American Mineralogist, Volume 98, pages 1368–1371, 2013

LETTER

Discovery of dmisteinbergite (hexagonal $CaAl_2Si_2O_8$) in the Allende meteorite: A new member of refractory silicates formed in the solar nebula

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ABSTRACT

Dmisteinbergite, $CaAl_2Si_2O_8$ with $P6_3/mcm$ structure, was identified in a rounded coarse-grained igneous Type B2 Ca-,Al-rich inclusion (CAI) *STP*-1 from the Allende CV3 carbonaceous chondrite. *STP*-1 belongs to a very rare type of refractory inclusions, *F*ractionation and *U*nknown *N*uclear effects (FUN) CAIs, which experienced melt evaporation and crystallization at low total gas pressure ($P < 10^{-6}$ bar) in a high-temperature (>1200 °C) region, possibly near the proto-Sun and were subsequently radially transported away from region, possibly by a disk wind. The Allende dmisteinbergite occurs as irregular single crystals (100–600 μm in size) in contact with gehlenitic melilite and Al,Ti-diopside, poikilitically enclosing euhedral spinel, and rare anorthite. It is colorless and transparent. The mean chemical composition, determined by electron microprobe analysis, is (wt%) SiO_2 42.6, Al_2O_3 36.9, CaO 20.2, MgO 0.05, sum 99.75, giving rise to an empirical formula of $Ca_{1.01}Al_{1.96}Si_{2.02}O_8$. Its electron backscatter diffraction patterns are a good match to that of synthetic $CaAl_2Si_2O_8$ with the $P6_3/mcm$ structure and the unit cell a = 5.10 Å, c = 14.72 Å, and Z = 2. Dmisteinbergite could have crystallized from a silicate melt at high temperature (~1200–1400 °C) via rapid cooling. Dmisteinbergite in Allende, the first find in a meteorite, is a new member of refractory silicates, among the first solid materials formed in the solar nebula.

Keywords: Dmisteinbergite, hexagonal $CaAl_2Si_2O_8$, new refractory silicate, Allende meteorite, carbonaceous chondrite, Ca-,Al-rich refractory inclusion, solar nebula, EBSD