D/H, O^{18}/O^{16}, C^{13}/C^{12}, and Si^{30}/Si^{28} Studies of Apollo 11 and 12 Lunar Rocks and Minerals

by

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The O^{18}/O^{16} and Si^{30}/Si^{28} ratios of Apollo 12 minerals and whole-rock samples are essentially identical to those previously obtained from the Apollo 11 samples. This further demonstrates the apparent oxygen isotope homogeneity of the Moon and its marked oxygen isotopic similarity to terrestrial basaltic and gabbroic rocks. This uniformity in δO^{18} and δSi^{30} extends even to the most SiO_2-rich rock yet found on the Moon, rock 12013. Seven whole-rock samples from 12013 range in SiO_2 content from 51 to 61 % and in δO^{18} from +5.95 to +6.34, distinctly lower in O^{18} than tektites and terrestrial plutonic granitic rocks, but similar to oceanic rhyolite obsidians. These data strongly suggest that tektites do not come from the Moon.

The Apollo 12 soil contains approximately the same D/H ratio and amount ($\approx$ 20 μmoles/g) of solar wind hydrogen as the Apollo 11 soil. A number of experiments were made to obtain a more accurate upper limit for the deuterium concentration in the lunar fines and breccias. A δD value of −956 (7 ppm deuterium) was obtained for hydrogen gas extracted from 10061 breccia. This was done by first exchanging the sample with essentially deuterium-free water at about 350°C for 3 hrs., and thus eliminating a large fraction of the deuterium from the H_2O contaminant in the sample. The above value thus represents the <u>maximum</u> concentration of deuterium in the solar wind hydrogen. The breccia 10061 has the highest solar wind hydrogen content of any sample we have yet

analyzed, and it also has the highest whole-rock δO^{18} and δSi^{30} values. There is an apparent correlation between amount of solar wind hydrogen and enrichment in the heavier isotopes of oxygen and silicon. These isotopic enrichments are probably due to preferential stripping of the lighter isotopes during particle bombardment of the lunar surface. The C^{13}/C^{12} ratio of the Apollo 12 soil 12070 is 5 to 10 per mil lower than in the analyzed Apollo 11 samples, but the total carbon concentration is about the same.