STARDUST AND CI-CHONDRITE SULFIDES: EVIDENCE FOR PARENT BODY AQUEOUS PROCESSING

E. L. Berger[1], D. S. Lauretta[1], T. J. Zega[2] and L. P. Keller[3]. [1]Lunar & Planetary Laboratory, Dept. of Planetary Sciences, Univ. of Arizona, Tucson AZ. e-mail: elberger@lpl.arizona.edu. [2]Naval Research Laboratory, Washington D.C. 20375. [3]Robert M. Walker Laboratory for Space Sciences, ARES, Johnson Space Center, Houston, TX 77573.

Introduction: NASA's Stardust Mission successfully returned a diverse collection of material from Comet 81P/Wild 2; from high-temperature CAI-like components to low-temperature sulfide minerals. While the CAI-like assemblages returned by the spacecraft bear witness to mixing of high-temperature components in the early Solar System, sulfides provide complementary information about low-temperature material. Sulfides may represent the strongest evidence for preservation of grains that experienced aqueous alteration at some point in their history. Some Stardust sulfides are strikingly similar to sulfides in CI chondrites, suggesting a possible relationship between the two types of material. In particular, pyrrhotite, pentlandite, cubanite, and Zn-bearing iron sulfides occur in both collections. The mineralogical heritage of these grains aids in clarifying early solar system processes.

Methods: Compositions and crystal structures of Stardust sulfides are characterized using transmission electron microscopy (TEM) at Johnson Space Center, on the JEOL 2000FX STEM and the JEOL 2500SE field emission STEM. CI-chondrite sulfides are characterized using a combination of electron microprobe analysis and TEM, using the Cameca SX-50 Electron Microprobe at the University of Arizona (UA) and the JEOL 2200FS TEM at the Naval Research Laboratory. Laser ablation inductively coupled plasma mass spectroscopy (LA-ICP-MS) measurements are done at UA on a Thermo Finnigan ELEMENT2 high resolution ICP mass spectrometer coupled with a New Wave Research UP193FX Excimer laser ablation unit.

Results & Discussion: The crystal structures and compositions of these sulfides, both individually and in combination, yield constraints for formation conditions. For example, the presence of orthorhombic cubanite, in the Stardust and CI-chondrite collections, provides a maximum temperature constraint of 210°C [e.g., 1]. The stability of 4C monoclinic pyrrhotite, which has been identified in both collections, is restricted to temperatures below ~250°C [2]. Combinations of cubanite and pyrrhotite in the CI-chondrite collection, as well as pyrrhotite and pentlandite, in both collections, furnish further constraints. LA-ICP-MS analysis of a CI-chondrite pyrrhotite grain is consistent with the presence of a sphalerite inclusion within the pyrrhotite grain, which provides a direct analog to the Stardust Track 27 pyrrhotite/sphalerite assemblage.

If the Stardust sulfides formed via the same aqueous mechanisms as they did on the CI-chondrite parent body, they represent remnants of aqueous alteration on a cometary body.

References: [1] Pruseth *et al.* (1999) *Eur. J. Mineral* 11: 471-476. [2] Wang *et al.* (2008) *J. Sulfur Chem.* 27: 271-282.

Acknowledgements: Special thanks to the Vatican Observatory for providing samples. This work was supported by NASA grants: NNX09AC60G (DSL) and NNX08AW48H (ELB).