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Quantification of the timescales of the magmatic processes within a silicic magma chamber

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The goal of this study is to quantify rates of magmatic processes and establish how they vary with the composition of highly evolved magmatic system. We utilise both Rb-Sr and U-series methods because they have distinct chemical behaviour and respond in different ways to magmatic processes.

Timescale of magmatic processes in High-Silica Rhyolite (HSR) are well studied (e.g. Hildreth, 1983; Reid et al., 1997; Davies and Halliday, 1998), and are shown to operate on timescales between 1 ka to >100ka. On contrast to the HSR magmas, this project focuses on peralkaline magma [Agpaitic Index -(Na_2O+K_2O)/Al_2O_3- AI>1] that have a different composition to the HSR and hence physical characteristics (e.g. viscosity).

Peralkaline magmas are most prevalent within plate upwelling and/or rifting environments (Fitton and Upton, 1987), but also occur in a wide range of geodynamics settings. The Eburru volcanic complex, the subject of this study, is located in the central portion of the Kenya rift in a region marked by the Kenya Dome (KD). The centre of the KD consists of five major volcanic centres. Three trachyte-phonolite volcanoes have small caldera (Menengai, Longonot, Suswa). The other two systems (Eburru and Olkaria) are generally more chemically evolved trachyte- comendites/pantellerites (Sutherland, 1971; Bailey et al., 1975; Velador et al., 2003) but without caldera.

The Olkaria comendites are well studied (Heumann and Davies, 2002). Lavas ages are from ∼20 kyr till recent (> 1 kyr.). In 1987, Macdonald and co-workers showed that the aphyric to sparsely porphyritic Olkaria comendites (A.I.=1.0-1.4) are halogen rich, and characterized by strong trace element depletions (e.g. Sr) and enrichments (e.g. Rb, Th, Nb, Ta, Zr, REE). Davies and Macdonald (1987) have shown

that comendites have variable Sr-Nd-Pb isotope systematic that define a series of distinct chemostratographic groups. These data were initially interpreted as evidence of derivation from isotopically heterogeneous crustal source by the influx of halogen (Bailey and Macdonald, 1987), followed by extensive fractional crystallisation. More recently, Heumann and Davies (2002) demonstrated that, within the different compositional groups, chemical fractionation of both Rb-Sr and U-Th isotopic systems occurred rapidly at 47 ± 2 ka and 24 ± 1 ka. These events could be directly related to fractional crystallisation.

The study of the Eburru complex is in an early stage. The trachyte-pantellerite rocks are more peralkaline, AI$>$1.8 (Macdonald, 1987), than the Olkaria suite such that they will have lower viscosity potentially making melt extraction, magma mixing and fractional crystallisation processes operate on a different timescale compare to Olkaria and HSR. Major and trace element data will be presented along with initial Rb-Sr and U-series results to demonstrate how fractional crystallisation has controlled the late stage evolution of the pantellerites. Isotopic analyses have yet to be initiated.

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