Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 216

Nature of the Sub-Continental Mantle Under the North Atlantic Craton: Evidence from Peridotite Xenoliths of the Safartoq Area, Southwestern Greenland

Martin Bizzarro & **Ross K. Stevenson**

Geotop, Universite du Quebec a Montreal, P.O. Box 8888, succ. Centre-ville, Montreal (Quebec), H3C 3P8, Canada

The sub-continental mantle is a heterogeneous geochemical reservoir of considerable mass and volume, extending for more than 300km below some Archean cratons. Dating of melt depletion events with the use of the Re-Os chronometer has showed that continental roots have existed for extensive periods of time, perhaps as long as the overlying crust (Pearson, 1999). Because of it's mass and age, this reservoir plays an important role in the storage of the terrestrial trace element budget. Although the petrogenesis of the lithosphere under oceans is well as the result of low-pressure melt extraction, the origin of the continental equivalent is still under debate. In order to characterize the nature of the cratonic mantle under the North Atlantic Craton, we have investigated a suite of kimberlite-hosted peridotite xenoliths from the Safartoq area of southwestern Greenland. The kimberlites are part of the 600 Ma Safartoq kimberlite dike swarm intruded at the northern margin of the Archean craton of Greenland. Although the swarm straddles the boundary between Proterozoic and Archean basement, the localities studied are situated within undisturbed Archean gneisses. The suite consists of large (5-45cm), fresh spinel and garnet facies lherzolites, harzburgites and dunites having coarse, porphyroclastic and granuloblastic textures. Spinel dunites show a gradual variation from coarse to granuloblastic textures, while the spinel facies lherzolites and harzburgites as well as the garnet bearing harzburgites constantly have coarse textures. Garnet lherzolites are all characterized by porphyroclastic textures. Major element compositions of the suite testify to the refractory nature the Safartoq peridotites as they are depleted in elements such has Fe, Ti, Ca and Al in comparison with primitive mantle models. Although the Safartoq xenoliths are similar to suites from South Africa or Siberia by having comparable degrees of depletion and olivine fosterite compositions (average Fo = 92,2), they differ in their lower modal abundances of orthopyroxene (average = 15%). In this respect, the Safartoq suite shows greater similarities with the Wiedemann spinel harzburgites of eastern Greenland (Bernstein et al, 1998) and the garnet peridotites of the Canadian arctic (Schimdberger and Francis, 1999). Comparison of bulk and mineral elemental data with recent experimental work (Walter, 1998) indicate that the Safartoq peridotites may have been generated by high-pressure (>4 GPa) partial melting (40%) of a pyrolitic source. Geothermobarometry shows that the peridotites have equilibrated at pressures and temperatures ranging from 2.2 to 6.5 GPa and 650 to 1300ºC. The high temperature (> 1100ºC) porphyroclastic garnet lherzolites all have equilibrated within the diamond stability field whereas only a small proportion of the coarse garnet harzburgites show such high equilibration pressures. Coexistence of garnet and spinel in a harzburgite xenolith constrains the spinel-garnet transition at around 2.3GPa which is agreement with experimental data. Assuming a mantle heat flow of 14mW/m2 and a crustal thickness of 50km, the data aligns best along a 44mW/m2 conductive paleogeotherm with a 0,6$\mu W/m^3$ average crustal heat production model. Isotopic Sr and Nd compositions of whole-rock and mineral separates of the Safartoq suite attest to the depleted character of the mantle root. Initial $^{143}Nd/^{144}Nd$ and $^{87}Sr/^{86}Sr$ vary from 0.511798 to 0.512172 and from 0.721791 to 0.722852. The compositional and isotopic differences between the North Atlantic and Kaapvaal lithospheres suggest distinct histories for each mantle. The enriched nature of the Kaapvaal lithosphere is commonly attributed to carbonatite metasomatism related to ancient plume events (Menzies and Murphy, 1980). Because Greenland has been the site of alkaline magmatic activity for more than 2.5 Ga, the depleted nature of the Safartoq lithosphere is not well reconciled with such metasomatic models. Subduction related metasomatism could alternatively generate the enriched isotopic signature of the Kaapvaal root via recycling of old continental crustal material. This model also supports the high orthopyroxene abundance of the Kaapvaal, as orthopyroxene enrichment in peridotites is fueled by interactions with slab derived silica-rich melts (Kelemen et al, 1998). The low orthopyroxene modal abundance coupled with the depleted isotopic character of the Safartoq suite may indicate that subduction related metasomatic processes might not have played an important role in the history of the North Atlantic lithosphere contrary to the Kaapvaal.

Pearson DG, *Lithos*, **48**, 171-194, (1999).
Bernstein S, Kelemen PB & Brooks CK, *Earth and Planetary Science Letters*, **154**, 221-235, (1998).
Schimdberger SS &Francis D, *Lithos*, **48**, 195-216, (1999).
Walter MJ, *Journal of Petrology*, **39**, 29-60, (1998).
Menzies M & Murph, VR, *Nature*, **284**, 634-636, (1980).
Kelemen PB, Hart S.R & Bernstein S, *Earth and Planetary Science Letters*, **164**, 387-406, (1998).