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The origin of melanophlogite, a clathrate mineral, in natrocarbonatite lava at Oldoinyo Lengai, Tanzania

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Abstract

We report new observations of a clathrate mineral, melanophlogite [$46SiO_2 \cdot 6(N_2,CO_2) \cdot 2(CH_4,N_2)$], as part of a tuffaceous layer within a sample of the 2006 natrocarbonatite lava, whose composition reflects the typical magma erupted passively at Oldoinyo Lengai throughout the last ~50 yr. The mineral has been identified by chemical composition, micro-X-ray diffraction, and transmitted light optical characteristics. This is the first reported occurrence of a clathrate in an igneous carbonatite, and we conjecture that this mineral may be recognized elsewhere in alteration products of natrocarbonatite ash and in particular, combeite-bearing carbonatite lithologies. Specifically, melanophlogite is a rare polymorph of SiO_2 with guest molecules (e.g., CH_4, CO_2, SO_2, N_2, OH, Xe, and Kr) within a silicate framework. It occurs in an ash pellet-rich layer within the natrocarbonatite lava, as abundant groundmass crystals and as cores of individual ash pellets, with pseudocubic and pseudohexagonal habits, ranging from 50 to 100 μm in size, with numerous inclusions of nepheline laths aligned parallel to the crystal margins. It has high-C contents (up to 2.25 wt%) and CO_2 is considered to be the guest molecule due to crystallization within an alkaline carbonatitic-CO_2-rich environment.

Keywords: Oldoinyo Lengai, melanophlogite, natrocarbonatite, combeite