Coastal Erosion Monitoring At The Barents And Kara Seas

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The development of Russian sea coasts and shelves for natural gas mining requires construction of sea ports, approach channels, artificial islands, drilling platforms, terminals, ground-surface and underwater pipelines. Knowledge of natural processes, particularly coastal dynamics is necessary for geotechnical and geoecological safety of the facilities' construction and operation. Natural geomorphic processes set the rules of oil and gas resources development in offshore and coastal areas in the Arctic. The coastal zone here is highly dynamic due to the contact with the cryolithozone. The coasts of Barents and Kara Seas which are composed of dispersive frozen deposits have poor erosion resistance qualities. In natural conditions such coasts may retreat with a rate of 0.5 to 2 m a year. Considering eventual human impact and forecasted climatic change, coastal retreat rate may significantly increase in the coming years. Technogenic disturbances activate trigger mechanisms of wave-induced coastal erosion. Under the conditions of global warming and ice cover reduce this effect is enhanced by the increase of the duration of the dynamic activity period and wave fetch. As a result, local human impact and climate change form synergetic effect due to which coastal retreat rates can double and even triple. We are presenting here three examples for Barents and Kara Seas where human impact has already brought in negative effects. To determine the speed of coastal retreat and shore zone profile deformations, approximately 120 benchmarks have been established at the Varandey (Barents Sea) and Kharasavey (Kara Sea) industrial key areas, as well as at the gas pipeline underwater crossing of the Baydarata Bay (Kara Sea) in the 80-90s of the XX century for coastal dynamics monitoring. The benchmarks were attributed to the Baltic-77 (Russian) system of heights. Coastal dynamics monitoring from constant benchmarks is executed by direct measurements and by trigonometric leveling. An additional method of receiving an overview of multiannual coastal dynamics is studying multi-temporal aerial and satellite images of high and extra-high definition. One of the examples is Varandey Coast of the Barents Sea. From 1979 to 2012 a deliberate destruction of the dune chain of a barrier beach by vehicle traffic and beach material removal for construction needs led to quick intensification of the coastal retreat here. And now, storm surges penetrate inland for

several kilometers without hindrance. We also present data from a key area further east to the Kara Sea: the Kharasavey Coast of the Yamal Peninsula. Large-scale extraction of sediments from the coastal slope has resulted in a depletion of the material on the beaches and triggered violent thermoabrasion of the coast in 1982-1985 and 2006-2008. The third example of the negative impact of human activity has been documented at the sites underwater pipeline crossing on both coasts of the Baydaratskaya Bay, Kara Sea. Designers and builders have not taken into account the negative experience of unsustainable management and sediment removal observed at Varandey and Kharasavey industrial areas. The construction of the pipeline, accompanied by the use of many technical devices and sediment removal from the beach and tide-flat, during the period from 2007 to 2012 led to significant increase in the rate of coastal erosion. A truly responsible decision making towards the strategy of developing the northern coasts of Russia and constructing new facilities has to be based on integrated knowledge of the ongoing environmental processes, in particular coastal dynamics. The ignoring of this issue may cause irreversible damage to both the coastal geosystems and the facilities themselves, which, once they are destructed, may drag in enormous environmental implication.