IRON SULFIDE FORMATION IN ASTROPHYSICAL ENVIRONMENTS: EXPERIMENTALLY PRODUCED SULFUR-BEARING SILICATE SMOKES. N. M. Abreu[1] and J. A. III Nuth[2]. [1]Pennsylvania State University - DuBois Campus. nma12@psu.edu. [2]Astrochemistry Laboratory - Goddard Space Flight Center.

Introduction: Nanophase Fe-sulfides in association with amorphous silicates are ubiquitous components of the matrices of the most primitive carbonaceous chondrites [1,2], chondritic interplanetary dust particles [3-5], and samples from Comet 81P/Wild 2 [6,7]. Furthermore, observations of the outer disks of young stellar objects suggest that sulfides may be the primary reservoirs for S [e.g., 8]. However, the mechanism by which these sulfides formed is unclear. Three different scenarios for sulfide formation in nebular environments have been proposed: (1) nebular sulfidization of pre-existing metallic Fe precursors [9]; (2) formation by annealing during chondrule formation events [2]; and (3) direct condensation during cooling of a parcel of nebular material under disequilibrium conditions [2]. We have initiated an experimental study to test the third hypothesis.

Experimental Protocol and Results: Five different experimental runs were carried out by vaporizing solid S in a H_2 atmosphere and exposing it to Fe-carbonyl, silane, and O gas streams in a dust generator flow apparatus under a range of temperatures (175-340°C) and Fe:Si:O (60:30:30, 50:20:40, 50:20:20) ratios. Samples were ground into a powder, suspended in isopropyl alcohol, and dispersed by sonication. Droplets from the resulting solutions were deposited onto holey C-grids for transmission electron microscopy (TEM) examination. High-resolution TEM and energy dispersive spectroscopy (EDX) revealed that these samples are texturally heterogeneous, non-stoichiometric, low-density, amorphous condensates containing Fe, Si, O, and S in variable proportions. Sulfur contents of these smokes was generally very low (≤ 5 element wt%). No systematic spatial correlations have been observed among the different elemental abundances. No crystalline phases have been identified.

Discussion: Our observations suggest that direct condensation of crystalline Fe-sulfides may not occur under the experimental conditions described above. There are several possible explanations for this result. First, insufficient mixing between stagnant S vapor and gas streams may have precluded the formation of sulfides. Low S content observed in most regions of the samples may be attributable to limited mixing. Subsequent studies will substitute vaporized S for a H_2S stream in an effort to facilitate gas-phase reactions. Alternatively, low S content may be a matrix-effect artifact of EDX analysis. Finally, it is also possible that Fe-sulfides may form by processing of this or other nebular phases, as suggested by hypotheses (1) and (2). These scenarios will be evaluated in forthcoming studies.

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