CHARACTER OF THE COASTAL DESTRUCTION AND DYNAMICS OF THE YUGORSKY PENINSULA COAST

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The coastal zone of Yugorsky peninsula is represented by a hilly plain, gradually lowering from Pai-Khoi ridge to the Kara sea. The western portion of the coast is characterized by rocky cliffs. Starting at Pervaya Peschanaya river (7 km east of Amderma town) eastward terraced surfaces are built of Quaternary sandy-clayey deposits. Coastal bluffs have a binomial geological structure: clayey deposits are overlain by sandy sequences. An important element of the geological structure of the study area is tabular ground ice. Some sections enclose two ice layers. A coastal section of ca. 36 km length is considered in this study. At least 7 sites 0.2 to 1 km long have tabular ground ice exposures within specific forms of coastal destruction – thermodenudational cirques. Ice wedges are less common and play a minor role in coastal evolution.

The key site in the central part of Yugorsky peninsula represents the hilly plain with heights of 35-55 m above sea level, with sandy-clayey deposits enclosing two layers of tabular ground ice. Coastal bluffs have a relative height from 12 up to 29 m, thermocirque scarps are up to 32 m high. Coasts are of erosion-thermodenudation type, wave-erosion niches are not formed. Numerous ravines and gullies are formed at the terrace edges. Sandy-clayey material is transported through the canyon-like ravines and loaded on a rather narrow beach, forming sandy-silty fans. These fans are wave-eroded. They are washed away most actively by the storm surges. This material is involved in alongshore drift directed west-to-east.

The development of thermocirques in the coastal zone increases the volume of erosion per meter of a shoreline due to a concentrated sediment flux through a narrow exit. The fans formed on the beach at the thermocirque "mouth" are, as a rule, built of clayey deposits. Compared with sandy deposits, the clays are washed away slower. The catchment of thermocirques is larger, the scarps are curved and thus longer than the shoreline for the smooth-faced bluffs. The thawing of tabular ice results in material flows and overlying blocks collapse. Lateral thermoerosion develops in the bottom of thermocirques providing channels for mudflows along the frozen base, carrying suspended matter derived from the ice and enclosing deposits.

In the course of three field trips in 1999, 2001 and 2002, the structure of the coastal zone was under study at Shpindler Urochishche: 69°43′ N and 62°42′ E (Cherkashov et al. 1999). In 2001 a comprehensive topographical survey was undertaken in joint effort with VNIIOceangeology Institute at a key site 2 km west of Khubtyakha-river estuary, and a monitoring network established at a thermocirque scarp edge. In 2002 the first measurement was made and the change in the contour of the edge and its retreat were determined (Fig.1). The retreat was irregular through the edge and ranged from 30 up to 325 cm. The average retreat for a 256 m long scarp edge was 1,6 m. The summer of 2002 was cool and started late, therefore measurements conducted in mid-August did not give maximum retreat values per year because the process was on-going until September.

The dynamics of long-term thermocirque growth was revealed based on comparisons of the field survey of modern outlines of a thermocirque scarp edge and the interpretation of aerial photographs of 1947, scale 1:60000. The most actively retreating scarp in the years 1947 to 2001 was analyzed and retreat rate determined to be 0.6-1 m/yr, while the coastal bluff retreated at 1.3-1.6 m/yr.

The topographic survey allowed to compile a digital model of the relief in SURFER software which gave an instrument to reconstruct the topography of the area prior to thermocirque formation and calculate the sediment input from the thermocirque during 54 years. The sediment input from the thermocirques normalized to the shoreline appeared to be approximately 3 times as high as from the smooth-faced coastal bluffs. Thus, active thermocirques provide the significant contribution to the sediment discharge into the frontshore zone though locally.

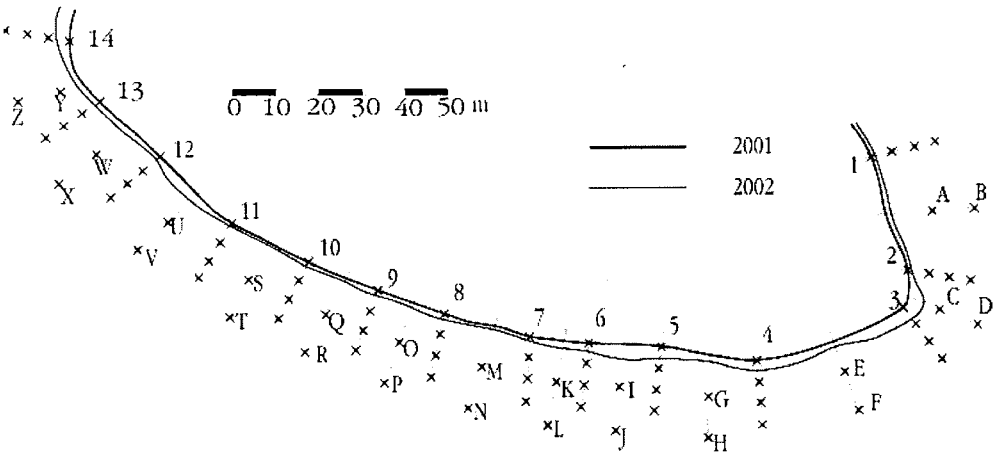

Figure 1. Scheme of the thermocirque scarp retreat in 2001-2002, key site «Shpindler».

To compare the coasts of different type, a rather low terrace of clayey and icy deposits was considered. The interviewing of the local inhabitants allowed to conclude, that the shoreline there retreated for the last decades with a rate of about 3 m/yr. Therefore in 2002 another observation network was established to monitor the coast of 10-12 m height. The stakes cover 110 m of the coastal bluff.

As a whole, Yugorsky coast represents a combination of sites with smooth-faced bluffs retreating practically parallel to themselves, and sites with thermocirques, where the scarp edge invades deep into the land by 200-400 m from the backshore. In the second type of coasts, the zone of mutual influence of the sea and land is considerably increased, the complex of thermodenudation processes and sediment discharge becomes complicated. Out of 36 km of considered coast, river estuaries cover 1 km, thermocirques about 2 km, and smooth-faced bluffs cover 33 km.

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Reference

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