Shallow, interconnected magmas as key to geothermal reservoirs in the Central Kenya Peralkaline Province, East Africa Rift

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Kenya is posed to become completely green by 2050 with a combination of resources including geothermal [1]. Geothermal production from the active volcanoes in Central Kenya (Figure 1a) is a vital part of this goal. These volcanoes are, from north to south, Menengai, Eburru [2, 3], Longonot, Olkaria, and Suswa [4]. Mafic cones and fissure-fed flows (Elmenteita, Ndabibi, Tandamara) are peripheral to the caldera-centric edifies. Suswa shield volcano erupted trachyte and phonolite from two nested calderas. The initial trachyte shield (activity from at least ca. 110 ka) culminated in a mingled magma caldera eruption (ca. 46 ka). Post-caldera activity shifted to phonolite and included early post caldera lavas, episodic construction of the Ol-Dinyo Nyoke cone (32 to 11 ka) and continued activity (11 ka to present) from a ring trench associated with the second caldera. The Masotta barometer for clinopyroxene and glass data (Figure 1b, c) yields pressures of 78 MPa for the shield, 62 MPa for early post-caldera lavas, 285 MPa for the cone, and 30 MPa for the most recent Ring Trench Group. These shallow depths re-inforce modelling of InSAR images for Suswa and other EARS volcanoes [5].

Composition of ternary feldspars as well as U-series disequilibria provide evidence for magma mingling amongst the peripheral mafic and caldera centric eruptions. End member feldspars are bytownite for mafic rocks and anorthoclase for trachytes. The second line of evidence relies on 230 Th decays from horizontal arrays characteristic of eruptions less than 20 ka towards the equiline. (Figure 1d). Suswa and Elmenteita are colinear as are Longonot and Ndabibi, which agrees with the feldspar compositions for these mingled eruptions. Non-mingled Suswa eruptions lie between these horizontal arrays and the equiline reflecting progressive decay of ²³⁰Th. The only eruptions on the equiline are from Olkaria and represent crustal anatexis.

References

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