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The Late Glacial Chronology from Lake Suigestu: A new approach to varve interpolation using frequency distributions of annual sub-layers

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The 1993 sediment core from Lake Suigetsu is one of the most comprehensive terrestrial radiocarbon records. It is extremely rich in leaf fossils, providing a unique, truly atmospheric record of radiocarbon for the last 10-50 kyr BP (Kitagawa & van der Plicht, 2000). Since the Lake Suigetsu sediment is annually laminated (varved) for much of its depth it is suitable for extending the terrestrial radiocarbon calibration model up to 50 kyr BP. However, the data presented by Kitagawa & van der Plicht (2000) significantly diverged from alternative, marine-based calibration datasets, due to gaps in the sediment profile and varve counting uncertainties (Staff et al., 2009).

In 2006 four new parallel cores were recovered from Lake Suigetsu and combined to construct a new complete and continuous master profile (SG06). Along with a new program of AMS radiocarbon measurement, varve counting is being carried out using two different techniques: i) thin section microscopy and ii) high-resolution X-ray fluorescence and X-radiography. In addition, a novel interpolation approach has been developed.

First results are presented for the Late Glacial (10,200 - 15,000 kyr BP). The U-Oki Tephra at the top of this interval is used as tie point for the floating varve count chronology. Initially, the two counting methods are carried out independently. The results are then compared in detail to identify the differences down to the sub-mm scale. This new approach substantially reduces internal error and results in a greater degree of accuracy than previously possible.

Due to poor varve preservation in some sediment intervals, the counts of these sections have to be interpolated. Commonly, interpolation is carried out manually using sedimentation rate estimates from neighbouring sections. The new approach presented here is based on an automated analysis of frequency distributions of annual sub-layers from the compromised section itself, allowing an estimate of the sedimentation rate unbiased by neighbouring sections or by subjective interpretation. Sedimentation rates are calculated from the independent varve counts and are then combined. The application of these sedimentation rates (combined and independent) to the raw counts yields a varve count synthesis as well as an error estimate for the age model.

Comparison of the varve count synthesis with the Late Glacial radiocarbon dates calibrated using Intcal04 (Reimer et al. 2004) and Fairbanks et al. (2005) shows a good agreement between the chronologies.

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