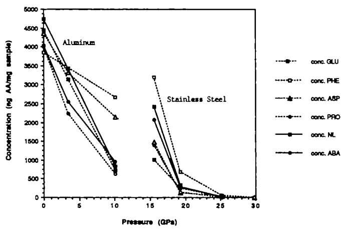


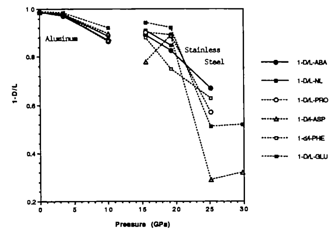


FIG. 1. Decomposition of amino acids as a function of increasing peak pressures. Discontinuity represents difference between metals with different EOS used as target assemblies for holding test mixture.

FIG. 2. Loss of optical activity of amino acids with increasing shock pressure as noted for target assemblies with different EOS (equations-of-state).

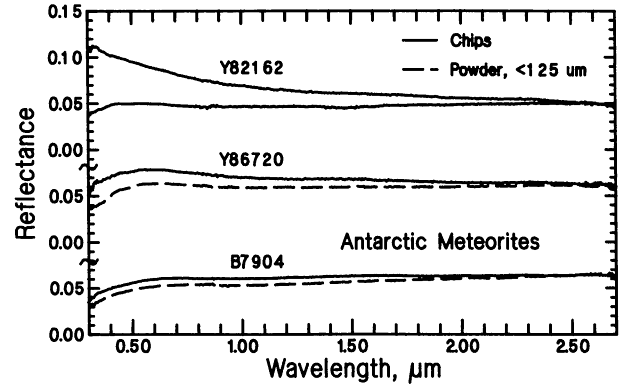
This result parallels findings in organic geochemistry in which the acidic amino acids survive longer in the sedimentary column. In contrast, phenylalanine survives poorly in the sedimentary column, but shows remarkable stability up to 30 GPa. (c) Racemization increased as a function of increased pressure. The acidic amino acids, ASP and GLU, were most extensively racemized at 30 GPa, followed by proline, a heterocyclic amino acid (see Fig. 2). (d) Secondary product formation increased with increased peak pressure (impact velocity) beginning at 19 GPa with the appearance of β-alanine and glycine in trace amounts. At 30 GPa, secondary amino acids, such as β-alanine, alanine, glycine, and γ-aminobutyric acid, and a number of yet unidentified compounds, were generally more abundant than most remaining parent compounds, ASP and GLU being the exceptions. These results suggest that low velocity meteroid impacts ($\leq$4–5 km/s) on asteroids permit survival of amino acids. On the other hand, impacts at velocities >5 km/s will produce a secondary population of amino acids. In addition, it now seems possible that amino acids will be preserved in micrometeoroids collected at even higher velocities in underdense foams or aerogel in orbital platforms. References: Gibbons R. V., Morris R. V. and Horz F. (1975) *Proc. Lunar Sci. Conf* **6th,** 3143–3171. Kvenvolden K. A., Peterson E. and Pollock G. E. (1972) *Adv. in Org. Geochem.,* 387–401. Schaal R. B., Horz F., Thompson T. D. and Bauer J. F. (1979) *Proc. Lunar Sci. Conf.* **10th,** 2547–2571.

Vis/NearIR reflectance spectra of CI/CM Antarctic consortium meteorites: B7904, Y82162, Y86720. Carlé M. Pieters, Dan Britt and Janice Bishop. Dept. Geological Sciences, Brown University, Providence, RI 02912, USA.

A consortium to study a group of unusual Antarctic carbonaceous chondrites with CI affinities is being led by Y. Ikeda of Ibaraki University. Reported here and in a companion abstract (Bishop and Pieters) are initial results of reflectance measurements of B7904, Y82162, and Y86720. These carbonaceous chondrites have been variously classified as CI, CM, C1 and C2, but when both chemical and petrographic characteristics are considered, they do not easily fall into the current classification scheme (1). They may represent distinct differences in thermal history and pre- and post-accretionary processes of their respective parent bodies (2).

Binocular microscope inspection of representative chips received for reflectance measurements revealed these low albedo samples exhibit a variety of alteration. Sample B7904 appears unaltered throughout. Several areas of Y86720 chips exhibit red-yellow alteration, a presumed weathering product. Chips of Y82162 are unusual; almost all exhibit a thin coating (<10 μm) of a brighter substance but little, if any, red-yellow weathering.

Reflectance spectra were first obtained for small areas on the meteorite chips. Samples Y86720 and B7940 were then ground and dry sieved to <125 μm and spectra were obtained for the powder form. [Chips of Y82162 will not be ground until the origin and character of the coating is better known and, if possible, the coating removed.] Near-infrared spectra obtained from 0.3 to 2.7 μm with the RELAB bidirectional spectrometer set at i = 30°, e = 0° are shown below. Although similar in general character to other carbonaceous chondrites (low albedo, al-



most featureless spectra), these Antarctic meteorites do not exhibit the 0.74 μm phyllosilicate absorption that is common to Murchison and Meghei CM meteorites (3). On the other hand, the 0.5 μm feature seen in Y86720 also occurs in spectra of Orgueil (Moroz, unpublished spectra; (4)), but this feature is most likely a ferric absorption due to weathering processes.

Spectra were obtained for chips of Y82162 with and without the coating. The distinctively "blue" spectrum for Y82162 is characteristic of a thin transparent coating over a dark substrate. The shorter wavelengths interact more with the coating and reflectance is higher than the longer wavelengths which pass through the coating and are absorbed by the substrate. The Y82162 spectrum is indicative of the presence of a coating, but it does not provide mineralogical information in this part of the spectrum. When these data are combined with the mid-infrared, however, the character of the coating becomes more obvious (see Bishop and Pieters abstract, these volumes). The Y82162 coating exhibits exceptionally strong water absorptions at 3 and 6 μm and a distinctive feature at 6.8 μm attributed to carbonates (5, 6). References: (1) Ikeda (1989) *Fourth Consortium Circular.* (2) Paul and Lipschutz (1990) *Proc. NIPR Symp. Antarc. Met.* **3,** 90–95. (3) Moroz and Peters (1991) *Lun. Planet Sci.* **22,** 923. (4) Gaffey (1976) *JGR* **81,** 905. (5) Sanford (1984) *Icarus* **60,** 115. (6) Miyamoto (1987) Icarus **70,** 146.

Chromium isotopic compositions of individual spinel crystals from the Murchison meteorite. F. A. Podosek,[1] C. A. Prombo,[1] L. Grossman[2] and E. K. Zinner.[1] [1]McDonnell Center for the Space Sciences, Washington University, One Brookings Drive, St. Louis, MO 63130-4899, USA. [2]Enrico Fermi Institute, University of Chicago, 5630 S. Ellis Ave., Chicago, IL 60637-1433, USA.

Kuehner and Grossman (1) have described an unusual suite of spinels separated from Murchison by freeze-thaw disaggregation, density separation and hand picking. These spinels are large ($\geq$100 μ) and rich in FeO and Cr_2O_3 (1); their O isotopic compositions are close to normal (2), much less anomalous than spinels in Murchison dissolution residues (3, 4). Esat and Ireland (5) studied Cr isotopic compositions in Murchison spinels which, judging by separation technique, size, color and mineral chemistry, appear to represent a population indistinguishable from that prepared by Kuehner and Grossman (1); they (5) found striking Cr isotopic anomalies at both ^{53}Cr (up to 3‰) and ^{54}Cr (up to 5‰), larger even than anomalies in Allende FUN CAIs (6). Here we report Cr isotopic data for individual Murchison spinel crystals previously studied by Kuehner and Grossman (1) and Grossman *et al.* (2), with the objective of extending the survey of Cr anomalies in these grains and seeking possible correlations with mineral chemistry.

We used a direct-load procedure in which solid grains (*cf.* (5)) were loaded on V-shaped Re filaments with boric acid and silica gel. For calibration, we examined terrestrial (Burma) spinel (2) loaded the same way, and also reagent Cr solution. Isotopic analyses were performed in a VG-354 thermal ionization mass spectrometer, using a Daly detector in pulse-counting mode for ion collection. Corrections for instrumental discrimination were based on $^{50}Cr/^{52}Cr$ normalization assuming the "exponential" mass-dependence law; data for ^{53}Cr and ^{54}Cr are reported as ϵ-unit (parts in 10^4) deviations from the normal composition of Papanastassiou (6). Data are organized into "sets," each comprising five cycles integrating the ion signal of each isotope for 5 sec, with the ^{52}Cr

Cr Isotopic Analyses			
Sample[a]	Group[a]	ϵ_{53}[b]	ϵ_{54}[b]
Reagent		2 ± 3	3 ± 5
Burma spinel		0 ± 2	−2 ± 4
SP 27	B	7 ± 10	
SP 28	A	6 ± 6	14 ± 16
SP 29	A	2 ± 5	−6 ± 10
SP 31	B	−1 ± 1	3 ± 2
SP 34	A	−3 ± 2	−10 ± 9

[a] Sample and group designations as in (1, 2).
[b] Deviations from normal (6) composition in parts in 10^4; two-sigma errors.

beam at 2×10^5 cps. For about half the data, set-to-set reproducibility is consistent with the limit dictated by Poisson statistics (standard deviations of 18ϵ for ^{53}Cr and 34ϵ for ^{54}Cr); for the other half, set-to-set variability was larger because of beam instabilities. Results to date (see Table) are reported as the mean and error of the mean for all sets obtained for a given sample, including the Burma spinel and reagent Cr. Data are of variable quality according to beam stability and duration for each sample.

A first order observation is that our results indicate no anomalies beyond error limits. In particular, we do not observe anomalies that would be expected on the basis of the size and frequency of anomalies observed by Esat and Ireland (5). Our results also suggest (weakly) that this population of spinels may lack the "endemic" 5–10 ϵ ^{54}Cr anomaly of refractory inclusion spinels (6, 7), a result which parallels the small (negligible?) O anomalies (2) in this population. References: (1) Kuehner S. M. and Grossman L. (1987) *Lunar Planet. Sci.* **18,** 519. (2) Grossman L. *et al. (1988) Lunar Planet. Sci.* **19,** 435. (3) Clayton R. and Mayeda T. (1984) *EPSL* **67,** 151. (4) Virag A. *et al.* (1991) *GCA*; in press. (5) Esat T. M. and Ireland T. R. (1989) *EPSL* **92,** 1–6. (6) Papanastassiou D. A. (1986) *Ap. J. Lett.* **308,** L27. (7) Birck J.-L. and Allègre C. J. (1988) *Nature* **331,** 579.

Are chondrules precursors of some cosmic spherules? T. Presper and H. Palme. MPI f. Chemie (Abteilung Kosmochemie), Saarstraße 23, D-6500 Mainz, Germany.

Twenty-one arctic cosmic spherules, collected by M. Maurette (Orsay, France) in Greenland, were analysed by Instr. Neutron Activation Analysis (INAA). All samples were round spherules, apparently droplets melted through atmospheric heating. Weights of the spherules were in the range of 20–50 μg, diameters were >100 μm.

(1) Most spherules showed large depletions of the moderately volatile elements Na, Zn, Se when compared with their abundances in chondritic meteorites. In all particles Fe/Mn ratios are essentially chondritic (*ca.* 100 ± 10%). A major volatility-related loss of Mn can therefore be excluded.

(2) Refractory lithophile elements occur mostly in chondritic relative abundances. More or less flat REE-patterns are typical (except positive and negative Eu-anomalies). This implies a lack of igneous fractionation. Ca-depletions by a factor of 0.4 to 0.8 were found.

(3) Siderophile elements are fractionated in most cases. Several compositional groups are observed: A) no depletion of siderophiles relative to lithophile refractory elements (Sc) and more or less chondritic ratios (2 particles); B) typical pattern resulting from metal-silicate-fractionation with increasing depletions from Fe through Co, Ni to Ir, Au (5 particles); C) Ir-enrichment relative to Ni but chondritic Ni/Au-ratios (this is the most common case, 14 particles). Type-A-pattern represents unfractionated chondritic material. Type-B-particles may have lost metal during melting in the atmosphere. Type-C-particles are more difficult to explain. Two distinct groups are observed: particles with Ni-contents similar to those of chondritic meteorites and particles with much lower Ni-concentrations. Variations of Ir-contents in both groups are similar. It is unlikely that the siderophile element pattern is influenced by remelting of the spherules in the Earth's atmosphere. Also, a simple metal-silicate-fractionation is insufficient to explain the observed patterns because loss of a metal phase would imply proportionally higher losses of Ir than of Ni which is against the observed trends. Therefore we conclude that the low Ni-contents and variable Ni/Ir ratios are characteristic of the original cosmic particles. Bulk chondritic meteorites show very little variation in Ni/Ir-ratios (*ca.* 20–30•10^3). However, chondrules have lower and more variable Ni/Ir ratios that are comparable to the spherules (10^2–10^3). The depletion of iron and the essentially chondritic Ni/Au ratios found in our particles are also typical of chondrules in carbonaceous and unequilibrated ordinary chondrites. We, therefore, suggest that the cosmic spherules with low Ni/Ir-ratios were once chondrules that were remelted in the Earth's atmosphere.

LEW88055: Aubritic inclusions in a Si-free iron meteorite. M. Prinz,[1] M. K. Weisberg[1,2] and N. Chatterjee.[1,2] [1]Dept. Mineral Sci., Amer. Museum Nat. History, New York, NY 10024, USA. [2]Dept. Geology, Brooklyn College, CUNY, Brooklyn, NY 11210, USA.

LEW88055 is a 1.7 g iron meteorite which contains several mm-sized silicate inclusions. The host iron meteorite is Si-free kamacite with a high concentration of Neumann bands, many of which are distorted (1). Some small taenite areas contain martensitic plessite and are associated with schreibersite along grain boundaries. These observations suggest it is an anomalous iron (1).

The silicate inclusions are angular, and range in size from 1–3 mm. Modally, the inclusions consist mainly of ortho- and clinoenstatite. Coexisting minor phases include diopside, K-spar, ferroan alabandite, Ti-bearing troilite, daubreelite, schreibersite and tiny particles of FeNi too small to analyze with an electron microprobe. Forsterite, albitic plagioclase and oldhamite, usually present in aubrites, were not found. Oldhamite may have been dissolved due to cutting the sample in water. This is the first occurrence of K-spar in an aubrite. Mineralogically, enstatite has no detectable FeO; some FeO when present is due to minor rust. Clinoenstatite twinning is often distorted, in a manner similar to that of the Neumann bands in the host iron. Enstatite is highly clouded with fine phases (too small to analyze) in selected areas; this is probably due to subsolidus heating. Diopside has (in wt.%) 0.2 FeO, 0.13 Al_2O_3, 20 MgO and 24 CaO. K-spar has 64.7 SiO_2, 19.6 Al_2O_3, 0.56 Na_2O, 16.7 K_2O. Troilite has 0.9–3.1 Ti, similar to that found in aubrites (2). Ferroan alabandite has 11–15 Fe, 0.4–1.2 Mg, 0.1–0.7 Cr, similar to aubrites. Daubreelites have 0.15 Ti, whereas the average in aubrites is 0.3 Ti (2). Schreibersites have 47–52% Ni. The bulk composition of the aubritic inclusions (in wt.%, by broad beam electron microprobe analysis) is 59.8 SiO_2, 0.03 TiO_2, 0.11 Al_2O_3, 38.9 MgO, 0.50 CaO, 0.03 Na_2O; Cr_2O_3, K_2O, P_2O_5, S and Ni are below detection, and FeO is difficult to analyze due to minor rust and is very low.

Conclusions. The host iron meteorite is clearly out of equilibrium with the aubritic silicate inclusions since the host consists of Si-free metal. Thus, this is the first example of aubritic silicate inclusions in an unrelated iron. The only other meteorite which has aubritic silicates mixed with metallic FeNi is Mt. Egerton, but it consists primarily of enstatite encrusted with, and in some cases included within, the metal (3, 4). Also, the metal is Si-bearing. LEW88055 appears to be still another example of an unusual iron meteorite with silicate inclusions that is part of the small population of iron meteorites from Antarctica. Wasson (5) has already noted that 39% of the iron meteorites from Antarctica are ungrouped, and LEW88055 will join this group. Prinz *et al.* (1991) described chondritic and modified chondritic silicate assemblages in two ungrouped Antarctic irons (LEW86211 and ALH84233); these types of silicates are usually found in IAB-IIICD irons. The LEW88055 iron meteorite and its aubritic inclusions clearly formed in different portions of the solar system and presumably came together by impact collision. The presence of distorted Neumann bands in the metal and distorted clinoenstatite twinning in the aubritic inclusions indicates a severe shock history during or after the collision. Larger samples of this type of meteorite would be helpful for future studies. References: (1) Clarke R. S. (1990) *Antarctic Meteorite Newsletter* **13,** No. 3, 14–15. (2) Watters T. R. and Prinz M. (1979) *LPSC* **10,** 1073–1093. (3) McCall J. G. H. (1965) *Min. Mag.* **36,** 241–249. (4) Cleverly W. H. (1968) *J. Roy. Soc. W. Austr.* **51,** 83–88. (5) Wasson J. T. (1990) *Science* **249,** 900–902.

S-process Ba in SiC from Murchison series KJ. C. A. Prombo,[1] F. A. Podosek,[1] S. Amari,[1,2] E. Anders[2] and R. S. Lewis.[2] [1]McDonnell Center for Space Sci., Washington U., St. Louis, MO 63130, USA. [2]Enrico Fermi Inst., U. of Chicago, Chicago, IL 60637, USA.