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Stardust (Comet) Samples and the Meteorite Record

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Perhaps the most intriguing aspect of the material collected by Stardust from ï¿_comet Wild 2 is the preponderance of high temperature and reduced crystalline phases, which are characteristic of chondrites thought to derive from the main Asteroid Belt (2-4 AU) [1]. Here we compare the mineralogy of Stardust samples to that of chondrite groups. Results: Investigation by the Preliminary Examination Team (PET) of particles from Wild 2 shows a mineral assemblage typical of chondrites, with olivine, pyroxene, FeNi-metal and sulfide as common components. Olivine and low-Ca pyroxene have a range of mg# (Fa0.5-41 and Fs0-48, respectively), which indicates that the material is unequilibrated, similar to types 2 and 3 chondrites. Some forsterite with <1 wt% FeO has up to 6.4 wt% MnO and 1.4 wt% Cr2O3. Other silicates observed are Ti-bearing aluminus diopside and rare melilite, typical of some calcium, aluminum-rich

inclusions (CAIs) in carbonaceous (C) chondrites. Additionally, FeNi-metal and sulfides including pentlandite [(FeNi)9S8)] and Fe-Ni-Cu and Fe-Zn sulfide, phases observed in C and enstatite (E) chondrites, are present in some particles. V-bearing osbornite (TiN), a phase also observed in some C and E chondrites, occurs associated with unidentified Zr-rich phase(s). Discussion: The observations by the PET are based on work done in a short period of time on a limited number of particles less than several microns in size, and, hence, conclusions based on these data are tentative. Many C chondrite groups have the wide range of ferromagnesian silicate compositions found in the Stardust samples. However, the range of olivine and pyroxene compositions, occurrence of Mn-, Cr-rich olivine, metal and pentlandite are features most consistent with CR and CH chondrites, though a CM-like lithology cannot be ruled out. Mn-, Cr- rich forsterite is found in the matrix and in amoeboid olivine aggregates in CR chondrites [2, 3]; Osbornite-bearing CAIs have been identified in the ALH 85085 CH chondrite [4] and the Isheyevo CH/CB chondrite [5]. Thus, the Stardust samples analyzed thus far have mineral assemblages close to those of CR and CH chondrites, members of the CR chondrite clan. References: [1] Scott and Krot (2005) Chondrules and the Protoplanetary Disk, 15-54. [2] Weisberg et al. (1993) GCA 57, 1567-1586. [3] Weisberg et al. (2004) MAPS 39, 1741-1753. [4] Weisberg et al. (1988) EPSL 91, 19-32. [5] Krot et al. (2006) MAPS #1506.