SULPHUR CONCENTRATIONS AND ISOTOPE RATIOS IN APOLLO 16 AND 17 SAMPLES. C. E. Rees and H. G. Thode, Dept. of Chemistry, McMaster University, Hamilton, Ontario, Canada L8S 4K1.

Sulphur concentrations and $\delta^{34}S$ (1) values have been measured for Apollo 16 and 17 samples. Experimental procedures have been described elsewhere (2). Reported sulphur concentrations have an estimated error of ±3% while the standard deviation of an individual $\delta^{34}S$ determination is ±0.07‰. Table 1 shows the results for Apollo 16 samples.

Table 1

Sulphur concentrations and $\delta^{34}S$ values for Apollo 16 samples

Sample	Description	Sulphur concentration, ppm	$\delta^{34}S$, ‰
61016,137	anorthosite	518	-0.1
68815,101	breccia	500	+0.4
68502,20	1-2 mm fines		
I	non-magnetic fraction	509	+1.4
II	magnetic fraction	742	+1.9
III	fine residue	646	+5.8
68501,47	<1 mm fines	581	+8.6
61501,18	<1 mm fines	589	+9.6
60601,16	<1 mm fines	663	+9.9
64501,21	<1 mm fines	500	+9.7

The data in Table 1 are in general agreement with previously determined values (see (3) and references there-in). The anorthosite sample 61016 is the first for which we have found a negative $\delta^{34}S$ value. The coarse fines sample 68502 was crudely separated into magnetic and non-magnetic fractions with a hand magnet. These fractions have distinctly different sulphur concentrations while the $\delta^{34}S$ values are similar and reflect the rock-like character of the coarse particles. A small amount of fine material, initially adhering to the coarse particles, was washed off with acetone. This fraction has a much higher $\delta^{34}S$ value.

Table 2 shows the results for analyses of Apollo 17 samples.

Sulphur Isotopes

Rees, C. E. et al.

Table 2

Sulphur concentrations and $\delta^{34}S$ values for Apollo 17 samples

Sample	Description	Size, g	Sulphur concentration, ppm	$\delta^{34}S$, ‰
79135,36	Breccia	----	828	+ 5.5
75081,5	<1 mm Fines	----	1010	+ 9.5
72501,42	<1 mm Fines	----	540	+ 9.9
72501,42	(Sieve experiment):			
IA	1000μ - 53μ	0.72	580	+ 5.3
IB	53μ - 45μ	0.16	436	+ 7.8
II	45μ - 30μ	0.46	580	+ 8.9
III	30μ - 20μ	0.42	560	+10.4
IV	20μ - 10μ	0.66	693	+12.9
V	10μ - 5μ	0.33	745	+17.7
VI	<5μ	0.02	1164	-----

The sieving experiment on 72501 extends the similar experiment (4) on the Apollo 14 fines sample 14163. The tabulated results clearly show the increase of $\delta^{34}S$ value with decreasing particle size. This strongly suggests that the high $\delta^{34}S$ values are related to the high surface areas of the smaller particles. The following crude model yields surprising results. Consider a spherical particle of radius r with an outer shell of thickness a. The fraction, f, of the volume of the particle which is in the outer shell is:

$$f = \frac{\text{volume of outer shell}}{\text{total volume}} = \frac{r^3-(r-a)^3}{r^3} .$$

Figure 1 shows a plot of $\delta^{34}S$ against f where r is taken as the average particle size of each sieve fraction and a is assigned the value 3μ. The experimental data points fall in a linear array to within the precision of measurement of the $\delta^{34}S$ values. The reasons why this should be so are not clear. Extrapolating to the extreme values of f (0 and 1) leads to the conclusion that the dust particles examined here have inner and outer layers of different sulphur isotope compositions. The outer layer, 3μ thick, contains sulphur with a $\delta^{34}S$ value of +21.2 ‰. The inner layer, below 3μ depth, contains sulphur with a $\delta^{34}S$ value of +5.2 ‰. Particles of a particular size exhibit $\delta^{34}S$ values intermediate between +5.2‰ and +21.2‰ in a manner reflecting the ratio of outer material to inner material.

Sulphur Isotopes

Rees, C. E. et al.

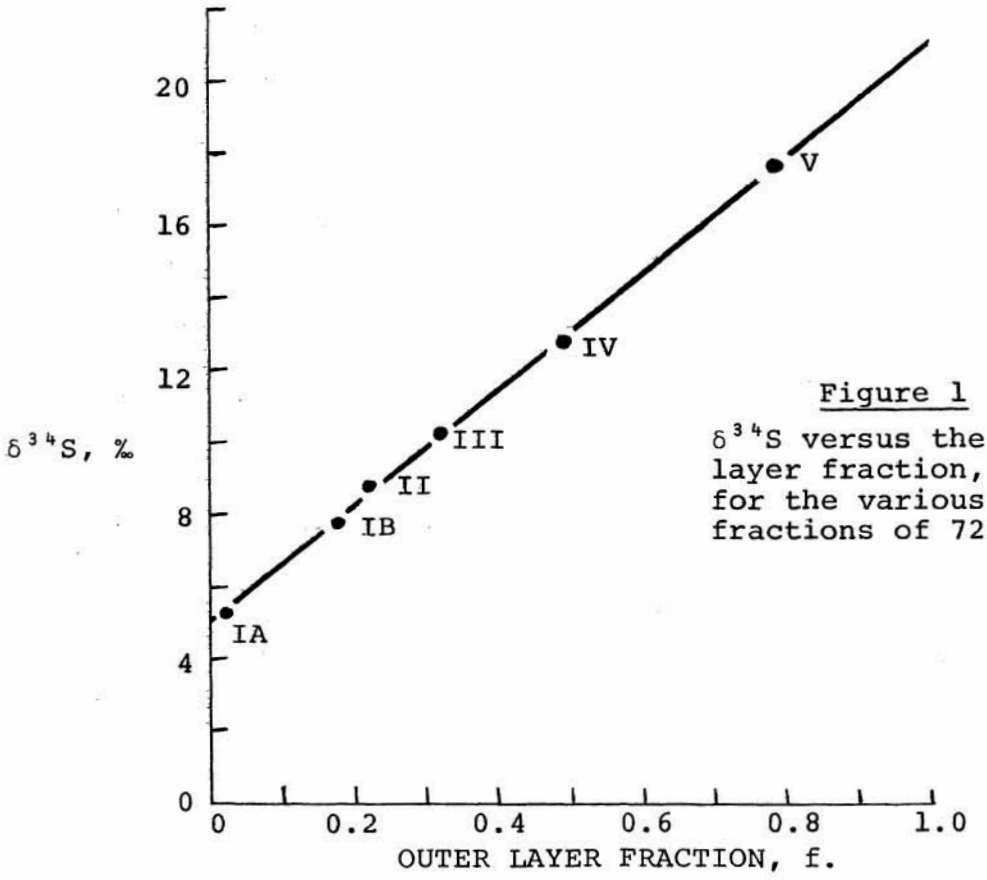

Figure 1

$\delta^{34}S$ versus the outer layer fraction, f, for the various sieve fractions of 72501-42.

References and Notes

1. $\delta^{34}S$,‰ = {[($^{34}S/^{32}S$)sample/($^{34}S/^{32}S$)standard] - 1} x 1000; standard is Canyon Diablo troilite.

2. Thode, H. G. and Rees, C. E., Earth Planet. Sci. Lett. 12, 434 (1971).

3. Rees, C. E. and Thode, H. G., Proc. Third Lunar Sci. Conf., Geochim. Cosmochim. Acta, Suppl. 3, Vol. 2, 1479-1485 (1972).

4. Thode, H. G. and Rees, C. E. In "The Apollo 15 Lunar Samples" 402-403, The Lunar Science Institute, Houston (1972).

5. We gratefully acknowledge the assistance of Colin McEwing in the mass spectrometer analyses.

6. Supported by the National Research Council of Canada.