



Reconstructing Younger Dryas plateau icefields in the Tweedsmuir Hills, Southern Uplands, Scotland: Style, dynamics and palaeo-climatic implications

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In Britain, the glacial geomorphological record has been widely utilised to infer palaeo-glacier geometries and ice dynamics, with much of this work focusing on the Scottish Highlands during the Last Glacial Interglacial Transition (LGIT), in particular the Younger Dryas (YD; c. 12.9 – 11.7 ka BP). The Southern Uplands represents the largest upland area south of the Highlands but has received limited research attention over the last century.

The Tweedsmuir Hills are located in the central Southern Uplands, which form an area of dissected plateau approximately 320 km². Early research in the 1800s identified moraines thought to be associated with the YD. However, the majority of previous work has focussed on isolated valleys and ignored the potential for plateau icefield glaciation, which has significant implications for the understanding of ice dynamics and geometries. Recent numerical modelling experiments covering the period 38 - 10.4 ka BP (Hubbard et al., 2008 cf. E109B8 and E102b2) have predicted a significant body of ice for the Southern Uplands at the onset of and throughout the YD, which cannot be verified at present due to a lack of empirical data. This research aims to provide the first systematic geomorphological mapping and Lateglacial climate reconstruction for the Tweedsmuir Hills.

The results of air-photo interpretation and field mapping, which utilised a morphostratigraphic approach, have demonstrated a more extensive glaciation than previously mapped, reflecting more closely the Hubbard et al. (2009) modelled extent than earlier research. This consists of two separate icefields over the southern and northern Tweedsmuir Hills covering an area c. 45 km² and 25 km² respectively with Equilibrium Line Altitudes (ELAs) calculated to have ranged from c.419 m to 634 m. For both icefields ELAs of individual outlets reflect topographic controls rather than steep precipitation gradients similar to those derived for other icefields in Scotland (e.g., the Monadhliath Mountains and Beinn Dearg). New radiocarbon dating of basal contact organics place the ice-mass within the context of the YD but new Cosmogenic Nuclide Analysis (CNA) of bedrock and in situ boulders are inconclusive, implying limited erosion and limited resetting during the YD. Landform evidence also indicates smaller independent glaciers occupied some of the south-easterly catchments until the end of the YD. All of these results differ significantly from the traditional paradigm which suggests that due to low accumulation rates, only restricted ice masses developed in the Tweedsmuir Hills during this time.

References: Hubbard, A. et al., (2009). Dynamic cycles, ice streams and their impact on the extent, chronology and deglaciation of the British–Irish ice sheet. *Quaternary Science Reviews*, (28), 7–8, 758-776