with 100 g crushed granite, by controlled soxhlet extraction at 70° C. This figure is equivalent to 2.7 μeq/l. Although no figures have been given for the specific surface of the sample which was used in his experiments, it can be deduced from the descriptions to be of the order of 4.4 10^{-4} m^2/g, which gives a Na^+ release of approximately 250 $\mu eq/m^2$.

References

Langway, C. C. 1967: Stratigraphic analysis of a deep ice core from Greenland. *Res. Rep. Cold Reg. Res. Engng Lab.* **77,** 130 pp. New Hampshire.

Pedro, G. 1964: Contribution a l'étude expérimentale de l'altération géochimique des roches cristallines. *Ann. agronom.* **15,** 85-191.

HYDROLOGICAL PROJECT AT NARSSAQ BRÆ, SOUTH GREENLAND, AS PART OF THE INTERNATIONAL HYDROLOGICAL DECADE PROGRAMME

Leo B. Larsen

Narssaq river valley constitutes the third Danish representative area investigated in the UNESCO International Hydrological Decade (IHD) (see Larsen, 1970). Field work continued there in 1971 from the beginning of June to the end of August.

As proposed by UNESCO/IASH (1970) a drainage basin selected for a combined balances project should meet the following requirements: (a) the basin should be well defined hydrologically and include a glacier covering at least 30 % of the drainage area, (b) the glacier should be normal in regard to size, accumulation, activity and other characteristics and (c) there should be a possibility of measuring simultaneously heat, mass and water balances for at least three years during the IHD.

Narssaq Bræ meets most of these requirements. The glacier occupies two well-defined cirques which form a compound glacier basin with two individual accumulation areas feeding two coalescing ablation areas. The glacier lobes are situated at different levels and have contrasting exposure and directions of movement. The lowest one (900–1200 m above sea level) has a north-western exposure and the highest glacial lobe (1100–1300 m above sea level) a south-western exposure. About 60 % of the total drainage area of the glacier basin is glaciated.

Heat balance

A climatological station at Narssaq Bræ (1015 m above sea level) yields together with the long-term climatological station in Dyrnæs (15 m above sea level),

information about air temperature, humidity, wind speed and direction, and barometric pressure. Furthermore, sunshine and snow temperature are recorded.

The temperatures recorded this summer were somewhat lower than usual and at Narssaq Bræ monthly mean temperatures above 0° C occurred only in June (0.1°), July (2.1°) and August (0.3°). The ablation season is not entirely restricted to this period but melting in May and September is of minor importance. According to Ahlmanns classification system, Narssaq Bræ is temperate. This definition is somewhat inadequate and it is more accurate to talk about the zones of the glacier. Narssaq Bræ has only a soaked zone and an ablation zone separated by the firn line.

Mass balance

Establishment and regular reading of a network of ablation stakes made up an important part of the mass balance work. Maximum melting occurs at the snout of the lower glacial lobe where all the winter accumulation, plus about 1 m of glacier ice, melt during the ablation season. Towards the head of the glacier melting gradually decreases and the results from this summer indicate that the height-melting relation is expressed as a power function. Similar conditions are found at the high glacier, but the power function for this glacier differs from that of the low glacier because of differences in exposure, gradients, etc.

Another part of the mass balance work consisted of measurement of the water equivalent of the snow accumulation which is the key figure for the hydrological situation of the glacier. The method chosen for these measurements is based on sampling in open pits. This allows the highest accuracy to be achieved and the snow-pits make it possible to study other snow characteristics such as stratification, grain size and shape, snow temperature and humidity and vertical variation of density. The measurements have given important information about the orographic effect in this area. At Dyrnæs annual precipitation at sea level is about 800 mm, whereas at the glacier it is about 2000 mm. The correction factor is 2.5 in this case, but may differ from year to year and certainly differs from place to place. Estimates of the elevation of firn lines should never be made without knowledge of the orographic effect. The elevation of the firn lines is about 1060 m and 1175 m above sea level for the low and high glaciers respectively. This is rather low for the latitude (61° N).

Water balance

All water balance measurements were carried out at three points along the part of the river situated inside the glacier basin. A water stage recorder was placed at the intersection between the Narssaq river and the water divide of the glacier basin. To find the stage-discharge relation several discharge measurements were made by means of the current meter method and the instant rate salt dilution method. The stage-discharge relation is expressed as the power function $Y = 4.51894 \times 10^{-12} X^{6.40823}$

Air temperature and water flow records show that during bright summer weather, the discharge of the river shows a marked diurnal variation. The maximum instantaneous discharge is roughly twice the minimum. The daily peak in discharge usually occurs 5-6 hours after the daily peak in the rate of ice melt. The time difference between the daily peaks in discharge and rate of melt seems not to be the same as the time taken for the water to travel through and underneath the glacier.

References

Larsen, L. 1970: The International Hydrological Decade programme in Narssaq river valley, South Greenland. *Rapp. Grønlands geol. Unders.* **28,** 35-36.

UNESCO/IASH, 1970: Combined heat, ice and water balances at selected glacier basins. A guide for compilation and assemblance of data for glacier mass balance measurements. *Tech. Pap. Hydrol.* **5,** 20 pp. Paris: Unesco.

A PRELIMINARY DESCRIPTION OF THE KLOKKEN INTRUSION, SOUTH GREENLAND

Ian Parsons

Klokken is a small (3 × 2 km), Gardar igneous complex at 60° 56′ N, 45° 05′ W. The intrusion is oval in form and the rock types are arranged in almost perfectly concentric fashion, an outer ring of gabbro giving way inwards via syenogabbros and basic syenites to a strikingly layered body of syenite. Quartz occurs in druses and in aplites and pegmatites, so that although the complex lies only 1 km south of the Igaliko nepheline syenites (Emeleus & Harry, 1970), it is oversaturated and should not be regarded as a satellite of Igaliko. Klokken was visited in 1959 and 1960 by K. Ellitsgaard-Rasmussen in whose field notes many of the observations presented here may be found. The object of the 1971 field work was to obtain comprehensive specimen coverage, to look closely at the remarkable field relations and to extend the detail of the mapping.

The complex has sharp contacts with the surrounding Julianehåb granite and the existence of substantial protrusions, roof pendants and rotated xenoliths of country rock can be demonstrated. Hornfelsing and local mobilisation of the country rock has occurred.

The gabbros

An outer zone of gabbro up to 200 m wide forms a partial ring which broadens towards lower levels and is absent at high levels at the south-east margin. Fine-