

Brownleeite: A new manganese silicide mineral in an interplanetary dust particle

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ABSTRACT

Brownleeite, ideally stoichiometric MnSi, is a manganese silicide not previously observed in nature that was discovered within an interplanetary dust particle that likely originated from a comet. Three submicrometer brownleeite grains were found, with one of them poikilistically enclosed by Mn-bearing forsterite. Owing to the small size of the brownleeite grains, it was not possible to determine conventional macroscopic properties of this mineral; however, the chemical composition and crystal structure were well constrained by extensive quantitative energy dispersive X-ray analysis and electron diffraction using transmission electron microscopy (TEM). The crystal system for brownleeite is cubic ($a = 4.557 \text{ \AA}$) with space group $P2_13$, cell volume = 94.63 \AA^3 , $Z = 4$, density (calculated) = 2.913 g/cm^3 , and empirical formula: $(\text{Mn}_{0.77}\text{Fe}_{0.18}\text{Cr}_{0.05})\text{Si}$. These brownleeite grains likely formed as high-temperature condensates either in the early Solar System or in the outflow of an evolved star or supernova explosion.

Keywords: MnSi, new minerals, electron microscopy, TEM, electron diffraction, lunar and planetary studies, IDPs