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Melt globules as micro-magmachambers: Extreme fractionation in peralkaline nephelinite at Nyiragongo, East African Rift

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Highly peralkaline leucite nephelinite from the active volcano Nyiragongo in the Virunga province of the East African Rift contains globules of iron- and volatile-rich, highly peralkaline silicate glass with (Na+K)/Al up to 18, which has formed as a late differentiate of less peralkaline precursors, probably by fractional crystallization at a shallow level in the volcanic system. Several uncommon minerals coexist with this glass (kalsilite, kirschsteinite, chlorbartonite, götzenite, delhayelite, zirconian cuspidine, rare alkali-barium minerals), while combeite is a near-solidus mineral.

Low-variance mineral assemblages define a cooling trend from eruptive temperatures $\geq$980 ºC to the solidus of extremely peralkaline residual liquids at 600 ºC. Oxygen fugacities well below the QFM buffer (QFM-2 to-3) persisted throughout the magmatic crystallization stage. The oxygen fugacity increased to QFM+1 or higher during the final stage of postmagmatic recrystallization. Highly alkaline, volatile-rich minerals such as delhayelite, götzenite and cuspidine were stabilized by a combination of high peralkalinity and elevated activity of chlorine and fluorine; these conditions persisted to sub-solidus temperatures.

The exotic mineralogy in these melt globules is similar to mineral assemblages in agpaitic nepheline syenites. The crystallization hisotory of these globules may be an analogue to fractionation processes in large, agpaitic intrusions (e.g. Ilímaussaq, Greenland), including the interplay of the controlling factors peralkalinity, oxygen- and volatile fugacity.