Calibration of cosmogenic ^{3}He production rates from postglacial lava flows in Iceland

J.M. LICCIARDI AND M.D. KURZ

Department of Marine Chemistry and Geochemistry, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, USA (jlicciardi@whoi.edu; mkurz@whoi.edu)

We measured cosmogenic ^{3}He production rates in olivine phenocrysts from two radiocarbon-dated postglacial basalt flows in Iceland's Western Volcanic Zone. These measurements are the first direct calibrations of high latitude, near-sea level cosmogenic isotope production rates. Five calibration sites from the Leitahraun flow (5300 ± 110 cal yr BP) yield a cosmogenic ^{3}He production rate of 132 ± 5 atoms g^{-1} yr^{-1}, and six sites from the Búrfellshraun flow (8080 ± 150 cal yr BP) yield a rate of 135 ± 4 atoms g^{-1} yr^{-1} (±1_; at high latitudes at sea level).

These ^{3}He production rate calibrations establish a reproducible local production rate that will significantly enhance the accuracy of exposure dating in Iceland. Determination of the local production rate eliminates the need for large latitudinal and altitudinal scaling of isotopic production rates measured at distant non-Icelandic sites, thereby greatly minimizing scaling uncertainties in exposure age calculations. Moreover, the results are insensitive to time-varying geomagnetic field effects, owing to the high latitude (~64ºN) of the Iceland calibration sites.

The new Icelandic production rate data also have potentially global implications for increasing the accuracy of surface exposure dating methods involving all cosmogenic isotopes. Icelandic ^{3}He production rates are ~10% higher than normalized values measured in the western United States (Cerling and Craig, 1994; Licciardi et al., 1999). This result agrees closely with the prediction by Stone (2000) that anomalously low atmospheric pressure over Iceland throughout the Holocene would act to increase the local Icelandic production rate of cosmogenic isotopes by about 6-8% relative to the globally averaged production rate, and by about 10% relative to that in the western United States. The Icelandic calibrations therefore provide support for Stone's (2000) suggestion that scaled local production rates (and resulting exposure ages) around the globe should be adjusted for regional variations in long-term atmospheric pressure. By extending the geographic coverage of previous calibration studies, these results are also useful for evaluating scaling factors.

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Pb- and Nd-Isotope Records of Baltic Mn/Fe-Precipitates: Evidence for Anthropogenic Pollution and Temporal Variation of Circum Baltic Weathering During the Little Ice Age

V. LIEBETRAU [1], A. EISENHAUER [1], R. FREI [2], B. BOCK [1], A. KRONZ [3], B.T. HANSEN [3], J. BAKER [4], T. LEIPE [5]

[1] GEOMAR Forschungszentrum für marine Geowissenschaften, Wischhofstr.1-3, 24148 Kiel, Germany (vliebetrau@geomar.de)

[2] Geocenter, Øster Voldgade 10, DK-1350 Copenhagen, Denmark

[3] GZG - Geowissenschaftliches Zentrum der Universität Göttingen, Goldschmidtstr. 1-3, 37077 Göttingen, Germany

[4] Danish Lithosphere Center, Øster Voldgade 10, DK-1350 Copenhagen, Denmark

[5] Institut f. Ostseeforschung, Seestr. 15, 18119 Warnemünde, Germany

Ferromanganese precipitates are a widespread phenomena of the Baltic Sea. Their growth patterns are predominantly caused by seasonal and decadal variations of the redox conditions within the water column and the sediments. ($^{226}Ra_{excess}$/Ba)-dated Mn/Fe-precipitates of the Mecklenburg Bay (SW-Baltic, 20 m water depth) indicate that their growth started at about 4300 years BP showing growth rates of up to 0.021 mm/year. $^{207}Pb/^{206}Pb$-ratios reflect historically known changes of anthropogenic activities during the industrial revolution and early Ag and Pb mining. The Nd isotope record shows a significant change of the εNd-value from around –13 for ages older than 800 years BP to approx. –18 around 400 years BP. The comparison with a temperature reconstruction for Fennoscandia documents a close relationship of the εNd record to temperature variations during the Little Ice Age. In general, the εNd profile reflect the northern hemisphere temperature variations during the last 1000 years. We propose that changes of the circum Baltic weathering and erosional input as well as the water exchange between North Sea and Baltic Sea could be dominating factors.