Proc. NIPR Symp. Antarct. Geosci., **8**, 213-218, 1995

PRELIMINARY REPORT ON SUBMARINE TOPOGRAPHY AROUND THE ONGUL ISLANDS, EAST ANTARCTICA

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Abstract: Sounding of the sea floor around the Ongul Islands was conducted. 410 depth data were newly obtained in the sea area from south to west of West Ongul Island. North-south trending topographic features dominate in the area west of West Ongul Island. On the other hand, the Minami-no-seto Strait between West Ongul and North Teöya Islands is composed of three small oval-shaped depressions trending east-west. The submarine landforms newly revealed in this study are generally continuous to the formerly revealed topographies. A bathymetric chart and two kinds of topographic images based on a set of DEM data around the Ongul Islands are presented.

1. Introduction

Glacial geomorphological investigations of the submarine topography have been carried out in the Lützow-Holm Bay area from the 9th Japanese Antarctic Research Expedition (JARE-9) (1968) to JARE-22 (1981) (FUJIWARA, 1971; MORIWAKI, 1975, 1979; HAYASHI, 1977; OMOTO, 1976; MORIWAKI and YOSHIDA, 1983). In particular, soundings from JARE-9 to JARE-18 (1977) were conducted at fine-mesh intervals of 50 to 100 m around the Ongul Islands in the northern part of Lützow-Holm Bay (Figs. 1, 2). Nevertheless, two areas around the Ongul Islands had remained as unknown areas since then: one is north of Ongulkalven and the other is south and southwest of West Ongul Island. Therefore the present author carried out depth-sounding in the latter area in JARE-34 (1992-1994) to reveal the detailed characteristics of the submarine topography.

2. Conduct of Survey

2.1. Sounding equipment

The survey was carried out using a GS-3 echo sounder with two types of transducers: one for use on the ice surface and the other for use under ice (Oki Kaiyo Electronics, LTD.). These instruments are specifically developed for the use in the Antarctic environment of severe climatic and mechanical conditions (YOSHIDA, 1969; MORIWAKI, 1979). The survey items were carried by a snow vehicle (model SM-255) equipped with a 100 V A.C. generator to supply electric power for heating the sounder and drilling into sea ice. The main electric power of 24 V D.C. for the sounder was supplied from batteries mounted on the vehicle to avoid a drop in accuracy in using A.C. power as reported by MORIWAKI

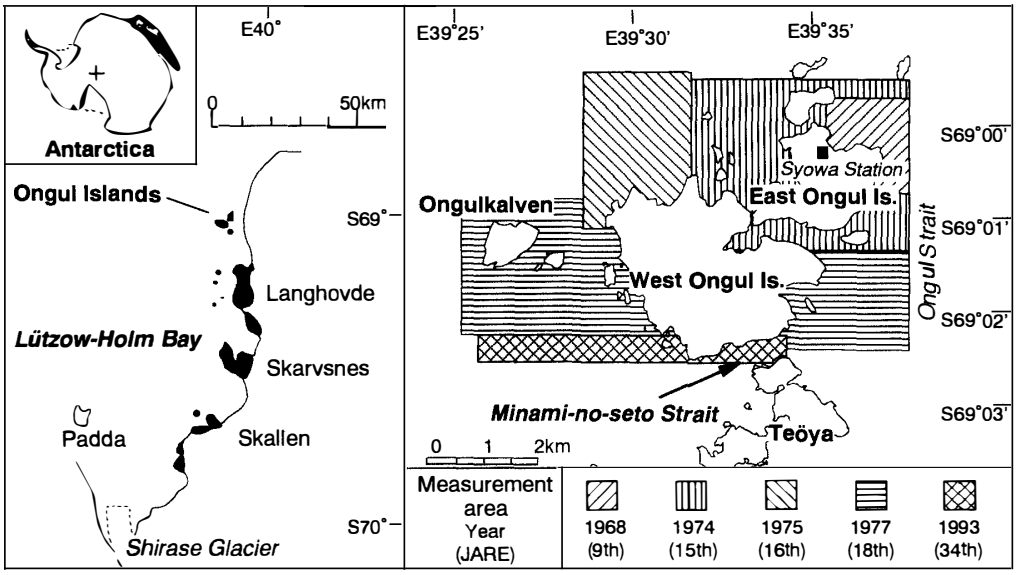

Fig. 1. Surveyed area around the Ongul Islands, Lützow-Holm Bay.

(1975).

2.2. Positioning of sounding

The sounded area ranges nearly 6 km long east-west and 1 km wide north-south, approximately from 69°02′00″ S to 02′30″ S and from 39°25′40″ E to 34′30″ E (Fig. 1). A drum was placed at each corner of this area as a landmark. Other drums and flags were placed on lines connecting these corner points at intervals of 100 m to 1 km. Positions of these landmarks were determined by triangulation from several geodetic stations on West Ongul and Ongulkalven Islands. The soundings were carried out at intervals of 100 m, keeping on the extension of the line connecting two or more of these landmarks. The interval between two neighboring sounding points was measured with a 50-m measuring tape and the distance meter of the snow vehicle.

2.3. Conduct of sounding operations

The survey started at the beginning of April and continued until the end of October except during June when the sun never rises above the horizon. At the end of August, the sensitivity of the sounder became inadequate owing to some problems in the amplitude circuit. In this low sensitivity condition of the sounder, only the "under ice type" transducer could receive echo sufficiently to record the depth data. Accordingly, soundings were carried out using the "under ice type" transducer after sea ice was drilled with a CRREL ice auger. From September, as the sensitivity of the sounder was recovered by help of a radio engineer in Syowa Station, the "ice-surface" type transducer became usable. It is necessary to keep the "ice-surface" type transducer in close contact with the ice surface. Therefore, snow accumulated on the ice was removed and a little of the gasoline was burned on the ice to melt it and make its surface smooth;then grease was applied between the ice and the transducer.

South of Ongulkalven, snow drift accumulated more than 1 m above sea ice.

Moreover, the sea ice in the area was also thick (max. 250 cm) with a hummocky surface. These features made it difficult to drill through the ice or to sound from the ice surface. Accordingly, sounded points available in one day were limited to 10–15 at most.

This study omits the correction of sounding values due to water temperature and salinity. Before starting the systematic sounding, the values by echo-sounding were compared with those by wire-sounding using a fishing string at several points west of East Ongul Island. The obtained ratios of wire-sounding to echo-sounding ranged from 1.01 to 1.02. It is difficult to determine which gives better values (MORIWAKI, 1979). Since the maximum depth in the sounded area is around 150–200 m, the error due to this difference is at most 3 to 4 m. In this study, however, the values obtained by echo-sounding are adopted without any corrections.

3. Results

3.1. Bathymetric chart

410 points were sounded in this study. On the basis of these data and a previously published bathymetric chart (MORIWAKI, 1979), a bathymetric chart around the Ongul Islands was drawn (Fig. 2). Although this study deals with a small area, the newly revealed topographic features are briefly stated below.

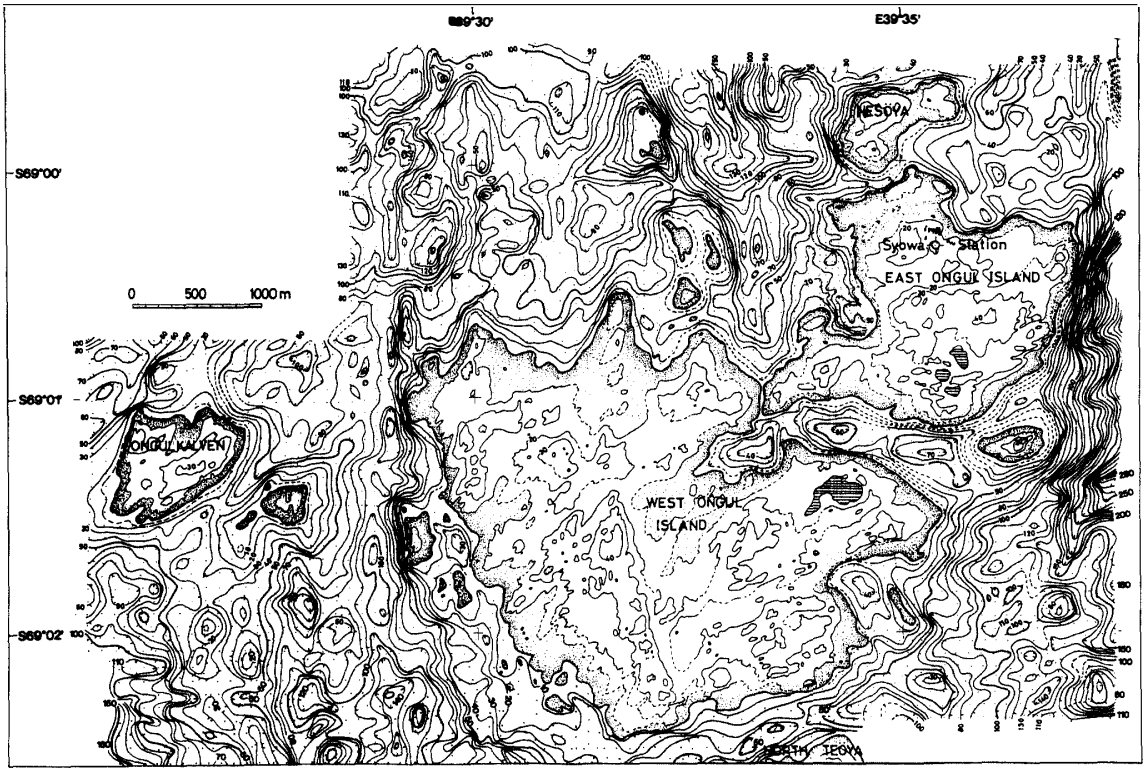

Fig. 2. Bathymetric chart around the Ongul Islands. Dots in the sea area mark depth-sounding positions. Newly obtained data of the sea area south west of West Ongul Island are added to the map compiled by MORIWAKI (1979), whose data sources were FUJIWARA (1971), MORIWAKI (1975, 1979) and HAYASHI (1977).

In the area west of West Ongul Island, north-south trending topography is remarkable. A shallow and relatively flat floor less than 50 m deep extends to the west of West Ongul Island. To the west of this floor, a north-south trending trough with steep side walls is situated between 39°28′ and 30′E. A northern extension of the trough connects a narrow and long trough between West Ongul and Ongulkalven Islands. A conspicuous ridge rising to 10 m in depth extends southward from Ongulkalven. Between the ridge and trough, depressions around 120 m deep and several mounds are arranged roughly north-south, respectively.

On the other hand, an east-west trending trough is recognized between West Ongul and North Teöya Islands, in the narrow strait of Minami-no-seto. The bottom of the trough is subdivided into three smaller oval-shaped depressions around 50–60 m deep.

3.2. Digital elevation model

Numerical depth and position data were collected at intervals of 100 m by using a digitizer from the chart of this study (Fig. 2). The collected data comprise a digital elevation model (DEM) that is available for the recently developed geographical information system (GIS). The GIS provides a feasible method of analyzing the wide regional geographic development and relationships between various factors. In particular, this method provides a superb tool to analyze topography that is hard to observe directly, such as submarine topography. This report presents a gray scale image of the height distribution (Fig. 3) and a three-dimensional geomorphic surface model (Fig. 4) around the Ongul Islands to demonstrate the DEM data. Each pixel in the gray scale image indicates a 100 m × 100 m square. The value of each pixel is the average height of the square, and the lower pixels are painted darker in continuous gradation. The position of the center of the upper-left pixel is 68°59′40″ S, 39°26′00″ E, and that of the center of the lower-right-pixel

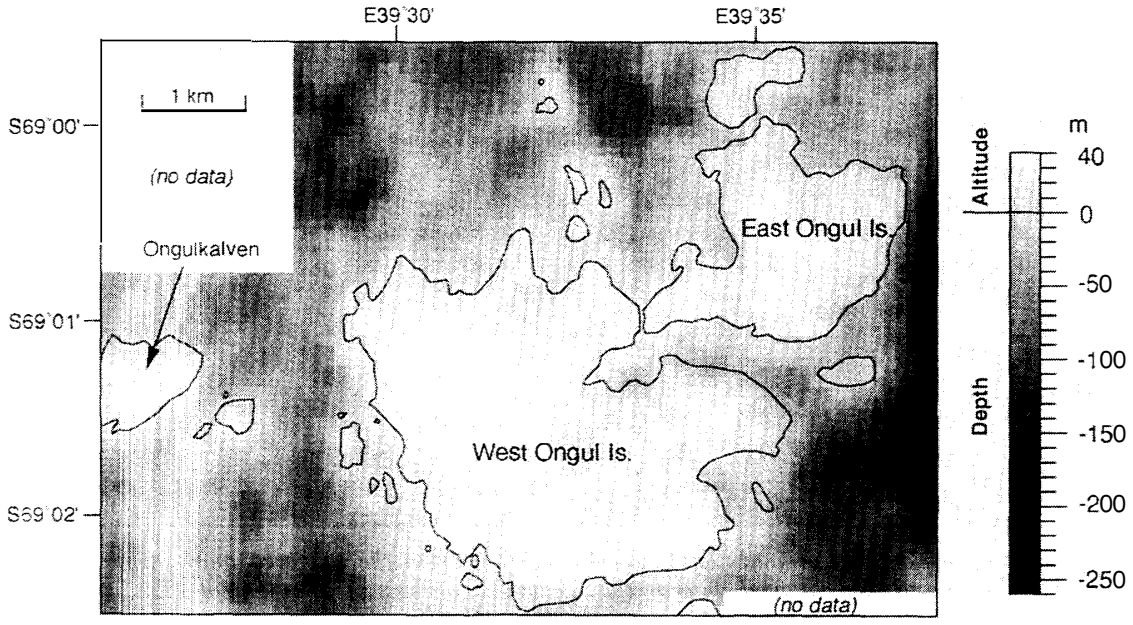

Fig. 3. Altitude and depth distributions on and around the Ongul Islands.

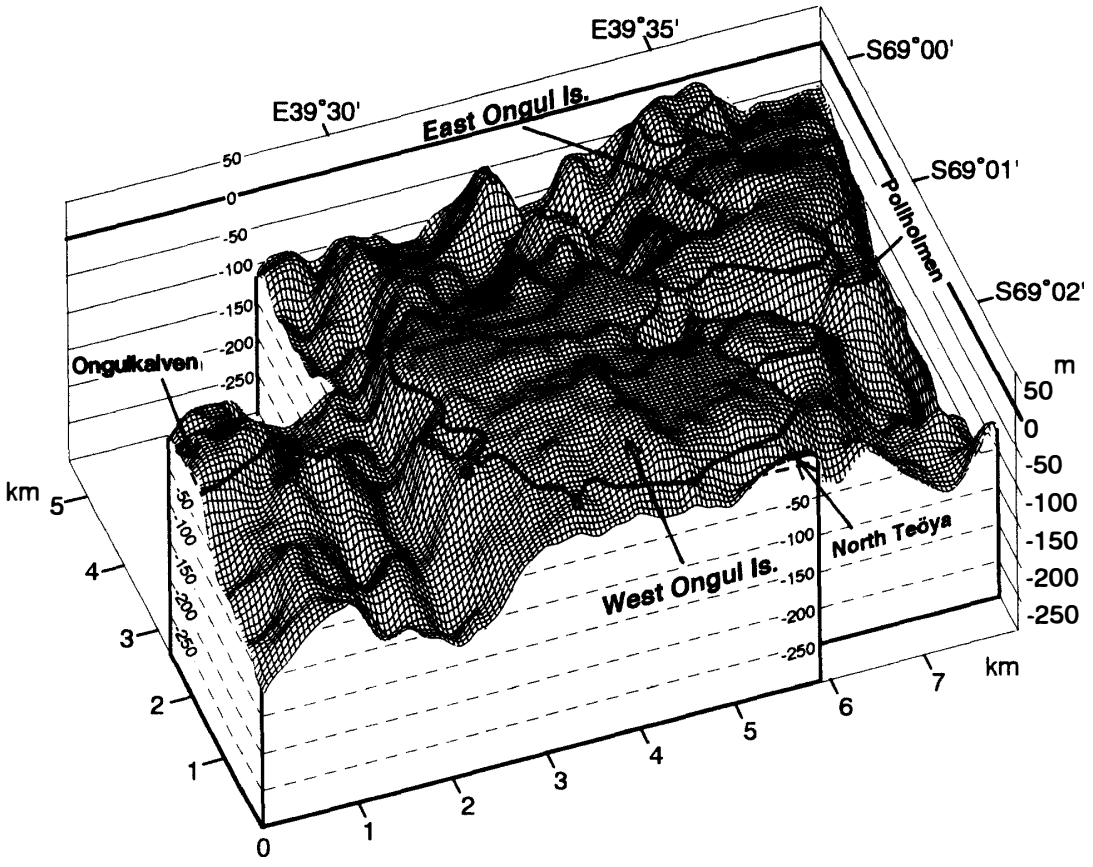

Fig. 4. Three-dimensional geomorphic surface model around the Ongul Islands.

is 69°02′30″ S, 39°37′30″ E. Since this area ranges 7.9 km long east-west and 5.5 km wide north-south, the numbers of pixels in rows (E-W) and columns (N-S) are 79 and 55 respectively. The north-south trending submarine features west of West Ongul Island, and deeply sculptured submarine topography in contrast with the gently undulating subaerial topography, are depicted in Fig. 4.

The submarine topography of the continental shelf around Antarctica, including this area, presents many interesting problems, particularly concerning the fluctuation of the Antarctic ice sheet. In this connection, further studies based on the submarine topography and/or using DEM will be discussed in the near future.

Acknowledgments

The survey was supported by all the members of JARE-34. Without their help, the survey would not have been completed. The author wishes to express his grateful thanks to them. In particular, thanks are offered to Mr. K. KOZUMI, a radio engineer of JARE-34, for his help in repairing the sounder, and to the Biological Group of JARE-34 for their kind offer to use their ice auger. Sincere thanks are extended to Dr. Y. YOSHIDA of Rissho University, Dr. K. MORIWAKI of the National Institute of Polar Research and Dr. K. HIRAKAWA of Hokkaido University for their suggestions and support for this study.

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(Received January 26, 1995; Revised munuscript received May 18, 1995)