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Radionuclides in Lunar Cores: Gauges of Particle Flux and AMS Measurement Capability

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Radionuclides are ideal gauges for monitoring the energetic particle environment of the lunar surface and near sub-surface. The physics of the production mechanisms of the radionuclides and the production rates are known. The measurement of radionuclides in depth profiles from the lunar surface has allowed us to better characterize both the galactic and cosmic ray fluxes in addition to identifying some of the processes and time-scales for processes that garden the upper layer of the lunar surface.
Often overlooked in the measurement and reporting of these radionuclide profile data are the demands that they place on the measurement technique, and consequently, what can be said about the robustness of these measurements. Over the years AMS laboratories have conducted many comparisons of 10Be, 26Al, 36Cl, and 41Ca standards and a few reference materials. In general, the concordance between laboratories and reproducibility of these measurements is excellent. But standards are prepared from homogenous solutions, samples are typically derived from complex geologic materials that vary in composition from one sample to the next. The radionuclide measurements from lunar cores conducted over many decades represent yet another means to assess the robustness of the chemical extraction techniques, AMS precision, normalization standards, and reproducibility of the entire technique.
The figure below shows a comparison of AMS measurements of 26Al along with 26Al measurements conducted by decay counting in Apollo 17 drill core [Fruchter et al. (1976, 1979)]. The precision of the AMS measurements is better than decay counting, but the agreement between the two different techniques is striking. Also shown is a comparison of 36Cl measurements taken decades apart [Nishiizumi et al. (1984, 1989)]; the upper portion which isn't exponential reflects solar cosmic ray production. The agreement is excellent, both profiles show the same exponential behavior and concentrations.

References:

Nishiizumi et al. (1984) EPSL 70:157-163; Nishiizumi et al. (1989) Proc. 19th LPSC, 19:305-307; Fruchter et al. (1976) Proc. 9th LPSC, 9:2019-2032; Fruchter et al. (1979) Proc. 10th LPSC, 10:1243-1251

Student Submission

No

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