

LETTER

Murchisite, Cr₅S₆, a new mineral from the Murchison meteorite

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ABSTRACT

Murchisite (IMA 2010-003), Cr₅S₆, is a new chromium sulfide mineral, discovered in the Murchison CM2 meteorite. The type material occurs as one subhedral crystal (1.3 × 4 μm in size) in contact with low-Ni iron (“kamacite”), martensitic iron, schreibersite, and a Ca-,Al-rich glass, all of which are included in an isolated forsteritic olivine grain in the meteorite’s matrix. The mean chemical composition determined by electron microprobe analysis of the type material is (wt%) Cr 53.32, S 42.87, V 1.44, Fe 1.14, P 0.10, Ni 0.10, sum 98.97. The empirical formula calculated on the basis of 6 S atoms is (Cr_{4.60}V_{0.13}Fe_{0.09}Ni_{0.01})_{Σ4.83}(S_{6.00}P_{0.01})_{Σ6.01}. Murchisite was also identified in another isolated olivine grain from the same meteorite. These crystals are subhedral to round in shape, 300 nm to 1 μm in size, and occur in association with tochilinite and serpentine, within which it is included, chromite, and eskolaite. Its electron backscatter diffraction patterns are an excellent match to that of synthetic Cr₅S₆ with the $P\bar{3}1c$ structure, showing $a = 5.982$, $c = 11.509$ Å, $V = 356.67$ Å³, and $Z = 2$, based on previously published data from synthetic material. Murchisite is named for the locality (the Murchison meteorite). It is a low-temperature phase (~327 °C in the Cr-S system), probably formed from higher temperature Cr_{1-x}S exsolved or expelled from a Cr-,S-bearing, metal-rich spherule included in forsteritic olivine grains that were probably derived from chondrule fragments. The formation of this phase reflects sulfur fugacities intermediate between those that would have led to troilite and those that would have led to no sulfide at all. The high-temperature Cr_{1-x}S phase equilibrated with coexisting alloys to ~600 °C. Murchisite formed from this precursor at low temperatures (<~300 °C) through ordering of S vacancies.

Keywords: Murchisite, Cr₅S₆, new mineral, chromium sulfide, olivine, Murchison meteorite, carbonaceous chondrite