Towards the understanding of the distribution of microplastic particles in the ice cores

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FATE AND IMPACTS OF MICROPLASTICS: KNOWLEDGE AND RESPONSIBILITIES

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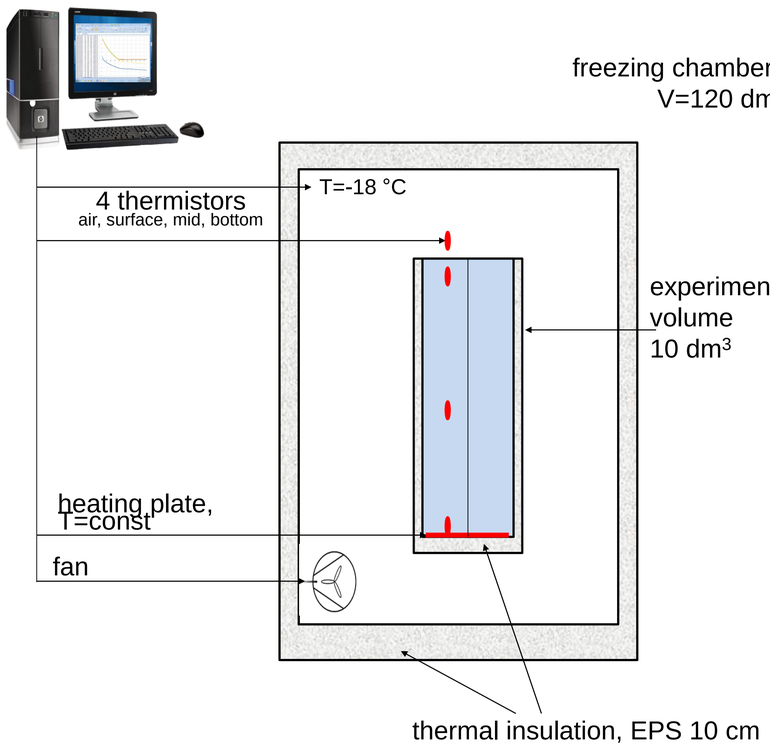
Laboratory experiment

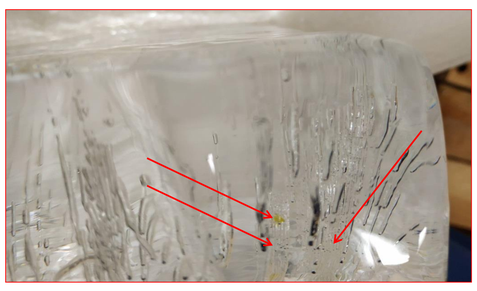


Containers were made from PS-foam (5 cm)
(3 sections, 12 liters each: 20 x 20 x 30 cm).
On the picture:
- ❑ on the left - brine 35 psu (table rock salt);
- ❑ on the right - distilled water.

Water is poured into dense PE bags.
The left bag leaked - experiments were continued only with distilled water.

Three 3 types of MP were added:
- ❑ two sinking:
- ❑ yellow PS;

bundles of red polyester fibers
floating tiny pieces of PS-foam.
Some yellow PS pieces remained floating on the surface.



Laboratory experiment results:

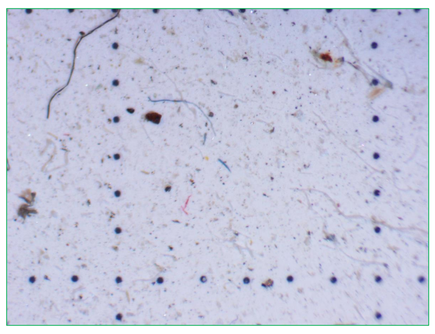
- ❑ all MP particles are trapped in the chains of bubbles, i.e.
- ❑ (a) MP particles were not crystallization centers and
- ❑ (b) were displaced from the ice. They are located substantially below the surface.

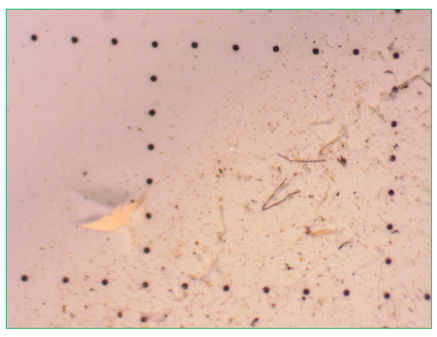
Introduction

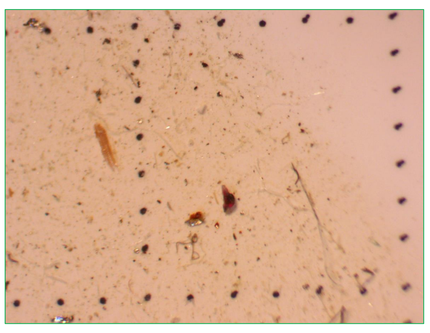
Concentrations of MP in Arctic sea ice are by several orders of magnitude greater than those found in "garbage patches" at the surface of the Pacific Ocean [Obbard et al., 2014; Bergmann et al., 2017] and in its deep-sea sediments [Bergmann et al., 2017], thus the transport of microplastic in the ocean is determined not only by antropogenic presence, but also by hydrophysical processes (in this case, with the global thermohaline circulation) [Cózar et al., 2017].
There are currently no publications on the physical mechanisms of interaction between MP particles and sea ice. The paper [Obbard et al., 2014] presents the first evidence of MP particles presence in sea ice samples from the Chukchi Sea and the Beaufort Sea: all four studied cores (taken at stations separated by hundreds of kilometers) contained MP concentration ranging from 38 to 234 particles per cubic meter of water, that is several orders of magnitude higher than those found in in Atlantic waters north of Scotland (0.34 particles per cubic meter of water) or in waters of the North Pacific Subtropical Gyre (0.12 particles per cubic meter of water) [Obbard et al., 2014]. The paper [Obbard et al., 2014] also suggests that irregularly shaped particles and particles less dense than water are more effectively trapped in sea ice than silt and sand. Similar results were obtained in the laboratory of Helmholtz Center for Polar and Marine Research (Germany): mean MP concentrations of 2x106 particles/m3 in pack ice and 6x105 particles/m3 in land-locked ice were detected in ice cores from the Fram Strait (between Greenland and Svalbard).

This paper presents the results of:
(a) laboratory tests (samples of fresh and salt (35 ppm) water containing different types of floating and sinking MP particles were frozen);
(b) ice cores taken from the Amur Bay (Sea of Japan).

Results







Examples:
fibers, fragments, films

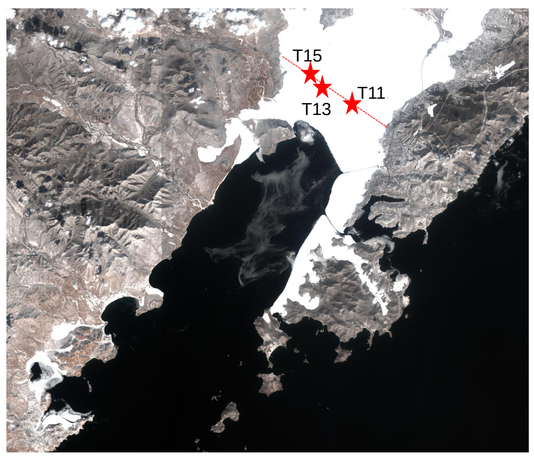
The concentration:
0.21 items/cm³

found:

	%
fibers	61
fragments	37
films	2

fibers:	%
red	25
dark blue	21
green	15
yellow	10
black	9
pink	6
orange	6
violet	4
«zebra»	3
blue	2

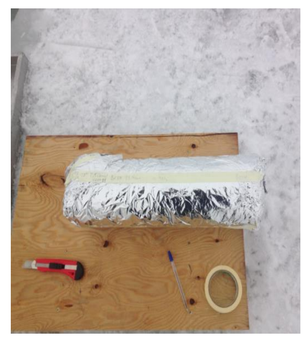
Study area



We analyzed 13 sea ice cores collected during February 2020 in the Amur Bay (Sea of Japan) from three separate areas of the ice field; the total length is about 6 m.

Sampling

The cores were obtained with a ring drill (inner diameter 18 cm, outer diameter 22 cm) on flat (unhummocked) areas of the ice field. From January 21 to February 27 the ice thickness was measured 10-12 times with a measuring ruler (accuracy 0.5 cm), physical parameters in the water column were measured by CTD probe, the ice cores were taken 2-4 times for layer-by-layer (5 cm thick) determination of the integral salinity and dissolved organic matter.



Each sea ice core removed from the ice field was placed on a metal tray to remove sea water and a part of brine (within 4-5 minutes). The core length (ice thickness) was measured and photographed. Then, two sheets of aluminum foil (44x80 cm) were spread on a wooden table (60x80 cm), the core was placed on these sheets and packed. At the next stage, plastic bags were used to pack the cores. The packed ice cores were placed in plastic boxes (20x38x56 cm) installed in the car's cabin. One box could store 2-3 ice cores (gasket material was used in addition).
Sea ice cores were delivered to the laboratory of the National Scientific Center for Marine Biology (NSCMB FEB RAS) by car and placed in a chest refrigerator (T-18C).

The work with ice samples was carried out under laboratory conditions. The cores were fragmented into sections of approx. 5 cm thick, placed in sterile zipp-bags, weighed (700-900 g) and melted at room temperature.
Then, portions of water were passed through a vacuum filter unit. As a result, filters with a suspended matter were obtained.

References:

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