ELEMENTS DEPLETED ON LUNAR SURFACE: IMPLICATIONS FOR ORIGIN OF MOON AND METEORITE INFLUX RATE

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Compared to terrestrial basalts and eucrite meteorites, Apollo 11 and 12 basalts are consistently depleted in siderophile elements (Ir, Pd, Ag, Au) and volatile elements (Zn, Cd, In, Tl, Bi, Br), by factors of 10^{-1} to 10^{-2}. The depletion of siderophiles suggests that the Earth and Moon segregated their metal and silicate in two discrete events, contrary to the fission hypothesis. Moreover, if the Earth-eucrite pattern is typical of independently-formed planetary bodies, the greater depletion of the Moon speaks against an independent origin, as required by the capture hypothesis. The depletion of volatiles implies that the Moon either formed at high temperatures, or had a very low growth rate in the terminal stages of accretion. This might be expected if it formed in the Earth's neighborhood.

The coarse-grained, 18-cm layer of core 12028 shows extreme enrichment in Bi and Cd (38 and 22 ppm), some 10^3 to 10^5 times the content of Apollo 11 and 12 crystalline rocks and soil. Such material must be rare on the Moon, judging from the low Bi content of all soil and breccia samples examined to date. Sample 12013, on the other hand, seems to represent a more abundant rock type. Relative to Apollo 12 basalts, it is enriched in Rb, Cs, Tl, Zn, and Cd by factors of up to 10^2. About 10-20% of such material is required to account for the high Rb, Cs, and Cd content of nine Apollo 12 soils. Rock 12013 fits various trace element correlations for Apollo 11,12 rocks, which suggests a close genetic relationship to mare basalts, and a local rather than highland origin.

All soil and breccia samples are enriched in elements thought to be largely of meteoritic origin: Ag, Au, Bi, Br, Cd, Ir, Te, Tl, and Zn. The enrichment pattern at the Apollo 11 site suggests that most of the meteoritic material has a primitive composition similar to C1,2 or E3,4 chondrites. The pattern at the Apollo 12 site shows a less distinct enrichment of Bi and Tl, perhaps implying a smaller proportion of primitive meteoritic material. The amount of meteoritic material is constant within a factor of 3 in all Apollo 11 and 12 soils and breccias examined, and in different layers of the 12028 core. It corresponds to an average meteoritic component of 1.9% C1 material or equivalent in Apollo 11 and 1.6% in Apollo 12 samples. The average meteorite influx rate is 4×10^{-9} g cm^{-2} yr^{-1}.

The glassy exterior of rock 12017 is enriched in "meteoritic" elements (Au, Br, Cd, Ir, etc.) relative to the interior. Apparently the glass represents molten material splashed onto the rock from a crater, not a glazing made in place by a solar outburst, as proposed by Gold.