

MINERALOGICAL DESCRIPTIONS OF EIGHT HYDRATED INTERPLANETARY DUST PARTICLES AND THEIR RELATIONSHIP TO CHONDRITE MATRIX;

K.L.Thomas¹, M.E. Zolensky², W.Klöck³, and D.S.McKay³ ¹Lockheed, 2400 Nasa Rd.1, Houston, Tx, 77058; ²SN21, NASA/JSC, Houston, Tx, 77058; ³SN14 NASA/JSC, Houston, Tx, 77058

INTRODUCTION AND METHODS Chondritic interplanetary dust particles (IDPs) are divided into two major groups based on mineralogy and bulk chemistry [1]: anhydrous particles consist of olivines and/or pyroxenes and are chondritic in major element composition. Hydrated IDPs are dominated by layer-lattice silicates and are often depleted in Ca compared to the anhydrous group [2]. The anhydrous particles can be subdivided into two classes, Olivine and Pyroxene, as determined by the relative abundances of these two minerals. The hydrated IDPs can also be divided into two classes: Serpentine and Smectite-type [1, 3-5]. Sandford and Walker [3] determined by infrared spectroscopy that 11 of 23 IDPs examined by them were hydrated, and of the 12 anhydrous particles, 6 belonged to the olivine class and 6 belonged to the pyroxene class. Bradley [1] used transmission electron microscopy (TEM) to determine that 12 of 25 IDPs were hydrated: 2 were serpentine and 10 were smectite-type. The 13 anhydrous IDPs were dominated by pyroxenes: 9 were pyroxene particles and 4 were olivine. A total of 17 IDPs was examined for our study. Eight particles were hydrated, 3 serpentine and 5 smectite-type (Table 1). The nine anhydrous particles included 5 in the pyroxene class, 3 in the olivine class, and one mixed particle (equal distribution of pyroxene and olivine grains). Three of the anhydrous particles are reported to contain grains with solar flare tracks (J. Bradley, pers. comm.). These IDPs were thin sectioned (about 800-1000 Å thick) using an ultramicrotome and examined with a JEOL 100CX and 2000 FX STEM.

MINERALOGY All serpentine IDPs were found to contain a minor proportion of anhydrous grains, some which are mantled by spongy, poorly crystalline material. These mantled grains are dispersed and range in size from about 10 to 500 nanometers. Most of the anhydrous grains are sulfides, some glass is present, and olivines were found in two of the three serpentine IDPs. In W7017A14, some LIME olivines [6] are present. Pyroxene grains were not found in any of the serpentine IDPs. Serpentine is present as flakes, cylinders, and plates [7] with crystals up to 750 nanometers in width.

Smectite-type IDPs contain anhydrous grains, some which are mantled by spongy, poorly crystalline material; this material is texturally different from smectite. Anhydrous grains, including sulfides, glass, olivines, and pyroxenes, in smectite-type particles are present in minor amounts and range in size from approximately 10 to 500 nanometers. The pyroxenes are disordered clino- and ortho-enstatites. LIME olivines and pyroxenes were found in W7027A17. The smectite is usually present as flakes, fibers, and bundles [7] and range in size from a few Angstroms up to 15 nanometers across. Although dominated by smectite, smectite-type particle W7017A3 also contains serpentine. The serpentine is only of the flaky variety, with a maximum width of 20 nanometers. Smectite-type IDPs have a much finer grain size than those in the serpentine class. The smectite basal spacings vary from 10-15 Å; some crystals have 14 or 10 Å spacings only while others have variable spacings with considerable edge dislocations.

COMPARISON OF THE TWO MAJOR IDP GROUPS The anhydrous and hydrated IDPs are two distinct groups of extraterrestrial particles. A gradation from anhydrous to hydrated IDPs was not observed. Anhydrous IDPs may contain phyllosilicates but if so, no more than 1-2 % by volume. Hydrated particles are typically composed of phyllosilicates with abundant dispersed anhydrous grains; no completely hydrated particle was observed.

COMPARISON TO CHONDRITE MATRICES Serpentine IDPs are similar to matrix from CM carbonaceous chondrites with regard to the presence of serpentine. The dominant presence of smectite in CIs, in some unequilibrated ordinary chondrite (UOC) matrices, and in smectite-type IDPs would indicate that they are likely related (Table 2) [8, 9]. However, there are significant

DESCRIPTION OF 8 HYDRATED IDPS: Thomas K.L. et al.

differences between hydrated IDPs and chondrite matrix material:

- no glass is found in CIs and UOC matrices while it is present in smectite class IDPs.
- no glass is found in the matrix of CMs while it is present in serpentine class IDPs.
- Tochilinite is pervasive in CMs but is not present at all in serpentine IDPs [8].

The presence of glass in hydrated IDPs points out the disequilibrium nature of this assemblage: either incomplete alteration or alteration which pre-dated particle accretion has occurred. Based strictly upon mineralogical criteria, our data indicate that hydrated IDPs are not identical to matrix material for any class of chondrite.

References: [1] Bradley J.P. (1988) *Geochim.Cosmochim.Acta*, **52**, 889-900. [2] Schramm L.S. et al. (1989) *Meteoritics*, **24**, 99-112. [3] Sanford S.A. and Walker R.M. (1985) *Astrophys.Jour*, **291**, 838-851. [4] Tomeoka K. and Buseck P.R. (1985) *Nature*, **314**, No.6009, 338-340. [5] Rietmeijer F.J.M. and Mackinnon I.D.R. (1985) *Proc.Lunar Planet.Sci.Conf.*, **16th**, D149-D155. [6] Klöck W. et al. (1989) *Nature*, **339**, No. 6220, 126-128. [7] Barber D.J. (1981) *Geochim.Coschim.Acta*, **45**, 945-970. [8] Zolensky M.E. and McSween Jr. H.Y. (1988) In *Meteorites and the Early Solar System*, 114-143. [9] Alexander C.M.O. et al. (1989) *Geochim.Cosmochim.Acta*, **53**, 3045-3057.

Table 1

Hydrated IDPs

Particle name	Class
I2001-16	Smectite
*U230A39	Smectite
U2022E17	Serpentine
W7013A8	Smectite
W7017A3	Smectite
W7017A14	Serpentine
W7027A17	Smectite
W7027E11	Serpentine

* Supplied to us by J. Bradley.

Table 2

		ANHYDROUS GRAINS			PHYLLOSILICATES		
		Glass	Pyroxene	Olivine	Serpentine	Smectite	Tochilinite
Serpentine IDPs		x	o	x	x	o	o
		x	x	x	x (Rare)	x	o
Carbonaceous Meteorite Matrices *	CI	o	o	x	x	x	o
	CM	o	x	x	x	o	x
	CV	x	x	x	o	x	o
Unequilibrated Ordinary Chondrite Matrix *		o	x	x	o	x	o

X - Present
 O - Not Observed
 * Data from [8]