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"STAGNANT-ICE" TOPOGRAPHY AND ITS RELATION TO DRUMLIN GENESIS, WITH REFERENCE TO SOUTH-CENTRAL ULSTER

(Abstract only)

by

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ABSTRACT

Previous work on drumlin genesis considers the problem at the ice-rock interface and ignores the environmental significance of inter-drumlin sediments and superimposed landform associations. Present work by the author examines two drumlin fields in south-central Ulster, Northern Ireland, and proposes a mechanism of drumlin formation which is time-dependent and results from changes of thermal regime through time.

Drumlin exposures in south-central Ulster reveal a particular facies association in drumlin tills showing considerable lithological variation; striae, *roches moutonnées*, and basal lodgement till beneath drumlins indicate an event early in the last glaciation characterized by a temperate thermal regime. This association is overlain by a basal melt-out till, characterized by striated clasts and containing numerous pockets of stratified sediment. The melt-out till is related to changes in provenance of erratics in the till, associated with a shift in the centre of ice accumulation during the course of glaciation.

The stratigraphy suggests that a considerable amount of drift was formed prior to drumlin formation and that a change of thermal state may have characterized the shift in the ice accumulation zone. This change is also suggested by evidence of high-level melt-water transport in the Sperrin Mountains, indicating a sub-polar or sub-temperate thermal regime existing in the early part of the late Weichselian deglaciation.

A model based on thermal convection theory of polar ice sheets (Hughes 1976) is proposed in an attempt to relate the juxtaposition of drumlins and glaciofluvial assemblages in south-central Ulster. In an ice accumulation zone, as characterized this area during the late Weichselian glacial maximum, advection is generally absent and convection is the dominant flow in the ice sheet. In this environment motive ice may develop in the basal zone, resulting from vertical buoyancy stresses acting downward on a column in the ice sheet. This flow environment may coexist within an ice sheet which is "stagnant" and perhaps subject to supraglacial insolation melting, depending on the overall climatic regime. If convection is dominant, it may create areas of basal compression and tension, acting to establish co-existing zones of "hot" and "cold" ice; hot-ice zones are subject to basal erosion, leading to migration of subglacial sediments to points of englacial storage above the density inversion layer. Cold-ice zones act to protect underlying sediments and result in isolation of drift nuclei, protection being afforded by the yield strength of frozen drift being greater than either debris-laden or clean ice.

If the model is tenable, it seems likely that drift nucleation in drumlin fields may have been accomplished before the drumlin formation or streamlining event. Vertical migration of subglacial materials also explains the similarity of sediment sources of glacigenic and glaciofluvial assemblages which occur in juxtaposition, and without reduction in drumlin density. The sequence of events in south-central Ulster may be summarized as follows:

(1) Build-up of ice, associated with sub-drumlin erosion forms and basal lodgement till. Change of thermal regime from temperate to sub-temperate.

(2) Shift in the ice-accumulation zone from highland to lowland, indicated by erratic dispersals of glaciogenic sediments. Change of thermal regime from sub-polar to polar at the late Weichselian glacial maximum.

(3) High-level insolation melting with concomitant basal freezing. Initiation of polygonal array in basal zone. Change of thermal regime from polar to sub-polar or sub-temperate.

(4) Down-wastage of ice and nunatak formation. Formation of high-level melt-water phenomena. Deposition of basal melt-out till. Further development of basal polygonal array. Till nuclei established and englacial sediment isolated. Change of thermal regime from sub-polar to sub-temperate.

(5) Change of thermal state to temperate. Uncoupling of ice from bedrock. Streamlining of till nuclei and reworking of englacial sediment by melt water.

(6) Final disintegration of ice.

REFERENCE

Hughes T J 1976 The theory of thermal convection in polar ice sheets. *Journal of Glaciology* 16(74): 41-71

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