

LETTER

Grossmanite, $\text{CaTi}^{3+}\text{AlSiO}_6$, a new pyroxene from the Allende meteorite

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ABSTRACT

Grossmanite, $\text{Ca}(\text{Ti}^{3+}, \text{Mg}, \text{Ti}^{4+})\text{AlSiO}_6$ with an end-member formula $\text{CaTi}^{3+}\text{AlSiO}_6$, is a new member of the Ca clinopyroxene group, where the trivalent cations are dominant in the M1 site with Ti^{3+} being the dominant trivalent cation. It occurs as micrometer-sized crystals along with spinel and perovskite in a melilite host in Ca-, Al-rich refractory inclusions from the Allende meteorite. The mean chemical composition determined by electron microprobe analysis of the type material is (wt%) SiO_2 27.99, Al_2O_3 24.71, CaO 24.58, Ti_2O_3 10.91, TiO_2 6.68, MgO 4.45, Sc_2O_3 0.43, V_2O_3 0.19, ZrO_2 0.13, FeO 0.08, Cr_2O_3 0.03, sum 100.20. Its empirical formula calculated on the basis of 6 O atoms is $\text{Ca}_{1.00}[(\text{Ti}_{0.35}^{3+}\text{Al}_{0.18}\text{Sc}_{0.01}\text{V}_{0.01}^{3+})_{\Sigma 0.55}\text{Mg}_{0.25}\text{Ti}_{0.19}^{4+}]_{\Sigma 1.00}(\text{Si}_{1.07}\text{Al}_{0.93})_{\Sigma 2.00}\text{O}_6$. Grossmanite is monoclinic, $C2/c$; $a = 9.80 \text{ \AA}$, $b = 8.85 \text{ \AA}$, $c = 5.36 \text{ \AA}$, $\beta = 105.62^\circ$, $V = 447.70 \text{ \AA}^3$, and $Z = 4$. Its electron back-scatter diffraction pattern is an excellent match to that of Ti^{3+} -rich pyroxene with the $C2/c$ structure. The five strongest calculated X-ray powder diffraction lines are [d spacing in Å , (l), hkl] 2.996 (100) ($\bar{2}21$), 2.964 (31) (310), 2.581 (42) (002), 2.600 (28) ($\bar{1}31$), 2.535 (47) (221). The name is for Lawrence Grossman, a cosmochemist at the University of Chicago.

Keywords: Grossmanite, $\text{Ca}(\text{Ti}^{3+}, \text{Mg}, \text{Ti}^{4+})\text{AlSiO}_6$, $\text{CaTi}^{3+}\text{AlSiO}_6$, new mineral, Ti-rich pyroxene, refractory inclusion, Allende meteorite, carbonaceous chondrite