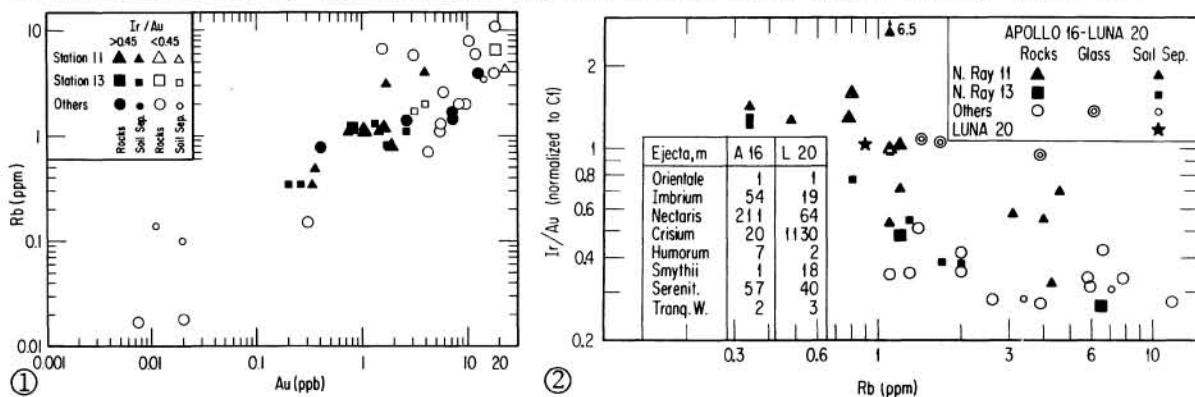


METEORITIC AND VOLATILE ELEMENTS IN APOLLO 16 ROCKS AND IN
SEPARATED PHASES FROM 14306

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Stratigraphy of Apollo 16 Site. The new data (Table 1) support our previous interpretation (1). Cataclastic anorthosites, comprising the middle unit at N. Ray Crater, have very low Rb and Au contents (lower left in Fig. 1). They may represent deep ejecta from Nectaris. The remaining rocks have higher Au contents, owing to the presence of ancient meteoritic components. One group, found only at Stations 11 and 13 and in 3 glasses from other stations, is characterized by intermediate Rb and Au but high Ir/Au ratios (Fig. 2).



It consists mainly of B4-B5 dark-matrix breccias such as Outhouse Rock 67915, and apparently comprises the lowest of the 3 strata recognized by AFGIT. It probably represents shallow ejecta from Nectaris and older basins. Another group, found all over the site, has high Rb and Au, but low Ir/Au ratios. It consists mainly of B2 light-matrix breccias, and apparently comprises the top stratum. It probably represents ejecta from post-Nectaris basins. Tentative assignments to specific basins are found in the abstract by Morgan *et al.* (2), which also reports our Apollo 17 data.

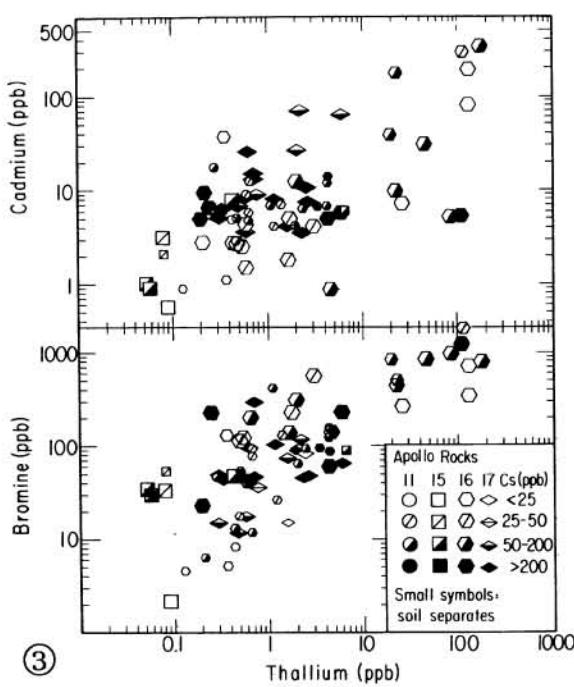
Planetary Debris? We attempted to find a soil separate similar to the fine-grained breccia 67602,14-3 (1) whose high Ir/Au and low Ge/Au ratios (6.5 and 0.25, normalized to C1 chondrites) suggested a meteoritic component similar to the bulk Moon in composition: rich in refractories, poor in metal and volatiles (corresponding ratios estimated for the Moon are 11.5 and 0.093; see abstract by Ganapathy and Anders, 3). Such material might represent debris of one of the building blocks of the Moon. However, the two new samples had lower Ir, Re contents and lower Ir/Au ratios (0.54 and 1.45). A microprobe search for Ir-rich metal grains in these separates also gave negative results.

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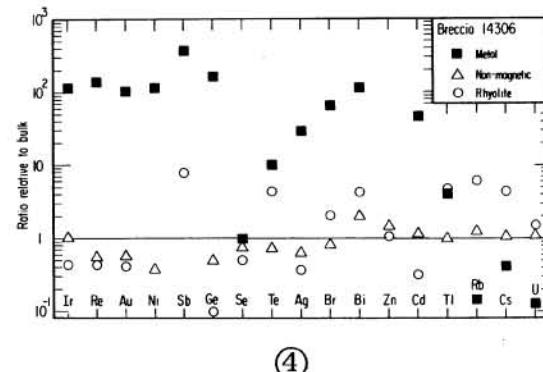
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Volatile Enrichment. Two of the newly analyzed rocks (64455 basalt and glassy coating, and 68115) show a substantial enrichment of Tl, which we attribute to fumarolic volcanism (1). It is often accompanied by similar enrichments of Br and Cd (Fig. 3). All such volatile-rich rocks for which data are available have cosmic-ray ages of 1-7 Myr, suggestive of an origin from S. Ray Crater.

Distribution of Trace Elements Within a Breccia. Most of our trace elements are strongly siderophile in the lunar crust, judging from their ~100-fold enrichment in a metal fraction from 14306 (Fig. 4). Interestingly, this includes Br, Bi, Zn, and Cd, which are often thought to be chalcophile. In contrast, the indisputably chalcophile Se shows no enrichment in metal, while Te shows a moderate enrichment.



(3)



(4)

- (1) KRAHENBÜHL U. et al. (1973) GCA Suppl. 4, 1325.
- (2) MORGAN J.W. et al. (1974) Lunar Sci. V
- (3) GANAPATHY R. and ANDERS E. (1974) Lunar Sci. V.



Table 1. Abundances of Trace Elements in Apollo 16 and 14 Samples (ppb; Ni, Zn, and Rb, ppm)

	Class. ⁺	Ir	Re	Au [†]	Ni	Sb [‡]	Ge	Se	Te	Ag	Br	B1	Zn ⁺	Cd	Tl	Rb	Cs	U	
<u>Rocks</u>																			
60017,8A [‡]	B4 DG-MMSB	1.24	0.103	<u>4.25</u>	47	0.37	9.4	21	6.8	3.4	230	0.36	3.3	5.0	1.76	0.70	41	135	
60017,8B	B4 DG-MMSB	1.75	0.161	0.41	35	1.01	20	17.7	7.2	0.59	560	0.24	5.4	4.1	3.09	0.78	49	117	
60095,5	Glass	25.4	2.17	7.11	560	2.62	306	187	26	1.2	136	0.59	1.55	1.8	1.66	1.67	64	670	
60315,79	C2 Poik	11.0	1.36	18.3	798	11.0	625	520	4.7	0.94	23	0.13	0.30	5.0	0.20	10.8	540	2280	
63335,17	B5	1.32	0.136	0.81	70	3.19	28	24	6.1	4.9	310	2.02	16.3	12.4	2.03	1.20	67	159	
63355,7	B4 DG-MRB	16.6	2.27	18.4	800	5.87	1910	340	38	2.3	230	0.44	5.2	5.7	6.0	6.5	300	980	
64455,25	Glass	40.6	4.11	12.7	905	3.16	500	390	12.8	1.6	930	0.63	2.4	5.2	83.2	3.9	144	860	
64455,27	C2 Basalt	2.25	0.284	1.56	80	0.45	62	190	2.5	1.2	1200	0.08	2.2	5.3	109	6.6	280	1430	
65016,7	Glass	26.3	2.29	7.19	532	1.66	225	96	12.8	0.59	42	0.23	0.52	1.5	0.60	1.44	62	650	
67955,20	C2(B1?) LMB	5.56	0.572	1.60	231	0.23	59	26	9.7	1.2	199	0.34	6.7	4.3	0.66	1.20	64	360	
68115,77	B5 DG	0.040	0.005	<u>2.28</u>	≤7	0.19	6.7	3.4	0.4	0.19	700	0.22	0.47	81	130	0.043	8.1	1.8	
69935,8	B4	12.7	1.55	11.9	583	3.63	325	190	2.8	1.3	220	0.19	0.88	6.6	0.25	5.9	260	870	
<u>Soil Separates</u>																			
67702,16-5	Breccia	2.62	0.279	1.45	120	0.44	123	34	5.0	0.61	13	0.12	1.35	2.8	0.44	1.1	54	180	
67702,16-6	Breccia	1.63	0.144	0.34	60	0.16	17	19.0	0.7	0.40	6.3	0.15	1.35	2.8	0.21	0.34	18	57	
<u>Apollo 14</u>																			
14306,35,8 [‡]	B Rhyolite	3.6	0.28	2.2		11.8	39	50	23	0.92	550	1.2	2.9	10	28	114	4500	7200	
14306,35,9 [‡]	B Bulk	8.14	0.64	5.3		1.41	390	99	5.3	2.5	270	0.28	2.7	31	6.0	18.6	1030	4800	
14306,35,10	B Metal	950	90.2	553	45600	525	64600	98	53	73	17600	32	<u>41600</u>	1430	24.0	2.7	440	630	
14306,35,11	B Nonmagn.	3.71	0.361	3.05	151	<u>22.8</u>	195	75	3.9	1.6	220	0.56	4.0	36	5.87	23	1100	5200	
14258,36,14	S Metal	36.2	4.75	45.2	3570	163	129000	430	16	1.3		7.8	0.37	0.65	17	0.45	2.1	61	820

* Classified according to Wilshire et al. (1973) and Warner et al. (1973):

† Italicized values are high, owing to contamination.

B = breccia

LMB = light matrix breccia

B1 = light matrix, light clast

MMSB = melted matrix shocked breccia

B4 = dark matrix, light clast

MRB = mesostasis-rich basalt

B5 = dark matrix, dark clast

poik = poikilitic rock with plagioclase, olivine, and/or lithic relics

C2 = crystalline, metaclastic

Ganapathy et al. (1973) Geochim. Cosmochim. Acta, Suppl. 4, 1239-1261.

DG = devitrified glass with plagioclase and/or lithic relics

‡ Krahnenbuhl et al. (1973) Geochim. Cosmochim. Acta, Suppl. 4, 1325-1348.

§ Ganapathy et al. (1973) Geochim. Cosmochim. Acta, Suppl. 4, 1239-1261.

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