Novel cosmogenic iosotope tools and progress towards historic time-scales

JOERG M. SCHAEFER[1], GUNTHER KORSCHINEK[2], THOMAS FAESTERMANN[2], KLAUS KNIE[3], ROBERT FINCKEL[4], FERIDE SERIFIDDIN[4], GREG HERZOG[5], GISELA WINCKLER[1], CHRISTIAN SCHLUECHTER[6], GEORGE DENTON[7] AND SAMUEL NIEDERMANN[8]

[1]Lamont-Doherty Earth Observatory, Palisades, NY-10964, USA
[2]Technische Universität München, 85748 Garching, Germany
[3]Universität Wien, 1010 Wien, Austria
[4]UC Berkeley/LLNL, USA
[5]Rutgers University, Piscataway, USA
[6]Universität Bern, Switzerland
[7]University of Maine, Orono, USA
[8]GFZ Potsdam, Germany

Terrestrial cosmogenic isotope techniques have been revolutionizing earth sciences over the last decade and the methodological progress is accelerating. Related to the US/EU framework of the CRONUS initiative, substantial advances have been made over the last two years in developing new cosmogenic isotope systems and in sharpening exisiting cosmogenic tools.

We present analysis and production rate calibrations of several cosmogenic isotope systems focusing on terrestrial ^{53}Mn, a long-lived radio isotope previously limited to extraterrestrial applications. This novel tool will allow new insights into landscape dynamics in arid regions on the million year time scale. On the other end, we present recent progress in the ^{10}Be technique allowing precise and accurate dating of Holocene climate changes including processes less than two hundred years in age.

Weathering rates determined on eroding moraine crests using cosmogenic ^{10}Be and base cation depletion

M. SCHALLER, J.D. BLUM, AND T.A. EHLERS

Department of Geological Sciences, University of Michigan, 1100 N, University Ave., Ann Arbor, MI 48109-1005, USA (mirjam@umich.edu: jdblum@umich.edu; tehlers@umich.edu)

Quantification of weathering rates is important for the understanding of landscape evolution and soil formation. Chemical weathering rates are influenced by many factors such as climate, vegetation, physical erosion, parent material composition, and soil age. Weathering rates of soils are typically calculated from non-eroding surfaces of known deposition age (e.g. Bain *et al*., 1993; Taylor and Blum, 1995) or surfaces assumed to erode at steady-state (e.g. Green *et al*., 2006; Riebe *et al*., 2001). Unfortunately, the assumption of non-eroding or steady-state landscapes is not always justified (e.g. moraine crests). In this study we integrate cosmogenic radionuclides (^{10}Be) and base cation depletion in two ~2 m depth profiles from moraines of different age to quantify soil mixing, denudation, and chemical weathering.

Depth profiles were sampled from terminal moraines in the Wind River Mountains, Wyoming. The two profiles were collected on the crests of the Pinedale (~21 ka) and Bull Lake (~140 ka) moraines. Calculations of weathering rates are based on base cations (Ca, K, Mg, Na) and reported as g(oxide) cm^{-2} yr^{-1}. Weathering rates assuming no physical erosion of the moraine surfaces are 1.0 x 10^{-5} and 3.1 x 10^{-5} g(oxide) cm^{-2} yr^{-1} for the Pinedale and Bull Lake moraines, respectively. Measurement of in situ-produced cosmogenic ^{10}Be in each depth profile suggest denudation rates of 0.01 mm yr^{-1}, and soil mixing depths of 40 to 60 cm. Results to date suggest the assumption of steady-state denudation is not applicable to the investigated moraines due to their young age. Calculation of weathering rates based on transient denudation of the moraines needs to be investigated further.

Prelimenary Results suggest that weathering rates accounting for physical erosion are higher than rates based on the assumption of no erosion. The increase in weathering rates might be larger for older surfaces as more weathered material has been eroded. Taking into account physical erosion, the decrease of weathering rates over time might be less than previously determined by assuming no erosion (e.g. Taylor and Blum, 1995).

References

Bain D.C., Mellor, A., Robertson-Rintoul M.S.E., and Buckland S.T. (1993), *Geoderma* **57**(3) 275-293

Green E.G., Dietrich W.E., and Banfield J.F. (2006), *Earth and Planet. Sci Letters* **242** 155-169

Riebe C.S., Kirchner J.W., Granger D.E. and Finkel R.C. (2001), *Geology* **29** 5111-514

Taylor A. and Blum J.D. (1995), *Geology* **23**(11) 979-982