Geochemistry of the Lower Crust Beneath the Eastern Meguma Zone, Nova Scotia

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Xenoliths occurring in a spessartite dyke near Tangier (Nova Scotia) can be subdivided into two distinct mineralogical groups. Group A includes sapphirine-orthopyroxene and garnet-orthopyroxene granulites and most of them have abundant graphite, aluminosilicates and spinel. Group B xenoliths are devoid of graphite and aluminosilicates and include two-pyroxene, orthopyroxene-amphibole and clinopyroxene-amphibole assemblages. Both groups give peak P-T estimates of 12-14 kb and 1000-1100°C.

Group A xenoliths have high Al_2O_3 ($\bar{x}$=22.5 wt. %) but very variable SiO_2 (46-67 wt. %). They have an overall major-element chemistry within the range of average shale but contrast sharply with Meguma Zone, low grade metasediments. Most Group A xenoliths are corundum-normative (3.5-18%), but some have normative diopside (aluminosilicate free) indicating a more calcareous protolith for the latter. Group B xenoliths have a narrow range in silica (50.46-51.31 wt. %) but a wide range in CaO (6.93-12.80 wt. %) and MgO (7.70-16.73 wt. %). Together with the high and variable compatible trace element abundances of Cr ($\bar{x}$=923) and Ni ($\bar{x}$=122) this reflects extensive crystal accumulation (cpx, opx, amph) of the igneous (basaltic) protolith. The K/Rb ratios for both groups ($\bar{x}$=321) are similar to average Archean crust (approx. 300). Some trace element ratios, such as Th/U and Zr/Nb, are very similar for both groups, averaging 3.5 and 14 respectively. However, they can be clearly distinguished by their Ti/V and Ti/Zr ratios (Group A: Ti/Zr<40, Ti/V>25 and Group B: Ti/Zr>40, Ti/V<25).

Both groups show LREE-enriched patterns but the total of 12 REEs is characteristically high for Group A xenoliths (106-248 ppm) when compared to Group B xenoliths (47-84 ppm). None of the REE patterns show positive Eu anomalies as is typical for the meta-tonalite-trondjemite-granodiorite suite of regional granulite terrains.

The most remarkable feature of both xenolith groups is their high abundance of LIL elements, compared to rocks from other granulite-facies terrains. This rules out significant melt extraction or loss of LIL elements during CO_2 flushing or prograde dehydration reactions. The lower crustal xenoliths are therefore unlikely source rock candidates for the Devonian-Carboniferous granitoids of Nova Scotia.

We infer that the lower crust beneath the Meguma Zone is composed of shales, calcareous shales, mafic cumulates and gabbros.