

## THE ICE-CONTACT ENVIRONMENT OF THE KUTNO MORAINES NEAR SŁAWOSZEW, NORTH-CENTRAL POLAND

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A commonly occurring feature of most glaciogenic convex forms of the Wartanian (late Saalian, MIS 6) in Central Poland is the internal structure formed mainly by accumulation of meltwater with a slight share of direct glacial accumulation. Sedimentation structures originated in this way are characterised by a great variety, which indicates a considerable diversity of features of sedimentation basins – variability of their conditions both in time and space. This is superimposed with the occurrence of deformation structures. Additionally, the fact that they are not remains of the most recent (Vistulian) but the penultimate glaciation increases the interpretation difficulties owing to transformations of the relief taking place for more than 130 thousand years: since the end of the Wartanian until the present day. It is the so called old moraine landscape (orig. “krajobraz staroglacjalny“).

This richness of internal structure in glaciogenic forms of Central Poland has been the cause of a lively discussion on the genesis of many of them. Many convex forms, initially interpreted as typical end moraines, were identified in later research as kames or other forms related to areal deglaciation (among others: Klatkova 1972, Klajnert 1978, Rdzany 2009). In the event of the association of forms near Sławoszew, referred to as the Kutno Moraines (Lencewicz 1927), no detailed analyses of its internal structure have been conducted to date (except for geological charting), none of the oldest views on their end-moraine genesis have been verified and it became the primary aim of these studies.

Results of the conducted geomorphologic research (analysis of hypsometry, slope gradients etc.), particularly the clear asymmetry of slopes (with the southern slope being more steep) can indicate – in accordance with classical views on glacial relief (Klimaszewski 1978) – that these forms originated as a result of accumulation processes at the ice sheet front. Besides, the relief lacks elements which might indicate a connection with the most recent glaciation. However, its maximum extent is not far away – the distance of roughly 20-25 km. Analyses of the structures may indicate a contact of the northern slope with the active margin of the ice lobe, but the deformations are minor and few. The existing outcrops, especially those located in the three operating open-pit mines, allowed for lithofacial analysis to be conducted, which provided evidence for accumulative genesis of the studied forms. Therefore, there are no grounds for defining them as push moraines. They also reveal no features characteristic of kames (Baraniecka 1969).

A great abundance of sediment texture types was identified – from fine glaciolacustrine sediments to megaclasts (of up to even 2 m in diameter) – related to high energy water transport and movements of masses in the zone of close contact with the ice sheet front. Lithofacial analysis indicates a predominance of accumulation characteristic of outwash fans with a slight content of channel transport in the conditions of free fluvial flows. However, some flows were hyperconcentrated, while others were of debris flow type. A great lithofacial diversity may indicate irregular character of ice sheet melting, without a clearly ordered ablation rhythm. Besides, the geologic structure of the deeper substratum features no

indications whatsoever as to the formation of these end moraines in strict dependency on the sub-Quaternary and sub-Cainozoic bedrock.

Currently, the research results, despite allowing for significant conclusions to be drawn, still contain a number of issues which require explanation, therefore the research will be continued.

Keywords: old moraine landscape, end moraine, Kutno Plain, hyperconcentrated flow, debris flow

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# Geomorfologický sborník 16

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