NUCLIDE PRODUCTION IN (VERY) SMALL METEORITES; James R. Arnold and Kunihiko Nishiizumi, Dept. of Chemistry, Univ. of Calif., San Diego, La Jolla, CA 92093.

One of the most interesting open questions in the study of cosmic-ray effects in meteorites is the expected behavior of objects which are very small compared to the mean interaction length of primary GCR particles. A reasonable limit might be a pre-atmospheric radius of 5 gram/cm^2, or 1.5 cm for chondrites. These are interesting for at least three reasons: (1) this is a limiting case for larger objects, and can help us make better models, (2) this size is intermediate between usual meteorites and irradiated grams (spherules), and (3) these are the most likely objects to show SCR effects. We are now engaged in a search for suitable objects for experimental study.

Reedy (1984) has recently proposed a model for production by GCR of radioactive and stable nuclides in spherical meteorites. We expect the very small objects to deviate from this model in the direction of fewer secondary particles (larger spectral shape parameter α), at all depths. The net effect will be significantly lower production of such low-energy products as ^{53}Mn and ^{26}Al. The SCR production of these and other nuclides will be lower, too, because meteorite orbits extend typically out into the asteroid belt, and the mean SCR flux must fall off approximately as r^{-2} with distance from the sun. Kepler's laws insure that for such orbits most of the exposure time is spent near aphelion.

None the less the "equivalent mean exposure distance" R_{exp}, is slightly less than the semimajor axis A, in fact $A(1 - e^2)^{1/4}$, because of the weighting by R^{-2}. For the three meteorite orbits we have, R_{exp} has a narrow range, from about 1.6 to 2.1 a.u. This is probably true for the great majority of meteorites. If we take 1.8 a.u. as representative, the SCR flux is lowered by a factor of 3.24.

For a very small meteorite, we can estimate that ^{26}Al produced by GCR is perhaps 30 dpm/kg, while the SCR production will add another 30-40 dpm/kg, with no ablation. Obviously such objects are unlikely to be identified by non-destructive counting. The rarity of high ^{26}Al values is to be expected.

Reference:

Reedy, R. C., Proc. 15th, LPSC (in press).