Radio Echo Sounding in western Dronning Maud Land, 1972

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Introduction

For the second consecutive year a radio echo sounding programme was implemented in western Dronning Maud Land by the South African National Antarctic Expedition. The traverse initially planned for 1972 (from Borga Base along the seismic line of the Norwegian-British-Swedish Antarctic Expedition (1949-52) to the Polar Plateau) was shelved, and a shorter traverse in roughly the same region, across the Pencksokket to Enden in the Kirwanveggen at the foot of the Polar Plateau (Fig. 1) was undertaken. From Enden the traverse route returned to a point 30 km due west of Isbrynet and then back to Borga Base. In addition soundings were also made along the route from Borga Base to Sanae.

Equipment

The Scott Polar Research Institute Mk II radio echo sounder described by *Schaefer* (1972) was again used. With a pulsed power output of 500 watts at 35 MHz, echoes from as deep as 1,7 km could be resolved.

In order to increase the gain of the system and also to cut down on some of the side lobes, an extra folded dipole antenna array was fitted to the Geophysical Caboose at the beginning of 1972. This was fed in parallel with the existing antenna and gave a vertical gain of approximately 3 dB for the array. Except for this change the equipment was as described by *Schaefer* (1972, 1973).

Navigation over the traverse route was done by the Expedition's surveyor. Across the Pencksokket, distance measurements were taken with a Tellurometer for the establishment of a stake line to determine ice flow. From these an odometer correction was obtained which allows for highly accurate positioning of the various stations and thus of the profiles obtained from the echo sounding record.

Snow surface altitudes were taken every kilometre with a Fuess Barolux barometer. By referring to the barometric records of Sanae, reasonably accurate altitude determinations are possible, making interpretation of the radio echo sounding data more meaningful.

General

The effectiveness of radio echo sounding is very much dependent on the temperature of the ice, which influences the dielectric constant of the ice. On the above traverse, ice temperatures in the Pencksokket measured in auger holes 5 to 10 metres deep were between —29°C and —31°C, giving an absorption figure of 2 dB per 100 m. Another factor governing the effectiveness is size and type of antenna. A multiple antenna capable of high gain at a frequency of 35 MHz would be large, cumbersome and easily prone to breaking from wind or vehicle motion, and could thus not be used.

The interface reflection coefficient also plays an important role. A typical figure of —14 dB to —20 dB of energy return can be expected from an ice-rock interface. When the ice is floating, virtually total reflection could occur at the ice-water interface, but this rarely happens in practice because the roughness of the interface reduces the reflected component, and the energy return is further reduced as a result of impurities and inhomogeneities in the ice.

Measurements and Results

Over 600 km of continuous sounding were completed in the summer months of November and December, 1972. The preceding time was spent on geological and cartographical work, and the solving of a few minor technical problems with the echo sounder.

The 230 km traverse to Enden and back gave reasonable results although the depth of the Pencksokket proved to be beyond the maximum range of the echo sounder. The results are presented in Fig. 3 in the form of profiles along the traverse lines shown in Figs. 1 and 2, and are discussed below.

From Borga Base south to Nunatak 2045 in the Pencksokket the records (profile AB) are very confused, partly because of multiple echoes from the close proximity of Huldreslottet and also because the film was sticking in the camera drive. A sharp

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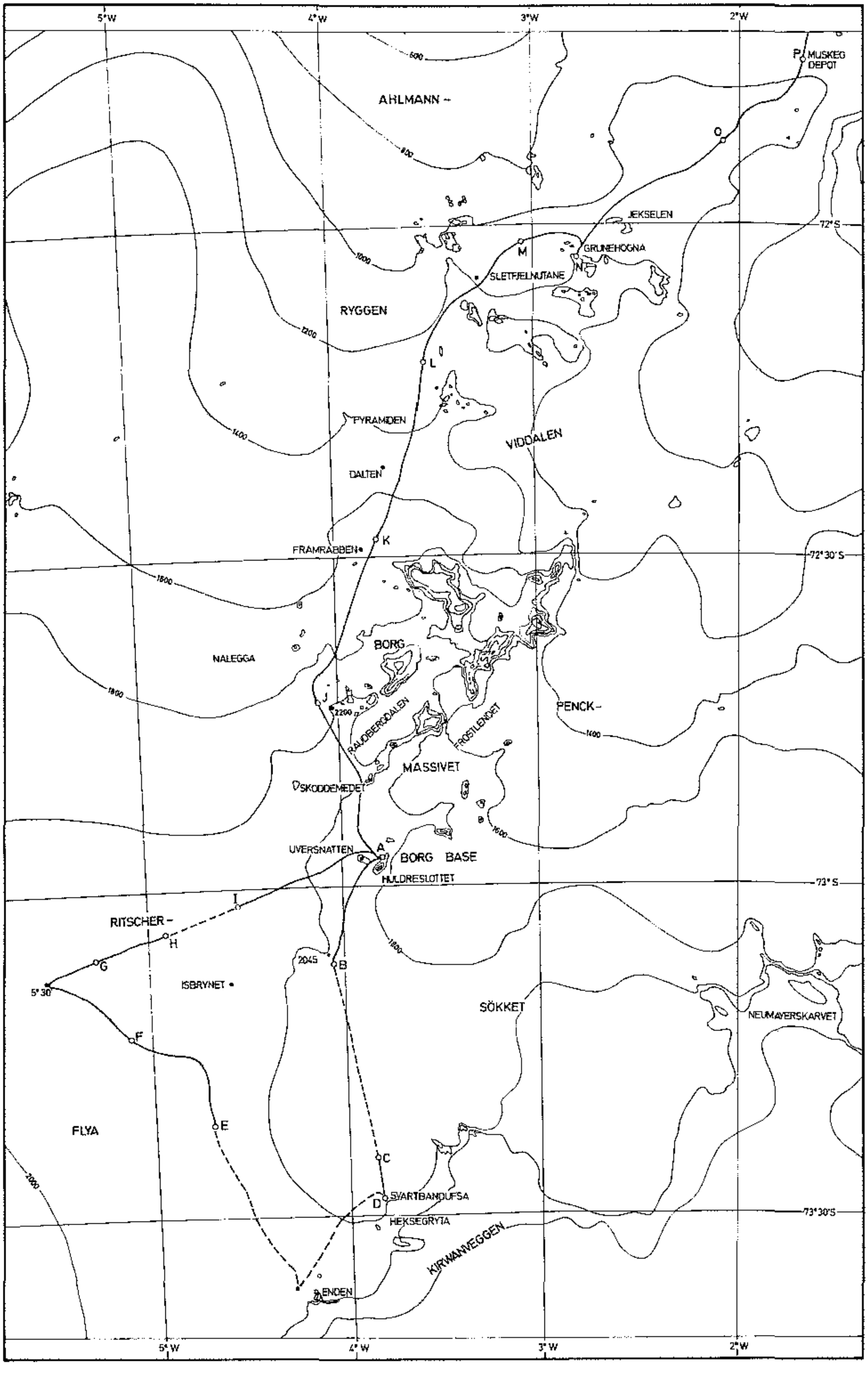
5°W
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P MUSKEG DEPOT
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SKODDEMEDET
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A
BORG BASE
HULDRESLOTTET
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I
RITSCHER -
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2045
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5°30'
ISBRYNET
SÖKKET
NEUMAYERSKARVET
F
FLYA
E
2000
C
SVARTBANDUFSA
D
HEKSEGRYTA
73°30'S
KIRWANVEGGEN
ENDEN
5°W
4°W
3°W
2°W

subglacial peak just before Nunatak 2045 indicates the western boundary of the Pencksokket and the bedrock then dips away steeply to go beyond the echo sounder's range as the route crosses into the Pencksokket. From here on there are no records until near Heksegryta. However, *Robin* (1958) in his seismic line to the north-east measured ice depths of up to 2,35 km for this area. Just before Heksegryta is reached the bedrock comes up steeply, probably from below sea level, to form Svartbandufsa nunatak (profile CD).

The traverse then went further south-east along the Kirwanveggen to Enden and from there turned north-west (profile EF) to a point 72° 08′ S, 5° 30′ W, due west of Isbrynet. Just before this point there is an interesting graben-like valley in the subglacial range that forms the north-western boundary of the Pencksokket (profile FG).

From this point to Borga Base the records show an undulating terrain (profile GH) with a deep valley (profile IA) as Uversnatten is approached. This could indicate an extension of the Frostlendet into the Ritscherflya.

The records of the journey from Borga Base to Sanae show the Frostlendet and Raudbergdalen as extremely deep valleys (profile AJ), but they do not descend below sea-level. From here on to Sletfjellnutane the records show undulating topography except for the ridge at Dalten (profiles JK, KL and LM). From Sletfjellnutane to Sanae (profiles MN to WX) the results agree with those obtained by the previous expedition (*Schaefer*, 1973) and also fill in some missing records. Discrepancies do exist, but these can be attributed to the very rugged subglacial terrain and the fact that the routes between marker points are not exactly the same.

At the point where the ice shelf is grounded near Eskimo Ice Rise (profiles ST and TU) it can be seen clearly where the interface changes from ice-water to ice-bedrock. *Van Autenboer & Decleir* (1972) have discussed this fully and the present results are in exact agreement with those obtained by them from airborne observations in 1969.

Acknowledgements

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Fig. 1 (left). Route traversed between Muskeg Depot and Kirwanveggen.

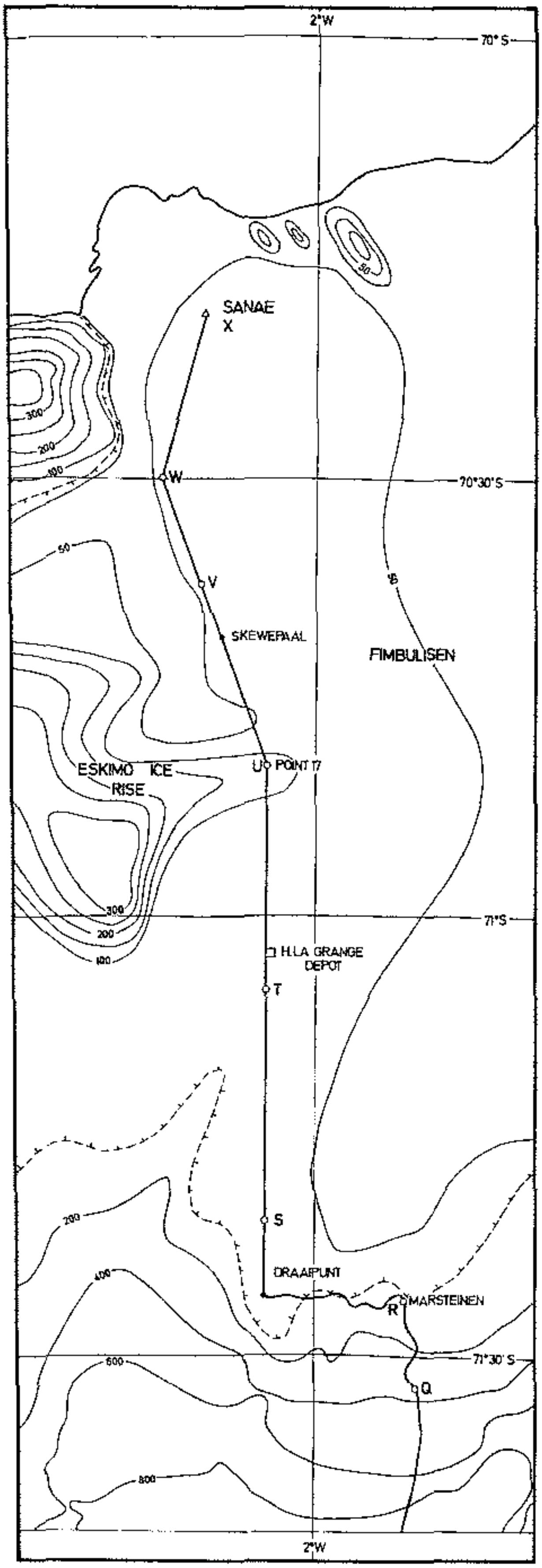

Fig. 2. Route traversed between Muskeg Depot and Sanae.

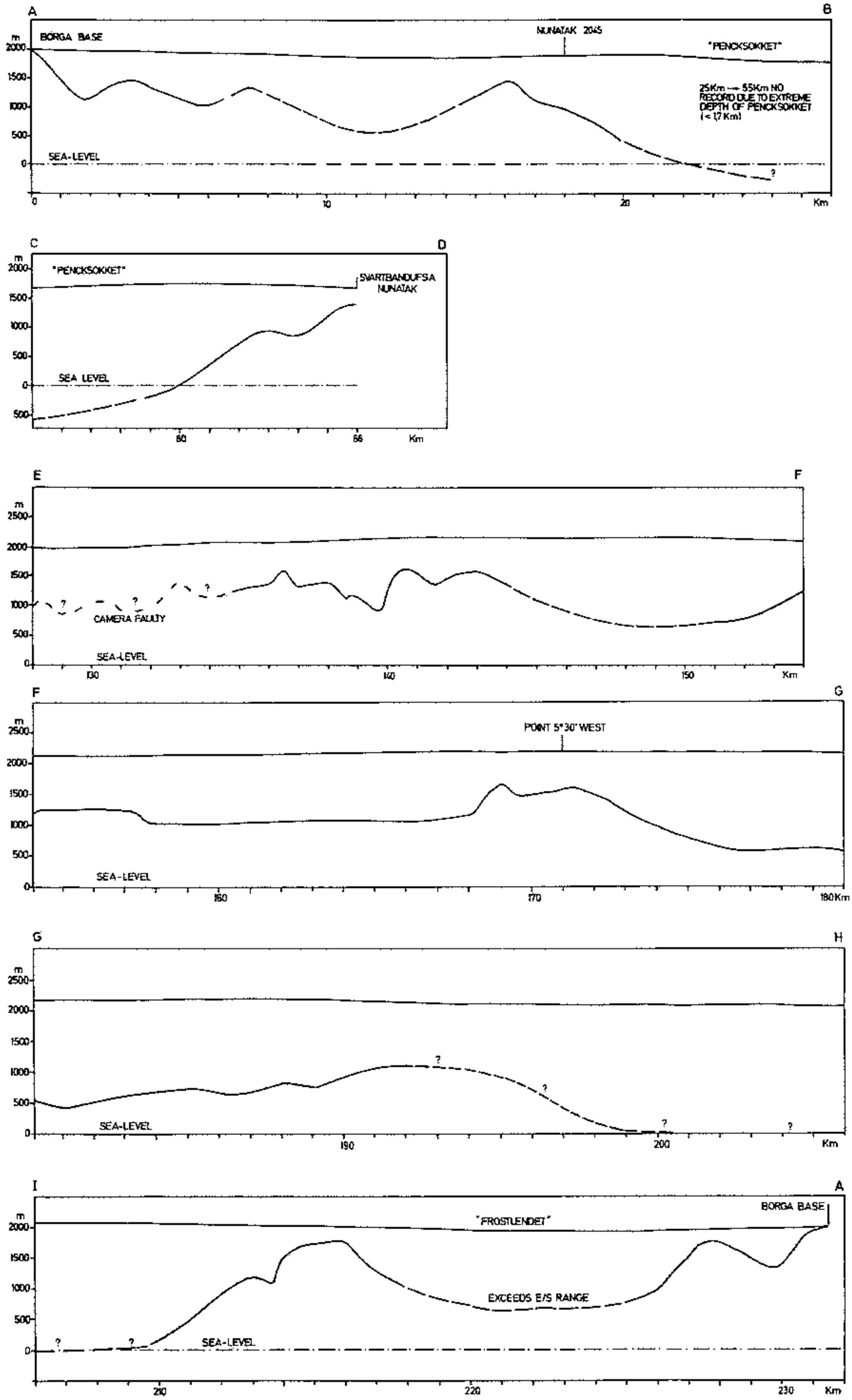

Fig. 3. Profiles of surface and subglacial topography.

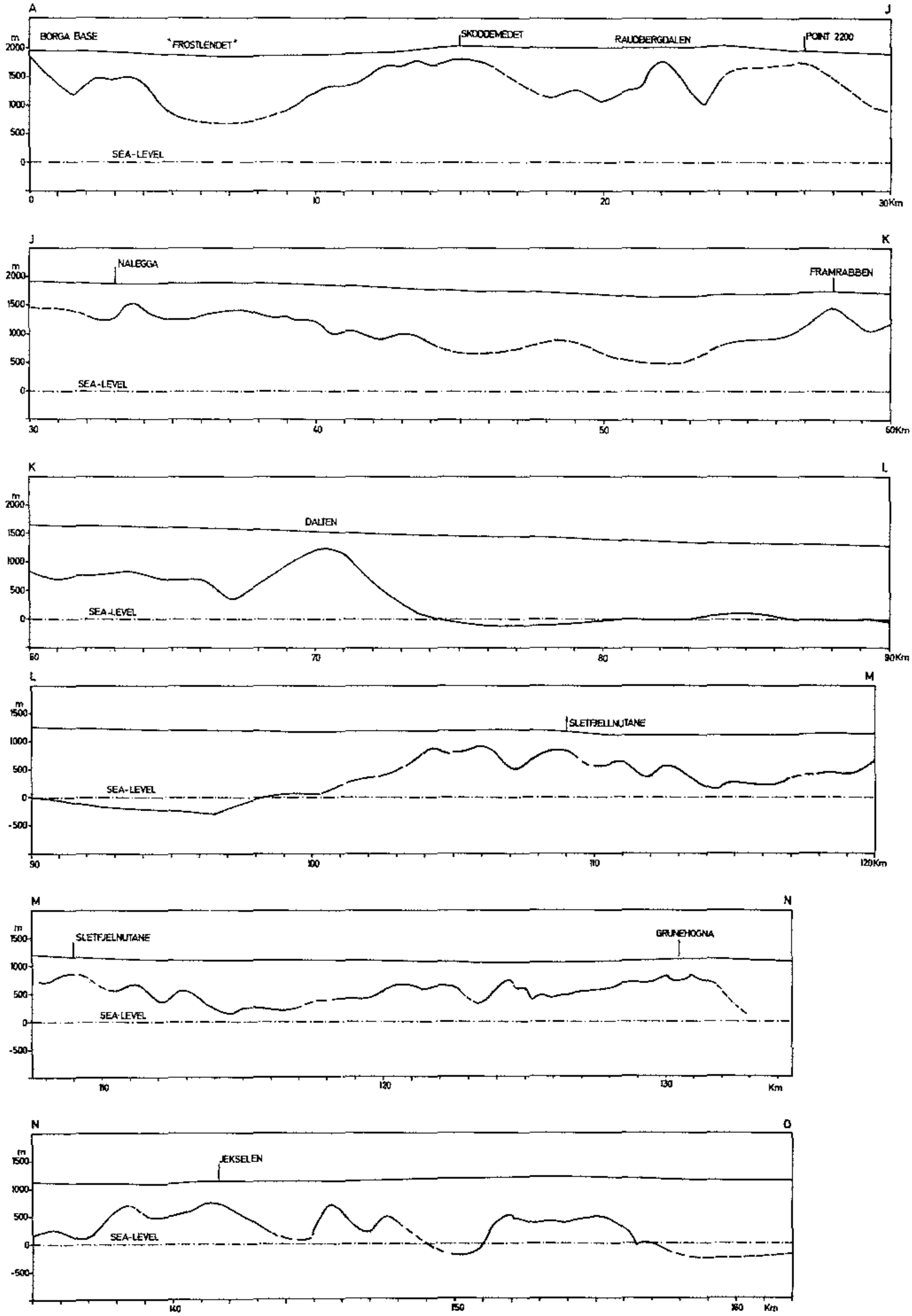

Fig. 3 (continued). Profiles of surface and subglacial topography.

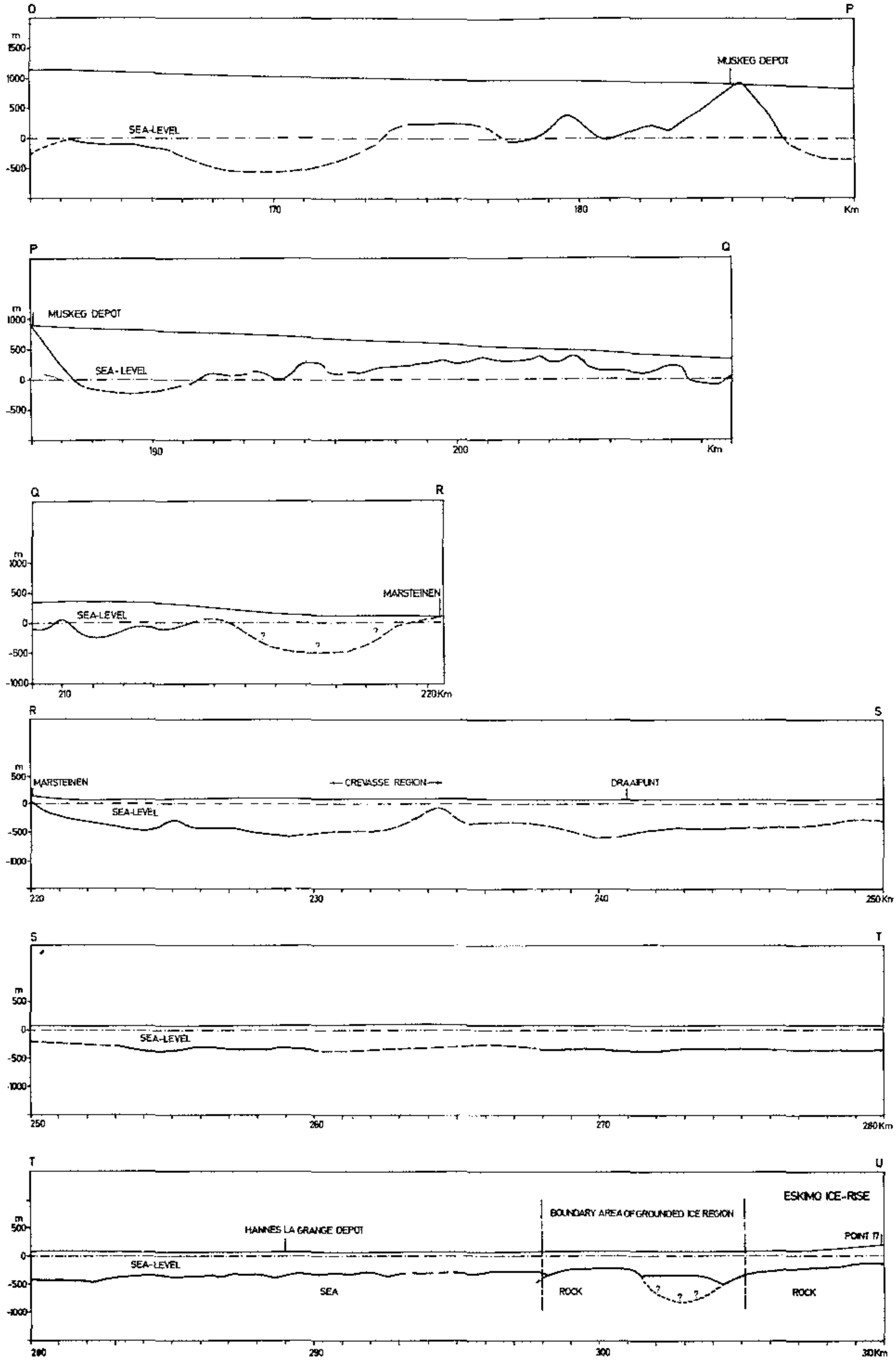

Fig. 3 (continued). Profiles of surface and subglacial topography.

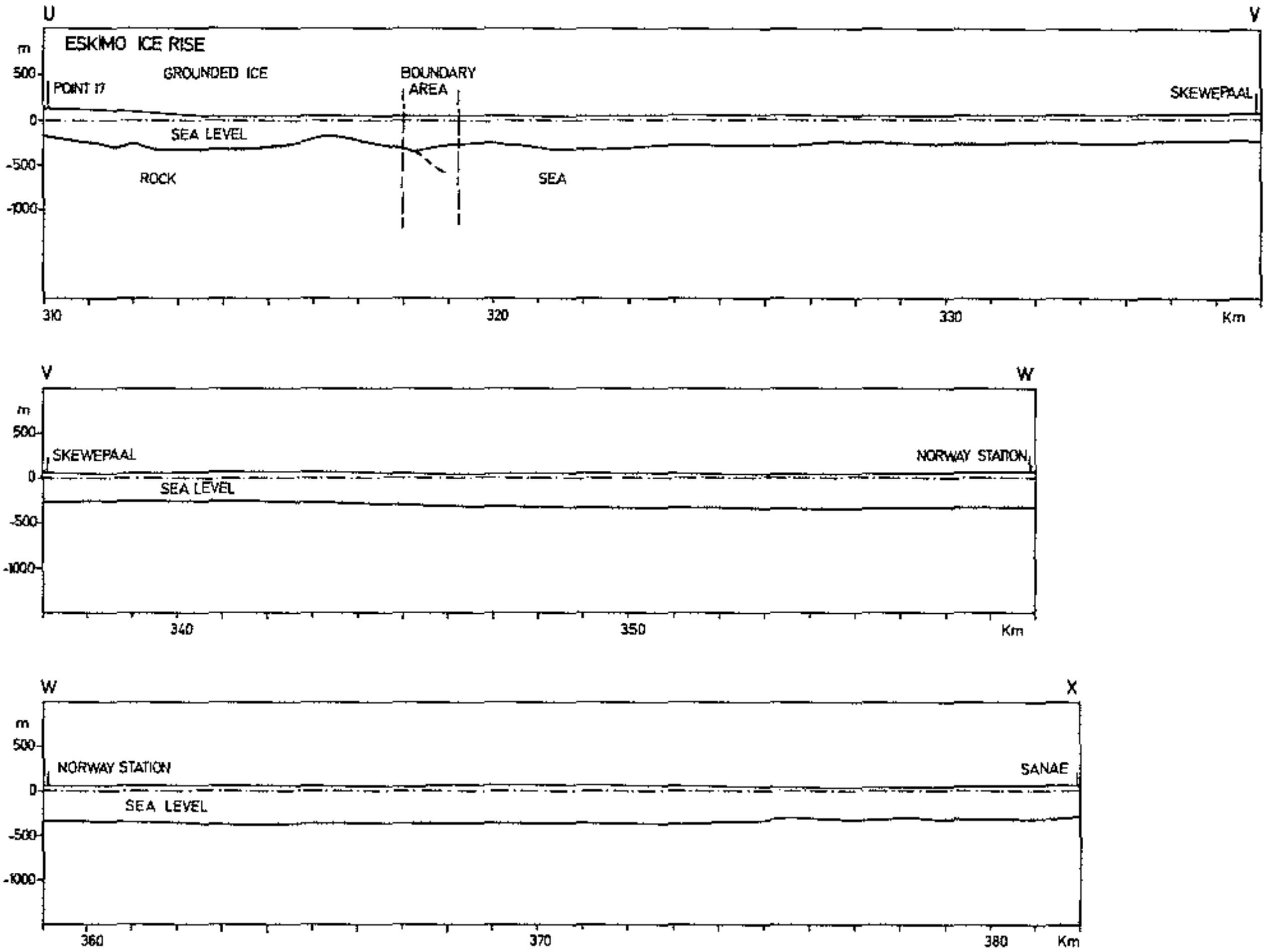

Fig. 3 (continued). Profiles of surface and subglacial topography.

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