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NEW RADIOCARBON AGES TO CONSTRAIN LATE GLACIAL ENVIRONMENTAL CHANGE AT WHITRIG BOG, SE SCOTLAND

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Whitrig Bog in the Tweed valley is a small palaeolake basin, which started to infill after the local Last Glacial Maximum (LGM) and the retreat of the former Tweed Palaeo-ice stream. Previous research at Whitrig Bog focused on reconstructing the environmental change over the Late Glacial period. The site specifically records a thick Windermere Interstadial sediment sequence where pollen, macrofossil, sedimentology and chironomid-inferred temperature (C-IT) proxies (Mayle et al., 1997; Brooks et al., 1997; Brooks and Birks, 2000), reveal a site that is highly responsive to rapid environmental change during the Late Glacial. Based on this work, Walker and Lowe (2019) argue that the Whitrig Bog archive could represent a type-site for the Scottish Late Glacial period, although greater insight into this period of abrupt climate change would require a more robust chronological control on the sediments. This work forms part of a broader PhD studentship to constrain the timing of deglaciation and understand the timing of landscape response to rapid environmental change at specific locations in northern Britain. For Whitrig Bog, the aim was to generate an improved age model for the site by generating a revised tephrostratigraphy and radiocarbon chronology, using terrestrial plant macrofossils (TPM), combined with a varve chronology from the Dimlington Stadial age sediments. The work funded by the QRA specifically concentrated on generating robust radiocarbon dates from the sequence.

Figure 1 presents the lithological sequence recovered from Whitrig Bog in 2023, with the position of new ^{14}C dates, organic content, carbonate content, minerogenic content from this study against the C-IT change reported by Birks et al. (1997). The presence of carbonate-rich lake sediments in the Windermere Interstadial and marl in the early Holocene required the careful identification of terrestrial material for radiocarbon dating to avoid recognised issues with radiocarbon ages generated from bulk sediment samples.

Table 1 shows the results of four radiocarbon dates sent for analysis as part of the QRA 14Chrono award. UBA-55420 was unsuccessful in producing sufficient carbon for a radiocarbon determination. UBA-55419 and UBA-55421 produced results that demonstrate the viability of using above ground parts of terrestrial plant macrofossil material, as each of these dates are coherent with the other stratigraphic information (see Table 1 for details). UBA-58568 produced an anomalous result; stratigraphically the age is too young for a sample mid-Loch Lomond Stadial and highlights potential issues with downward intrusion of younger plant material into older sediments.

Combining these new radiocarbon dates with improved tephrostratigraphic resolution within a new Bayesian Age model has been possible for two ages (Table 1). This method shows the importance of using a combined approach for generating highly resolved chronologies of the Late Glacial and provides robust understanding of rapid environmental change during the WI in SE Scotland.

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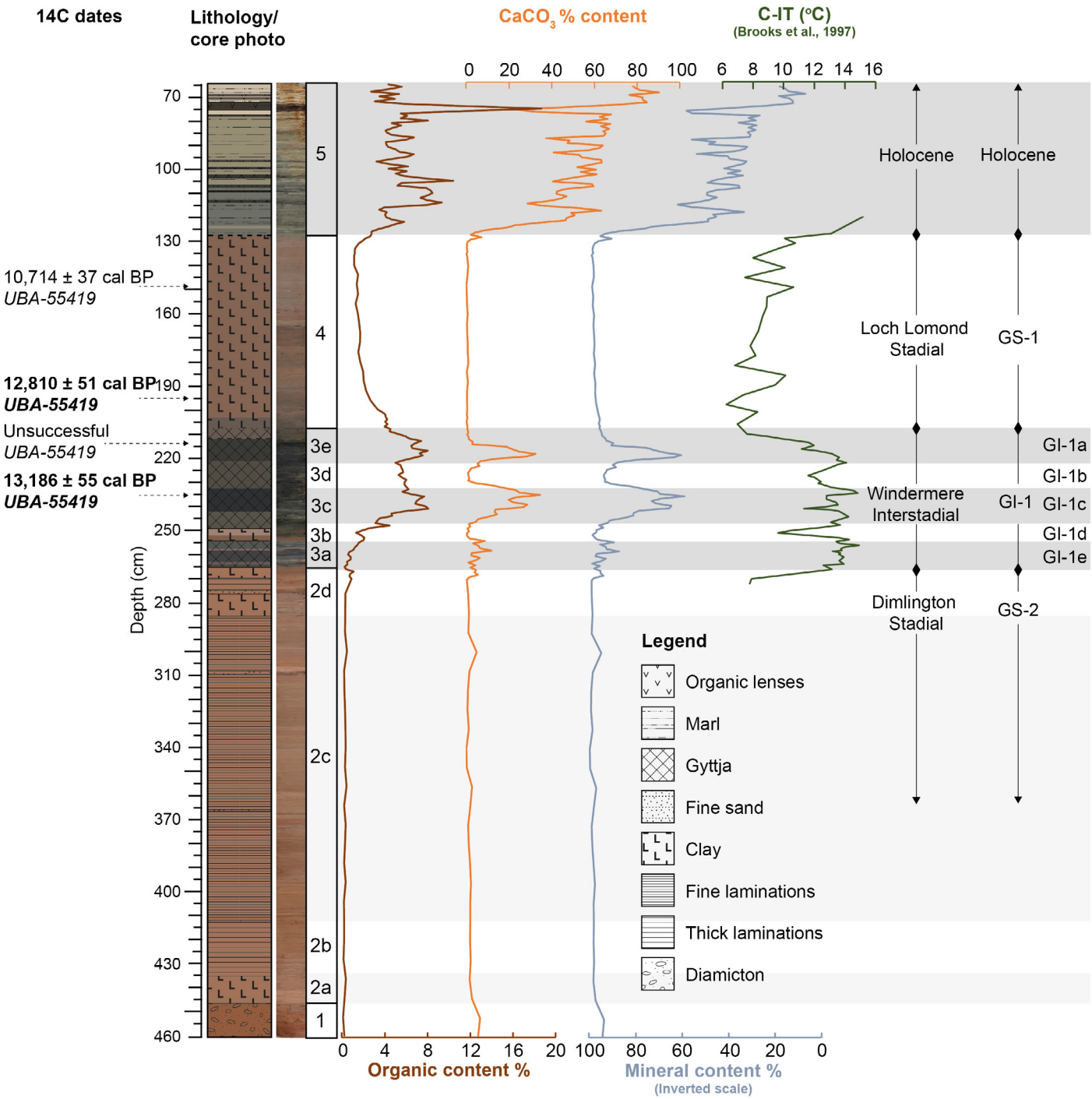

Figure 1. Lithostratigraphy of the WB23 sequence alongside sedimentary properties: organic content, calcium carbonate content and minerogenic content. Scaled Chironomid Inferred Temperature change from work on the Whitrig sequence by Birks et al., (1997). Radiocarbon dates obtained through the 14Chrono award are presented on the left, with the two in bold considered to be reliable and will be utilised in a Lateglacial age model in Beckett et al., (in prep).

Sample code	Sample ID	Material Type	Depth (cm)	^{14}C age	Age cal BP (mean)	Age cal BP (median)	Uncertainty 1σ (95.4)	Stratigraphic position	Accepted for age model (Y/N)
UBA-55419	WB23_191-194	12 x wood fragments, 8 x leaf fragments, 6 x *Ericaceae sp.* Seeds, 2 x *Betula* fruit, 1 x *Poaceae* seed	191 - 194	10,883 ± 55	12,810	12,803	51	Transitional sediments between the WI and LLS	Y
UBA-55420	WB23_214-216	1 x *Harimanella hypnoides* seeds, 9 x *Ericaceae sp.* seeds, 2 x *Betula nana* fruit, 1 x *Betula* fruit, ericaceous wood fragments, wood fragments, 3 x leaf fragments	214 - 216	Failed		Failed	Failed	Mid WI sediments, likely GI-1a to GI-1b positioning	N/A
UBA-55421	WB23_232-235	1 x *Alnus glutinosa* fruit, 8 x *Betula* fruit, 1 x *Betula nana* fruit, 6 x woody fragments, 15 x small leaf fragments cf. *Betula*	232 - 235	11,293 ± 56	13,191	13,186	55	Mid WI, positioning within likely GI-1c expression	Y
UBA-58568	WB23_149-152	4 x *Salix herbacea* budscales, 1 x *Salix sp.* fruit capsule, *Salix* leaf fragments, 4 x undiff. Budscales, seeds (terrestrial)	149 - 152	9473 ± 37	10,746	10,714	37	Mid-late LLS sediments, post Vedde Ash deposition, pre tentative Abernethy Tephra	N

Table 1: Details of the sample content for 4 radiocarbon dates obtained from Whitrig Bog. Each with indication of material identified, stratigraphic justification, and reliability for use in an age model. Calibrated ages have been undertaken using Oxcal v4.4.4 (Bronk Ramsey, 2009) and utilised the IntCal20 curve (Reimer et al., 2020)