

Bathymetry and Geomorphology of the Approaches to *Dakshin Gangotri*, Princess Astrid Coast, Queen Maud Land, Antarctica.

H. N. Siddiquie¹ and M. C. Pathak¹

ABSTRACT

The continental margin of the Princess Astrid Coast has been poorly surveyed earlier and very few depths have been shown on the navigational charts. The depths along the route undertaken by the First Indian Expedition ranged from about 740 m at the northern edge of the ice pack (January 1982) to 224 m at the ice shelf. The route has been found to be safe for navigation except for the presence of seasonal ice cover and large semi-permanent icebergs. The characteristic feature of the topography in the area is marked by a sill at about 120 m depth which separates the deeper open ocean (>700 m) in the north and more than 200 m (even 700 m) in the south. The position of the sill is marked by the grounding of numerous icebergs. The sill perhaps plays a significant role in the separation of water masses of the area and even in the development of polynya.

INTRODUCTION

Several expeditions undertaken earlier have added considerable knowledge to the bathymetry of the continental margins of Antarctica. However, inspite of the large number of expeditions, the data on the bathymetry of the Antarctic continental margin are still scanty. The continental margin of Antarctica, between 10° to 30°E, has been shown on a small scale chart with limited soundings (1:15,00,000).

MV *Polar Circle* which took the First Indian Expedition was equipped with a satellite navigation system collected over 17000 line km of echosoundings of which more than 7700 line km were in Antarctic Treaty Area, 350 line km in the area covered by the ice pack and polynya (in December 1981 and January 1982). The polynya at the time of the survey extended approximately from 69°37' to 69°55'S and 11°35' to 11°55'E and covered an area of over one thousand km². The open waters were, therefore, utilised for an extensive bathymetric survey. Since no bathymetric data have been shown earlier on the published navigational charts, these are presented here. Bathymetric data of the remaining area are also being processed and these will be published separately.

METHODS

- (a) Position fixing : Positions during the surveys were obtained by a Magnavox MX 1112 (single channel) satellite navigation system interfaced with a gyro and speed log. This provided an accuracy of about ± 150 to 300 m which is considered sufficient for a reconnaissance survey.
- (b) Echosounding: Echosounding was carried out using a Simrad EKS-12 echosounder having a maximum depth range of 10,000 m with a Simrad 1100 recorder (20 cm wide dry paper).

RESULT AND DISCUSSION

The depth at the northern edge of pack ice in December 1981-January 1982 (Lat. 69°15.48' Long. 11°3.6'E) were about 740 m. To the south, the depth is reduced to about 120 m (sill) after which the depth increases again to more than 220 m (Fig. 1). The shallow depth of about 120 m perhaps forms a sill and is marked by grounding of numerous icebergs.

The sea bed from the northern edge of the ice pack to the polynya (Fig. 2a) has a gradient from 1:1500 to 1:57. This is marked by minor irregularities of the order of about 10 m. However, the sea bed from the southern edge of the pack ice to the base of the sill is relatively devoid of irregularities and has gradients of

¹ National Institute of Oceanography, Dona Paula, Goa - 403004.

1:100. The northern flank of the sill has gradients of the order of 1:50 and irregularities of the order of 10 m. The southern flank of the sill is not very steep (1:100) and further south towards the ice shelf, it becomes almost flat (1:4000). The depths further south increases to 220 m. and excepting some irregularities of about 15 to 20 m, the sea bed in the area is devoid of significant topographic features.

In the polynya, because of a number of icebergs, small lines, only upto 10 km, could be surveyed. The sounding indicate that the depth in the polynya and along the ice shelf is about 220 m, although in the east, depths of about 172 m were also recorded. The seabed in the polynya is devoid of large irregularities and the only irregular features of about 5 m and rarely of more than 10 m could be seen (Fig. 2b).

The route followed by the expedition was considered to be safe for navigation except for the presence of seasonal ice cover and semi-permanent icebergs.

The sill at about 120 m depth appears to be a major topographic feature. It was observed that a large number of icebergs were grounded at this depth. The height of the ice shelf was about 100 m in January 1982. Earlier Buinitskii (1964) had observed that the height of the ice shelf above water in this area ranges from about 107 to 160 m.

It is thus apparent that a break-up of the shelf ice during the summer may lead to the formation of large icebergs which will run aground on the sill. Voronov and Koblents (1965) recorded a similar grounding of icebergs in the vicinity of Mirny station on the Hasswell sill at a depth of about 200 m. During the present cruise, only one track could be surveyed and hence it has not been possible to indicate the direction and lateral extent of the sill. Seismic surveys conducted at the Lazarev ice shelf (Bakaev, 1966) indicate the thickness of the ice shelf ranges from about 200 to 500 m. The depth of the sea bed below the ice shelf varies from 200 to 750 m and in some areas, the ice rests on peaks which rise sharply from the sea bed. It would thus appear that the large fragments of ice, broken from the ice shelf, form icebergs, which are grounded on the sill. Thus, the sill, to a large extent, controls the thickness of the icebergs released to the north of this area. The sill probably not only grounds the icebergs but it may possibly control the movement of the water in the area. It may even influence the formation of polynya.

REFERENCES

- Bakaev, V. G., Editor, (1966)
Atlas of Antarctica, Chief Organisations for Geodesy and Cartography of the USSR (In Russian), 225 p
- Buinitskii, V. Kh., (1964)
Lazarev ice shelf, its morphology and origin. In : *Soviet Antarctic Expedition, Informaion Bulletin*, Vol. II. Elsevier Publishing Co., Amsterdam, 215-218.
- Voronov, P. S. and Koblents, Ya. P. (1965).
Iceberg drift as an aid in the study of the relief of the Antarctic continental shelf. In : *Soviet Antarctic Expedition, Information Bulletin*, Vol. III. Elsevier Publishing Co., Amsterdam, 248-252.

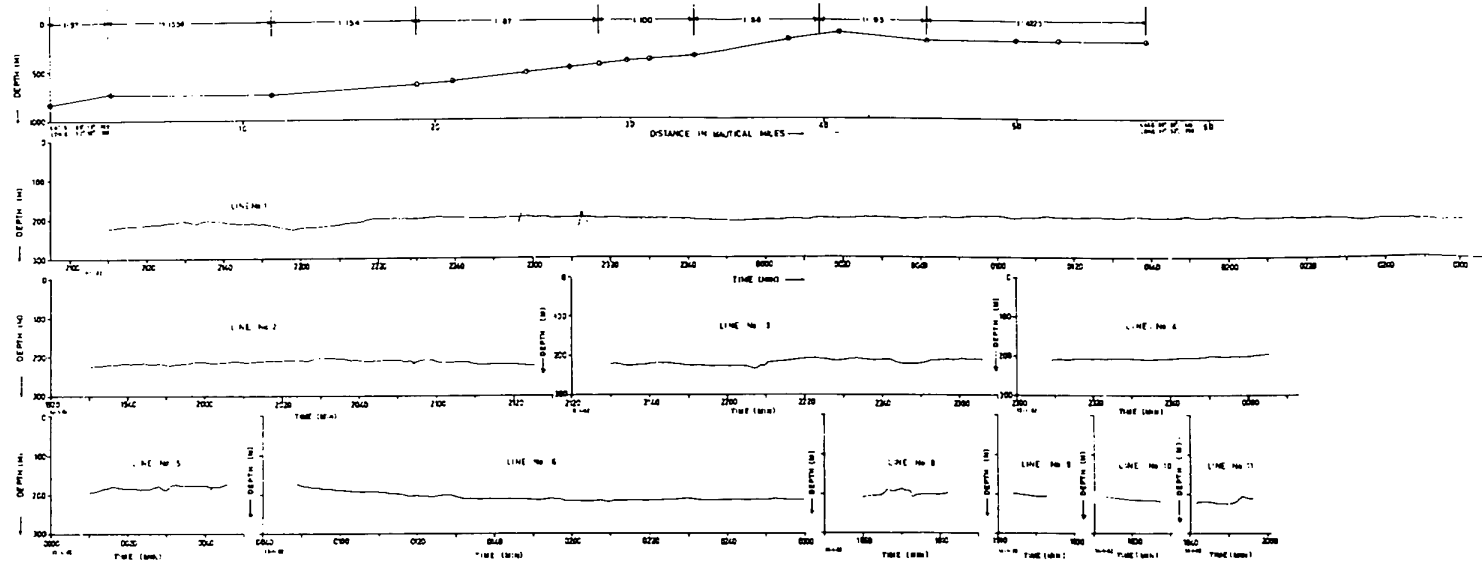


Fig. 2 : Selected profiles — Approaches to *Dakshin Gangotri*
 (a) Sea bed from the northern edge of the ice pack to polynya. (b) Sea bed from the southern edge of the pack ice to the base of the sill.

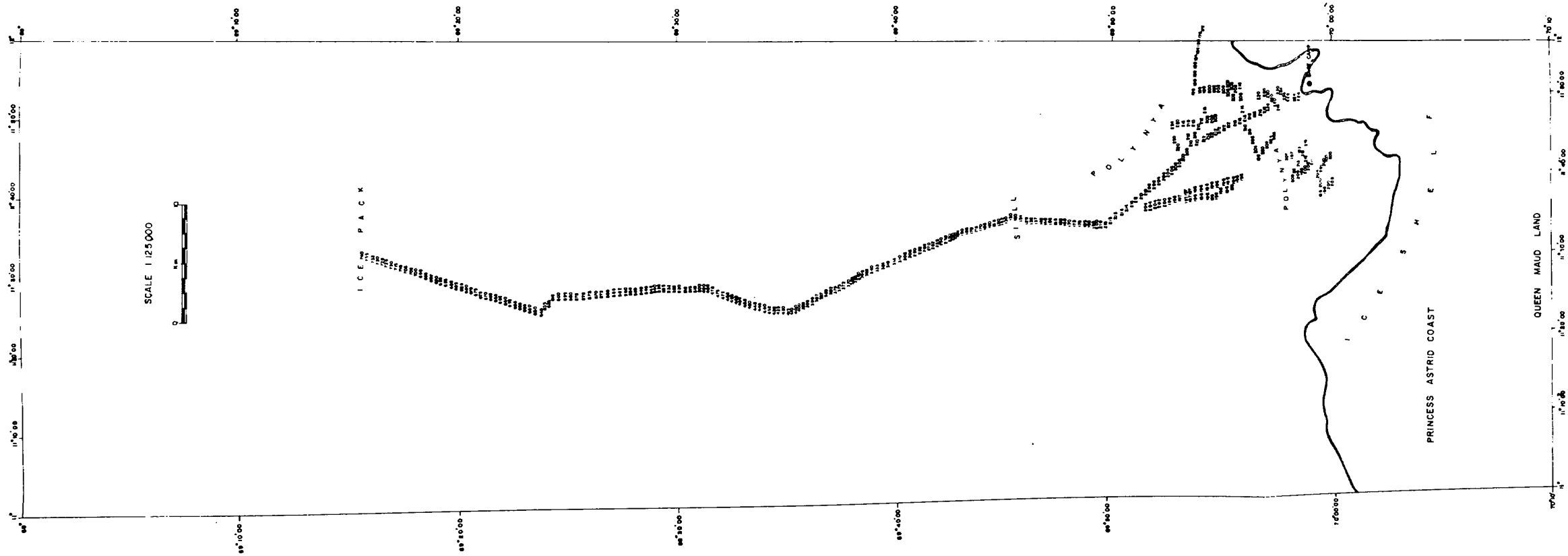


Fig. 1 : Bathymetry of approaches to *Dakshin Gangotri*.