

SEA-ICE FORMATION AND WATER STRUCTURES IN COASTAL  
POLYNYAS OFF LÜTZOW-HOLM BAY AND BREID BAY  
(ABSTRACT)

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In a coastal region where strong offshore winds and currents prevail, newly-formed sea ice is removed as quickly as it forms. Consequently, the open water areas are maintained for a long period of time, despite considerable ice production. Such open waters, or coastal polynyas, release latent heat of fusion of ice and moisture from the ocean to the atmosphere. High-salinity brine is also excluded to the ocean by sea-ice formation. The polynyas may have great influence on the atmosphere-ocean interaction.

Satellite images have suggested the presence of winter coastal polynyas between fast ice (or ice shelf) and pack ice regions off Lützow-Holm Bay and Breid Bay, Antarctica. In 1990–1992, oceanographic observations were intensively conducted by the 31st and 32nd Japanese Antarctic Research Expeditions to understand sea-ice and oceanic processes in the polynya off Lützow-Holm Bay. Under windy conditions, aircraft observations revealed many new-ice streaks formed approximately parallel to the wind direction and generation of frost smoke from the open water. Water temperature profiles in the polynya were obtained by using aircraft-deployed expendable bathythermographs (AXBT) with a depth capability of 460 m. Based on the temperature data, it is estimated that the thickness of the convective-mixed layer with its freezing point is 350–450 m. The mixed layer has a tendency to deepen in winter. According to the austral summer oceanographic data acquired on board the icebreakers FUJI and SHIRASE, winter convective-mixed layers remain cold and oxygen-rich in the polynya regions. These mixed layers were evidently thicker than those in pack ice regions. Such water structures were also formed in the Breid Bay polynya. The thick convective-mixed layer is considered to reflect the processes of vigorous sea-ice production and the resultant convective mixing in the open polynyas.

*(Received December 1, 1993)*