Geophysical Research Abstracts
Vol. 14, EGU2012-12413, 2012
EGU General Assembly 2012

Magma storage and evolution in the Henties Bay-Outjo dyke swarm, Namibia –feeder systems of the Etendeka lavas

J.K. Keiding (1), O. Frei (2), A. Renno (2), I.V. Veksler (1,3), and R.B. Trumbull (1)

(1) GFZ German Research Centre for Geosciences, Potsdam, Germany (jakob@gfz-potsdam.de), (2) Technische Universität Bergakademie Freiberg, Freiberg, Germany, (3) Technical University Berlin, Berlin, Germany

At the roots of continental flood basalts in the Paraná-Etendeka province are mafic dyke swarms that cover areas of several hundred kilometers. Studies of these dykes have focused mainly on the age, paleomagnetic properties and geochemistry, but less on pressure (P) and temperature (T) conditions of emplacement. However, the P and T conditions under which dyke magmas are stored are crucial for models of magma plumbing systems in flood basalt provinces. The erupted lavas are typically far from primitive compositions and generally show evidence for strong crustal assimilation in addition to magma fractionation. Unknown is where this magma modification took place in the crust. This is the kind of information that dyke studies can provide.

The Henties Bay Outjo dyke swarm (HOD) in NW Namibia is the subject of this study. This is inarguably the best exposed of major dyke swarms associated with South Atlantic rifting and breakup and its geochemical diversity is well documented but aspects relating to the magma dynamics in the dyke swarm have not been studied before. Our approach is to use geochemical data from selected dykes to assess the differentiation and assimilation history of the magmas, and combine that with petrologic constraints on the temperature-pressure conditions of crystallization derived from mineral-melt equilibria.

We have determined P-T estimates from olivine-melt and clinopyroxene-melt equilibria using analysis of phenocrysts by electron microprobe and applying the thermodynamic relations from Putirka (2008), who considered the standard error to be 1.7 kbar and 30°C. The calculations reflect only mineral-melt (proxied by whole-rock) compositions that are consistent with equilibrium. Crystallization temperatures range from 1040°C to 1350°C with a mean (n=58) of 1170 °C. These T-variations are not random, the high-temperature results come from a specific region of dyke emplacement but the reason for this is not yet clear. Olivine-melt temperatures are higher than those from clinopyroxene-melt. The inferred crystallization sequence is in harmony with petrographic and geochemical observations. Pressures of clinopyroxene crystallization range from 0.7 to 7.1 kbar. The average pressure (n=12) is 4.9 kbar, few dykes yielded lower than 3 kbar, and the majority of dykes appear to have crystallized at 4-6 kbar. These estimates can be linked with bulk geochemistry to derive viscosity and melt densities to explore the mechanics of dyke emplacement.

Reference:

Putirka, K. (2008) Thermometers and Barometers for Volcanic Systems. In: Putirka, K., Tepley, F. (Eds.), Minerals, Inclusions and Volcanic Processes, Reviews in Mineralogy and Geochemistry, Mineralogical Society of America v. 69, pp. 61-120.