INVESTIGATING THE PROVENANCE OF COMET 81P/WILD 2 GRAINS USING SuperSTEM. John P. Bradley, Institute of Geophysics and Planetary Physics, Lawrence Livermore National Laboratory, Livermore, CA. E-mail: bradley332@llnl.gov.

A new generation of electron microscope known as SuperSTEM has recently become available for meteoritics research. Key attributes of the instrument are a monochromator and spherical aberration (C_s) correctors that enable sub-Ångstrom image resolution, x-ray and energy-loss spectroscopy at atomic-column resolution, and core-edge electron spectroscopy with 100-200 meV energy resolution. Other attributes include improved detection of minor and trace elements and high-resolution petrographic mapping of fine-grained meteoritic materials, with sub-nanometer and single-atomic-column spatial resolution. We present SuperSTEM comparisons of comet 81P/Wild 2 grains with other classes of fine-grained meteoritic materials, with particular focus on the GEMS-rich chondritic porous (CP) subset of interplanetary dust particles (IDPs) collected in the stratosphere.

The Wild 2 sample was expected to resemble CP IDPs because some and possibly all of these IDPs appear to be from comets or small, cold "comet-like" bodies [1-3]. The captured sample was also expected to contain well-preserved materials that were resident in the outer solar nebula environment ~4.6 Gyr ago, including refractory stardust grains (e.g. SiC), as well as other outer nebula residents (e.g. GEMS) that were never exposed to hotter, denser regions of the inner nebular environment. Instead, accumulating evidence suggests that the 81P/Wild 2 sample better resembles chondritic meteorites than CP IDPs, suggesting that much of the non-volatile fraction of Wild 2 formed originally in inner solar system and was transported outwards to the Kuiper Belt [1,4-5].

Since GEMS are typically the most abundant silicate in CP IDPs, their presence or absence in the comet Wild 2 sample is a key arbitrator of whether there is a relationship between CP IDPs and Wild 2 grains. Initially, it appeared that GEMS are abundant in the Stardust sample [6], but subsequent measurements, in conjunction with light gas-gun shots using Stardust grain analogues, suggest that much if not all of this "GEMS-like" material may have been produced by melting, ablation and mixing of Wild 2 grains with aerogel during hypervelocity capture [5,7]. We are using the SuperSTEM to explore in more detail the relationship between GEMS in IDPs and GEMS-like material in Stardust impact tracks. High-resolution petrographic mapping, (with ~1 nm spatial resolution), reveals that some GEMS in CP IDPs contain nanoscale concentrations of carbonaceous material dispersed throughout their interiors. Systematic petrographic mapping of GEMS-like material in Stardust impact tracks is now being performed, even though carbonaceous material is much less abundant in the Stardust sample than in GEMS-rich CP IDPs.

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