TOTAL CARBON AND SULFUR CONTENTS OF APOLLO 17 LUNAR SAMPLES

Carleton B. Moore, Charles F. Lewis,
Jerry D. Cripe and Marva Volk
Arizona State University, Tempe, Arizona 85281

Total carbon and sulfur abundances have been run in a suite of Apollo 17 fines, breccias and rock samples. The analytical techniques utilized were the same as those used for Apollo 11 through Apollo 16 samples. The results given in Table 1 are from samples provided during the regular sample allocation. Table 2 gives carbon analyses done during the Apollo 17 lunar sample preliminary examination.

The analytical results for total carbon and sulfur follow the same pattern as those of the earlier Apollo missions. Fines and dark soil-breccia samples generally have higher total carbon contents than do the fragmental rock-breccias and igneous rocks. It is of importance to note that the total carbon contents of the Apollo 17 basalts are similar to those found for the Apollo 11 basalts. For the Apollo missions 11 through 16 the trend for total carbon in rocks was constantly downward dropping from 60 to 70 μg/g in the Apollo 11 basalts to lows of less than 5 μg/g in the Apollo 16 anorthosites. The return to higher values for the Apollo 17 rocks indicates that the trend was a real one and not due to improved contamination control in the sample handling procedure. Likewise the total sulfur contents in the Apollo 17 basalts and associated fines returned to the higher values, in the greater than 1000 μg/g range, found in the related Apollo 11 samples. Total carbon values obtained for different splits of the same sample run during both the preliminary examination and later show the same range in values found in replicates run for earlier missions. The decrease in total carbon content in the gabbroic breccia 78155 from 85 μg/g to 21 μg/g may be attributed to the fact that the preliminary examination sample was from a rock surface and may have contained high carbon fines particles. The second analysis of the orange soil 74220 gave a much lower value of 5 μg/g then the preliminary value of 100 μg/g. The lower value is preferred.

Most of the fines samples are gray to black in color and are similar in total carbon content to the normal mature fines of earlier Apollo missions. There is a correlation of total carbon content and the sample collection station. Individual samples from each station show lower ranges in total carbon content than samples between stations. Such variations may be attributed to grain size differences and percent agglutinates at the different areas in the Taurus Littrow landing site. Inspection of both of these parameters for the preliminary examination data shows direct correlations between them and the total carbon content. Fines samples from Steno Crater have consistantly lower total carbon contents than the mature fines indicating that they are in part composed of rock fragments from the cratering event that have not had surface exposure to solar wind. These samples together with those from Shorty Crater exhibit the largest mean grain sizes and the lowest agglutinate contents of the fines samples studies. The orange soil 74220 from Shorty Crater has the largest mean grain size and essentially

C AND S OF APOLLO 17 LUNAR SAMPLES

Moore, Carleton B.

Table 2. Total Carbon in Apollo 17 P.E.T. Samples

Sample No.	Station	Sample Type	µg/g C
70161,2	ALSEP	<1mm Fines	150
70181,2	ALSEP	<1mm Fines	165
71041,2	1A	<1mm Fines	90
71061,2	1A	<1mm Fines	40
71501.2	1A	<1mm Fines	75
72501,3	2	<1mm Fines	125
72701,3	2	<1mm Fines	140
73221,2	3	<1mm Fines	155
73261,2	3	<1mm Fines	170
74220,4	4	unsieved fines	100
74240,4	4	unsieved fines	55
74260,3	4	unsieved fines	45
75081,2	5	<1mm Fines	115
76501,3	6	<1mm Fines	120
77531,2	7	<1mm Fines	180
78155,3	8	Gabbroic Breccia	85
78501,3	8	<1mm Fines	170
79221,3	9	<1mm Fines	160
79261,3	9	<1mm Fines	145

no agglutinate content. The fines samples collected at station 8 from different depths in a trench shows no significant differences in either total carbon or sulfur content.

Total sulfur contents of lunar fines are also well correlated with the sample collection stations. Those from the valley center have higher total sulfur contents than those along the massifs reflecting the higher mare basalt percentage in their make-up. Basalt sample 75035 with 3140 µg/g total sulfur has the highest total sulfur content we have measured in a lunar sample.

There is no indication from the data found in the analysis of the Apollo 17 samples that our previous conclusions that most of the carbon in the fines is of solar wind origin and most of the sulfur is of lunar origin should be modified.

ACKNOWLEDGEMENTS

This work was supported by NASA grants NGL-03-001-001 and NGR-03-001-057.

C AND S OF APOLLO 17 LUNAR SAMPLES

Moore, Carleton B.

Table 1. Total Carbon and Sulfur in Apollo 17 Samples

Sample No.	Station	Sample Type	Total µg/g C	µg/g S
70011,17	LM	SESC	120	1200
70215,53	SEP-LM	Fine Basalt	31	2040
71055,29	1A	Medium Basalt	54	1860
72141,17	LRV 2	<1mm Fines	155	950
72161,12	LRV 3	<1mm Fines	200	990
72275,71	2	Layered light-grey breccia	23	860
72395,42	2	Green-grey breccia	105	
72441,8	2	<1mm Fines	135	750
72701,30	2	<1mm Fines	125	790
73121,12	2a	<1mm Fines	120	710
73141,14	2	<1mm Fines	120	730
73235,46	3	Blue grey breccia	54	500
74121,14	LRV 6	<1mm Fines	140	890
74220,84	4	unsieved fines	5	
75035,42	5	Medium Basalt	64	3140
75121,10	LRV 7	<1mm Fines	145	1120
76240,12	6	unsieved fines	125	870
76260,6	6	unsieved fines	100	880
76321,12	6	<1mm Fines	140	770
77017,47	7	Brecciated Olivine Gabbro	80	910
78121,8	LRV 11	<1mm Fines	125	970
78155,28	8	Gabbroic Breccia	21	380
78221,9	8	<1mm Fines	190	950
78421,32	8	<1mm Fines	165	890
78441,17	8	<1mm Fines	155	890
78461,13	8	<1mm Fines	180	890
78481,29	8	<1mm Fines	180	950
79135,27	9	Dark matrix breccia	150	1110
79221,20	9	<1mm Fines	150	1280
79241,20	9	<1mm Fines	140	1160
79261,26	9	<1mm Fines	110	1330