Application of XCT in determining the 3-D environment of PGM and sulphide minerals in the Bushveld Complex

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Platinum group minerals (PGM) in the Bushveld Complex are known to be intimately associated with sulphides and chromite. The relationship between these phases is crucial to understanding mechanisms of PGE concentration within mineralised reefs. Our current understanding of this relationship is based on 2-D imaging (principally SEM). However, recent studies have highlighted how 3-D imaging via X-Ray computed tomography (XCT) can extend our understanding of relationships between these phases. In this study, 2-D surface imaging using SEM was combined with high-resolution (micron–scale) XCT analysis of 25mm block mounts to investigate the relationship between PGM grains, sulphides and chromite in different reef samples. The combination of 2-D and 3-D imaging was necessary in order to accurately identify different mineral phases and to delineate their grain boundaries. Many PGM grains were found to be of significant size (100-200 microns diameter) while their grain shape was extremely irregular (Fig. 1). This irregularity in shape appears to lead to an underestimation of grain size using 2-D imaging (Fig. 1). Moreover, grain boundary relationships do not appear to be so straight forward with PGM grains being partially immersed in the sulphide grains rather than just on the boundary or at junctions between sulphides with chromite or silicates. While the generally small grain-size of most PGM are problematic in conventional XCT analysis, the new generation of micro-XCT, especially in combination with 2-D imaging using SEM and appropriate image processing software can circumvent this problem.

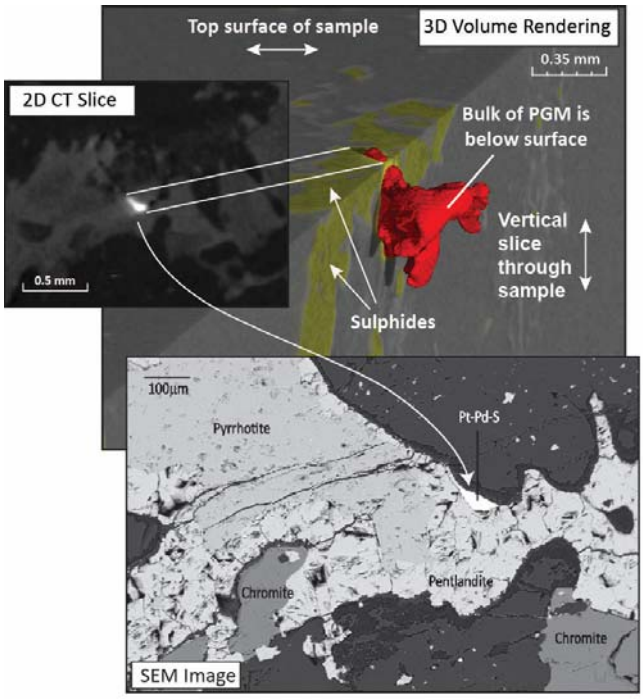

Figure 1: 2-D CT slice correlated with SEM image and 3-D volume rendering of highlighted PGM (Pt-Pd-S) in red within pentlandite (green). Voxel resolution of XCT images is 10µm. The PGM grain is situated on the boundary of a pentlandite grain in the SEM image but partially within the pentlandite in the 3-D volume. The PGM volume was extracted to expose the full extent of the grain whilst cutting a vertical slice through the remaining rock volume.