ARCHEAN AND PROTEROZOIC MANTLE IN WEST GREENLAND

Dorte Garrit[1], W.L. Griffin[2] and Suzanne Y. O'Reilly[3]

[1] Geological Museum, Ostervoldgade 5-7, Copenhagen, Denmark.
[2] CSIRO Div. of Exploration and Mining, Box 136, North Ryde, Sydney, 2113, Australia.
[3] Centre for Petrology and Lithospheric Studies, School of Earth Sciences, Macquarie University, Sydney, 2109, Australia.

West Greenland consists of an Archean craton surrounded to the north and south by Proterozoic mobile belts. Ultramafic xenoliths from localities around the northern border of the Archean craton provide an ideal opportunity to compare the structure, chemical composition and thermal states of the lithospheric mantle beneath such tectonically contrasting regions.

Three localities have been chosen for that purpose: the Holsteinborg (Sisimiut) region situated in the Proterozoic northern Nagssugtoqidian mobile belt, the Sarfartoq area in the transition zone between the mobile belt to the north and the Archean block to the south, and the Sukkertoppen region (Maniitsoq) well inside the Archean craton. The ultramafic xenoliths from the three localities occur in kimberlite dykes and cone sheets emplaced into the gneissic basement rocks during a relatively short time interval in the late Proterozoic (at ca 600 Ma; Larsen, 1991; Larsen & Rex, 1992). In addition to the ultramafic xenoliths, mineral concentrates have been obtained for all of these localities.

Major element analyses for the garnet-bearing ultramafic xenoliths from Sukkertoppen and Sarfartoq have been carried out by electron microprobe (EMP). Major element and trace element analyses for garnet concentrates from kimberlite host rocks from all three localities have been carried out by EMP and proton microprobe (PMP), respectively. The preliminary results show that garnets with geochemical signatures characteristic of lherzolites (CaO 4-7 wt% and Cr_2O_3 3-14 wt.%) dominate in all three areas. In the Sukkertoppen and Sarfartoq areas there are also subcalcic garnets with CaO 2-6 wt.% and Cr_2O_3 3-14 wt.%, typical of garnets from harzburgites. Low Ca (<2 wt.%) high Cr harzburgitic garnets (G10) are only found in Sukkertoppen. Wehrlitic garnets from Sarfartoq and Sukkertoppen contain CaO 6-8 wt.% and Cr_2O_3 3-6 wt.%.

Geothermobarometry has been carried out based on coexisting clinopyroxene, orthopyroxene and garnet in the available xenoliths using standard methods and on garnet concentrates using the trace-element methods of Ryan et al. (in press). The garnets from *Holsteinsborg* (Proterozoic mobile belt) give $P_{(Cr)}$ vs $T_{(Ni)}$ values that plot around 850°C to 700°C at about 30-35kb, ie within the graphite rather than the diamond stability field. The data plot close to a typical conductive 40 mW/m^2 geotherm. P-T calculations based on EMP data from one garnet lherzolite xenolith give slightly higher P-T conditions also near the 40 mW/m^2 geotherm.

P-T data from the *Sarfartoq* garnets (northern margin of the craton) show a very wide distribution with some differences between garnets from different rock types. Most of the Ca and low-Ca harzburgitic garnets and some of the lherzolitic garnets from Sarfartoq define a cluster around 850°C and 30 kb. However, some lherzolitic, harzburgitic, wehrlitic and low Cr garnets scatter from 900°C up to 1300°C. Most lie within the graphite stability field. Geothermobarometry based on EMP data from garnet lherzolite xenoliths indicates some higher P and T conditions (1000-1300°C at 40-60 kb). All of these preliminary P-T data plot near to or just below a conductive 40mW/m^2 geotherm.

At Sukkertoppen (well inside the craton) Ca harzburgitic and lherzolitic garnets generally give T ≈ 1000-1300°C, from about 30 to 50 kb with very few in the diamond stability field. The garnet concentrates analysed so far from Sukkertoppen also indicate a geotherm around 40mW/m^2.

The three areas show significant differences in the rock type mix. *The Holsteinsborg* lithospheric mantle sampled is dominated by lherzolites showing different degrees of metasomatic signature. The garnets range from moderately depleted with low Zr (15-25 ppm), Y (2-5 ppm), and TiO2 (200-500 ppm). to highly enriched in Zr (55-115 ppm) and moderately enriched in Y (10-30 ppm) and TiO2 (<0.1 wt.%). *The Sarfartoq area* has the greatest variety of rock types. Lherzolite occurs over the whole depth range sampled to about 180 km. Again, there is a range of both depleted (shallower) and enriched (deeper) lherzolitic garnets. There also is a significant amount of low-Ca harzburgite garnets with very low contents of Zr (<3 ppm), Y (<3 ppm) and TiO2 (<<0.1 wt.%) at around 120 km and of Ca-harzburgite garnets between 100 to 200 km. *At Sukkertoppen*, lherzolite is found from 90-200 km. The lherzolite in this area is moderately depleted in the upper part, with garnets that contain 6-20 ppm Zr, <20 ppm Y and <0.3 wt.% TiO2. The rest of the column seems to consist of fertile, partly enriched lherzolite with garnets that contain 10-30 ppm Y, up to 100 ppm Zr and up to 1.2 wt.% TiO2. Ca harzburgite appears to be concentrated at about 120-220 km. The lower part has relatively enriched garnets with Y 10-12 ppm, Zr 30-50 ppm and TiO2 0.3-0.4wt.%. Very rare low-Ca harzburgite also is present. The garnet data also indicate the occurrence of some wehrlites very enriched in Y, Zr and Ti.

The preliminary geochemical and geothermobarometric results thus reveal distinct differences in the lithospheric mantle rock types and their distribution with depth in the three areas studied from West Greenland, but a similarity in paleaogeothermal conditions consistent with a conductive 40mW/m^2 geotherm.

References

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