P and S in Primitive IDPs

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Equilibrium condensation models predict that P condenses from a gas of Solar composition when previously condensed Fe-metal interacts with P at 1265 K forming schreibersite. At lower temperatures the schreibersite interacts with the nebular gas forming fluorapatite (710 K) and whitlockite (680 K), and S interacts with Fe-metal forming troilite (704 K) [1].

Chondritic porous interplanetary dust particles (CP IDPs), anhydrous unequilibrated aggregates with compositions indicating they are relatively pristine samples [2] of the original Solar Protoplanetary Disk condensates, never experienced significant aqueous or thermal processing. The mineralogy of the primitive CP IDPs provides a test of condensation models.

Fe-sulfide is abundant in the primitive CP IDPs, but as pyrrohotite not triolite. The P speciation had not been determined. We mapped the spatial distribution of elements from Mg to Ca in 9 large, cluster IDPs, most of the anhydrous CP-type, and determined the P and S speciation by X-ray Absorption Near-Edge Structure (XANES) spectroscopy of element hot-spots using the Tender Energy Spectroscopy instrument at the National Synchrotron Light Source II. These IDPs were analyzed while still in the silicone oil in which they were collected to minimize interaction with the atmosphere.

Our P-XANES results show the P in these primitive, anhydrous IDPs is found in oxidized form (phosphates) with no detectable reduced P (phosphides). However, most P hot-spots do not show a shoulder on the high-energy side of the main peak that is characteristic of fluorapatite and whitlockite, the phosphates predicted by modelling. Alternate models of nebular condensation may be needed to match the specific P- and S-mineralogy found in the primitive CP IDPs.

References: [1] Fegley, B and L. Schaefer (2010) Cosmochemistry, in *Principles and Perspectives in Cosmochemistry*, Springer-Verlag, Berlin, 347-377. [2] Ishii, H. et al. (2008) *Science*, 319, 447-450.