INERT GAS STRATIGRAPHY OF THE LOWER HALF OF THE APOLLO 16 DRILL CORE

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Section 60003 of the Apollo 16 drill core broke into two "halves" when it was opened. One "half" was processed according to normal procedures. Ninety-five small samples were collected with special tools from selected locations of the other "half". The objective was to obtain the purest possible aliquots from the various lithologies in this intricately laminated and marbled core. Also, three "massive, uniform units" of the core were sampled in a "grid pattern", i.e. samples were obtained both radially and axially in these units. Splits from each sample were made available for magnetic and track studies, which are reported elsewhere, and for the inert gas studies reported here. The objective is to first characterize the samples and then to try to better understand the stratigraphy of this section.

Inert gas studies have shown (1) that the surface soils at Apollo 16 are mixtures of at least three inert-gas components; I, relatively dark soils with $^{4}He/^{20}Ne$ generally greater than 40 and $^{40}Ar/^{36}Ar$ 1.0 $\pm$ 0.2; II, relatively light colored soils with $^{4}He/^{20}Ne \sim 20$-25 and $^{40}Ar/^{36}Ar \sim 4$-5; and III, relatively light colored soils with $^{4}He/^{20}Ne \sim 35$-40 and $^{40}Ar/^{36}Ar \sim 1.0 \pm 0.2$. Component III is clearly related to North Ray Crater; component II is related to trench soil 61220; component I is related to the "country" soils prevalent on Stone Mountain. It seemed reasonable that components II and III should show up in the lower half of the drill core. Component I is related to a large, young "anomaly" at Apollo 16 which is unlikely to occur in this portion of the core. This does not imply that no material from the northern mountains around North Ray Crater is present in the lower half of the core. It there is, we might not be able to tell from inert gas data alone. Even magnetic and track data may not be conclusive. Additional major element chemistry is needed.

We have already shown (2) that component II is abundantly present in 60002 from 7 cm from the top of this section to its base (3). In contradistinction, component II is either absent, or very scarce in 60004 between 4 cm from the top to 39 cm from the top, i.e. nearly at the base of 60004. In fact, we anticipated that 60003 might be transitional between 60002 and 60004; and might show distinct differences between light and dark lithologies. Table 1 gives results for samples from the normal dissection made. These samples reflect general trends in the core, but represent, in most cases, mixtures of light and dark lithologies in unknown proportions. $^{40}Ar/^{36}Ar$, although uncorrected for radiogenic ^{40}Ar is still diagnostic. Corrected values would be $\sim$ 10% smaller. The uncorrected ratios in 60004 are 1.13, 1.13, 1.26, 1.57, 1.20, 1.31. In 60002, below 7 cm, the ratio

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is never smaller than 2.0 and ranges up to 4.3. Grossly, then, 60003 seems indeed transitional between 60002 and 60004, i.e. poorer in component II than 60002, but generally richer than 60004.

There are some interesting details. From 4.2 - 5.4 cm, 60003 seems richer in component II than below 5.4 cm. This corresponds well with a major stratigraphic boundary (from massive to laminated) at about 5 cm. The transition from this enriched zone to the component II-poor soils in 60004 must lie very close to the physical boundary of 60003 and 60004. 60003 remains somewhat depleted in component II down to ~ 20 cm at least. An increase is seen around 34-35 cm. Photos of the core suggest a local concentration of light clasts here.

We have not yet completed the measurements of all 95 special samples. Table 2 gives results for 21 samples from the marbled and laminated zone ~ 4-7.5 cm depth. The average $^{40}Ar/^{36}Ar$ ratios of light and dark lithologies show only a marginally significant difference. Yet, some component II is present as deduced from sample 1316. Apparently, the special sample collecting technique, although more selective than the standard dissection technique, is not perfect either.

The stratigraphy of the lower half of the Apollo 16 deep drill core shows the following broad trend. From the base of 60002 to about 7 cm from the top of this section, the soils are relatively rich in component II. Next, a zone of as yet unknown thickness, extending into 60003 is relatively poor in this component. Much of 60003 is intermediate, but component II increases towards the top of this section. Somewhere near the base of 60004 the soils become again poor in component II and remain so throughout most of 60004. The light lithologies in 60003 seem to be richer in component II than the dark lithologies. We conclude that these trends reflect "transgressions" of components II and III in the vicinity of the core site.

Table I
Inert gas relationships of samples from 60003, taken in the normal dissection mode

Sample	Parent	Depth (cm)	$^{4}He/^{20}Ne$	$^{40}Ar/^{36}Ar^{*}$
443	204	4.2	47	1.49
442	202	4.5	51	1.48
441	180	4.8	49	1.52
440	176	5.4	45	1.42

REFERENCES: (1) Heymann D., Walton J.R., Jordan J.L., Lakatos S., Yaniv A. (1975), The Moon 13, 81; (2) Jordan J.L., Heymann D. (1976) Lunar Science VII, 434; (3) Bogard D.D., Hirsch W.C.(1975) Proc. Lunar Sci. Conf. VI, 2057.

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Table I (cont.)

Sample	Parent	Depth (cm)	$^4He/^{20}Ne$	$^{40}Ar/^{36}Ar$*
439	174	5.7	49	1.31
438	170	6.2	47	1.36
437	138	13.8	47	1.32
436	134	14.4	49	1.39
435	132	14.6	46	1.40
434	130	14.9	45	1.31
433	122	16.6	52	1.33
432	120	16.9	50	1.32
431	118	17.2	47	1.37
430	101	21.0	47	1.32
429	100	20.5	46	1.36
428	37	34.4	43	1.46
427	35	34.6	49	1.49
426	34	34.8	48	1.49

* Not corrected for radiogenic ^{40}Ar

Table 2

$^{40}Ar/^{36}Ar$ in samples from laminated zone 4-7.5 cm depth in 60003

SAMPLE NO.	$^{40}Ar/^{36}Ar$*	Lithology
60003.1315	1.52	light
1316	2.59	light
1317	1.43	dark
1318	1.55	dark
1319	1.62	light
1320	1.53	light
1321	1.44	light
1322	1.53	light
1323	1.49	dark
1324	1.47	light
1325	1.37	lt-dark
1326	1.25	light
1327	1.60	dark
1328	1.50	light
1329	1.21	dark
1330	1.53	breccia
1331	1.34	dark
1332	1.32	light
1333	1.37	dark
1334	1.45	light
1335	1.30	dark

*Not corrected for radiogenic ^{40}Ar
Avge light = 1.56
Avge dark = 1.41