

with the PANURGE ion probe. All Nin exhibit enrichment of the lighter Cr isotopes relative to Dau and chromite,  $F_{Cr} \sim 8\%$ /amu; data are corrected for  $^{50}\text{Ti}$  overlap on  $^{50}\text{Cr}$  and normalized to  $^{50}\text{Cr}/^{52}\text{Cr} = 0.051859$ . Two Nin show small but well resolved  $^{53}\text{Cr}$  excesses ( $\delta^{53}\text{Cr} \sim 5.2\%$ ); the other two Nin and the Dau contain isotopically normal Cr within the analytical uncertainty. No correlation between the isotopic composition of Nin and petrography is apparent. A correlation line fitted to the data from Nin and Dau has slope corresponding to  $^{53}\text{Cr}^*/^{55}\text{Mn} \sim 7 \times 10^{-6}$ . However,  $^{53}\text{Cr}/^{52}\text{Cr}$  ratios for niningerite alone do not correlate with Mn/Cr ratios and the data do not allow a firm conclusion regarding *in situ* decay of  $^{53}\text{Mn}$ . The Nin have different textural occurrences and may not derive from a common source with uniform  $^{53}\text{Mn}/^{55}\text{Mn}$ . Evidence of Ca isotopic heterogeneity among Qingzhen oldhamite (4) suggests the presence of several, isotopically distinct nebular components. The 4 Nin analyzed occur in different lithologies and may not share a common source. If sulfides in Qingzhen preserve a record of the isotopic composition of precursor dust aggregates, Cr isotope heterogeneity among Nin should not be unexpected. References: (1) Birck J.-L. and Allegre C. J. (1988) *Nature* **33**, 579. (2) Hutcheon I. D. and Olsen E. (1991) *LPSC* **22**, 605. (3) El Goresy A. *et al.* (1988) *Proc. NIPR Symp. Antarc. Meteorites* **1**, 65. (4) Lundberg L. L. *et al.* (1991) *LPSC* **22**, 835.

**The L6 chondrite fall at Glatton, England, 1991 May 5.** R. Hutchison,<sup>1</sup> J. C. Barton<sup>2</sup> and C. T. Pillinger.<sup>3</sup> <sup>1</sup>Mineralogy Dept., The Natural History Museum, London SW7 5BD, UK. <sup>2</sup>Physics Dept., Birkbeck College, Malet St, London WC1E 7HX, UK. <sup>3</sup>Earth Sciences Dept., The Open University, Milton Keynes MK7 6AA, UK., plus various colleagues.

A single stone of 0.767 kg fell in the garden of Mr A. Pettifor in the village of Glatton, 15 km SSW of Peterborough, England. (Coordinates of Glatton: 52°28'N, 0°19'W). At about 12.30 pm British Summer Time (1130 hrs GMT), Mr Pettifor was startled by a whining noise as he worked in his garden. He heard something crash through a hedge, some 20 metres from where he stood. The meteorite lay beneath damaged shrubs in a pit about 2 cm deep. The stone was warm when picked up. It probably came from a northerly direction. The sky was overcast, so no fireball was seen and no sonic booms were reported. The stone was polyhedral and completely crusted; secondary crust covered one tiny face (3 cm<sup>2</sup>) caused by shearing of one corner in atmospheric flight.

On 9 May, R. Hutchison and C. T. Pillinger were alerted to the possibility of a new fall by Mr Howard Miles of the British Astronomical Association and news media, respectively. A visit to Mr Pettifor that evening confirmed that his stone is a meteorite. On Sunday 12 May, volunteers searched E-W swathes of farmland both north and south of the place of fall, looking for more stones; none was found. The stone was loaned to The Natural History Museum, and after 37 grams were broken from it, low-level counting began on 13 May. The Museum has acquired the main mass.

In reflected light, a polished mount revealed a granular texture with few chondrules. The olivine is close to Fo<sub>75.5</sub> and the pyroxene is about En<sub>9</sub>. Areas tens of micrometres across have low reflectivity consistent with plagioclase; two analyses gave Ab<sub>86</sub>Or<sub>3</sub>An<sub>9</sub>. Texture and mineral compositions indicate an L6 classification.

The gamma ray spectrum from 730 grams of the stone was measured in the Holborn Underground laboratory, using a germanium detector. Observations began 8 days after the fall and continued, with intervals for background measurement, for a total of 23 days. The <sup>26</sup>Al content, 48 ± 3 disintegrations/min/kg, is near the lower end of the range reported for L6 chondrites. The <sup>22</sup>Na:<sup>26</sup>Al ratio is 1.19 ± 0.03, consistent with the stone's arrival close to a solar maximum. The <sup>60</sup>Co content ( $t_{1/2} = 5.3$  a) was below the detection limit of 1 dpm kg<sup>-1</sup>; this indicates that the pre-atmospheric size was less than about 20 cm in diameter during the previous decade.

**Adrar 003: A new extraordinary unequibrated ordinary chondrite.** R. Hutchison,<sup>1</sup> S. J. B. Reed,<sup>2</sup> R. D. Ash<sup>3</sup> and C. T. Pillinger.<sup>3</sup> <sup>1</sup>Mineralogy Dept., The Natural History Museum, London SW7 5BD, UK. <sup>2</sup>Earth Sciences Dept., Downing St., Cambridge CB2 3EQ, UK. <sup>3</sup>Earth Sciences Dept., The Open University, Milton Keynes MK7 6AA, UK.

A 287 g stone found in southern Algeria proved to be a highly unequibrated ordinary chondrite. Abundant chondrules ranging from over 3

mm to less than 50 µm are set in opaque matrix. Metal-sulphide objects are smaller; discrete objects in matrix are up to 500 µm in diameter, whereas those within silicate chondrules, or situated along their margins, range down to micrometre-size. Reflected light microscopy indicates that many metal-sulphide objects have rims with layering on a 10 µm scale where they abut interchondrule matrix. Veins of highly reflecting material up to about 10 µm wide cross cut the matrix. These are texturally similar to the Fe-carbide veins in Semarkona. Again, like Semarkona (1), some chondrules and irregularly shaped inclusions contain crystalline feldspar. A barred olivine chondrule almost 2 mm across has olivine dendrites, Fo<sub>95</sub>, sometimes rimmed by pigeonite, Wo<sub>12</sub>En<sub>83</sub>Fs<sub>5</sub>, or in contact with interstitial granular pigeonite, Wo<sub>10</sub>En<sub>84</sub>Fs<sub>6</sub>. Plagioclase, An<sub>86-89</sub>, is intergrown with the olivine bars.

Mineral analyses by Bischoff (2) and this work indicate that olivine generally ranges from Fo<sub>93-69</sub>, and pyroxene from En<sub>95-76</sub>, but in places, overgrowths of Fe-rich olivine, Fo<sub>30</sub>, occur on Mg-rich olivines in contact with matrix. Many overgrowths, however, do not have stoichiometric olivine compositions but include a feldspathic component. These resemble overgrowths on the olivines of chondrule rims in Krymka and Chainpur (3).

In the SEM, most silicate chondrules and clasts do not appear to have well defined rims. Instead, these objects abut matrix with a patchy appearance that probably results from a negative correlation between grain-size and mean atomic number. Patches of matrix with 10 µm grains have about 30 wt.% total Fe as FeO, compared with about 50 wt.% in very fine-grained areas. The evidence indicates that in the matrix, Mg-rich, high-temperature objects reacted with an oxidising fluid or fluids.

A distinguishing feature of Semarkona is the greatly enhanced D/H ratio of water released by pyrolysis of bulk samples (4) and chondrules (5); this meteorite affords one fraction with δD almost six times higher than SMOW during a stepped pyrolysis. The bulk samples of Adrar 003 analysed for D/H ratio show quite low amounts of water with no δD values > +42‰. In this respect, Adrar 003 resembles Krymka which previously, alone amongst low petrologic type 3 ordinary chondrites, failed to show substantial D enrichments. Results from hydrogen isotopic studies of highly unequibrated ordinary chondrites have been notoriously variable, possibly because of sample heterogeneity. In reality this variability may be a clue to the carrier of the D anomaly: it might well be located in a very minor component and be truly astronomical in magnitude. Further studies of Adrar 003 can contribute to the understanding of D/H systematics. References: (1) Hutcheon and Hutchison (1989) *Nature* **337**, 238-241. (2) A. Bischoff (1991) pers. comm. and *Meteorit. Bull.*, in press. (3) Alexander *et al.* (1989) *EPSL* **95**, 187-207. (4) McNaughton *et al.* (1982) *JGR* **87**, A297-A302. (5) Morse *et al.* (1988) *Meteoritics* **23**, 291.

**Na-Cr sulfide phases in the Indarch (EH4) chondrite.** M. L. Hutson. Lunar and Planetary Lab., Univ. of Arizona, Tucson, AZ, 85721, USA.

Two hydrated alkali-bearing Cr-sulfides (referred to as mineral A and mineral B, containing approximately 10 and 20 wt.% oxygen, respectively (1)) have been observed in several enstatite chondrites, including Indarch (2). Mineral B is generally described as occurring as exsolution in mineral A (1, 2). In addition, two Zn-Cu-bearing hydrated Na-Cr sulfides are reported from Y-691 (3) and a new Fe-Cr sulfide with about 5 wt.% water has been observed in four E-chondrites, including Indarch (4).

Indarch (USNM sec. #334-1) contains numerous examples of alkali-bearing Cr-sulfide grains. Most are lath-shaped and too small for accurate microprobe analyses. Fourteen of the larger grains have been examined optically, with BSE and an electron microprobe. For microprobe analyses, a pseudo-crysal was used to determine oxygen.

All of the hydrated Na-Cr-S grains observed in Indarch are <60 microns across, and are in contact with troilite. Of the fourteen grains analyzed with the microprobe, five are lath-shaped, eight are blocky and rectangular, one is roughly equant, and none appear to have exsolved from their troilite hosts.

Ten out of the fourteen grains (from nine different opaque regions) have approximately 10 wt.% O (mineral A). Some of the grains have uniform compositions, while others vary from 8-13 wt.% O. These variations correlate with Z-variations observed with BSE and with color