LEW86018: A Rare L3.1 Unequilibrated Ordinary Chondrite. C.P. Hartmetz[1], J.M. DeHart[1], and F.A. Hasan[2]. [1]Mail Code SN2, Planetary Science Branch, NASA-JSC, Houston, TX 77058. [2]Agronomy Department, University of Arkansas, Fayetteville, AR 72703.

Type 3.0 and 3.1 ordinary chondrites (OC) were once considered to be some of the least altered meteorites. Certainly they are one of the least thermally altered types of meteorites residing in present collections. Metallographic evidence indicates that Krymka (LL3.1) and Bishunpur (LL3.0) never experienced temperatures above 400°C (1,2). The unequilibrated ordinary chondrites (UOCs) heterogeneous nature makes it difficult to determine the extent to which shock has affected their properties. However, most authors agree that only mild to moderate shock events have occurred in UOC material (3). Recent evidence suggests that abundant aqueous alteration products exist in Semarkona (LL3.0) and to a lesser extent in Bishunpur (LL3.0), while Krymka (LL3.1) had none (4). This aqueous alteration of 3.0 OCs (4) and the fact that 3.3-6 OCs have been thermally metamorphosed (5,6) constrain the range in which the least altered OC nebular material may be found to 3.1-3.2 UOCs. Therefore, all samples that are discovered in this range are extremely important specimens. Only one other known 3.1 (Krymka) and three known 3.2s (ALHA76004 an L, ALHA77176 an LL, and RKPA80207 an L) (7) make an extremely small sampling of this type of unaltered nebular material.

Lewis Cliffs 86018 was originally estimated to be an L3.5 UOC on the basis of petrographic fabric and mineral composition (8). During preparation of the sample for total carbon and sulfur measurements it was noted that this particular sample was visibly unique (among a suite of ~100 Antarctic meteorites under study) because of its reddish brown matrix and abundant large chondrules. Its carbon and sulfur abundances were higher than any type 3 OC in the suite (9). On this basis it was decided that further measurements should be performed to determine its classification because little literature data was available on this meteorite. Since then thermoluminescence and cathodoluminescence investigations, and an electron microprobe study of olivine and pyroxene compositions have been performed.

Thermoluminescence Properties: Thermoluminescence (TL) sensitivity indicates that LEW86018 is a 3.1 UOC (TL sensitivity=0.007±0.001). A plot of TL sensitivity vs. Fa percent mean deviation (PMD, which is defined as the standard deviation of the fayalite compositions divided by the mean fayalite composition, expressed as a percent) illustrates the assignment of LEW86018 as a 3.1 UOC (Fig. 1).

Cathodoluminescence Properties: The epoxy in this thin section rapidly degraded under the 15 KeV, 7μA electron beam of the cathodoscope. This has temporarily prevented a detailed determination of cathodoluminescence (CL) properties and the production of a CL photomosaic. However, a qualitative assessment of CL properties was made before the thin section degradation was noticed. The CL properties of LEW86018 were all consistent with a 3.1 classification (10,11). There is an abundance of type Ia chondrules with red luminescent grains and, unlike Semarkona (3.0), LEW86018 contains blue luminescent mesostases. Interchondrule matrices are essentially nonluminescent, with a few scattered grains emitting red CL. Several type II chondrules with nonluminescent grains and glasses are present.

Electron Microprobe Studies: Grains for analyses were chosen by superimposing a 60 micron grid over an SEM photomicrograph mosaic of the thin section. If a point on the grid did not coincide with a grain, the nearest grain to the point was analyzed. Olivine compositions from 56 grains ranged from $Fa_{0.88-55.0}$ with a mean composition of 20.91 and a PMD of 59.4. A histogram displaying the various fayalite compositions is shown in Fig. 2. Pyroxene compositions ranged from $Fs_{0.83-33.93}$ with a mean composition of 11.79 and a PMD of 80.5. These values are consistent with a petrologic type of 3.1-3.4.

Total Carbon and Sulfur Abundances: The bulk carbon abundance of LEW86018 from three measurements is 0.308±0.003 wt%, and the bulk sulfur abundance is 3.25±0.07 wt%. Carbon abundances have been used in the past to determine type 3 subclassification (12,13). However, recent carbon stable isotope stepped combustion experiments (14) show that meteorite falls contain greater abundances of carbon than Antarctic meteorites. This excess carbon in falls was found to be terrestrial organic material probably added during collection, curation, and handling of the samples. This occurs because non-Antarctic meteorites are not handled with the same rigorous care (adherence to strict clean room conditions) as that used with Antarctic meteorites. The carbon abundances of falls often do not fit into distinct groups (e.g. Krymka an established 3.1 has carbon abundances consistent with a type 3.7 UOC under the old system) (13). If the old carbon abundance classification scheme (13) is used LEW86018 would be considered a 3.6; all other data presented in this study suggest that it is a lower petrologic type.

Conclusions: TL and CL properties suggest that LEW86018 should be reclassified as a 3.1 UOC. Fayalite PMD agrees, narrowing the possible petrologic classification to 3.1-3.4. However, confirmation of this assessment awaits further study.

Acknowledgments: We would like to express our thanks to E.K. Gibson Jr., J.H. Wagstaff, S.V. Yang, D.W. Mittlefehldt, R.A. Socki, W.L. Manger, S.J. Wentworth, D.W.G. Sears, and the National Research Council's Postdoctoral program for making this research possible.

References: (1) Wood J.A. (1967) *Icarus*, 6, 1-49. (2) Rambaldi E.R. and Wasson J.T. (1981) *GCA*, 45, 1001-1015. (3) Huss G.R. (1980) *Meteoritics*, 15, 305-306. (4) Hutchison R. *et al.* (1987) *GCA*, 51, 1875-1882. (5) Guimon R.K. *et al.* (1985) *GCA*, 49, 1515-1524. (6) Guimon R.K. *et al.* (1989) *GCA*, 52, 119-127. (7) Sears D.W. and Hasan F.A. (1987) *Surveys in Geophys.*, 9, 43-97. (8) Mason B. (1987) *Antarctic Meteorite Newsletter*, 10 (2), 32. (9) Hartmetz C.P. *et al.* (1989) *Meteoritics* (in press). (10) DeHart J.M. *et al.* (1986) LPS XVII, 160. (11) DeHart J.M (1989) PhD Thesis. (12) Sears D.W. *et al.* (1980) *Nature*, 287, 791-795. (13) Sears D.W. *et al.* (1982) *GCA*, 46, 2471-2481. (14) Grady M.M. *et al.* (1989) *Antarctic Meteorite Workshop* (52nd Meeting of the Meteoritical Society) special publication, LPI (Vienna) 15-17.

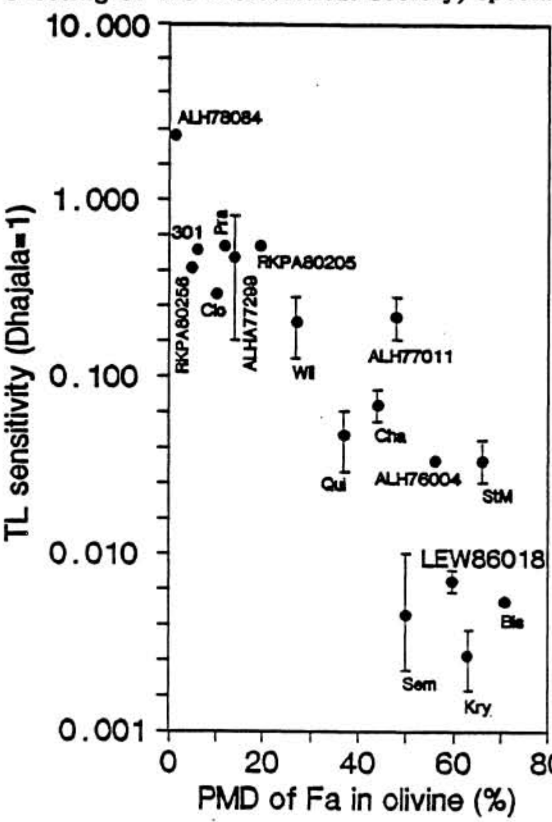

Figure 1. Plot of TL sensitivity vs Fa PMD for 17 3.0-3.9 UOCs. LEW86018 plots in the same area as three other known 3.0 and 3.1 UOCs. The first three letters of a falls name, and the last three numbers of OTTA80301 identify, its data point. For data without error bars, a typical error of 5% can be assumed. Data are taken from 7, 13, and 14.

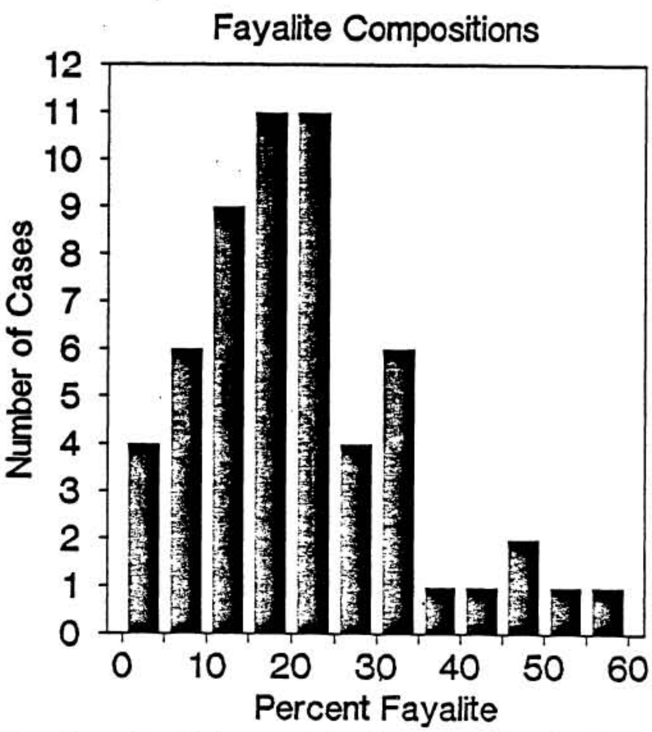

Figure 2. Histogram of fayalite compositions in five percent increments. Nine analyses fall outside the maximum fayalite composition reported in (8).