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Morphometric Parameters of Stamukhas in the Laptev Sea

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The article presents the results of an analysis of the expedition data on morphometry and internal structure of stamukhas, investigated in spring 2017 in the southwestern part of the Laptev Sea. Using a thermal drilling method, researchers obtained average and extreme values of all measured parameters and made an approximation by theoretical distribution functions. Analysis of sonar and tachometric survey data shows the average values of stamukha volume/mass to be more than five times greater than the average values of ice ridge volume/mass. The maximum duration of the recorded stamukhas' drift was thirty days.

INTRODUCTION

Stamukhas are grounded hummocked ice features (WMO, 2014). They present typical forms of immobile ice in the shallow offshore area of the Arctic ice-covered seas. Stamukhas are located in the coastal areas of the ice-covered seas at depths of 20–25 m. One distinguishes both large, separate stamukhas and chains consisting of several stamukhas. Being natural anchors, stamukhas influence the stability of landfast ice and the structure of the ice drift field, since ice floes are destroyed or change drift direction when they come into collision with stamukhas.

In the winter-spring period, stamukhas floating in the shipping routes are high-risk sites for ships and icebreakers, especially when visibility is poor. At the time of significant surge and tidal fluctuations of sea level in spring-summer, stamukhas can possibly float up to the surface and start drifting. Having a larger mass than ice ridges, stamukhas can influence the offshore structures, which makes it necessary to take them into account when calculating the ice loads (Alekseev et al., 2001). In addition, in the wintertime, influenced by the tidal currents, stamukhas can move over insignificant distances, but gouging the seabed at the same time. These negative phenomena should be taken into account in the design and pipe-laying over the seabed of shallow water areas of the seas.

In the 20th century, observations of stamukhi were mainly made during the airborne ice reconnaissance flights, when stamukhi's number and coordinates were recorded and the draft of stamukhi was indirectly determined from the navigation charts. Generalization of aviation observations in the Russian Arctic Seas was made in Mironov et al. (2012). Only in the 1990s–2000s, when environmental studies began in the local regions for exploration of hydrocarbon fields on the shelf of the Russian Arctic Seas, did special expedition activities begin to investigate ice ridges and stamukhi (Zubakin, 2006). Similar studies were carried out on the shelf of the Sea of Okhotsk (Astafyev et al., 1997; Surkov et al., 2002).

Complex studies of morphometric parameters and internal structure of ice ridges and stamukhi in the Laptev Sea were carried out only in 2015–2017 by AARI specialists commissioned by the Rosneft Oil Company (Pashali et al., 2018). The aim of this article is to analyze the data of the morphometric characteristics of stamukhi, obtained on the basis of improved technology of thermal drilling and by means of tachometric and sonar surveys in the southwestern area of the Laptev Sea, during maximum ice cover development in 2017. During this period, 16 stamukhi and 24 ice ridges were surveyed. Analysis and generalization of such a large volume of fill-scale data allow us to hope that we can reveal new regularities and extend the current scientific understanding of the role of physical processes, determining the formation of stamukhi and their difference from ice ridges.

SPREADING OF STAMUKHI IN THE LAPTEV SEA

Historical data on the spreading of stamukhi were obtained from materials of airborne ice reconnaissance, which was regularly performed in the Laptev Sea from the beginning of the 1950s to 1991 (Mironov et al., 2012). The entire southern part of the Laptev Sea is shallow in general, but nevertheless, the seabed relief here is quite variable. In the southwestern and especially southeastern parts of the sea, there are numerous banks with depths less than 10 m. Small depths and variable seabed relief contribute to the generation of stamukhi, which form at intensive ice ridging and drift of ice ridges, at the condition of seabed tilting with subsequent jamming of brash ice to the bottom. In the southeastern part of the sea, stamukhi are mainly formed of young and first-year ice, which occurs first of all on banks. The

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KEY WORDS: Stamukha, ice ridge, morphometric parameters, Laptev Sea.