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Types of glacial outburst flood outlets differentiated by englacial feeding systems at the end of the Weichselian glaciation (NE Poland)

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Rapid climate changes during the Late Weichselian glaciation caused a sudden increase in meltwater activity and significantly transformed land relief. This transformation was accompanied by the supply of considerable quantities of meltwaters in glacial lakes in the southern periphery of the Scandinavian ice sheet. Their sudden release was responsible for the development of the Megaflood Landform System in north-eastern Poland which includes floodwater flow pathways represented by the Western and Eastern Spillways (Weckwerth et al., 2019). In the proximal part of the Western Spillway, the Bachanowo and Szeszupka Outburst Fans developed, while scabland-like topography was formed at the front of the Prudziszki Gate in proximal part of the Eastern Spillway. Bachanowo and Szeszupka Outburst Fans have surface characterized by the existence of subsequent bedforms, which include (1) streamlined bars developed as downstream elongated ridges and separated by channels of the braiding pattern, (2) scours with channel lag sediments deposited from traction carpet and gravel bedload sheets, (3) scour infills originated due to hydraulic jumps, and (4) expansion bars or chute bars evolved during the waning flood stage. These bars consist of sheet-like beds dipping downstream, and were formed due to low-angle forests progradation under condition of pulsed deposition from the traction carpet and fast sheetflows, the energy of which gradually decreased. As a common, an openwork texture was observed in sedimentary successions of all recognized features.

The bottom of proximal part of the Eastern Spillway at the front of Prudziszki Gate is characterised by butte-and-basin topography with landforms representing different types of bedforms typical for high-energy supercritical outflow. These include longitudinal furrows, transverse furrows, potholes, furrows of different shape, kettle holes and associate obstacle marks including lateral and frontal scours (Weckwerth et al., 2022). Transverse furrows are oriented perpendicular to the floodwater outflow and compose longitudinal clusters separated by ridges. Sedimentary successions of these ridges reflect a clear deposition cyclicity related to reactivated upstream progradation of scour infills and sedimentation on downflow-side of hydraulic jump.

The outburst fans and their characteristic bedforms were formed at the mouth of deep subglacial tunnel valleys, while the scabland-like topography developed at the mouth of flat-bottomed subglacial valleys which were transformed into open ice-walled canyons. The bedforms typical for outburst fans and the scabland-like topography consist of similar facies deposited due to flood

outbursts emanating from two different englacial systems, but these facies form different associations related with changeable riverbed morphology transformed under condition of the upper flow regime.

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