MEASUREMENTS OF COSMIC RAY PRODUCED ^{53}MN AND ^{10}BE IN LUNAR CORES.

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We have measured cosmic ray produced ^{53}Mn ($t_{1/2}$ = 3.7 My) in double drive tube 64002 for the continuing study of lunar surface regolith mixing. We have also measured ^{10}Be ($t_{1/2}$ = 1.6 My) in the Apollo 15 long core for study of the galactic cosmic ray (GCR) production profile using accelerator mass spectrometry.

^{53}Mn. Core 64002/1 was collected at Stone Mountain on a 16° slope [1]. This is the steepest slope we have ever measured ^{53}Mn profiles in. Core 64002 which is 26.4 cm in length and had a density of 1.65 g/cm^3 after extrusion, is the top half of double drive tube 64002/64001. 64002 includes five stratigraphic units [1]. We have received 12 samples covering all five units. Before dissolution we examined the sample microscopically. Half the samples included small metallic grains, whose diameters ranged from 100 to 500 μm. Several large metallic grains were separated from bulk soil for further studies. The preliminary SEM study shows a few metallic grains composed of almost pure Fe, S, Ni and P. Goldstein and Axon [2] have found high Fe, Ni, P, Co and S content in metallic particles from three Apollo 16 soils.

The preliminary ^{53}Mn contents of 64002 are shown in Fig. 1. The ^{53}Mn profile for the top 20-25 g/cm^2 is rather flat and higher than the Reedy-Arnold calculated curve. The integral of apparent SCR (Solar Cosmic Ray) ^{53}Mn down to 25 g/cm^2 is higher by 40-45%. Activity levels fall to the Reedy-Arnold GCR production line [3] below 25 g/cm^2. A textural boundary at 26 g/cm^2 [1] matches this result. The high and flat ^{53}Mn profile above 20 g/cm^2 strongly indicates that this surface soil was recently deposited on this site over a short period. If we assume sudden deposition, such an event happened about 1.5-3 My ago and this soil was well-exposed to cosmic rays above ∿4 g/cm^2 depth before deposition. This time is consistent with the 2 My so-called South Ray Crater event. Many rock samples collected at station 0, 4, 6, 8 and 9 have about a 2 My exposure [4], especially 64435 and 64455 which were collected about 10 m distant from core 64002/1 [5]. However, rare gas [4,6], track [7] and FMR [8] studies of all soil samples collected at these stations indicate those soils were well-irradiated, ≳100 My, and mature. From these studies and this ^{53}Mn measurement, we conclude that either (1) surface soil samples at station 4 are not South Ray Crater materials, or (2) South Ray Crater is much older than 2 million years. This intriguing puzzle requires more measurements to resolve it.

^{10}Be. Three samples of ^{10}Be in the Apollo 15 drill core were measured by accelerator mass spectrometry using the Rochester MP Tandem Van de Graaff. We have measured ^{10}Be/^{9}Be ratios of 2-6x10^{-12} (∿4-10x10^{-4} dpm ^{10}Be) with better than 10% accuracy. Fig. 2 shows ^{10}Be activity in the Apollo 15 long core along with previous measurements of ^{10}Be by β counting in 12002 [9], 14310 and 14321 [10]. All rock data are normalized to Apollo 15 chemical composition. In Fig. 2, a solid line shows the Reedy-Arnold calculation curve [3] normalized to the surface rock results. The absolute calculated value is a factor 2.5 lower than this line assuming the cross section ratio $\sigma(^{10}Be)/\sigma(^7Be) = 0.15$. This large discrepancy is not yet understood. The Reedy-Arnold calculated ^{53}Mn is 40% lower and calculated ^{26}Al 13% higher than measured values. Even though our new results are about 20% higher than this normalized line, the shape of the profile is in fairly good agreement with the Reedy-Arnold profile. The measured half attenuation length, $d_{1/2}$ = 120 g/cm^2, is slightly longer than the Reedy-Arnold model ($d_{1/2}$ = 107 g/cm^2). The main target element for ^{10}Be in extraterrestrial material is O. Although ^{10}Be is considered a high energy product, if we compare the mass difference from target nuclide, ΔA, and half attenuation length of ^{10}Be and ^{53}Mn ($d_{1/2}$ = 145 g/cm^2), it seems that ^{10}Be is a medium energy product in contrast to high energy products such as ^{36}Cl and ^{40}K from Fe. We will need to complete the ^{10}Be profile in the drill core and accurate cross section data for further study.

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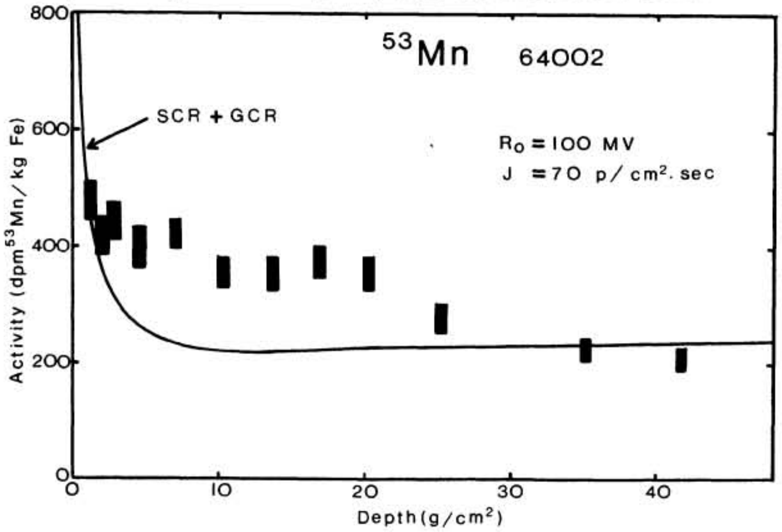

Figure 1.

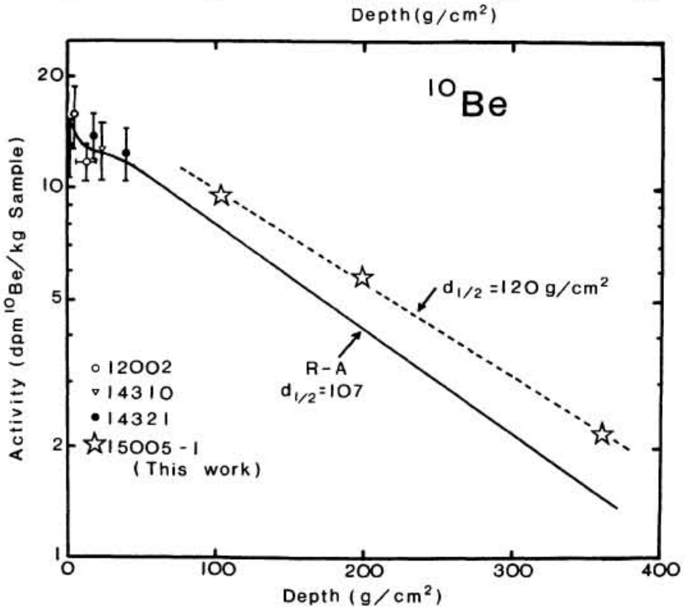

Figure 2.