SESSION 5

Return Samples and Instrumentation to Open Up a New Era for Cosmochemistry

DAY 3 – Feb.19, 2016
4:30 pm – 7:20 pm

OSIRIS-REx SAMPLE COLLECTION REQUIREMENT: TEMPERATURE AND VOLATILES. H. C. CONNOLLY Jr[1,2,3], D. S. LAURETTA[3] and OSIRIS-REx Sample Analysis Team [1]Dept. of Physical Sciences, Kingsborough Community College of CUNY Brooklyn NY, NY 11235 USA and Earth and Environmental Sciences, The Graduate Center of CUNY, 365 5th Ave, NY, NY 10016 USA (hconnolly@gc.cuny.edu), Dept. Earth and Planetary Sciences, American Museum of Natural History, Central Park West, NY, NY USA. [3]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, USA.

NASA's New Frontiers 3 asteroid sample return mission, OSIRIS-REx (O-REx), will return a minimum of 60 g and up to 2 kg of pristine asteroid regolith. The target asteroid, Bennu, is a spectral type B and hypothesized to be carbonaceous chondrite-like (1). The O-REx mission has a level 2 requirement to maintain the temperature of the collected sample to ≤ 75 C from collection through to Earth return. This requirement levees an important constraint on the mission: If sample collection occurs close to or at asteroid perihelion, the TAGSAM collector head may reach temperatures > 75 C after collection due to direct exposure to solar radiation, thus violating the mission temperature requirement.

The O-REx temperature requirement is generated from the science team and based on the analyses of analog (to Bennu) chondrites that have shown the behavior of labile elements during heating experiments (2,3). However, the database on the behavior labile elements during heating events within carbonaceous chondrites is fairly limited. One major confining factor within the community at large for investigating these elements may have been the lack in applicability of the data to practical problems in the field. With the return of samples from Itokawa by Hayabusa and the future return of asteroid samples by Hayabusa2 and O-REx, understanding in detail behavior of labile elements is now a science issue propelled to the forefront.

It has been shown (2,3) that heating Murchison to ~ 100 C begins to affect the bulk composition, with a release of S from a yet unknown phase, with maximums at 300 and 600 C. At > 200 C Se begins to release from a yet unknown phase. According to (1), based on VIR data, CM or CI chondrites may be the most analogous chondrite types to Bennu. Thus, the level 2 requirement for O-REx is directly based on the results of (3). A major science question that needs to be addressed in the future is to determine what phases are the source(s) of S and Se, along with other labile element.

Finally, the O-REx Design Reference Asteroid (4) defines the average surface temperature at the equator of Bennu at be ~77 C with a maximum at perihelion slightly above 100 C. Therefore, why does the O-REx mission impose the level 2 temperature requirement on the collection and storage of the sample? It is entirely possible that the collector will penetrate the subsurface regolith and thus collect cooler regolith that could be richer in organic and other volatiles compared with the current surface that is directly exposed to solar radiation.

References: (1) Clark B. E. et al., (2011) Icarus **216**, 462-475. (2) Goreva J. S. and Lauretta D. S. (2005) *LPCS* #1462. (3) Lauretta et al. (2001) *LPSC* #1356. (4) Hergenrother C. W. et al., (2014) Earth and Planetary Astrophysics, arXiv:1409.4704.