Genesis and evolution of highly alkaline magmas at Oldoinyo Lengai, Tanzania

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The volcano of Oldoinyo Lengai is located in the Gregory rift, in the Eastern branch of the East African Rift. It is the only active carbonatitic volcano on Earth and therefore represents a natural laboratory to study carbonatite genesis. The most recent explosive eruption, in 2007-2008, began with natrocarbonatite and nephelinite material, and rapidly turned to combeite-wollastonite nephelinite compositions [1]. Cumulate nodules from this last episode of eruption were sampled for this study; the rocks are melt-bearing cumulative ijolites which crystallized at the margins of the magma chamber which produced the 2007-2008 eruption. The petrographic observations allow us to determine the crystallographic sequence; the first mineral to appear is clinopyroxene (cpx), followed by garnet, apatite and finally nepheline. Melt inclusions are present in all the minerals and these, along with the late interstitial melt (glass), permit us to define the liquid line of descent (LLD) of the 2007-2008 magma. Based on major element compositions, the liquid evolved from phonolitic to nephelinitic. Peralkalinity increases and Si content decreases during the liquid evolution. The REE concentration evolution along the LLD has been determined by LA-ICP-MS, and the partitioning of REE between the different phases (minerals and melts) will be detailed at the meeting. Composite melt inclusions are also present, especially in nepheline, with three major phases: silicate melt, carbonate melt and a gas bubble. Pressure and temperature estimates based on equilibrium cpx-melt pairs document the plumbing system, with the magma chamber located around 1.7 kbar with magma 950°C magma. The noble gases (He, Ne, Ar) have been measured in cpx in order to document the mantle source, and to possibly bring new constraints on late stage contamination of the magma. Low $^{20}Ne/^{22}Ne$ ratios (below the air composition) suggest that kinetic fractionation may have occurred during interaction between magma and hydrothermally altered magma chamber margins.

[1] Mattsson, H. B., and Reusser, E., 2010. *Journal of African Earth Sciences* **58**(5):752–63