

Peculiarities of the Structure and Properties of Ice Ridges in the Eastern Barents Sea Based on the 2003 Expedition Data

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Based on the field research carried out in May 2003 in the eastern part of the Barents Sea, we examined the ensemble of characteristics of 2-year-old ice hummocks, as well as the main features distinguishing them from the annual hummocks of the Barents Sea and other areas of the Arctic regions. Second-year ice floes, on which the ice testing work was carried out, have been found in the immediate proximity of the Shtokman gas condensate deposit. Their occurrence in this area is considered an abnormal phenomenon, caused by the Barents Sea's receiving residual and 2-year-old ice from the northeastern Kara Sea in the winter of 2002–03.

INTRODUCTION

In May 2003, in the course of conducting the expedition's ice studies onboard the R/V *Mikhail Somov* in the eastern Barents Sea—to be more exact, in the area of the Shtokman gas condensate field (SGCF)—between 74° and 76 °N, inclusions of second-year ice were detected and investigated. Detection of second-year ice in the SGCF area was not unexpected, as specialists on satellite monitoring warned about its occurrence at these latitudes before the start of the expedition. Second-year ice is exported to the Barents Sea from the northern area of the Arctic Basin (through the Shilling Strait) and from the northeastern area (from the Arctic Basin and northeastern Kara Sea, through the Makarov Strait). Because it is considered typical of the northern areas of the Barents Sea (USSR Seas Project, 1990), its appearance in the SGCF region was an anomalous phenomenon. The source of second-year ice inclusions was the residual and second-year ice of the northeastern Kara Sea being exported through the Makarov Strait during the entire winter of 2002–03 (Figs. 1 and 2).

The ice studies carried out in the spring of 2003 were comprehensive in character and included studies of the morphometry, internal structure and physical-mechanical properties of level ice and ice ridges. Based on field data, this article considers an ensemble of characteristics of second-year ice ridges, as well as some typical features distinguishing them from first-year ice ridges in the Barents Sea and the other Arctic regions. The studies of ice ridge morphometry were made from the air (using aerial photography), from the ice surface (geodetic topographic survey and mechanical drilling of ice ridges), and from underwater (underwater sonar surveys and also divers' photo and video surveys of the lower ice ridge surface). Investigation of the internal structure of ice ridges was performed in the course of drilling and coring (determination of the consolidation of ice fragments, study of ice texture and crystalline structure). The core samples from the ice ridges were used for determining the physical-mechanical ice properties in ridges (temperature, salinity, density, and compressive and flexural ice strength measurements).

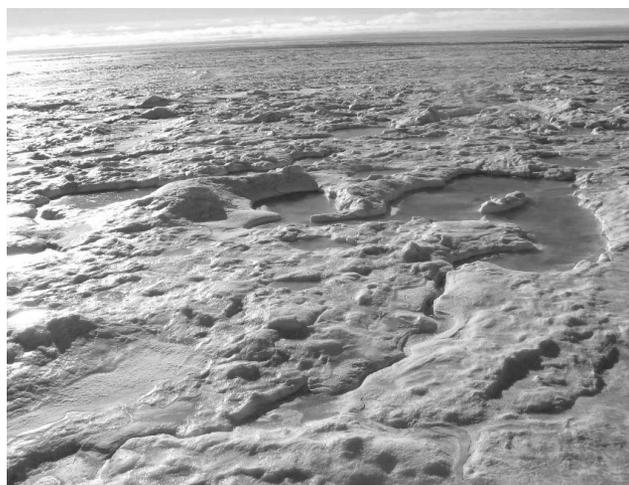


Fig. 1 September photo of residual ice in northeastern Kara Sea, one of second-year ice sources in Barents Sea

Inclusions of second-year ice and conglomerations of first-year ice fragments resulted from repeated ridging of second-year (residual) and first-year ice. In the course of operations in the SGCF region, such ice ridges were observed practically at every ice station. The contact studies of ice ridge properties, including drilling, core sampling and determination of physical-mechanical properties, were conducted as a rule on the largest ridged features. As a result, second-year inclusions were detected in each of 20 ice ridges surveyed during the expedition. This accounts for the fact that most of the characteristics and properties of ice ridges determined during the expedition in 2003 differed from the properties of first-year ice ridges investigated earlier in this and other regions of the Barents Sea (Naumov et al., 2003; Gudoshnikov et al., 2003; Stepanov and Kubyshekin, 2003; Stepanov et al., 2002).

MORPHOMETRY OF ICE RIDGES

A distinguishing feature of ice ridges investigated during the 2003 expedition was a pronounced difference in the character of their upper and lower surfaces. The sails of ice ridges had comparatively small sizes. Their shape and structure were similar to typical first-year ridges that have not undergone summer melting and smoothing. At the sail surface, one could easily distinguish the separate grey-white and white ice blocks comprising it. In

Received July 14, 2004; revised manuscript received by the editors December 9, 2004. The original version (prior to the final revised manuscript) was presented at the Sixth (2004) ISOPE Pacific/Asia Offshore Mechanics Symposium (ISOPE PACOMS-2004), Vladivostok, Russia, September 12–16, 2004.

KEY WORDS: Barents Sea, hummocks, ice.