Kr$^{81}$-Kr and K-Ar$^{40}$ AGES, COSMIC-RAY SPALLATION PRODUCTS AND NEUTRON EFFECTS IN APOLLO 11 AND 12 LUNAR SAMPLES.

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Abstract

Cosmic-ray exposure ages of lunar rocks were obtained by the Kr$^{81}$-Kr dating method and are compared to ages derived from stable rare gas isotope data. In two rocks, 10017 and 12002, depth dependent production rates were obtained. Solar flare effects are clearly visible in the radioisotope Kr$^{81}$, but only very small effects are found in the integrating stable rare gas isotopes. The K-Ar$^{40}$ ages obtained in our Apollo 12 bulk rock samples are similar to those previously found in Apollo 11 rocks. Data obtained from Apollo 11 soil separates show that the Ar$^{40}$ excess is located in glass and microbreccia and not uniformly distributed. Thermal neutron capture anomalies in the Gd isotopes are found to correlate with the Xe spallation mass yields, suggesting that fast neutrons are partially responsible for a high relative yield of Xe$^{132}$. This correlation also allows estimates on the average burial depth of the rocks during cosmic-ray irradiation.