2.97	7.20	0.31	20.27	4.30	0.12	0.05	99.20	Purple Garnet
F8-23	42.49	0.07	21.34	4.25	5.32	0.25	22.52	2.65	0.13	0.03	99.05	Purple Garnet
F8-24	42.05	0.32	21.24	3.75	6.40	0.33	20.53	4.44	0.13	0.02	99.21	Purple Garnet
F8-25	41.90	0.05	19.68	6.04	6.10	0.30	20.93	4.33	0.14	0.04	99.51	Purple Garnet
F8-26	41.92	0.03	22.18	2.93	7.46	0.36	19.92	4.45	0.11	0.03	99.38	Purple Garnet
F8-27	42.04	0.10	21.07	4.21	6.59	0.35	20.23	4.95	0.13	0.03	99.70	Purple Garnet
F8-28	41.93	0.10	20.83	4.55	7.15	0.39	19.05	5.64	0.10	0.04	99.76	Purple Garnet
F8-29	41.90	0.09	21.55	3.41	6.64	0.31	20.23	4.58	0.16	0.01	98.86	Purple Garnet
F8-30	41.95	0.06	21.76	3.49	7.65	0.39	19.61	4.56	0.10	0.03	99.59	Purple Garnet
F8-31	41.49	0.12	18.58	7.30	5.98	0.34	20.70	4.11	0.18	0.04	98.82	Purple Garnet
F8-32	42.38	0.07	21.44	4.40	5.15	0.25	23.44	1.62	0.11	0.03	98.89	Purple Garnet
F8-33	41.73	0.14	18.85	7.09	5.83	0.32	20.78	4.07	0.11	0.03	98.95	Purple Garnet
F8-34	42.15	0.09	21.28	4.35	5.27	0.36	22.53	2.60	0.12	0.02	98.77	Purple Garnet
F8-35	41.57	0.07	19.08	6.33	6.23	0.33	20.69	4.37	0.11	0.04	98.81	Purple Garnet
F8-36	41.95	0.04	19.15	7.26	4.95	0.32	22.92	1.94	0.13	0.04	98.70	Purple Garnet
F8-37	42.18	0.01	19.46	6.48	5.60	0.27	22.73	2.02	0.10	0.03	98.88	Purple Garnet
F8-38	42.09	0.03	21.98	2.95	6.99	0.39	20.12	4.39	0.09	0.02	99.03	Purple Garnet
F8-39	41.63	0.03	18.29	7.84	5.60	0.36	21.88	3.09	0.12	0.04	98.87	Purple Garnet
F8-40	42.06	0.03	18.84	7.59	5.33	0.31	23.90	0.51	0.06	0.04	98.66	Purple Garnet
F8-41	41.80	0.03	21.65	3.83	6.21	0.37	20.87	4.29	0.14	0.04	99.24	Purple Garnet
F8-42	41.93	0.07	18.69	7.68	5.83	0.36	22.88	1.50	0.11	0.02	99.08	Purple Garnet
F8-43	42.87	0.00	22.14	3.80	4.78	0.18	24.92	0.36	0.11	0.03	99.19	Purple Garnet
F8-44	42.24	0.01	22.51	2.70	6.42	0.37	20.61	4.44	0.08	0.02	99.40	Purple Garnet
F8-45	41.70	0.16	18.86	7.10	5.78	0.36	20.86	4.01	0.12	0.04	99.00	Purple Garnet
F8-46	41.69	0.14	20.04	5.23	6.34	0.27	20.31	4.58	0.11	0.03	98.75	Purple Garnet
F8-47	41.68	0.17	19.14	6.88	5.91	0.35	21.11	3.95	0.13	0.04	99.33	Purple Garnet
F8-48	42.08	0.12	21.43	3.98	5.82	0.30	21.82	3.29	0.12	0.03	98.99	Purple Garnet
F8-49	42.33	0.03	22.13	2.59	6.77	0.32	20.60	4.26	0.13	0.04	99.20	Purple Garnet
F8-50	41.92	0.10	21.81	3.49	6.64	0.40	20.05	4.53	0.17	0.03	99.13	Purple Garnet
F8-51	41.51	0.01	20.66	4.61	6.83	0.37	19.70	4.78	0.14	0.05	98.67	Purple Garnet
F8-52	41.83	0.05	22.57	2.05	7.71	0.40	19.57	4.45	0.11	0.04	98.77	Purple Garnet
F8-53	42.23	0.07	19.11	7.19	5.06	0.30	23.10	1.95	0.13	0.05	99.18	Purple Garnet
F8-54	41.27	0.12	20.53	4.46	7.18	0.34	19.12	5.40	0.13	0.04	98.59	Pink Garnet
F8-55	41.77	0.08	20.77	4.24	6.57	0.31	19.76	4.90	0.13	0.04	98.57	Pink Garnet
F8-56	41.70	0.17	19.83	5.25	6.10	0.37	20.20	4.90	0.10	0.04	98.64	Pink Garnet
F8-57	42.42	0.19	21.34	3.10	6.69	0.34	20.51	4.32	0.15	0.03	99.08	Pink Garnet
F8-58	41.93	0.13	21.45	3.22	6.77	0.33	20.15	4.45	0.12	0.03	98.58	Pink Garnet
F8-59	41.60	0.08	21.88	3.00	7.46	0.37	19.96	4.45	0.09	0.03	98.91	Pink Garnet
F8-60	42.01	0.14	21.88	3.01	7.40	0.30	20.23	4.31	0.12	0.03	99.42	Pink Garnet
F8-61	41.54	0.24	19.37	5.97	6.30	0.29	20.01	4.99	0.15	0.04	98.90	Pink Garnet

Table 14 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F8-62	41.67	0.35	20.57	4.17	6.05	0.30	20.69	4.53	0.19	0.03	98.54	Pink Garnet
F8-63	42.18	0.06	22.69	2.13	6.76	0.31	20.37	4.13	0.11	0.04	98.78	Pink Garnet
F8-64	41.78	0.15	22.41	2.16	8.52	0.37	18.96	4.52	0.14	0.04	99.05	Pink Garnet
F8-65	42.01	0.15	21.76	2.94	6.99	0.26	20.03	4.27	0.13	0.03	98.57	Pink Garnet
F8-66	41.92	0.13	21.68	2.98	7.01	0.33	20.20	4.29	0.16	0.04	98.73	Pink Garnet
F8-67	41.69	0.12	22.24	2.73	7.55	0.36	19.81	4.36	0.12	0.03	99.00	Pink Garnet
F8-68	41.94	0.03	20.72	4.04	6.65	0.34	20.17	4.92	0.15	0.04	99.00	Pink Garnet
F8-69	41.82	0.08	22.55	2.60	7.28	0.35	20.24	4.23	0.13	0.03	99.31	Pink Garnet
F8-70	41.79	0.14	22.51	2.11	8.33	0.37	19.20	4.30	0.14	0.05	98.94	Pink Garnet
F8-71	41.93	0.21	20.57	4.18	7.16	0.32	19.98	4.88	0.14	0.05	99.41	Pink Garnet
F8-72	41.52	0.11	20.84	4.36	6.99	0.36	19.77	4.71	0.15	0.03	98.83	Pink Garnet
F8-73	41.49	0.16	20.11	4.82	6.37	0.34	20.31	4.73	0.19	0.02	98.53	Pink Garnet
F8-74	41.48	0.12	19.43	5.72	6.63	0.39	19.56	5.29	0.15	0.03	98.79	Pink Garnet
F8-75	42.33	0.06	22.20	2.65	7.24	0.28	20.75	4.28	0.07	0.01	99.88	Pink Garnet
F8-76	41.86	0.06	20.77	4.08	6.66	0.26	20.73	5.00	0.04	0.02	99.48	Pink Garnet
F8-77	41.71	0.13	20.64	4.07	6.90	0.26	20.53	4.74	0.07	0.02	99.06	Pink Garnet
F8-78	41.82	0.09	22.64	2.13	8.65	0.38	19.61	4.25	0.02	0.01	99.60	Pink Garnet
F8-79	42.13	0.15	20.98	4.03	6.89	0.32	20.28	4.60	0.03	0.01	99.43	Pink Garnet
F8-80	42.16	0.23	21.99	2.79	6.81	0.29	21.25	4.37	0.09	0.01	99.97	Pink Garnet
F8-81	42.32	0.22	21.93	2.60	6.44	0.25	20.95	4.44	0.11	0.02	99.27	Pink Garnet
F8-82	42.21	0.16	21.83	3.08	7.35	0.30	20.38	4.47	0.09	0.01	99.88	Pink Garnet
F8-83	42.29	0.14	22.41	1.89	7.59	0.27	20.68	4.11	0.06	0.01	99.44	Pink Garnet
F8-84	41.90	0.06	20.65	4.48	7.18	0.36	19.89	4.78	0.05	0.00	99.35	Pink Garnet
F8-85	42.68	0.17	22.31	2.42	7.44	0.26	20.85	4.08	0.07	0.01	100.30	Pink Garnet
F8-86	42.62	0.03	21.97	3.54	6.65	0.36	20.55	4.72	0.03	0.01	100.47	Pink Garnet
F8-87	42.20	0.20	21.17	4.30	7.73	0.31	20.14	4.93	0.04	0.00	101.03	Pink Garnet
F8-88	41.61	0.31	19.87	4.99	6.78	0.28	20.40	4.75	0.04	0.02	99.05	Pink Garnet
F8-89	42.23	0.10	22.78	1.86	7.46	0.30	20.54	4.08	0.10	0.01	99.46	Pink Garnet
F8-90	42.51	0.16	22.35	2.40	7.14	0.27	20.97	4.25	0.07	0.02	100.14	Pink Garnet
F8-91	41.66	0.32	19.65	5.37	6.70	0.39	20.11	4.71	0.11	0.01	99.02	Pink Garnet
F8-92	42.05	0.12	22.26	2.23	7.45	0.27	20.76	4.12	0.03	0.00	99.29	Pink Garnet
F8-93	42.34	0.22	21.90	2.89	6.49	0.26	21.38	4.44	0.13	0.01	100.06	Pink Garnet
F8-94	41.83	0.18	20.96	3.93	6.94	0.31	20.60	4.85	0.01	0.02	99.62	Pink Garnet
F8-95	42.21	0.17	22.50	1.75	7.57	0.33	20.50	4.13	0.08	0.01	99.25	Pink Garnet
F8-96	41.71	0.48	22.27	1.87	8.35	0.31	20.28	4.23	0.11	0.01	99.62	Red Garnet
F8-97	42.10	0.48	21.69	1.97	8.03	0.29	20.23	4.24	0.09	0.03	99.15	Red Garnet
F8-98	42.05	0.62	22.76	1.11	7.96	0.32	20.20	4.47	0.10	0.01	99.59	Red Garnet
F8-99	42.43	0.53	22.05	1.88	7.48	0.30	20.52	4.09	0.13	0.01	99.42	Red Garnet
F8-100	42.15	0.44	22.50	1.66	7.31	0.27	21.01	4.12	0.20	0.02	99.68	Red Garnet
F8-101	42.28	0.46	22.12	1.90	8.16	0.28	20.43	4.16	0.11	0.01	99.91	Red Garnet
F8-102	42.76	0.44	22.87	1.14	7.31	0.28	20.75	4.05	0.09	0.02	99.71	Red Garnet
F8-103	42.05	0.41	22.09	1.85	8.16	0.31	20.19	4.18	0.10	0.01	99.35	Red Garnet

Table 14 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F8-104	42.07	0.53	21.43	2.41	8.21	0.30	20.28	4.20	0.05	0.02	99.49	Red Garnet
F8-105	42.38	0.50	22.10	1.98	8.29	0.28	20.29	4.17	0.14	0.04	100.16	Red Garnet
F8-106	42.24	0.42	22.39	1.90	8.69	0.34	20.05	4.09	0.13	0.01	100.25	Red Garnet
F8-107	42.12	0.37	23.24	0.77	7.51	0.29	20.61	3.98	0.12	0.01	99.02	Red Garnet
F8-108	42.12	0.66	22.59	1.06	7.67	0.34	20.29	4.33	0.08	0.00	99.14	Red Garnet
F8-109	42.32	0.21	21.63	2.83	6.48	0.27	21.46	4.58	0.02	0.01	99.81	Red Garnet
F8-110	42.51	0.19	22.52	1.98	7.51	0.29	20.80	4.21	0.08	0.00	100.09	Red Garnet
F8-111	42.09	0.22	21.48	3.10	6.27	0.25	20.89	4.67	0.06	0.02	99.04	Red Garnet
F8-112	42.32	0.54	22.16	1.90	8.35	0.30	20.28	4.29	0.07	0.01	100.21	Red Garnet
F8-113	41.97	0.47	22.22	1.61	8.31	0.30	20.24	3.98	0.12	0.01	99.23	Red Garnet
F8-114	42.00	0.37	21.33	3.46	6.81	0.32	21.03	4.55	0.09	0.00	99.94	Red Garnet
F8-115	42.24	0.44	21.57	2.71	7.34	0.31	20.53	4.21	0.10	0.02	99.47	Red Garnet
F8-116	41.97	0.17	21.70	2.97	7.71	0.42	20.01	4.39	0.05	0.01	99.38	Red Garnet
F8-117	41.80	0.38	20.54	4.05	6.85	0.33	20.59	4.58	0.09	0.02	99.23	Red Garnet
F8-118	42.31	0.45	21.83	2.40	6.93	0.36	20.57	4.33	0.11	0.02	99.31	Red Garnet
F8-119	42.09	0.24	21.54	2.82	7.08	0.32	20.51	4.49	0.07	0.02	99.17	Red Garnet
F8-120	42.02	0.64	20.94	3.64	7.35	0.35	20.21	4.68	0.12	0.02	99.97	Red Garnet
F8-121	42.41	0.54	22.51	1.64	8.11	0.30	20.12	4.12	0.13	0.00	99.88	Red Garnet
F8-122	42.25	0.31	22.11	2.08	7.72	0.32	20.43	4.40	0.07	0.03	99.70	Red Garnet
F8-123	42.34	0.20	22.71	1.21	8.28	0.33	20.46	4.08	0.06	0.01	99.67	Red Garnet
F8-124	42.15	0.19	22.19	2.29	7.36	0.30	20.46	4.32	0.16	0.03	99.45	Red Garnet
F8-125	42.26	0.02	21.99	2.58	7.05	0.31	20.73	4.34	0.04	0.01	99.33	Red Garnet
F8-126	41.92	0.13	22.54	2.12	8.75	0.41	19.19	4.63	0.06	0.02	99.76	Red Garnet
F8-127	42.22	0.15	22.19	2.30	7.10	0.30	20.51	4.25	0.09	0.01	99.12	Red Garnet
F8-128	42.39	0.13	22.41	1.79	7.62	0.23	20.87	4.27	0.07	0.00	99.77	Red Garnet
F8-129	42.21	0.09	22.24	2.42	7.28	0.29	20.59	4.26	0.08	0.01	99.48	Red Garnet
F8-130	42.16	0.13	21.95	2.34	7.34	0.34	20.53	4.27	0.05	0.01	99.11	Red Garnet
F8-131	41.58	0.52	20.61	3.71	7.47	0.34	20.03	4.65	0.10	0.01	99.01	Red Garnet
F8-132	41.99	0.30	21.09	3.70	6.84	0.32	20.45	4.39	0.06	0.01	99.13	Red Garnet
F8-133	42.09	0.27	21.73	3.06	6.37	0.27	20.82	4.50	0.03	0.01	99.14	Red Garnet
F8-134	41.85	0.30	20.04	5.06	6.84	0.44	20.25	4.66	0.10	0.00	99.54	Red Garnet
F8-135	42.00	0.35	20.23	4.42	6.27	0.24	20.70	4.64	0.14	0.01	99.00	Red Garnet
F8-136	42.25	0.35	21.47	3.47	7.20	0.32	20.47	4.58	0.05	0.01	100.16	Red Garnet
F8-137	42.38	0.22	21.59	2.81	7.17	0.27	20.48	4.54	0.06	0.02	99.53	Red Garnet
F8-138	41.73	0.30	21.34	3.58	8.86	0.40	19.82	3.66	0.08	0.00	99.77	Red Garnet
F8-139	42.89	0.12	22.66	1.95	7.57	0.26	20.49	4.18	0.02	0.01	100.13	Red Garnet
F8-140	41.93	0.17	21.66	2.89	7.20	0.31	20.66	4.52	0.05	0.02	99.40	Red Garnet
F8-141	41.99	0.24	21.73	2.99	6.41	0.30	21.26	4.45	0.05	0.00	99.41	Red Garnet
F8-142	42.18	0.16	22.14	2.20	7.21	0.29	20.70	4.32	0.07	0.01	99.28	Red Garnet
F8-143	42.10	0.22	23.00	1.18	8.34	0.32	20.22	4.02	0.06	0.01	99.46	Red Garnet
F8-144	42.07	0.33	21.82	2.90	7.06	0.27	20.72	4.29	0.10	0.00	99.56	Red Garnet
F8-145	42.10	0.45	22.91	0.96	6.88	0.29	20.87	4.06	0.07	0.02	98.60	Red Garnet

Table 14 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F8-146	41.90	0.21	21.15	3.36	7.71	0.37	20.25	4.63	0.04	0.03	99.65	Red Garnet
F8-147	41.98	0.13	21.46	3.06	7.28	0.27	20.43	4.43	0.05	0.02	99.10	Red Garnet
F8-148	42.04	0.42	20.97	3.53	7.04	0.30	20.23	4.47	0.09	0.01	99.10	Red Garnet
F8-149	42.10	0.20	21.70	2.98	6.45	0.27	21.27	4.52	0.07	0.01	99.56	Red Garnet
F8-150	41.82	0.05	21.66	3.13	8.74	0.26	19.27	4.88	0.06	0.00	99.85	Red Garnet
F8-151	42.07	0.37	22.14	1.83	7.71	0.27	20.78	4.09	0.11	0.04	99.41	Red Garnet
F8-152	42.60	0.41	22.93	1.13	7.04	0.27	20.97	4.03	0.10	0.03	99.49	Red Garnet
F8-153	42.23	0.45	22.07	1.84	7.57	0.32	20.65	4.20	0.11	0.00	99.44	Red Garnet
F8-154	42.29	0.50	22.37	1.89	8.35	0.35	19.99	4.33	0.10	0.00	100.17	Red Garnet
F8-155	42.12	0.27	22.23	2.03	7.89	0.36	19.90	4.31	0.05	0.01	99.16	Red Garnet
F8-156	42.44	0.23	21.73	2.84	6.21	0.31	20.77	4.39	0.07	0.01	99.01	Red Garnet
F8-157	42.16	0.43	22.40	1.86	7.06	0.32	20.87	4.19	0.08	0.01	99.38	Red Garnet
F8-158	42.34	0.51	21.64	3.14	7.47	0.29	20.53	4.54	0.09	0.01	100.55	Red Garnet
F8-159	42.34	0.51	22.42	1.93	8.41	0.30	20.24	4.30	0.11	0.01	100.56	Red Garnet
F8-160	41.98	0.46	22.09	1.93	8.09	0.32	20.13	4.31	0.08	0.01	99.39	Red Garnet
F8-161	41.60	0.52	22.13	1.88	8.24	0.32	20.27	4.23	0.16	0.02	99.37	Red Garnet
F8-162	41.84	0.66	22.71	1.20	7.68	0.25	20.37	4.30	0.03	0.00	99.04	Orange Garnet
F8-163	41.81	0.71	22.83	1.12	7.84	0.31	20.70	4.36	0.07	0.01	99.75	Orange Garnet
F8-164	40.83	0.62	23.10	0.17	12.27	0.33	18.55	3.25	0.14	0.00	99.27	Orange Garnet
F8-165	42.10	0.47	23.14	1.17	7.57	0.30	20.77	4.17	0.04	0.00	99.73	Orange Garnet
F8-166	40.90	0.54	22.64	0.58	12.09	0.30	18.01	4.40	0.07	0.01	99.54	Orange Garnet
F8-167	41.89	0.77	22.74	1.11	7.50	0.27	20.57	4.22	0.10	0.00	99.17	Orange Garnet
F8-168	40.25	0.38	23.02	0.07	16.15	0.37	15.68	3.58	0.12	0.01	99.63	Orange Garnet
F8-169	40.85	0.21	23.79	0.22	12.57	0.42	18.29	3.11	0.12	0.00	99.59	Orange Garnet
F8-170	40.74	0.53	23.14	0.11	12.51	0.33	17.57	3.98	0.15	0.00	99.06	Orange Garnet
F8-171	41.63	0.78	22.77	1.24	7.68	0.34	20.32	4.29	0.08	0.01	99.14	Orange Garnet
F8-172	41.68	0.54	22.34	1.16	8.84	0.35	19.75	4.37	0.06	0.01	99.09	Orange Garnet
F8-173	41.94	0.41	23.04	0.91	7.58	0.26	20.85	4.10	0.11	0.01	99.22	Orange Garnet
F8-174	40.37	0.39	23.24	0.06	16.45	0.38	15.69	3.65	0.15	0.02	100.39	Orange Garnet
F8-175	41.92	0.55	22.65	1.01	8.11	0.26	20.09	4.32	0.09	0.01	99.01	Orange Garnet
F8-176	40.90	0.58	23.34	0.18	12.27	0.34	18.60	3.22	0.16	0.02	99.61	Orange Garnet
F8-177	40.34	0.79	21.56	0.65	13.90	0.43	16.82	4.53	0.07	0.01	99.09	Orange Garnet
F8-178	40.41	0.56	22.94	0.18	12.09	0.31	18.78	3.21	0.12	0.01	98.60	Orange Garnet
F8-179	39.98	0.37	22.89	0.09	15.69	0.38	15.66	3.57	0.12	0.00	98.74	Orange Garnet
F8-180	42.06	0.42	22.88	1.17	7.39	0.30	20.62	4.10	0.14	0.03	99.11	Orange Garnet
F8-181	41.09	0.15	23.75	0.15	10.12	0.25	19.76	3.31	0.06	0.00	98.65	Orange Garnet
F8-182	41.35	0.88	21.15	2.90	7.56	0.30	20.56	4.47	0.11	0.01	99.28	Orange Garnet
F8-183	41.67	0.51	22.28	1.81	8.04	0.35	20.30	3.99	0.07	0.00	99.03	Orange Garnet
F8-184	41.95	0.75	22.77	1.04	7.56	0.33	20.43	4.38	0.13	0.02	99.35	Orange Garnet
F8-185	41.25	0.49	21.79	1.90	8.88	0.31	19.85	4.07	0.10	0.00	98.64	Orange Garnet
F8-186	41.33	0.61	23.30	0.17	12.13	0.31	18.55	3.15	0.15	0.00	99.69	Orange Garnet
F8-187	40.55	0.36	23.16	0.08	16.39	0.34	15.55	3.51	0.13	0.00	100.06	Orange Garnet

Table 14 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F8-188	41.36	0.67	22.47	1.17	8.20	0.30	20.06	4.36	0.05	0.00	98.63	Orange Garnet
F8-189	41.67	0.52	22.33	1.72	8.19	0.30	20.27	4.16	0.08	0.00	99.25	Orange Garnet
F8-190	41.66	0.53	22.44	1.62	8.10	0.33	20.40	4.12	0.10	0.02	99.32	Orange Garnet
F8-191	41.80	0.35	23.56	0.04	8.15	0.32	20.77	3.45	0.08	0.03	98.54	Orange Garnet
F8-192	40.77	0.31	23.21	0.04	16.51	0.32	15.55	3.54	0.07	0.01	100.32	Orange Garnet
F8-193	40.46	0.37	23.04	0.13	16.35	0.37	15.77	3.57	0.12	0.02	100.20	Orange Garnet
F8-194	40.28	0.25	22.90	0.08	16.60	0.26	12.29	7.50	0.11	0.01	100.28	Orange Garnet
F8-195	40.85	0.38	23.37	0.10	16.37	0.42	15.74	3.67	0.13	0.00	101.01	Orange Garnet
F8-196	40.82	0.38	23.12	0.05	16.11	0.35	15.82	3.49	0.08	0.00	100.21	Orange Garnet
F8-197	40.58	0.33	23.15	0.13	16.44	0.38	15.64	3.70	0.09	0.00	100.44	Orange Garnet
F8-198	41.37	0.61	23.22	0.15	12.47	0.34	18.38	3.25	0.16	0.01	99.95	Orange Garnet
F8-199	40.84	0.20	23.58	0.33	11.87	0.34	17.81	4.35	0.11	0.00	99.41	Orange Garnet
F8-200	41.42	0.63	22.69	1.10	7.69	0.26	20.57	4.32	0.09	0.02	98.79	Orange Garnet
F8-201	40.41	0.37	23.14	0.07	16.15	0.40	15.62	3.57	0.11	0.02	99.85	Orange Garnet
F8-202	41.31	0.57	22.40	1.61	8.02	0.35	20.28	4.04	0.11	0.01	98.70	Orange Garnet
F8-203	41.42	0.45	22.06	1.67	7.92	0.34	20.45	4.22	0.09	0.01	98.65	Orange Garnet
F8-204	41.84	0.73	22.59	1.47	7.52	0.32	20.43	4.23	0.09	0.02	99.24	Orange Garnet
F8-205	41.14	0.57	22.14	1.61	7.98	0.32	20.58	4.15	0.14	0.00	98.62	Orange Garnet
F8-206	41.62	0.88	22.67	1.10	7.49	0.34	20.59	4.14	0.10	0.00	98.93	Orange Garnet
F8-207	41.10	0.53	22.15	1.84	8.37	0.32	20.66	4.23	0.11	0.00	99.30	Orange Garnet
F8-208	41.71	0.75	22.92	0.84	6.97	0.31	21.66	3.87	0.18	0.01	99.21	Orange Garnet
F8-209	41.67	0.65	22.75	1.22	7.90	0.31	20.82	4.33	0.11	0.00	99.75	Orange Garnet
F8-210	41.62	0.45	23.16	1.16	7.44	0.28	20.64	4.19	0.09	0.02	99.05	Orange Garnet
F8-211	41.63	0.76	21.71	2.07	7.46	0.27	20.59	4.13	0.08	0.01	98.70	Orange Garnet
F8-212	41.57	0.55	22.30	1.89	8.24	0.27	20.41	4.20	0.10	0.00	99.53	Orange Garnet
F8-213	41.85	0.52	22.24	1.70	8.17	0.32	20.34	3.99	0.06	0.01	99.18	Orange Garnet
F8-214	41.75	0.51	22.50	1.68	7.99	0.31	20.48	4.06	0.05	0.02	99.36	Orange Garnet
F8-215	41.79	0.72	23.01	1.17	7.85	0.33	20.84	4.37	0.07	0.00	100.13	Orange Garnet
F8-216	41.84	0.56	22.45	1.71	7.90	0.30	20.43	4.14	0.08	0.02	99.43	Orange Garnet

Table 15: Finsch unit F1 clinopyroxene.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F1-1	55.77	0.10	2.71	4.59	2.18	0.13	15.35	15.24	3.51	0.05	99.63	CPX
F1-2	55.46	0.14	1.81	1.08	2.76	0.11	18.08	17.60	1.40	0.06	98.51	CPX
F1-3	55.67	0.06	0.45	1.85	2.19	0.08	18.01	19.68	1.04	0.01	99.06	CPX
F1-4	55.26	0.03	2.19	1.84	2.08	0.06	16.74	18.66	1.92	0.01	98.79	CPX
F1-5	51.65	0.07	6.51	0.75	3.15	0.12	14.55	21.64	0.63	0.01	99.07	CPX
F1-6	55.09	0.11	1.79	1.96	2.47	0.03	16.26	19.18	1.78	0.03	98.70	CPX
F1-7	54.72	0.46	0.36	0.67	1.87	0.05	17.56	22.95	0.34	0.01	98.98	CPX
F1-8	51.75	0.03	6.33	0.88	2.96	0.17	15.11	21.96	0.47	0.00	99.66	CPX
F1-9	52.38	0.39	4.39	1.11	3.23	0.10	15.40	21.08	0.81	0.00	98.89	CPX
F1-10	51.10	0.04	7.40	0.89	2.76	0.12	14.31	21.73	0.60	0.01	98.97	CPX
F1-11	55.65	0.17	1.96	1.04	2.79	0.07	18.08	17.76	1.56	0.04	99.12	CPX
F1-12	55.85	0.21	1.93	0.92	2.85	0.09	17.86	17.75	1.53	0.05	99.03	CPX
F1-13	51.03	0.05	7.60	0.84	2.99	0.12	14.03	22.02	0.69	0.01	99.37	CPX
F1-14	52.01	0.01	6.63	0.65	3.02	0.15	14.28	21.72	0.57	0.00	99.04	CPX
F1-15	51.66	0.11	7.64	0.85	2.85	0.11	14.09	21.83	0.79	0.01	99.92	CPX
F1-16	55.51	0.10	2.37	0.89	2.77	0.09	17.73	17.30	1.78	0.04	98.59	CPX
F1-17	55.31	0.21	1.29	2.78	2.43	0.13	16.54	17.96	2.00	0.03	98.67	CPX
F1-18	55.18	0.14	2.60	4.67	2.09	0.07	15.39	15.24	3.51	0.05	98.93	CPX
F1-19	55.50	0.04	1.75	1.35	2.72	0.11	18.15	17.53	1.52	0.03	98.70	CPX
F1-20	51.56	0.04	6.27	0.88	2.87	0.07	14.82	21.52	0.48	0.01	98.51	CPX
F1-21	55.39	0.13	0.54	1.97	2.04	0.13	17.85	19.89	0.95	0.01	98.90	CPX
F1-22	55.53	0.15	2.27	2.44	2.35	0.07	16.42	17.16	2.42	0.04	98.86	CPX
F1-23	55.68	0.00	2.49	1.32	2.26	0.02	16.62	18.70	1.92	0.01	99.02	CPX
F1-24	55.56	0.22	1.30	2.79	2.45	0.09	16.53	18.16	2.08	0.02	99.19	CPX
F1-25	51.54	0.06	6.58	0.74	2.96	0.09	14.43	21.63	0.63	0.01	98.66	CPX
F1-26	51.42	0.03	7.13	0.81	2.91	0.16	14.47	21.49	0.66	0.00	99.09	CPX
F1-27	55.80	0.20	2.60	0.12	4.32	0.10	16.05	19.10	1.77	0.01	100.08	CPX
F1-28	55.62	0.11	2.91	1.36	2.21	0.06	15.96	18.16	2.10	0.03	98.50	CPX
F1-29	55.11	0.27	0.36	1.81	2.72	0.14	18.50	18.80	0.87	0.01	98.58	CPX
F1-30	55.47	0.12	1.85	1.14	2.77	0.07	18.12	17.65	1.44	0.06	98.68	CPX
F1-31	51.98	0.07	6.15	1.20	3.11	0.09	15.08	20.20	0.81	0.01	98.70	CPX
F1-32	55.69	0.19	1.30	2.27	2.71	0.06	16.63	18.46	1.97	0.01	99.27	CPX
F1-33	56.05	0.15	1.89	1.68	2.52	0.08	17.79	17.67	1.78	0.06	99.67	CPX
F1-34	55.58	0.21	1.65	2.45	2.29	0.11	16.46	18.31	2.01	0.03	99.09	CPX
F1-35	55.81	0.13	2.46	1.56	2.09	0.06	16.41	18.84	2.01	0.01	99.37	CPX
F1-36	55.63	0.09	1.86	1.12	2.83	0.06	18.12	17.74	1.55	0.05	99.05	CPX
F1-37	55.38	0.19	0.89	1.44	2.84	0.10	17.47	19.25	1.33	0.02	98.91	CPX

Table 16: Finsch unit F2 clinopyroxene.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F2-1	55.43	0.20	2.06	3.78	1.83	0.11	16.02	17.46	2.84	0.03	99.75	CPX
F2-2	53.44	0.40	3.69	1.78	2.36	0.09	16.18	19.98	1.44	0.02	99.38	CPX
F2-3	53.34	0.40	3.92	1.81	2.10	0.06	15.50	20.48	1.54	0.00	99.15	CPX
F2-4	53.42	0.41	3.48	1.74	2.26	0.10	16.32	20.28	1.44	0.03	99.50	CPX
F2-5	55.67	0.03	2.54	1.44	2.04	0.11	16.67	19.27	2.01	0.03	99.81	CPX
F2-6	53.37	0.49	4.07	1.86	2.27	0.12	16.28	19.79	1.67	0.03	99.94	CPX
F2-7	53.13	0.43	3.96	1.73	2.44	0.09	15.63	20.43	1.54	0.06	99.43	CPX
F2-8	52.87	0.43	3.86	1.85	2.50	0.11	15.77	20.32	1.51	0.02	99.23	CPX
F2-9	53.52	0.48	3.38	1.57	2.16	0.11	15.81	20.58	1.59	0.03	99.22	CPX
F2-10	53.17	0.38	3.79	1.90	2.18	0.08	15.61	20.16	1.54	0.03	98.85	CPX
F2-11	51.68	0.03	6.34	1.01	2.71	0.07	15.26	21.48	0.54	0.01	99.13	CPX
F2-12	53.69	0.39	3.56	1.54	2.46	0.09	15.98	20.20	1.53	0.01	99.45	CPX
F2-13	52.92	0.38	3.85	1.81	2.35	0.12	15.55	20.44	1.53	0.01	98.96	CPX
F2-14	52.01	0.01	6.44	1.02	3.18	0.08	17.04	18.98	0.50	0.01	99.27	CPX
F2-15	53.97	0.38	3.59	1.57	2.50	0.10	16.24	20.39	1.56	0.01	100.31	CPX
F2-16	53.71	0.48	4.01	1.82	2.44	0.17	15.54	20.32	1.56	0.01	100.05	CPX
F2-17	53.70	0.33	3.71	1.66	2.50	0.06	15.79	20.22	1.44	0.02	99.43	CPX
F2-18	53.84	0.37	3.77	1.73	2.24	0.07	15.70	20.36	1.54	0.00	99.62	CPX
F2-19	55.73	0.18	1.67	2.00	2.27	0.05	16.82	18.78	1.88	0.05	99.42	CPX
F2-20	55.28	0.02	0.78	2.28	2.03	0.10	17.00	20.77	1.50	0.01	99.76	CPX
F2-21	55.59	0.01	2.14	2.05	2.04	0.03	16.30	18.95	2.00	0.02	99.14	CPX
F2-22	55.54	0.14	2.03	1.73	2.14	0.09	17.17	18.16	1.88	0.09	98.97	CPX
F2-23	55.40	0.17	0.55	2.92	2.41	0.11	16.60	19.53	1.82	0.02	99.53	CPX
F2-24	52.21	0.04	6.01	0.85	3.09	0.13	16.07	21.06	0.46	0.01	99.92	CPX
F2-25	55.86	0.12	1.62	1.17	2.77	0.14	18.34	18.40	1.48	0.04	99.94	CPX
F2-26	51.76	0.03	6.35	0.95	2.82	0.09	14.74	22.13	0.60	0.01	99.48	CPX
F2-27	55.48	0.00	1.72	2.17	2.18	0.10	16.73	19.14	1.73	0.01	99.27	CPX
F2-28	55.71	0.38	2.87	1.13	2.36	0.09	17.07	17.18	2.30	0.09	99.19	CPX
F2-29	55.32	0.16	0.57	2.82	1.97	0.11	17.32	19.74	1.26	0.03	99.29	CPX
F2-30	55.37	0.19	1.17	2.31	2.43	0.08	16.86	18.35	1.87	0.02	98.64	CPX
F2-31	55.48	0.01	2.21	2.08	1.99	0.10	16.52	18.82	2.02	0.02	99.24	CPX
F2-32	55.57	0.00	2.19	2.12	1.87	0.06	16.56	18.70	2.06	0.01	99.13	CPX
F2-33	55.42	0.05	2.24	2.16	1.97	0.06	16.26	18.87	1.98	0.01	99.01	CPX
F2-34	55.40	0.02	2.21	2.07	2.05	0.02	16.29	18.74	2.08	0.03	98.90	CPX
F2-35	55.29	0.04	2.15	2.11	1.92	0.07	16.66	18.80	2.08	0.03	99.16	CPX
F2-36	55.54	0.06	2.22	2.10	1.99	0.07	16.24	18.54	2.12	0.02	98.89	CPX
F2-37	55.50	0.14	0.66	1.89	2.06	0.09	18.02	20.17	0.90	0.22	99.64	CPX
F2-38	54.79	0.29	1.15	2.63	2.82	0.10	16.77	18.97	1.70	0.00	99.20	CPX
F2-39	56.52	0.02	1.83	2.09	2.07	0.07	16.48	19.46	1.75	0.02	100.31	CPX
F2-40	55.80	0.11	0.91	1.84	2.30	0.11	19.33	18.24	0.92	0.03	99.58	CPX
F2-41	55.34	0.00	2.16	2.02	1.47	0.09	16.25	19.91	1.87	0.01	99.12	CPX
F2-42	55.88	0.10	1.73	1.50	2.32	0.11	18.05	17.94	1.63	0.09	99.35	CPX

Table 16 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F2-43	55.69	0.00	1.31	0.93	1.99	0.08	18.68	19.73	0.90	0.16	99.48	CPX
F2-44	55.33	0.01	0.40	2.15	1.72	0.05	17.15	21.28	1.22	0.02	99.32	CPX
F2-45	55.51	0.19	1.14	2.26	2.46	0.08	16.75	18.47	1.77	0.05	98.69	CPX
F2-46	55.42	0.01	2.25	2.12	2.01	0.14	16.40	18.79	2.01	0.01	99.16	CPX
F2-47	55.86	0.00	2.24	2.04	2.01	0.07	16.29	18.53	2.11	0.02	99.16	CPX
F2-48	55.45	0.08	2.15	2.04	2.02	0.08	16.25	18.63	1.95	0.02	98.68	CPX
F2-49	55.81	0.06	1.46	2.75	2.18	0.07	17.59	17.56	1.89	0.05	99.41	CPX
F2-50	55.78	0.07	1.47	2.76	2.06	0.07	17.44	17.33	1.92	0.07	98.97	CPX
F2-51	55.66	0.13	0.84	1.72	2.48	0.07	18.37	19.18	1.08	0.00	99.53	CPX

Table 17: Finsch unit F3 clinopyroxene.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F3-1	54.57	0.16	2.16	3.20	2.26	0.11	16.47	18.83	2.54	0.02	100.32	CPX
F3-2	54.98	0.07	1.80	3.76	1.73	0.11	16.63	18.59	2.36	0.02	100.04	CPX
F3-3	54.53	0.23	2.00	2.33	2.32	0.11	17.01	19.52	1.88	0.03	99.95	CPX
F3-4	54.60	0.29	2.04	2.33	2.43	0.12	16.98	19.53	1.84	0.03	100.18	CPX
F3-5	54.95	0.08	1.93	3.20	1.98	0.10	16.92	18.90	2.10	0.07	100.23	CPX
F3-6	54.56	0.06	1.86	3.17	1.89	0.04	16.71	18.88	2.17	0.05	99.38	CPX
F3-7	54.84	0.09	1.78	3.13	1.98	0.06	16.60	18.94	2.09	0.05	99.57	CPX
F3-8	54.37	0.26	2.04	2.33	2.37	0.10	16.52	19.11	1.90	0.03	99.03	CPX
F3-9	54.95	0.04	2.47	1.66	1.87	0.11	16.59	19.42	1.94	0.02	99.06	CPX
F3-10	54.91	0.11	2.52	1.77	2.09	0.07	16.53	19.63	1.95	0.02	99.60	CPX
F3-11	54.97	0.09	1.87	3.13	1.94	0.16	16.87	18.98	2.14	0.05	100.20	CPX
F3-12	54.82	0.29	2.04	3.30	2.41	0.08	16.28	18.24	2.43	0.04	99.92	CPX
F3-13	54.18	0.20	2.65	2.48	2.11	0.07	16.19	18.71	2.51	0.05	99.15	CPX
F3-14	53.93	0.32	2.39	2.66	3.08	0.10	16.19	18.37	2.43	0.04	99.50	CPX
F3-15	53.95	0.36	2.42	2.68	2.65	0.05	16.27	18.43	2.62	0.03	99.45	CPX
F3-16	53.78	0.31	2.03	2.58	2.30	0.08	16.21	19.49	2.27	0.04	99.09	CPX
F3-17	54.25	0.22	2.92	2.29	2.17	0.12	16.38	18.16	2.74	0.04	99.27	CPX
F3-18	54.08	0.33	2.46	2.64	3.07	0.10	16.12	18.47	2.40	0.03	99.70	CPX
F3-19	54.09	0.27	1.28	2.43	2.54	0.13	16.57	19.84	1.94	0.04	99.12	CPX
F3-20	54.02	0.33	2.22	3.34	2.64	0.13	16.01	18.10	2.68	0.05	99.52	CPX
F3-21	53.48	0.21	0.94	2.86	2.16	0.06	16.99	21.07	1.37	0.02	99.15	CPX
F3-22	54.19	0.27	1.67	1.58	3.14	0.09	16.98	19.95	1.76	0.04	99.68	CPX
F3-23	54.35	0.25	3.08	2.37	2.26	0.07	15.98	18.50	2.76	0.02	99.63	CPX
F3-24	54.12	0.35	2.40	2.82	2.79	0.08	16.52	18.36	2.55	0.03	100.03	CPX
F3-25	53.96	0.21	2.38	2.83	2.94	0.11	15.66	18.42	2.73	0.03	99.26	CPX
F3-26	54.32	0.06	2.12	1.47	2.21	0.06	17.08	20.44	1.76	0.02	99.54	CPX
F3-27	54.37	0.01	1.20	1.54	1.50	0.07	17.58	22.34	1.01	0.02	99.63	CPX
F3-28	54.38	0.01	1.10	1.53	1.47	0.08	17.62	22.63	1.00	0.03	99.85	CPX
F3-29	53.95	0.32	2.25	1.64	3.77	0.05	16.39	19.45	2.07	0.02	99.90	CPX

Table 17 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F3-30	54.11	0.26	1.69	2.15	2.47	0.06	16.71	20.00	1.97	0.03	99.44	CPX
F3-31	54.50	0.23	1.74	1.24	2.84	0.07	17.46	20.69	1.55	0.04	100.37	CPX
F3-32	54.38	0.29	2.79	2.91	2.24	0.09	15.91	18.39	2.89	0.02	99.92	CPX
F3-33	54.79	0.04	1.85	1.82	1.75	0.07	17.04	21.24	1.72	0.06	100.38	CPX
F3-34	53.86	0.16	1.91	2.97	2.63	0.13	16.23	18.75	2.23	0.03	98.90	CPX
F3-35	54.09	0.27	2.05	1.93	3.02	0.09	16.16	19.90	2.07	0.03	99.60	CPX
F3-36	54.23	0.34	2.09	1.90	2.89	0.08	16.03	19.91	2.03	0.02	99.52	CPX
F3-37	54.29	0.17	1.94	2.90	2.66	0.10	16.53	18.86	2.33	0.03	99.81	CPX
F3-38	54.44	0.27	3.19	2.16	2.25	0.05	16.08	18.31	2.80	0.02	99.58	CPX
F3-39	54.53	0.28	2.49	1.57	2.42	0.08	17.21	18.51	2.10	0.08	99.26	CPX
F3-40	54.58	0.25	2.14	2.42	2.56	0.15	16.57	19.26	2.29	0.02	100.24	CPX
F3-41	54.76	0.09	1.78	1.33	2.53	0.12	18.06	19.69	1.53	0.08	99.94	CPX
F3-42	54.58	0.08	1.81	2.68	2.06	0.13	16.49	20.03	2.06	0.02	99.94	CPX
F3-43	54.39	0.33	2.19	1.93	3.06	0.07	16.17	19.74	2.21	0.04	100.12	CPX
F3-44	54.69	0.03	2.29	2.51	1.94	0.06	16.43	20.05	2.20	0.02	100.22	CPX
F3-45	53.78	0.09	0.77	3.28	1.52	0.09	17.34	21.79	1.18	0.01	99.85	CPX
F3-46	54.80	0.00	1.42	1.84	2.17	0.10	18.23	19.73	1.41	0.05	99.75	CPX
F3-47	54.93	0.25	1.56	2.29	2.33	0.10	17.03	19.56	2.01	0.03	100.09	CPX
F3-48	54.30	0.27	1.46	2.22	2.46	0.09	17.23	19.69	1.97	0.02	99.71	CPX
F3-49	53.98	0.33	2.09	1.93	2.99	0.12	16.29	19.59	2.10	0.02	99.44	CPX
F3-50	54.68	0.07	1.75	2.56	2.17	0.11	16.54	20.13	1.93	0.02	99.96	CPX
F3-51	54.57	0.29	1.62	2.34	2.72	0.04	17.02	19.45	2.04	0.02	100.10	CPX
F3-52	54.61	0.31	2.55	2.08	2.46	0.12	16.52	19.13	2.37	0.02	100.17	CPX
F3-53	54.46	0.07	2.35	2.48	2.00	0.08	16.40	19.48	2.31	0.01	99.64	CPX
F3-54	54.96	0.11	1.78	1.29	2.61	0.11	18.27	19.30	1.47	0.06	99.95	CPX
F3-55	54.35	0.14	2.22	3.07	2.31	0.09	16.03	18.67	2.50	0.02	99.39	CPX
F3-56	54.35	0.28	2.03	1.86	2.91	0.12	16.39	19.75	1.99	0.03	99.71	CPX
F3-57	54.91	0.25	2.87	2.54	2.05	0.06	16.22	18.34	2.79	0.04	100.06	CPX
F3-58	54.35	0.28	2.57	2.02	2.48	0.11	16.39	19.05	2.49	0.01	99.74	CPX
F3-59	54.55	0.18	1.65	2.24	2.46	0.06	16.99	19.80	1.87	0.02	99.82	CPX
F3-60	54.39	0.25	1.80	2.56	2.09	0.05	16.64	19.59	2.02	0.03	99.42	CPX
F3-61	54.00	0.28	1.82	2.65	2.23	0.10	16.84	19.54	1.98	0.03	99.47	CPX
F3-62	54.18	0.25	1.86	2.73	2.30	0.11	16.76	19.83	2.12	0.03	100.18	CPX
F3-63	54.61	0.14	2.44	3.77	1.80	0.09	15.96	18.57	2.80	0.02	100.20	CPX
F3-64	54.23	0.23	2.13	3.14	2.31	0.12	16.48	18.83	2.60	0.02	100.08	CPX
F3-65	54.52	0.30	2.24	3.45	2.40	0.09	16.37	18.37	2.84	0.05	100.63	CPX
F3-66	54.22	0.24	1.91	2.61	2.17	0.09	16.95	19.74	2.06	0.02	100.00	CPX

Table 18: Finsch unit F4 clinopyroxene.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F4-1	55.28	0.09	1.35	1.37	0.06	0.01	1.32	19.57	18.25	2.63	99.93	CPX
F4-2	55.31	0.11	2.23	2.19	0.02	0.03	2.04	19.15	16.33	2.03	99.45	CPX
F4-3	54.93	0.07	1.19	1.84	0.01	0.04	0.98	21.02	17.43	2.06	99.57	CPX
F4-4	55.04	0.08	1.47	1.60	0.01	0.05	1.21	19.56	17.87	2.27	99.16	CPX
F4-5	55.55	0.10	2.21	2.15	0.02	0.04	2.03	19.01	16.19	1.96	99.26	CPX
F4-6	55.59	0.09	1.31	1.52	0.07	0.03	1.23	19.09	18.20	2.32	99.45	CPX
F4-7	55.72	0.14	1.05	1.07	0.07	0.05	0.89	19.43	18.40	2.89	99.72	CPX
F4-8	55.15	0.14	2.20	1.43	0.08	0.24	1.99	18.17	17.24	2.47	99.12	CPX
F4-9	54.87	0.15	2.20	1.17	0.02	0.20	1.93	19.34	15.66	3.72	99.27	CPX
F4-10	55.18	0.11	0.85	1.40	0.03	0.12	0.93	20.10	18.23	2.34	99.28	CPX
F4-11	55.06	0.09	2.39	3.58	0.07	0.11	2.67	17.19	15.92	2.08	99.17	CPX
F4-12	51.19	0.15	6.74	0.99	0.02	0.05	0.63	22.30	14.57	2.70	99.34	CPX
F4-13	55.48	0.12	0.28	1.19	0.03	0.07	0.67	21.52	18.00	2.05	99.41	CPX
F4-14	55.69	0.17	0.60	1.54	0.03	0.10	0.73	20.74	18.49	2.11	100.20	CPX
F4-15	55.82	0.18	1.57	2.67	0.03	0.02	1.74	19.20	16.84	2.01	100.09	CPX
F4-16	55.58	0.11	1.99	1.28	0.05	0.07	1.63	18.34	17.68	2.54	99.27	CPX
F4-17	55.15	0.12	2.02	1.32	0.05	0.09	1.65	18.16	17.90	2.56	99.02	CPX
F4-18	55.64	0.10	1.94	1.35	0.03	0.14	1.67	18.39	17.85	2.67	99.79	CPX
F4-19	55.53	0.13	2.37	1.61	0.02	0.04	1.92	19.48	16.51	2.10	99.71	CPX
F4-20	55.38	0.11	1.82	1.66	0.02	0.00	1.67	20.21	16.81	1.68	99.36	CPX
F4-21	56.10	0.13	1.96	1.26	0.05	0.12	1.73	18.29	17.69	2.55	99.87	CPX
F4-22	53.72	0.16	2.37	3.47	0.07	0.13	3.04	17.11	17.07	2.15	99.29	CPX
F4-23	55.93	0.10	1.98	1.61	0.01	0.00	1.69	20.26	16.96	1.79	100.33	CPX
F4-24	55.50	0.12	1.96	1.27	0.06	0.11	1.62	18.32	18.05	2.64	99.65	CPX
F4-25	54.75	0.18	1.94	1.26	0.03	0.23	0.64	19.89	18.87	2.87	100.65	CPX
F4-26	55.28	0.12	1.58	1.68	0.02	0.07	1.23	20.81	16.50	2.14	99.42	CPX
F4-27	55.03	0.14	1.94	1.28	0.05	0.10	1.71	18.25	17.98	2.57	99.06	CPX
F4-28	55.41	0.13	2.36	1.57	0.03	0.00	1.97	19.26	16.29	2.06	99.08	CPX
F4-29	55.07	0.16	1.03	2.02	0.02	0.06	1.05	21.05	16.65	2.09	99.19	CPX
F4-30	56.24	0.16	0.39	1.47	0.02	0.13	0.57	20.77	17.28	1.97	99.00	CPX
F4-31	55.04	0.17	2.21	1.06	0.02	0.20	1.87	19.50	15.73	3.77	99.57	CPX
F4-32	55.51	0.15	1.98	1.25	0.05	0.15	1.60	18.43	17.94	2.51	99.57	CPX
F4-33	55.28	0.15	1.87	1.65	0.02	0.01	1.69	20.22	16.92	1.72	99.52	CPX
F4-34	55.62	0.13	1.92	1.22	0.04	0.11	1.62	18.41	17.76	2.65	99.48	CPX
F4-35	54.33	0.15	1.24	1.19	0.02	0.13	1.16	20.80	16.58	3.93	99.54	CPX
F4-36	53.90	0.25	1.01	1.23	2.81	0.09	19.05	22.57	0.48	0.03	101.42	CPX
F4-37	54.11	0.33	2.09	1.67	2.71	0.10	17.15	19.65	2.09	0.05	99.94	CPX
F4-38	54.80	0.27	1.44	2.53	2.52	0.14	17.00	19.75	1.91	0.06	100.41	CPX
F4-39	50.24	0.05	7.35	0.61	3.59	0.09	14.78	23.27	0.92	0.02	100.92	CPX
F4-40	55.21	0.13	0.74	1.23	2.01	0.07	17.48	22.90	1.05	0.05	100.87	CPX
F4-41	55.00	0.26	1.93	3.22	2.22	0.09	16.51	18.44	2.32	0.04	100.03	CPX
F4-42	55.27	0.05	2.42	1.45	2.07	0.09	17.04	19.77	1.85	0.02	100.01	CPX

Table 19: Finsch unit F5/F6 clinopyroxene.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F5/F6-1	53.39	0.27	2.65	3.51	2.15	0.12	16.17	18.06	2.86	0.01	99.20	CPX
F5/F6-2	53.44	0.22	2.21	3.32	1.62	0.08	16.78	19.13	2.53	0.02	99.36	CPX
F5/F6-3	54.74	0.15	2.22	3.44	2.26	0.10	16.13	17.99	2.50	0.02	99.53	CPX
F5/F6-4	54.91	0.33	1.57	2.64	2.23	0.08	16.72	19.61	2.15	0.03	100.28	CPX
F5/F6-5	54.43	0.08	1.89	2.84	2.33	0.13	16.83	18.95	2.03	0.03	99.53	CPX
F5/F6-6	54.80	0.13	1.87	2.86	2.21	0.12	17.06	19.19	2.12	0.03	100.39	CPX
F5/F6-7	54.44	0.07	2.62	3.17	1.92	0.05	16.20	18.06	2.60	0.01	99.14	CPX
F5/F6-8	54.17	0.12	0.68	3.17	1.99	0.10	16.83	20.54	1.44	0.02	99.05	CPX
F5/F6-9	54.05	0.11	2.63	3.16	2.01	0.05	16.37	18.60	2.54	0.00	99.52	CPX
F5/F6-10	54.18	0.20	0.88	2.05	2.36	0.10	17.28	21.06	1.26	0.01	99.39	CPX
F5/F6-11	54.72	0.09	3.30	2.07	2.64	0.05	16.35	17.18	2.89	0.03	99.33	CPX
F5/F6-12	40.15	0.19	15.05	10.67	6.54	0.36	15.72	11.76	0.03	0.00	100.48	CPX
F5/F6-13	54.82	0.33	2.40	2.94	2.13	0.07	16.51	18.49	2.60	0.06	100.35	CPX
F5/F6-14	54.37	0.01	1.58	1.95	1.84	0.05	17.84	20.97	1.43	0.08	100.13	CPX
F5/F6-15	54.94	0.06	1.52	1.57	1.84	0.04	18.38	19.95	1.32	0.07	99.70	CPX
F5/F6-16	55.50	0.04	2.37	1.90	1.99	0.06	16.97	20.05	1.94	0.03	100.85	CPX
F5/F6-17	55.26	0.01	2.08	1.85	2.03	0.07	17.43	19.63	1.70	0.02	100.08	CPX
F5/F6-18	55.33	0.02	2.19	2.87	1.89	0.06	17.45	18.66	2.19	0.04	100.69	CPX
F5/F6-19	40.28	0.15	14.90	10.55	6.42	0.41	15.53	11.65	0.06	0.01	99.95	CPX
F5/F6-20	55.34	0.20	2.13	0.88	2.57	0.06	18.62	18.78	1.56	0.08	100.21	CPX
F5/F6-21	55.03	0.09	2.20	2.33	1.87	0.11	17.37	19.64	2.04	0.01	100.69	CPX
F5/F6-22	54.59	0.07	2.34	2.19	2.05	0.12	17.13	18.92	2.06	0.03	99.49	CPX
F5/F6-23	54.37	0.20	0.62	1.87	2.07	0.08	17.64	22.40	0.80	0.01	100.04	CPX
F5/F6-24	54.41	0.12	2.33	2.41	2.14	0.11	16.98	18.38	2.13	0.04	99.05	CPX
F5/F6-25	55.16	0.16	2.40	3.25	2.45	0.10	16.22	17.57	2.65	0.02	99.97	CPX
F5/F6-26	54.84	0.07	3.28	1.93	2.43	0.07	16.39	17.52	2.62	0.03	99.18	CPX
F5/F6-27	54.70	0.25	2.63	2.61	2.08	0.11	16.90	18.31	2.47	0.02	100.07	CPX
F5/F6-28	55.21	0.00	2.46	1.32	2.11	0.04	17.14	19.89	1.70	0.02	99.90	CPX
F5/F6-29	40.57	0.17	15.18	10.74	6.31	0.41	15.72	11.29	0.04	0.00	100.43	CPX
F5/F6-30	54.50	0.16	2.50	3.14	1.94	0.09	16.23	18.07	2.50	0.01	99.15	CPX
F5/F6-31	54.69	0.14	2.79	3.82	2.28	0.09	15.65	17.09	3.07	0.01	99.64	CPX
F5/F6-32	54.72	0.25	1.63	2.93	2.14	0.14	16.97	19.28	2.07	0.03	100.14	CPX

Table 20: Finsch unit F8 clinopyroxene.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F8-1	52.19	0.01	6.27	0.77	4.39	0.08	17.94	17.57	0.41	0.00	99.64	CPX
F8-2	55.95	0.28	2.64	2.28	1.99	0.10	16.49	17.23	2.37	0.06	99.37	CPX
F8-3	41.59	0.16	14.64	11.51	7.35	0.40	17.98	6.91	0.03	0.00	100.57	CPX
F8-4	55.76	0.21	3.06	1.50	2.52	0.08	16.27	17.78	2.41	0.05	99.63	CPX
F8-5	41.63	0.24	14.52	11.52	7.24	0.40	17.86	7.04	0.04	0.00	100.48	CPX
F8-6	55.82	0.31	2.66	2.28	2.16	0.09	16.84	17.27	2.52	0.08	100.03	CPX
F8-7	41.78	0.20	14.52	11.45	7.09	0.42	18.17	6.99	0.05	0.02	100.69	CPX
F8-8	41.85	0.42	15.28	10.76	6.13	0.38	18.91	6.39	0.06	0.00	100.19	CPX
F8-9	55.04	0.15	0.85	3.36	2.07	0.11	16.93	19.28	1.44	0.01	99.24	CPX
F8-10	55.63	0.27	2.46	1.56	3.75	0.13	15.10	17.66	2.67	0.01	99.23	CPX
F8-11	56.11	0.20	2.96	1.44	2.53	0.07	16.03	17.80	2.46	0.02	99.61	CPX
F8-12	56.27	0.05	1.71	1.77	2.60	0.10	17.89	17.73	1.72	0.06	99.89	CPX
F8-13	55.21	0.12	0.90	2.25	2.48	0.07	17.30	19.27	1.46	0.02	99.07	CPX
F8-14	55.77	0.09	1.71	1.72	2.46	0.15	17.58	17.60	1.65	0.09	98.81	CPX
F8-15	55.56	0.01	1.28	1.65	2.09	0.08	18.11	18.59	1.19	0.07	98.64	CPX
F8-16	55.91	0.18	1.16	2.56	2.44	0.10	16.83	18.27	1.89	0.03	99.37	CPX
F8-17	51.20	0.00	7.72	0.52	3.44	0.08	14.46	20.92	0.52	0.01	98.87	CPX
F8-18	51.39	0.07	7.96	0.49	3.35	0.12	14.33	20.96	0.55	0.03	99.24	CPX
F8-19	55.85	0.06	1.76	1.71	2.54	0.12	17.49	17.59	1.60	0.08	98.82	CPX
F8-20	55.89	0.06	1.74	1.72	2.60	0.11	17.70	17.71	1.62	0.08	99.22	CPX
F8-21	56.34	0.04	1.79	1.71	2.53	0.10	17.63	17.75	1.72	0.07	99.69	CPX
F8-22	55.70	0.03	1.80	1.78	2.62	0.09	17.45	17.55	1.71	0.09	98.81	CPX
F8-23	56.41	0.14	1.70	1.27	2.57	0.13	17.79	18.28	1.47	0.06	99.82	CPX
F8-24	56.54	0.18	1.79	2.14	2.49	0.11	17.43	17.52	1.96	0.05	100.18	CPX
F8-25	51.78	0.04	6.68	0.83	2.91	0.06	14.84	21.74	0.51	0.01	99.39	CPX
F8-26	51.70	0.05	6.52	1.02	2.68	0.11	14.71	21.61	0.60	0.03	99.02	CPX
F8-27	55.72	0.30	2.63	2.25	2.16	0.07	16.40	17.29	2.55	0.07	99.45	CPX
F8-28	55.67	0.20	1.81	2.06	2.49	0.12	17.32	17.34	1.94	0.06	99.01	CPX
F8-29	55.39	0.19	3.04	1.43	2.47	0.07	15.92	17.66	2.40	0.06	98.63	CPX
F8-30	52.73	0.02	5.35	1.03	2.74	0.13	15.90	20.22	0.54	0.00	98.66	CPX
F8-31	52.98	0.02	5.29	1.08	2.21	0.09	15.03	21.96	0.61	0.05	99.32	CPX
F8-32	55.70	0.07	1.74	1.82	2.50	0.15	17.70	17.62	1.71	0.08	99.07	CPX
F8-33	52.06	0.04	6.47	1.04	2.69	0.09	14.38	21.75	0.55	0.02	99.09	CPX
F8-34	52.27	0.00	5.78	1.11	2.80	0.07	15.81	20.45	0.50	0.02	98.80	CPX
F8-35	52.74	0.00	5.72	1.15	2.74	0.13	15.68	20.90	0.53	0.01	99.59	CPX
F8-36	56.50	0.05	1.82	1.04	2.90	0.11	17.96	17.98	1.46	0.04	99.88	CPX
F8-37	52.52	0.03	6.26	1.06	2.96	0.09	14.70	21.40	0.52	0.02	99.56	CPX
F8-38	52.46	0.04	6.30	0.74	2.83	0.07	14.96	22.20	0.50	0.01	100.11	CPX
F8-39	55.89	0.01	1.72	1.81	2.64	0.08	17.63	17.81	1.74	0.08	99.42	CPX
F8-40	51.90	0.08	5.88	1.03	2.64	0.12	14.96	22.07	0.56	0.00	99.24	CPX
F8-41	51.76	0.08	7.08	0.91	3.00	0.10	14.57	21.60	0.50	0.00	99.58	CPX
F8-42	56.55	0.25	2.45	0.75	2.74	0.11	17.43	18.01	1.73	0.04	100.06	CPX

Table 20 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total	Comment
F8-43	51.35	0.00	7.50	0.50	2.99	0.11	14.57	21.81	0.52	0.01	99.37	CPX
F8-44	52.08	0.05	7.62	0.48	3.10	0.10	14.45	21.82	0.46	0.00	100.16	CPX
F8-45	52.58	0.05	5.94	1.09	2.48	0.12	14.93	21.93	0.50	0.02	99.65	CPX
F8-46	56.27	0.25	2.79	0.82	3.15	0.14	17.51	16.80	2.03	0.04	99.80	CPX

Table 21: Finsch unit F1 chromite.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Comment
F1-1	0.03	0.12	8.70	61.62	14.41	0.47	14.09	0.00	99.43	Chromite
F1-2	0.14	0.99	12.34	52.57	19.34	0.43	13.43	0.00	99.24	Chromite
F1-3	0.06	0.29	8.03	61.01	17.14	0.46	12.72	0.00	99.71	Chromite
F1-4	0.05	0.79	7.67	60.33	17.53	0.51	12.86	0.00	99.75	Chromite
F1-5	0.08	0.29	6.01	62.92	16.40	0.46	13.06	0.00	99.21	Chromite
F1-6	0.01	0.93	11.72	55.30	18.92	0.51	12.59	0.00	99.98	Chromite
F1-7	0.02	0.41	7.09	63.16	15.69	0.47	13.48	0.00	100.31	Chromite
F1-8	0.06	0.01	9.00	61.65	16.48	0.47	13.14	0.00	100.80	Chromite
F1-9	0.05	0.21	8.39	61.49	16.51	0.43	13.36	0.00	100.44	Chromite
F1-10	0.06	0.23	7.66	62.33	15.56	0.44	13.76	0.00	100.06	Chromite
F1-11	0.00	0.29	7.97	61.42	17.45	0.53	12.59	0.00	100.24	Chromite
F1-12	0.04	0.28	10.35	57.33	18.10	0.45	13.23	0.00	99.77	Chromite
F1-13	0.06	0.52	6.85	62.06	16.71	0.47	12.99	0.00	99.67	Chromite
F1-14	0.08	0.86	5.39	62.86	16.56	0.55	13.09	0.00	99.38	Chromite
F1-15	0.04	1.78	3.69	62.40	18.43	0.58	12.46	0.00	99.38	Chromite
F1-16	0.03	0.93	8.22	60.97	14.88	0.45	14.05	0.01	99.53	Chromite
F1-17	0.01	0.32	6.85	62.18	15.49	0.52	13.69	0.00	99.04	Chromite
F1-18	0.08	0.40	6.75	62.28	15.45	0.51	13.41	0.00	98.88	Chromite
F1-19	0.02	1.88	3.72	62.13	18.56	0.60	12.69	0.00	99.59	Chromite
F1-20	0.13	0.22	10.30	56.79	17.27	0.44	14.43	0.00	99.58	Chromite
F1-21	0.09	0.38	7.90	60.09	16.52	0.48	14.17	0.00	99.63	Chromite
F1-22	0.02	0.74	6.32	61.76	17.84	0.52	12.53	0.00	99.73	Chromite
F1-23	0.05	0.80	7.82	60.18	17.79	0.47	12.93	0.00	100.04	Chromite
F1-24	0.07	0.11	8.18	62.47	14.74	0.42	13.63	0.00	99.63	Chromite
F1-25	0.06	0.55	6.37	62.64	16.45	0.55	12.97	0.00	99.58	Chromite
F1-26	0.03	0.23	7.86	59.71	19.38	0.48	11.83	0.00	99.51	Chromite
F1-27	0.02	0.91	2.01	63.66	22.36	0.61	10.13	0.00	99.69	Chromite
F1-28	0.05	1.47	6.89	61.14	15.22	0.51	13.88	0.00	99.16	Chromite
F1-29	0.01	0.16	8.24	60.55	17.14	0.54	12.62	0.00	99.26	Chromite
F1-30	0.01	1.71	4.78	58.51	21.54	0.51	11.92	0.00	98.98	Chromite
F1-31	0.02	0.33	8.01	61.68	14.41	0.45	14.25	0.00	99.15	Chromite
F1-32	0.04	0.51	6.92	62.18	16.43	0.43	13.22	0.00	99.72	Chromite
F1-33	0.11	0.29	5.95	63.63	16.22	0.54	13.11	0.00	99.85	Chromite
F1-34	0.09	0.21	9.24	58.17	17.54	0.40	14.03	0.00	99.68	Chromite

Table 21 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Comment
F1-35	0.01	1.37	4.51	64.33	16.37	0.51	13.22	0.00	100.32	Chromite
F1-36	0.05	0.99	6.43	55.21	26.24	0.48	10.20	0.00	99.60	Chromite
F1-37	0.04	0.10	8.37	62.61	13.70	0.49	14.18	0.00	99.48	Chromite
F1-38	0.07	0.72	6.72	61.43	17.26	0.53	12.76	0.00	99.49	Chromite
F1-39	0.04	1.36	7.98	56.37	20.32	0.50	12.19	0.00	98.76	Chromite
F1-40	0.05	0.91	8.79	57.35	19.26	0.44	12.81	0.00	99.61	Chromite
F1-41	0.03	0.22	7.72	62.37	14.60	0.48	13.43	0.00	98.84	Chromite
F1-42	0.06	0.03	9.02	61.59	15.51	0.50	12.84	0.00	99.54	Chromite
F1-43	0.04	0.08	8.85	60.45	15.58	0.47	13.23	0.00	98.70	Chromite
F1-44	0.05	0.67	6.63	60.49	17.00	0.48	13.50	0.00	98.81	Chromite

Table 22: Finsch unit F2 chromite.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Comment
F2-1	0.10	0.20	12.39	55.41	15.81	0.37	15.35	0.00	99.62	Chromite
F2-2	0.06	0.04	8.40	62.89	14.07	0.49	14.26	0.00	100.20	Chromite
F2-3	0.05	0.57	29.59	35.95	19.79	0.38	13.30	0.00	99.63	Chromite
F2-4	0.03	0.82	7.56	60.79	16.77	0.42	13.11	0.00	99.49	Chromite
F2-5	0.14	0.13	12.61	54.82	15.39	0.38	15.50	0.00	98.96	Chromite
F2-6	0.03	0.74	26.00	40.24	19.16	0.44	12.51	0.00	99.12	Chromite
F2-7	0.02	0.07	9.53	60.06	16.86	0.46	12.85	0.01	99.85	Chromite
F2-8	0.09	0.09	9.20	61.55	14.01	0.49	13.37	0.00	98.82	Chromite
F2-9	0.04	0.09	8.52	62.33	13.40	0.48	14.56	0.00	99.42	Chromite
F2-10	0.09	0.22	8.37	62.34	13.77	0.51	14.30	0.00	99.59	Chromite
F2-11	0.00	0.48	24.38	41.12	22.70	0.52	10.49	0.00	99.69	Chromite
F2-12	0.16	0.44	15.89	44.22	24.10	0.51	13.67	0.00	98.98	Chromite
F2-13	0.05	1.49	7.64	59.21	18.61	0.49	12.79	0.00	100.28	Chromite
F2-14	0.06	0.55	8.10	60.64	17.63	0.52	12.59	0.00	100.09	Chromite
F2-15	0.02	0.15	8.94	62.03	14.03	0.48	14.40	0.00	100.04	Chromite
F2-16	0.07	0.13	8.39	62.48	14.55	0.50	14.31	0.00	100.43	Chromite
F2-17	0.05	0.41	7.04	63.41	14.43	0.43	14.19	0.00	99.95	Chromite
F2-18	0.10	0.47	5.15	63.25	17.27	0.59	13.02	0.00	99.83	Chromite
F2-19	0.04	0.27	7.12	63.12	14.18	0.51	13.82	0.00	99.07	Chromite
F2-20	0.07	0.29	7.29	63.53	14.02	0.47	14.52	0.00	100.19	Chromite
F2-21	0.01	1.72	3.70	63.45	17.58	0.54	12.94	0.00	99.93	Chromite
F2-22	0.06	0.40	6.90	63.42	15.64	0.49	13.65	0.00	100.55	Chromite
F2-23	0.08	0.28	7.94	63.34	13.62	0.47	14.54	0.00	100.26	Chromite
F2-24	0.09	0.18	8.28	62.19	14.49	0.45	14.12	0.00	99.81	Chromite
F2-25	0.01	1.02	7.37	61.35	15.47	0.59	13.94	0.00	99.74	Chromite
F2-26	0.01	0.96	7.79	58.53	19.64	0.55	12.11	0.00	99.58	Chromite
F2-27	0.03	0.07	8.95	60.76	15.96	0.49	12.76	0.00	99.02	Chromite
F2-28	0.04	0.53	6.77	64.43	13.74	0.41	14.32	0.00	100.24	Chromite

Table 22 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Comment
F2-29	0.09	0.24	6.27	63.74	15.05	0.46	14.05	0.00	99.90	Chromite
F2-30	0.03	3.19	3.79	56.03	24.64	0.48	11.26	0.00	99.41	Chromite
F2-31	0.01	0.53	7.91	60.48	17.44	0.50	12.51	0.00	99.38	Chromite
F2-32	0.01	0.52	9.34	59.57	16.76	0.51	12.72	0.01	99.44	Chromite
F2-33	0.10	0.90	7.37	60.85	16.63	0.52	13.41	0.00	99.76	Chromite
F2-34	0.03	0.43	10.59	56.50	18.40	0.46	13.13	0.00	99.54	Chromite
F2-35	0.00	0.04	10.99	59.00	16.08	0.45	12.99	0.00	99.55	Chromite
F2-36	0.14	0.34	7.60	60.29	17.32	0.46	13.89	0.00	100.04	Chromite
F2-37	0.04	0.95	7.50	57.97	19.84	0.47	13.53	0.00	100.29	Chromite
F2-38	0.02	1.10	5.40	62.27	17.32	0.38	13.39	0.00	99.88	Chromite
F2-39	0.06	0.21	7.99	62.71	13.82	0.44	14.36	0.00	99.60	Chromite
F2-40	0.02	0.89	7.51	60.58	16.64	0.52	13.33	0.00	99.49	Chromite
F2-41	0.03	2.13	4.33	61.77	18.02	0.55	12.88	0.00	99.70	Chromite
F2-42	0.04	0.85	7.37	60.08	16.96	0.50	13.27	0.00	99.07	Chromite

Table 23: Finsch unit F3 chromite.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Comment
F3-1	0.02	1.89	4.98	59.66	19.60	0.54	11.90	0.00	98.59	Chromite
F3-2	0.02	0.34	7.92	61.04	14.55	0.44	14.29	0.00	98.58	Chromite
F3-3	0.04	0.87	7.49	60.50	15.20	0.46	14.13	0.00	98.70	Chromite
F3-4	0.03	1.52	6.07	56.47	22.65	0.49	11.59	0.00	98.81	Chromite
F3-5	0.02	2.59	7.82	55.13	21.02	0.51	12.29	0.00	99.39	Chromite
F3-6	0.05	1.81	6.40	57.17	21.16	0.55	11.94	0.00	99.08	Chromite
F3-7	0.10	0.25	6.11	63.16	15.94	0.46	13.08	0.00	99.10	Chromite
F3-8	0.06	3.30	3.27	55.76	24.64	0.51	11.23	0.00	98.78	Chromite
F3-9	0.03	0.87	7.18	58.50	20.02	0.44	12.04	0.00	99.08	Chromite
F3-10	0.01	1.33	7.54	58.29	19.35	0.48	11.86	0.00	98.87	Chromite
F3-11	0.00	0.05	15.95	53.06	16.42	0.50	12.99	0.00	98.96	Chromite
F3-12	0.01	0.06	8.74	61.47	14.27	0.44	13.69	0.00	98.69	Chromite
F3-13	0.02	1.90	6.88	57.85	19.96	0.46	11.81	0.00	98.88	Chromite
F3-14	0.02	2.82	4.98	57.66	21.67	0.54	11.70	0.00	99.39	Chromite
F3-15	0.01	0.14	7.28	62.41	15.03	0.46	13.71	0.00	99.05	Chromite
F3-16	0.01	0.05	8.24	62.06	13.62	0.46	14.09	0.00	98.53	Chromite
F3-17	0.07	3.18	4.11	55.30	24.27	0.48	11.69	0.00	99.09	Chromite
F3-18	0.00	1.87	4.18	60.47	19.22	0.52	12.80	0.00	99.06	Chromite
F3-19	0.01	1.12	6.22	60.06	17.87	0.54	12.90	0.00	98.71	Chromite
F3-20	0.02	2.84	7.05	53.86	22.71	0.56	11.56	0.00	98.60	Chromite
F3-21	0.00	0.45	30.28	33.35	22.16	0.35	12.15	0.00	98.74	Chromite
F3-22	0.00	0.40	22.86	42.05	22.31	0.36	10.74	0.00	98.72	Chromite
F3-23	0.07	0.73	6.88	58.44	21.71	0.50	10.71	0.00	99.04	Chromite
F3-24	0.06	1.19	7.11	57.61	20.98	0.42	11.77	0.01	99.15	Chromite

Table 23 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Comment
F3-25	0.00	0.05	15.16	54.41	17.14	0.41	12.34	0.00	99.52	Chromite
F3-26	0.03	1.66	6.66	57.57	21.16	0.48	11.92	0.00	99.49	Chromite
F3-27	0.02	0.10	8.56	60.81	16.50	0.41	12.67	0.00	99.06	Chromite
F3-28	0.03	3.52	6.01	53.54	23.24	0.55	11.82	0.00	98.70	Chromite
F3-29	0.00	3.13	3.05	56.79	24.46	0.50	10.83	0.00	98.76	Chromite
F3-30	0.03	3.28	3.50	55.91	23.34	0.55	11.97	0.00	98.57	Chromite
F3-31	0.05	2.37	5.23	55.70	23.68	0.48	11.32	0.00	98.82	Chromite

Table 24: Finsch unit F4 chromite.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Comment
F4-1	0.05	1.57	5.25	51.81	31.51	1.26	8.33	0.00	99.78	Chromite
F4-2	0.03	0.40	5.45	63.78	17.24	0.56	13.39	0.00	100.85	Chromite
F4-3	0.14	0.20	27.49	35.11	25.70	0.46	10.24	0.00	99.34	Chromite
F4-4	0.17	2.94	1.80	38.48	46.68	1.38	7.31	0.00	98.76	Chromite
F4-5	0.07	0.09	8.43	62.54	14.11	0.51	14.28	0.00	100.03	Chromite
F4-6	0.10	1.05	6.41	56.84	24.56	1.08	9.91	0.00	99.95	Chromite
F4-7	0.09	0.24	4.87	65.32	14.88	0.56	13.94	0.00	99.89	Chromite
F4-8	0.08	0.88	6.76	60.31	19.15	0.53	12.65	0.00	100.37	Chromite
F4-9	0.20	0.13	8.28	61.19	14.75	0.53	15.29	0.00	100.36	Chromite
F4-10	0.12	0.81	5.93	62.58	16.40	0.55	13.56	0.00	99.95	Chromite
F4-11	0.07	0.36	7.70	61.99	15.27	0.53	13.64	0.00	99.56	Chromite
F4-12	0.15	0.14	6.40	63.58	15.04	0.53	13.97	0.00	99.81	Chromite
F4-13	0.09	0.53	6.25	61.42	17.52	0.52	13.69	0.00	100.02	Chromite
F4-14	0.15	0.20	6.28	64.15	14.76	0.53	13.91	0.00	99.97	Chromite
F4-15	0.12	0.23	8.18	62.15	14.24	0.47	14.08	0.00	99.48	Chromite
F4-16	0.03	1.22	4.76	58.04	25.31	1.01	9.29	0.00	99.66	Chromite
F4-17	0.05	0.53	5.80	62.66	16.37	0.56	13.36	0.00	99.33	Chromite
F4-18	0.21	0.52	16.77	46.83	20.35	0.53	14.81	0.00	100.02	Chromite
F4-19	0.12	0.20	4.93	65.40	15.19	0.54	13.52	0.03	99.90	Chromite
F4-20	0.10	0.76	7.69	62.72	14.37	0.45	14.49	0.00	100.58	Chromite
F4-21	0.11	0.24	7.44	61.80	15.66	0.49	14.05	0.00	99.79	Chromite
F4-22	0.17	2.43	4.65	60.52	17.44	0.57	13.96	0.00	99.75	Chromite
F4-23	0.18	0.59	16.95	44.28	23.13	0.44	13.74	0.00	99.30	Chromite
F4-24	0.10	0.59	9.23	57.23	18.64	0.52	13.52	0.00	99.83	Chromite
F4-25	0.08	0.35	8.45	62.07	13.41	0.52	14.80	0.01	99.68	Chromite
F4-26	0.11	0.21	6.12	64.75	14.63	0.47	14.10	0.00	100.39	Chromite
F4-27	0.19	0.08	30.86	30.79	26.84	0.40	10.01	0.00	99.17	Chromite
F4-28	0.13	0.26	4.89	65.10	15.68	0.51	13.42	0.00	100.00	Chromite
F4-29	0.12	0.33	11.06	54.71	19.18	0.52	13.49	0.00	99.40	Chromite
F4-30	0.08	0.17	6.81	62.83	16.26	0.62	13.16	0.00	99.93	Chromite

Table 25: Finsch unit F5/F6 chromite.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Comment
F5/F6-1	0.09	0.31	5.65	62.42	17.45	0.48	12.61	0.00	98.99	Chromite
F5/F6-2	0.07	0.67	8.60	58.33	18.10	0.50	13.00	0.00	99.28	Chromite
F5/F6-3	0.03	0.06	8.02	61.29	16.41	0.49	12.83	0.01	99.14	Chromite
F5/F6-4	0.02	0.94	6.60	57.69	21.69	0.57	11.32	0.00	98.83	Chromite
F5/F6-5	0.05	0.26	6.76	62.58	16.35	0.55	12.76	0.00	99.32	Chromite
F5/F6-6	0.02	0.61	11.12	54.30	19.49	0.46	13.04	0.00	99.02	Chromite
F5/F6-7	0.01	3.50	4.41	56.99	22.38	0.54	11.55	0.00	99.39	Chromite
F5/F6-8	0.04	0.20	8.23	62.06	14.82	0.43	14.00	0.00	99.77	Chromite
F5/F6-9	0.02	0.08	8.45	61.41	14.58	0.51	13.92	0.00	98.97	Chromite
F5/F6-10	0.09	0.06	5.83	63.08	17.25	0.52	12.22	0.00	99.04	Chromite
F5/F6-11	0.08	0.16	8.16	61.57	14.78	0.45	13.67	0.00	98.87	Chromite
F5/F6-12	0.05	1.24	7.50	58.91	18.48	0.49	12.58	0.00	99.24	Chromite
F5/F6-13	0.07	0.40	9.27	57.25	18.57	0.52	12.82	0.02	98.91	Chromite
F5/F6-14	0.06	0.49	7.72	60.67	17.55	0.47	12.00	0.00	98.96	Chromite
F5/F6-15	0.11	0.36	4.28	63.11	17.43	0.50	12.89	0.00	98.68	Chromite
F5/F6-16	0.09	0.63	5.98	62.75	16.28	0.53	13.53	0.00	99.79	Chromite
F5/F6-17	0.04	0.49	6.57	60.62	18.36	0.53	12.65	0.00	99.26	Chromite
F5/F6-18	0.04	0.08	8.00	61.41	16.39	0.52	12.73	0.00	99.17	Chromite
F5/F6-19	0.10	0.29	9.80	56.66	18.97	0.52	13.43	0.00	99.77	Chromite
F5/F6-20	0.04	0.28	8.40	61.10	15.30	0.47	13.50	0.00	99.08	Chromite
F5/F6-21	0.01	0.13	9.04	61.17	14.07	0.48	14.12	0.00	99.01	Chromite
F5/F6-22	0.02	1.77	7.44	57.83	20.63	0.53	11.89	0.01	100.12	Chromite
F5/F6-23	0.02	1.38	6.44	60.20	17.48	0.54	12.61	0.00	98.67	Chromite
F5/F6-24	0.09	0.41	9.21	57.37	18.75	0.55	12.89	0.00	99.27	Chromite
F5/F6-25	0.01	0.44	7.70	60.91	17.12	0.50	12.32	0.00	98.99	Chromite
F5/F6-26	0.05	0.14	8.06	62.25	14.40	0.49	13.90	0.00	99.30	Chromite
F5/F6-27	0.09	0.21	7.83	62.25	14.87	0.55	13.75	0.00	99.55	Chromite
F5/F6-28	0.00	0.78	7.13	59.58	19.06	0.43	12.44	0.01	99.43	Chromite
F5/F6-29	0.03	0.08	8.87	61.80	14.85	0.46	13.54	0.00	99.63	Chromite
F5/F6-30	0.03	2.37	4.51	57.23	23.16	0.49	11.66	0.01	99.45	Chromite
F5/F6-31	0.05	2.82	4.58	55.70	23.89	0.50	11.53	0.00	99.07	Chromite
F5/F6-32	0.05	0.45	9.07	57.18	18.90	0.46	12.99	0.00	99.08	Chromite
F5/F6-33	0.10	0.26	7.12	61.07	17.03	0.49	13.02	0.00	99.08	Chromite
F5/F6-34	0.06	0.40	9.27	57.40	18.71	0.44	12.87	0.00	99.16	Chromite
F5/F6-35	0.06	0.40	9.26	57.39	18.85	0.51	13.08	0.01	99.56	Chromite
F5/F6-36	0.01	0.03	8.24	62.59	13.75	0.44	14.35	0.01	99.41	Chromite
F5/F6-37	0.00	0.03	8.89	60.88	15.66	0.52	12.64	0.02	98.64	Chromite
F5/F6-38	0.05	0.06	8.56	61.24	15.95	0.49	12.96	0.00	99.30	Chromite
F5/F6-39	0.19	0.30	20.45	42.66	19.75	0.39	15.16	0.00	98.89	Chromite
F5/F6-40	0.06	0.46	9.28	57.77	18.69	0.48	12.66	0.00	99.39	Chromite
F5/F6-41	0.06	0.16	8.38	62.28	14.65	0.51	13.90	0.00	99.92	Chromite
F5/F6-42	0.08	0.65	13.43	51.27	19.35	0.45	13.78	0.00	99.01	Chromite

Table 25 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Comment
F5/F6-43	0.07	0.15	6.39	64.89	13.15	0.44	13.78	0.00	98.87	Chromite
F5/F6-44	0.07	0.07	8.63	61.83	14.07	0.45	14.10	0.00	99.19	Chromite
F5/F6-45	0.02	0.04	8.82	61.47	13.61	0.46	14.16	0.00	98.57	Chromite
F5/F6-46	0.15	0.60	6.37	58.33	20.48	0.49	12.38	0.00	98.80	Chromite
F5/F6-47	0.02	0.79	7.50	60.05	18.64	0.49	12.71	0.00	100.18	Chromite
F5/F6-48	0.08	0.05	8.21	62.16	14.30	0.42	13.66	0.01	98.88	Chromite
F5/F6-49	0.06	2.33	6.44	57.20	21.87	0.53	11.76	0.00	100.18	Chromite

Table 26: Finsch unit F8 chromite.

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Comment
F8-1	0.05	0.22	7.94	60.83	16.03	0.50	13.32	0.00	98.88	Chromite
F8-2	0.08	0.59	7.37	61.46	15.08	0.51	13.56	0.00	98.66	Chromite
F8-3	0.03	0.09	8.92	61.56	14.41	0.47	13.59	0.00	99.05	Chromite
F8-4	0.01	0.12	8.49	61.25	14.73	0.44	13.79	0.00	98.83	Chromite
F8-5	0.04	0.81	7.11	59.57	18.02	0.55	12.55	0.00	98.65	Chromite
F8-6	0.05	0.30	7.94	60.78	16.94	0.50	12.69	0.00	99.20	Chromite
F8-7	0.06	0.23	7.27	62.73	13.88	0.47	13.98	0.00	98.62	Chromite
F8-8	0.00	0.38	7.70	60.44	16.83	0.48	12.74	0.00	98.56	Chromite
F8-9	0.06	0.42	7.83	61.59	14.80	0.45	13.62	0.00	98.76	Chromite
F8-10	0.08	0.52	8.51	58.14	18.45	0.54	13.04	0.00	99.28	Chromite
F8-11	0.11	0.74	4.93	62.32	17.14	0.51	13.10	0.00	98.86	Chromite
F8-12	0.11	0.33	9.74	56.86	17.39	0.44	13.81	0.01	98.70	Chromite
F8-13	0.19	0.34	9.95	57.09	17.71	0.43	13.42	0.00	99.12	Chromite
F8-14	0.07	1.16	7.52	59.23	17.29	0.50	13.12	0.00	98.89	Chromite
F8-15	0.09	1.81	7.88	56.66	19.64	0.56	12.43	0.00	99.05	Chromite
F8-16	0.05	0.17	8.09	61.30	14.74	0.49	13.95	0.01	98.80	Chromite
F8-17	0.03	0.71	7.96	60.76	15.51	0.43	13.59	0.00	99.00	Chromite
F8-18	0.06	0.05	8.88	61.62	14.42	0.51	13.94	0.01	99.48	Chromite
F8-19	0.05	0.27	7.60	62.37	14.57	0.52	14.13	0.01	99.52	Chromite
F8-20	0.09	0.43	7.55	61.41	15.95	0.50	12.79	0.00	98.72	Chromite
F8-21	0.14	0.54	11.18	54.91	18.73	0.45	13.52	0.00	99.47	Chromite
F8-22	0.09	0.31	3.04	65.97	17.75	0.64	11.40	0.00	99.20	Chromite
F8-23	0.09	0.50	11.25	54.55	19.30	0.49	13.14	0.00	99.32	Chromite
F8-24	0.08	0.52	9.51	56.14	19.63	0.52	12.82	0.01	99.22	Chromite
F8-25	0.00	1.31	6.99	58.40	19.07	0.43	12.73	0.00	98.94	Chromite
F8-26	0.15	0.50	11.30	54.45	18.94	0.46	13.11	0.00	98.91	Chromite
F8-27	0.11	0.53	11.19	54.40	18.82	0.43	13.23	0.00	98.72	Chromite
F8-28	0.05	0.19	8.04	61.40	14.42	0.45	14.21	0.00	98.75	Chromite
F8-29	0.04	0.28	12.55	53.65	17.60	0.41	14.01	0.00	98.53	Chromite
F8-30	0.10	0.24	6.18	63.95	14.69	0.50	13.57	0.00	99.22	Chromite
F8-31	0.07	0.05	7.46	61.15	15.74	0.49	13.79	0.00	98.74	Chromite

Table 26 continued

Sample Name	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Total	Comment
F8-32	0.16	0.43	5.76	63.22	16.31	0.50	12.67	0.00	99.05	Chromite
F8-33	0.04	1.66	6.98	59.52	17.94	0.49	12.75	0.00	99.38	Chromite
F8-34	0.02	0.17	8.11	61.27	14.52	0.49	14.06	0.00	98.64	Chromite
F8-35	0.17	0.17	4.73	63.20	17.14	0.49	13.05	0.00	98.94	Chromite

Appendix C: Trace element data for garnet, presented in ppm.

Table 27: Finsch unit F1 garnet trace element data.

Sample Name	Comment	Sc	Ti	V	Co	Ni	Rb	Sr	Y	Zr	Nb	La	Ce	Pr	Nd	Sm	Eu	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	Pb	Th	U
F1-1	Purple Garnet	17.25	0.07	3.46	0.08	5.09	0.01	0.20	0.18	0.74	<d.l	0.42	2.10	6.14	14.69	10.72	5.90	0.78	2.18	0.32	0.31	0.15	0.16	0.33	0.67	0.27	1.21	1.21	0.52	7.30
F1-2	Purple Garnet	14.41	0.18	3.98	0.08	3.46	0.07	0.48	0.45	1.56	<d.l	2.35	10.77	13.93	12.59	4.70	2.97	0.91	1.58	0.57	0.60	0.45	0.59	1.08	2.42	1.10	0.51	3.85	3.66	17.97
F1-3	Purple Garnet	30.33	0.51	2.74	0.08	3.80	0.11	0.46	3.69	12.98	<d.l	1.37	8.38	19.26	33.19	28.56	20.81	8.73	13.61	6.05	3.86	3.48	2.06	2.43	2.40	11.07	1.40	5.26	3.31	26.67
F1-4	Purple Garnet	28.36	0.49	2.74	0.07	3.68	<d.l	0.42	3.47	12.00	<d.l	1.34	8.02	17.81	31.71	26.69	20.21	8.32	12.40	6.12	4.02	2.58	1.84	2.11	2.60	9.49	0.88	1.82	3.31	27.64
F1-5	Purple Garnet	10.21	0.33	2.67	0.08	3.41	0.02	0.00	3.78	3.29	<d.l	0.05	0.21	0.35	0.84	1.66	2.10	2.74	1.57	3.33	5.14	4.75	5.32	6.71	7.44	2.60	0.55	0.81	1.25	5.54
F1-6	Purple Garnet	12.36	1.00	3.99	0.08	5.15	0.06	0.06	2.32	4.85	<d.l	0.22	0.76	1.42	4.21	6.87	5.62	2.30	3.45	2.50	2.28	2.78	3.43	4.31	4.80	4.69	2.79	1.21	0.57	5.00
F1-7	Purple Garnet	13.53	1.85	4.43	0.08	6.54	0.03	0.03	2.43	7.91	<d.l	0.09	0.31	0.96	1.97	5.03	6.58	4.89	4.75	3.47	2.97	2.28	1.70	1.59	1.87	6.68	2.24	1.62	0.16	2.03
F1-8	Purple Garnet	14.50	0.56	2.88	0.08	3.23	0.00	0.01	3.68	1.61	<d.l	0.21	0.37	0.57	1.02	1.47	2.01	2.12	2.09	2.70	3.96	4.61	5.06	7.37	8.92	1.06	1.10	3.24	2.84	18.24
F1-9	Purple Garnet	14.29	2.60	4.84	0.08	6.05	0.01	0.03	4.11	2.83	<d.l	0.09	0.46	0.72	2.24	4.23	4.94	3.84	3.79	4.55	5.27	5.57	5.86	6.97	7.09	2.54	2.90	1.01	0.53	2.91
F1-10	Purple Garnet	12.65	4.57	4.54	0.08	4.48	0.01	0.07	12.43	12.08	<d.l	0.17	0.79	1.75	4.26	11.33	12.36	14.46	11.90	14.57	14.50	12.71	11.03	11.45	9.84	10.69	1.18	1.62	0.22	3.85
F1-11	Purple Garnet	15.30	0.77	4.87	0.08	5.67	0.09	0.08	3.68	6.83	0.56	0.13	0.66	2.26	4.82	11.57	12.63	7.26	9.05	5.49	3.69	2.79	2.19	2.07	1.67	5.31	0.66	<d.l	0.16	3.78
F1-12	Purple Garnet	14.98	0.77	4.84	0.08	5.75	<d.l	0.08	3.72	6.84	0.49	0.19	0.70	2.27	4.87	11.56	12.63	6.79	8.90	5.09	4.35	3.04	2.06	2.12	1.88	5.61	0.42	2.23	0.33	4.39
F1-13	Pink Garnet	13.08	0.23	2.20	0.09	3.61	<d.l	0.00	2.73	0.62	1.63	0.09	0.17	0.24	0.50	0.96	0.91	1.70	1.07	1.97	2.80	3.64	4.37	6.33	6.88	0.21	0.63	5.47	3.09	10.32
F1-14	Pink Garnet	11.29	1.33	3.88	0.08	6.13	<d.l	0.02	2.19	9.26	1.16	0.08	0.26	0.47	1.46	3.73	4.52	2.96	3.48	2.38	3.00	2.58	3.50	4.31	4.96	8.44	1.76	0.81	0.10	1.82
F1-15	Pink Garnet	10.12	0.28	2.17	0.09	3.49	0.07	0.00	3.47	0.36	1.49	0.11	0.21	0.35	0.43	0.86	0.84	1.58	0.85	2.45	3.79	4.66	5.55	7.49	7.63	0.18	0.96	3.44	1.84	15.61
F1-16	Pink Garnet	15.74	0.58	2.75	0.08	3.06	<d.l	0.01	3.73	2.05	2.11	0.12	0.34	0.54	1.06	1.43	1.89	2.10	2.17	3.11	3.83	5.07	5.12	7.87	8.43	0.81	1.76	2.29	2.67	18.11
F1-17	Pink Garnet	13.80	1.09	3.19	0.09	4.11	0.04	0.04	4.02	3.29	2.71	0.24	1.28	2.44	3.50	3.95	3.98	2.98	3.31	3.93	4.37	4.83	4.93	7.35	7.56	1.61	2.06	1.62	0.41	6.22
F1-18	Pink Garnet	11.65	0.47	2.55	0.08	3.37	0.12	0.01	3.54	5.99	1.55	0.13	0.43	0.86	1.35	1.70	2.14	2.13	1.84	3.08	3.96	4.39	4.25	7.22	7.90	4.01	1.07	1.82	1.20	11.98
F1-19	Pink Garnet	14.56	1.76	4.24	0.08	5.24	0.08	0.04	6.10	7.64	0.32	0.03	0.25	0.75	2.63	8.13	9.50	7.68	8.27	7.30	6.47	5.91	4.84	5.80	5.73	7.21	1.32	1.62	0.12	1.76
F1-20	Pink Garnet	15.80	0.30	2.66	0.09	3.58	0.03	0.01	3.76	2.57	1.53	0.10	0.19	0.47	0.79	1.54	1.56	2.22	1.50	3.23	4.00	5.41	5.88	8.53	10.73	2.15	1.25	2.23	4.16	9.91
F1-21	Pink Garnet	17.91	0.63	2.88	0.08	3.30	0.05	0.00	4.48	2.71	1.72	0.11	0.20	0.38	0.78	1.73	2.21	3.37	2.50	4.49	5.04	6.13	7.35	10.17	12.62	1.61	1.10	0.81	5.28	15.95
F1-22	Pink Garnet	11.44	0.49	2.23	0.08	2.50	<d.l	<d.l	1.80	0.19	0.24	<d.l	<d.l	<d.l	<d.l	0.03	<d.l	<d.l	0.33	1.24	1.47	2.02	3.32	3.84	1.34	<d.l	0.66	<d.l	<d.l	<d.l
F1-23	Pink Garnet	11.54	0.48	2.04	0.08	2.53	0.03	0.00	2.08	0.17	0.46	0.02	0.05	0.04	0.10	0.38	0.78	1.66	0.85	1.42	2.16	2.76	3.45	4.64	5.11	0.08	0.15	5.26	<d.l	2.70
F1-24	Pink Garnet	16.77	0.54	2.78	0.08	5.89	0.04	0.01	3.47	0.27	0.94	0.13	0.24	0.43	0.54	0.46	0.53	1.48	0.79	2.53	3.59	5.00	5.53	7.92	9.17	0.31	1.43	2.63	0.34	2.12

Table 28: Finsch unit F2 garnet trace element data.

Sample Name	Comment	Sc	Ti	V	Co	Ni	Rb	Sr	Y	Zr	Nb	La	Ce	Pr	Nd	Sm	Eu	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	Pb	Th	U
F2-1	Purple Garnet	12.77	1.00	4.39	0.08	6.09	0.02	0.04	1.10	3.99	<d.l	0.09	0.48	1.14	2.45	4.51	4.46	2.56	3.78	1.84	1.34	1.04	0.89	0.97	1.00	3.90	2.10	1.82	0.29	2.34
F2-2	Purple Garnet	11.71	1.02	4.72	0.08	6.48	0.02	0.04	1.21	3.51	<d.l	0.06	0.52	1.34	2.44	5.26	4.56	2.47	3.25	1.71	1.21	1.14	1.17	1.05	1.28	3.07	2.32	1.82	0.28	2.36
F2-3	Purple Garnet	15.67	2.29	5.36	0.08	6.26	0.04	0.06	3.37	4.94	<d.l	0.16	1.07	2.11	4.30	6.85	8.22	4.85	6.22	4.50	4.36	4.25	4.20	4.66	5.88	4.83	2.06	1.42	0.30	4.01
F2-4	Purple Garnet	18.85	2.64	5.56	0.07	5.65	0.08	0.05	1.92	5.10	<d.l	0.26	0.71	1.67	3.99	6.62	6.40	3.76	4.39	2.57	2.01	1.87	2.19	2.73	3.40	4.29	2.83	2.02	1.16	6.76
F2-5	Purple Garnet	11.48	0.23	1.99	0.08	2.15	<d.l	0.01	4.00	0.22	<d.l	0.09	0.25	0.52	0.91	0.85	0.83	1.51	0.83	2.59	4.00	4.49	5.87	8.21	9.11	0.16	0.74	3.04	0.40	6.62
F2-6	Purple Garnet	12.75	0.27	5.27	0.08	5.56	0.08	0.04	0.22	3.73	<d.l	0.12	0.74	1.86	2.55	1.60	1.31	0.91	1.13	0.49	0.34	0.25	0.38	0.76	1.00	2.62	0.99	1.21	1.24	4.73
F2-7	Purple Garnet	13.16	0.61	5.26	0.08	5.62	0.05	0.05	0.36	4.22	<d.l	0.26	0.77	1.63	2.59	2.10	1.65	0.80	1.15	0.47	0.35	0.35	0.20	0.68	0.91	2.50	1.07	1.82	0.86	5.05
F2-8	Purple Garnet	11.34	0.46	2.43	0.08	3.34	0.00	0.01	4.71	2.35	<d.l	0.08	0.23	0.57	0.94	1.88	1.95	3.20	1.91	3.65	5.03	5.44	6.56	8.60	9.82	1.71	0.88	2.02	1.16	5.88
F2-9	Purple Garnet	12.01	0.49	2.70	0.08	3.24	0.01	0.01	3.95	3.01	<d.l	0.27	0.55	0.84	1.47	2.24	3.18	2.77	2.22	3.51	3.86	4.43	6.50	7.41	7.10	1.38	0.96	1.42	1.72	13.24
F2-10	Purple Garnet	13.36	0.56	5.27	0.08	5.85	0.06	0.04	0.36	3.79	<d.l	0.19	0.74	1.75	2.43	2.33	1.83	0.75	1.03	0.71	0.31	0.39	0.43	0.79	1.28	3.24	0.85	4.99	1.19	5.34
F2-11	Purple Garnet	11.60	0.66	2.98	0.09	6.00	0.02	0.01	4.43	0.52	<d.l	0.07	0.32	0.56	0.94	0.86	0.98	2.70	1.32	3.52	4.32	5.61	6.52	8.38	8.58	0.51	1.43	1.42	0.22	3.18
F2-12	Purple Garnet	18.33	2.89	6.00	0.08	5.86	<d.l	0.06	1.80	5.87	<d.l	0.22	0.75	2.00	4.06	6.72	6.48	4.09	4.77	3.01	2.35	2.19	1.66	2.96	3.09	5.23	4.19	1.21	1.21	8.24
F2-13	Pink Garnet	13.99	0.27	2.47	0.09	2.39	0.01	0.00	5.42	0.14	<d.l	0.11	0.38	0.46	0.85	0.51	0.44	2.17	0.80	3.74	5.45	7.59	9.30	12.25	12.98	0.23	0.44	1.82	0.95	9.73
F2-14	Pink Garnet	14.87	0.29	2.69	0.09	2.26	0.03	0.01	5.75	0.20	<d.l	0.08	0.35	0.77	1.04	0.72	0.90	2.63	0.82	4.12	6.98	8.25	9.41	13.91	14.37	0.14	0.88	2.02	0.91	8.92
F2-15	Pink Garnet	13.44	0.51	2.61	0.09	3.55	0.03	0.01	5.23	2.70	<d.l	0.11	0.27	0.43	1.14	1.66	2.15	2.97	2.36	4.24	5.76	6.60	8.32	10.28	11.21	1.60	0.85	1.01	1.45	3.72
F2-16	Pink Garnet	12.34	0.45	2.58	0.09	3.70	0.09	0.01	4.63	2.36	<d.l	0.05	0.23	0.49	0.89	1.75	2.02	2.68	2.28	3.80	4.40	6.10	5.93	9.61	10.16	1.41	0.81	2.63	1.12	5.54
F2-17	Pink Garnet	13.86	2.74	3.71	0.08	4.26	0.04	0.09	8.37	7.86	<d.l	0.17	1.09	2.32	4.77	7.95	9.11	9.07	8.17	9.21	9.96	9.72	10.15	11.27	11.31	5.00	2.17	1.21	0.12	4.59
F2-18	Pink Garnet	13.68	0.51	2.62	0.09	3.60	<d.l	0.01	5.25	2.78	<d.l	0.05	0.27	0.65	1.00	1.97	2.74	2.80	2.76	4.31	5.76	6.78	8.04	10.09	13.11	1.81	1.43	3.85	1.56	6.08
F2-19	Pink Garnet	14.27	3.41	4.32	0.08	4.43	0.01	0.04	4.45	4.32	<d.l	0.18	0.84	1.81	3.08	4.23	5.16	4.70	4.58	5.40	4.81	4.91	5.06	5.15	5.31	3.74	1.40	0.81	0.57	6.35
F2-20	Pink Garnet	12.56	2.60	3.03	0.09	3.64	0.02	0.01	7.97	3.36	<d.l	0.01	0.01	0.06	0.23	1.93	3.41	6.59	4.61	7.87	9.36	9.83	9.85	11.85	12.86	3.75	0.07	1.82	0.26	2.09
F2-21	Pink Garnet	15.93	0.32	2.73	0.09	2.32	0.04	0.01	6.53	0.21	<d.l	0.09	0.39	0.63	0.90	0.59	0.53	2.39	0.99	4.37	7.19	9.21	10.54	14.75	16.07	0.36	0.85	3.64	0.97	10.47
F2-22	Pink Garnet	12.34	2.91	3.88	0.08	4.27	<d.l	0.04	3.81	3.99	<d.l	0.21	0.78	1.63	2.78	3.84	4.48	4.46	3.80	4.61	4.60	3.98	4.84	4.08	4.23	3.03	0.88	7.69	0.47	5.41
F2-23	Pink Garnet	11.61	0.73	2.28	0.08	3.41	0.06	0.01	5.41	1.98	<d.l	0.04	0.27	0.40	0.90	1.38	1.94	3.29	2.28	4.82	5.71	6.59	6.70	8.68	9.20	1.25	0.55	2.16	0.93	5.95

Table 29: Finsch unit F3 garnet trace element data.

Sample Name	Comment	Sc	Ti	V	Co	Ni	Rb	Sr	Y	Zr	Nb	La	Ce	Pr	Nd	Sm	Eu	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	Pb	Th	U
F3-1	Purple Garnet	17.33	3.65	6.98	0.07	5.59	<d.l	0.12	2.00	2.67	2.85	0.52	2.03	3.29	5.31	5.80	5.38	3.45	3.39	2.66	2.34	2.44	2.75	3.77	4.59	2.53	5.00	15.99	1.87	8.45
F3-2	Purple Garnet	12.46	1.83	5.91	0.08	5.82	<d.l	0.01	1.67	1.12	1.17	0.11	0.39	0.44	0.89	1.71	2.00	1.75	1.69	1.83	1.59	2.14	2.63	3.40	4.19	1.48	1.18	2.43	0.78	2.57
F3-3	Purple Garnet	12.66	1.89	6.20	0.08	5.96	<d.l	0.01	1.92	1.19	1.49	0.16	0.40	0.51	1.06	1.67	1.95	1.44	1.88	2.07	2.43	2.15	2.62	3.30	4.00	1.18	1.51	0.81	0.47	2.70
F3-4	Purple Garnet	19.88	0.75	3.98	0.07	3.97	0.10	0.05	2.14	34.33	2.55	0.04	0.33	1.38	4.34	26.38	30.75	9.36	19.23	4.33	2.94	2.15	1.66	2.48	2.54	21.84	3.71	0.61	0.07	1.69
F3-5	Purple Garnet	26.29	0.80	3.93	0.07	3.94	0.08	0.05	3.09	48.05	3.20	0.07	0.36	1.33	5.18	33.35	35.38	12.51	26.34	6.10	3.89	2.87	2.25	3.27	3.70	30.74	3.35	1.82	0.17	1.42
F3-6	Purple Garnet	24.86	0.80	3.94	0.07	3.78	0.06	0.06	2.92	45.63	2.95	0.07	0.36	1.45	5.12	32.40	35.92	12.74	25.80	5.96	3.64	2.78	2.59	3.03	3.27	30.62	3.50	1.42	0.07	1.35
F3-7	Purple Garnet	17.63	0.14	3.36	0.07	3.44	0.06	0.05	0.75	13.10	1.94	0.11	0.58	1.69	4.76	19.53	22.02	5.02	14.27	2.04	0.71	0.56	0.53	0.83	0.98	8.09	1.88	1.01	0.17	3.85
F3-8	Purple Garnet	17.84	0.15	3.38	0.07	3.51	<d.l	0.00	0.46	14.08	1.27	<d.l	0.23	<d.l	3.46	16.46	14.18	0.30	11.28	0.17	<d.l	<d.l	<d.l	<d.l	<d.l	<d.l	<d.l	<d.l	<d.l	<d.l
F3-9	Purple Garnet	22.60	3.77	3.77	0.07	3.82	0.08	0.06	19.00	35.93	1.41	0.18	0.62	1.80	4.44	13.20	16.69	23.13	20.10	24.99	22.95	20.02	15.47	17.87	14.96	21.43	1.96	1.42	0.19	3.04
F3-10	Purple Garnet	23.88	4.01	3.97	0.07	3.77	0.07	0.07	20.03	37.11	1.64	0.14	0.65	1.82	5.02	13.79	18.45	23.35	21.05	25.98	24.04	21.40	18.46	18.91	17.36	21.79	1.88	0.81	0.21	3.18
F3-11	Purple Garnet	17.39	3.61	3.94	0.07	3.89	0.04	0.05	13.11	25.61	1.14	0.08	0.62	1.40	3.77	10.49	14.54	16.59	14.21	17.76	15.92	14.08	12.17	12.83	11.17	12.66	1.43	0.61	0.21	2.57
F3-12	Purple Garnet	16.70	3.56	4.00	0.07	3.89	0.04	0.06	13.37	24.47	1.19	0.09	0.60	1.37	3.73	10.19	14.38	15.01	14.23	17.68	14.88	14.08	10.91	12.39	10.75	13.40	1.43	1.82	0.17	2.84
F3-13	Purple Garnet	15.42	0.38	3.39	0.08	4.33	0.03	0.39	1.61	5.94	0.81	0.84	4.29	7.63	14.58	8.45	6.19	2.98	4.73	2.48	1.51	1.44	1.35	1.67	2.17	4.14	0.29	1.82	2.10	10.63
F3-14	Pink Garnet	11.28	0.35	3.40	0.08	4.60	0.03	0.29	0.95	3.90	0.80	0.65	4.08	6.12	10.96	6.26	4.20	2.24	3.15	1.66	1.20	1.07	0.71	1.13	1.32	2.94	0.48	2.02	1.28	10.34
F3-15	Pink Garnet	12.29	0.37	3.38	0.08	4.41	0.03	0.33	1.20	4.63	0.87	0.67	4.22	6.55	12.18	6.79	5.17	2.46	3.43	1.84	1.58	1.16	1.15	1.27	1.46	3.29	0.44	0.40	1.66	9.01
F3-16	Pink Garnet	16.71	0.56	2.32	0.08	3.32	0.01	0.01	5.66	8.94	1.45	0.16	0.51	1.08	2.24	4.04	4.27	4.88	4.20	5.59	6.86	7.03	6.90	10.05	10.54	4.50	1.30	1.21	1.90	10.32
F3-17	Pink Garnet	12.08	4.16	3.70	0.08	4.41	<d.l	0.04	12.45	26.71	1.30	0.07	0.41	1.01	2.60	6.35	9.02	12.61	9.95	13.87	14.42	14.34	14.70	15.75	14.23	18.77	1.43	3.64	0.33	3.65
F3-18	Pink Garnet	12.11	4.14	3.63	0.08	4.23	0.07	0.04	12.56	26.80	0.83	0.11	0.40	1.25	2.52	6.30	9.19	12.56	9.80	14.21	14.41	14.65	13.50	15.71	14.15	18.99	1.25	1.01	0.21	2.70

Table 30: Finsch unit F4 garnet trace element data.

Sample Name	Comment	Sc	Ti	V	Co	Ni	Rb	Sr	Y	Zr	Nb	La	Ce	Pr	Nd	Sm	Eu	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	Pb	Th	U
F4-1	Purple Garnet	10.36	0.09	3.64	0.07	3.21	0.04	0.66	0.17	0.50	<d.l	0.61	1.58	1.91	2.60	2.17	1.36	0.11	0.47	0.08	0.14	0.35	0.66	1.15	1.61	0.32	1.36	2.02	3.74	9.05
F4-2	Purple Garnet	12.86	0.94	4.55	0.07	4.12	0.05	0.04	2.31	0.96	<d.l	0.31	1.33	2.44	4.21	3.20	2.65	1.65	1.49	1.86	2.28	3.01	3.32	4.92	5.11	0.98	0.92	0.81	0.79	10.81
F4-3	Purple Garnet	10.44	0.11	2.51	0.08	3.58	0.01	0.01	1.66	0.44	<d.l	0.33	0.77	0.94	1.39	1.41	1.83	1.00	1.08	0.98	1.89	2.52	3.59	4.25	5.22	0.14	2.24	1.42	2.78	26.71
F4-4	Purple Garnet	11.57	0.10	4.05	0.07	3.47	0.03	0.04	0.18	0.79	<d.l	0.88	2.22	2.99	3.80	2.75	1.91	0.54	0.84	0.20	0.23	0.39	0.57	1.07	1.83	0.39	1.58	2.02	5.26	11.15
F4-5	Purple Garnet	15.68	0.24	2.76	0.07	3.48	<d.l	0.33	0.47	3.16	3.63	0.97	6.50	24.67	53.00	24.41	9.72	1.48	3.28	0.79	0.51	0.51	0.67	0.77	1.10	3.26	2.50	2.83	1.45	31.04
F4-6	Purple Garnet	31.83	0.43	3.82	0.07	4.30	0.01	0.19	1.01	6.19	1.22	1.15	4.80	8.47	11.27	7.83	5.49	1.59	3.09	1.42	1.27	1.17	0.95	1.88	2.68	5.45	0.66	0.40	3.15	14.73
F4-7	Purple Garnet	20.11	0.83	3.80	0.07	4.53	<d.l	0.10	1.56	9.91	3.67	0.19	1.62	6.72	19.36	19.20	13.28	4.42	7.07	2.58	1.98	1.54	1.58	1.33	1.87	8.64	4.34	0.61	0.76	8.24
F4-8	Purple Garnet	22.71	1.96	4.83	0.07	3.78	0.00	0.08	6.09	19.08	1.87	0.51	1.95	3.97	8.17	12.09	12.40	9.54	10.56	8.82	7.75	6.15	5.91	5.88	5.63	12.21	1.32	2.43	1.41	12.12
F4-9	Purple Garnet	12.02	0.20	2.51	0.08	4.03	<d.l	0.01	1.85	1.43	2.43	0.28	0.85	1.19	1.81	1.89	1.63	1.37	1.17	1.47	1.98	2.68	2.78	5.30	6.14	0.42	1.84	5.26	1.76	18.31
F4-10	purple Garnet	10.91	0.50	2.92	0.07	3.44	<d.l	0.01	2.59	7.60	4.12	0.32	0.81	0.82	1.22	1.46	1.53	2.31	1.63	2.44	2.73	3.43	3.27	5.30	5.67	4.53	2.10	3.44	2.66	23.69
F4-11	Purple Garnet	11.21	0.21	2.60	0.09	3.46	0.00	0.00	2.90	0.73	1.51	0.07	0.23	0.20	0.55	0.80	0.93	1.81	0.70	2.06	2.53	4.04	4.36	6.64	7.34	0.70	0.85	<d.l	2.48	19.64
F4-12	Purple Garnet	15.76	0.18	4.94	0.08	3.75	<d.l	0.49	0.15	1.44	3.62	2.99	10.29	13.21	10.18	2.94	2.11	0.68	1.40	0.33	0.21	0.27	0.14	0.70	1.18	1.46	2.61	16.06	6.30	22.25
F4-13	Purple Garnet	10.10	3.69	3.58	0.08	4.59	<d.l	0.04	7.40	5.28	0.79	0.13	0.45	1.05	2.58	4.98	5.85	6.54	5.35	7.72	7.78	8.18	8.43	11.10	11.12	3.42	1.51	2.43	0.24	2.16
F4-14	Pink Garnet	7.44	0.41	0.02	0.01	0.01	<d.l	0.00	157.24	6.90	0.01	0.03	0.01	0.17	2.22	61.91	9.24	117.95	95.53	147.51	181.11	211.23	221.85	277.95	286.72	4.43	0.15	2.97	<d.l	0.41
F4-15	Pink Garnet	10.12	1.18	2.21	0.07	3.72	<d.l	0.04	1.24	3.97	1.35	0.10	0.61	1.54	2.98	6.29	5.64	2.27	3.96	1.61	1.58	1.40	2.53	4.06	4.99	2.97	1.43	2.02	0.17	4.32
F4-16	Pink Garnet	12.13	0.04	2.95	0.08	2.35	0.05	0.00	0.66	0.01	0.54	0.06	0.09	0.04	0.01	0.01	0.03	0.09	0.08	0.22	0.65	1.13	1.46	2.57	2.91	0.07	0.15	<d.l	0.41	4.37
F4-17	Pink Garnet	13.54	0.55	3.72	0.08	2.37	0.06	0.02	2.52	2.99	2.90	0.54	2.14	2.03	3.26	4.49	5.40	2.62	3.12	2.85	2.42	2.89	2.87	4.12	4.77	1.39	1.84	1.42	0.79	27.97
F4-18	Pink Garnet	10.45	0.20	2.36	0.08	3.18	<d.l	0.01	2.66	0.54	1.69	0.08	0.18	0.37	0.70	1.01	0.75	1.42	1.06	2.11	2.97	3.70	3.52	5.60	5.20	0.24	0.77	0.40	2.48	7.57
F4-19	Pink Garnet	13.10	1.22	2.66	0.09	4.42	0.11	0.05	8.62	6.00	2.68	0.26	1.00	2.79	5.16	6.82	6.34	7.08	5.87	7.67	9.34	10.60	10.93	13.59	14.32	3.13	2.43	3.24	3.60	9.32
F4-20	Pink Garnet	12.73	0.19	2.51	0.08	3.94	<d.l	0.01	1.88	1.60	2.46	0.23	0.81	0.98	1.78	1.59	1.80	1.47	1.35	1.51	1.81	2.93	3.29	4.60	4.65	0.78	2.57	3.44	1.59	18.24
F4-21	Pink Garnet	11.76	1.80	3.15	0.08	4.33	0.05	0.11	4.55	23.02	1.17	0.23	1.21	2.89	5.61	6.05	6.36	4.61	4.48	3.83	4.47	5.55	8.26	8.88	7.90	19.27	2.13	3.24	0.29	8.24
F4-22	Pink Garnet	10.05	1.16	2.27	0.07	4.06	0.00	0.04	1.46	3.90	1.22	0.10	0.61	1.47	3.21	6.26	6.44	2.55	4.21	1.55	1.47	1.83	2.54	4.13	5.22	2.85	2.17	3.64	0.21	4.19

Table 30 continued

Sample Name	Comment	Sc	Ti	V	Co	Ni	Rb	Sr	Y	Zr	Nb	La	Ce	Pr	Nd	Sm	Eu	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	Pb	Th	U
F4-23	Pink Garnet	12.35	1.18	2.85	0.08	3.61	0.02	0.04	5.41	8.78	<d.l	0.13	0.63	1.72	3.30	6.76	7.90	6.83	6.65	6.54	5.88	5.96	5.79	6.75	7.34	5.17	0.96	0.81	0.22	4.05
F4-24	Pink Garnet	11.23	0.33	2.52	0.08	3.36	0.03	0.01	2.72	0.69	<d.l	0.29	0.74	0.87	1.10	1.47	1.57	1.45	1.08	2.03	2.64	3.70	5.30	6.12	6.10	0.58	1.67	3.44	2.40	17.70
F4-25	Pink Garnet	11.12	0.13	2.01	0.08	2.69	0.05	0.01	3.04	0.43	<d.l	0.10	0.22	0.34	0.64	0.94	1.14	1.30	0.92	2.30	3.11	4.17	4.57	7.28	8.35	0.21	0.51	3.44	1.09	9.59
F4-26	Pink Garnet	11.69	0.35	2.61	0.08	3.48	0.01	0.01	2.92	0.68	<d.l	0.29	0.82	0.85	1.14	1.60	1.79	1.44	1.11	2.17	3.06	4.04	4.25	6.54	7.75	0.39	2.24	6.07	2.72	20.36

Table 31: Finsch unit F5/F6 garnet trace element data.

Sample Name	Comment	Sc	Ti	V	Co	Ni	Rb	Sr	Y	Zr	Nb	La	Ce	Pr	Nd	Sm	Eu	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	Pb	Th	U
F5/F6-1	Purple Garnet	18.59	0.93	4.23	0.07	2.53	0.05	0.05	1.57	6.40	<d.l	0.18	1.09	3.27	7.38	11.97	11.36	4.25	6.61	2.80	1.61	1.08	1.01	1.17	1.37	4.55	1.80	3.85	1.14	14.82
F5/F6-2	Purple Garnet	13.40	1.03	4.09	0.08	4.63	0.04	0.27	1.11	4.94	<d.l	0.50	3.01	7.04	10.44	5.29	3.78	1.77	2.78	1.41	1.06	1.12	1.03	1.17	1.44	3.48	0.44	1.01	0.88	8.58
F5/F6-3	Purple Garnet	18.69	0.08	4.39	0.08	4.70	0.09	0.46	0.34	1.29	<d.l	0.87	3.72	8.76	10.91	3.55	2.68	0.71	1.60	0.51	0.38	0.32	0.16	0.50	0.81	0.71	0.48	1.01	0.76	6.62
F5/F6-4	Purple Garnet	12.53	0.27	3.97	0.08	5.54	0.08	0.01	0.38	0.13	<d.l	0.08	0.29	0.53	0.70	0.70	0.62	0.44	0.37	0.32	0.52	0.50	1.01	1.68	2.32	0.11	0.48	4.86	0.43	3.72
F5/F6-5	Purple Garnet	15.26	2.39	4.73	0.08	5.56	0.05	0.03	4.14	5.15	<d.l	0.07	0.40	1.10	2.05	5.49	6.32	3.62	4.32	4.04	4.85	4.66	5.18	6.34	6.23	4.14	2.72	2.63	0.19	2.23
F5/F6-6	Purple Garnet	13.25	0.32	3.71	0.08	4.56	0.04	0.73	0.59	1.19	<d.l	1.03	5.41	7.39	9.35	3.63	2.53	0.93	1.43	0.52	0.60	0.85	1.42	2.47	2.99	1.00	0.33	4.05	1.19	7.57
F5/F6-7	Purple Garnet	14.58	0.08	3.99	0.08	4.86	0.06	0.58	0.34	1.20	<d.l	1.08	5.73	10.61	10.82	4.12	2.73	1.05	1.66	0.52	0.48	0.35	0.51	0.91	1.42	0.81	0.48	1.21	1.71	15.09
F5/F6-8	Purple Garnet	13.25	0.59	3.13	0.07	4.51	0.04	0.22	0.43	1.51	<d.l	0.38	2.03	3.42	4.74	3.34	3.08	0.91	1.65	0.68	0.59	0.28	0.32	0.59	0.75	1.20	1.51	3.64	0.52	7.16
F5/F6-9	Purple Garnet	21.36	0.39	4.14	0.08	4.04	0.01	0.29	0.49	4.17	<d.l	2.07	6.81	8.07	7.39	4.41	2.94	1.44	1.92	0.83	0.53	0.52	0.51	0.86	1.77	3.14	0.96	0.81	4.06	12.70
F5/F6-10	Purple Garnet	12.94	0.17	2.15	0.07	3.51	0.03	0.15	0.42	3.41	<d.l	0.63	4.42	12.19	28.85	12.83	6.47	1.16	2.64	0.73	0.44	0.45	0.30	0.27	0.63	2.61	1.14	2.02	1.13	22.16
F5/F6-11	Purple Garnet	11.35	0.42	3.26	0.08	4.26	0.02	0.07	0.98	6.39	<d.l	0.15	1.48	3.88	5.86	3.46	3.03	1.16	1.99	0.86	0.81	1.36	2.13	3.39	4.67	4.71	2.72	1.01	0.31	6.89
F5/F6-12	Purple Garnet	15.53	4.36	5.18	0.08	6.02	0.03	0.05	6.27	5.48	<d.l	0.24	0.89	1.84	2.77	4.58	5.71	7.23	5.56	7.54	7.32	7.10	6.40	6.68	5.57	6.68	1.99	1.62	0.50	3.65
F5/F6-13	Pink Garnet	11.49	0.53	3.31	0.08	5.97	<d.l	0.01	2.26	1.20	<d.l	0.05	0.24	0.33	0.88	1.32	1.43	1.29	1.13	1.85	2.52	2.79	3.45	4.83	5.38	0.78	1.88	<d.l	0.09	2.43
F5/F6-14	Pink Garnet	15.34	3.83	4.63	0.07	5.49	0.05	0.03	6.16	3.95	<d.l	0.04	0.29	0.82	1.80	3.66	4.54	5.86	4.71	6.29	5.82	6.78	7.59	8.26	8.40	4.09	1.40	2.83	0.26	1.80
F5/F6-15	Pink Garnet	15.98	1.95	4.20	0.08	5.83	0.08	0.03	4.61	3.23	<d.l	0.07	0.32	0.69	1.67	3.64	4.06	3.85	3.45	4.44	5.01	6.06	6.91	8.35	8.28	3.17	2.01	3.04	0.24	1.89
F5/F6-16	Pink Garnet	12.86	0.86	3.65	0.08	6.26	0.02	0.01	3.25	1.35	<d.l	0.06	0.28	0.60	1.11	1.45	1.43	1.96	1.60	2.74	3.60	4.33	5.20	6.81	7.72	0.79	1.73	3.24	0.10	2.48
F5/F6-17	Pink Garnet	12.33	1.28	3.53	0.09	6.39	0.01	0.01	3.96	1.73	<d.l	0.06	0.20	0.46	1.11	2.24	2.76	2.59	2.53	3.29	4.76	4.94	5.83	6.97	8.18	1.12	2.46	2.02	0.19	1.28
F5/F6-18	Pink Garnet	14.27	1.00	3.39	0.09	6.09	<d.l	0.02	5.70	1.87	<d.l	0.06	0.20	0.57	1.00	1.83	2.06	3.56	2.49	5.01	6.13	6.92	8.56	10.00	9.63	1.30	1.30	0.81	0.03	1.55
F5/F6-19	Pink Garnet	11.31	2.70	3.08	0.08	4.84	0.03	0.02	5.63	3.62	<d.l	0.11	0.56	0.82	1.20	2.30	4.02	5.90	4.14	6.02	6.29	6.51	6.74	7.21	7.05	2.89	1.32	1.01	0.23	3.45
F5/F6-20	Pink Garnet	13.06	2.24	3.13	0.08	3.18	0.04	0.03	6.43	4.62	<d.l	0.25	0.95	2.06	4.89	6.86	6.87	7.24	6.04	7.46	7.47	8.32	7.03	9.04	9.19	5.22	0.18	2.63	2.79	30.81
F5/F6-21	Pink Garnet	11.17	2.01	2.95	0.08	3.14	0.01	0.02	5.84	4.14	<d.l	0.21	0.78	1.89	4.05	6.58	7.11	5.77	5.93	6.54	6.74	6.83	6.57	8.18	8.20	3.00	0.27	2.02	2.75	24.28
F5/F6-22	Pink Garnet	12.09	2.49	3.42	0.08	6.03	0.02	0.02	0.73	4.87	<d.l	0.03	0.24	0.53	1.29	3.59	4.42	2.54	3.44	1.44	0.76	0.41	0.53	0.61	1.04	3.69	1.32	1.21	0.22	1.69
F5/F6-23	Pink Garnet	13.10	0.57	3.73	0.09	6.47	<d.l	0.02	2.40	0.43	<d.l	0.11	0.38	0.65	0.82	0.77	0.64	1.28	0.83	1.72	2.37	3.46	4.19	5.18	5.92	0.48	2.35	2.23	0.52	3.69

Table 32: Finsch unit F8 garnet trace element data.

Sample Name	Comment	Sc	Ti	V	Co	Ni	Rb	Sr	Y	Zr	Nb	La	Ce	Pr	Nd	Sm	Eu	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	Pb	Th	U
F8-1	Purple Garnet	16.41	0.06	3.82	0.08	4.32	0.10	1.18	0.31	7.05	<d.l	2.86	15.66	21.02	23.19	13.57	8.05	1.01	3.23	0.62	0.39	0.23	0.26	0.21	0.43	6.01	1.73	2.83	3.54	30.54
F8-2	Purple Garnet	23.10	0.24	3.65	0.08	4.44	0.01	0.08	1.60	25.87	<d.l	0.13	0.95	3.16	9.33	18.66	21.49	11.80	18.92	5.34	2.28	0.69	0.36	0.51	1.04	19.73	2.72	2.23	0.17	4.41
F8-3	Purple Garnet	11.88	0.58	4.16	0.08	5.81	0.02	0.09	0.80	2.88	<d.l	0.11	0.40	1.26	4.01	8.03	6.71	2.20	2.96	1.41	1.14	1.07	0.91	1.27	2.15	3.09	0.07	7.69	0.09	2.70
F8-4	Purple Garnet	11.43	1.06	3.58	0.08	5.96	0.03	0.01	4.30	1.37	<d.l	0.06	0.20	0.20	0.51	1.04	1.24	2.31	1.84	3.55	4.60	5.44	6.40	7.60	7.93	0.91	3.16	2.02	0.64	4.73
F8-5	Purple Garnet	13.71	1.06	4.29	0.08	5.63	0.05	0.03	3.02	4.08	<d.l	0.05	0.23	0.70	1.58	6.73	6.71	3.14	4.81	3.44	3.24	3.61	4.19	5.15	5.42	3.36	0.74	1.82	0.16	1.49
F8-6	Purple Garnet	16.33	1.40	5.75	0.08	3.97	0.01	0.03	2.67	1.57	<d.l	0.28	0.95	1.69	3.05	3.43	2.96	2.56	2.32	2.85	3.35	3.43	3.83	4.48	5.88	1.35	1.29	1.21	4.52	9.55
F8-7	Purple Garnet	13.72	0.56	5.16	0.08	6.11	0.07	0.06	1.26	5.33	<d.l	0.09	0.53	1.34	3.23	8.49	6.51	2.71	4.89	2.07	1.20	1.03	0.69	1.07	1.30	4.13	0.85	1.62	0.14	2.52
F8-8	Purple Garnet	16.65	0.51	2.44	0.07	4.34	0.07	0.14	0.34	8.70	<d.l	0.29	1.64	4.12	10.62	13.30	11.81	3.08	7.27	0.90	0.38	0.23	0.22	0.39	0.71	5.26	2.72	0.81	0.26	6.62
F8-9	Purple Garnet	10.07	0.20	3.90	0.08	3.40	0.03	0.04	2.17	0.04	<d.l	0.48	1.92	3.15	3.88	1.31	0.45	0.30	0.19	1.15	1.95	3.10	4.25	6.04	6.32	0.19	2.17	3.24	2.89	11.62
F8-10	Purple Garnet	15.79	1.78	4.17	0.07	3.98	0.08	0.07	3.67	10.11	<d.l	0.31	1.42	2.81	5.94	7.09	6.32	4.47	4.53	3.91	3.90	3.88	4.20	4.80	4.53	8.60	0.70	0.81	0.56	5.63
F8-11	Purple Garnet	11.65	0.58	2.40	0.08	3.25	0.03	0.01	4.75	0.64	<d.l	0.11	0.37	0.89	1.21	0.71	0.70	1.97	1.07	3.64	5.09	5.84	8.38	9.60	10.11	0.54	1.47	1.21	0.97	9.55
F8-12	Purple Garnet	17.77	0.53	2.52	0.07	4.58	0.01	0.15	0.36	9.50	<d.l	0.34	1.81	4.40	12.14	15.30	12.87	2.92	8.12	0.95	0.62	0.32	0.18	0.36	0.77	6.25	3.27	4.86	0.79	8.58
F8-13	Pink Garnet	13.42	1.33	2.76	0.09	4.22	<d.l	0.06	6.14	6.76	<d.l	0.13	1.07	2.54	4.87	7.32	7.98	7.17	6.68	7.45	6.95	7.24	7.61	9.30	9.72	3.29	2.10	4.86	0.24	6.22
F8-14	Pink Garnet	11.95	1.55	3.35	0.09	4.88	<d.l	0.00	4.61	1.12	<d.l	0.05	0.04	0.10	0.17	0.88	1.91	3.90	2.55	4.39	5.54	6.02	7.22	8.71	9.13	1.40	0.33	2.02	0.17	2.50
F8-15	Pink Garnet	14.80	3.38	4.59	0.08	4.61	0.03	0.05	7.89	11.91	<d.l	0.07	0.58	1.85	4.28	10.51	12.71	9.83	11.29	10.08	9.20	9.21	9.29	9.85	10.15	11.12	2.57	<d.l	0.19	2.23
F8-16	Pink Garnet	13.31	1.54	3.26	0.09	4.82	0.00	0.01	5.14	1.20	<d.l	0.07	0.05	0.07	0.25	1.10	1.89	4.09	2.53	4.62	5.74	6.49	6.84	9.19	9.04	1.14	0.69	2.63	0.33	3.38
F8-17	Pink Garnet	13.29	0.19	2.60	0.08	3.80	0.00	0.05	2.03	2.82	<d.l	0.22	1.28	3.66	6.92	8.22	6.18	2.09	3.52	1.77	2.12	2.69	3.56	5.17	6.77	1.08	1.84	0.40	0.29	7.75
F8-18	Pink Garnet	14.85	2.19	5.12	0.08	6.80	0.03	0.03	3.93	1.89	<d.l	0.08	0.36	0.93	1.53	2.43	2.71	3.96	2.89	3.96	4.51	4.89	5.10	6.60	7.98	2.26	1.94	1.82	0.29	2.64
F8-19	Pink Garnet	12.82	1.13	3.20	0.09	6.04	0.02	0.02	4.47	2.24	<d.l	0.03	0.20	0.39	1.41	3.23	2.90	2.78	2.58	3.53	4.51	5.91	7.41	8.95	9.65	1.62	1.91	1.42	0.14	1.96
F8-20	Pink Garnet	19.36	1.67	5.71	0.08	5.94	0.04	0.05	1.35	2.09	<d.l	0.15	0.72	1.85	3.06	3.20	2.44	1.61	1.79	1.48	1.60	1.33	1.11	2.32	2.28	1.94	3.82	1.21	0.60	3.51
F8-21	Pink Garnet	11.43	0.57	2.84	0.09	6.07	0.04	0.01	3.21	0.55	1.14	0.06	0.24	0.52	1.30	1.95	1.68	1.55	1.24	2.53	3.40	4.39	4.99	7.30	6.89	0.39	2.02	0.81	0.16	1.67
F8-22	Pink Garnet	14.65	1.54	3.04	0.08	6.09	0.03	0.02	8.28	3.17	1.00	0.04	0.24	0.74	1.46	2.64	3.01	5.24	3.51	7.38	9.62	10.64	11.57	15.36	16.06	2.53	2.16	4.05	0.10	1.35
F8-23	Pink Garnet	17.57	0.95	3.68	0.08	3.81	0.06	0.07	4.13	18.37	1.55	0.14	0.87	2.94	7.99	19.62	19.74	10.06	14.14	7.25	5.17	3.51	3.18	3.45	4.02	10.12	1.95	1.42	0.22	4.66
F8-24	Pink Garnet	10.74	1.28	2.88	0.08	5.85	0.03	0.01	5.83	2.13	0.97	0.06	0.23	0.62	0.99	1.61	2.32	3.94	2.54	5.53	6.58	7.64	8.48	10.11	11.28	1.61	2.02	1.62	0.12	1.55
F8-25	Pink Garnet	11.11	1.37	2.83	0.09	6.11	0.05	0.02	5.77	2.26	1.07	0.04	0.22	0.41	1.23	2.37	2.36	4.01	2.63	5.30	6.71	7.63	9.98	11.60	11.45	1.58	1.99	2.23	0.10	0.27

Appendix D: Kimberlite indicator mineral sorting results

Table 33: Kimberlite indicator mineral sorting results for unit F1

Finsch

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY
INDICATOR MINERAL SORTING RESULTS

LAB NO: Helam Lab
SAMPLE NO: MSC 9
BATCH NO: F1
PICKER'S NAME: KARABO THUNTSI
DATE STARTED: 12 Nov 2015
DATE COMPLETED: 17 Nov 2015

CONC. CHECKED BY:
QC. BY:
capture:
results:
stock:

SIEVE FRACTION WEIGHTS OF 100%

GROSS SINKS:	23,453 g
Sieve Sizes	Weights
-300	1,932 g
+300-425	3,232 g
+425-710	4,400 g
+710-1000	3,338 g
+1000	10,532 g
TOTAL SINKS:	23,434 g

NOTES:

MSC 9

Unit F1

THINGS TO REMEMBER

Sort for all Garnets, C.D., & Chromites.
G10&G9_120-180 Grains
Megacrystic_60 Grains
Eclogitic_60 Grains
Ilmenite_60 Grains
Chromite_60 Chrome Grains
Diopside_60 Grains

INDICATOR MINERAL SORTING RESULTS

Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
7B 0.78%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
7A 0.78%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
6 1.56%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
4B 5 3.12%		0,181	+300-425	58	64	66	7	15	12	2
		0,197	+425-710							4
			+710-1000							
			+1000							
			Total	58	64	66	7	15	12	2
4A 6.25%		0,163	+300-425				10	13	13	3
		0,313	+425-710							6
			+710-1000							
			+1000							
			Total				10	13	13	3
3 12.5%		0,436	+300-425				45	32	29	5
		0,501	+425-710							20
			+710-1000							
			+1000							
			Total				45	32	29	5
2 25%		0,774	+300-425							3
			+425-710							
			+710-1000							
			+1000							
			Total							3
1 50%		1,681	+300-425							7
			+425-710							
			+710-1000							
			+1000							
			Total	58	64	66	62	60	54	50
			Grand Total:							

Lowest Split:	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
	58	64	66	62	60	54	50

Table 34: Kimberlite indicator mineral sorting results for unit F2

Finsch (KARABO)

SIEVE FRACTION WEIGHTS OF 100%	
GROSS SINKS:	170.209 g
Sieve Sizes	Weights
-300	4.959 g
+300-425	10.983 g
+425-710	22.551 g
+710-1000	22.684 g
+1000	108.962 g
TOTAL SINKS:	170.106 g

THINGS TO REMEMBER

G10 & G9 _ 120 Grains

Red & Orange _ 120 Grains

Opaques _ 60 Grains

Chrome Diopside _ 60 Grains

NOTES:

MSC 5

Unit F2

LAB NO: FIN 147

SAMPLE NO: MSC-5-L10-EXT-3

BATCH NO: 02/12/2015

PICKER'S NAME: MARIKA

DATE STARTED: 05-01-16

DATE COMPLETED: 05-01-16

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY

INDICATOR MINERAL SORTING RESULTS

capture: 18/01/16

results:

stock:

CONC. CHECKED BY: Marci René

QC. BY: Hes

INDICATOR MINERAL SORTING RESULTS

	Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10 & G9)	Red & Orange	Ilmenites	Chromites	Chrome Diopside
7	7B 0.78%		0.079	+300-425	0	1	2	0	0
			0.173	+425-710	0	N/A	N/A	N/A	0
			0.219	+710-1000	0	N/A	N/A	N/A	0
			0.741	+1000	0	N/A	N/A	N/A	0
				Total	0	1	2	0	0
6	7A 0.78%		0.072	+300-425	1	2	1	1	0
			0.157	+425-710	0	N/A	N/A	N/A	0
			0.187	+710-1000	0	N/A	N/A	N/A	0
			0.745	+1000	0	N/A	N/A	N/A	0
				Total	1	2	1	1	0
5	6 1.56%		0.160	+300-425	1	1	5	0	0
			0.332	+425-710	1	N/A	N/A	N/A	0
			0.339	+710-1000	2	N/A	N/A	N/A	0
			1.227	+1000	0	N/A	N/A	N/A	0
				Total	4	1	5	0	0
4	5 3.12%		0.301	+300-425	2	6	5	2	0
			0.135	+425-710	5	N/A	N/A	N/A	0
			0.137	+710-1000	0	N/A	N/A	N/A	0
			3.501	+1000	0	N/A	N/A	N/A	0
				Total	7	6	5	2	0
3	4 6.25%		0.611	+300-425	1	6	16	4	0
			1.331	+425-710	3	N/A	N/A	N/A	0
			1.332	+710-1000	0	N/A	N/A	N/A	0
			5.751	+1000	1	N/A	N/A	N/A	0
				Total	5	6	16	4	0
2	3 12.5%		1.295	+300-425	11	17	25	7	0
			2.642	+425-710	5	N/A	N/A	N/A	0
			2.747	+710-1000	1	N/A	N/A	N/A	0
			12.956	+1000	3	N/A	N/A	N/A	0
				Total	20	17	25	7	0
1	2 25%		2.707	+300-425	20	26	N/A	16	0
			5.710	+425-710	6	N/A	N/A	N/A	0
			5.821	+710-1000	4	N/A	N/A	N/A	0
			27.241	+1000	3	N/A	N/A	N/A	0
				Total	33	26	N/A	16	0
0	1 50%		5.615	+300-425	20	85	N/A	30	0
			11.427	+425-710	11	N/A	N/A	N/A	0
			11.332	+710-1000	7	N/A	N/A	N/A	1
			56.496	+1000	3	N/A	N/A	N/A	0
				Total	41	85	N/A	30	1

	Purple G10	Purple G9	Red	Orange	Ilmenites	Chromites	Crome Diopside
Grand Total:	52	59	117	27	54	60	1

Lowest Split:	Purple (G10 & G9)		Red & Orange		Ilmenites	Chromites	Chrome Diopside
Lowest Split Number of	0	0	0	0	2	0	0

Table 35: Additional kimberlite indicator mineral sorting results for unit F2

Finsch

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY
INDICATOR MINERAL SORTING RESULTS

LAB NO: Helam Lab

SAMPLE NO: MSC 5B (S70/172)

BATCH NO: F2

PICKER'S NAME: KARABO THUNTSI

DATE STARTED: 2 MARCH 2016

DATE COMPLETED: 15 March 2016

CONC. CHECKED BY:

QC. BY:

capture:
results:
stock:

SIEVE FRACTION WEIGHTS OF 100%		
GROSS SINKS:	367,088	g
Sieve Sizes	Weights	
-300	21,556	g
+300-425	40,182	g
+425-710	62,405	g
+710-1000	55,477	g
+1000	186,900	g
TOTAL SINKS:	366,520	g

THINGS TO REMEMBER

Sort for all Garnets, C.D., & Chromites.
G10&G9_120-180 Grains
Megacrystic_60 Grains
Eclogitic_60 Grains
Ilmenite_60 Grains
Chromite_60 Grains
Chrome Diopside_60 Grains

NOTES:

Additional grains for probing

MSC 5B

Unit F2

INDICATOR MINERAL SORTING RESULTS

Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
7B 0.78%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
7A 0.78%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
5B 6 1.56%		1,362	+300-425							0
			+425-710							NA
			+710-1000							NA
			+1000							NA
			Total							NA
5A 3.12%		1,322	+300-425							0
			+425-710							NA
			+710-1000							NA
			+1000							NA
			Total							NA
4 6.25%		2,585	+300-425							0
			+425-710							NA
			+710-1000							NA
			+1000							NA
			Total							NA
3 12.5%		5,140	+300-425							3
			+425-710							NA
			+710-1000							NA
			+1000							NA
			Total							NA
2 25%		9,682	+300-425							6
			+425-710							NA
			+710-1000							NA
			+1000							NA
			Total							NA
1 50%			+300-425							NA
			+425-710							NA
			+710-1000							NA
			+1000							NA
			Total							NA
			Grand Total:							9

	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
Lowest Split:	N/A	N/A	N/A	N/A	N/A	N/A	9

Table 36: Additional kimberlite indicator mineral sorting results for unit F2

Finsch

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY
INDICATOR MINERAL SORTING RESULTS

LAB NO: Helam Lab
SAMPLE NO: MSC 5C (S70/173)
BATCH NO: F2
PICKER'S NAME: KARABO THUNTSI
DATE STARTED: 25 Feb 2016
DATE COMPLETED: 2 March 2016

capture:
results:
stock:
CONC. CHECKED BY:
QC. BY:

SIEVE FRACTION WEIGHTS OF 100%

Sieve Sizes	Weights	
GROSS SINKS:	162,289	g
-300	11,632	g
+300-425	19,383	g
+425-710	23,365	g
+710-1000	19,322	g
+1000	85,451	g
TOTAL SINKS:	159,152	g

NOTES: Additional grains for probing

MSC 5C

Unit F2

THINGS TO REMEMBER

Sort for all Garnets, C.D., & Chromites.
G10&G9_120-180 Grains
Megacrystic_60 Grains
Eclogitic_60 Grains
Ilmenite_60 Grains
Chromite_60 Grains
Chrome Diopside_60 Grains

INDICATOR MINERAL SORTING RESULTS

Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
7B 0.78%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
7A 0.78%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
5B6 1.56%		0,624	+300-425				0			3
		0,739	+425-710				NA			0
		0,622	+710-1000				NA			0
		2,400	+1000				NA			0
			Total				0			3
5A 3.12%		0,618	+300-425				0			1
		0,775	+425-710				NA			0
		0,546	+710-1000				NA			0
		2,547	+1000				NA			0
			Total				0			1
4 6.25%		1,179	+300-425				0			1
		1,656	+425-710				NA			1
		1,218	+710-1000				NA			0
		5,084	+1000				NA			0
			Total				NA			2
3 12.5%		2,283	+300-425				0			6
		3,192	+425-710				NA			2
		2,289	+710-1000				NA			0
		12,209	+1000				NA			0
			Total				0			8
2 25%		4,717	+300-425				9			8
		6,589	+425-710				NA			2
		4,810	+710-1000				NA			0
		21,865	+1000				NA			0
			Total				9			10
1 50%		9,951	+300-425				20			8
		13,402	+425-710				NA			8
		9,822	+710-1000				NA			2
		41,282	+1000				NA			0
			Total				20			18
			Grand Total:				29			32

	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
Lowest Split:	N/A	N/A	N/A	29	N/A	N/A	42

Table 37: Kimberlite indicator mineral sorting results for unit F3

Finsch

SIEVE FRACTION WEIGHTS OF 100%		
GROSS SINKS:	141,88	g
Sieve Sizes	Weights	
-300	12,696	g
+300-425	5,543	g
+425-710	10,587	g
+710-1000	12,130	g
+1000	100,705	g
TOTAL SINKS:	141,861	g

NOTES: Kerabo.

MSC 3

Unit F3

THINGS TO REMEMBER

G10 & G9 _ 120 Grains

Red & Orange _ 120 Grains

Opaques _ 60 Grains

Chrome Diopside _ 60 Grains

INDICATOR MINERAL SORTING RESULTS

	Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10 & G9)	Red & Orange	Ilmenites	Chromites	Chrome Diopside
5	5B 0.78%		0,113	+300-425	1	0	51	6	0
			0,327	+425-710	0	0	N/A	N/A	0
			0,354	+710-1000	0	0	N/A	N/A	0
			3,132	+1000	0	0	N/A	N/A	0
				Total	1	0	51	6	0
4	5A 0.78%		0,181	+300-425	2	0	N/A	3	0
			0,339	+425-710	0	0	N/A	N/A	0
			0,320	+710-1000	0	0	N/A	N/A	0
			2,930	+1000	0	0	N/A	N/A	0
				Total	2	0	N/A	3	0
3	4 1.56%		0,322	+300-425	0	0	N/A	17	0
			0,625	+425-710	0	0	N/A	N/A	1
			0,797	+710-1000	0	0	N/A	N/A	0
			5,975	+1000	0	0	N/A	N/A	0
				Total	0	0	N/A	17	1
2	3 3.12%		0,644	+300-425	0	0	N/A	10	0
			1,207	+425-710	0	0	N/A	N/A	3
			1,522	+710-1000	0	0	N/A	N/A	0
			12,425	+1000	0	0	N/A	N/A	0
				Total	0	0	N/A	10	3
1	2 6.25%		1,399	+300-425	5	1	N/A	21	1
			2,676	+425-710	0	0	N/A	N/A	2
			3,087	+710-1000	0	1	N/A	N/A	0
			25,451	+1000	0	0	N/A	N/A	0
				Total	5	2	N/A	21	3
0	1 12.5%		2,843	+300-425	3	1	N/A	N/A	1
			5,400	+425-710	3	1	N/A	N/A	2
			6,102	+710-1000	0	0	N/A	N/A	2
			50,892	+1000	0	0	N/A	N/A	0
				Total	6	2	N/A	N/A	5
	2 25%			+300-425					
				+425-710					
				+710-1000					
				+1000					
				Total					
	1 50%			+300-425					
				+425-710					
				+710-1000					
				+1000					
				Total					

	Purple G10	Purple G9	Red	Orange	Ilmenites	Chromites	Crome Diopside
Grand Total:	12	2	4	0	51	57	12.

Lowest Split:	Purple (G10 & G9)		Red & Orange		Ilmenites	Chromites	Chrome Diopside
Lowest Split Number of	0	0	0	0	5	5	0

LAB NO: FIN145

SAMPLE NO. MSC.3.72L EKT-3 58717

BATCH NO: 02/12/2015

PICKER'S NAME: Merel

DATE STARTED: 01/12/15

DATE COMPLETED: 04/12/15

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY

INDICATOR MINERAL SORTING RESULTS

CONC. CHECKED BY: MARVIN.

QC. BY: HES.

capture: 18/01/16 ✓

results:

stock:

Table 38: Kimberlite indicator mineral sorting results for unit F4

Finsch

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY
INDICATOR MINERAL SORTING RESULTS

SIEVE FRACTION WEIGHTS OF 100%		
GROSS SINKS:	209,50	g
Sieve Sizes	Weights	
-300	6,156	g
+300-425	11,352	g
+425-710	26,663	g
+710-1000	28,938	g
+1000	136,420	g
TOTAL SINKS:		g

NOTES:
Kara bo.

MSC 1

Unit F4

THINGS TO REMEMBER
G10 & G9 _ 120 Grains
Red & Orange _ 120 Grains
Opaques _ 60 Grains
Chrome Diopside _ 60 Grains

LAB NO: FIN 144
SAMPLE NO: finsch MSC.1.L70 EKT.2 585523
BATCH NO: 02/12/2015
PICKER'S NAME: René
DATE STARTED: 26-11-2015
DATE COMPLETED: 11-12-2015

capture: 18/01/16
results:
stock:

CONC. CHECKED BY:
QC. BY:

INDICATOR MINERAL SORTING RESULTS

	Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10 & G9)	Red & Orange	Ilmenites	Chromites	Chrome Diopside
	7B 0.78%			+300-425					
				+425-710					
				+710-1000					
				+1000					
				Total					
	7A 0.78%			+300-425					
				+425-710					
				+710-1000					
				+1000					
				Total					
	6 1,56%			+300-425					
				+425-710					
				+710-1000					
				+1000					
				Total					
4	4B 3.12%		0,519	+300-425	0	1	4	4	0
			1,549	+425-710	0	0	0	0	0
			1,698	+710-1000	1	0	0	0	0
			9,490	+1000	0	0	0	0	0
				Total	1	1	4	4	0
3	4A 6.25%		0,733	+300-425	0	0	4	3	0
			1,523	+425-710	1	0	3	1	0
			1,819	+710-1000	0	0	0	0	0
			8,777	+1000	0	0	0	0	0
				Total	1	0	7	4	0
2	3 12.5%		1,422	+300-425	0	0	3	1	0
			3,347	+425-710	1	0	0	0	2
			3,748	+710-1000	0	0	0	1	0
			18,226	+1000	0	0	0	0	0
				Total	1	0	3	2	2
1	2 25%		2,802	+300-425	0	0	0	2	0
			6,625	+425-710	0	0	4	10	1
			6,768	+710-1000	0	0	1	1	1
			35,975	+1000	0	0	0	0	0
				Total	0	0	5	13	2
0	1 50%		5,877	+300-425	0	0	0	0	0
			13,595	+425-710	1	0	3	8	2
			14,902	+710-1000	0	0	2	2	1
			65,881	+1000	0	0	0	1	0
				Total	1	0	5	11	3

	Purple G10	Purple G9	Red	Orange	Ilmenites	Chromites	Crome Diopside
Grand Total:	1	3	1	0	24	34	7

Lowest Split:	Purple (G10 & G9)		Red & Orange		Ilmenites	Chromites	Chrome Diopside
Lowest Split Number of	0	0	0	0	0	0	0

Table 39: Additional kimberlite indicator mineral sorting results for unit F4

Finsch

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY
INDICATOR MINERAL SORTING RESULTS

LAB NO: Helam Lab
SAMPLE NO: MSC1 (S73/068)
BATCH NO: F4
PICKER'S NAME: KARABO THUNTSI
DATE STARTED: 20 APRIL 2016
DATE COMPLETED: 21 APRIL 2016

capture:
results:
stock:

CONC. CHECKED BY:

QC. BY:

SIEVE FRACTION WEIGHTS OF 100%	
GROSS SINKS:	g
Sieve Sizes	Weights
-300	g
+300-425	g
+425-710	g
+710-1000	g
+1000	g
TOTAL SINKS:	g

NOTES: Additional grains for probing

MSC 1B

Unit F4

THINGS TO REMEMBER

Sort for all Garnets, C.D., & Chromites.
G10&G9_120-180 Grains
Megacrystic_60 Grains
Eclogitic_60 Grains
Ilmenite_60 Grains
Chromite_60 Grains
Chrome Diopside_60 Grains

INDICATOR MINERAL SORTING RESULTS

Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
7B 0.78%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
7A 0.78%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
6 1.56%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
4B 5 3.12%		0,582	+300-425	1	1	1	1	NA	NA	0
		0,474	+425-710	0	0	0	0	NA	NA	0
		0,106	+710-1000	0	0	0	0	NA	NA	0
		0,061	+1000	0	0	0	0	NA	NA	0
			Total	1	1	1	1	NA	NA	0
4A 6.25%		0,605	+300-425	0	0	2	2	NA	NA	0
		0,488	+425-710	1	0	2	1	NA	NA	0
		0,099	+710-1000	1	0	0	0	NA	NA	0
		0,053	+1000	0	0	1	0	NA	NA	0
			Total	2	0	5	3	NA	NA	0
3 12.5%		1,220	+300-425	1	2	2	1	NA	NA	0
		0,968	+425-710	2	1	3	2	NA	NA	0
		0,265	+710-1000	0	0	0	0	NA	NA	0
		0,243	+1000	1	0	0	0	NA	NA	0
			Total	4	3	5	3	NA	NA	0
2 25%		2,677	+300-425	6	9	5	6	NA	NA	0
		0,986	+425-710	6	1	5	3	NA	NA	0
		0,455	+710-1000	0	0	0	0	NA	NA	0
		0,313	+1000	1	0	1	0	NA	NA	0
			Total	13	10	11	9	NA	NA	0
1 50%		5,361	+300-426	9	13	14	9	NA	NA	0
		3,806	+425-710	11	3	12	2	NA	NA	1
		0,965	+710-1000	2	0	0	0	NA	NA	0
		0,493	+1000	0	0	1	0	NA	NA	0
			Total	22	16	27	11	NA	NA	1
			Grand Total:	43	30	49	27	NA	NA	1

Lowest Split:	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside

Table 40: Additional kimberlite indicator mineral sorting results for unit F4

Finsch

SIEVE FRACTION WEIGHTS OF 100%	
GROSS SINKS:	g
Sieve Sizes	Weights
-300	g
+300-425	g
+425-710	g
+710-1000	g
+1000	g
TOTAL SINKS:	g

NOTES: Additional grains for probing

MSC 1C

Unit F4

THINGS TO REMEMBER

Sort for all Garnets, C.D., & Chromites.
G10&G9_120-180 Grains
Megacrystic_60 Grains
Eclogitic_60 Grains
Ilmenite_60 Grains
Chromite_60 Grains
Chrome Diopside_60 Grains

LAB NO: Helam Lab

SAMPLE NO: 573/069 (MSC 1)

BATCH NO: F4

PICKER'S NAME: KARABO THUNTSI

DATE STARTED: 21 APRIL 2016

DATE COMPLETED: 21 APRIL 2016

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY
INDICATOR MINERAL SORTING RESULTS

capture: | results: | stock:

CONC. CHECKED BY:

QC. BY:

INDICATOR MINERAL SORTING RESULTS

Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
7B 0.78%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
7A 0.78%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
6 1.56%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
4B 3.12%		0,936	+300-425	15	27	NA	15	NA	NA	1
			+425-710	NA	NA	NA	NA	NA	NA	NA
			+710-1000	NA	NA	NA	NA	NA	NA	NA
			+1000	NA	NA	NA	NA	NA	NA	NA
			Total	15	27	NA	15	NA	NA	1
4A 6.25%		0,976	+300-425	NA	NA	NA	NA	NA	NA	2
			+425-710	NA	NA	NA	NA	NA	NA	NA
			+710-1000	NA	NA	NA	NA	NA	NA	NA
			+1000	NA	NA	NA	NA	NA	NA	NA
			Total	NA	NA	NA	NA	NA	NA	2
3 12.5%		1,809	+300-425	NA	NA	NA	NA	NA	NA	8
			+425-710	NA	NA	NA	NA	NA	NA	NA
			+710-1000	NA	NA	NA	NA	NA	NA	NA
			+1000	NA	NA	NA	NA	NA	NA	NA
			Total	NA	NA	NA	NA	NA	NA	8
2 25%		3,547	+300-425	NA	NA	NA	NA	NA	NA	16
			+425-710	NA	NA	NA	NA	NA	NA	NA
			+710-1000	NA	NA	NA	NA	NA	NA	NA
			+1000	NA	NA	NA	NA	NA	NA	NA
			Total	NA	NA	NA	NA	NA	NA	16
1 50%			+300-425	NA	NA	NA	NA	NA	NA	NA
			+425-710	NA	NA	NA	NA	NA	NA	NA
			+710-1000	NA	NA	NA	NA	NA	NA	NA
			+1000	NA	NA	NA	NA	NA	NA	NA
			Total	NA	NA	NA	NA	NA	NA	NA
			Grand Total:	15	27	NA	15	NA	NA	27

Lowest Split:	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside

Table 41: Additional kimberlite indicator mineral sorting results for unit F4

Finsch

SIEVE FRACTION WEIGHTS OF 100%

GROSS SINKS:	223,522	g
Sieve Sizes	**Weights**	
-300	11,138	g
+300-425	28,853	g
+425-710	41,950	g
+710-1000	32,405	g
+1000	109,114	g
TOTAL SINKS:	223,460	g

NOTES:

Additional grains for probing

MSC 1D

Unit F4

THINGS TO REMEMBER

Sort for all Garnets, C.D., & Chromites.
G10&G9_120-180 Grains
Megacrystic_60 Grains
Eclogitic_60 Grains
Ilmenite_60 Grains
Chromite_60 Grains Chrome
Diopside_60 Grains

LAB NO: Helam Lab

SAMPLE NO: MSC1 (S73/070)

BATCH NO: F4

PICKER'S NAME: KARABO THUNTSI

DATE STARTED: 14 MARCH 2016

DATE COMPLETED: 20 APRIL 2016

capture:
results:
stock:

CONC. CHECKED BY:

QC. BY:

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY
INDICATOR MINERAL SORTING RESULTS

INDICATOR MINERAL SORTING RESULTS

Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
7B			+300-425							
0.78%			+425-710							
			+710-1000							
			+1000							
			Total							
7A			+300-425							
0.78%			+425-710							
			+710-1000							
			+1000							
			Total							
6			+300-425							
1.56%			+425-710							
			+710-1000							
			+1000							
			Total							
4B 5	1,766	20	+300-425	0	0	0	0	1	17	0
3.12%	2,644	10	+425-710	0	0	0	0	NA	NA	0
	2,230	10	+710-1000	0	0	0	0	NA	NA	1
	7,452		+1000	0	0	0	0	NA	NA	0
			Total	0	0	0	0	1	17	1
4A	1,816	20	+300-425	0	0	0	0	4	NA	0
6.25%	2,665	10	+425-710	0	0	0	0	NA	NA	0
	2,159	10	+710-1000	0	0	0	0	NA	NA	1
	7,309		+1000	0	0	0	0	NA	NA	0
			Total	0	0	0	0	4	NA	1
3	3,670	10	+300-425	0	0	0	1	11	NA	0
12.5%	5,567	20	+425-710	0	0	1	0	NA	NA	2
	4,385	20	+710-1000	0	0	0	0	NA	NA	0
	14,727		+1000	0	0	0	0	NA	NA	0
			Total	0	0	1	1	11	NA	2
2	7,262	20	+300-425	0	1	1	3	17	NA	1
25%	10,588	30	+425-710	1	0	0	0	NA	NA	0
	8,157	20	+710-1000	1	0	0	0	NA	NA	0
	28,662		+1000	0	0	0	0	NA	NA	0
			Total	2	1	1	3	17	NA	1
1	14,338	30	+300-425	0	0	0	2	NA	NA	2
50%	20,493	40	+425-710	0	1	0	2	NA	NA	0
	15,473	20	+710-1000	0	0	0	1	NA	NA	0
	50,917	20	+1000	0	0	0	0	NA	NA	0
			Total	0	1	0	5	NA	NA	2
			Grand Total:	2	2	2	9	33	17	7

	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
Lowest Split:							

Table 42: Kimberlite indicator mineral sorting results for unit F5/F6

Finsch

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY
INDICATOR MINERAL SORTING RESULTS

LAB NO: FIN 14
SAMPLE NO: MSC-4-L61-SLT-6
BATCH NO: 02/12/2016
PICKER'S NAME: [illegible]
DATE STARTED: 11/12/16
DATE COMPLETED: 11/12/16
CONC. CHECKED BY:
QC. BY:
capture:
results:
stock:

SIEVE FRACTION WEIGHTS OF 100%	
GROSS SINKS:	58.01 g
Sieve Sizes	Weights
-300	3.495 g
+300-425	15.328 g
+425-710	18.212 g
+710-1000	7.748 g
+1000	13.178 g
TOTAL SINKS:	57.961 g

NOTES:

MSC 4

Unit F5/F6

THINGS TO REMEMBER

G10 & G9 _ 120 Grains
Red & Orange _ 120 Grains
Opaques _ 60 Grains
Chrome Diopside _ 60 Grains

INDICATOR MINERAL SORTING RESULTS

	Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10 & G9)	Red & Orange	Ilmenites	Chromites	Chrome Diopside
7	7B 0.78%		0.111	+300-425	12	10	5	1	0
			0.127	+425-710	N/A	N/A	N/A	N/A	0
			0.056	+710-1000	N/A	N/A	N/A	N/A	0
			0.123	+1000	N/A	N/A	N/A	N/A	0
				Total	12	10	5	1	0
6	7A 0.78%		0.117	+300-425	19	13	5	3	0
			0.134	+425-710	N/A	N/A	N/A	N/A	0
			0.050	+710-1000	N/A	N/A	N/A	N/A	0
			0.112	+1000	N/A	N/A	N/A	N/A	0
				Total	19	13	5	3	0
5	6 1.56%		0.246	+300-425	28	25	3	5	0
			0.267	+425-710	N/A	N/A	N/A	N/A	0
			0.122	+710-1000	N/A	N/A	N/A	N/A	0
			0.158	+1000	N/A	N/A	N/A	N/A	0
				Total	28	25	3	5	0
4	5 3.12%		0.463	+300-425	53	58	5	6	0
			0.501	+425-710	N/A	N/A	N/A	N/A	0
			0.285	+710-1000	N/A	N/A	N/A	N/A	0
			0.520	+1000	N/A	N/A	N/A	N/A	0
				Total	53	58	5	6	0
3	4 6.25%		0.967	+300-425	N/A	N/A	33	10	0
			1.072	+425-710	N/A	N/A	N/A	N/A	0
			0.186	+710-1000	N/A	N/A	N/A	N/A	0
			0.604	+1000	N/A	N/A	N/A	N/A	0
		/		Total	N/A	N/A	33	10	0
2	3 12.5%		1.635	+300-425	N/A	N/A	N/A	29	0
			2.170	+425-710	N/A	N/A	N/A	N/A	0
			0.972	+710-1000	N/A	N/A	N/A	N/A	0
			1.411	+1000	N/A	N/A	N/A	N/A	0
				Total	N/A	N/A	N/A	29	0
1	2 25%		4.071	+300-425	N/A	N/A	N/A	N/A	0
			4.711	+425-710	N/A	N/A	N/A	N/A	0
			2.001	+710-1000	N/A	N/A	N/A	N/A	0
			3.312	+1000	N/A	N/A	N/A	N/A	0
				Total	N/A	N/A	N/A	N/A	0
0	1 50%		7.521	+300-425	N/A	N/A	N/A	N/A	0
			9.225	+425-710	N/A	N/A	N/A	N/A	0
			3.826	+710-1000	N/A	N/A	N/A	N/A	0
			7.087	+1000	N/A	N/A	N/A	N/A	0
				Total	N/A	N/A	N/A	N/A	0

	Purple G10	Purple G9	Red	Orange	Ilmenites	Chromites	Chrome Diopside
Grand Total:	62	50	75	31	51	51	0

Lowest Split:	Purple (G10 & G9)		Red & Orange		Ilmenites	Chromites	Chrome Diopside
Lowest Split Number of	4	4	4	4	3	2	0

Table 43: Additional kimberlite indicator mineral sorting results for unit F5/F6

Finsch

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY
INDICATOR MINERAL SORTING RESULTS

capture:
results:
stock:

CONC. CHECKED BY:

QC. BY:

SIEVE FRACTION WEIGHTS OF 100%	
GROSS SINKS:	191,399 g
Sieve Sizes	Weights
-300	7,791 g
+300-425	18,691 g
+425-710	25,310 g
+710-1000	21,992 g
+1000	117,602 g
TOTAL SINKS:	191,886 g

NOTES: Additional grains for probing

LAB NO: Helam Lab

SAMPLE NO: MSC 2

BATCH NO: F5/F6 – SWPC

PICKER'S NAME: KARABO THUNTSI

DATE STARTED: 19 Oct 2015

DATE COMPLETED: 11 Nov 2015

THINGS TO REMEMBER

Sort for all Garnets, C.D., & Chromites.
G10&G9_120-180 Grains
Megacrystic_60 Grains
Eclogitic_60 Grains
Ilmenite_60 Grains
Chromite_60 Grains
Chrome Diopside_60 Grains

MSC 4B

Unit F5/F6

INDICATOR MINERAL SORTING RESULTS

Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
7B 0.78%			+300-425	7	13	3	7	0	2	0
			+425-710					0		0
			+710-1000					0		0
			+1000					0		0
			Total	7	13	3	7	0	2	0
7A 0.78%			+300-425	5	14	6	1	0	2	0
			+425-710					0		0
			+710-1000					0		0
			+1000					0		0
			Total	5	14	6	1	0	2	0
6 1.56%			+300-425	17	33	5	1	1	4	0
			+425-710					0		1
			+710-1000					0		0
			+1000					0		0
			Total	17	33	5	1	1	4	1
5 3.12%			+300-425	32		30	18	2	4	0
			+425-710					0		1
			+710-1000					0		0
			+1000					0		0
			Total	32		30	18	2	4	1
4 6.25%			+300-425			28	36	0	15	0
			+425-710					0		0
			+710-1000					0		0
			+1000					0		0
			Total			28	36	0	15	0
3 12.5%			+300-425					3	30	0
			+425-710					0		0
			+710-1000					0		0
			+1000					0		0
			Total					3	30	0
2 25%			+300-425					1		0
			+425-710					0		1
			+710-1000					0		0
			+1000					0		0
			Total					1		1
1 50%			+300-425					2		0
			+425-710					0		1
			+710-1000					0		0
			+1000					0		0
			Total					2		1
			Grand Total:	61	60	72	63	9	57	5

Lowest Split:	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside

Table 44: Additional kimberlite indicator mineral sorting results for unit F5/F6

Finsch

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY
INDICATOR MINERAL SORTING RESULTS

capture: | results: | stock:

CONC. CHECKED BY:

QC. BY:

LAB NO: Helam Lab

SAMPLE NO: MSC 6

BATCH NO: F5/F6 - SWPC

PICKER'S NAME: KARABO THUNTSI

DATE STARTED: 13 DEC 2015

DATE COMPLETED: 18 Jan 2016

SIEVE FRACTION WEIGHTS OF 100%

GROSS SINKS:	642,859 g
Sieve Sizes	**Weights**
-300	30,738 g
+300-425	63,468 g
+425-710	152,121 g
+710-1000	108,652 g
+1000	287,700 g
TOTAL SINKS:	642,679 g

NOTES: Additional grains for probing

MSC 4B

Unit F5/F6

THINGS TO REMEMBER

Sort for all Garnets, C.D., & Chromites.
G10&G9_120-180 Grains
Megacrystic_60 Grains
Eclogitic_60 Grains
Ilmenite_60 Grains
Chromite_60 Grains
Chrome Diopside_60 Grains

INDICATOR MINERAL SORTING RESULTS

Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
7B 0.78%		0,469	+300-425	2	12	7	7	1	1	1
		0,878	+425-710					0		0
		0,590	+710-1000					0		0
		1,946	+1000					0		0
			Total					1		1
7A 0.78%		0,406	+300-425	5	9	7	11	2	2	0
		1,060	+425-710					0		0
		0,663	+710-1000					0		0
		2,095	+1000					0		0
			Total	5	9	7	11	2		0
6 1.56%		0,888	+300-425	11	7	23	13	0	6	2
		2,174	+425-710					0		0
		1,549	+710-1000					0		0
		4,457	+1000					0		0
			Total	11	7	23	13	0	6	2
5 3.12%		1,785	+300-425	38	31	26	23	1	12	1
		4,493	+425-710					0		
		3,074	+710-1000					0		0
		8,892	+1000					0		0
			Total							
4 6.25%		3,813	+300-425	NA	NA	NA	NA	2	31	3
		9,601	+425-710					0		
		6,582	+710-1000					0		0
		17,704	+1000					0		0
			Total					2	31	3
3 12.5%		7,690	+300-425	NA	NA	NA	NA	2	NA	4
		18,790	+425-710					0		0
		12,692	+710-1000					0		0
		33,123	+1000					0		0
			Total					2		4
2 25%		16,255	+300-425	NA	NA	NA	NA	3	NA	3
		37,871	+425-710					0		0
		27,645	+710-1000					0		0
		71,154	+1000					0		0
			Total					3		3
1 50%		63,468	+300-425	NA	NA	NA	NA	2	NA	4
		77,218	+425-710					0		0
		55,945	+710-1000					0		0
		148,120	+1000					0		0
			Total					2		4
			Grand Total:	56	59	63	54	13	52	20

Lowest Split:	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside

Table 45: Kimberlite indicator mineral sorting results for unit F8

Finsch

SIEVE FRACTION WEIGHTS OF 100%	
GROSS SINKS:	86,822 g
Sieve Sizes	**Weights**
-300	3,096 g
+300-425	14,386 g
+425-710	21,714 g
+710-1000	12,799 g
+1000	34,717 g
TOTAL SINKS:	86,712 g

NOTES:

MSC 7

Unit F8

THINGS TO REMEMBER

Sort for all Garnets, C.D., & Chromites.
G10&G9_120-180 Grains
Megacrystic_60 Grains
Eclogitic_60 Grains
Ilmenite_60 Grains
Chromite_60 Grains
Chrome Diopside_60 Grains

LAB NO: Helam Lab

SAMPLE NO: MSC 7

BATCH NO: F8

PICKER'S NAME: KAIZABO THUNTSI

DATE STARTED: 18 Jan 2016

DATE COMPLETED: 24 Jan 2016

INDICATOR MINERAL SORTING RESULTS

Split Number Picked & (%)	Split Weight (g)	Fraction Weight (g)	Size Fraction	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
7B 0.78%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
7A 0.78%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
6 1.56%			+300-425							
			+425-710							
			+710-1000							
			+1000							
			Total							
4B 5 3.12%		0,936	+300-425	53	57	66	63	8	17	5
			+425-710							
			+710-1000							
			+1000							
			Total	53	57	66	63	8	17	5
4A 6.25%		0,940	+300-425	NA	NA	NA	NA	10	20	4
			+425-710							
			+710-1000							
			+1000							
			Total					10	20	4
3 12.5%		1,845	+300-425	NA	NA	NA	NA	35	25	17
			+425-710							
			+710-1000							
			+1000							
			Total					35	25	17
2 25%		3,426	+300-425	NA	NA	NA	NA	NA	NA	26
			+425-710							
			+710-1000							
			+1000							
			Total							26
1 50%			+300-425	NA	NA	NA	NA	NA	NA	NA
			+425-710							
			+710-1000							
			+1000							
			Total							
			Grand Total:	53	57	66	63	53	62	52

	Purple (G10)	Purple (G9)	Red (Megacrystic)	Orange (Eclogitic)	Ilmenite	Chromite	Chrome Diopside
Lowest Split:	53	57	66	63	53	62	52

PETRA DIAMONDS SAMPLE PREPARATION LABORATORY
INDICATOR MINERAL SORTING RESULTS

CONC. CHECKED BY:

QC. BY:

capture:
results:
stock: