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Magmatic cycles at Oldoinyo Lengai : an integrated model relying on melt inclusions

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Oldoinyo Lengai (OL) is the only active carbonatite-phonolite volcano which allow us to study magmatic processes along the liquid line of descent and the relationship between silicate melt and carbonatite at an alkaline igneous complex. In the last decades, Oldoinyo Lengai has been extensively studied through petrography, geochemistry and experiments leading to several petrogenetic and eruptive models. Here, we present a review of literature data, together with new chemical data from cognate cumulate samples that probe the active magma reservoir during the 2007-2008 explosive eruption. Our study presents new melt inclusion compositions included in clinopyroxene, garnet, nepheline, and interstitial melt from cumulate samples in order to track magmatic processes during the last explosive eruption. Measurements of three-phase (carbonatite + silicate glass + gas) melt inclusions have similar compositions to that observed for the 1917, 1966 and 1993 explosive eruptions, and allow the elaboration of a general model.

We describe 3 chemical components (2 chemical trends) based on major elements that can be used to constrain magmatic processes during the differentiation. The dominant stage of the eruptive cycle is a steady state and operates at open conduit conditions with the effusion of carbonatite magmas at surface from a likely stratified shallow reservoir (stagnant carbonatite on silicate magma; *component C*). Destabilisation of the system triggering the explosive eruption is likely related to the recharge of a Na-, Ca-poor melt identified in clinopyroxene-hosted melt inclusions (*component A*). Mixing between the resident (component C) and recharge silicate magmas (component A) can be tracked within the melt inclusion series. During the explosive stage, melt continues to differentiate at depth (A to B *component* composition) through protracted crystallisation of nepheline, wollastonite, apatite and minor clinopyroxene and garnet minerals.

We propose an integrated model using the previous extensive studies and the new data acquire herein to constrain the temporal evolution of magmas, and the related differentiation processes within mid-crustal reservoirs of the Oldoinyo Lengai plumbing system.