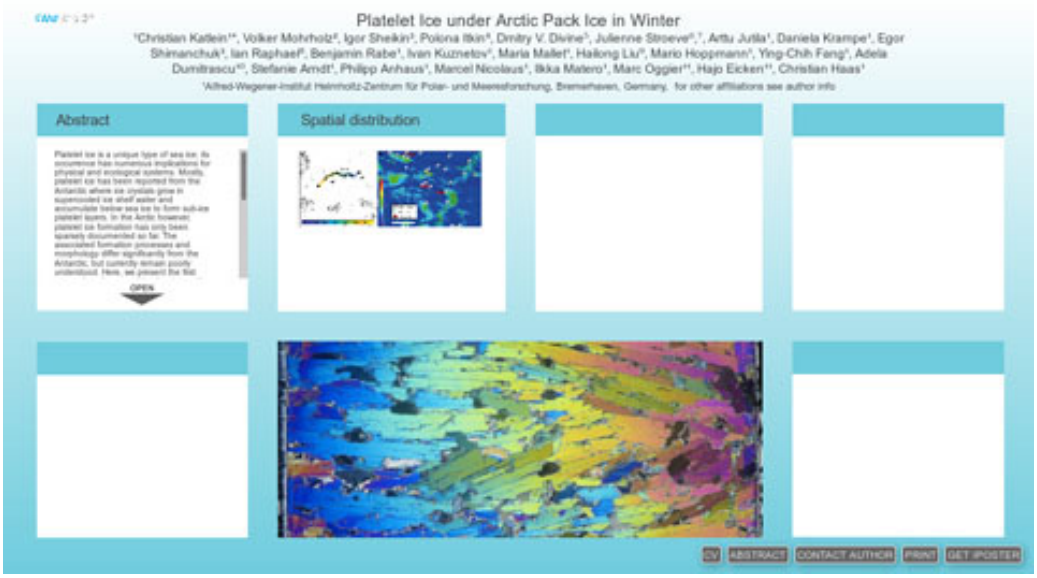
Platelet Ice under Arctic Pack Ice in Winter



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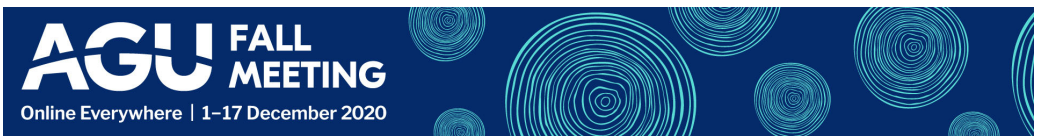


SUMMARY

- First comprehensive observation of wintertime sub-ice platelet layers in the Arctic
- Substantial supercooling in the surface mixed layer
- Widespread, yet overlooked feature of winter sea ice growth

For details check out the pre-recorded talk (https://www.youtube.com/watch?v=eVkCCe-uenk&feature=youtu.be&fs=1&modestbranding=1&rel=0&showinfo=0&fs=1&modestbranding=1&rel=0&showinfo=0) or our publication:

Katlein, C., Mohrholz, V., Sheikin, I., Itkin, P., Divine, D. V., Stroeve, J., et al. (2020). Platelet ice under Arctic pack ice in winter. Geophysical Researc Letters, 47, e2020GL088898. https://doi.org/10.1029/2020GL088898 (https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2020GL088898)

[VIDEO] https://www.youtube.com/embed/eVkCCe-uenk?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0

SPATIAL DISTRIBUTION

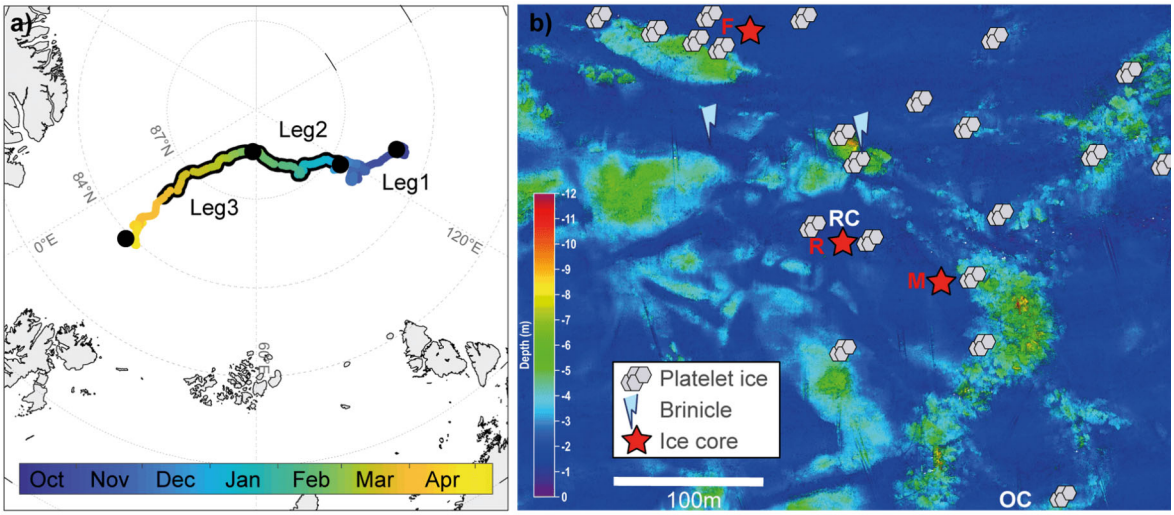


Fig. 1, left: A sub-ice platelet layer was observed between December 2019 and April 2020 in the central Arctic (black line); right: it was observed unde parts of the surveyed ice floe, both under level ice and at pressure ridges.

SUPERCOOLING

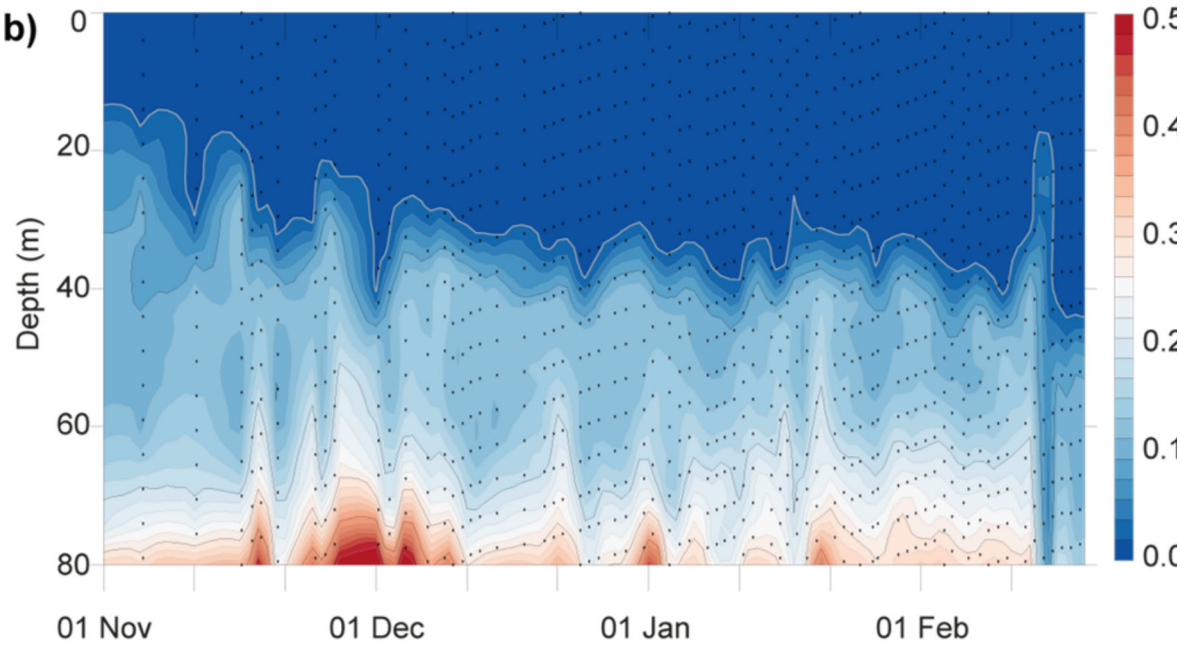


Fig. 2: From mid december onwards, the mixed layer was supercooled below the surface freezing point down to depths over 20m.

The exact process for supercooling remains unclear, but it is likely caused by excessive atmospheric cooling. Ice pump mechanisms and keel melting co be other possibile explanations.

TEMPORAL EVOLUTION

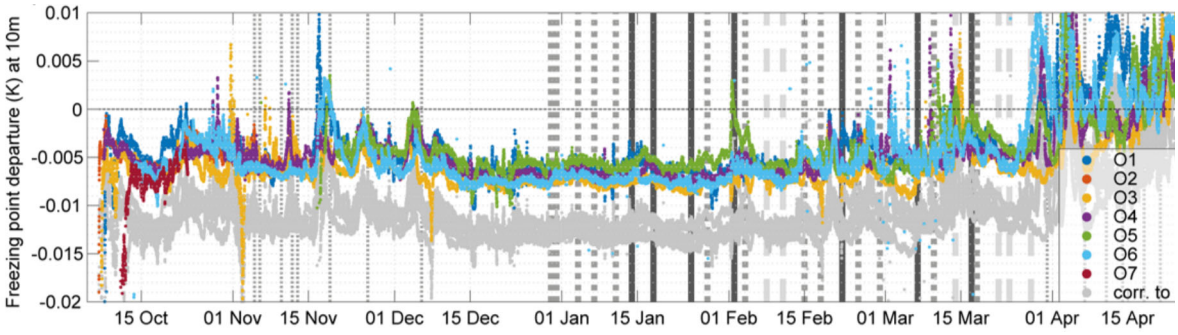


Fig. 3: Temporal evolution of freezing point departure in the vicinity (~50km) around the MOSAiC site. Vertical grey lines indicate the strength of Plat ice growth increasing from dotted to solid

- Formation due to consistently supercooled mixed layer
- Widespread feature detected over >50km distance

HOW COULD IT BE OVERLOOKED?

No extensive regular under-ice investigations had been conducted in the Central Arctic during winters before MOSAiC. Only novel ROV technology deployed from the winter drift station allowed for this discovery.

In addition, the impact of platelet ice on the columnar texture can be very subtle and hard to detect. Thus it was likely often missed in ice core texture analysis.

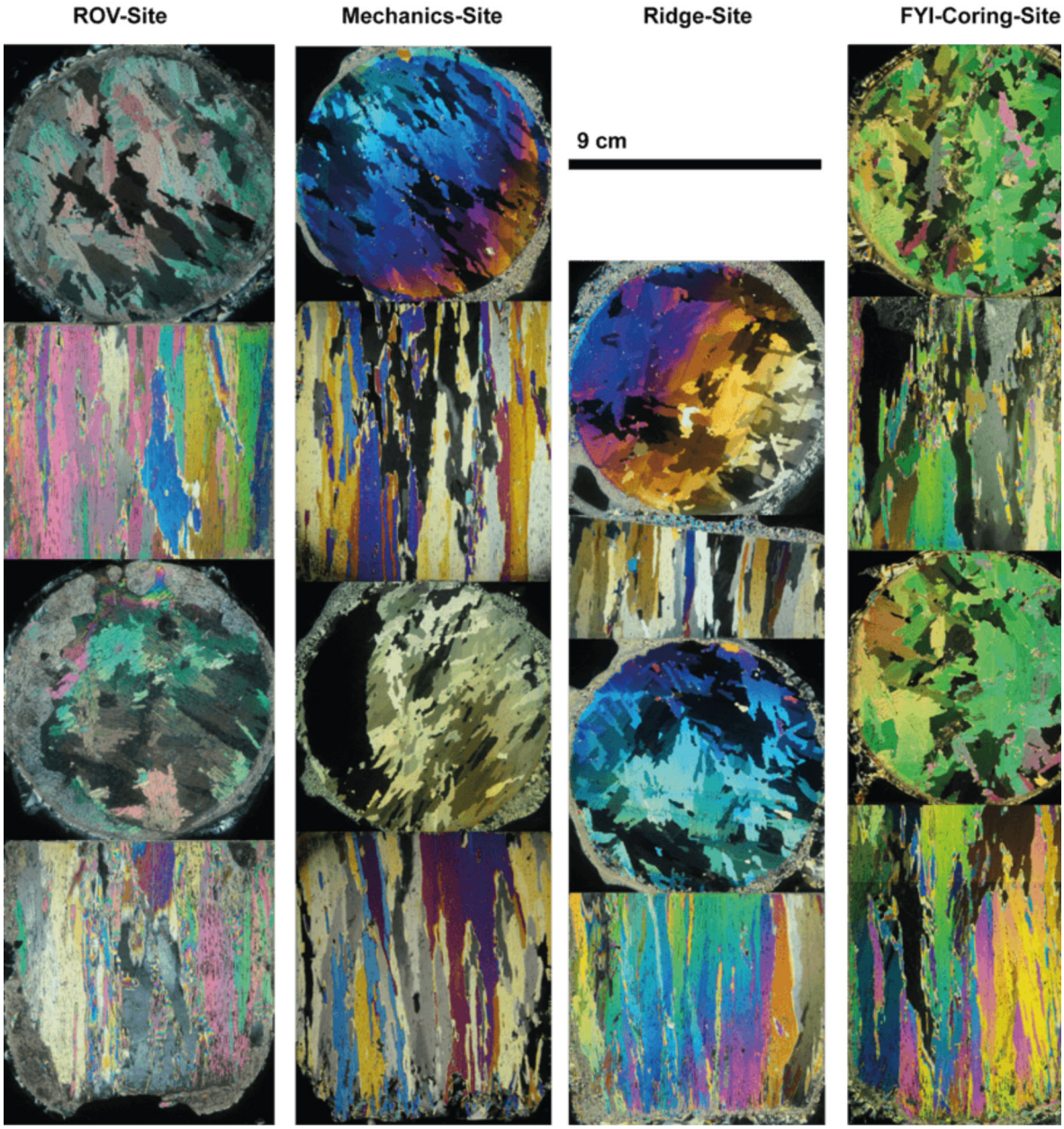
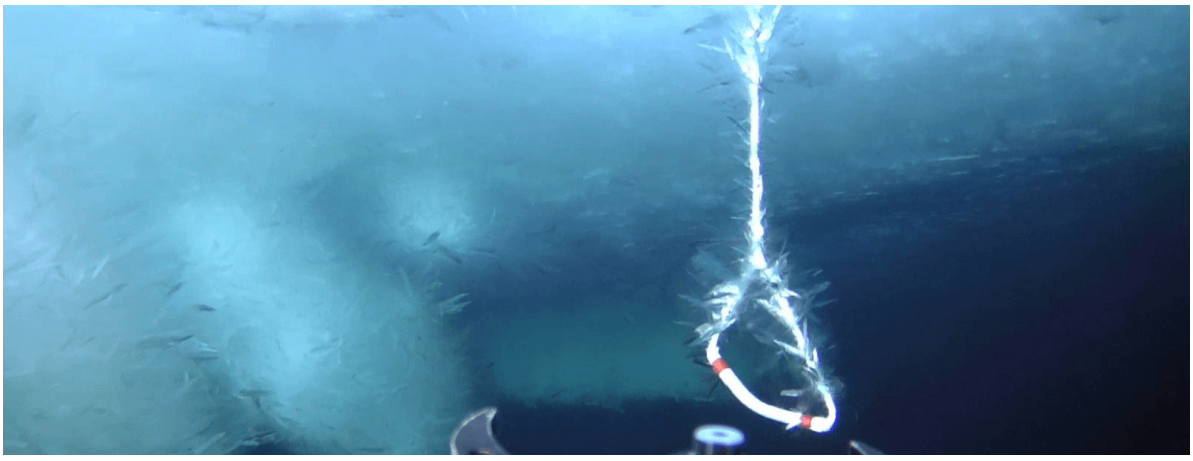
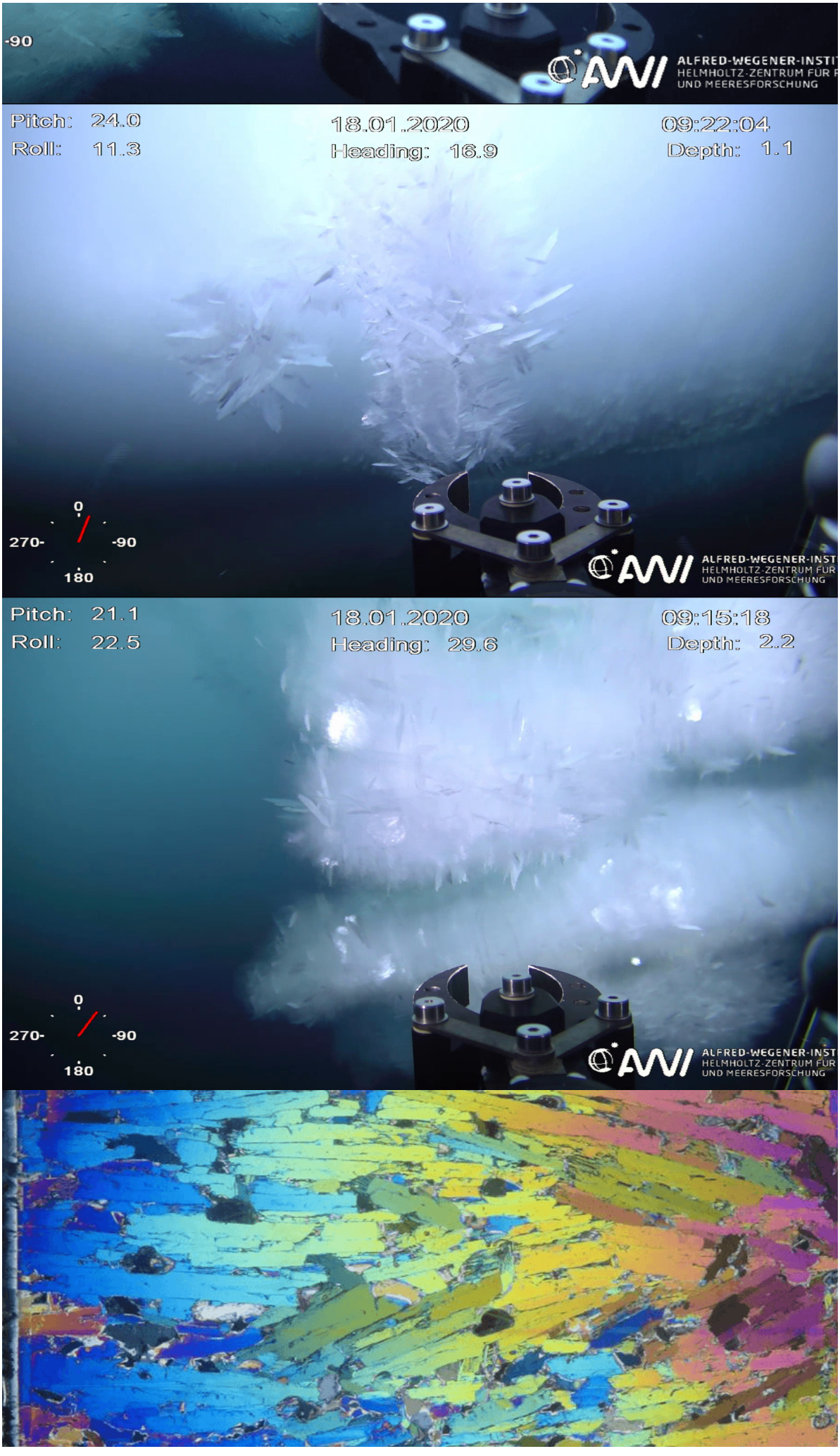


Fig. 4: Horizontal and vertical thin sections of the ice core bottoms in four locations with confirmed platelet growth.

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Pitch: 24.0
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Pitch: 21.1
Roll: 22.5
18.01.2020
Heading: 29.6
09:15:18
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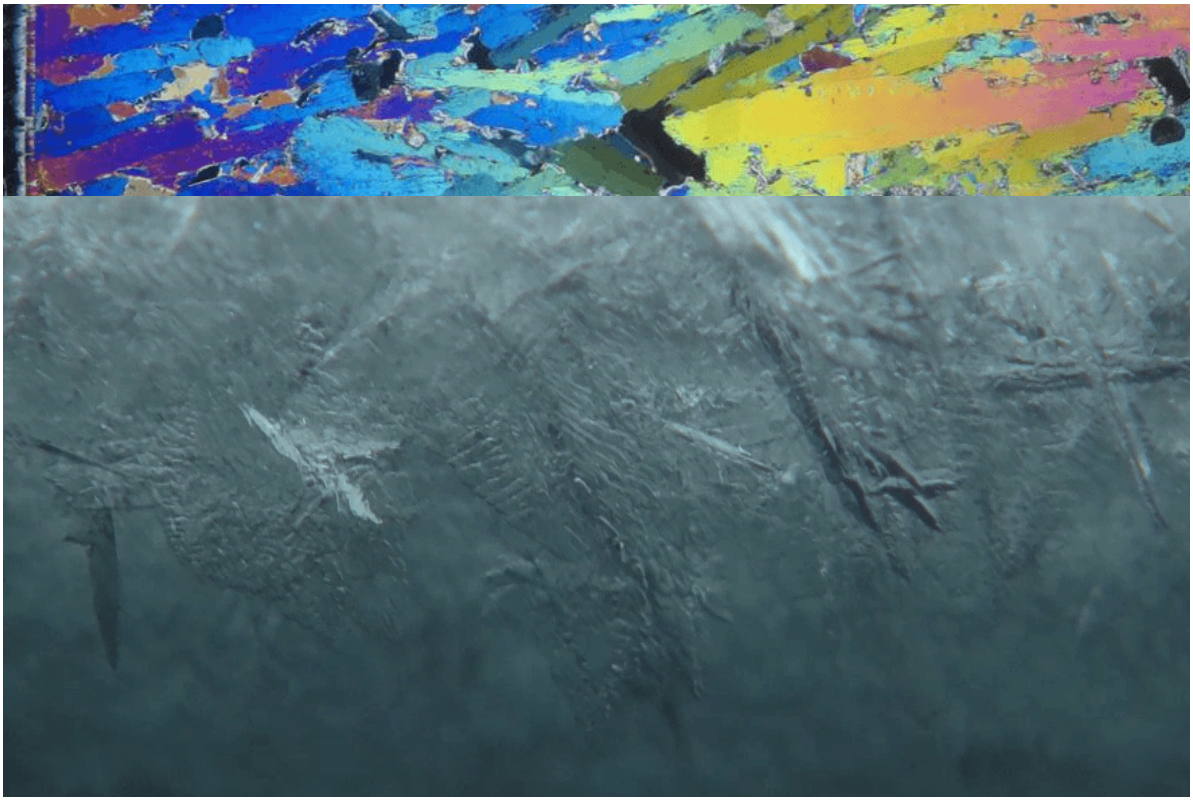

WHAT IS IT IMPORTANT FOR?

- Likely no big effect on sea ice mass balance (local effect)
- Process for pressure ridge consolidation
- Improved habitat for ice associated fauna

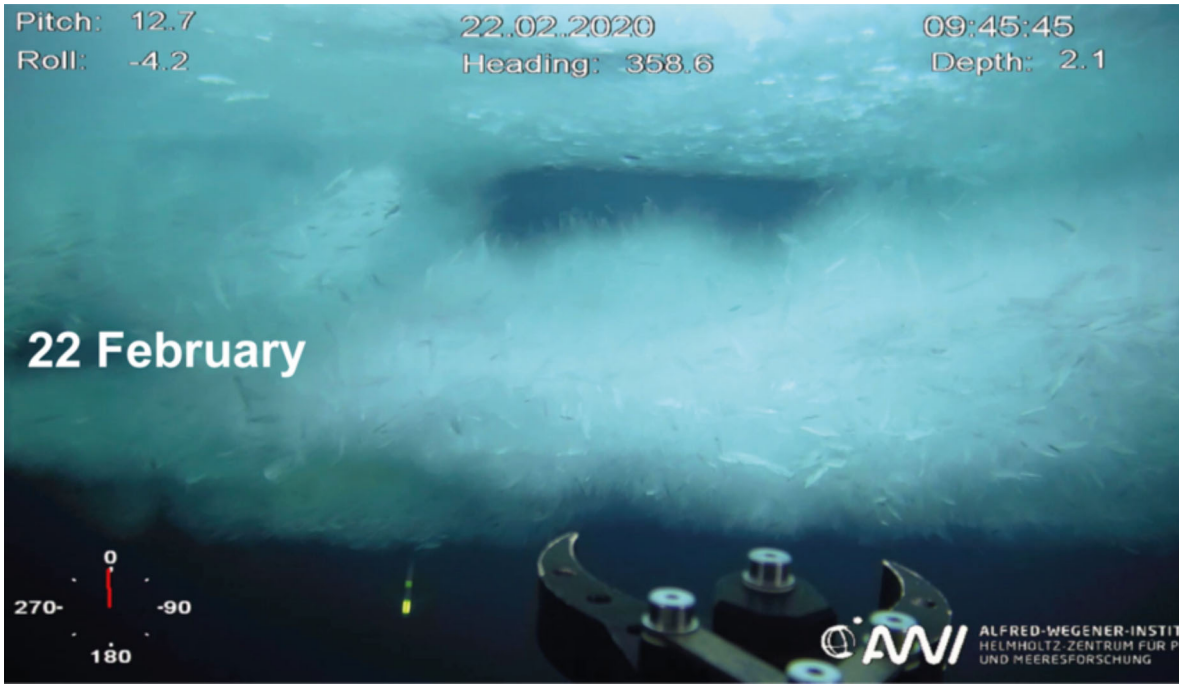

Fig. 5: Upward growing platelet ice in a cavity.

Fig. 6: Amphipod (white arrow) roaming the porous mesh of the sub-ice platelet layer.

AUTHOR INFORMATION

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ABSTRACT

Platelet ice is a unique type of sea ice; its occurrence has numerous implications for physical and ecological systems. Mostly, platelet ice has been reported from the Antarctic where ice crystals grow in supercooled ice shelf water and accumulate below sea ice to form sub-ice platelet layers. In the Arctic however, platelet ice formation has only been sparsely documented so far. The associated formation processes and morphology differ significantly from the Antarctic, but currently remain poorly understood. Here, we present the first comprehensive, repeat in-situ observations of a decimeter thick sub-ice platelet layer under drifting pack ice of the Central Arctic in winter. Observations carried out with a remotely operated underwater vehicle (ROV) during the midwinter leg of the MOSAiC drift expedition provided clear evidence of the growth of platelet layers from supercooled water present in the ocean mixed layer. This process was observed under all ice types present during the surveys. Oceanographic data from autonomous observing platforms leads us to the conclusion that platelet ice formation is a widespread yet overlooked feature of Arctic winter sea ice growth.

REFERENCES

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