Investigating Glacial Hummocky Terrain using LiDAR and Ground-Penetrating Radar

Catherine Delaney , School of Science and the Environment, Manchester Metropolitan University, c.delaney@mmu.ac.uk
Kathryn Adamson School of Science and the Environment, School of Science and the Environment Manchester Metropolitan University, k.adamson@mmu.ac.uk
Stephen McCarron Department of Geography, Maynooth University, Stephen.mccarron@nuim.ie
Stephen Davis, School of Archaeology, University College Dublin, Stephen.davis@ucd.ie

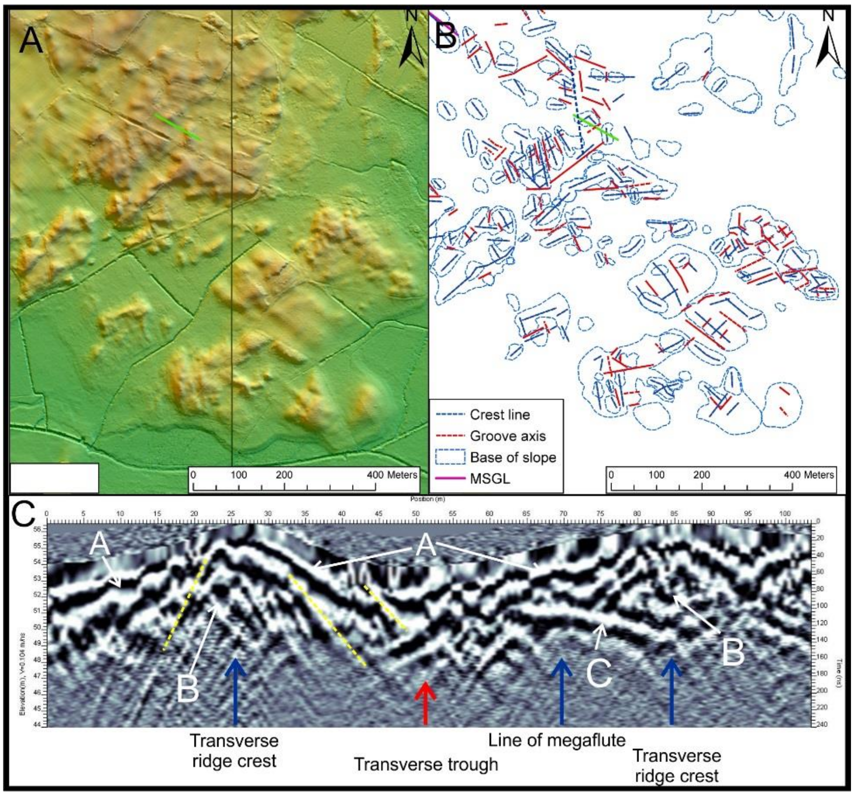
Introduction

Hummocky terrain (HT) dating from the Last Glacial Termination (LGT; 20-15,000BP) is widespread in the Irish Midlands, and is generally assumed to have formed supraglacially along a stagnating ice margin during ice recession. However, detailed investigations of this HT have been not been undertaken. This is a problem because HT can arise due to a variety of glacial dynamics, and has differing morphological expressions depending on conditions during formation.

New high resolution Digital Terrain Models (DTMs) generated from airborne laser survey (ALS, or LIDAR) indicated to us that HT was often controlled, i.e. distinct ridge orientations were discernible. BSG funding has allowed us to undertake GPR surveying and sedimentary logging to examine the sedimentary structure of these features, in order to identify how they were formed. This fieldwork took place in summer 2016; 27 GPR lines totalling 2640m were collected using an EkkoPro and 50mhz sensors to maximise depth of readings, combined with logging of sedimentary exposures and collection of samples for thin section analysis.

Results

Preliminary analysis indicates that HT was generated in at least two different ways:



Type A (Figure 1): the Lidar DTMs indicate that this HT is formed of fragments of megascale glacial lineations (MSGLs) that have been partly eroded and overlain by ridges oriented at an angle to ice flow direction (Figure 1A, 1B). The GPR indicates this HT type is directly underlain by a relatively continuous facies (A on Figure 1C) we interpret as diamicton, based on minor exposures. High angle ridges are cored by a distinct radar facies (B on Figure 1C), indicating they are a constructive feature. The lateral margins are characterised by dipping reflectors that disrupt radar facies A and are interpreted as faults; the downstream margins are steeper than upstream margins. A distinct, near-horizontal reflector at C is interpreted as the buried crestline of an MSGL. We consider Type A HT to have formed as a subglacial continuum associated with a surging ice lobe, with MSGLs formed during accelerated ice flow, followed by ridge formation as sub-marginal crevasse squeeze features formed at cessation of flow.

Type B: this HT is formed from low-sinuosity ridge networks associated with eskers. GPR indicates the occurrence of overlapping packets of horizontal or dipping reflectors interpreted as cross-bedded and horizontally bedded sands and gravel. Ridge margins are marked by steeply dipping reflectors, interpreted as faults, and indicating deposition on buried ice. These sediments are interpreted as conduit or channel fills, deposited either supraglacially or englacially, formed during high energy flood events during deglaciation.

Thanks to BSG funding, we are currently preparing a paper for submission to ESPL, and the data collected will form the basis of future grant applications to examine deglacial landforms associated with a regional readvance across the Irish Midlands.