SCALING PRODUCTION RATES OF TERRESTRIAL COSMOGENIC NUCLIDES FOR ALTITUDE AND GEOMAGNETIC EFFECTS

DESILETS, Darin, ddesilet@hwr.arizona.edu, and ZREDA, Marek, marek@hwr.arizona.edu, Dept. of Hydrology, University of Arizona, PO Box 210011, Tucson, AZ

Methods of surface exposure dating using terrestrial cosmogenic nuclides require accurate knowledge of the spatial variability of nuclide production rates. The hadron component of the secondary cosmic-ray flux is responsible for a major fraction of terrestrial nuclide production. This component is particularly sensitive to changes in both altitude and geomagnetic cutoff imposed on primary cosmic-rays. Production rates must therefore be scaled to account for any spatial variations in these two factors.

Production rates have typically been scaled according to formulas derived by Lal (1991, *Earth and Planetary Science Letters* 105: 424-439) from atmospheric measurements of slow-neutron intensity. More recently, Dunai (2000, *Ibid* 176: 157-169) developed new scaling formulas based on data from neutron monitors, cloud chambers and nuclear emulsions. We feel there are several inadequacies in the available scaling models, a few of which we outline here: (1) They incorporate only cosmic-ray measurements taken prior to 1958. (2) Cosmic-ray data from latitude surveys are ordered according to models which do not take into account the eccentricity of the geomagnetic dipole field. (3) They do not adequately address the effects of instrumental biases on measurements of the neutron attenuation length.

Here we report new scaling formulas for spallogenic nuclide production derived from published altitude and latitude surveys conducted with neutron monitors. The data were corrected for the effects of muon and constant background contributions to the neutron monitor counting rate and for biases in energy sensitivity. This latter correction increases attenuation lengths for spallogenic production by 5-10 g cm^{-2} for the $Ca(n,x)^{36}Cl$ reaction, bringing neutron monitor derived attenuation lengths into agreement with those given by Lal (1991). Calculations are presently underway for reactions with higher energy thresholds (e.g., $O(n, x)^{14}C$ and $O(n,x)^{10}Be$) for which corrections to the neutron monitor attenuation length are expected to be smaller.

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