crometeorites have been referred to collectively as chondritic aggregates, with further division into subgroups based either on particle appearance (*17*) or on the presence of characteristic infrared transmission absorption bands (*18*). Observations of morphology and surface microstructures made it possible to categorize the particles as CP (chondritic porous), CF (chondritic filled), or CS (chondritic smooth) (*17*). The major drawback with this type of scheme, however, is that not all micrometeorites fall clearly into a particular category. Although many micrometeorites with highly porous surface structures (CP's) are the anhydrous variety and most with smooth surfaces (CS) are hydrated, there have been numerous exceptions. For example, micrometeorites exhibiting highly porous surface structures have, upon crushing or sectioning, turned out to be solid and dominated by hydrated silicates. Using infrared spectral transmission measurements, Sandford and Walker (*18*) found that most chondritic micrometeorites fall into one of two categories: those whose mineralogy is dominated by anhydrous silicates (olivines and pyroxenes) and those dominated by hydrated (layer-lattice) silicates. Examination of microtomed sections confirms the validity of the infrared classification scheme, since chondritic particles do indeed fall clearly into hydrous and anhydrous subgroups. Although both types of particle can exhibit almost identical bulk compositions and outward appearances (Fig. 1), they are distinct from one another in thin section. Only the anhydrous variety exhibits high porosity typical of cometary meteoroids, although a lack of porosity does not necessarily preclude the possibility of a cometary origin for the hydrated particles (*1*).

Electron microscopic characterization of ultramicrotomed thin sections is a useful means of determining the true nature of small extraterrestrial particles. It is probably the ultimate method for studying fine-grained meteoritic materials that are mineralogically heterogeneous at the submicrometer level. In principle, it is possible to section a single 10-μm particle into 200 slices with almost complete preservation of internal microstructure in three dimensions. The present application has revealed a subset of chondritic particles that are without doubt the most porous meteoritic materials known. These aggregates of anhydrous silicates, sulfides, carbides, glass, and other phases are the only materials sufficiently fragile and porous to be considered similar to the typical cometary particles observed as meteors in the night sky. The structure of these particles closely matches Verniani's (1, p. 258) description of cometary meteors as "porous crumbly objects made of loosely conglomerate, spongelike material." Material similar to the sectioned anhydrous particles may be encountered as the spacecraft approaches comet Halley.

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13. Problems can arise with large (>2 μm) olivine and pyroxene grains (commonly found in anhydrous micrometeorites), which tend to fragment during sectioning (see Fig. 3b). This phenomenon, which is referred to as "chatter" (*8*), is often encountered during ultramicrotomy of materials that are very hard or that lack cleavage. Problems can also arise with materials that are very soft and that exhibit good cleavage. For example, hydrated (phyllosilicate) micrometeorites (Fig. 2a) respond well to diamond knife sectioning but the phyllosilicates themselves tend to cleave spontaneously in thin section. Therefore, some of the porosity observed in Fig. 2a may be an artifact of sample preparation. Despite these potential complications, examination of thin sections cut sequentially from micrometeorites suggests that the positions of most grains are relatively undisturbed by the sectioning procedure.
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A Carbonate-Rich, Hydrated, Interplanetary Dust Particle: Possible Residue from Protostellar Clouds

KAZUSHIGE TOMEOKA AND PETER R. BUSECK

Transmission electron microscopy of a hydrated interplanetary dust particle (IDP) indicates that it contains abundant magnesium-iron carbonates, primarily breunnerite and magnesian siderite. This IDP displays a strong absorption band at 6.8 micrometers in its infrared spectrum, similar to that in certain protostellar spectra. The carbonates probably account for the 6.8-micrometer band in the IDP spectrum, suggesting that carbonate also may occur in interstellar dust and be the source of the controversial 6.8-micrometer feature from the protostellar spectra.

INTERSTELLAR DUST AND INTERPLANETARY dust particles are two types of fine-grained extraterrestrial materials whose character and origin are subjects of current interest and controversy. Interstellar dust contains relatively few distinctive spectral features that permit detailed characterization (*1*). Interplanetary dust particles (IDP's), a relatively recently discovered class of primitive solar-system materials, contain a limited range of minerals (*2*). There is an intriguing correspondence between the infrared (IR) spectra of the so-called hydrated IDP's and those of protostars like W33 A (*3, 4*), suggesting that at least some of the two types of materials may be similar mineralogically and that the hydrated IDP's may contain residual material from protostellar clouds.

One of the most prominent features in the spectra of both W33 A and hydrated IDP's is a strong absorption band at 6.8 μm. This band, when it occurs in interstellar spectra, is generally ascribed to hydrocarbons (*4, 5*),

Departments of Geology and Chemistry, Arizona State University, Tempe, AZ 85287.

although this attribution is a source of controversy (*1, 6*). The most prominent absorption band of carbonate falls at the same position. Several authors (*3, 6*) have speculated that the interstellar dust contains carbonates as well as hydrocarbons. In this report we present transmission electron microscope (TEM) observations of a hydrated IDP that displays a particularly strong absorption band at 6.8 μm and in which we have found abundant magnesium-iron carbonates. Our observations suggest that carbonates may also occur in interstellar dust and perhaps account for the band at 6.8 μm.

The hydrated, chondritic IDP called Calrissian (NASA No. r21-M1-9A) was studied by Sandford and Walker (*3*) with IR transmission spectroscopy. On the basis of the presence of a strong band at 6.8 μm and a correlated weaker band at 11.4 μm, they suggested that Calrissian contains carbonate. The microstructures and compositions of minerals in Calrissian have been investigated by high-resolution TEM imaging, selected-area electron diffraction (SAED), and convergent-beam electron diffraction. Quantitative chemical analyses have been performed by energy-dispersive x-ray spectroscopy (EDS) using thin-film x-ray microanalysis (*7*). Details of the experimental procedures and reference standards for the quantitative analyses are given elsewhere (*8*).

Many carbonate crystals occur as rhombohedral grains 500 to 3000 Å in diameter. They occur individually (Fig. 1a) and, more typically, in clusters of similarly oriented euhedral crystals (Fig. 1b). They contain magnesium and iron as major cations with a wide range of ratios (Table 1). Their single-crystal SAED patterns correspond to the calcite structure (space group $R\bar{3}c$). Therefore the magnesium-rich carbonates are identified as breunnerite $(Mg_{1-x}, Fe_x)CO_3$ ($x < 0.5$), and the iron-rich ones as magnesian siderite $(Fe_{1-x}, Mg_x)CO_3$. Most grains also contain minor amounts of calcium and manganese. Calcium appears to be correlated with iron. In synthetic and natural terrestrial samples, magnesite ($MgCO_3$) and siderite ($FeCO_3$) form a complete solid-solution series and also form limited solid solutions with calcite ($CaCO_3$) and rhodochrosite ($MnCO_3$) (*9*). In EDS spectra, most carbonate grains also show small but variable peaks of silicon. It is uncertain whether the silicon is contributed by neighboring silicate or is in the carbonates (*10*).

Rounded carbonate grains 100 to 1000 Å in diameter are also common and occur in clusters. They typically show mottled textures. Although much less abundant than in Calrissian, such anhedral carbonates also occur in the Low-Ca and Skywalker IDP's, from which they were described as grains of an unidentified mineral containing iron, magnesium, calcium, manganese, and silicon (*8*).

Table 1. Thin-film, x-ray microanalyses (mole percentages) of carbonates from the Calrissian IDP and a microprobe analysis of breunnerite from the Orgueil CI carbonaceous chondrite. Grains 1 and 6 show the highest and the lowest magnesium contents among the analyzed grains, respectively. Original data were obtained in relative ratios, then normalized to 100 percent.

Carbonate	Grain number						
	1	2	3	4	5	6	*
$MgCO_3$	91.0	72.7	59.2	47.1	36.2	20.9	69.6
$FeCO_3$	6.8	26.2	38.7	49.6	57.3	70.2	25.7
$CaCO_3$	1.5	0.3	1.4	2.7	5.0	7.1	1.0
$MnCO_3$	0.7	0.8	0.7	0.6	1.5	1.8	3.7

*Breunnerite from the Orgueil CI meteorite (*17*).

Although the carbonates are the only minerals of the hydrated IDP's that we have discussed so far, other minerals occur and, indeed, are necessary in order to explain the source of the water that is detected in the IR spectra. In Calrissian, iron- and magnesium-rich smectite or mica (*8*) occurs as a major hydrated phase; its average composition is $(Fe^{2+},Fe^{3+})_{2.8}Mg_{1.9}Al_{0.7}Si_4O_{10}(OH)_2$. Rounded grains (~1000 Å in diameter) of pyrrhotite and pentlandite are abundant. Forsterite and enstatite platelets occur but are rare; we identified one grain (~2500 Å) of magnesium pyroxene with a composition of $Fe_{0.06}Ca_{0.05}Mn_{0.03}Mg_{0.81}SiO_3$.

The relation between IDP's and interstellar dust is not well understood, so we cannot be confident of the correlation between Calrissian and interstellar dust. However, IDP's are widely believed to be derived from comets (*2, 11*), which are among the most primitive planetary bodies in the solar system (*12*). IDP's thus may contain interstellar materials that existed before or during the early history of the solar system. Such a primitive origin is suggested by the recent discovery of unusual deuterium (^2H) enrichments in many IDP's (*13*); certain interstellar clouds are also known to be highly enriched in ^2H (*14*). Calrissian shows particularly strong ^2H enrichments (a maximum of 1913 per mil) (*13*).

Certain hydrocarbons may also be present in IDP's (*15*) and may be partly or entirely responsible for the 6.8-μm band. However, this possibility for Calrissian was precluded by recent acid dissolution experiments (*16*). Thus our observations of breunnerite and magnesite in the Calrissian IDP provide independent evidence for the identification by Sandford and Walker (*3*) of the 6.8-μm feature as a carbonate band.

Carbonates occur in minor amounts in both CI and CM carbonaceous chondrites, primitive meteorites that also contain hydrated layer silicates. The CI chondrites mainly contain breunnerite and dolomite $[CaMg(CO_3)_2]$ (*17–19*); the CM chondrites largely contain calcite (*20, 21*). Breunnerite in the Orgueil CI meteorite shows a considerable range of iron contents [from 15 to 40 mole percent $FeCO_3$ (*19*)] and contains

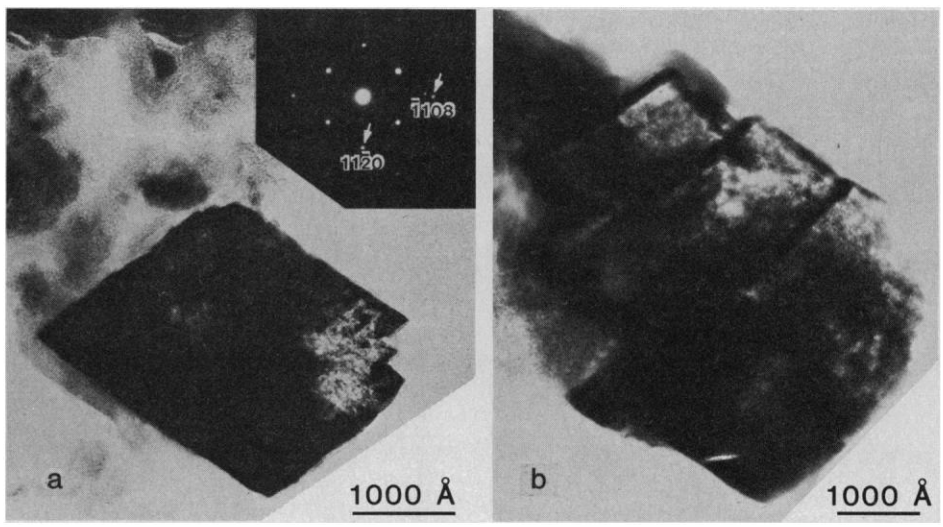

Fig. 1. (a and b) Transmission electron micrographs of euhedral breunnerite crystals in the Calrissian IDP. (Inset) SAED pattern from the crystal in (a). Compositions of the crystals in (a) and (b) are given by grains 3 and 1 in Table 1, respectively.

small amounts of calcium and manganese (*17, 19*); it thus has a composition similar to that of the breunnerite in the Calrissian IDP (Table 1).

Carbonates in carbonaceous chondrites are believed to have crystallized during aqueous alteration of their parent bodies (*18–20*). However, Macdougall and coworkers (*22*) recently showed, on the basis of strontium isotopic measurements, that the carbonates in Orgueil were probably produced much earlier (possibly billions of years earlier) than the period of extensive aqueous activity during which sulfate veins were produced. Thus, they suggested that carbonate formation may have occurred at the time of parent body formation.

Alternatively, the carbonates in the Orgueil meteorite and the Calrissian IDP may be primary components that formed before or during accumulation of solar nebula condensates and interstellar dust to planetary bodies. Lancet and Anders (*23*) suggested that the carbonates in the carbonaceous chondrites could have formed in the solar nebula at approximately 400 K and 10^{-4} atm through catalysts like hydrated silicates and magnetite. Recent TEM studies of IDP's provide evidence that a low-temperature, catalytic synthesis was probably involved in the formation of another mineral in IDP's (*15, 24*).

Studies of interstellar dust have largely been based on theoretical and spectroscopic methods. Now infrared, isotopic, and mineralogical studies of IDP's suggest that they may contain primitive solar materials, some of which may be residues of the protostellar clouds. Detailed investigation of IDP's, therefore, offers potentially important insights into the nature and history of interstellar dust.

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A New HTLV-III/LAV Protein Encoded by a Gene Found in Cytopathic Retroviruses

TUN-HOU LEE, JOHN E. COLIGAN, JONATHAN S. ALLAN, MARY F. MCLANE, JEROME E. GROOPMAN, M. ESSEX

The DNA of the HTLV-III/LAV group of retroviruses contains certain additional open reading frames that are not found in typical avian or mammalian retroviruses. The role of these sequences in encoding for gene products that may be related to pathogenesis remains to be resolved. An open reading frame whose 5′ end overlaps with the *pol* gene, but is unrelated to the *env* gene, has been observed in HTLV-III/LAV and visna virus, both cytopathic mammalian retroviruses. Evidence presented here shows that this open reading frame is a bona fide coding sequence of HTLV-III/LAV and that its product, a protein with a molecular weight of 23,000, induces antibody production in the natural course of infection.

THE THIRD MEMBER OF THE RECENTLY identified family of human T-lymphotropic viruses, HTLV-III/LAV [also designated ARV (*1–7*)] is now generally accepted as necessary, if not sufficient, for the development of the acquired immune deficiency syndrome (AIDS). In addition to the *gag*, *pol*, and *env* genes that are present in all replication-competent animal retroviruses, HTLV-III/LAV also contains in its genome several other open-reading frames (orf's) (*8–11*). Recently, two lines of evidence have suggested that at least two of the HTLV-III/LAV orf's are indeed functional genes. First, in the process of searching for regions that mediate the observed transactivation, a new gene, *tat*, unrelated to *gag*, *pol*, and *env*, was identified (*12, 13*). Second, an antigen with a molecular weight of 27,000 (p27) was shown to be encoded

T.-H. Lee, J. S. Allan, M. F. McLane, M. Essex, Department of Cancer Biology, Harvard University School of Public Health, 665 Huntington Avenue, Boston, MA 02115.
J. E. Coligan, Laboratory of Immunogenetics, National Institute of Allergy and Infectious Diseases, Bethesda, MD 20892.
J. P. Groopman, Department of Medicine, New England Deaconess Hospital, Boston, MA 02215.

Table 1. Deduced protein sequence for CNBr cleaved sor product of HTLV-III/LAV, based on the nucleotide sequence of Ratner *et al.* (*8*).

Expected CNBr peptides of p23	Number of amino acids in each CNBr peptide	Deduced NH_2-terminal protein sequence of each CNBr peptide*
Peptide 1	7	NH_2-M E N R W Q V M
Peptide 2	8	I V W Q V D R M
Peptide 3	13	R I R T W K S L V K H H M
Peptide 4	160	Y V S G K A R G W F Y R H H Y E—M
Peptide 5	3	N G H—COOH

*The amino acids identified by the radiosequence analysis are underlined.