Geophysical Research Abstracts
Vol. 17, EGU2015-1091, 2015
EGU General Assembly 2015

Dynamics of the Zemgale Lobe of the Scandinavian Ice Sheet reconstructed from the subglacial landform record

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Deglacial ice dynamics were inferred from the distribution, morphometry and sedimentology of subglacial bedforms such as drumlins, mega-flutes, mega-scale glacial lineations (MSGL), ribbed moraines, from meltwater features such as subglacial channels and eskers, and ice-marginal landforms, which were identified and mapped from the topographical maps and digital elevation models. The Zemgale Lobe operated in the area of the Central Latvian and Lithuanian Lowlands, and it was characterized by the fast ice flow that was sustained by a combination of subglacial deformation and basal sliding. The mosaic ice-bed deformation model is favoured due to observed sediment structures indicating ice/bed coupling and decoupling episodes. The landform record indicates on two major reactivations of the Zemgale Lobe during the overall deglaciation of the Late Weichselian Scandinavian Ice Sheet and may imply surge-type behaviour. The coexistence of subglacial bedform assemblage and overlapping of their morphometry demonstrates subglacial bedform continuum.

A significant number of prominent esker chains are distinguished proximally from the marginal ridges of the North Lithuanian deglacial phase with an average spacing of 10 – 15 km. Some of eskers are found within subglacial channels recording change in meltwater discharge. The cores of the many eskers consist of coarse deposits – gravels, cobbles and boulders indicating episodes of high-energy and hyper-concentrated flow conditions.

Ribbed moraines are superimposed on streamlined subglacial features, thereby indicating a shift of subglacial conditions, which promoted the shutdown of the SE part of the Zemgale Lobe. The presence of ribbed moraines on the Zemgale Lobe bed proves that they are distributed not only at the central parts of ice sheets but also outside the core areas. The structure or ribbed moraines is glaciotectonically deformed, and comprises multiple units of diamicton and sorted sediments, which formed by repeated subglacial thrusting. These overthrusts formed at the migrating zone or patches of warm/cold based ice.

The cores of studied drumlins are composed of sorted sediments capped by subglacial till. Some of the cores are heavily deformed, while the others are deformed only in the topmost part of drumlin. The formation of the drumlins consisting of un-deformed cores probably occurred by the vertical erosion of a deforming till layer into pre-existing sediments. They subsequently acted as an obstacle around which till was deposited and deformed.