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**ПРОБЛЕМЫ ОЛЕДЕНЕНИЯ ЗАПАДНОГО ЯМАЛА ЗА ПОСЛЕДНИЕ 50
ТЫСЯЧ ЛЕТ**

**PROBLEMS OF GLACIATION OF WESTERN YAMAL
IN THE LAST 50 THOUSAND YEARS**

АННОТАЦИЯ. В данной статье ставится задача рассмотреть и охарактеризовать две теории развития территории Западного Ямала. В результате подробного анализа и изучения гипотез таких ученых как В.И. Астахов, А.А. Васильев и т.д., сделан вывод, что, несмотря на хорошую изученность взятого нами района, тема оледенения остается открытой для вопросов. Опираясь только на теорию, невозможно дать точного ответа, какая из теорий верна и почему.

ABSTRACT. This paper considers investigating two theories of glaciation of Western Yamal. As a result of a detailed study of the theory of such scholars as V.I. Astakhov, A.A. Vasiliev and etc., we come to the conclusion that despite being well-examined, the theme of glaciations of the western part of Yamal remains open for

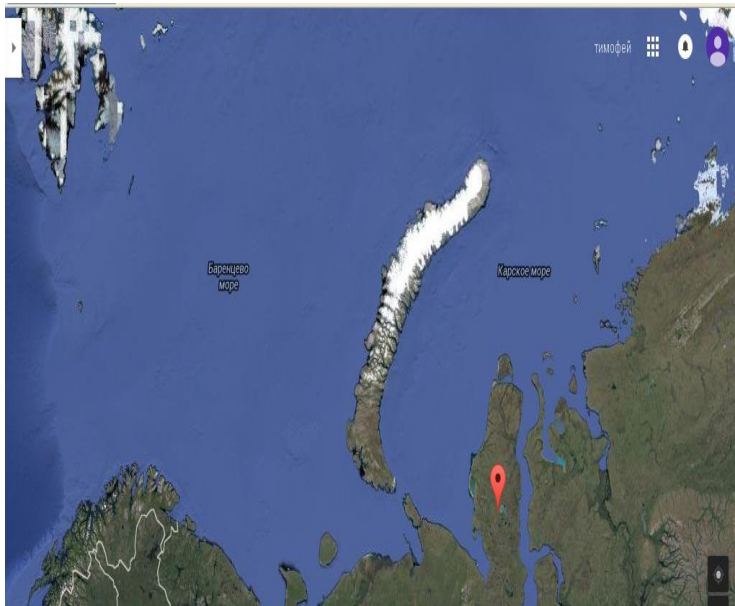
future discussions. Having based only on the permafrost theories, it is impossible to make a clear choice between the existing ones.

КЛЮЧЕВЫЕ СЛОВА: криогенный, четвертичные отложения, супесь, эоловые отложения, флювиогляциальные отложения, морская трансгрессия (также трансгрессия моря), степень эродированности почв.

KEY WORDS: cryogenic, overburden, sandy loams, aeolian deposits, drift deposit, marine transgression, soil erosion.

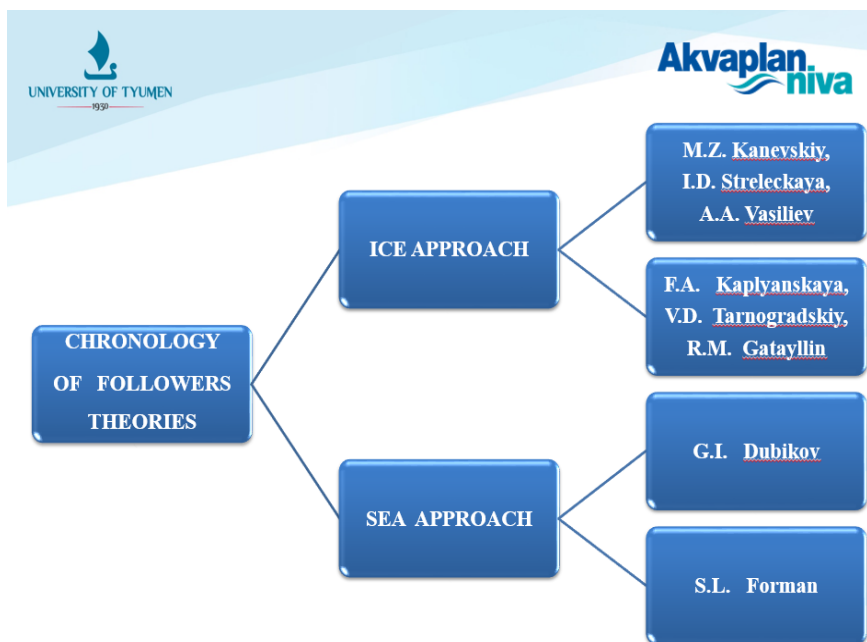
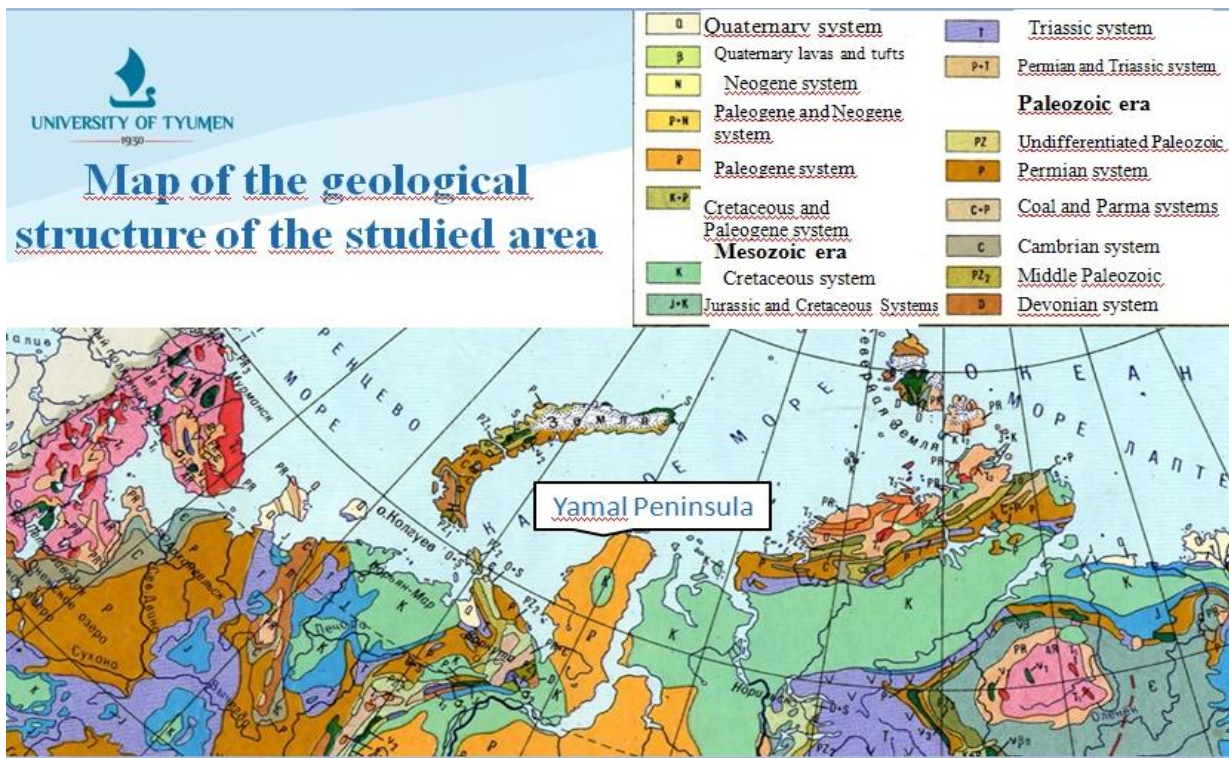
The topicality and urgency of the topic comes from the fact that the issue of glaciation of Western Yamal remains controversial. The existing hypotheses on the origin of the Arctic peninsulas vary, which explains the existence of diametrically different points of view on issues of dynamics and conditions of formation and existence of glaciation in the north of Western Siberia, which is undoubtedly of interest in the conditions of the strong anthropogenic impact on the territory taking place nowadays.

The object under analysis is located in the Russian Federation and is geographically positioned between 68°-71°N and 67°-73°E in the north of Western Siberia. The peninsula has an elongated shape (reaching 700 km in length and up to 240 km in width). The harsh climate of the territory can be explained by the influence of the waters of the Kara Sea and those of the Gulf of Ob. The peninsula's landscapes are essentially represented by tundra and forest-tundra areas found in the south. Numerous lakes of various origins are typical to the territory. The peninsula has so far been only marginally cultivated. The main activities of the indigenous population are reindeer herding and fishing. The geological exploration has shown that very large deposits of natural gas are located in the south and west of the peninsula. As of 2009, proven gas reserves amounted to 16 trillion cubic metres.



The territory of Western Yamal is a geologically young formation. The last marine transgression here ended about 100.000 years ago, which was successively followed by the lagoon and continental stages of development. Quaternary sediments are underlain by marine greenish types of clay of the Late Cretaceous .

At the base of the Yamal lies the Epipaleozoic platform that has Mesozoic sedimentary cover on its top. Prominences in the crystalline basement have not been observed.



Currently, two approaches to the Quaternary history of the Yamal Peninsula development and in particular its west coast exist, namely the sea and the ice approaches. According to the sea approach, in the Quaternary, a greater part of its territory was occupied by the sea, which gradually receded starting from the late Pleistocene time. It is known that the main constituent of the geological structure of the Yamal Peninsula and in particular its western part is the Quaternary marine

sediments, which determine the terrain of sea terraces at different levels. Continental sediments (of lake-alluvial, swamp, aeolian origin) have lesser importance and were formed at the stage of the surface raising above sea level.

Coastal sediments possess a 2-tiered structure. The leading role in their formation was played by the sea and the lagoon-sea sediments of the Late Marre-Sale suite. On top of their eroded surface lies a stratum of continental sand deposits (Nenets suite), often peated-off from the surface.



During the addition of the territory of Yamal had two points of view on the historical development of the territory of the LS Forman and his colleagues detailed geological - geomorphological research in the area of Marre Sale , found no traces of glaciation during the last 50 thousand years

Formation ice at the bottom of the coastal cliff has not been found, the ice goes down below the sea level. Heavy isotope composition of the ice and the ratio of hydrogen and oxygen isotopes point to the sea origin of the water source.

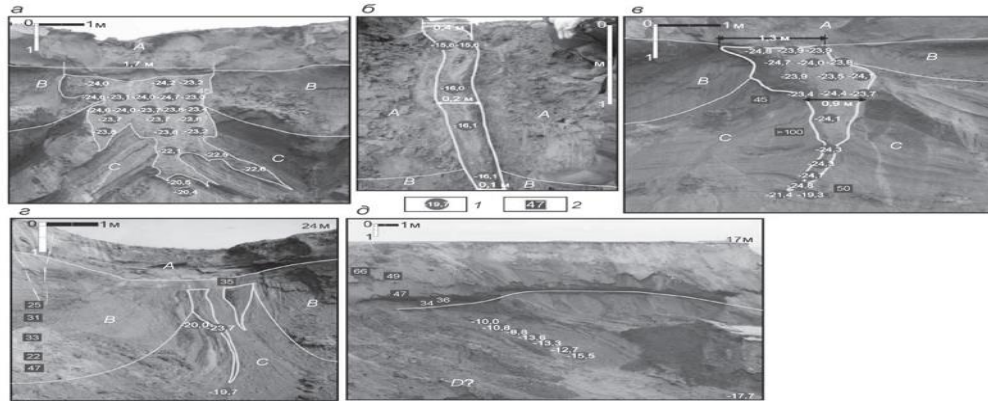
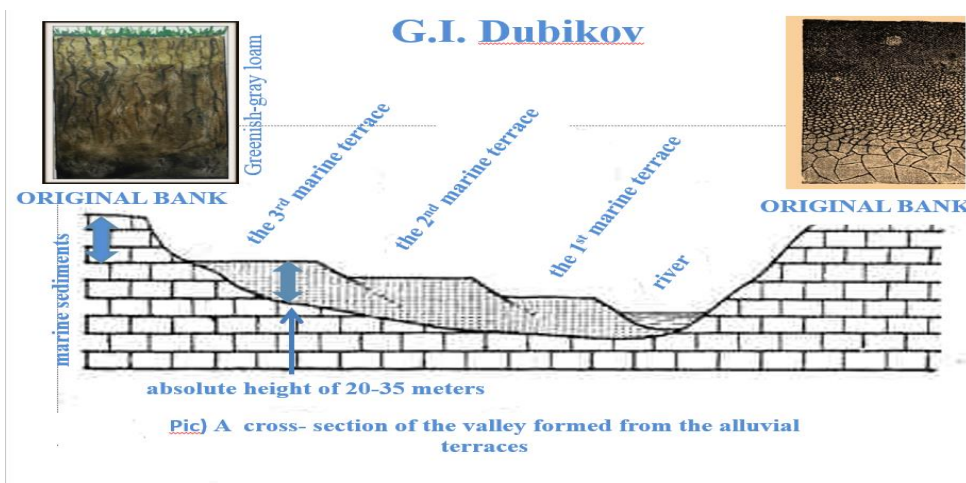


Рис. 4. Схема опробования и результаты изотопно-кислородного анализа полигонально-жильных (а – Ms1, б – Ms2, в – Ms3, г – Ms5) и пластовых (д – Ms7) льдов.
 1 – место опробования и количество изотопов кислорода в пробе из льда, ‰; 2 – суммарная влажность отложений, ‰
 Fig. 4. The sampling points and the results of oxygen isotope analysis of ice-wedges (а – Ms1, б – Ms2, в – Ms3, г – Ms5) and massive ground ice (д – Ms7).
 1 – The sampling points and value of oxygen isotopes in samples of ice, ‰; 2 – the total moisture sediments, ‰

In geomorphology, the territory of Western Yamal is made of the 3rd - and 2nd - type marine terraces. 3rd-type deposits on the coast of marine terraces occupy surfaces with an absolute height of 20-35 meters and are represented by interbedded dark gray and greenish-gray loams, more rarely clay, silty sands and sandy loams with an overall prevalence in the bottom section of loamy material. It is believed that the thickness of sediments of the 3rd terrace is less than 25 meters, so that the basis of its sections with marks higher than 25 meters is made of marine sediments of more than 100 thousand years of age.



As it has been shown by the studies of cryogenic structure, composition and properties of Quaternary sediments at the site of Western Yamal Kara Sea coast in the area of the polar station Marre-Sale spanning around 6.5 km, in the sections of coastal cliffs reaching 20-30 meters in height, two major complexes of Quaternary deposits developed: the upper one is made of continental sandy-loam deposits and the lower one is represented by marine and coastal-marine saline clay deposits. Within these complexes, depending on the cryogenic structure and the freezing conditions, different types of deposits are found, whereby data describing their iciness have been obtained.



I share the viewpoint proposed by V.I. Astakhov and his colleagues, according to which the process of freezing of the western part of the Yamal Peninsula could only have taken place during the Holocene, between 100,000 and 20,000 years ago, starting from the time when the last ice bridge had been formed (see Figure).

The glaciation of Siberia proceeded in the north-south direction, and, therefore, could have captured the north-western part of the Yamal Peninsula. This can be explained by the fact that during 80,000 years (i.e. in the late and middle Quaternary period, during the formation of the material processed by a glacier at the top of the Quaternary sediments and overlying sand deposits, the ice bridge could have moved

closer to the western part of Yamal, which would confirm the presence of glaciers in the area.



Despite being well-researched, the theme of glaciations of the western part of Yamal remains open to questions. Basing on the academic work of permafrost experts only, it is impossible to make a clear choice between the existing theories, which necessitates further research.

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