



## **Glaciohydraulic supercooling under the last Scandinavian Ice Sheet: geomorphic and sedimentary imprints from northern Poland**

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Some geomorphic and sedimentological traces of possible glaciohydraulic supercooling have been found in one of the highly elevated morainic upland on Polish Lowlands. The Lubawa Upland is located some distance to the north of the last Scandinavian Ice Sheet maximum extent in northern Poland. The area is a conspicuous morainic elevation rising up to 200 m above the adjacent morainic plateaus. Distinct and varied glacial landscape of this region is characterized by the occurrence of numerous glacial meltwater channels intersecting the study area. Analyses the ice margin profiles vs. ice bed topography together with sedimentological studies at field outcrop indicate the possible conducive conditions for glaciohydraulic supercooling under the last Scandinavian Ice Sheet in this region.

Spatial distribution of glacial meltwater channels (subglacial and ice-marginal systems) and fabric measurements in glacial deposits suggest consistent NW-SE directions of the last ice sheet movement over the Lubawa Upland. On the basis of the orientation of ice-marginal channels and the location of subglacial channels mouths, the extents of four stationary phases of the last ice sheet, subsequent to the LGM of this region, have been mapped. Analyzing the geological maps and borehole dataset of the study area a reconstruction of the approximate ice bed topography of the last ice sheet was conducted. In order to do so, the elevations of upper surfaces of the youngest (i.e. the uppermost) till layers from each profile have been interpolated throughout the study area. Moreover, the ice margin slope profiles were calculated for each four stationary limits using empirical formula of Orowan with appropriate topographic corrections.

The results show clearly that the highest part of the Lubawa Upland was a conspicuous bump under the last Scandinavian Ice Sheet, which probably overrode a significant obstacle in this region. The analyses of the relation between ice margin slope and ice bed topography suggest that during one of the interpreted stationary phases (when the edge of the ice sheet was located near the highest elevation of the area) conditions facilitating glaciohydraulic supercooling could occur. Along the subglacial channels dissecting elevation, adverse slope of the ice base exceeds the ice surface slope about 2 times, what could result in freezing of the subglacial meltwater when it has flowed up. Additionally, series of a basal melt-out till with numerous sandy intercalations found at the field site near this locality, may support the supercooling process and formation of a thick debris-rich basal ice layers at a proximal side of the Lubawa Upland.