

Formation of selected eskers and related forms of the old glacial area of the Polish Lowland in the light of geomorphological and sedimentological research

The main goal of the work is to determine the course of formation of eskers and related forms in the old glacial area of the Polish Lowland. The research, undertaken in the years 2015–2020, was designed to verify the basic hypothesis: Eskers of the old glacial area of Poland are characterised by exceptional morphological, sedimentological and palaeogeographic distinctiveness in the inventory of glacial forms. An important motivation for starting the research was the fact that until now there has been no research into eskers formed on non-consolidated substratum conducted in such a vast area. International literature is dominated by results of research into eskers formed on consolidated substratum.

Field research was conducted in 7 test areas which included the selected eskers. Sediments were subjected to lithofacial and lithogenetic analysis, as well as analysis of grain size distribution, shape and rounding of gravel clasts. The flow dynamics was reconstructed on the basis of palaeohydraulic analysis. Morphological analysis was performed for eskers charted on the basis of the *Detailed geological map of Poland* and topographic maps. In order to verify the genesis, geologic data were analysed.

The majority of eskers of the old glacial area is characterised by a length of more than 3 km, width between 100 and 300 m, elongation factor of more than 5, low bendiness (< 1.2), fragmentation (mostly from 2 to 5 sections) and orientation compatible with the direction of ice-sheet advance (NNW–SSE and NNE–SSW). Morphological features of eskers allow for the following form types to be distinguished: 1 – continuous, visibly bending ridges (1a – short, 1b – long), 2 – multi-sectional, long ridges (2a – visibly bending, 2b – straight), 3 – straight, continuous, broad ridges, 4 – esker systems, 5 – short, individual, slight bendiness. In eskers and their related forms, we can distinguish sediments originated in 4 sub-environments: subglacial tunnel, narrow ice-walled crevasse, ice-open channel and broad glacial crevasse. Numerous common lithological features were identified in the analysed eskers such as: dominance of gravelly lithofacies, including Gm, Gt, GSt and Gp, fining up of sediments towards the top of the profile, presence of openwork texture, common occurrence of imbrication, strong orientation of gravel clasts, pseudo-anticlinal configuration of strata in the so-called core, presence of intraclasts and pebbles, and local deformations – mainly gravity and density related.

The formation of many eskers was significantly influenced by flood events, which are responsible for the accumulation of most sediments. Eskers of the old glacial area are often complex and originated in several stages: 1 – formation of a subglacial tunnel valley, 2 – start of accumulation related to modified geometry of the channel or forced by the presence of obstacles in the bottom of the valley, 3 – accumulation along long sections under hydrostatic pressure, 4 – accumulation in the narrow ice-walled crevasse, 5 – accumulation in an ice-open glacial channel, 6 – accumulation between blocks of dead ice and formation of complex and intermediate forms. The main stage of sedimentation was in the period of ice-sheet decay, during the stage of stagnation and transition to dead ice.

Eskers of the old glacial area of Poland reveal shared morphological features. They are characterised by sedimentological coherence and similar sequence of sedimentation sub-environments, which allow for them to be distinguished from other landforms. Their formation started in active ice and continued until the advanced deglaciation stage, whose course conditioned their morphological and sedimentological features to a considerable degree.