

**KUSHIROITE,  $\text{CaAl}_2\text{SiO}_6$ , A NEW MINERAL IN CARBONACEOUS CHONDRITES: ITS FORMATION CONDITIONS AND GENETIC SIGNIFICANCE IN Ca-AL-RICH REFRACTORY INCLUSIONS.** M. Kimura<sup>1</sup>, A. El Goresy<sup>2</sup>, T. Mikouchi<sup>3</sup>, A. Suzuki<sup>4</sup>, M. Miyahara<sup>4</sup>, and E. Ohtani<sup>4</sup>. <sup>1</sup>Ibaraki University, Japan, E-Mail: makotoki@mx.ibaraki.ac.jp, <sup>2</sup>Bayerisches Geoinstitut, Universität Bayreuth, Germany, <sup>3</sup>University of Tokyo, Japan, <sup>4</sup>Tohoku University, Japan.

**Introduction:** Ca-Tschermak (hereafter CaTs),  $\text{CaAl}_2\text{SiO}_6$ , component has been one of the most important hypothetical members of pyroxene, and CaTs-rich pyroxene was abundantly reported from refractory inclusions in carbonaceous chondrites [e.g., 1]. However, the nature of such pyroxene has not been characterized in detail because of their tiny grain size. For the first time, we succeeded to identify the exact nature of highly CaTs-rich pyroxene [2, 3], and named it kushiroite, which was approved by the Commission on New Minerals, Nomenclature and Classification of the International Mineralogical Association (IMA2008-059) on January, 2009. Here we discuss the formation condition and significance of kushiroite in refractory inclusions.

**Petrography of kushiroite-bearing inclusions:** Kushiroite was first identified, occurring with grossite, in an inclusion (#186) of ALH 85085 (CH) [1-3]. Later possible kushiroite has been reported from inclusions in CH and other carbonaceous chondrites [e.g., 4-6]. These inclusions are mostly spherical in shape. Kushiroite is always encountered in the outer peripheral parts of inclusions, surrounding grossite, hibonite and other minerals. The bulk composition of such inclusion is highly refractory: 18.6 wt.%  $\text{SiO}_2$ , 55.6%  $\text{Al}_2\text{O}_3$ , 23.0% CaO for #186 in ALH 85085 [1].

**Discussion:** Although CaTs is stable under high-pressure conditions [7], no obvious evidence for impact in CAI #186 indicates that the metastable crystallization of this pyroxene took place from refractory melt in the solar nebula. The bulk composition of #186 CAI plots just on the liquidus surface of hibonite, not grossite or others. This strongly indicates that this inclusion never experienced crystallization process under equilibrium conditions. We suggest that grossite and kushiroite in #186 did not simultaneously or continuously crystallized from the same melt droplet, but formed separately. Textural observation and bulk chemistry indicate that precursor of kushiroite plastered grossite and other minerals which had been pre-existed condensates.

Coexisting grossite-bearing CAIs in the type specimen ALH 85085 show  $^{26}\text{Mg}$  excesses with inferred initial  $^{26}\text{Al}$ - $^{27}\text{Al}$  ratios between  $2.1 \times 10^{-6}$  to  $3.9 \times 10^{-5}$  [1], thus evidencing that condensation, melting and crystallization took place in the solar nebula when  $^{26}\text{Al}$  was still extant.

**References:** [1] Kimura M. et al. 1993. *Geochimica et Cosmochimica Acta* 57: 2329-2359. [2] Kimura M. et al. 2008. *Meteoritics & Planetary Science* 43: A75. [3] Kimura M. et al. 2009. *American Mineralogist* (submitted). [4] Simon S. B. et al. 1998. *Meteoritics & Planetary Science* 33: 411-424. [5] Krot A.N. et al. 1999. Abstract #2018. 30th Lunar & Planetary Science Conference. [6] Petaev M. I. et al. 2001. Abstract #1445. 32nd Lunar & Planetary Science Conference. [7] Hays, J.F. 1966. *American Mineralogist*, 51, 1524-1529.