

Shelf ice-associated cryo-benthos and environmental features

Biology

Cryobenthos in Drescher Inlet

Cryo-benthic isopod crustaceans attached head-down populate the underside of floating shelf ice at Drescher Inlet (DI) 72°50'S-19°09'W, (Riiser-Larsen Ice Shelf, eastern Weddell Sea). These filter-feeding crustaceans (*Antarcturus* cf. *spinacoronatus*, Figs 1 - 3) occur in dense aggregations under the shelf ice at DI (average: 25 adults/m²). The presence of all life stages including ovigerous females indicates local reproduction away from the seabed.

Molecular barcoding demonstrates that the same species occurs in nearby benthic communities, albeit abundances in the seabed are at 5 orders of magnitude lower.

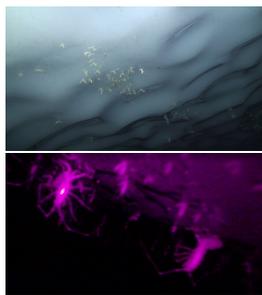


Fig. 1: Video frame from ROV footage with aggregation of isopods (*Antarcturus* cf. *spinacoronatus*) and scallop structure of shelf ice (top) and Weddell seal-borne IR still picture of isopods head-down under the shelf ice (bottom); both images taken at Drescher Inlet at 100 m water depth.

Fig. 2: Closeup of *Antarcturus* cf. *spinacoronatus* from eastern Weddell Sea benthos. Note long setae used for filter-feeding on antennae and walking legs and broodpouch on ventral side of the female.



Benthos

The local megabenthos represents a mixed community of a relatively low seabed cover of sessile suspension feeders (bryozoans, few glass and demosponges, cnidarians, and ascidians), compared to the highly diverse stations e.g. at Kapp Norvegia with high biomass. Among mobile organisms ophiuroids were most abundant (2-10 m⁻²), while other mobile and infauna species were holothurians, echinoids, gastropods, and echiuroids. Stations at Drescher Inlet were more similar to those 70 km North of Drescher, than to stations 70 km South of the Inlet with more soft bottom, but also more sessile suspension feeders such as compound ascidians and sponges with mounds indicating an abundant infauna (see Fig. 4).

Conclusions

Cryobenthos & environmental features

- Single species of isopod under shelf ice
- Also occurs in the seabed fauna in lower abundance
- Filter-feeding lifestyle
- Occurrence depends on
 - Advection of plankton with currents
 - Availability of plankton within reach of isopods (<1 cm), favoured by scallop structure of melting shelf ice
- Advection of microalgae with currents
- Weddell seals feed in corresponding depths (70-150 m), possibly on isopods and related fish fauna
- Bottom topography may promote close contact between nutrient-rich water masses and shelf ice underside



Fig. 3: Aggregation of juvenile *Antarcturus* cf. *spinacoronatus* inside depressions, adults on ridges suggest the importance of hydrographic conditions across scallop structure associated with melting ice surfaces. Microturbulences may bring plankton particles within reach of juveniles.



Fig. 4: Sea-bed photo taken inside the Inlet along three transects, showing fine sediment, high gravel fraction (50% seabed cover), and organic debris. The benthos represents a mixture of mobile and sessile organisms.

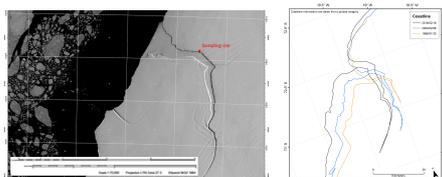


Fig. 5: Landsat image (left) showing the ca 25 km long Drescher Inlet (LANDSAT 7 ETM, Bd 8, Level1G, 2002). Comparison of satellite images taken between 1986 and 2016 (right) yield flow velocities of the shelf ice of ~300 m per year to the north-west.

Oceanography

Hydrography

The Drescher Inlet is under immediate influence of the open ocean, as isobaths indicate a steep gradient within a short distance off the inlet mouth. The continuity of isobaths along the coast suggests the coastal current flowing beneath the ice shelf (Figs 5 – 8), transporting eastern shelf water south-ward. The thermocline within the coastal current is seasonally undulating in the vertical along the continental slope (being more shallow in summer); temperatures are hence higher (~-1.45°C = MWDW) at the bottom. The lower 130 m show increased temperatures during late summer, and this water mass is able to make contact with the shelf ice.

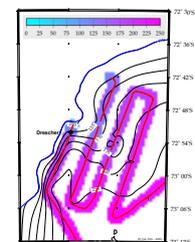
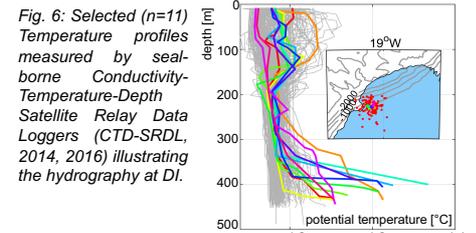


Fig. 7: Thickness contours of the floating shelf ice along Drescher Inlet range from 100 to 250 m along the inlet (research aircraft Polar 2, EMR data, 2001).

Bathymetry

Depths range from 400 to 520 m (Fig. 8), reaching the 1,000 m isobath 4 km beyond the inlet. The seabed under the shelf ice extends for over 100 km to the nearest grounding line of Dronning Maud Land.

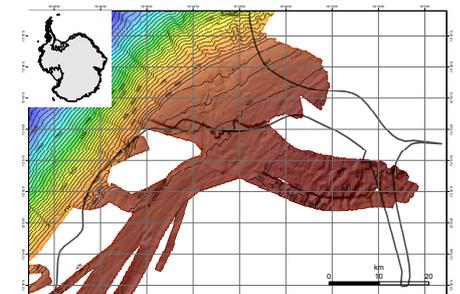


Fig. 8: Composite bathymetric chart with projection of the shelf ice contour at Drescher Inlet (AWI Hydrosweep multibeam data 1989 - 2016, ADD v6.0 coastline). Coastline contour and inlet bathymetry do not match as a result of continuous ice flow to the north-west (cf. Fig. 5).