Geophysical Research Abstracts
Vol. 18, EGU2016-7032, 2016
EGU General Assembly 2016

Volcanic activities in the Southern part of East African rift initiation: Melilitites and nephelinites from the Manyara Basin (North Tanzania rift axis)

Celine Baudouin, Fleurice Parat, Christel Tiberi, Stéphanie Gautier, and Sophie Peyrat
Géosciences Montpellier, France (baudouin@gm.univ-montp2.fr)

The East African Rift exposes different stages of plate boundary extension, from the initiation of the rift (North (N) Tanzania) to oceanic accretion (Afar). The N Tanzania rift-axis (north-south (S) trend) is divided into 2 different volcanic and seismic activities: (1) the Natron basin (N) with shallow seismicity and intense volcanism and (2) the Manyara basin (S) with deep crustal earthquakes and sparse volcanism.
The Natron basin is characterized by extinct volcanoes (2 Ma-0.75 Ma) and active volcano (Oldoinyo Lengai) and a link between seismicity and volcanism has been observed during the Oldoinyo Lengai crisis in 2007. In the S part of the N Tanzanian rift, volcanoes erupted in the Manyara basin between 0.4 and 0.9 Ma. In this study, we used geochemical signature of magmas and deep fluids that percolate into the lithosphere beneath Manyara basin, to define the compositions of magmas and fluids at depth beneath the S part of the N Tanzania rift, compare to the Natron basin and place constrain on the volcanic and seismic activities.
The Manyara basin has distinct volcanic activities with mafic magmas as melilitites (Labait) and Mg-nephelinites (carbonatite, Kwaraha), and more differentiated magmas as Mg-poor nephelinites (Hanang). Melilitites and Mg-nephelinites are primary magmas with olivine, clinopyroxene (cpx), and phlogopite recording high-pressure crystallization environment, (melilitites >4 GPa and Mg-nephelinites>1 GPa) with high volatile contents (whole rock: 0.7-4.6 wt% CO_2, 0.1-0.3 wt% F and 0.1 wt% Cl). FTIR analyses of olivine constrained the water content of Labait and Kwaraha magmas at 0.1 and 0.4 wt% H_2O, respectively. Geochemical modelling suggests that mafic magmas result from a low degree of partial melting (1-2%) of a peridotitic source with garnet and phlogopite (high Tb/Yb (>0.6) and Rb/Sr (0.03-0.12) ratio).
Mg-poor nephelinites from Hanang volcano crystallized cpx, Ti-garnet, and nepheline as phenocrysts. Magmas result from fractional crystallization of melilitites at crustal conditions. The crystallization of cpx occurred at low pressure at 340-640 MPa and 1075°C from silicate melt with low water content (<3600 ppm, FTIR on cpx). Melt inclusions in nepheline have CO_2-rich and H_2O-poor melts (33-8800 ppm CO_2, <0.1 wt%H_2O) with high F (0.6-2.8 wt%), Cl (0.3-1wt%), and S (0.3-1.1 wt%) content and a CO_2-rich phase exsolved during ascent, suggesting the presence of CO_2-rich and H_2O-poor deep fluid during magma evolution. The sulphur speciation ($S6+/\sum S$ ratios=0.38-0.65) indicates that nephelinite magmas evolved under oxidized condition (ΔFQM +0.95 to +1.2).
At the early stage of rifting, volcanism in Manyara basin erupted CO_2-rich and H_2O-poor mafic magmas from at least 120 km below the rift escarpment, whereas few magmas evolved during ascent at mantle and crustal conditions. Manyara volcanism has similarities with the N Tanzania rift-axis (including Lengai) with a deep garnet-phlogopite-bearing source, CO_2-rich magmas (silicate lavas and carbonatite) but differs by deeper crystallisation environment, more oxidized conditions and very low water content in magmas. The small amount of volcanic rocks erupted in Manyara basin may indicate that trapping of CO_2-rich magmas/fluids at depth may have occurred and are potential trigger of deep crustal earthquakes. We will investigate the potential interactions between recorded seismicity and the above analyses through a series of recent and combined projects in the area (CRAFTI-CoLiBrEA).