

Continental glaciation and conditions for the formation of exaration relief on the territory of the Baltic shield

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Abstract. The hypothesis about the absence of a powerful multi-kilometer ice sheet on the territory of the Baltic Shield is discussed. It is believed that in the Quaternary period, the glacier plowed up powerful strata of crystalline rocks on the shield and spread their boulders for thousands of kilometers. The article analyzes the arguments of supporters of the concept of continental glaciations. Modern studies have shown that the bottom layers of glaciers do not participate in the general movement of ice masses, and there are no moraine layers at their base. As for the exaration relief, "curly rocks", "sheep's foreheads", fiords, lake basins, finite moraine ridges, etc., their origin is associated with neotectonic processes, large vertical and horizontal movements of blocks of crystalline rocks, shallow and large scale scaly thrust faults.

Keywords. Baltic shield, glaciation, exaration relief, scaly thrust faults.

Introduction

In the middle of the century before last, a group of naturalist scientists (J. Charpentier, L. Agassiz and others), in an attempt to substantiate the reasons for the accumulation of boulders of crystalline rocks on the plains of Europe, put forward a hypothesis of powerful continental glaciation in the Quaternary period in northern Europe, Asia and America. The works of the German geologists A. Penck and E. Brueckner on the alpine ice sheets and "moraine formations" of the r. Danube - formed the basis for the periodization of the ice ages: gunz, almond, riss, wurm. Subsequently, the supporters of this hypothesis (O. Torrell, A. Geiki and others) argued that the glaciers of Scandinavia actively formed the so-called exaration relief, plowing lake basins, deep fjords, furrowed and polished "sheep's foreheads", "curly rocks" and other "glacial" landforms. Since then, the number of publications based on the glacial hypothesis has amounted to many thousands.

However, in parallel, the greatest naturalists C. Darwin, C. Lyayel, R. Murchison, A. Keyserling put forward a drift theory of the formation of boulder accumulations in the Northern

Hemisphere due to the spread of boulders by floating ice during transgressions of sea basins. During the war, Professor I.G. Pidoplichko, as part of the active army, examined all the known "glacial" deposits in the Alps. In his works, he argued that all these glacial constructions of German scientists and their followers are deeply mistaken and based on self-hypnosis and a kind of mass hypnosis. In the 50-60s, many domestic geologists (A.I. Popov, I.D. Danilov, R.B. Krapivner, P.P. Generalov, etc.) came to the conclusion that the northern territories of Europe and Siberia were not exposed, and thick strata of boulder loam accumulated as a result of transportation of boulder material by icebergs and fast ice floes. In the scientific world on the issues of continental glaciation of Western Siberia and the European North, two points of view coexist - glacial and "marine". However, the "exaration relief" of Scandinavia and Canada until recently was considered indisputable proof of the inviolability of the main prostates of the glacial theory.

Postulates of the glacial theory and the results of drilling out modern ice sheets

University and academic scientists, united in scientific and glacial schools, constantly refer to the ice sheets of Antarctica and Greenland, which, in their opinion, did a great job of transforming the ancient surface of platforms and crystalline shields. It is believed that the very existence of these mighty glaciers testifies to the inviolability and fidelity of the glacial doctrine, and that in the Quaternary period, such glaciers plowed up and carried away from the Baltic shield strata of crystalline rocks up to 200 m thick and carried rocks and boulders of bedrock for thousands of kilometers, dragged huge rejects hundreds of kilometers.

However, to date, the dynamics and patterns of movement of ice sheets throughout their section have been studied by the works of glaciologists, geologists, drillers and geophysicists. The results of the through - to the basement, drilling out of the ice of Antarctica and Greenland, obtained under international projects, are of unique importance. It turned out that instead of strata of moraine-containing ice, completely filled with huge blocks and boulders (which is usually depicted in diagrams and figures in textbooks on general and Quaternary geology), only inclusions of sandy-loamy and fine-earth matter are recorded in the continental ice. Even in the bottom parts of glaciers - where it is customary to place a powerful bottom moraine filled with huge blocks and iron-like boulders (for example, in the schemes of V.M. Kotlyakov and N.V. Koronovsky), only small lenses and clots of clay and sandy loam matter, and rare sandy grains are recorded. These mineral inclusions are mainly represented by volcanic ash, aeolian dust of distant deserts, rare inclusions of fine-earth terrigenous matter, as well as spores and pollen. Glaciologists also found that the bottom layers of ice of the cover glaciers (according to the canons of glacial theory and must do all the geological work) do not participate in the general movement of ice masses, they lie in place as a dead weight for hundreds of thousands of years, protecting the underlying rocks from denudation. Moreover, the

cover ice preserves large paleotectonic lakes, with their relict, very ancient water, and protects them from the notorious glacial plowing out.

Origin and mechanism of formation of textbook-exaration relief. Based on almost fifty years of geological work in the Kola-Karelian region, V.G. Chuvardinsky resolutely opposes the generally accepted doctrine of enormous ice ages, the cover glaciers of which, plowing the bedrock of the glacier bed, moved huge boulders and kilometer-long rock outcrops and moved southward, covering Europe and North America with ice sheets up to 3 km thick. In his works [1,2,3,] he analyzes the arguments of the supporters of the concept of continental glaciers, which ascribes the role of an active relief-forming factor to the powerful glaciers rapidly advancing on Europe.

Glaciological studies on the continental glaciers of Antarctica and Greenland have shown that the bottom layers of ice are practically motionless, and they do not produce any “plowing out” of the glacier bed - all movements in the glaciers occur higher as a result of viscous-fluid sliding of packets of ice plates along intraglacial cleavages. The bed of mountain-valley glaciers keeps the primary rock surface, soil layers and even the grass cover completely intact under the moving ice masses. And the bed of the Greenland and Antarctic huge glaciers is generally mothballed for hundreds of thousands of years, and kilometer thick ice calmly glides over this bed without affecting it. The modern researcher of the glaciers of Antarctica D.Yu. Bolshiyarov concludes: "... Cover-type glaciers are not able to actively transform the continental bed."



Fig. 1. Tectonic formation of "sheep's foreheads" in granodiorites, in the process of neotectonic growth of granite domes.

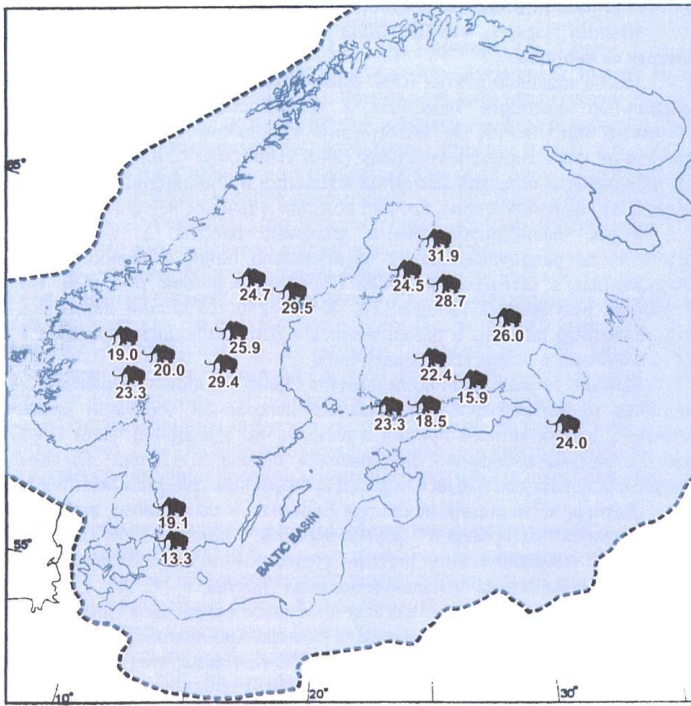


Fig. 2. Locations of fossil remains of mammoths in Fennoscandia during the last (Würm) ice sheet (age 26000-10000 years).

As for the exaration relief, "curly rocks", "sheep's foreheads", fiords, lake basins, finite moraine ridges, etc., V.G. Chuvardinsky connects all these formations with neotectonic processes, vertical and horizontal movements of rocks, small- and large-scale scaly thrust faults (Fig. 1).

The materials of the 2014 Geological Meeting in Lund (Sweden) devoted to the problem of glaciation in Scandinavia are presented in the last article by D.Yu. Bolshiyanova (Bolshiyanov, 2015). The final communiqué says: "... The latest geographic, geological and botanical studies indicate the absence of a continuous ice sheet on the Scandinavian Peninsula during the last glacial maximum. Instead of ice sheets, small ice domes developed in these territories, which could not actively mechanically influence the ice bed".

New literary data on paleontology, paleobotany and Quaternary climatology cast doubt on the presence of powerful continental glaciation even in the citadel of the adherents of the glacial theory - in Scandinavia. Numerous publications point to permanent finds of mammoth remains where, according to the glacier theory, the thickness of the ice in the wurm reached 4 km (Fig. 2).

Numerous Würm radiocarbon dates of mammoth remains (26-11 thousand years) indicate the comfortable living conditions of these voracious animals in the valleys of the rivers of Finland and Norway overgrown with lush vegetation. Modern studies show that the climate of Scandinavia in wurm was colder and more continental than the modern climate, but on the whole is close to the

modern climate of Siberia, and forest-tundra steppes with permafrost in the basement and lush vegetation in river valleys occupied vast territories in Europe, including Scandinavia.

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