Geophysical Traverses in the Ahlmannryggen, western Dronning Maud Land, 1973

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Introduction

During the southern summer of 1973-74 geophysical traverses totalling 670 km were made on the inland ice sheet in western Dronning Maud Land (Figs. 1 and 2) with the primary objects of determining ice thickness and the subglacial topography.

Field equipment and procedures

In order to calculate the elevation of the rock sub-surface and ice thickness, the elevation of the snow surface had to be determined. The technique used was the single-base method described by *Schaefer* (1971). On account of local weather conditions between the field station and the base station this method is subject to some error, which rarely exceeds 5% *(Schaefer*, 1971).

For the radio echo sounding the same equipment and techniques described by *Schaefer* (1972) were used. In general the equipment performed well, and with the exception of the traverses between Pyramiden and Juletoppane the results are considered satisfactory. The average maximum range of the echo sounder was found to be 1 500 m, and consequently the true elevation of the rock sub-surface could not be measured in a few places. At intervals of 0,5 km the ice thickness was read off the continuous record on the recorder film and plotted on the profiles shown in Fig. 3.

Gravity measurements were made at intervals of 3 km along all traverses. This was done to supply a means of calculating ice thickness if the echo sounder failed to obtain a return, and also to test the reliability of gravity data in the determination of ice thickness and subglacial topography.

The instrument used was a Worden Master gravity meter (No. 576) with a small dial constant of 0,1004 mgal per scale division. The range of this instrument was not sufficient to allow the geodetic dial to remain unchanged, and a number of different geodetic dial constants had to be used. Drift was rather high, and varied between 0,135 and 0,201 mgal per hour. On particular traverses the drift rate was fairly constant, and the high drift is not considered to have had a marked influence on the accuracy of the measurements.

Gravity data for Grunehogna were tied in with the gravity base station at Peak 1320 (established in 1971 by the Norwegian Summer Expedition). The free air gravity at Grunehogna was determined as 982,85390 gal. Free air anomalies for all stations are shown in Fig. 3.

Changes in free air anomaly from station to station have been plotted against changes in bedrock elevation between the same stations (Fig. 4) in an attempt to find a simple factor with which to relate free air anomalies to rock elevation. The regression line shown in Fig. 4 was found by the method of least squares and has a value of 17 m/mgal. However, the use of this factor for calculating bedrock surface elevation gave unrealistic results, pointing to the existence of a marked regional gravity gradient.

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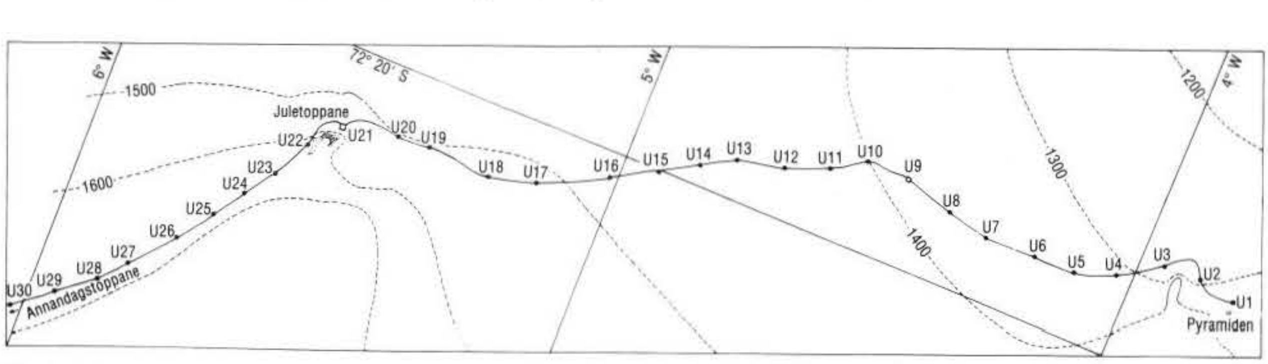


Fig. 1. Route traversed between Pyramiden and Annandagstoppane.

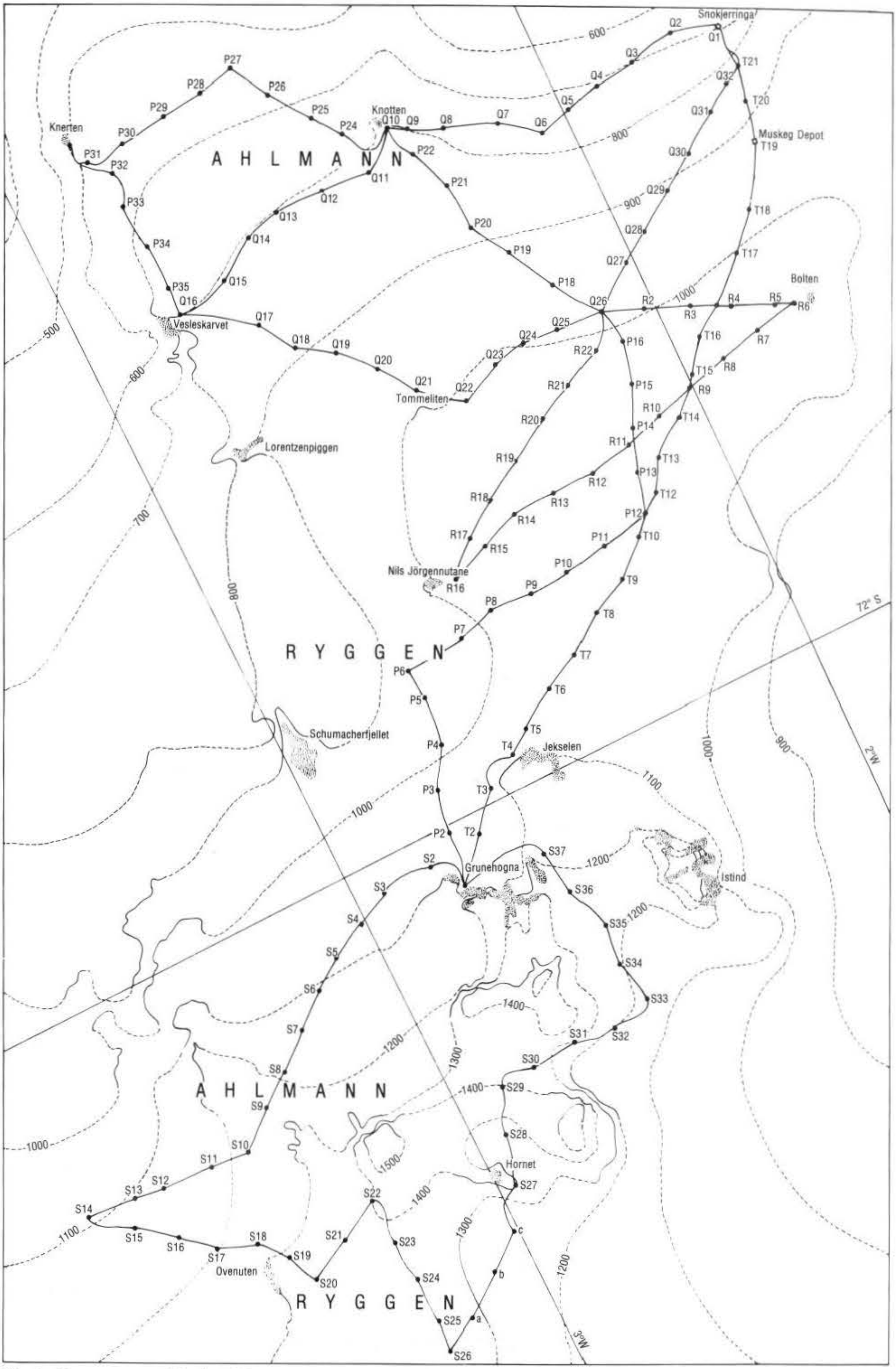


Fig. 2. Routes traversed in the Ahlmannryggen.

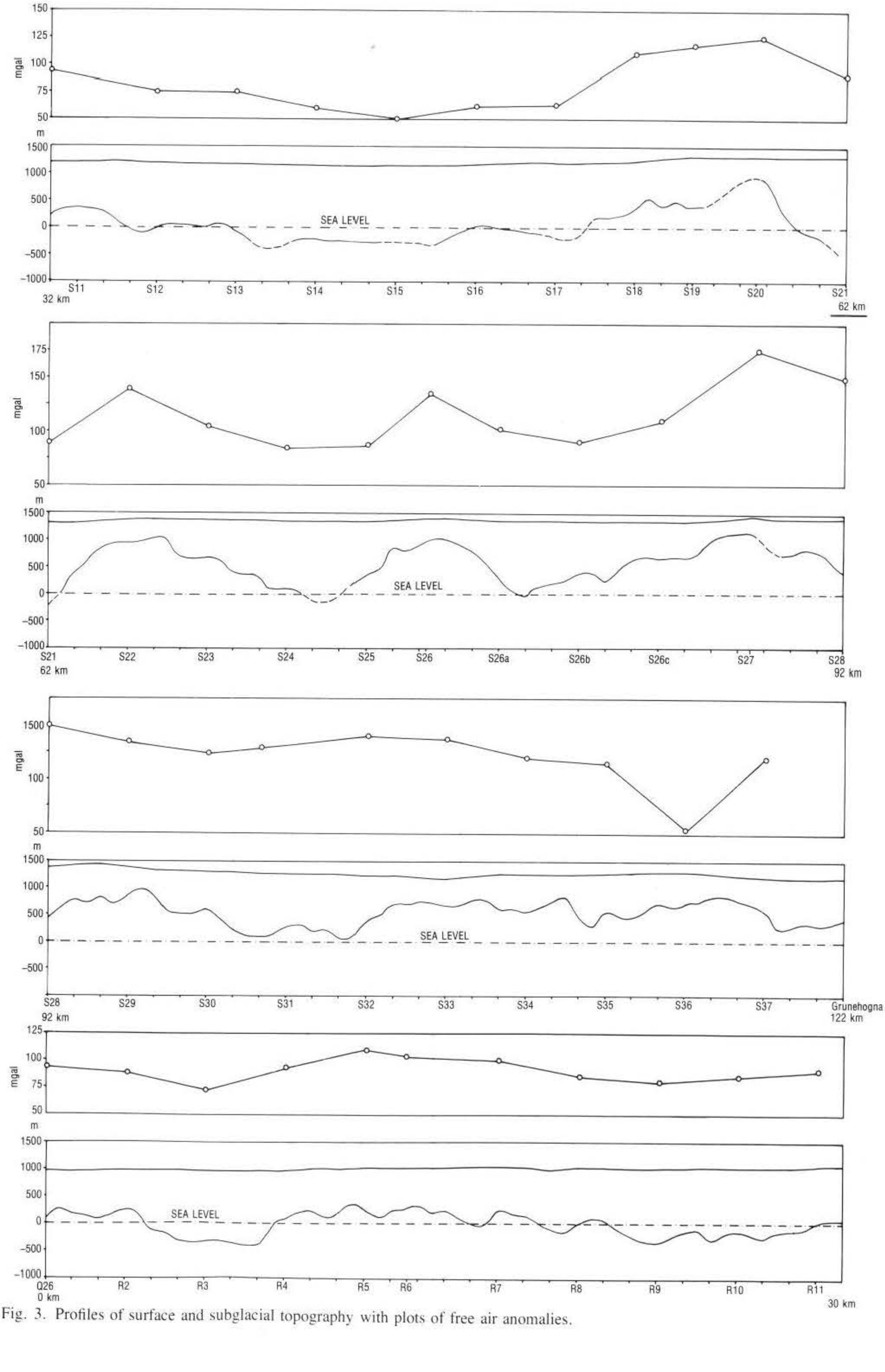


Fig. 3. Profiles of surface and subglacial topography with plots of free air anomalies.

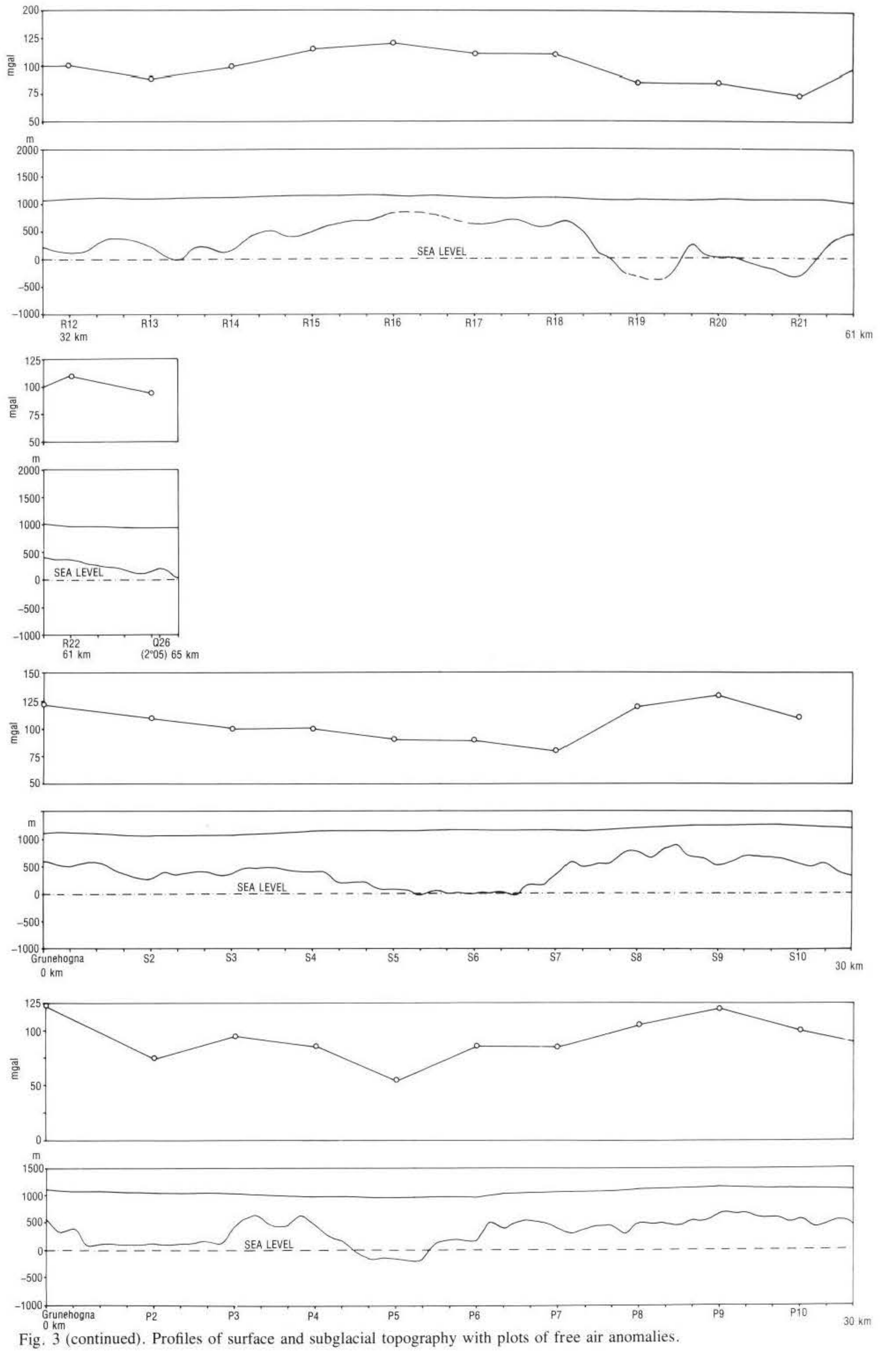


Fig. 3 (continued). Profiles of surface and subglacial topography with plots of free air anomalies.

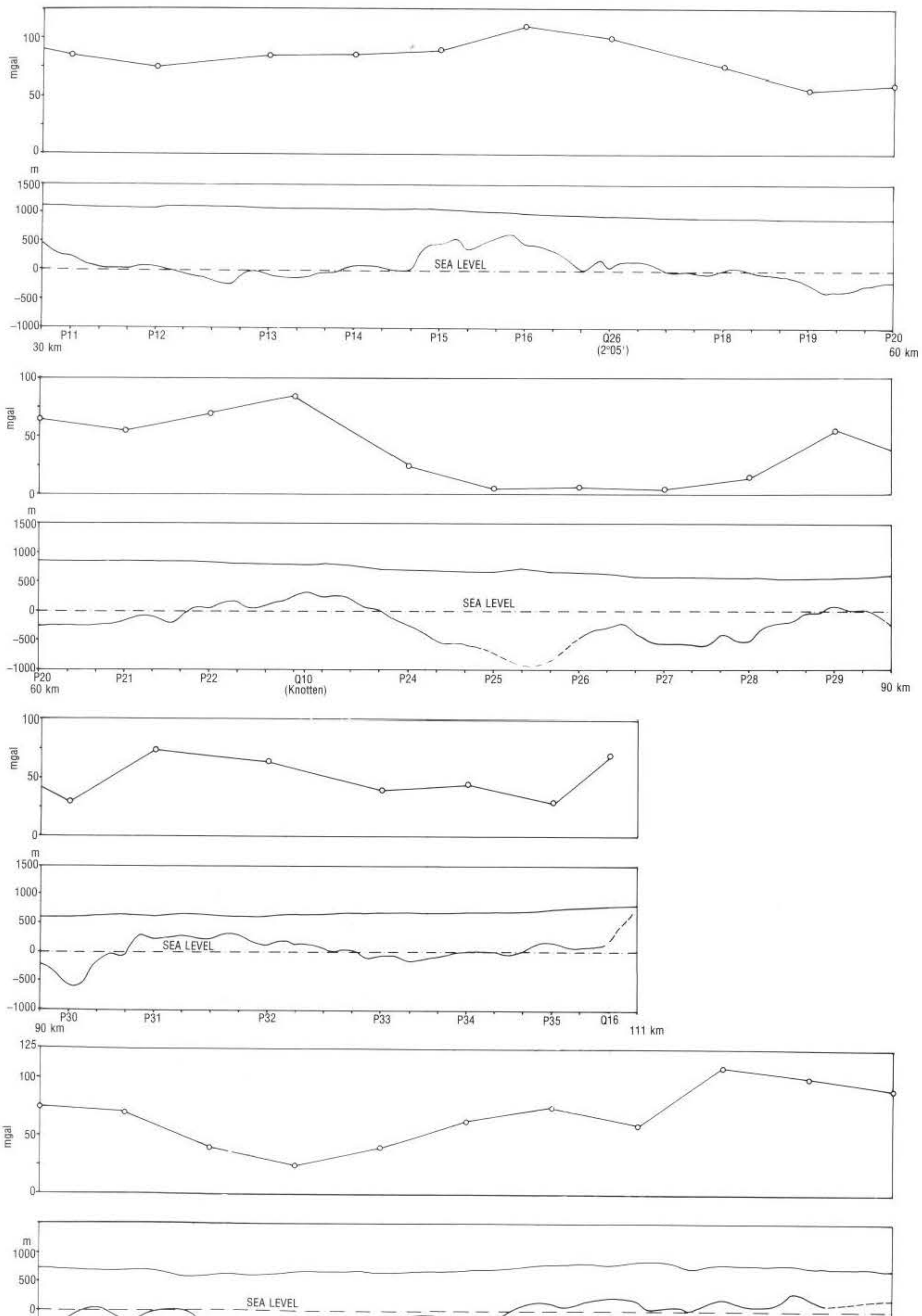


Fig. 3 (continued). Profiles of surface and subglacial topography with plots of free air anomalies.

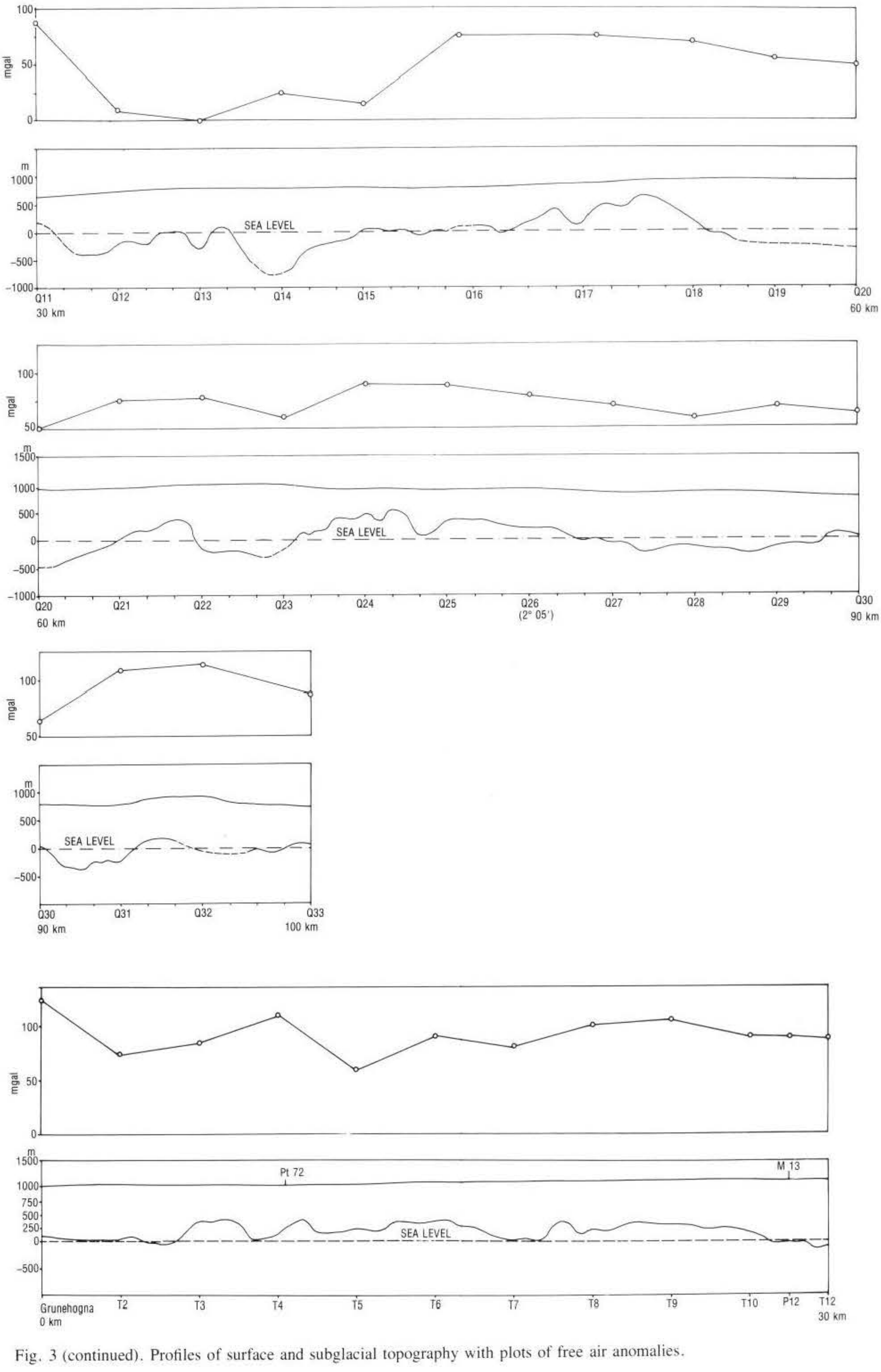
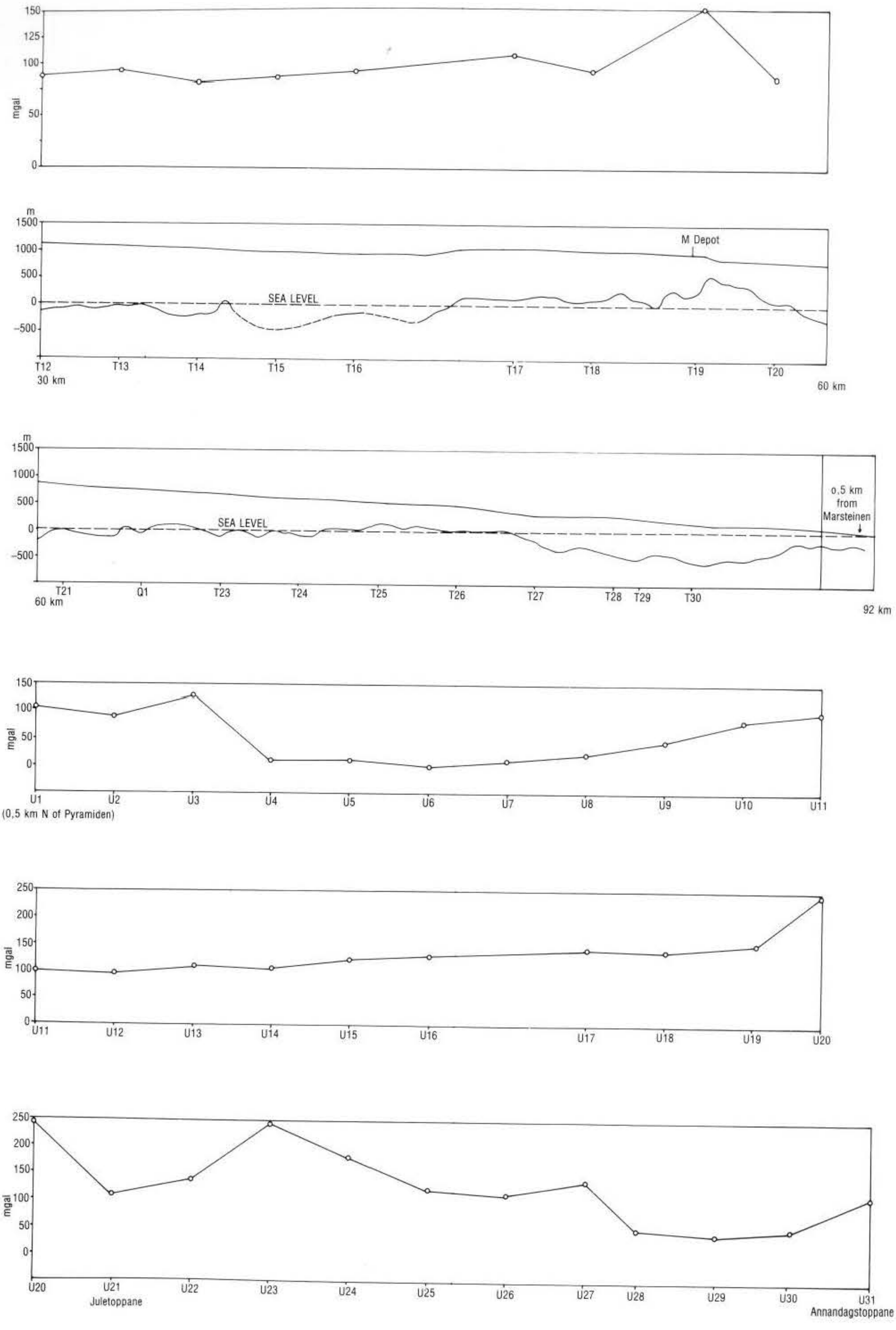


Fig. 3 (continued). Profiles of surface and subglacial topography with plots of free air anomalies.



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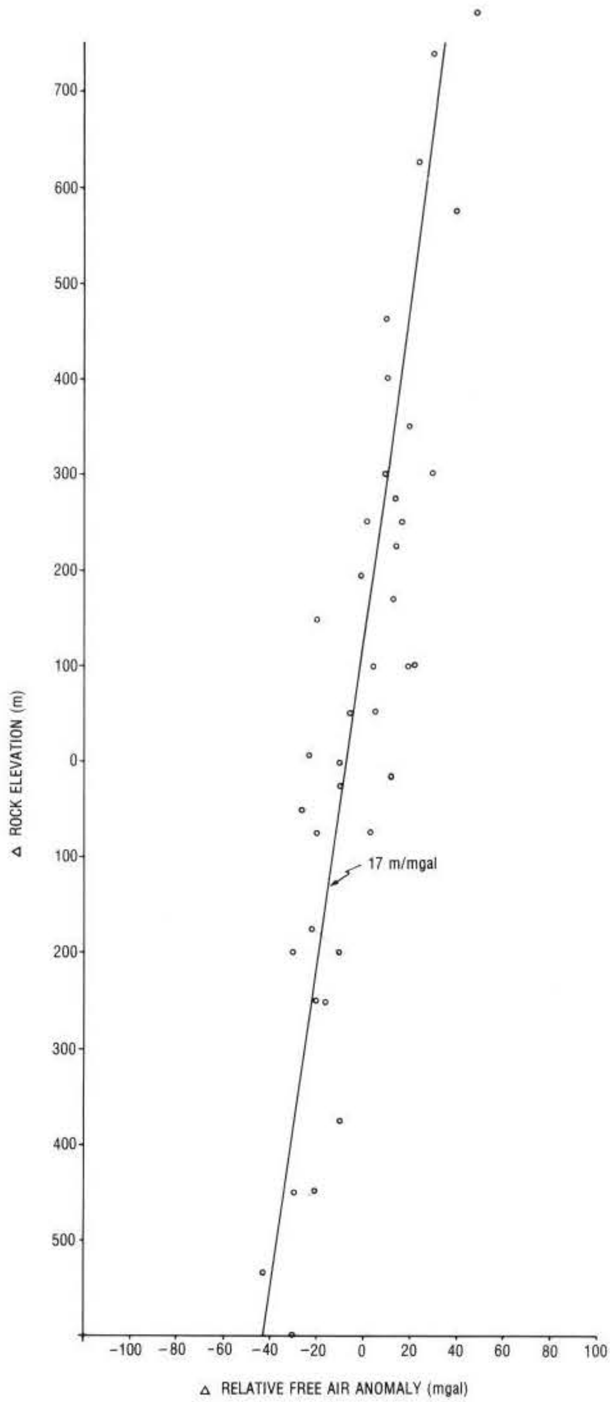

Fig. 4. Regression of rock elevation on free air anomaly.

Conclusions

It is clear that the subglacial coastline of this part of Dronning Maud Land is highly irregular. From the profiles it may be seen that the floor of the eastern side of the Schyttbreen is below sea level. The same probably applies to the Jutulstraumen, and the Ahlmannryggen is therefore actually a long peninsula. The profiles indicate that the isolated nunataks of Knerten, Knotten, Krylan, Marsteinen, and Vesleskarvet are islands surrounded by areas below sea level.

Acknowledgements

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References

Schaefer, T.G. Barometric altitude determinations. Annual Report, Series 1204. Geological Survey, Pretoria, 1971.

Schaefer, T.G. Radio echo sounding in western Dronning Maud Land, 1971 – a preview. *South African Journal of Antarctic Research*, no. 2, 53-56, 1972.

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