

Terrestrial cosmogenic nuclides as a dating tool of landforms and near-surface materials: applicability and limitations

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This study overviews methodology for application of terrestrial cosmogenic nuclides for dating of diverse types of landforms and near-surface materials. Accumulation of the nuclides in the bedrock or sediment on land surfaces enables us to determine exposure ages of the landform. This methodology targets reconstruction of environmental changes in mountainous areas due to climatic transition, timings of large landslide occurrence, and formation ages of fluvial or marine terraces. In this application, post-event erosion or sedimentation, and/or pre-event irradiation of cosmic rays enlarge uncertainty in the model ages. The nuclide concentration in an eroding bedrock or current sediment reflects residence time of the material near the land surface, which then can be converted to denudation rates of the landform. This application has revealed rates of carbonate denudation as a function of climatic conditions of the sites, soil production and catchment-wide denudation rates in silicate areas, which corresponds to topography of the terrain. For samples of deeply-buried sediments, ratio of paired nuclides in identical mineral grains indicates ages of burying of the debris. The pair of ^{10}Be and ^{26}Al in quartz has been used for dating sediments in caves, for a timescale of 10^6 years. Analysis of such samples provides also a clue to reconstruct paleo denudation rates of the source areas of the debris. In this presentation, applicability and limitations of this method will be discussed with several actual data and outputs from various models of nuclide accumulation.

Keywords: Terrestrial cosmogenic nuclides, Exposure age, Denudation rate, Burial age, Landscape evolution