Geophysical Research Abstracts, Vol. 7, 05213, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05213

The absolute chronology of the last glacial

N Shackleton

Godwin Laboratory, Department of Earth Sciences, University of Cambridge, Pembroke Street, Cambridge CB2 3SA, UK

In 2004 I and colleagues proposed that the best way to create a precise and accurate time scale for the rapid events of Marine Isotope Stage (MIS) 3 of the last glacial cycle, is to calibrate the Greenland air-temperature record using radiometric dates. We started with the GRIP data using the age scale of Johnsen et al. (2001) and inserted two age controls. For Greenland Interstadial (GIS) 3 at the recent end of MIS 3 we used radiocarbon dates in a deep sea core, and intercalibration between radiocarbon ages and uranium-series ages. Specifically we assigned an age of 29.0 thousand years (ka) to the base of GIS 3.

For the beginning of MIS 3 we assigned an age of 59.0 ka to the base of GIS 17 on the basis of uranium-series dates on speleothems in Austria that tightly constrain the age of GIS 15 (Spőtl and Mangini, 2002)

We interpolated between these two ages, interpolating on age as given by Johnsen et al. (2001) rather than interpolating on depth in the ice for two reasons. First, this scale takes account (by modelling) of the thinning of the annual layers deep in the ice sheet that occurs as a consequence of ice flow and second, because this scale takes account of the effect of temperature (estimated by isotopic composition of ice) on snowfall.

We noted that some age determinations in the Hulu cave stalagmite suggested that GIS 8 might be slightly younger than the age that we derived, but decided that the discrepancy was not enough to warrant an additional age control in our model. Recently very precise dates have been published for a stalagmite from Toca da Boa Vista Cave, Brazil (Wang et al., 2004) that suggest GIS 8 may be about 0.5 ka younger than our published age. I therefore propose a modified GRIP age scale that incorporates a third age control at 38.5 ka for the base of GIS 8.

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