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Vorlanite ($CaU^{6+}O_4$)—A new mineral from the Upper Chegem caldera, Kabardino-Balkaria, Northern Caucasus, Russia

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Abstract

The new mineral vorlanite, ($CaU^{6+}O_4$), D_{calc} = 7.29 g/cm^3, H = 4–5, VHN_{10} = 360 kg/mm^2, was found near the top of Mt. Vorlan in a calcareous skarn xenolith in ignimbrite of the Upper Chegem caldera in the Northern Caucasus, Kabardino-Balkaria, Russia. Vorlanite occurs as aggregates of black platy crystals up to 0.3 mm long with external symmetry $\bar{3}m$. The strongest powder diffraction lines are [*d*(Å)/(*hkl*)]: 3.107/(111), 2.691/(200), 1.903/(220), 1.623/(311), 1.235/(331), 1.203/(420), 1.098/(422), 0.910/(531). Single-crystal X-ray study gives isometric symmetry, space group $Fm\bar{3}m$, a = 5.3813(2) Å, V = 155.834(10) Å^3, and Z = 2. X-ray photoelectron spectroscopy indicate that all U in vorlanite is hexavalent. The mineral is isostructural with fluorite and uraninite ($U^{4+}O_2$). In contrast to synthetic rhombohedral $CaUO_4$, and most U^{6+} minerals, the U^{6+} cations in vorlanite are present as disordered uranyl ions. $^{[8]}Ca^{2+}$ and $^{[8]}U^{6+}$ are disordered over a single site with average M-O = 2.33 Å.

Vorlanite is believed to be a pseudomorphic replacement of originally rhombohedral $CaUO_4$. We assume that this rhombohedral phase transformed by radiation damage to cubic $CaUO_4$ (vorlanite). The new mineral is associated with larnite, chegemite, reinhardbraunsite, lakargiite, rondorfite, and wadalite, which are indicative of high-temperature formation (>800 °C) at shallow depth.

Keywords: Vorlanite, $CaUO_4$, uranium, skarn, structure, Raman, XPS, Lakargi