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SHORT COMMUNICATION

# Live autochthonous benthic diatoms on the lower depths of Arctic continental shelf. Preliminary results

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**Summary** An autochthonous community of benthic diatoms was discovered in June 2015 in the upper sediment layer at depths of 170, 205, and 245 m in the central Barents Sea. At least three benthic microalgae species (*Gyrosigma fasciola*, *Pleurosigma angulatum*, and *Pleurosigma* sp. 1) were detected in the sediment but not the upper water column. Analyses revealed that these benthic microalgae represent a depleted fragment of Arctic littoral microphytobenthos. Compared with the littoral flora, the deep-water assemblage is less diverse and displays low abundance. The data reported here challenge the generally accepted belief that the presence of certain microalgae at significant depths results from vertical or horizontal transfer.
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Microphytobenthos, together with phytoplankton and ice algae, are important components of the primary production potential in Arctic marine ecosystems. The importance of benthic microalgae in the littoral and sublittoral coastal zones is well established (Cahoon and Laws, 1993). However, the entire current database of microphytobenthic production in Arctic waters comprises only 10 published studies, according to which the benthic production in Arctic coastal waters exceeds the pelagic production by a factor of ca. 1.5 (reviewed in Glud et al., 2009, see Fig. 1). An overview study conducted by Cahoon (1999) directly indicated that there is substantial underestimation of the benthic microalgal contribution to the productivity of marine ecosystems, especially for oligotrophic (including Arctic) waters. This underestimation results from the narrowness of the generally accepted approach to such investigations, which are often conducted at sites that presuppose the presence of the object under investigation. Consequently, an important unresolved issue is the depth distribution of benthic microalgae. According to the common point of view, sustainable

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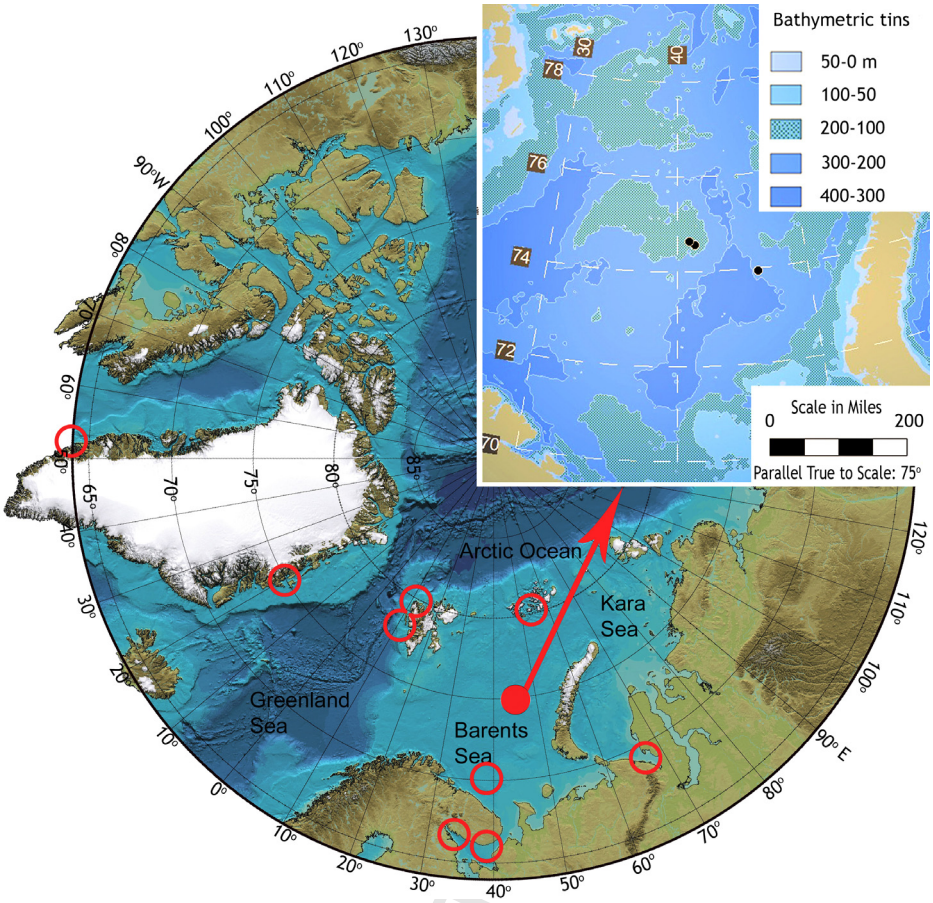


**Figure 1** Locations of sampling stations in the Barents Sea, June 2015 (filled red dot). The figure of Arctic region is modified from Glud et al. (2009).

existence of algal communities is governed by the availability of photosynthetically active radiation and in aquatic habitats is limited by the compensation depth (i.e. the depth at which the energy of incoming light balances the metabolic costs), which constitutes the first tens of meters for continental shelf seas and 100—300 m for oceanic water areas (Raymont, 1980). The zone of the World Ocean below 200 m is considered to be free of floral organisms (Kiselev, 1969). However, there have been several studies indicating the presence of living microalgae at depths below 100 m (Cahoon, 1999), e.g. chlorophyll-*a* was reported from sediments of the continental shelf at depths down to 222 m (Cahoon et al., 1990; Cahoon and Cooke, 1992), and even to 2000 m (Cahoon et al., 1994), indicating that benthic microalgae may exist at significant depths. However, this hypothesis has not been verified, as previous investigations were conducted using indirect and/or calculation methods (Karsten et al., 2011). Although such data extend the lower distribution limits of live benthic microalgae, the lack of direct observations renders the conclusions questionable. We have found only one previous study in which indirect measurements of the biomass of deep-sea benthic microalgae using chlorophyll-*a* values were directly verified. In October 2003 in Onslow Bay, McGee et al. (2008) collected sediment samples at depths of 67—191 m and discovered 11 species of live benthic diatoms by direct microscopy. Moreover, that study indicated and substantiated an autochthonous origin for the species found.

The objective of this study was to investigate the surface sediments of the Barents Sea Continental Shelf to determine whether microphytobenthic assemblages are present at depth.

The study was conducted on the Central Plateau of the Barents Sea (Fig. 1) during a cruise by the Murmansk Marine Biological Institute on board the r/v *Dalnie Zelentsy* in June 2015. Samples were obtained at three stations (74.56°N, 41.41°E, depth 205 m; 74.64°N, 40.96°E, depth 174 m; 73.94°N, 46.15°E, depth 245 m) at a distance of 130—240 miles from the nearest shore.

The sediment consisted of red mud with some inequigranular sand. The depth of photic zone (45—75 m) was determined as 3 times the Secchi depth for case 2 water (Abakumov, 1983; Jerlov, 1968).

A Van Veen grab device was used to collect sediment from the surface layer in triplicate. Each subsample (ca. 30 ml volume and 1 cm depth) was obtained from a separate sediment sample. All three subsamples, taken from one station, were placed together into one sample cup (total volume ca. 100 ml) and preserved in 40% formaldehyde (final concentration of 2%). Water samples were gathered with a bathometer ("Hidro-bios", 5l) from the surface water layer, the pycnocline (30 m), the intermediate layer (100 and 120 m water depths), and the near-bottom layer, and by a small-meshed plankton net with a mesh size of 29 μm × 29 μm from the 150—50 m water layer.

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