

Alkali carbonates and sulfides in kimberlite-hosted chloride-carbonate nodules (Udachnaya pipe, Russia)

V.V. SHARYGIN¹, V.S. KAMENETSKY² AND M.B. KAMENETSKY²

¹Institute of Geology and Mineralogy, Novosibirsk, Russia; sharygin@uiggm.nsc.ru

²CODES, University of Tasmania, Hobart, Australia; Dima.Kamenetsky@utas.edu.au

A block of unaltered kimberlites has been recently exposed in the eastern body of the Udachnaya pipe mine pit at > 400-500 m depths. This kimberlite is characterized by abundant chloride-rich nodules (up to 90-95% NaCl+KCl) and rare chloride-carbonate nodules (roughly similar amounts of chloride and carbonate minerals). Two types of chloride-carbonate nodules are distinguished in the carbonate-sulfide assemblage: nyerereite-shortite-calcite-rasvumite and shortite-northupite-calcite-djerfisherite.

Nyerereite $\text{Na}_2\text{Ca}(\text{CO}_3)_2$ forms the cores of zoned crystals in the first type of the nodules are characterized by strong compositional variations, especially in K_2O and SO_3 . (in wt%: CaO - 25-30; Na_2O - 23-27; K_2O - 2.5-7; SO_3 - 1-7). Nyerereite is partly or completely replaced by pirssonite $\text{Na}_2\text{Ca}(\text{CO}_3)_2 \cdot 2\text{H}_2\text{O}$ and contains minute apthitalite $\text{K}_3\text{Na}(\text{SO}_4)_2$ crystals. Shortite $\text{Na}_2\text{Ca}_2(\text{CO}_3)_3$ and calcite are main minerals of the rims of zoned crystals. We envisage the formation of the rims resulting from breakdown of nyerereite at reducing temperatures. Associated shortite, northupite $\text{Na}_3\text{Mg}(\text{CO}_3)_2\text{Cl}$ and calcite in other type of carbonate-rich nodules are close to ideal compositions.

Rasvumite forms prismatic, often split crystals (up to 5 mm) at the contacts between nyerereite and chlorides. It is chemically homogeneous: (n=28, in wt. %) Na 0.06; K 15.5; Fe 45.5; S 38.6; Cl 0.05; Rb - 0.7; Tl - 0.02; and corresponds to ideal KFe_2S_3 . Djerfisherite $\text{K}_6\text{Na}(\text{Fe,Ni,Cu})_{24}\text{S}_{26}\text{Cl}$ often forms octahedral crystals (up to 100 μm) or subhedral grains (up to 80 μm) in shortite. It is enriched in Fe (53.4-53.9 wt. %) and depleted in Ni and Cu (0.9-1.1 and <0.4 wt. %, respectively). Only some grains show elevated Ni, Cu and Co (8.6, 2.2 and 1.0 wt. %, respectively).

The chloride-carbonate nodules can originate either due prolonged fractionation of the kimberlite magma or from recrystallized evaporite fragments, trapped by ascending magmas. The appearance of nyerereite, rasvumite and djerfisherite unambiguously points to magmatic origin of the nodules. In many aspects these nodules are similar to the Oldoinyo Lengai natrocarbonatites. Preservation of highly hygroscopic alkali carbonates in the ~350 Ma Udachnaya-East kimberlite is enigmatic, but possible if the system remained closed since emplacement. As chlorides are dominant in all types of studied nodules, the presence of Cl-free rasvumite in some nodules and Cl-bearing djerfisherite in others requires further investigation.