

Chenmingite, FeCr_2O_4 in the CaFe_2O_4 -type structure, a shock-induced, high-pressure mineral in the Tissint martian meteorite

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ABSTRACT

Chenmingite (FeCr_2O_4 ; IMA 2017-036) is a high-pressure mineral, occurring as micrometer- to submicrometer-sized lamellae within precursor chromite grains along with xieite and Fe,Cr-rich ulvöspinel next to shock-induced melt pockets, from the Tissint martian meteorite. The composition of type chenmingite by electron probe analysis shows an empirical formula of $(\text{Fe}_{0.75}^{2+}\text{Mg}_{0.23}\text{Mn}_{0.02})(\text{Cr}_{1.60}\text{Al}_{0.29}\text{Fe}_{0.06}^{3+}\text{Fe}_{0.04}^{2+}\text{Ti}_{0.02})_{\Sigma 2.01}\text{O}_4$. The general and end-member formulas are $(\text{Fe,Mg})(\text{Cr,Al})_2\text{O}_4$ and FeCr_2O_4 . Synchrotron X-ray diffraction reveals that chenmingite has an orthorhombic *Pnma* CaFe_2O_4 -type (CF) structure with unit-cell dimensions: $a = 9.715(6)$ Å, $b = 2.87(1)$ Å, $c = 9.49(7)$ Å, $V = 264.6(4)$ Å³, and $Z = 4$. Both chenmingite and xieite formed by solid-state transformation of precursor chromite under high pressure and high temperature during the Tissint impact event on Mars. The xieite regions are always in contact with melt pockets, whereas chenmingite lamellae only occur within chromite, a few micrometers away from the melt pockets. This arrangement suggests that chenmingite formed under similar pressures as xieite but at lower temperatures, in agreement with experimental studies.

Keywords: Chenmingite, FeCr_2O_4 , high-pressure mineral, shock-induced phase, Tissint martian meteorite, shergottite