The Oldoinyo Lengai volcano plumbing system architecture, and composition from source to surface

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Cognate xenoliths that have been emitted during the last sub-plinian eruption in 2007-08 at Oldoinyo Lengai (OL) represent a unique opportunity to document the igneous processes occuring within the active magma chamber. Detailed petrographic descriptions coupled to a thermo-barometric approach, and to the determination of volatile solubility models, allow us to identify the melt evolution at magma chamber conditions, and the storage parameters (P, T). Results indicate that a fresh phonolite melt (~1060°C) was injected into a crustal magma chamber at 11.5 ±3.5 km depth, in agreement with geophysical surveys performed during the eruption. The phonolite contains high volatile contents: 3.2 wt.% H_2O and 1.4 wt.% CO_2. The liquid line of descent highlights an evolution to nephelinite compositions by cooling down to 880°C. Our results support previous results related to this eruption, and are similar to the historical products emitted during the whole volcano history, allowing us to suggest that no major modification in the plumbing system has occured during the OL evolution. New noble gas results show that: *i.* fumaroles display constant He isotopic signature since 1988; *ii.* Cognate xenoliths documenting the active magma chamber and fumaroles display similar He isotopic values (6.58±0.46R_A, and 7.31±0.40R_A, respectively); *iii.* OL He isotopic composition is similar to that of other silicate volcanoes of the Arusha region, and comparable to the typical subcontinental lithospheric mantle (SCLM) range (5.2 to 7.0 R_A); *iv.* Ne isotopic ratio of OL is following the MORB signature. Those results are interpreted as showing that 1/ no major modification in the hydrothermal system architecture has occured since 1988 despite major modification of the summit crater morphology, 2/ no contamination by either the atmospheric gases, or crustal material assimilation has occured between the magma chamber and the surface, and 3/ the source of OL and of the other silicate volcanoes in the Arusha region is a SCLM metasomatized by asthenospheric fluids.