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A critical review and re-investigation of the Pleistocene deposits between Cranfield Point and Kilkeel, Northern Ireland: Implications for regional sea-level models and glacial reconstructions of the northern Irish Sea basin

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ABSTRACT

The coastline of County Down includes sites that are pivotal to understanding the history of the last glaciation of the northern Irish Sea Basin in relation to relative sea level and regional glacial readvances. The cliff sections display evidence that has been used to underpin controversial models of glaciomarine sedimentation in isostatically-depressed basins followed by emergent marine and littoral environments. They also provide crucial evidence claimed to constrain millennial-scale ice sheet oscillations associated with uniquely large and rapid sea-level fluctuations. This paper reviews previous work and reports new findings that generally supports the 'terrestrial' model of glaciation, involving subglacial accretion and deformation of sediment beneath grounded ice. Deep troughs were incised into the till sheet during a post Late Glacial Maximum draw-down of ice into the Irish Sea Basin. Ice retreat was accompanied by glaciomarine accretion of mud in the troughs during a period of high relative sea level. The trough-fills were over-ridden, compacted, deformed and truncated during a glacial re-advance that is correlated with the Clogher Head Readvance. Grounding-line retreat accompanied by rapid subaqueous ice-proximal sedimentation preserved a widespread subglacial stone pavement. Raised beach gravels cap the sequence. The evidence supports an uninterrupted fall in relative sea level from c. 30 m that is consistent with sea level curves predicted by current glacio-isostatic adjustment modelling. Critical evidence previously cited in support of subaerial dissection of the troughs, and hence rapid fall and rise in relative sea level prior to the deposition of the glaciomarine muds, is not justified.

1. Introduction

During the last major glaciation (Middle to Late Midlandian/Devensian) a dynamic ice sheet developed over the central lowlands of Ireland sourced from ice centres positioned over the peripheral mountain massifs (McCabe, 1987; McCabe, 2008; Greenwood and Clark, 2009; Roberson et al., 2016). The onset of glaciation is debated (Bowen et al., 2002; Barth et al., 2016), but judging from radiocarbon-dated organic material beneath till obtained from the Isle of Man, the Irish Sea Basin (ISB) was not glaciated until after 36 ka (Roberts et al., 2007). All of Ireland was covered by ice at the Last Glacial Maximum (LGM) when an ice divide stretched across the northern ISB between Northern Ireland and south-west Scotland (Finlayson et al., 2010, 2014; Ballantyne and Small, 2018) and a vast ice stream flowed through the ISB to reach the Isles of Scilly (Scourse and Furze, 2001: Roberts et al., 2007; Ó Cofaigh and Evans, 2007; Scourse et al., 2009; Chiverrell and Thomas, 2010; Ó Cofaigh et al., 2012; Hughes et al., 2016; Smedley et al., 2017a) and beyond to the continental shelf break beneath the Celtic Sea (Praeg et al., 2015) (Fig. 1). Ice also expanded to the shelf break to the west of Ireland (Peters et al., 2015). There are different interpretations of the timing of the LGM globally, regionally and locally (Clark et al., 2009; Hughes et al., 2013; Lambeck et al., 2014; Hughes and Gibbard, 2015) and different sectors of the last British and Irish Ice Sheet (BIIS) probably reached their maximum extent asynchronously (Clark et al., 2012a; Hughes et al., 2016). A recent estimate of c. 30–27 ka for the Atlantic Shelf

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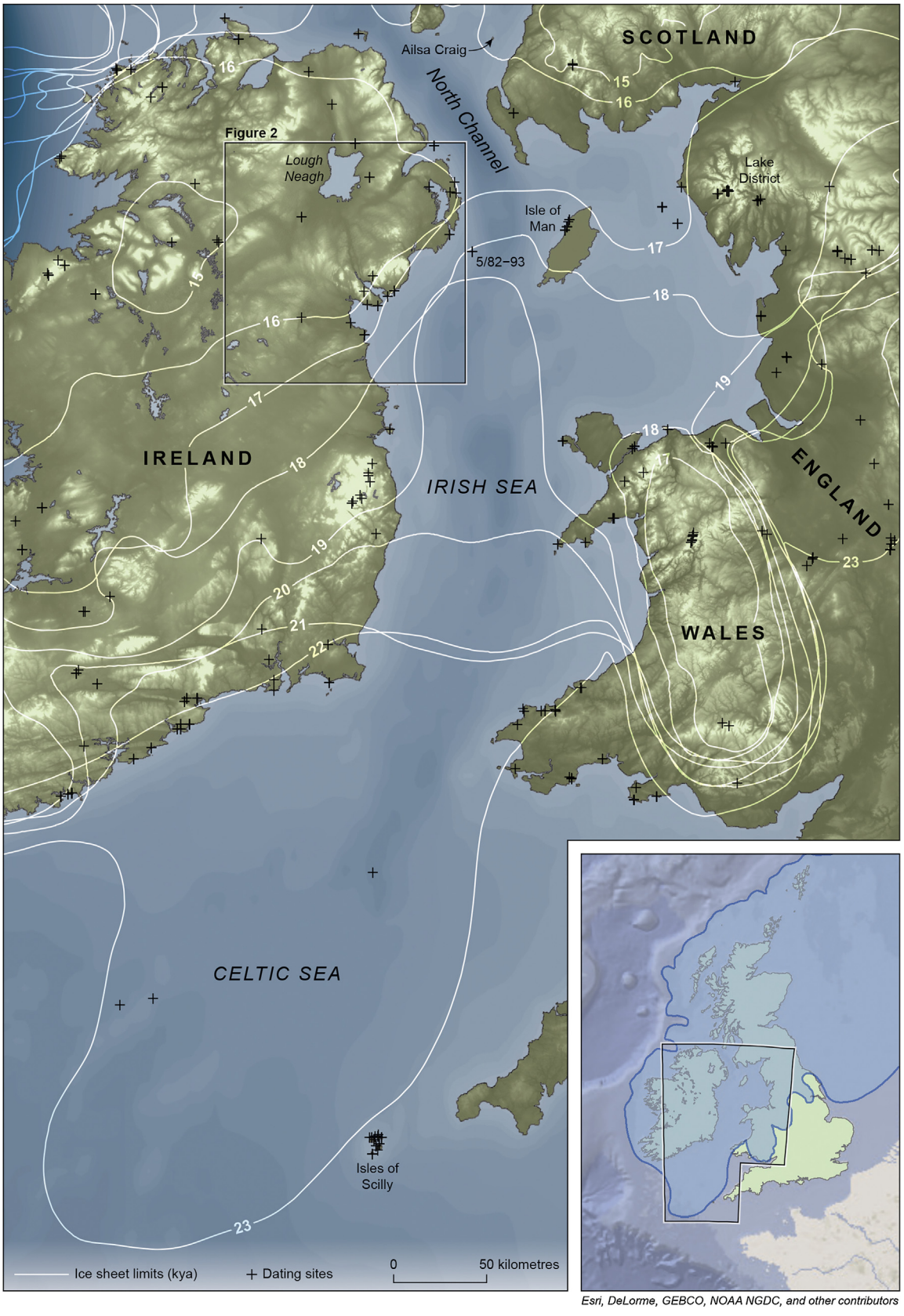

Fig. 1. Median deglacial ice sheet limits around the Irish Sea Basin (after Hughes et al., 2016). Inset: maximum limits of the BIIS at the LGM.