Chapter 5: Conclusions

This study has served to expand the geological map of surroundings of the Venetia Mine incorporating the area lying south of the kimberlite deposit and bounded in the south by the Dowe-Tokwe fault. The most significant conclusion stemming from this mapping project is that the Venetia Klippe seems to be tectonically separate from the surrounding area. This is shown by the structural lineations, faults and mylonite zones mapped on aerial photographs and by other workers (Doorgapershad, et al, 2003) that bound the Venetia Klippe on the South and West. This Klippe is a shallowly dipping thrust onto the Krone Metamorphic terrane and the Gotha Complex (Barton et al, 2003). Barton et al. (2003) termed the latter rocks (younger than 2.0 Ga) the Gotha Igneous Complex. Identical petrographic descriptions of quartzofeldspathic lithologies found in the Krone Metamorphic Terrane to the west of the Venetia Klippe (Mellonig, 2004) suggest that they also belong in the Gotha Igneous Complex.

Farm Gotha and Venetia Klippe samples were compared in terms of their geochemical compositions. There are no obvious differences between the two suites of rock, especially when considering the freshness of the mined rock vs. the state of weathering in the Farm Gotha outcrops.

Based on their petrographic, XRD and other geochemical results, all the lithologies analysed for Farms Gotha and Venetia have experienced weak deuteric alteration and no dynamic metamorphism. The assumption is, therefore, that most samples retained their original chemical compositions (Chapter 4).

Major elements classify the rocks on the Farm Gotha as ranging from monzogranite through granodiorite to tonalite and quartz diorite. Those from the Venetia Mine only range from monzogranite to granodiorite. The diagrams also suggested that the rocks are I-type granitoids. This can be confirmed by the REE patterns as a large majority of the samples show steep slopes typical of felsic rocks. However, some samples show flat patterns that seem to indicate a less felsic composition.

Examining the data further by means of trace and rare earth element discrimination diagrams in Chapter 4, several distinctions between of the suites emerge. The Venetia Mines samples have more pronounced Eu anomalies than those from Farm Gotha indicating a presence of plagioclase and K-feldspar in the source magma. One outcrop on the Venetia Mine site classify on Pearce diagrams (Chapter 4) as being within-plate granite, while all the other samples analysed classify as volcanic-arc. The multi-element patterns for the Farm Gotha samples are typical of volcanic arc settings. Whether this component is inherited or primary can only be determined by further isotope studies.

A group of rocks from Gotha and Venetia show totally different geochemical features than those described above. They have flat REE patterns, either no Eu* anomaly or a positive Eu* anomaly and a mixed multy-element pattern that does not clearly indicate a crustal origin. These rocks are generally depleated in P, Ti, Nb (partly), Ta and Zr, all indicating a possible relationship to the kimberlite intrusion on the Venetia Mine property. However, there are more complex interpretations of the multi-element patterns that involve contamination by sedimentary rocks and influences of volcanic arcs.

The amount of U and Th in the igneous rocks of the Farms Gotha and Venetia (contained in minerals found within quartz, plagioclase, amphibole and K-feldspar

crystal boundaries and the magmatic zircons of the Farm Gotha samples, Chapter 1) and the distinctive pattern of heat producing elements (Council for Geoscience radiogenic map, Figure 4.21), indicate that that the concentration of these elements are not the result of regional metamorphism, but is the remnant of the final crystallisation phase of the magma of the area. Some of the rocks are extremely rich in Th and, in comparison, depleted in U. This could indicate a general characteristic of the crustal block.

Groundwater studies have identified six main targets in the northwestern quadrant of the farm (Chapter 1). This part of the Farm Gotha was the main focus of the groundwater study as there are yielding boreholes on the rest of the farm.

To reveal any economic implications for the rocks of Farm Goha, isotope concentrations would be necessary to decipher whether the chemistry of the rocks are due to magma mixing or influenced by the presence of the kimberlites of the Venetia Mine. A second step in further study of this area would be to understand the relationship, should one exist, between the Gotha Igneous Complex and the kimberlite to the north.

Another aspect that might need investigation is the probable epidote and allanite mineralization that could have influenced the geochemical signature of the REE and making the rocks seem more felsic than they are. This would necessitate further LA-ICP-MS studies of single crystals.