

Harmunite CaFe_2O_4 : A new mineral from the Jabel Harmun, West Bank, Palestinian Autonomy, Israel

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ABSTRACT

Harmunite, naturally occurring calcium ferrite CaFe_2O_4 , was discovered in the Hatrum Complex of pyrometamorphic larnite rocks close to the Jabel Harmun, the Judean Desert, West Bank, Palestinian Autonomy, Israel. The new mineral occurs in larnite pebbles of the pseudo-conglomerate, the cement of which consists of intensely altered larnite-bearing rocks. Srebrodolskite, magnesioferrite, and harmunite are intergrown forming black porous aggregates to the central part of the pebbles. Larnite, fluorellestadite, ye'elimite, fluormayenite, gehlenite, ternesite, and calciolangbeinite are the main associated minerals. Empirical crystal chemical formula of harmunite from type specimen is as follows $\text{Ca}_{1.013}(\text{Fe}_{1.957}^{3+}\text{Al}_{0.015}\text{Cr}_{0.011}^{3+}\text{Ti}_{0.004}^{4+}\text{Mg}_{0.003})_{\Sigma 1.993}\text{O}_4$. Calculated density is 4.404 g/cm^3 , microhardness VHN_{50} is 655 kg/mm^2 . The Raman spectrum of harmunite is similar to that of the synthetic analog. Harmunite in hand specimen is black and under reflected plane-polarized light is light gray with red internal reflections. Reflectance data for the COM wavelengths vary from ~22% (400 nm) to ~18% (700 nm).

The crystal structure of harmunite [$Pnma$; $a = 9.2183(3)$, $b = 3.0175(1)$, $c = 10.6934(4)$ Å; $Z = 4$, $V = 297.45(2)$ Å³], analogous to the synthetic counterpart, was refined from X-ray single-crystal data to $R1 = 0.0262$. The structure of CaFe_2O_4 consist of two symmetrically independent FeO_6 octahedra connected over common edges, forming double rutile-type ${}_2[\text{Fe}_2\text{O}_6]$ chains. Four such double chains are further linked by common oxygen corners creating a tunnel-structure with large trigonal prismatic cavities occupied by Ca along [001]. The strongest diffraction lines are as follows [d_{hkl} , (l)]: 2.6632 (100), 2.5244 (60), 2.6697 (52), 1.8335 (40), 2.5225 (35), 2.2318 (34), 1.8307 (27), 1.5098 (19). Crystallization of harmunite takes place in the presence of sulfate melt.

Keywords: Harmunite; calcium ferrite; Raman; structure; Jabel Harmun, Palestinian Autonomy, Israel