Geophysical Research Abstracts
Vol. 16, EGU2014-14504, 2014
EGU General Assembly 2014

Which mantle below the active rift segments in Afar?

Raphael Pik (1), Martin Stab (1,2), Marie-Anne Ancellin (1), Medynski Sarah (1), Christophe Cloquet (1), Charlotte Vye-Brown (3), Dereje Ayalew (4), Gilles Chazot (5), Nicolas Bellahsen (2), and Sylvie Leroy (2)

(1) CRPG, CNRS-Univ. Lorraine, Vandoeuvre, France (rpik@crpg.cnrs-nancy.fr), (2) ISTEP, CNRS-UPMC, Paris, France, (3) Bristish Geological Survey, Edinburgh, UK, (4) Dept of Earth Sciences, Addis Ababa Univ., Ethiopia, (5) IUEM, CNRS-UBO, Brest, France

The evolution of mantle sources beneath the Ethiopian volcanic province has long been discussed and debated with a long-lived controversy in identifying mantle reservoirs and locating them in the mantle. One interpretation of the isotopic composition of erupted lavas considers that the Afar mantle plume composition is best expressed by recent lavas from Afar and Gulf of Aden (e.g. Erta Ale, Manda Inakir and the 45°E torus anomaly on the Gulf of Aden) implying that all other volcanics (including other active segments and the initial flood basalt province) result from mixing of this plume component with additional lithospheric and asthenospheric components. A completely opposite view considers that the initial Oligocene continental flood basalts best represent the isotopic composition of the Afar mantle plume, which is subsequently mixed in various proportions with continental lithospheric mantle for generating some of the specific signature of Miocene and Quaternary volcanics.

The precise and correct identification of mantle components involved in the generation of magmas is of particular importance because this is the only way to document the participation of mantle during extension and its potential role in break-up processes. In this contribution we provide new isotopic data for central Afar and we revisit the whole data set of the Ethiopian volcanic province in order to: (i) precisely identify the distinct mantle components implicated and (ii) discuss their location and evolution not only considering geochemical mixings, but also taking into account additional characteristics of erupted magmatic suites (volumes, location and relationships with amount of extension and segmentation).

This new interpretation of geochemical data allows reconsidering the evolution of mantle in the course of rift evolution. In terms of mantle sources, two populations of active segments are frontally opposed in the volcanic province: those that share exactly the same composition with plume related CFBs (e.g. the Manda Hararo and the Main Ethiopian rift segments), and those that involve the participation of additional components characterized by more radiogenic lead isotopes (Erta Ale, Manda Inakir, Asal). We show that the material of the Afar mantle plume is not dispersed and attenuated laterally away from the centre of the province, but instead distributed and controlled spatially by rift segmentation.