Active subglacial drumlins at Múlajökull, Iceland

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The drumlin field at the Múlajökull surge-type glacier, Iceland, consists of 142 exposed drumlins, as mapped from a 2013 LiDAR DEM. It is an active field in that partly and fully ice-covered drumlins are being shaped by the current glacier regime. Sedimentological exposures and ground penetrating radar (GPR) profiles show that the drumlins consists of several till units where the youngest till commonly truncates older tills on the drumlin flanks and proximal slope. Along with clast and AMS fabrics, this suggests that the drumlins form by a combination of deposition during surges and erosion in interdrumlin areas and adjacent drumlin flanks during quiescent phases. This implies that the drumlins become more elongate and even migrate down-ice with time. This is suppoted by studies of drumlin morphometry which shows that drumlins are more elongate in parts of the forefield where more surges have occurred. A GPR survey shows that the drumlin field extends under the current ice c. 500 m up from the 2015 ice margin, most likely towards the downglacier-edge of a subglacial over-deepening.

A conceptual model suggests that radial crevasses create spatial heterogeneity in normal stress on the bed so that drainage, sediment transport and deposition is favoured beneath crevasses and erosion in adjacent areas. Consequently, the crevasse pattern of the glacier controls the location of proto-drumlins. A feedback mechanism leads to continued crevassing and increased sedimentation at the location of the proto-drumlins. Drumlin relief and elongation ratio increases as the glacier erodes the sides and drapes a new till over the landform through successive surge cycles.

The Múlajökull drumlin field, with its well-known glaciological conditions, can serve as an analogue to Pleistocene drumlin fields were glaciological conditions could not be observed.