Geophysical Research Abstracts
Vol. 17, EGU2015-13769-2, 2015
EGU General Assembly 2015

Geothermobarometry in dykes in the Etendeka province of NW Namibia and implications for the plumbing system beneath continental flood basalts

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Continental flood basalts like those in the Paraná-Etendeka province result from very large-scale melt generation in the mantle and emplacement through continental crust. This study provides new insights on the conditions of melt generation in the mantle, and of magma transport and storage in the crust beneath flood basalt provinces using petrologic data from feeder dykes. The Henties Bay Outjo dyke swarm in NW Namibia is arguably the best exposed and well-documented example of major dyke swarms associated with Early Cretaceous South Atlantic rifting and breakup. In this contribution we provide pressure-temperature estimates derived from mineral-melt equilbria in well-crystallized and unaltered dyke samples, with an emphasis on the early-formed minerals olivine and chromian spinel, which record the initial stage of cooling and crystallization. Olivine-melt temperatures range from about 1200° to 1350°C. Importantly, the highest-temperature olivines are not in equilibrium with the rock matrix. These olivines, with up to 93 mole-percent forsterite contents, apparently formed in a more primitive magma and were entrained in the host dyke. The composition of spinel inclusions in the forsterite-rich olivines have correspondingly high Cr contents, supporting the conclusion that these crystals are relics of "cryptic" high-temperature magma. This is especially interesting because they are close in composition to primary mantle melts and thus define a starting point to assess the evolution of the flood basalt system from melt generation to eruption. Clinopyroxene and plagioclase compositions document the later stages of magma crystallization, with temperatures estimated at 1050 to 1200°C and mid-crustal pressure conditions of 4-6 kbar.