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Titanium-rich signature and textures of a kimberlite from Letlhakane Mine, Botswana

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We present results of a study of spinel compositions from the Letlhakane kimberlite. The Letlhakane mine consists of two kimberlite pipes and is one of a cluster of three kimberlite mines in central Botswana. Kimberlite magmatism intruded the Archaean Zimbabwe craton at around 90 Ma. Core logging and additional petrographic study classifies this deposit as a Group I, opaque-mineral and perovskite -rich altered probable monticellite kimberlite. Most of the kimberlite examined is massive volcaniclastic kimberlite, whilst rare layered volcaniclastic and magmatic kimberlite is also present. The kimberlite is characterized throughout by predominant basalt country rock fragments and xenocrysts of olivine (commonly serpentinised), with rarer garnet, phlogopite, ilmenite and chrome-diopside xenocrysts. In the volcaniclastic kimberlite the common olivines and basalt fragments are frequently contained within distinct pelletal lapilli that contain common fresh perovskite and spinel grains and relict probable monticellite. The inter-fragment/lapilli groundmass is dominated by microlitic diopside and serpentine. These latter minerals appear to fill void spaces and are of probable hydrothermal origin. Occasional carbonate-rich segregations also invade the interstitial groundmass. The magmatic kimberlite is more uniform textured and contains common thermally altered crustal xenoliths.

Spinels are a ubiquitous component of kimberlites and their compositions are frequently used as petrogenetic indicators. The compositions of Letlhakane groundmass spinels will be used to fingerprint kimberlite facies by identifying the presence of several discrete batches of magma with unique evolution trends. The spinels are excellent indicators of these trends and are apparently immune to the affects of hydrothermal and subsequent alteration. Analysis has revealed that the Letlhakane spinel are un-

usually titanium-rich (TiO_2 from 4.93 to 17.91 wt%), which correlates with other titanium-rich textural indicators such as the presence of prograde overgrowths of sphene around atolled-textured spinels and an unusually high proportion of perovskite to spinel of around 10:1, which is the inverse of a typical kimberlite. We propose the spinel compositions belong to titaniferous magnesiochromites (TMC) and are similar to those reported from the Tunraq kimberlite in Canada. The entire Letlhakane kimberlite assemblage indicates an event which caused titanium enrichment, maybe related to the metasomatic event recorded by its included suite of mantle xenoliths, which include a wide range of Ti-rich metasomatic minerals such as ilmenite and Ti-rich phlogopite.