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OCEANOGRAPHY

Changing icescapes

In 2010, a massive iceberg hit the Mertz Glacier Tongue in East Antarctica, causing it to calve. This event changed the icescape along this coast with important implications for the biological and physical processes occurring there.


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The Antarctic land mass is surrounded by sea ice, which in winter can extend northwards for hundreds of kilometres. But the ice pack is not a continuous frozen icescape. Sea ice that forms along the Antarctic coast is driven offshore by strong winds that blow downhill from the Antarctic Plateau onto the shoreline, giving rise to an open water area known as a coastal polynya. Here, new ice is formed and again pushed away from the coast, making polynyas extremely efficient sea-ice factories.

These patches of persistent open water play a key role in the physical and biological processes in Antarctica. On the one hand, polynyas can sustain plankton blooms in early spring and are therefore important feeding and breeding grounds for penguin colonies. On the other hand, when sea ice forms, it expels salt brines into the underlying water — a process that increases water density and causes it to sink towards the ocean floor. These Antarctic bottom waters form the lower limb of the ocean conveyor belt: a key component of the global climate system.

The Mertz Polynya in East Antarctica, on the lee side of the glacier tongue, is the third most productive polynya in Antarctica. However, in 2010 a vast iceberg collided with the glacier and caused the massive calving of the tongue. This event significantly reduced the size of the Mertz Polynya, and the formation of dense bottom waters. Following the calving event, the iceberg became grounded in Commonwealth Bay, just west of the Mertz Glacier where it formed a barrier and blocked the offshore transport of newly formed ice. Since then, thick ice has covered the area landward of the iceberg and the coastal polynya has disappeared.

Christopher J. Fogwill and colleagues use *in situ* and satellite oceanographic observations from 2013 and high-resolution model simulations to determine the effect of the change in the icescape on the oceanographic regime in Commonwealth Bay (*The Cryosphere* **10,** 2603–2609; 2016). They find a shift in water properties in the lee of the grounded iceberg in the northwest part of the Bay, with saltier, colder water in the entire water column. This adjustment of water properties points to dense bottom water formation, and it is consistent with enhanced sea-ice production estimates from satellite observations — a new polynya may be emerging on the leeside of the iceberg. Furthermore, model simulations suggest that the transient state that the system is currently in while it adjusts to the calving event could lead to a new post-calving stable state where an active polynya — capable of producing dense bottom water — is becoming a permanent feature to the northwest of Commonwealth Bay.

The geographical reconfiguration of the prevalent polynya in this region has shifted the location of Antarctic bottom water formation from the Mertz and southern Commonwealth Bay to the northwestern side of the Bay. The effect of this new arrangement on the ocean overturning circulation remains unquantified as of yet, but the development of a new polynya may partly compensate for the reduction in dense water formation in the weakened Mertz Polynya. Marked biological changes can also be expected. The year-round sea-ice cover now found in the south of the Commonwealth Bay is thought to have severely affected benthic communities there. At the same time, a new area of marine productivity in the emerging northern polynya could provide much needed food to penguin colonies in the region.

This natural event, thought to occur every hundred years or so, highlights the sensitivity of regional ocean circulation and biology to changes in the local icescape, but also allows a glimpse on how the increased frequency of calving events due to global warming might affect the ocean and the ecosystem.

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