**Tuesday, July 25, 2017**
**CAIS AND OTHER REFRACTORY MATERIALS**
**1:30 p.m. Sweeney C**

*Petrographic and isotopic studies of refractory inclusions, including stable and short-lived isotopes and nucleosynthetic anomalies.*

**Chairs:** **Glenn MacPherson**
**Ming-Chang Liu**

1:30 p.m. Liu M.-C. * Han J. Brearley A.
*The Boron Isotopic Ratios of a Fine-Grained Inclusion from the Allan Hills 77307 Chondrite (CO3.0)* **[#6291]**
Whence did solar system derive $^{10}$Be / Irradiation or inheritance / Fine-grained CAIs will shed light.

1:45 p.m. Fukuda K. * Fujiya W. Hiyagon H. Takahata N. Kagoshima T. Sugiura N. Sano Y.
*Li-Be-B Isotopic Compositions in CH and CH/CB CAIs: Implication for the Origin of $^{10}$Be in the Early Solar System* **[#6210]**
Li-Be-B isotope systematics of CH and CB/CH CAIs imply that $^{10}$Be was not produced by *in-situ* irradiation of refractory solids, but by irradiation of a chondritic gas or by other mechanisms.

2:00 p.m. Dunham E. * Wadhwa M. Liu M.-C.
*The Range of Initial $^{10}$Be/$^{9}$Be Ratios in the Early Solar System: A Re-Assessment Based on Analyses of New CAIs and Melilite Composition Glass Standards* **[#6381]**
We report a more accurate range of initial $^{10}$Be/9Be in CAIs including FUN CAI CMS-1 from Allende (CV3) and a new CAI from NWA 5508 (CV3) using melilite composition glass standards; we suggest $^{10}$Be is largely produced by irradiation in the nebula.

2:15 p.m. Ma C. * Yoshizaki T. Krot A. N. Beckett J. R. Nakamura T. Nagashima K. Muto J. Ivanova M. A.
*Discovery of Rubinite, $Ca_3Ti^{3+}_2Si_3O_{12}$, a New Garnet Mineral in Refractory Inclusions from Carbonaceous Chondrites* **[#6023]**
Rubinite is a new refractory mineral, discovered in CV3 Vigarano, Allende and Efremovka. It formed either as a condensate or through crystallization from an $^{16}$O-rich Ca, Al, and Ti-rich melt under highly-reduced conditions.

2:30 p.m. Ivanova M. A. * Krot A. N. Nagashima K. Ma C. MacPherson G. J.
*Oxygen-Isotope Composition of UltraRefractory CAI from CV3 Chondrite Efremovka* **[#6037]**
We report O-isotope compositions of minerals from a ~1 cm-sized compound Efremovka CAI composed of ultrarefractory nodule (40E-1), CTA (40E) inclusion surrounding by Wark-Lovering rim, and discuss the origin of ultrarefractory CAIs.

2:45 p.m. Simon J. I. * Simon S. B. Nguyen A. N. Ross D. K. Messenger S.
*Multiple Nebular Gas Reservoirs Recorded by Oxygen Isotope Variation in a Spinel-Rich CAI in $CO_3$ Miller Range (MIL) 090019* **[#6123]**
We conducted NanoSIMS ion imaging studies of a primitive spinel-rich CAI from the MIL 090019 $CO_3$ chondrite. It records radial O-isotopic heterogeneity among multiple occurrences of the same mineral, reflecting distinct nebular O-isotopic reservoirs.

3:00 p.m. Frank D. R. * Huss G. R. Nagashima K. Zolensky M. E. Le L.
*Oxygen, Magnesium, and Aluminum Isotopes in the Ivuna CAI: Re-Examining High-Temperature Fractionations in CI Chondrites* **[#6355]**
The only whole CAI preserved in the aqueously altered CI chondrites is $^{16}$O-rich and has no resolvable radiogenic Mg. Accretion of CAIs by the CI parent object(s) may limit the precision of cosmochemical models that require a CI starting composition.

3:15 p.m. Krot A. N. * Nagashima K. Simon S. B.
*Mineralogically-Controlled Oxygen-Isotope Exchange in Refractory Inclusions from CO Carbonaceous Chondrites During Fluid-Rock Interaction* **[#6056]**
Grossite-rich CAIs in DOM 08006 (CO3.0) are uniformly $^{16}$O-rich ($\Delta^{17}$O ~ –24‰); in CAIs from DOM 08004 (CO3.1), grossite and melilite are $^{16}$O-depleted ($\Delta^{17}$O up 0‰) rel. to hibonite, spinel and pyroxene, suggesting O-isotope exchange on the CO asteroid.

3:30 p.m. MacPherson G. J. * Defouilloy C. Kita N. T.
*High-Precision Al-Mg Isotopic Systematics in USNM 3898 — The Benchmark "ALL" for Initial $^{87}$Sr/$^{86}$Sr in the Earliest Solar System* **[#6296]**
High-precision SIMS analysis of Al-Mg isotopes in USNM 3898, the CAI on which ALL is based, yields $^{26}$Al/$^{27}$Al = (4.88 ± 0.14) × $10^{-5}$ in its interior vs. $^{26}$Al/$^{27}$Al = (4.56 ± 0.11) × $10^{-5}$ in its outer mantle, suggesting later partial re-melting.

3:45 p.m. Han J. * Liu M.-C. Kööp L. Keller L. P. Davis A. M.
*Correlations Among MicroStructure, Morphology, Chemistry, and Isotopic Systematics of Hibonite in CM Chondrites* **[#6380]**
We present TEM observations of CM hibonites to examine possible correlations of their microstructure, morphology, mineralogy, and chemical and isotopic systematics and to better understand the formation history of hibonite in the early solar nebula.

4:00 p.m. Kööp L. * Davis A. M. Krot A. N. Nagashima K. Simon S. B.
*Calcium and Titanium Isotope Systematics in Refractory Inclusions from CM, CO, and CR Chondrites* **[#6280]**
We studied a large number of CAIs from three different chondrite groups (CM, CO, CR) for Ca and Ti isotopes. Large anomalies in the neutron-rich isotopes were found in CAIs from all three chondrite groups.

4:15 p.m. Ebert S. * Render J. Brennecka G. A. Bischoff A. Burkhardt C. Kleine T.
*$^{50}$Ti Isotope Excesses in CAIs from Ordinary and Rumuruti Chondrites* **[#6250]**
This initial study of Ti isotopes in CAIs from ordinary, Rumuruti, and CO3 chondrites reveals an excess of $^{50}$Ti within the range of values for CV CAIs.

4:30 p.m. Torrano Z. A. * Rai V. K. Wadhwa M.
*Titanium Isotopic Compositions of Refractory Inclusions from Several CV3 and CK3 Chondrites: Implications for Nebular Heterogeneity* **[#6318]**
This investigation extends the sample set of CAIs for which high precision Ti isotope compositions are available. Here we report the Ti isotopic compositions of six CAIs from distinct CV3 chondrites and discuss implications for nebular heterogeneity.

4:45 p.m. Render J. * Brennecka G. A. Wang S. J. Wasylenki L. E. Kleine T.
*Insights into CAI Formation from Nickel Isotopic Signatures* **[#6327]**
Refractory inclusions show isotopic variability in nickel, suggestive of a mixing line between the indigenous isotopic composition of CAIs and a second, yet to be identified component.

5:00 p.m. Schönbächler M. * Lai Y.-J. Henshall T. Fehr M. A. Cook D. L. Bullock E. S.
*The Evolution of the Protoplanetary Disk Recorded by Nucleosynthetic Isotope Variations of Variable Stellar Origin in Refractory Inclusions* **[#6222]**
New CAI data confirm the homogeneous distribution of the short-lived p-process isotope $^{92}$Nb in the early solar system with the exception of CAIs with group II REE pattern that show increased $^{92}$Nb abundances.

5:15 p.m. Lodders K. * Fegley B.
*Condensation at Varying Total Pressures and Metallicities: Rare Earth Elements* **[#6401]**
Condensation of ultrarefractory REE as oxides before Ca-bearing condensates at lower total pressures and [Fe/H] removes the need for hibonite or perovskite removal from equilibrium with gas within extremely small T intervals after they become stable.