LUNAR METEORITES Y82192 AND Y82193: GEOCHEMICAL AND PETROLOGIC COMPARISONS TO OTHER LUNAR BRECCIAS

Marilyn Lindstrom(1,2), Randy Korotev(2), David Lindstrom(3,2) and Larry Haskin(2)

1) NASA-Johnson Space Center, Houston, TX; 2) Washington University, St Louis, MO; 3) Lockheed EMSCO, Houston, TX

The lunar meteorites discovered in Antarctica during the last few years are important to our understanding of the Moon. They are random samples of the lunar crust that were sent to Earth by meteorite impact. As random samples they may be more representative of the average lunar crust than the returned samples which were selected to represent specific geologic units on the nearside. In this regard it is essential to determine from geochemical and petrographic studies whether the lunar meteorites represent a single or multiple impacts, and therefore, one or more regions of the lunar crust.

We have analyzed two subsamples of Y82192 by INAA for 22 major and trace elements. Results are presented in Table 1, where they are compared to previous analyses of lunar meteorites (1,2,3). As was noted at the 11th Symposium on Antarctic Meteorites Y82192 and Y82193 are feldspathic breccias with compositions very similar to ALHA81005 and Y791197. They have slightly lower concentrations of REE and other incompatible trace elements than the other lunar meteorites. Their siderophile element concentrations are also lower than the other lunar meteorites, but are within the range of lunar polymict breccias. Previous analyses have also shown that the bulk Mg' [molar Mg/(Mg+Fe) x 100] is in the range of Y791197 and distinctly lower than ALHA81005. All are within the range of lunar polymict breccias. We have also briefly examined a thin section of Y82193. It is a polymict breccia containing abundant monomineralic fragments, scattered irregular patches of dark brown glass and a few large lithic clasts. Lithic clasts are dominated by recrystallized rocks. Some coarse-grained poikilitic clasts were once plutonic rocks, but other fine-grained granulitic clasts have brecciated textures. Most lithic clasts have 20-40% mafic minerals, although some anorthosite clasts are found. All of the petrographic and bulk compositional characteristics of the two new meteorites are consistent with a lunar origin.

Comparison of the lunar meteorites to returned lunar samples has previously shown that they differ from typical lunar polymict breccias in being highly feldspathic and having much lower concentrations of incompatible elements (1,2,3). They are instead similar to both lunar granulites and feldspathic fragmental breccias from North Ray Crater, Apollo 16 (4,5). Granulites are common clasts in the lunar meteorites and in the NRC breccias (6). We showed that although the NRC breccias consist largely of different proportions of the same components, the variation in some components is extreme and leads to major differences in bulk composition, especially Mg'. We concluded that the lunar meteorites might have come from different parts of a heterogeneous target area analagous to that sampled by North Ray Crater (5). This conclusion is not altered by new data on Y82192 and Y82193. More recently Warren (7,8) has compared the compositional variations among lunar meteorites to those in Apollo 16 regolith breccias. Because Mg' variations are smaller in the Apollo 16 regolith breccias he concluded that the lunar meteorites are unlikely to have resulted from a single site. The question of which rocks are best used for comparison to the lunar meteorites is a difficult one. McKay (9) addresses the relationship betweeen NRC feldspathic fragmental breccias and regolith breccias saying that the fragmental breccias are similar to very immature regolith breccias. They may have been early breccias in the megaregolith which were buried and sheltered from further mixing and homogenization. The lunar meteorites are immature regolith breccias with textures and bulk compositions similar to those of the feldspathic fragmental breccias. Their compositions are distinct from the KREEP-enriched and more mafic Apollo 16 regolith breccias. We still feel that the NRC breccias are the best analogues for the lunar meteorites. This analogy does not prove that the lunar meteorites are from a single site, but does support that hypothesis. The evidence of exposure histories of the lunar meteorites should be reevaluated in light of variations in exposure histories of the NRC breccias. It is not suggested that the lunar meteorites are all paired (only Y82192 and Y82193 are paired), but that they might have been preexisting breccias at a single site on the Moon, and could have been sent Earthward by a single impact.

References:

(1) Various authors, 1983, Geophys. Res. Lett. 10, 773-840.
(2) Various authors, 1986, Proc. 10th Sym. Ant. Met., NIPR.
(3) Various authors, 1986, Abs. 11th Sym. Ant. Met., NIPR.
(4) Korotev et al, 1983, Geophys. Res. Lett. 10, 829-832.
(5) Lindstrom et al, 1986, Proc. 10th Sym. Ant. Met., 58-75.
(6) Lindstrom and Salpas, 1983, PLPSC13, JGR 88, A671-A683.
(7) Warren and Kallemeyn, 1986, Proc. 11th Sym. Ant. Met., NIPR.
(8) Warren and Kallemeyn, 1986, Meteoritics 21, 532.
(9) McKay et al, 1986, PLPSC16, JGR 91, D277-D303.

Fig. 1 REE in Lunar Meteorites

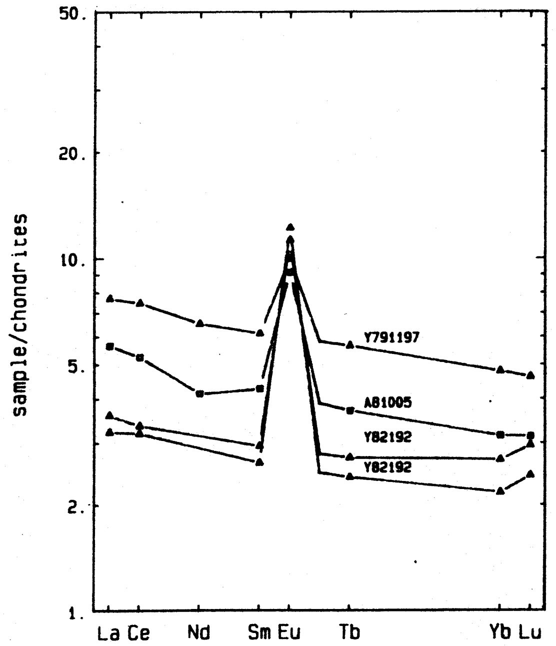

Fig. 2 North Ray Crater Breccias

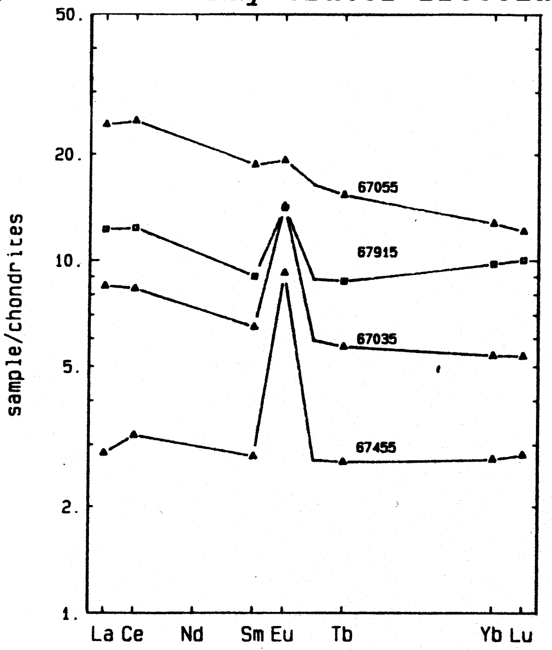

Table 1. **Compositions of Lunar Meteorites (INAA).**

	Y82192 141A1	Y82192 141A2	Y82192[1] mean	Y82193[1] mean	A81005[2] mean	Y791197[2] mean
TiO2(%)	--	--	0.22	0.27	0.26	0.33
Al2O3	--	--	27.0	25.8	25.7	26.3
FeO	5.05	4.12	4.60	5.64	5.51	6.41
MgO	--	--	4.5	5.1	8.20	5.98
CaO	14.4	15.0	15.1	16.7	15.0	15.3
Na2O	0.411	0.441	0.49	0.41	0.302	0.327
K2O	<.09	<.08	.020	.037	.023	.028
Sc(ppm)	10.9	8.23	8.68	12.2	9.1	13.4
Cr	894	701	753	1055	890	910
Co	15.8	13.0	14.4	19.2	21.0	25.0
Ni	140	110	121	148	198	250
Sr	163	180	190	180	135	137
Ba	29	25	26	28	28.4	33
La	1.18	1.06	1.11	1.27	1.98	2.38
Ce	2.90	2.76	2.7	3.0	5.2	6.0
Nd	<6	<6	1.5	2.0	3.2	4.1
Sm	.596	.534	0.54	0.65	0.95	1.13
Eu	.866	.939	0.94	0.82	0.69	0.79
Tb	.140	.123	0.12	0.14	.214	.256
Yb	.590	.475	0.55	0.73	0.84	1.07
Lu	.100	.082	.082	.117	.124	.157
Zr	37	36	--	--	27	32
Hf	0.46	0.43	0.36	0.45	0.73	0.86
Ta	.060	.058	.043	.034	.093	.103
Th	.133	.100	0.14	0.20	0.29	0.33
U	<.08	<.07	.031	.040	.098	.119
Ir(ppb)	3.2	3.8	2.9	5.7	6.8	6.6
Au	2.5	6.6	0.7	1.3	2.2	6.6

1) Various authors, Abs. 11th Sym. Ant. Met., NIPR.
2) Warren and Kallemeyn, Abs. 11th Sym. Ant. Met., NIPR.