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Thermo-mechanical facies representative of fast and slow flowing ice sheets based on the Weichselian ice sheet in Poland

Izabela Szuman-Kalita (1), Marek Ewertowski (2,1), and Leszek Kasprzak (1)

(1) Faculty of Geographical and Geological Sciences, Adam Mickiewicz University, Poznan, Poland (szuman@amu.edu.pl),
(2) Department of Geography, Durham University, Durham, United Kingdom

Ice streams are characterised by varied flow rates arising from subglacial conditions, especially from thermo-mechanical and related hydrological properties at the ice/bed interface. Those conditions play a crucial role in the dynamics of ice sheets. The effect of subglacial processes is recorded within subglacial landforms and sediments. The geomorphological impact of subglacial processes is well-known in the literaturę, but there is still a lack of sedimentary criteria for identifying former ice sheet thermal or dynamic regimes of ice sheets and glaciers.

This study deals with an issue of thermo-mechanical facies, reflecting specific thermal and mechanical properties of the subglacial environment. The main objective of this study was to develop a model of glacitectionic deformation and its sedimentary record beneath fast and slow flowing ice sheets, based on investigations conducted in Wielkopolska (west central Poland). Sedimentary structures, mainly at the contact between subglacial tills and glacifluvial sediments, were recognized to delineate typical facies associations in a Weichselian glacigenic succession. Each association was interpreted as a record of the different depositional environments related to different subglacial conditions. Those investigations suggest the substratum was composed of frozen and dry, and wet and mobile spots, and four thermomechanical facies were distinguished: A – is representative of slower ice flow, dry and cold subglacial conditions, where driving stresses and normal effective pressure were high; B – is also related to slow ice flow and occurrence of cold subglacial permafrost, but with little amount of unfrozen water (however, higher than in facies A), with similar physical characteristics of the ice sheet as facies A; thermomechanical facies C and D represent wet and warm ice sole, with low normal effective pressure and driving stresses, thus lowering sediments' shear strength and enabling high ice-flow velocities. We suggest that these facies have specific and non-random location, thereby revealing the relationship between subglacial thermo-mechanical conditions and ice sheet dynamics. Slow moving, cold-based ice occurred along ice sheet margins and inter-stream areas, whereas fast-moving, warm-based, welllubricated ice, was typical of the axial parts of ice streams.