KIGLAPAIT MAGMA EVOLUTION: MANTLE TO LABRADOR TO LAB

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Field relations of the Kiglapait Intrusion (KI) show a large (~81 %) troctolitic Lower Zone (LZ) grading upward by addition of augite to a strongly evolving Upper Zone (UZ) culminating in fayalite-ferrohedenbergite-mesoperthite syenite. The simplest hypothesis for the intrusion is emplacement of a single batch of magma and fractionation in a closed system (at ~1.3 Ga and ~3 kb), except for an olivine-rich basal LZ. A successful experimental test for consistency would yield the observed mineral compositions in the observed proportions. We carry out this test for the LZ-LLD (liq. line of descent) using separated minerals and a contact rock from the KI, mixing them in proportions to yield the observed cotectic L(OL, PL), and the observed crystal compositions at the liquidus. LZ experiments were run in graphite at 5 kb in 19-mm piston-cylinder apparatus. The LZ cotectic runs from 1245 deg C to 1203 deg C. Oxy-norm Liq comps. in the the AUG-PL-OL ternary run from AUG(5%) PL(73%) OL(22%) to AUG(24%)PL(62%)OL(14%) where AUG saturation occurs. The crystal compositions found are An67, Fo 74 to An53, Fo 62. The trend mimics that in Di-An-Fo and runs close to that determined previously from modal data. The cotectic is gently concave toward the PL apex, and its position depends solely on AUG, being indifferent to An, Fo, and minor variations in Ti & P. AUG saturation occurs at the same OL:(OL+AUG) ratio = 0.38 as in the modal data. The lever rule applied to the ternary curve shows AUG+ at 81% solidified, as in the modal result. The experiments are consistent with the simplest hypothesis. The source region was explored via the liquidus phases found in the bulk composition mix at higher pressures. L(OL,PL) persists to ~11 kb but the cotectic moves slightly toward OL; the Clapeyron slope is 7.75 deg C /kb. At 13 kb, SP, Al-CPX, Al-OPX, and GT all occur with 90%L at 1300 deg C. The SP field is narrow, possibly <2kb wide. The setting of KI and other late troctolitic magmas in the anorthositic Nain Plutonic Suite suggests crustal extension and a locally shallow depth to mantle (Olson & Morse, Nature 344, 760 1990). The data so far are consistent with melting beginning in the GT field and separating at or near the SP/PL boundary, with significant crystallization of OL at the level of emplacement, as found in the basal LZ. Similar mid-Proterozoic Hi-Al-Fe magmas and their sources are documented by Hoal (Lithos Slave-Kaapvaal issue, 2003). Melting of KI UZ rocks containing appreciable Ti and P indicates ingestion of carbon from the crucible and gives FeO(T) contents up to 32% (wt) in the melt. The sampled rocks fall far below this level of iron enrichment, so determination of the UZ-LLD evolutionary trace requires further study without Ti and P to complex the carbon.

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