JAH 031: A NEW LL CHONDRITE BRECCIA FROM OMAN. D. H. Hill[1], A. Patzer[1], and W. V. Boynton[2], [1]Lunar & Planetary Laboratory, 1629 E. University Blvd., University of Arizona, Tucson, AZ 85721, dhill@lpl.arizona.edu [2] also Dept. of Planetary Sciences, University of Arizona.

Introduction: Hundreds of meteorites have been recovered in recent years in the hot desert regions of Africa. Among them are meteorites from the Sultanate of Oman region known as Jiddat al Harasis (JaH). We report mineralogical, major element, and trace element data on a new LL5 (S5)(W2) breccia from this region: JaH 031. The importance of the recoveries cannot be underestimated as they provide valuable, rare specimens. Likewise, they present an expanded record and improved compositional and collision statistics for ordinary chondrites that is comparable to that of the Antarctic finds.

Circumstances of Recovery: JaH 031was recovered along with an unknown number of meteorites, by a Russian group in February 2000. The find location was reported as 19°49'53.0"-19°49'57.8'N 56°05'9.3"-56°5'2.5"E.

Comparison of JaH 031 with other OC samples from Oman: As of Meteoritical Bulletin No. 84 four strewn fields had been identified among the many samples recovered from Oman: Gubara (L5), Sayh al Uhaymir (L5), Dhofar 005 (L6), and Dhofar 020 (H4-5). None of them are breccias and they differ in composition from JaH 031 (LL5).

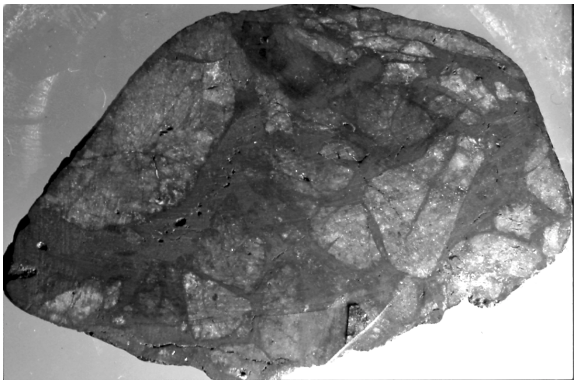

Fig. 1 Overall appearance of the brecciated structure of JaH 031. View is ~ 25 x 45 mm.

Physical Description: JaH 031 was recovered as a whole individual, somewhat ovoid in shape, 83.27 g, with ~ 70% fusion crust that was black-brown and smooth-textured. Its dimensions are approximately 4.5x2.5x3cm. The sample is brecciated with mostly sub-rounded chondritic clasts from ~0.25 cm to ~ 1 cm across and thick, vesicular melt veins (Fig. 1).

Melt Veins and Pockets. Melt veins vary in thickness from ~ 20 microns to 0.5 cm and bear a resemblance to melt dikes and pseudotachylytes seen in other impact shocked meteorites. The thickest regions contain up to 500 micron-wide vesicles easily visible in hand specimen. Many veins, but not all, contain micron-sized FeS globules with little or no kamacite. Occaisionally the veins cross cut chondrules.

Clasts. The clasts are separated by the melt veins and all exhibit indistinct boundaries. Relict chondrules are present but are not well-preserved. Most are 0.2 mm or less in diameter, with one large one, almost 0.4mm. Porphyritic pyroxene is the most common type. Recrystallization has taken place in all clasts.

Matrix. The matrix consists wholly of melt dikes and veins described above. One complex vein exhibits fine crystallites perpendicular to the length of the vein.

Opaques. FeS and taenite are the predominant opaques. Typical of equilibrated LL chondrites, very little or no kamacite is present [1].

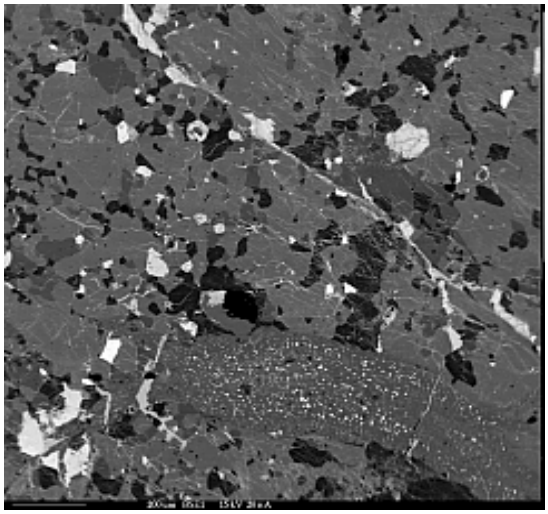

Fig. 2. BSE image of a shock melt vein that pervades a relict chondrule. Most of the tiny globules are FeS. Bright phases in the chondrule are FeS and taenite. Medium gray is pyroxene and dark gray is plagioclase.

Analytical methods: The sample was analyzed using LPL's Cameca SX-50 microprobe at 20nA, 15 keV. In addition, clasts and melt material were removed for INAA. They were irradiated in the University of Arizona TRIGA high flux rabbit facility for short-lived nuclides (50 kW power) and then for 3 hours with a flux of $0.7x10^{12}ncm^{-2}sec^{-1}$. The samples were counted in our Gamma Ray Spectroscopy Lab. INAA samples ranged in size from 15 to 90 mg.

Mineral compositions and classification parameters: Silicate analyses indicate that the clasts are all LL in composition. The average mineral composition for the meteorite is $Fa_{28.7}$ $Fo_{71.3}$. In

accordance with the Van Schmus and Wood [2] criteria for petrographic type 5, dispersion of both olivine and pyroxene is <1% for individual clasts and ~ 1.4% for the overall sample. Average Ni>20% in taenite (except for the melt ~ 18%). Sulfides contain < 0.5% Ni with the exceptions of clast 3 (> 0.5%) and clast 4 that varies from 0.25-5% Ni. The melt veins, however, vary from 0.2-12% Ni.

Table 1. Compositions of representative minerals in JaH 031

	Olivine		Pyroxene			Plagioclase		
	%Fa	%Fo	%Fs	%En	%Wo	%Or	%An	%Ab
Ave. all	28.70	71.30	26.00	71.20	2.80	7.50	12.20	80.40
Std. Dev.	1.40	1.40	3.00	4.40	2.60	6.00	2.80	8.70
Ave.Clasts	29.04	70.96	25.00	72.83	2.34	7.49	12.00	80.18
Std. Dev.	1.35	1.35	2.11	4.49	2.50	5.69	2.65	8.90
Ave Melts	28.87	71.13	26.58	70.07	3.37	n.d.	n.d.	n.d.
Std. Dev.	0.81	0.81	0.96	1.64	0.83	n.d.	n.d.	n.d.

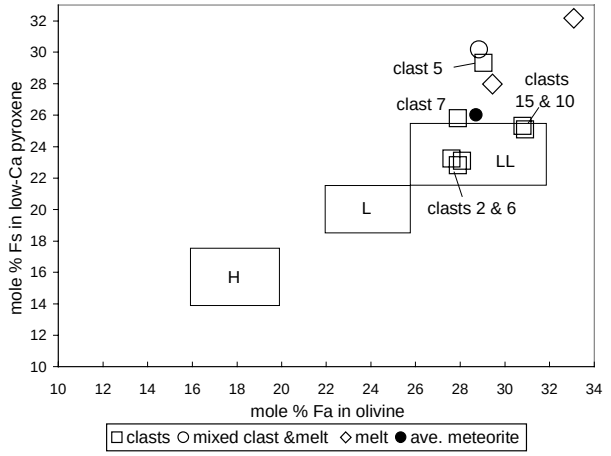

Fig. 3. The relationship of JaH 031clasts to typical olivine and pyroxene compositions in OC. Clasts plot in the LL realm but might have been considered "nonpaired" if they were analyzed as separate meteorites. This suggests that they may represent different fragments of LL colliding material. Or they could be dissimilar due to localized impact conditions.

Slight chemical differences between the clasts, presence of melt pockets in some clasts, and different degree of preservation of relict chondrules may reflect local differences in peak shock pressures and heating on the order of mm or cm. Alternatively, they might be the result of the collision between two LL asteroids. It would be reasonable to expect multiple collisions in the early solar system of bodies of similar composition. The resulting impact melt and clasts would be difficult to distinguish. With detailed study of the trace elements, it may be possible to identify more than one "parent body" (Fig. 3)

Shock effects: The presence of melt veins and pockets, with and without FeS globules, is an indication of significant shock heating experienced by this sample. The precise degree of peak shock pressure experienced differs from clast to clast. Some olivines are severely fractured. Planar deformation fractures are visible in most of the clasts. Melt veins are dominated by pyroxene compositions while melt pockets within clasts tend to be olivine. Stöffler et. al [3] have estimated that shock veins emplaced by initial frictional melts and subsequent melts intrusive to clasts may occur in a single impact on the scale of milliseconds to seconds (Fig. 2).

INAA of separated clasts and melt veins: Aliquants of 9 individual clasts and 3 melt samples were analyzed by INAA. Fig. 4 shows the similarities of clasts and melts for elements of similar chemical properties. With some exceptions, the data are consistent with equilibrated LL chondrite chemical compositions. Some of these "anomalies" are probably related to shock and heating. They have approximately the same amount of *total* iron. The most unusual deviation is excess Ti up to 10xCI in clast 2 and clast 10. Ti was not measurable in the other samples. In addition, Clast 18 displays a higher abundance of Fe and plots separately from other clasts and melts on graphs of Fe vs. Ni and Fe vs. Mn.

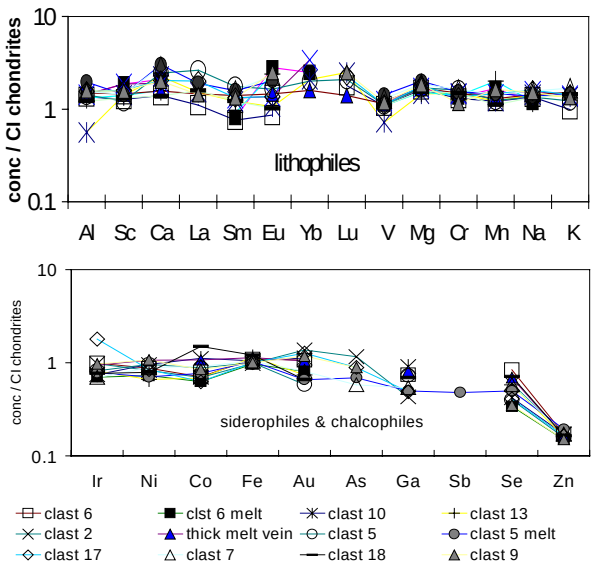

Fig. 4 **Trace** element data from clast and melt samples. The patterns are consistent with equilibrated LL chondrite compositions.

Conclusion: The target LL material that constitutes the JaH 031 chondrite suffered the effects of shock heating in at least one impact event that most likely involved other LL chondritic bodies. We will attempt to determine whether remnants of the impactor(s) were incorporated into JaH 031.

References: [1] Komatsu M. and Reid A. M. (1998) *LPSC* Abstract#1224. [2] Van Schmus W.R. and Wood J. A. (1967) *GCA, 31,* 747-765. [3] Stöffler et al. (1991) *GCA, 55,* 3845-3867.