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Petrology and volcanology of the Victor Kimberlite, Northern Ontario, Canada

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The Victor Kimberlite is a complex of several pipes. The steeply dipping (~70°) pipes occur in a ~275m thick Ordovician to Silurian sedimentary succession, and are unconformably overlying Precambrian granitoid basement. The kimberlite is overlain by 10-30m of glacial overburden. The early pipe, Victor Northwest, is crosscut by the later Victor Main pipe. The latter pipes are composed of contrasting types of kimberlite. The adjacent Victor South pipe comprises a similar rock type to the Victor Main pipe.

Victor NW consists of an alternation of macroscopically featureless, competent, dark-coloured, matrix-supported, macrocrystic (coarse mantle-derived olivine-crystal rich) and phenocrystic kimberlite, interlayered with massive volcanoclastic, probably primary pyroclastic, kimberlite. The nature of the featureless and competent rocks, previously described as hypabyssal kimberlite and possible kimberlite lava, is currently under investigation. Results of core logging, petrographic and volcanological studies undertaken in 2005-2006, will provide further constraints on whether this kimberlite pipe was infilled by intrusive or extrusive coherent and/or volcanoclastic processes.

The Victor Main pipe is composed of massive, clast-supported, macrocrystic and/or phenocrystic kimberlite. The deposit is primary pyroclastic in origin, and is dominated by discrete olivine crystals with only minor juvenile magmatic pyroclasts. The country rock fragment content varies from 2 to 50%, but the average is low at 7%. This indicates that during the early phases of the eruption most of the country rock material was expelled. De Beers' large diameter drilling program revealed significant internal changes in macrodiamond grade within the Victor Main kimberlite. Webb et al. (2004) subsequently indicated that the grade change coincides with the change in eruption between two pulses of kimberlite, as shown by contrasting modal abundances of olivine phenocrysts in the juvenile pyroclasts (8% versus 28%). Detailed SEM and CL studies on the juvenile pyroclasts are being undertaken to determine other characteristics that may differentiate the low-grade and high-grade kimberlites. The SEM data confirm the contrasting olivine phenocryst abundances in the juvenile pyroclasts, and also show that the juvenile pyroclast groundmass of both phases contains approximately 5% euhedral-subhedral apatite, ~6% primary calcite laths, ~7% spinel group minerals, and possible minor serpentine pseudomorphs after monticellite. The remainder of the groundmass comprises interstitial polycrystalline dolomite. The olivine phenocrysts are altered to serpentine ± dolomite. Apart from detailed petrographic work, the eruptive and depositional dynamics of the kimberlite volcano will be determined by detailed particle size analysis of polished core samples and thin sections.