COSMOGENIC NUCLIDES IN 15011 ROCKLETS; K. Nishiizumi, J. R. Arnold, J. Klein*, R. Middleton*, and J. N. Goswami**; Dept. of Chemistry, B-017, Univ. of Calif., San Diego, La Jolla, CA 92093; *Dept. of Physics, Univ. of Pennsylvania, Philadelphia, PA 19104; **Physical Research Lab., Ahmedabad 380 009, India.

We report here preliminary data for ^{10}Be ($t_{1/2}$ = 1.6x10^6 years) and ^{26}Al (7.05x10^5 years) in 18 rocklets of core 15011 determined by accelerator mass spectrometry, along with ^{53}Mn (3.7x10^6 years) determined by activation. We also report cosmic ray track measurements of some of these rocklets. These data provide a contrasting picture to the bulk soil determinations of ^{26}Al (1) and ^{53}Mn (2), and to the set of rocklets from core 60010 for which ^{53}Mn measurements were reported by Nishiizumi et al (3). The results are shown in Figs. 1 to 3. The most significant features seem to be:

(1) The ^{10}Be profile as expected, shows no visible SCR (Solar Cosmic Ray) effect. No data are available for bulk soil ^{10}Be measurements on this core. While the group of rocklets from 5-10 g/cm^2 depth show lower ^{10}Be than others we are not sure this is statistically significant. In any case, ^{10}Be is not far from a near-surface saturation value in all samples. None have recently come from great depth.

(2) The ^{53}Mn and ^{26}Al values for the rocklets, while exhibiting a wide range, are coherent in two respects. First, the values range between the levels found in the soil at the same depths and lower values characteristic of saturation GCR (Galactic Cosmic Ray) production near the surface. High values for ^{53}Mn and ^{26}Al correlate well, except for one probably erroneous point. Also, there seems to be a clear mass effect, the largest rocklets always displaying low (GCR only) values.

There is no striking correlation with rock type.

The track data provide further insight. One rocklet, 2267 (depth 3.2 g/cm^2), shows a high track density and steep gradient, corresponding to a surface exposure. It also shows the highest SCR-produced ^{53}Mn and ^{26}Al. These values imply a residence time of >5x10^6 years in the top ~1 cm of the regolith, ending at most ~3x10^5 years ago. Another, 2269 (5.8 g/cm^2), also shows high SCR activity and track density, but the track density gradient is small, indicating a long exposure at a depth on the order of one cm.

Three rocklets, 2264, 2268, and 1201 (2.7, 4.5 and 11.3 g/cm^2), show low track density and nuclide activity. Rocklet 2264, in particular, cannot have been long at a position nearer the surface than it is now. Two rocklets, 409 and 2038 (12.0 and 16.7 g/cm^2), are brecciated. They show evidence of surface exposure before brecciation, with high concentrations and gradients in what are now interior positions. None show significant SCR-produced activity. The last rocklet, 2274 (21.5 g/cm^2), contains uniform high track density. The duration of exposure at a near-surface depth is more than 10^7 yr. This exposure occurred more than 10^7 years ago.

The bulk soil measurements were earlier interpreted by Langevin et al (4) and Nishiizumi et al (2), in light of the local topography (13° slope near the rille) and Monte Carlo models. It was concluded that the large SCR excesses in ^{53}Mn and ^{26}Al resulted from downslope motion of individual grains produced by very small surface impacts, filling a local topographic depression most likely formed by impact cratering. Fruchter et al (1) had earlier reached similar conclusions from their ^{26}Al data.

The present results seem to us to give strong support to this interpretation. Rocklets should be less readily moved downslope by small collisions, and this difference of behavior should increase with mass. The larger ones seem to come from layers a few cm or more below the surface. Rocklet 2267, the possible exception, was most likely exposed in situ. They must have been transported in one or a few steps over longer distances, by rarer, larger scale events.

There seems to be a trend downward with depth in $^{26}Al/^{53}Mn$ for the "hotter" rocklets. This is consistent with rocklet 410 (2.1 g/cm^2) nearest the surface, having received much of its ^{26}Al in situ, while the deeper ones, such as 2269 (5.8 g/cm^2) and perhaps 413 (8.3 g/cm^2), have had enough time since deposition for appreciable decay.

In core 15011, as in 60010 previously, the rocklet data have been very useful in understanding its history.

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References:

(1) Fruchter J. S., et al. (1981) Proc. Lunar Planet. Sci. Conf. 12B, 567-575.
(2) Nishiizumi K., et al. (1983) Proc. Lunar Planet. Sci. Conf. 14th, in J. Geophys. Res., 88, B211-B219.
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(4) Langevin Y., et al. (1982) J. Geophys. Res., 87, 6681-6691.

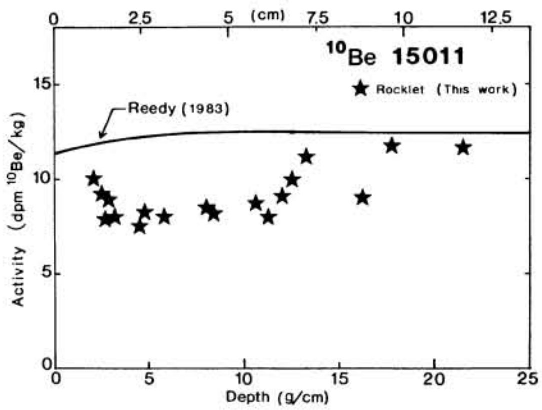

Figure 1.

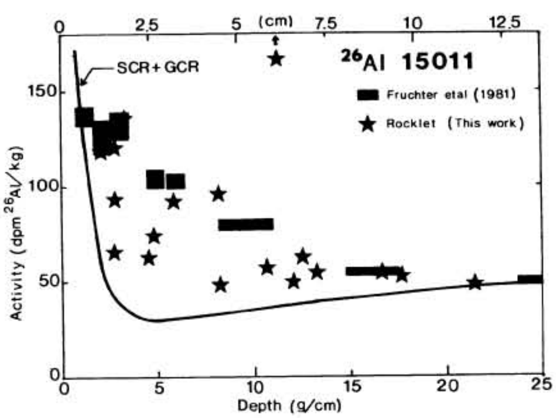

Figure 2.

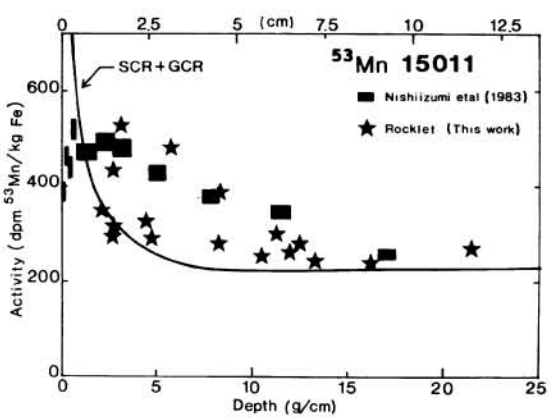

Figure 3.