RARE-EARTH AND OTHER TRACE ELEMENTS IN RIM AND INTERIOR PORTIONS OF A PECULIAR ALLENDE CHONDRULE. W. V. Boynton and D. H. HILL, Department of Planetary Sciences, U. of Arizona, Tucson, AZ 85721.

We report preliminary rare-earth element (REE) and other major and trace element data on rim and interior portions of a peculiar chondrule from the Allende meteorite. The sample is a 6 mm-diameter sphere that was extracted from the meteorite several years ago by M. J. Drake. A polished thick section was prepared and analyzed by electron microprobe (Table 1). Initially, the sample did not polish well. Two different types of polish artifacts resulted : star-shaped and spinafex-textured, and the analysis spots are keyed to these descriptions; rim samples were also analyzed. Analyses showing the maximum range of variation are given. There does not appear to be a significant difference in composition between the two types of areas. A second polishing attempt yielded a good result, but no clear mineral grain boundaries could be seen in either reflected light or a backscattered electron image. Scanning images in Ca x-rays showed Ca-rich spots with a size of about 5 m. Analyses of eleven interior spots were highly variable (within the ranges of Table 1) and were not indicative of known minerals. These results suggest that the sample is very fine-grained or glassy. For each analysis, higher Ca was always accompanied by slightly higher Si and lower Na, Al, Mg and Fe, suggesting that only two phases are present.

Two interior samples and a rim sample, which measured 0.30 x 0.26 x 0.94 mm, were analyzed by INAA and RNAA. (The results are given in Tables 2 and 3 in normalized units.). Interior Sample A included a vein which may have some alteration products, but Sample B is believed to be free of altered material. The higher Na content of Sample A may be due to this altered region. Except for Na and Sc, there is no significant difference between the two samples. The rim sample has higher Na than the unaltered interior but otherwise all other abundances are equal to that found in the whole rock. This observation suggests that alteration by matrix material may have formed the rim. The siderophile elements, Ni, Co, Ir, Au and to a lesser extent Fe, are strongly depleted in the chondrule. The depletion is over a factor of 200 for the true siderophile elements.

The microprobe data suggests that the chondrule is Ca, Al-rich compared to CI abundances normalized to Si; Ca, Al and Ti are each enriched by a factor of two in the mean of 11 interior analyses. However, the chondrule is clearly not Ca, Al-rich in the classic sense. The depletion of both volatile (Au) and refractory (Ir) siderophile elements suggests that this object does not have a simple origin as a condensate from the solar nebula and suggests that a secondary origin is more likely.

The REE data on the Allende whole rock sample shows the depletion of heavy REE (except Yb) relative to light, which is well-known for this meteorite. The Allende chondrule samples show a flat pattern with no significant anomalies at the 2 sigma level. Additional counting in the future will permit all REE except Er to be determined and the precision on many of the elements cited to improve. Nevertheless, even with these preliminary data, there is no evidence for any volatility fractionation (e.g., between Yb and Lu) at the level of 2 to 3 percent.

Clearly, more work is required before much insight into the origin of this chondrule is gained. It is hoped, however, that this peculiar object may provide some constraints on the formation processes that lead to the more common chondrules in Allende.

REE IN CHONDRULE RIM

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Table 1. Electron microprobe analysis of various spots in Allende chondrule. (M. J. Drake, Analyst)

	Spinafex		Star-shaped		Rim		
spot #	15	16	17	18	3	11	11 defoc.
Na_2O	0.84	2.91	2.94	0.33	1.79	0.34	1.24
CaO	11.08	3.53	5.20	12.04	0.60	10.1	3.74
Al_2O_3	5.93	8.29	8.59	3.87	4.55	4.43	4.52
SiO_2	45.3	42.9	43.6	45.7	39.6	44.1	41.0
MgO	34.6	37.6	36.1	34.2	37.2	31.8	36.2
FeO	3.57	4.84	5.41	4.53	14.97	10.6	1.31
TiO_2	0.27	0.31	0.34	0.23	0.12	0.27	0.22
	101.7	100.4	102.2	100.9	98.9	101.7	100.0

Table 2. Abundances of elements in Allende chondrule samples relative to whole rock.

	Interior A	Interior A	Rim
Na	3.98(4)	0.758(4)	1.532(10)
Ca	1.31(5)	1.31(5)	0.82(20)
Sc	1.595(4)	1.362(3)	1.075(3)
Cr	1.406(2)	1.361(3)	1.069(3)
Fe	0.1422(4)	0.1442(5)	0.345(7)
Ni	<0.004	<0.004	0.017(9)
Co	0.0045(4)	0.0052(1)	0.067(2)
Ir	<0.019	<0.005	<0.007
Au	<0.04	<0.011	0.015(5)

Table 3. Abundances of REE in Allende chondrule and whole rock relative to CI chondrites.

	Interior A	Interior B	Rim	Whole Rock
mass (mg)	1.59	1.34	0.23	9.92
La	0,982(5)	1.518(9)	1.136(12)	1.556(6)
Pr	-	1.2(4)	-	1.48(6)
Nd	1.18(12)	1.66(7)	1.45(15)	1.69(6)
Sm	0.996(10)	1.686(12)	1.164(10)	1.62(7)
Eu	0.80(10)	1.82(15)	1.20(30)	1.34(4)
Gd	0.92(22)	1.80(18)	1.9(5)	1.65(11)
Tb	1.05(4)	1.71(5)	1.29(16)	1.55(4)
Ho	0.97(5)	1.54(6)	1.10(10)	1.352(20)
Yb	1.132(12)	1.736(17)	1.283(20)	1.630(6)
Lu	1.112(17)	1.692(10)	1.248(31)	1.497(4)

Preliminary data, uncorrected for yield; absolute values maybe off by ±20% but REE ratios in one sample should be correct. Numbers in parentheses refer to uncertainty in final digit(s) and are determined as the greater of counting statistics or statistics of multiple determinations. CI normalization values from Evensen et al. (1978) GCA 42:1199.

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