

**Results.** The mineralogy of W7013F5 is dominated by phyllosilicates, carbonates, and sulfides. Trace phases include magnetite, kamacite, a Zn-bearing Fe sulfide, and a fibrous mineral with a 0.5 nm layer spacing.

The phyllosilicates exhibit a bimodal size distribution. Coarse-grained phyllosilicates up to 500 nm in length are common and occur in  $\mu$ m-sized clusters. Fine-grained phyllosilicates (typically <10 nm) are intergrown with carbonates and sulfides. High resolution (HRTEM) images show that the coarse phyllosilicates consist of intergrowths of 1- and 0.7-nm layers on the unit cell scale. EDS analyses combined with high-resolution images suggest that the coarse phyllosilicates are Fe-bearing saponite intergrown with Mg-Fe serpentine. The fine-grained phyllosilicates are poorly crystalline and show only 1-nm layer spacings in HRTEM images. Several curled flakes of a fine-grained layered mineral with a 0.5 nm periodicity (brucite?) occur with the coarse phyllosilicates but were too small to quantitatively analyse.

Mg-Fe carbonates are abundant in W7013F5 and occur in two morphologies, rhombohedral crystals up to 400 nm on edge, and rounded aggregates up to 200 nm in diameter. Molar Mg/Mg + Fe ratios in the carbonates range from 0.3 to 1. Ca and Mn occur as minor components. No correlation of carbonate morphology with composition was observed.

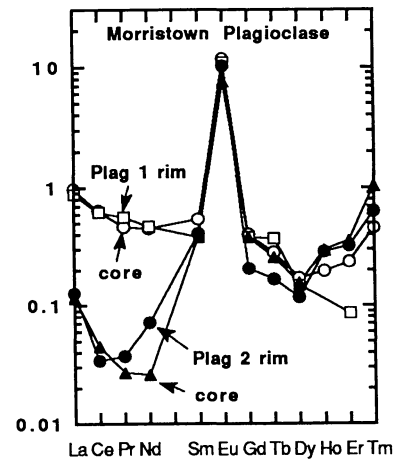
Rounded grains of pyrrhotite and pentlandite up to 200 nm in diameter are dispersed throughout the particle and are equally abundant. The maximum Ni content of the pentlandite is 26 wt.%. Rod-shaped grains (in cross-section) of pyrrhotite are also present.

**Discussion.** The distinctive unit cell intergrowth of saponite and serpentine has previously been reported only from the Orgueil CI chondrite (4). Mg-Fe carbonates are common in CI chondrites and in other hydrated IDPs (5), but are not observed in other chondrite types. The compositions of the phyllosilicates, carbonates, and sulfides in W7013F5 overlap with those in CI chondrites but tend to be more Fe-rich. A major difference between W7013F5 and CI chondrites is the oxidation state recorded by the mineral assemblages. Fe-Ni sulfides and kamacite occur in W7013F5, whereas ferrihydrite (a Fe oxyhydroxide with adsorbed S) and magnetite are the major Fe bearing phases in CI chondrites.

**Conclusions.** W7013F5 is the first IDP whose mineralogy and chemistry approximates that of CI chondrites. The similarity in mineralogy and mineral chemistry suggests that W7013F5 was altered under conditions similar to those that existed on the CI parent bodies. References: (1) Schramm L. S. *et al.* (1990) *Meteoritics* **24**, 99. (2) Thomas K. L. *et al.* (1991) *LPSC* **22**, 1395. (3) Keller L. P. and Buseck P. R. (1990) *GCA* **54**, 2113. (4) Tomeoka K. and Buseck P. R. (1988) *GCA* **52**, 1627. (5) Tomeoka K. and Buseck P. R. (1986) *Science* **231**, 1544.

**Trace element partitioning within Mesosiderite clasts.** A. K. Kennedy, B. W. Stewart, I. D. Hutcheon and G. J. Wasserburg. The Lunatic Asylum, Division of Geological and Planetary Sciences, Caltech, Pasadena, CA 91125, USA.

Mesosiderites are polymict silicate and metal breccias resulting from magmatic differentiation, brecciation, metal-silicate mixing, and metamorphic recrystallization in early planetary bodies. Petrographic and trace element studies have documented the great diversity of differentiated silicates, with eucritic basalt, gabbroic cumulate and diogenite clasts and trace element disequilibrium between phases (1–4). Isotopic studies using long-lived systems (U/Pb, Rb/Sr, Sm/Nd and K/Ar) suggest (1) silicate formation within  $10^7$  yr of the formation of the solar system, (2) mixing of metal and silicates, recrystallization and isotopic homogenization by 4.47AE (4–6) and (3) metamorphism at 3.4–3.8 AE (7). At present little is known about trace element partitioning within clasts, between matrix and clasts, and the effect of partial re-equilibration of trace elements on isotope systematics (4). To address this deficit we used the Panurge ion microprobe to measure Ba, Sr, Hf, Ti and Cr and REE concentrations in plagioclase, opx and phosphate in: (1) Vaca Muerta pebbles 5 and 12 (8), and (2) a phosphate-rich (25%) lithic clast, a phosphate-opx corona surrounding troilite, groundmass phosphate, and a plagioclase clast from Patwar. In addition we measured Ba, Hf and the REE in phosphate, plagioclase, cpx and opx from Morristown. Vaca Muerta and Patwar are slightly recrystallized and Morristown is highly recrystallized and pyroxene poikiloblastic (1). The trace element data reflect the diversity of mesosiderite silicates. Vaca Muerta pebble 5 contains LREE-depleted pyroxene (La  $0.3 \times$  chondritic (ch); Lu  $15 \times$  ch), LREE-enriched



plagioclase (La  $3\text{--}20 \times$  ch; Lu  $0.05\text{--}0.6 \times$  ch) and phosphate (La  $400 \times$  ch; Lu  $95 \times$  ch). Pebble 12 has much greater depletion of REE, especially the LREE, with plagioclase having a relatively flat REE pattern (La and Yb are  $0.02\text{--}0.03 \times$  ch); pyroxene is highly LREE-depleted (La  $0.01 \times$  ch; Lu  $4 \times$  ch). The partitioning of trace elements in both pebbles is similar to igneous partitioning in terrestrial and lunar cumulates. If both pebbles are cumulates, pebble 5 requires a melt with a relatively flat REE pattern and  $\approx 20 \times$  ch (4) and pebble 12 a LREE-depleted melt with  $\approx 0.04 \times$  ch La and  $\approx 0.4 \times$  ch Lu. In contrast to the equilibrium trace element partitioning in the Vaca Muerta pebbles, Patwar and Morristown contain abundant evidence of disequilibrium, with little consistency of REE patterns. Phosphates in the opx-phosphate clast in Patwar are LREE-enriched with a +ve Eu anomaly (La  $90 \times$  ch; Lu  $40 \times$  ch; Eu  $130 \times$  ch). Groundmass and corona phosphates have flat REE patterns (La and Lu  $80\text{--}110 \times$  ch) with or without a -ve Eu anomaly. A small plagioclase clast enclosed by troilite has lower REE abundances (La  $0.9 \times$  ch; Er  $0.1 \times$  ch) than plagioclase clasts (La  $6 \times$  ch; Er  $0.4 \times$  ch) with identical major element compositions. Orthopyroxene is LREE-depleted and the corona opx has  $6 \times$  lower HREE (Dy  $0.01 \times$  ch; Lu  $0.09 \times$  ch) than the opx in the opx-phosphate clast. Morristown phosphate, cpx and opx are LREE-depleted and have +ve Eu anomalies. Phosphate has La  $25 \times$  ch, Eu  $115 \times$  ch and Lu  $130 \times$  ch, and cpx and opx have La  $<0.02 \times$  ch and Lu  $0.9\text{--}2.5 \times$  ch. The cpx, opx and phosphate would be in equilibrium with a LREE-depleted melt which has a +ve Eu anomaly. In contrast neither plagioclase clast would be in equilibrium with such a melt. Plagioclase 1 is LREE-enriched and has a large +ve Eu anomaly (Fig. 1) and would be in equilibrium with a melt with a flat REE pattern or a slightly LREE-enriched pattern. Plagioclase 2 has an unusual REE pattern (Fig. 1), with (1) enrichment of La and Sm relative to Ce, Pr and Nd, (2) the usual large +ve Eu anomaly, (3) a decrease from Gd to Dy, (4) a rapid increase from Dy to Tm, and (5) an overall HREE enrichment. Both plagioclase 1 and 2 have much higher Sm/Nd (0.29–4.9) than plagioclase separates (0.11–0.13) (4), requiring at least two distinct plagioclase components. The presence of unequilibrated components may explain why one Morristown plagioclase separate lies off the best-fit isochron (4) and suggests that variation of initial  $\epsilon_{143}$  may be responsible for inconsistencies between the  $^{147}\text{Sm}\text{--}^{143}\text{Nd}$  and  $^{146}\text{Sm}\text{--}^{142}\text{Nd}$  isotope chronometers, rather than partial re-equilibration of phosphate and plagioclase (4). If plagioclase 2 is a relict of the source that melted to produce the mesosiderite silicates, the high Sm/Nd may explain the unsupported initial  $\epsilon_{143}$  of Morristown (4). References: (1) Rubin and Mittlefehldt (1979) preprint. (2) Floran (1978) *Proc. LPSC* **9**, 1053. (3) Mittlefehldt (1979) *GCA* **43**, 1917. (4) Prinzhofer *et al.* (1991) *GCA*, submitted. (5) Stewart *et al.* (1991) *LPSC* **22**, 1333. (6) Brouxel and Tatsumoto (1991) *GCA* **55**, 1121. (7) Bogard *et al.* (1990) *GCA* **54**, 2549. (8) Rubin and Jerde (1987) *EPSL* **84**, 1.

**Interstellar precursors in synthesis of meteoritic organic matter.** J. F. Kerridge. Inst. Geophysics, UCLA, Los Angeles, CA 90024, USA.

High D/H ratios measured in meteoritic organic matter are commonly attributed to presence of molecules enriched in D by isotopic fractionation during ion-molecule reactions at low temperatures in interstellar