Geophysical Research Abstracts
Vol. 17, EGU2015-12155, 2015
EGU General Assembly 2015

MARID-type Glimmerites from Kimberley, South Africa: Metasomes or high-pressure cumulates?

Michael W. Förster (1), Dejan Prelevic (1), Stephan Buhre (1), and Dorrit E. Jacob (2)

(1) Johannes Gutenberg-University Mainz, Institut for Geosciences, J.-J.-Becher-Weg 21, D-55099 Mainz, (2) Department of Earth and Planetary Sciences, Macquarie University, NSW-2109 Sydney, Australia

Mica- amphibole- rutile- ilmenite- diopside (MARID) xenoliths are alkali-rich, coarse-grained ultramafic rocks, typical for heavily metasomatized subcontinental lithospheric mantle (Dawson & Smith, 1977). They are produced either by interaction of mantle wall rock with lamproitic melts that percolate through the mantle (Dawson and Smith 1977; Sweeney 1993), or as direct crystallization products of those melts (Waters 1987).

Two rock samples of mica-rich (>90% phlogopite) xenoliths from the Boshof Road Dump of the Bultfontein kimberlite diamond mine in Kimberley, South Africa were analyzed for major and trace elements of minerals. Millimeter sized phlogopite is the dominant mineral, making up more than 90% of the rock. Other phases are in descending order: diopside, K-richterite, rutile and ilmenite.

Phlogopite is homogenous in composition and appears without zonation. They are perpotassic with K/Al between 1.1 and 1.2 at an Mg#-value of 84.5-86.5. Clinopyroxene is low in $Al2O_3$ with values <0.8%, but high in SiO_2 with values around 55% and CaO values of 21% for both samples. Clinopyroxene show a slight zonation with $Cr2O_3$ values rising towards the rim from 0.4 to 0.8%. All clinopyroxenes lie within the field of diopsides. REE to pyrolite normed pattern for diopsides show enrichment in LREE compared to HREE and a pronounced low in Ti.

The examined specimens are classified as Glimmerite-type xenoliths as they comprise >90% phlogopite. Perpotassic phlogopites with K/Al >1 values are typical for MARID-type xenoliths by comprising low Mg# of 82-88 (Dawson 1987). We performed thermobarometric calculations on the clinopyroxenes, by using the equations of Putirka (2008). With a proposed lamproitic melt, like Waters (1987) suggested for a MARID parental magma, a pressure of 13 kbar (39 km) and a temperature of 1300 C was calculated. This depth coincides with the crustal thickness of the Kaapvaal craton (Nguuri et al. 2001). However, the pressure calculations depend on the fractionation of Al between melt and mineral and are not realistic for low-Al diopsides. Calculations by Konzett et al. (2014) yielded 4.2 GPa (155 km) by using a Ca-in-opx thermometer and a cratonic geotherm of 40 mW/m^2 and seem to be more realistic.

By applying a sandwich experimental approach, mixing glimmerite samples with harzburgitic peridotites, we hope to achieve deeper insights into the origin of MARID-type glimmerites.

References

Dawson, J. B., & Smith, J. V. (1977). The MARID (mica-amphibole-rutile-ilmenite-diopside) suite of xenoliths in kimberlite. Geochimica et Cosmochimica Acta, 41(2), 309-323.

Dawson, J. B. (1987). The MARID suite of xenoliths in kimberlite: relationship to veined and metasomatised peridotite xenoliths. Mantle Xenoliths. Chichester: John Wiley, 465-474.

Konzett, J., Krenn, K., Rubatto, D., Hauzenberger, C., & Stalder, R. (2014). The formation of saline mantle fluids by open-system crystallization of hydrous silicate-rich vein assemblages–Evidence from fluid inclusions and their host phases in MARID xenoliths from the central Kaapvaal Craton, South Africa. Geochimica et Cosmochimica Acta, 147, 1-25.

Nguuri, T. K., Gore, J., James, D. E., Webb, S. J., Wright, C., Zengeni, T. G., Gwavava, O. & Snoke, J. A. (2001). Crustal structure beneath southern Africa and its implications for the formation and evolution of the Kaapvaal and Zimbabwe cratons. Geophysical Research Letters, 28(13), 2501-2504.

Putirka, K. D. (2008). Thermometers and barometers for volcanic systems. Reviews in Mineralogy and Geochemistry, 69(1), 61-120.

Sweeney, R. J., Thompson, A. B., & Ulmer, P. (1993). Phase relations of a natural MARID composition and implications for MARID genesis, lithospheric melting and mantle metasomatism. Contributions to Mineralogy and Petrology, 115(2), 225-241.

Waters, F. G. (1987). A suggested origin of MARID xenoliths in kimberlites by high pressure crystallization of an ultrapotassic rock such as lamproite. Contributions to Mineralogy and Petrology, 95(4), 523-533.