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# Glaciological, glacier-hydrological and climatological investigations around 66°N, West Greenland

**Ole B. Olesen and Jørn-Ole Andreasen**

As part of the GGU programme for the regional mapping of the hydroelectric potential of West Greenland, glaciological, glacier-hydrological and climatological investigations were carried out at three local ice caps near latitude 66° in West Greenland. Two of the ice caps, Sukkertoppen ice cap and 'Amitsulôq ice cap', contribute to the runoff from the Tasersiaq basin (fig. 41) while the third, Qapiarfiup sermia, drains into a smaller basin east of Sukkertoppen.

Investigations in the Tasersiaq basin were started by GGU in August 1981 (Olesen, 1982) while glaciological measurements at Qapiarfiup sermia were started in March 1981.

## *Glaciological investigations*

The 'Amitsulôq ice cap' covers an area of 165 km² and lies between approximately 700 and 1400 m above sea level in the easternmost part of the Tasersiaq basin. Field work started in early June by measuring the winter balance of the ice cap in eight snowpits and drilling down new stakes up to a total of 27. During the summer, transient balance was measured within this network. Naturally the more remote stakes were only visited a few times while stakes near the base camp were measured on a nearly day-to-day schedule.

In addition to mass balance measurements, some of the stakes were surveyed from fixed

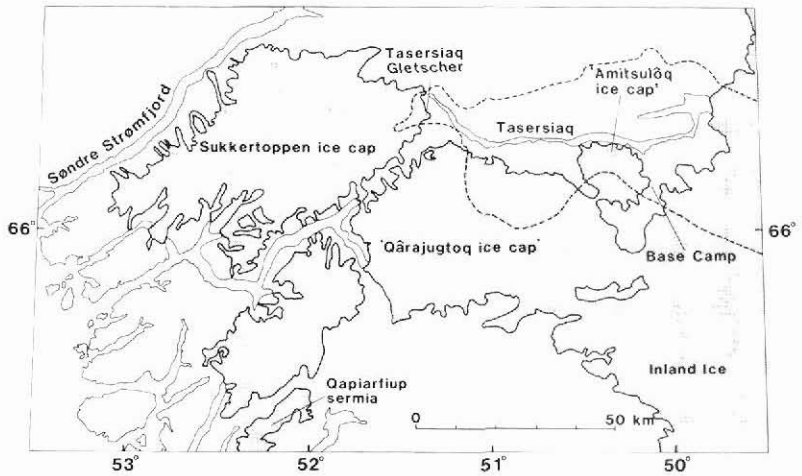


Fig. 41. Sketch map showing place names and localities mentioned in the text.

points on bedrock (not all the stakes can be seen from bedrock). Repeated measurements will give data on the rate and direction of ice flow.

Qapiarfiup sermia was only visited twice during the summer, once in early spring when the winter balance was measured in five snowpits and once in September to measure the summer balance.

*Preliminary results.* In fig. 42 winter, summer and net balance have been plotted for 'Amitsulôq ice cap' and for Qapiarfiup sermia.

For 'Amitsulôq ice cap' only measurements for one profile, from the snout of 'Base camp glacier' to the top of the ice cap, have been plotted.

From the net balance curves it can be seen that the equilibrium line is at approximately 800 m above sea level on Qapiarfiup sermia compared to approximately 1100 m on 'Amitsulôq ice cap'. This difference in the equilibrium line altitude reflects the shift in climate from Qapiarfiup sermia, 45 km from the outer coast with a maritime environment to 'Amitsulôq ice cap', 150 km inland dominated by the more continental climate of the Inland Ice. It is also clear that the difference lies in the heavier winter precipitation at Qapiarfiup sermia, 1.5 m, against 0.6 m at 'Amitsulôq ice cap', while the ablation only varies from 0.4 to 0.6 m.

A rough preliminary calculation shows that Qapiarfiup sermia had a slight net loss in mass in both 1981 and 1982.

Similar calculations for 'Amitsulôq ice cap' have not been made yet but measurements at the front of 'Base camp glacier' indicate that it has advanced 2.5 to 7 m between 1981 and 1982.

## *Glacier-hydrological investigations*

A glacier-hydrological project was started in 1982 as part of the glaciological investigations at the GGU Tasersiaq field station. The main object of the project is to obtain a better

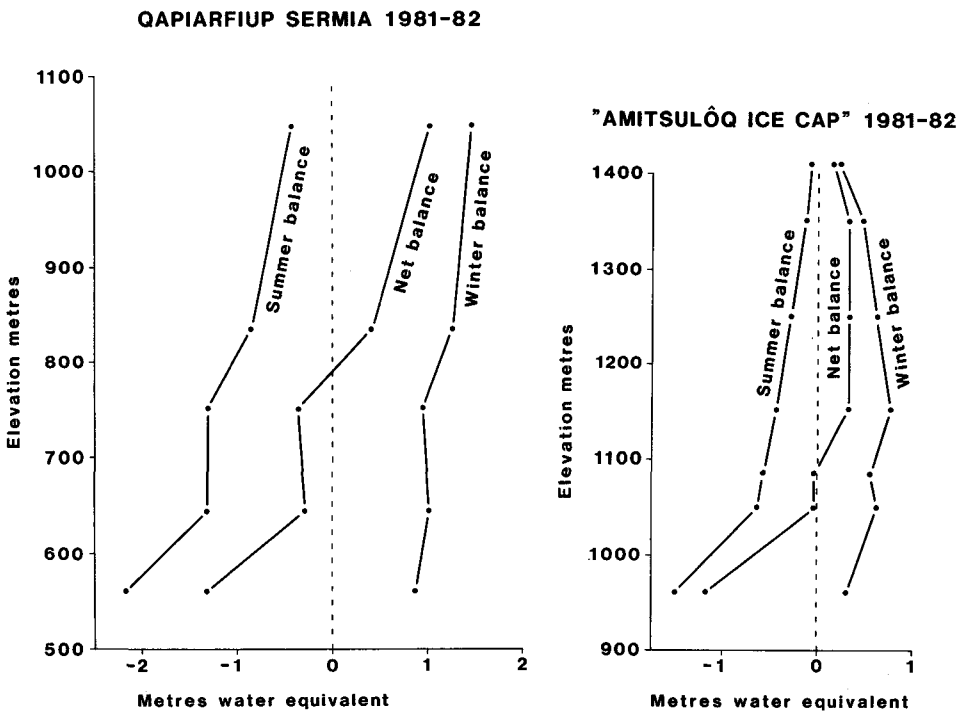


Fig. 42. Winter, summer and net balance in relation to elevation at Qapiarfiup sermia and 'Amitsulôq ice cap' 1981–1982.

understanding of the en- and subglacial drainage of subpolar glaciers. The work is being done by Jørn-Ole Andreasen in connection with a licentiate research project at Aarhus University.

The main investigation is undertaken at an outlet glacier 'Base camp glacier' from 'Amitsulôq ice cap'. The 'Base camp glacier' covers an area of approximately 25 km$^2$. The accumulation area reaches 1400 m above sea level from where the glacier drains eastwards down to 780 m above sea level.

*The programme.* The problems are examined using three approaches: (1) a traditional glacier-hydrological analysis; (2) determination of variations in ice velocity; and (3) meltwater chemistry.

The glacier-hydrological analyses comprise determinations of meltwater discharge and variations in discharge as a function of ablation and climatological elements. A water-level recorder was installed at the meltwater stream from 'Base camp glacier' and the relationship between discharge and water-level was established.

A nearby outlet glacier 'Medial moraine glacier' drains from the Inland Ice and ends in a lake. Another water-level recorder was installed at the outlet of this lake, but no discharge measurements were possible at the site. Both short-period (12 hour) and medium-interval

(one day to two weeks) variations in the ice velocities for seven stakes drilled into the glacier were measured.

Conductivity was recorded in the meltwater stream from 'Base camp glacier' and 'Medial moraine glacier', and a total of 133 water samples were collected for determination of oxygen isotopes and the major cations. During the summer an investigation of suspended sediment transport in the meltwater stream from 'Base camp glacier' was carried out.

*Some preliminary results.* Although only a few measurements have been analysed so far, some preliminary results are quoted.

Ice velocity shows a general decrease of the order of 25–35 per cent during a 2-month period from July to the beginning of September. This is in accordance with measurements at Qamanârssup sermia (Andreasen, 1982) but it seems to refute the idea that the maximum velocity on subpolar glaciers is reached in late summer and early fall (Brzozowski & Hooke, 1981).

Conductivity measurements (fig. 43) show lower values and less variation than temperate glaciers. One should note, however, that the very low values measured in the meltwater stream from 'Base camp glacier' (fig. 43A) can be the result of drainage of en- and subglacial water through two separate drainage systems, fig. 43A thus showing only the englacial part.

## *Climatological investigations*

At the base camp near 'Amitsulôq ice cap' (fig. 41) full climatological observations were made during the summer. On the ice cap this was supplemented by a thermohygrograph station placed at the same altitude as the base camp station (980 m above sea level).

Just below the snout of Tasersiaq glacier, 60 km west-north-west of the base camp station, a second thermohygrograph station was established at about 980 m above sea level. This station was supplemented by an anemometer for measuring run of the wind.

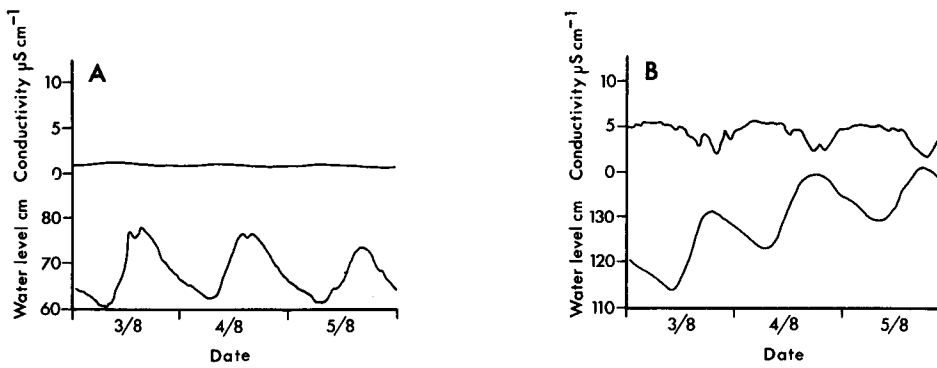


Fig. 43. Conductivity and water level record in 1982. A, At the meltwater stream from the local outlet glacier. B, At the stream from a lake in which the outlet glacier from the Inland Ice calves.

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# Glaciological and climatological investigations at Qamanârssûp sermia, West Greenland

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As part of the GGU programme of investigations in connection with hydropower in West Greenland, glaciological and climatological measurements were continued at Qamanârssûp sermia (inventory number 1CH21002) in 1982. The station was first established in late summer 1979 so that records for three complete summers 1980–1982 are now available. Brief reports on the work have been given by Olesen (1981) and Olesen & Braithwaite (1982) while a more detailed field report and data summary for 1979–1981 is given by Braithwaite & Olesen (1982). A similar report for 1982 is now in preparation.

The sketch map in figure 44 shows the lower glacier together with locations of stakes and survey points. It should be noted that the three highest stakes, numbered 013, 015 and 016, are located off the map to the north-east of Stake 012.

## *Field work on Qamanârssûp sermia*

Although some new additions were made to the field programme, the work was essentially the same as in previous years. Measurements of transient balance were made in the network of stakes which extends up to an elevation of 1500 m. Full climatological observations were made at the base camp, supplemented by a thermohygrograph station at Stake 075 on the glacier and by a new station established on Point 1020. Almost daily ablation readings were made at the three '751' stakes close to the base camp. The routine measurements of potential evaporation at the base camp, made with a Class-A pan and with a Piche-type recorder,