

Survey and Mapping of the Ice Front along the Antarctic Coast between 8° W and 62° W

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Summary: During the site survey expedition to the Filchner Ice Shelf the position of the ice front was mapped continuously between 25°W and the Antarctic Peninsula at 62°W using satellite positioning techniques. The height of the ice front was measured by the aid of optical methods and altimetry. Since the first ice front survey in 1957, which was carried out with classical nautical methods, the ice front of the Filchner/Ronne system seems to have advanced by 10 km to 25 km. This result, which has also been obtained from other West Antarctic ice shelves, has to be substantiated by future measurements.

Zusammenfassung: Während der Standorterkundungsexpedition zum Filchner-Ronne-Schelfeis 1979/80 wurde der Verlauf der Schelfeiskante entlang der antarktischen Küste von etwa 25°W bis zur Antarktischen Halbinsel bei 62°W mit Hilfe eines Satellitennavigationsgerätes kartiert. Die Höhe der Barriere wurde vermessen. Seit der Eisfrontaufnahme 1957 — allerdings mit klassischen nautischen Mitteln — scheint das Filchner-Ronne-Schelfeis um 10 km bis 25 km vorgestoßen zu sein. Dieses Ergebnis, das auch bei anderen Schelfeisen der Westantarktis beobachtet wurde, ist anhand zukünftiger Messungen zu überprüfen und zu erhärten.

The German Antarctic Expedition 1979/80 (site survey Filchner/Ronne Ice Shelf) left Buenos Aires on 18 December 1979 on board the Norwegian research icebreaker POLARSIRKEL heading first for South Georgia. From South Georgia the vessel passed the South Sandwich Islands and sailed through the eastern Weddell Sea between 24°W and 12°W towards the continent. The route of the expedition is shown in Fig. 1. Due to the excellent pack ice conditions POLARSIRKEL arrived at Cape Norvegia (71° 17' S, 12° 23' W) on 31 December 1979. Some scientific projects had already been carried out on the way south which are outlined elsewhere in this volume.

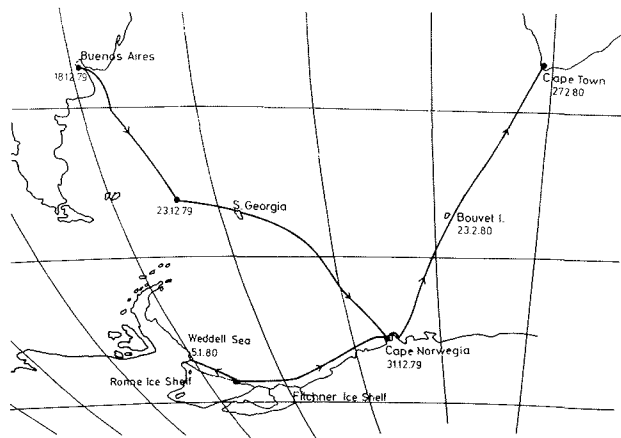


Fig. 1: The route of the German Antarctic Expedition 1979/80.

Abb. 1: Route der deutschen Standorterkundungsexpedition 1979/80.

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hand, this region was of secondary interest for the goal of the expedition, the ship proceeded straight to the British station Halley (71° 17' S, 12° 23' W). The height of the barrier was, nevertheless, estimated by optical methods wherever possible, yielding mean heights of 30 to 45 m over this section which could be confirmed on the way back.

From Halley westward POLARSIRKEL followed the continental fringe close to the coast line. The position of the ice front and the height of the barrier were surveyed continuously. The ice front was mapped by using the ship's one-channel doppler satellite-positioning instrument (type: Nautikon) together with the ship's radar and gyro-compass. The height of the barrier was estimated by optical methods (sextant) and sporadically by altimetry using the helicopter. The latter method was applied when the ice front was too far for the optical measurements. Tab. 1 and Fig. 2 contain the results.

Surveyed area with satellite-controlled positions	Mean height of the barrier	Remarks
25° 15' W — 27° 36' W 74° 39' S — 76° 06' S	20 m—45 m	Continuous vertical cliff with single inlets; Brunt Ice Shelf;
28° 26' W — 36° 12' W 76° 08' S — 77° 41' S	—	No distinct barrier; the coast is formed in this section by heavily crevassed glaciers;
36° 48' W — 41° 24' W 77° 45' S — 77° 34' S	10 m—25 m	Filchner Ice Shelf; continuous shallow barrier; slightly increasing from 10 m to 20 m at 40° 54' W (area Druzhnaya);
42° 09' W — 48° 59' W 77° 39' S — 77° 10' S	(35 m—40 m) 40 m	Gould Bay, Berkner Island; Gould Bay was covered with fast ice and optical height determinations were only sporadically possible; the values in brackets result from helicopter survey (altimeter);
50° W — 55° 57' W 77° S — 75° 53' S	7 m—15 m	Ronne Ice Shelf; flat and even barrier;
56° 23' W — 61° 18' W 75° 53' S — 74° 50' S	20 m—30 m	Ronne Ice Shelf to Antarctic Peninsula; the height of the barrier increases suddenly at a small inlet at about 56° W to 30 m

Tab. 1: Mean heights of the ice barrier between Halley and the Antarctic Peninsula determined optically from board the ship and partly by helicopter altimetry. The coordinates were measured by Doppler satellite-positioning and give the range within which the height determinations were carried out.

Tab. 1: Mittlere Höhen der Schelfeiskante zwischen Halley und der Antarktischen Halbinsel. Die Höhen wurden mit einem Sextanten von Bord des Schiffes sowie teilweise mittels des Helikopterhöhenmessers gewonnen. Die Positionen wurden mit einem Satellitennavigationsgerät bestimmt; sie geben den Bereich an, in dem die Höhenmessungen durchgeführt wurden.

The pack ice conditions of the 79/80 season were extremely favourable as shown in the previous chapter. The ship could, therefore, proceed unrestrained to the Antarctic Peninsula (most western position: 72° 42' S, 61° 19' W), which was reached on 5 January 1980.

The position of the ice front is plotted in Fig. 2. There is a gap in the data between 75° 50' S, 27° 20' W and Vahsel Bay. In this region all the coast is fringed by heavily crevassed glaciers which do not exhibit any distinct front line or barrier. We were consequently not able to map this part of the coast line with our method.

There is a distinct and very interesting difference in the positions of the ice front of the Filchner/Ronne Ice Shelf between 1957 and 1979/80. The accuracy of our measurements is about $\pm 1'$ in latitude, equivalent to ± 1 nM (nautical mile). It cannot be assumed that the ice front of 1957 was obtained with a similar precision because modern navigation and positioning techniques like those used by our expedition were not yet available at that time. Thus, an advance of the ice front of 10 to 25 km between 1957 and 1980, as can be deduced from the two different shore lines, has to be regarded with caution. However, extrapolating at 50° W the difference between ice movement at the front (1070 m/a; MÖLLER & GERDAU, 1981) and annual break-off (approximately 100 m/a; KOHNEN & HAG, 1981) over the past 23 years yields an advance of about 20 to 23 km. These numbers match fairly well the apparent advance of the Ronne Ice Shelf in this area obtained from the two ice front positions. The differences between the two shore lines are considerably smaller in front of Berkner Island where the movement of the grounded ice is much slower which is another hint of a real advance. ZAKHAROV & KOTLYAKOV (1980) have argued on the

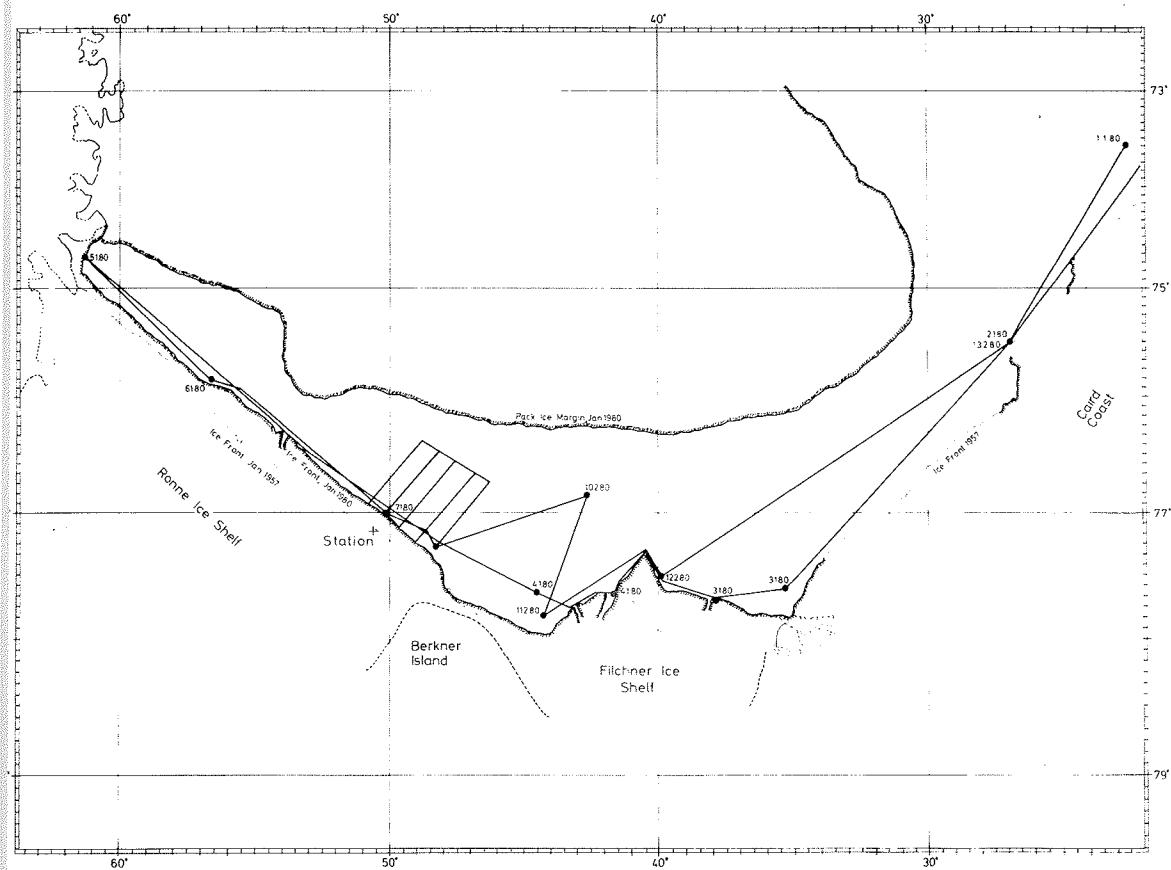


Fig. 2: Position of the ice front in 1957 and 1980 and expedition route 1979/80.

Abb. 2: Die Lage der Schelfeiskante 1957 und 1980 sowie die Operationen der POLARSIRKEL vor dem Schelfeis.

basis of satellite observations that the ice shelves fringing the Weddell Sea generally advance and that the advance is balanced by major calving activities every few decades.

Since advance and retreat of the ice front are of basic importance for mass balance and ice dynamic considerations, an accurate survey of the ice front will be one of our prime interests during the forthcoming years.

The cruise of POLARSIRKEL in the Weddell Sea is also plotted in Fig. 2 giving the accurate positions, dates and tracks of the biological and oceanographic observations.

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