Geophysical Research Abstracts, Vol. 7, 09383, 2005
SRef-ID: 1607-7962/gra/EGU05-A-09383

Quaternary fissural basalts in the Main Ethiopian Rift

B. Seth (1), R. Gloaguen (2), M. Thirlwall (1), J. Pfaender (2), G. Yirgu (3), U. Wnorowska (2)

(1) Geology Department, Royal Holloway University of London, UK, (2) Institut fuer Geologie, University of Freiberg, Germany, (3) Department of Geology, University of Addis Ababa, Ethiopia

The Main Ethiopian Rift MER represents the northern part of the East African Rift system. The volcanic activity related to the MER started with flood basalts c. 30 Ma ago. From Middle Miocene to Present, it was followed by alkaline lavas concentrated in localized rift zones. Within the MER valley the proportion of felsic volcanics is as high as c. 90% of the total volume of material produced. The origin of the felsic lavas might be discussed as derivation from mafic parent magmas by fractional crystallisation and crustal assimilation (AFC). However, it is still a matter of debate to what extent crustal assimilation is involved. Here, we address whether and to what degree the young MER basaltic lavas were derived from the mantle plume beneath the MER, the degree of crustal assimilation, and the kind of geochemical and petrological processes that occurred during the ascent of the lavas or during potential residence within a magma chamber.

For this study felsic and mafic volcanic products from five different Pleistocene volcanic centres along the MER have been sampled. Major and trace element data were determined using a Philips PW1480 X-ray fluorescence spectrometer. Sr-Nd-Hf isotope data were obtained from sample powders using standard dissolution and spiking procedures. Measurements were performed on a VG-354 five-collector thermal ionisation mass spectrometer (TIMS) using a multi-dynamic routine.

Alkaline basalts from the plateaus give $He_{Olivine}$ data as high as 15 to 17 (R/R_A) which is a strong argument against predominant crustal contamination. However, since no He data are available for basalts on the rift floor, we used major and trace element and Sr-Nd-Hf isotope data to reveal the source(s) and composition of parental melts and the degree of crustal assimilationMg-numbers show a slight negative correlation with Sr isotope compositions. Therefore, a slight crustal contamination (of lower crust) cannot be excluded although trace element signatures rule out that crustal assimilation does play a dominant role in the generation of these lavas. According to the MgO and Ni as well as Cr contents of some basaltic lava, we conclude that they might reflect asthenospheric melts, which have lost olivine and likely clinopyroxene on their way up or during a short stay in a magma chamber. Sr and Nd isotopes suggest that at least two different components are responsible for the evolution of the basaltic samples. One component is characterised by rather high $^{143}Nd/^{144}Nd$ (> 0.51294) and low $^{87}Sr/^{86}Sr$ (< 0.7036) isotope ratios, the other one by much lower Nd (< 0.51278) and moderate Sr (>0.7042) values. Both components, MORB and OIB are fairly enriched in incompatible elements.

The geographic distribution of Sr, Nd and Hf isotope signatures supports this two-component mixing with a higher MORB influence in the NE (high-Nd – low-Sr signatures in the north-eastern MER – south-western Afar area (Ayelu volcanic centre) and a higher plume influence in the SW (low-Nd – moderate-Sr signatures further south (Bosetti volcanic centre). Ongoing modelling will precise this hypothesis.