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Climate forcing of glaciolacustrine sedimentation in Scotland during GS-1

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The Greenland ice-core records have demonstrated that pronounced, decadal-scale climate shifts occurred during the last glacial cycle. In order to conduct high-resolution regional correlations, palaeoclimatic records obtained from marine and terrestrial sedimentary environments need to be reconstructed with comparable temporal resolution. The only sediment records that will normally enable this degree of age precision are annually-laminated (varved) deposits. Varved sediments which span the Last Termination have been reported from sites in continental Europe, Scandinavia and Greenland, but hitherto no detailed investigations of assumed varved deposits have been reported from sites in the British Isles. Here we report on progress with the construction of a varve chronology for the Last Termination in the British Isles. Initial investigations have focussed on varved deposits that accumulated in two areas of Scotland where ice-dammed lakes were formed by the advance of glacier ice during the Loch Lomond (Younger Dryas) Stadial (GS-1 in the Greenland stratotype sequence). The first concerns a series of lakes in the Glen Roy-Glen Spean area, and the second, Glacial Lake Blane, was blocked by ice advancing beyond the southern shores of Loch Lomond. We also report on attempts to employ tephrochronology as an independent tool for correlating the Scottish varved sequences with other records in Greenland, NW Europe and the North Atlantic.

Identification and measurement of the Scottish varved deposits is based on detailed examination using thin section micromorphology and sediment geochemistry (XRF). These approaches provide precise measurements of lamination thickness and demonstrate that the summer layers frequently comprise a number of sub-laminations,

interpreted as a series of discrete flux events. The summer layers vary considerably in number and thickness of sub-laminations, while both winter and summer layers show considerable structural variation. We contend that detailed examination of the internal structure of summer layers provides a more reliable index of variations in local summer climatic conditions than do measurements of varve thickness. The latter are more likely to reflect local changes in sediment supply and episodic surge events which are not directly related to climate forcing.

Comparison of summer layer data with the δ^{18}O variations in the GRIP ice-core record (ss08sea and ss09) for the latter part of GS-1 shows a visual cross-match between both records. The comparison suggests that: (i) 515 varves accumulated between 12,119 and 11, 506 GRIP years BP; (ii) the GS-1 ice cap on mainland Scotland reached its maximum extent ca. 840 years after the onset of GS-1 in Greenland (11, 797 GRIP years BP); (iii) Greenland ice and glaciolacustrine sedimentation in Scotland appear to have been responding to a common forcing factor - perhaps decadal migrations of the North Atlantic Polar Front or variations in solar radiation output. Current work is aiming to replicate and test for consistency between the varved sequences, and to independently constrain their ages and detailed correlations with other records using tephrostratigraphy. Future comparisons with the Greenland records will employ the new GICC05 timescale.

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