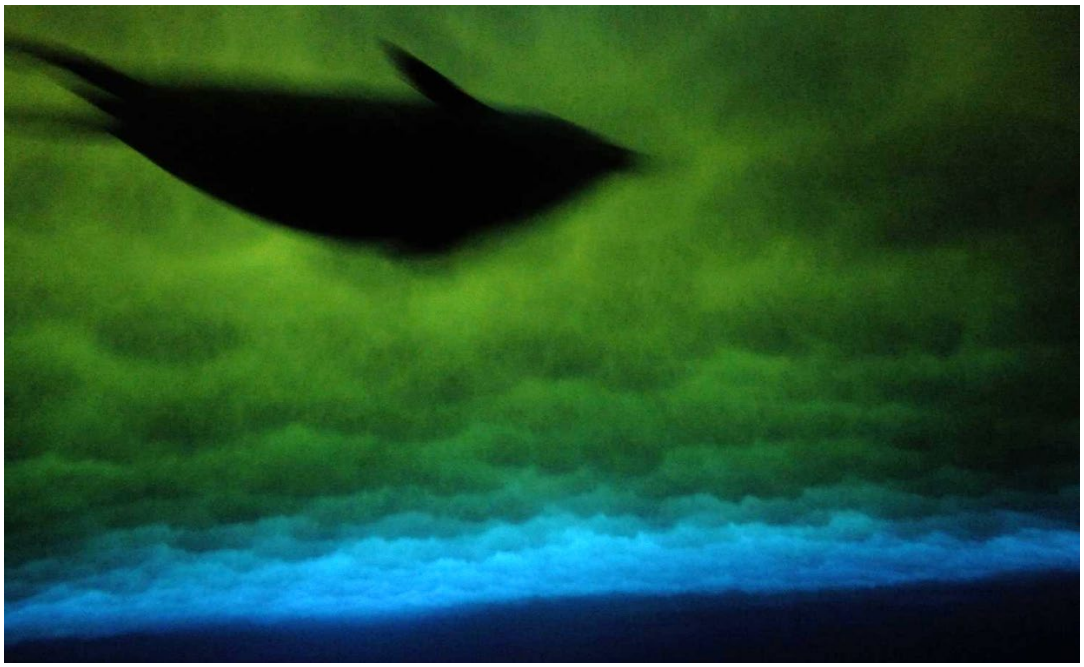
Platelet Ice: A Unique and Fragile Antarctic Ecosystem



A Weddell Seal silhouetted against the platelet layer. The blue shades identify crystal clear regions of the platelet layer, while green shades identify where the platelet layer has been colonized by large communities of algae. (Image credit: Natalie Robinson)

Just beneath the sea ice of the Ross Sea lies a fragile and largely unexplored world. Thin, delicate ice crystals come together in a layer, which can be several metres thick, attached to the bottom of the sea ice. These layers of 'platelet ice' create a unique habitat that provides a protective environment for algae and bacteria and offers a sheltered nursery for Antarctic silverfish to hatch. The platelet ice ecosystem could be hugely important for underpinning the Ross Sea marine food web, but there is much we do not understand about it and how it will be affected by a warming sea. Antarctic Science Platform research is bringing together scientists from different disciplines to advance our knowledge of the physical structure of platelet ice, and the marine life that it supports.

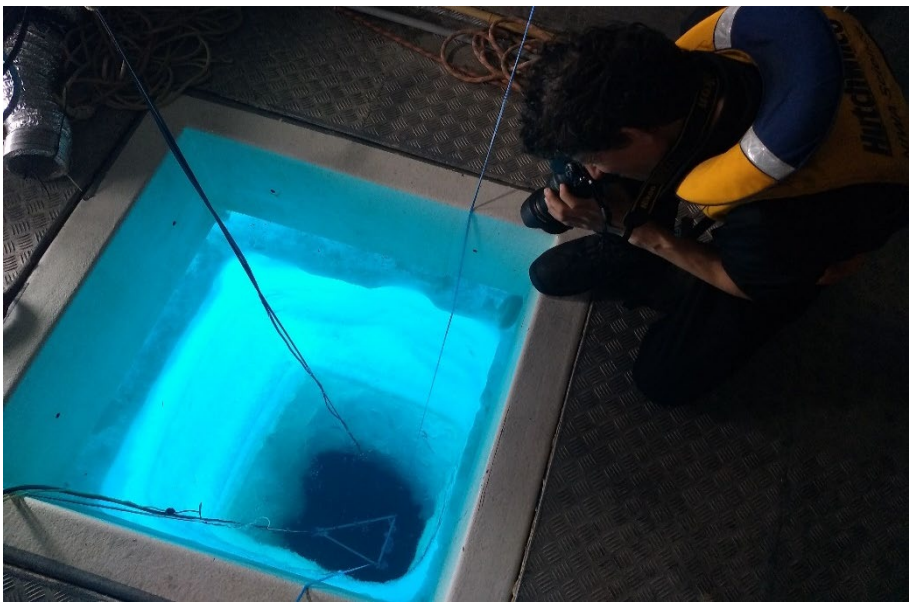
Platelet ice can only form where the ocean includes water that melts from the bottom of ice shelves, floating extensions of Antarctica's continental ice sheets. Although this melt-water is colder than the surrounding sea-water it is also fresher, making it less dense, and so it rises in plumes towards the surface. As the cold plumes rise the change in pressure allows the water to become 'supercooled' – below its normal freezing temperature while still remaining liquid – which supports the appearance of small ice crystals that are carried with the flow.

If conditions are right, these crystals can grow into larger platelets, each 2 to 4 millimetres thick and up to 200 millimetres wide. The platelets accumulate in a layer beneath the sea ice, which can be up to six metres thick after a single winter and over ten metres thick underneath multi-year sea ice. The thin shards continue growing and lock together to form a dense but fragile maze which creates an environment unlike any other on Earth.

Platelet ice rapidly forms and accumulates on equipment and instruments suspended in the plume of supercooled water. (Image credits: Natalie Robinson)

Platelet ice is found in several locations around Antarctica, including the Ross Sea. Because of its fragility and comparative rarity, it is very difficult to study. The lattice structure is very robust while in the water, but quickly falls apart when removed from the ocean and the water between the platelets drains out. Despite these difficulties, significant advances in recent years, including by New Zealand scientists, have revealed fascinating insights into how important the sub-ice platelet layer is for the Antarctic marine ecosystem.

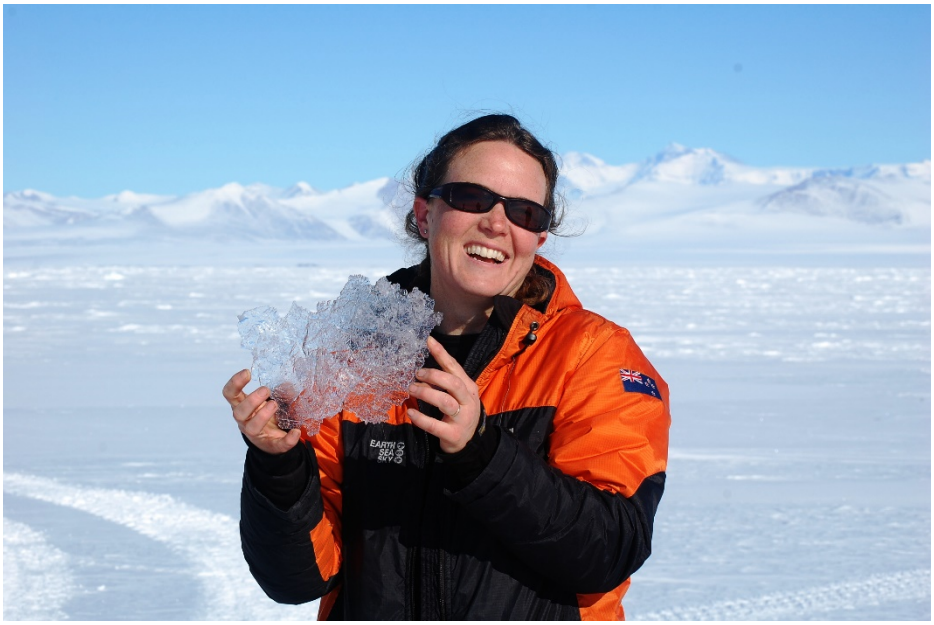
The water between the ice platelets acts as a calm refuge for algae to grow, with stable temperatures and protection from grazers such as krill. The large surface area of the platelets allows for more algae to grow than would be possible on the lower surface of the sea ice alone, and it has been identified as the most productive algal habitat in the Antarctic. Algae are concentrated at the top of the platelet layer where there is more sunlight, and are more abundant when there is less snow on top of the sea ice (less snow means more sunlight can get through). As the intense biological production amongst the platelets moves down through the ice crystals and into the water column, it provides a food source for many other organisms and is a key part of the marine food web.



Brett Grant (NIWA) photographs the sea ice, platelet layer and window to the ocean through the hole in the base of the converted shipping container. The blue colour is sunlight which has made its way into the ocean, filtered through snow, sea ice and platelet layers. (Image credit: Natalie Robinson)

Platelet ice is also a habitat for larger species. Antarctic silverfish are a one of the most common fish species in the Ross Sea and are a very important food source for sea birds, penguins and Weddell seals. Research has found that platelet ice acts as a "nursery" for silverfish eggs and young hatchlings. So far this has only been observed at Terra Nova Bay, about 300 kilometres north of Scott Base. An Antarctic Science Platform research project is looking at whether platelet ice closer to Scott Base plays a similar role. Bringing together physicists and biologists, this research will explore the connections between the physical structure and formation of platelet ice and its importance for the Ross Sea ecosystem.

New sampling techniques under development would allow platelet ice layers to be captured along with the water that fills the gaps between the ice crystals to prevent the structure from collapsing. This would also maintain the biological profile of the platelet layers, so that the algae, bacteria, crustacea and fish that are living between the platelets could be studied in their habitat.



Natalie Robinson (NIWA) with a large single platelet crystal, approx 25 cm across and recovered through a 25 cm access hole. (Image credit: Rebecca McLeod)

This research is especially important given the predicted changes in the region due to global climate change. Platelet ice is fragile and requires very specific conditions to form, and is potentially vulnerable to small shifts in the climate. Loss or reduction of platelet ice could be devastating for the Ross Sea marine ecosystem. Improvement in our knowledge of this largely unexplored environment is of special importance now, as we extend our understanding of the implications of a rapidly-changing world.

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