Geophysical Research Abstracts
Vol. 12, EGU2010-10364-1, 2010
EGU General Assembly 2010

Six centuries of annually resolved 10Be in varved lake sediments and its relation to production rates

Ann-Marie Berggren (1), Ala Aldahan (1,4), Göran Possnert (2), Eeva Haltia-Hovi (3), and Timo Saarinen (3)

(1) Department of Earth Sciences, Uppsala University, Uppsala, Sweden (ann-marie.berggren@geo.uu.se), (4) Department of Geology, United Arab Emirates University, Al Ain, UAE, (2) Tandem Laboratory, Uppsala University, Uppsala, Sweden, (3) Department of Quaternary Geology, University of Turku, Turku, Finland

A relatively short atmospheric residence time of a few months to one year, combined with a simple chemistry with only one charge state and a lack of anthropogenic sources, has made ^{10}Be a vital source of information about past variability in solar activity, cosmic rays and geomagnetic field intensity. Because these forces affect the cosmogenic isotope production rate, past variations can be traced and timed by measuring ^{10}Be in well-dated archives, among which are ice and sediment cores. Annually resolved terrestrial ^{10}Be archives other than polar ice sheets are a hereto unexplored source of past solar activity and climate information, the main impediment being difficulties in finding natural archives that allow for annual sampling with sufficient ^{10}Be for AMS (accelerator mass spectrometry) measurements.

Cosmogenic isotope production is geographically unevenly distributed, and despite subsequent atmospheric mixing, atmospheric circulation patterns and deposition pathways may cause local or regional variations of ^{10}Be deposition. Although ice cores from Greenland and Antarctica have provided interesting data, a lack of annually resolved ^{10}Be data from sediment archives represents a hindrance against exploring the nature of ^{10}Be signals in regions other than polar. Varved lake sediments are potential targets for this purpose, with sufficient temporal resolution to reveal whether the sediment ^{10}Be signal reflects production variations driven by the 11-year Schwabe solar cycle, or whether it is more controlled by local catchment parameters on this timescale.

Here we report for the first time annual distribution of ^{10}Be in varved sediments, from a lake situated at 63.6˚N, 29.1˚E, 96 m a.s.l. The focus on the last 600 years provides an unprecedented opportunity for comparison of sediment ^{10}Be data with annual ice core, neutron monitor and sunspot number data. The results indicate successful recovery of ^{10}Be atoms from as little as 20 mg sediment, with average concentrations of 4×10^{8} atoms g^{-1}. Deposition rates were determined using sediment accumulation rates and the size of the catchment area, and the range of 0.6-3.5$\times10^{6}$ atoms cm^{-2} a^{-1} agrees with modelled values in literature and earlier lake sediment findings. Several periods of raised ^{10}Be deposition were identified and can be matched to periods of low solar activity, such as during the Maunder and Spörer grand solar minima. We observe relatively high ^{10}Be values during some years, a variability which has also been recognized in ice core ^{10}Be records. This may relate to atmospheric transport and deposition processes, but in our case peaks may also indicate infrequent pulses of ^{10}Be from the catchment area.