



Using paired cosmogenic ^{26}Al and ^{10}Be to study landscape transience in the Belgian Ardennes

Angus Moore et al. [▶](#)

Cosmogenic nuclide concentrations are typically inverted for erosion and soil production rates under the assumption that these rates are temporally invariant, and that soil thickness is in steady state. Yet, transience in process rates and soil thickness is expected to occur in landscapes that are experiencing changes in land use, tectonic uplift, and climate. Pairing cosmogenic nuclides with different half-lives provides a means for resolving transience if process rates are sufficiently slow that radioactive decay is significant. Here, we examine ^{10}Be and ^{26}Al concentrations in quartz collected from saprolite at 6 positions along a hillslope transect in the Belgian Ardennes. This transect runs from a low relief paleosurface to the bottom of a catchment incised ca. 30 meters into the paleosurface. We find that all measured $^{26}\text{Al}/^{10}\text{Be}$ ratios are below the production ratio and that the ratio on the paleosurface is near secular equilibrium. Furthermore, all samples plot below the steady-state erosion line on an $^{26}\text{Al}/^{10}\text{Be}$ two-isotope plot. Given the geomorphic position of the site on a regional topographic high, it is unlikely that the ^{26}Al and ^{10}Be concentrations can be explained by burial by sediment to a depth sufficient to shut-off cosmogenic nuclide production. Rather, we model the isotope concentrations as resulting from transience in the soil production rate and soil thickness. The model indicates that the mean soil thickness over the integration timescale of the cosmogenic nuclide signal exceeds the modern measured soil thickness.

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