Exploring a Connection Between Carbonaceous Chondrites and Cometary Dust

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Cometary aggregate interplanetary dust particles (aIDPs) have been collected from the Earth's lower stratosphere for several decades. Some portions of aIDPs are fused agglomerates of metastable eutectic MgSiO and FeSiO dust condensates. These portions are composed of ~100 nm amorphous, ferromagnesian silicate grains which acts as a groundmass for nanoscale Fe-Ni sulphides and Fe-Ni metal grains. Transmission electron microscope (TEM) studies of the fine-grained materials inside primitive carbonaceous chondrites have revealed that they are similar to these fused ferromagnesian aIDPs in terms of texture, mineralogy and bulk composition with some areas composed entirely of amorphous silicate. However, many carbonaceous chondrites have been exposed to liquid water on their parent-body asteroids. This has precipitated secondary minerals. To explore the possibility that comets and asteroids contain a population of fine-grained materials that formed from the agglomeration of nebular dust with metastable eutectic compositions, we will expose synthetic Mg-Si-O smokes of compositions similar to those found in aIDPs to liquid water, at several water-rock ratios and for several lengths of time. Any changes that occur during the hydration will be documented with TEM techniques in order to gauge the mineralogy, crystallinity, growth rate, composition and extent of each resultant phase. The resultant textures, compositions and mineralogies of the hydrated smokes will be compared to those found in the fine-grained materials of primitive carbonaceous chondrites (matrices and fine-grained chondrule rims) in order to determine the likelihood that IDP-like smokes were the precursors to the hydrated fine-grained materials now found in carbonaceous chondrites.