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Paired ^{26}Al and ^{10}Be exposure ages from Lundy: new evidence for the extent and timing of Devensian glaciation in the southern British Isles

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ABSTRACT

Lundy lies in a strategic geographical position for understanding the glacial history of the British Isles. The island bears evidence of glaciation, largely in the form of ice-moulded bedrock and glacially-transported boulders – an unusual occurrence this far south in the British Isles. Irish Sea ice penetrated the western Bristol Channel overriding Lundy from the northwest during the last phase of glaciation in this area. The results of paired terrestrial cosmogenic nuclide analyses (^{26}Al/^{10}Be) constrain the timing of this extensive glaciation and provide, for the first time, an age for the exposure of Lundy granite following deglaciation. The results from nine paired samples yield ^{26}Al/^{10}Be exposure ages of 31.4–48.8 ka (^{10}Be) and 31.7–60.0 ka (^{26}Al). This challenges the view that any glaciation this far south must belong to Middle Pleistocene glaciations, such as the Anglian Stage (c. 480–420 ka) and a Devensian age for the last glaciation is consistent with findings from the Isles of Scilly further south. However, the findings suggest early-mid Devensian (marine isotope stage (MIS) 4–3) glaciation of Lundy. It also implies that the island was exposed or covered for a short time by non-erosive cold-based ice at the global Last Glacial Maximum (LGM) during MIS 2 (26–21 ka). The potential exposure of the island throughout MIS 2 contrasts with the evidence from the Isles of Scilly and the Celtic Sea, which were glaciated at the LGM.

1. Introduction

Lundy lies in an important strategic position for understanding the glacial history of the British Isles (Fig. 1). Along with the Isles of Scilly (Scourse, 1991; Hiemstra et al., 2006) Lundy is unique in recording offshore terrestrial evidence of glaciation at the southernmost limits of the Pleistocene glaciation of the British Isles. Mitchell (1968) interpreted smoothed bedrock features in the north of the island as glacial in origin and deep dry valleys in the northeast of the island as glacial meltwater channels. Mitchell also identified a large area of surface gravels composed of numerous erratic clasts on the watershed of the northern part of the island. Mitchell (1968) suggested that Lundy was glaciated by ice from the northwest during both the Anglian cold stage and 'Wolstonian Interval'. Bowen (1994) suggested an even older age – Marine Isotope Stage (MIS) 16 – for the Lundy gravels. although no geochronological evidence was reported. The evidence of glacial features on Lundy combined with the presence of what was originally reported as till in the Barnstaple area has been used to argue that ice was present in Barnstaple Bay during the Pleistocene (Stephens, 1966; Mitchell, 1968; Taylor, 1974). Although subsequently re-interpreted as proglacial lake sediments with dropstones (Croot et al., 1996), the sediments still imply a nearby ice-sheet margin. This evidence has also been used to support claims of ice reaching the Cornish coast to the southwest, such as at Trebetherick (Clarke, 1969), although some of the largest clasts at this site are now thought to been sourced from an inland area near Bodmin Moor (Scourse, 1996, p. 45).

Bowen et al. (2002) used ^{36}Cl to provide exposure ages for glacial landforms around Ireland and demonstrated that the most extensive phase of glaciation in many areas dates from the Early Devensian. A ^{10}Be exposure age of 19.8 ka from an upturned boulder on the Isles of Scilly (McCarroll et al., 2010), at the

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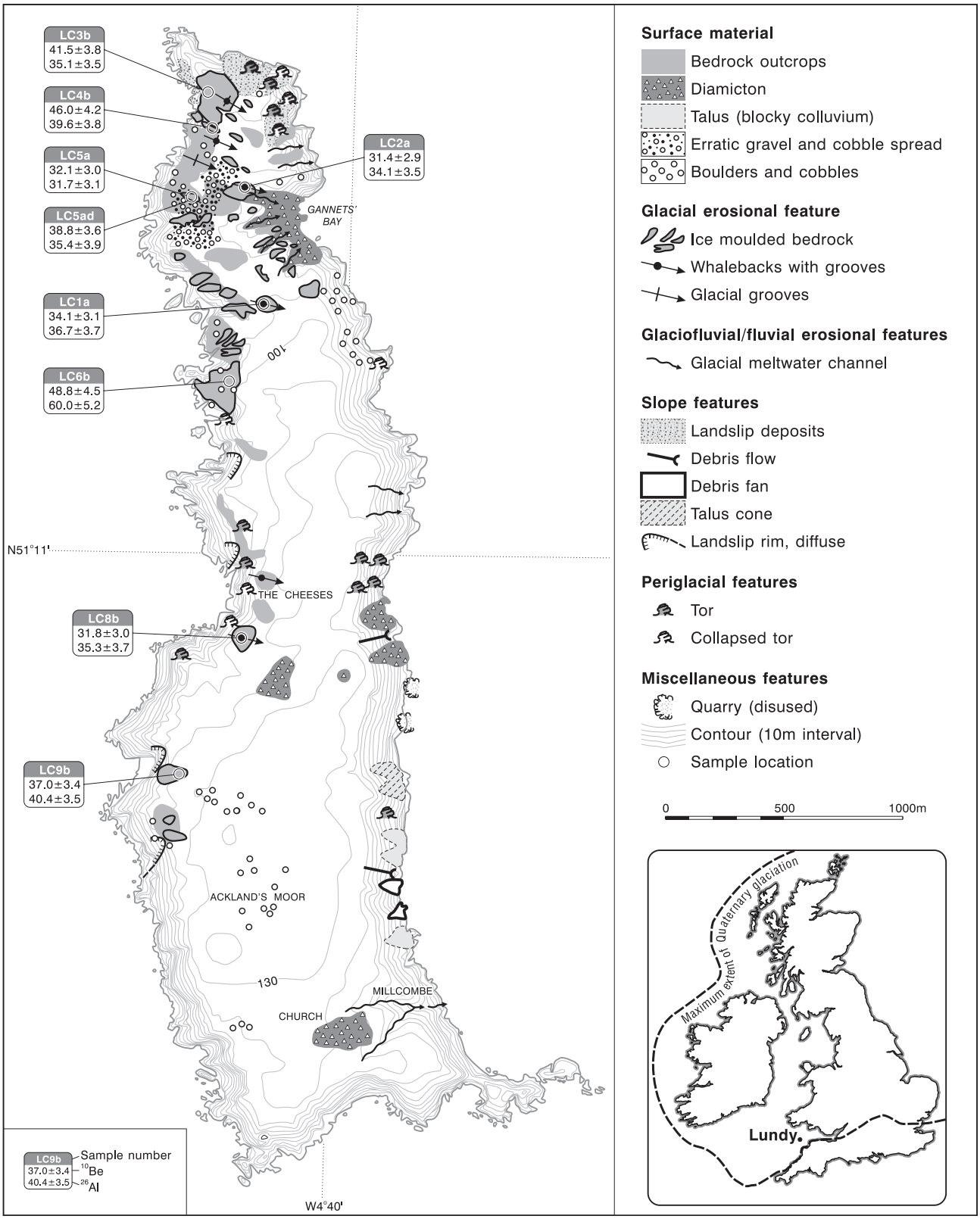

Fig. 1. Geomorphological map of Lundy showing location within the British Isles. Sample locations are illustrated on this map.

southernmost limit of an Irish Sea Ice Stream (ISIS), may suggest a Late Devensian age close to the global Last Glacial Maximum (LGM; 21 ka) a date which is supported by radiocarbon and thermoluminescence dates (Wintle, 1981; Scourse, 1991, 2006). Furthermore, this age for the glacial and related sediments on the Isles of Scilly is independently supported by ice rafted debris of Celtic Sea sources in continental margin cores from the Goban Spur that date to Heinrich Event 2 (Scourse et al., 2000, 2009;