# Integrating geomagnetic records and cosmogenic nuclide production

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Production of cosmogenic nuclides (CNs) in geologic material is a function of the cosmic ray flux at the Earth's surface, which in turn is a function of the intensity and orientation of the Earth's geomagnetic field. Temporal variations in the intensity of the geomagnetic field and the position of the geomagnetic dipole axis (i.e. polar wander) must be considered when calculating production rates that are integrated through time. We have developed a model, based on the theoretical framework of Desilets and Zreda (2003) and a variety of geomagnetic field intensity and pole position data, that accounts for these variations in an effort to systematically determine their impact on time-integrated production of short-lived (*in situ* $^{14}C$; $t_{1/2}$=5.73 ka) and long-lived (*in situ* $^{10}Be$; $t_{1/2}$=1.5 Ma) CNs (Pigati and Lifton, 2004).

Our model differs significantly from previous models in that integrated production rates are normalized to the modern production rate at the *geomagnetic*, rather than *geographic*, latitude of a given site. Integrated rates that are normalized to the modern rate at a site's geomagnetic latitude explicitly account for the fact that modern production reflects the current offset between the geomagnetic and geographic poles, and that time-integrated production is affected by polar wander differently at different locations. In contrast, normalizing integrated production rates to the modern rate at a site's geographic latitude incorrectly suggests that a single correction can be applied to all sites along a given parallel.

Our modelling results show that, depending on the exposure age and location, integrated *in situ* $^{14}C$ production rates at sea level that account for both intensity variations and polar wander range from 27% higher to 24% lower than modern rates at the same location (modern rates are referenced to the 1945.0 Definitive Geomagnetic Reference Field). Integrated *in situ* $^{10}Be$ rates range from 48% higher to 26% lower than modern. Differences between integrated and modern rates for both nuclides increase significantly at higher altitudes.

### References

Desilets, D., and Zreda, M. (2003), *Earth and Planetary Science Letters*, **206**, 21-42.

Pigati, J.S., and Lifton, N.A. (2004), *Earth and Planetary Science Letters*, **226**, 193-205.

# The CRONUS-Earth (Cosmic-Ray prOduced NUclide Systematics on Earth) Initiative

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Terrestrial Cosmogenic Nuclides (TCN) have become indespendable tools in various disciplines of modern Earth Sciences. However, the understanding of the fundamental physical processes underlying TCN production remains incomplete and the intercomparibility between different investigators and methods is not satisfying.

The CRONUS-Earth initiative is an interdisciplinary, multi-group project with the primary goals (i) to provide a firm linkage between cosmic-ray physics and the systematics of TCN production, (ii) to produce generally-accepted formulations and parameters for calculation of TCN production, and (iii) to establish a rigorous basis for intercomparison between measurement of different nuclides and by different investigators.

To achieve this, CRONUS-Earth will coordinate six major components: (i) A methodological intercomparison, including sample preparation as well as analytical measurement; (ii) refinement of neutron monitor data interpretation to better understand interaction of the cosmic ray flux and the geomagnetic field; (iii) measurement of contemporary TCN production rates and scaling factors by exposing targets to cosmic rays at selected locations; (iv) measurements of production cross-sections using laboratory neutron beams; (v) calibration of TCN production rates by measuring TCN on independently dated surfaces; (vi) modeling to synthesize results. The models will include purely physical models of cosmic-ray-particle propagation through the atmosphere down to Earth, stastically-based parameter-estimation models, and user models.

CRONUS-Earth is an international, collaborative effort with a close liason to the CRONUS-EU project. The intiative starts early 2005. CRONUS-Earth consist of a collaborative network of 17 PI's, the current CRONUS-Earth steering committee includes M. Caffee, Purdue University; R. Finkel, LLNL, Livermore; T. Jull & N. Lifton, University of Arizona, Tucson; M. Kurz, WHOI, Woodshole; F. Phillips, New Mexico Tech, Socorro; J. Schaefer, Lamont-Doherty Earth Observatory, Palisades; J. Stone, University of Washington, Seattle; T. Dunai, Vrije Universiteit, Amsterdam, Netherlands (CRONUS-EU).