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Kushiroite, $CaAlAlSiO_6$: A new mineral of the pyroxene group from the ALH 85085 CH chondrite, and its genetic significance in refractory inclusions

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Abstract

The new mineral kushiroite, belonging to the pyroxene group, was first discovered in a refractory inclusion in the CH group carbonaceous chondrite ALH 85085. The chemical formula is $Ca_{1.008}(Mg_{0.094}Fe_{0.034}Al_{0.878})(Al_{0.921}Si_{1.079})O_6$, containing 88% $CaAlAlSiO_6$ and 12% diopside components. We identified the exact nature of kushiroite by micro-Raman spectroscopy and electron backscatter diffraction (EBSD) analyses. The results are consistent with those obtained from the synthetic $CaAlAlSiO_6$ pyroxene, thus indicating a monoclinic structure (space group *C*2/*c*). Although $CaAlAlSiO_6$ has been one of the most important hypothetical components of the pyroxene group, it is here for the first time established to be a naturally occurring mineral. We named this pyroxene with >50% $CaAlAlSiO_6$ component kushiroite, which was recently approved by the Commission on New Minerals, Nomenclature and Classification of the International Mineralogical Association (IMA2008-059). The name is for Ikuo Kushiro, Professor Emeritus at the University of Tokyo, Japan, and eminent experimental petrologist, for his outstanding experimental investigations on silicate systems involving the Ca-Tschermak component. There is no obvious evidence for impact in this inclusion. We suggest that metastable crystallization of this pyroxene took place from refractory melts in the solar nebula. Coexisting grossite-bearing refractory inclusions in the type specimen ALH 85085 show ^{26}Mg excesses with inferred initial ^{26}Al-^{27}Al ratios between 2.1×10^{-6} to 3.9×10^{-5}, providing evidence that condensation, melting, and crystallization took place in the solar nebula when ^{26}Al was still extant.

Keywords: Kushiroite, pyroxene, Ca-Tschermak component, refractory inclusion, CH chondrite