Lunar Sample 14425: Corrected Analysis

Lunar sample 14425 is, as far as we know, the largest (8 mm) glass bead returned from the moon. We made a preliminary study (*1*) of this specimen to determine whether it deserved a more detailed investigation. Because of the uniqueness of the sample, it was decided not to perform any destructive analyses, which meant that the sample could not be ground and polished or coated with a conducting substance for scanning electron microscope or energy-dispersive x-ray studies.

Semiquantitative analysis of the bead was performed. Its composition was found to be unlike that of other lunar samples but similar to that of high-magnesium microtektites (*1*). We therefore decided that the spherule deserved more detailed study. A polished section was prepared, coated with carbon, and examined with a Cambridge 150 scanning electron microscope together with a Princeton Gamma Tech System 4 energy-dispersive x-ray analyzer. The silicon, aluminum, iron, magnesium, calcium, sodium, potassium, titanium, and chromium contents of the glass were determined. The analyses were corrected for background, atomic number effects, absorption, and fluorescence with a computer program prepared by Princeton Gamma Tech.

Two types of glass are visible in the polished section. One is clear and almost devoid of metallic spherules. The other is cloudy and contains numerous metallic spherules, some less than 1 μm in size. Both types of glasses are homogeneous and identical in composition (Table 1). This composition closely matches that of some Apollo 14 breccias or glass found in the breccias (Table 1).

Table 1. Composition of lunar sample 14425 (minus the metal spherules) and Apollo 14 breccias. Values are mean percentages by weight of major oxides and standard deviations of the individual measures from the mean unless otherwise indicated. Data for 14321 are from the Lunar Sample Preliminary Examination Team (*2*). Analyses 14068 represent the matrix of a dark breccia (*3*). 14311 is described as glass in a recrystallized fragmental rock (*4*). ND, not determined.

Oxide	Sample 14425				Breccias		
	Clear glass*	Cloudy glass*	Uncoated sample	Uncoated outer surface (*1*)	14321	14068	14311
SiO_2	47.1 ± 0.1	47.0 ± 0.1	51.4	56.0 ± 1.7	48	47.0	50.6
Al_2O_3	14.0 ± 0.1	13.9 ± 0.1	18.4	18.0 ± 1.2	14	15.8	14.20
FeO†	13.3 ± 0.1	13.4 ± 0.1	4.88	4.9 ± 1.5	12	10.40	13.1
MgO	13.0 ± 0.1	13.0 ± 0.1	15.8	16.9 ± 0.8	13	12.16	11.3
CaO	9.22 ± 0.06	9.27 ± 0.07	5.83	5.8 ± 0.7	8.5	9.37	7.7
Na_2O	0.72 ± 0.08‡	0.80 ± 0.06‡	1.38	0.1	0.40	0.73	1.2
K_2O	0.26 ± 0.01	0.32 ± 0.04	0.18	0.14 ± 0.07	0.33	0.21	0.6
TiO_2	1.36 ± 0.04	1.34 ± 0.04	0.61	0.6 ± 0.16	2.4	1.68	1.20
Cr_2O_3	0.30 ± 0.03	0.27 ± 0.03	0.10	0.19 ± 0.09	0.42	ND	0.2
NiO	0.02 ± 0.03	0.00 ± 0.01	0.00	ND	ND	ND	ND

*Average of ten analyses ± 1 standard deviation. †All iron as FeO. ‡Na_2O values are probably too high because of overlap with MgO.

The difference between the composition of the glass as we originally described it (*1*) and as we found in this study (Table 1) is probably due to charging effects during the analyses in which the sample was uncoated (*1*). Charging effectively lowers the accelerating voltage of the electron beam and causes the heavier elements to appear less abundant relative to the lighter elements. Analysis of the polished section with the carbon coating removed revealed a composition that is similar to that reported earlier (*1*) (Table 1). The apparent similarity in composition between lunar sample 14425 and the high-magnesium microtektites was thus a coincidence.

It is logical to ask whether this mistake could have been corrected if we had used uncoated standards for our uncoated sample. Tests run with uncoated standards show, however, that the results are even more unreliable than when the standards are coated.

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References and Notes

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2. Lunar Sample Preliminary Examination Team, *ibid.* **173**, 681 (1971).
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4. M. R. Dence and A. G. Plant, *ibid.*, p. 379.
5. We thank C. Meyers, NASA, Johnson Space Center, for advice on the effects of charging on compositional data obtained by energy dispersive x-ray analysis and B. Parker, NASA/Goddard Space Flight Center, for tests with uncoated standards.

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