Phosphorous Speciation in Interplanetary Dust

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Anhydrous chondritic porous interplanetary dust particles (CP IDPs) are believed to sample the original condensates of the Solar Protoplanetary Disk [1]. Thus, the mineralogy of CP IDPs tests predictions of equilibrium condensation. These models predict that P condenses in schreibersite [2]. An ~1 μm grain of schreibersite was identified in an unusual, hydrous IDP [3]. However there have been no comprehensive measurements of P speciation in anhydrous, primitive IDPs. The Tender Energy Spectroscopy (TES) instrument (Beamline 8BM, National Synchrotron Light Source II, Brookhaven National Laboratory) can map elements by x-ray fluorescence (XRF), and provide speciation by K-edge X-ray Absorption Near-Edge Structure (XANES) spectroscopy of P to Ca. We mapped elements from Mg to Ca in 9 large, cluster IDPs, most of which were of the anhydrous CP type. These particles have remained in silicone oil since collection to mitigate interaction with the atmosphere. Reduced P (e.g. schreibersite) is easily distinguished from oxidized P (e.g., apatite) by P-XANES (Fig. 1). We analyzed 17 spots by P-XANES. In each one P was present in oxidized rather than reduced form. At least two distinct P XANES spectra were seen in CP IDPs. One has the peak position and shoulder consistent with spectra of apatite group minerals [4]. A second, more common, phase has not been identified. We found no evidence of schreibersite in any P spot intense enough for P-XANES spectroscopy. This indicates P did not condense as schreibersite or that schreibersite was altered to oxidized P after condensation in this primitive nebular dust.

REFERENCES: [1] Ishii et al. (2008) *Science*, 319, 447-450. [2] Lodders (2003) *Ap. J.,* 591:1220–1247. [3] Bradley and Brownlee (1991) *Science*, 251, 549552. [4] Ingall et al. (2011) *J. Synch. Rad.,*18, 189-197.

Figure 1: P-XANES spectra of schreibersite, apatite and 3 P hot-spots on IDP L2005 AS11.