

Glacitectonic and geomorphological evolution of an ice-marginal terminal moraine complex during dynamic retreat

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There is a growing recognition from modern glacial environments that the retreat of an ice margin from its maximum extent is seldom linear. Instead evidence indicates that many modern ice margins exhibit a highly-dynamic pattern of ice-marginal behaviour superimposed upon an overall pattern of retreat. Recognising such ice-marginal complexity within the geological record can be problematic due to the often limited preservation of evidence and the difficulties associated with reconstructing a reliable stratigraphic framework within glaciated terranes. In this study, we utilise detailed structural, sedimentological and geomorphological data to develop a complex retreat model associated with a major advance of the North Sea sector of the Middle Pleistocene British Ice Sheet into eastern England. This 12 stage model identifies multiple ice-marginal oscillations superimposed upon an overall pattern of dynamic retreat and different styles of advance and retreat including possible surging, slow advance, active-retreat and mass-wastage. We also argue that the previously recognised ice limit defined by the famous Cromer Ridge moraine is incorrect and that the maximum ice limit lay considerably further to the south with the landform simply recording a still-stand. Critically, we suggest that changes in ice-marginal behavior can be recognised by the type of glacitectonic structure and geomorphological landforms displayed within the geological record which are driven by the degree of ice-substrate coupling. Collectively, these highlight the significance of substrate rheology, drainage and water availability in sub-marginal and proglacial areas as critically in controlling ice-marginal processes and dynamics.