III. SUBMARINE TOPOGRAPHY BY 12 kHz PDR

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Introduction

The GH77–1 cruise area covers the Magellan Rise and its neighboring deep sea basin and seamounts areas. The previous bathymetric map of this area was presented as a part of the wider regional map of the Pacific Ocean by WINTERER, EWING *et al.* (1973). Using this as a base map, we did some modification on it from our own bathymetric survey data with a NEC 12 kHz Deep Sea Precision Depth Recorder.

The modified bathymetric map (Fig. III–1) and the topographic profiles along the track lines (Fig. III–2) were prepared to show the general topographic features of the whole area. Besides, a detailed bathymetric map and topographic profiles were drawn to show the features of a particular part, the Magellan Trough (Figs. III–3 and III–4), and then local detailed bathymetric maps for each station area were figured to show the positions of sampling or observation on each topographic map (Figs. III–5 (1–19)).

General Topographic features

From the topographic features as shown in Figs. III–1 and III–2, the GH77–1 area is divided largely into three topographic areas, namely, two plateau like topographic highs of the Magellan Rise at a water depth of about 3,250 m at its top in the central southern area and the northern seamounts chains at a water depth of about 4,250 m at their tops, and the remaining deep sea basin area at a water depth of 5,500–6,500 m between or either side of the two topographic high areas, characterized by the development of repeated linear troughs and deep sea hills trending generally in WNW direction. Furthermore, in the deep sea basin area there is recognized a broad zone of considerable raised relief, which, intersecting the general WNW trend of the area, trends in NNE direction from the northeastern end of the Magellan Rise to the northern seamounts chain. And also there is found a remarkable lineated trough at a water depth deeper than 6,500 m at the maximum around the northern margin of the eastern side of the basin area. This is an extension part of the tentatively called "GH76–1 Trough" (TAMAKI, 1977 and MIZUNO *et al.*, 1977), and later formally called "Magellan Trough" (TAMAKI *et al.*, in press) in the GH76–1 area, though it loses its clear linear character as a trough around the intersecting part of it against the above-said NNE trending raised relief zone.

As a whole, the topography of the GH77–1 area seems to reflect both the original relief of oceanic crust and the results of the later sedimentation. Prevailing WNW trending lineated hills and troughs possibly represent the original oceanic crust of Early Cretaceous age, which was produced and moved sidewards from the now remanent spreading center of the Magellan Trough (TAMAKI *et al.*, in press), and the parts of the flat abyssal plain show the filling and flattening of the original irregularity by the sedimentation mainly of biogenic materials since then.

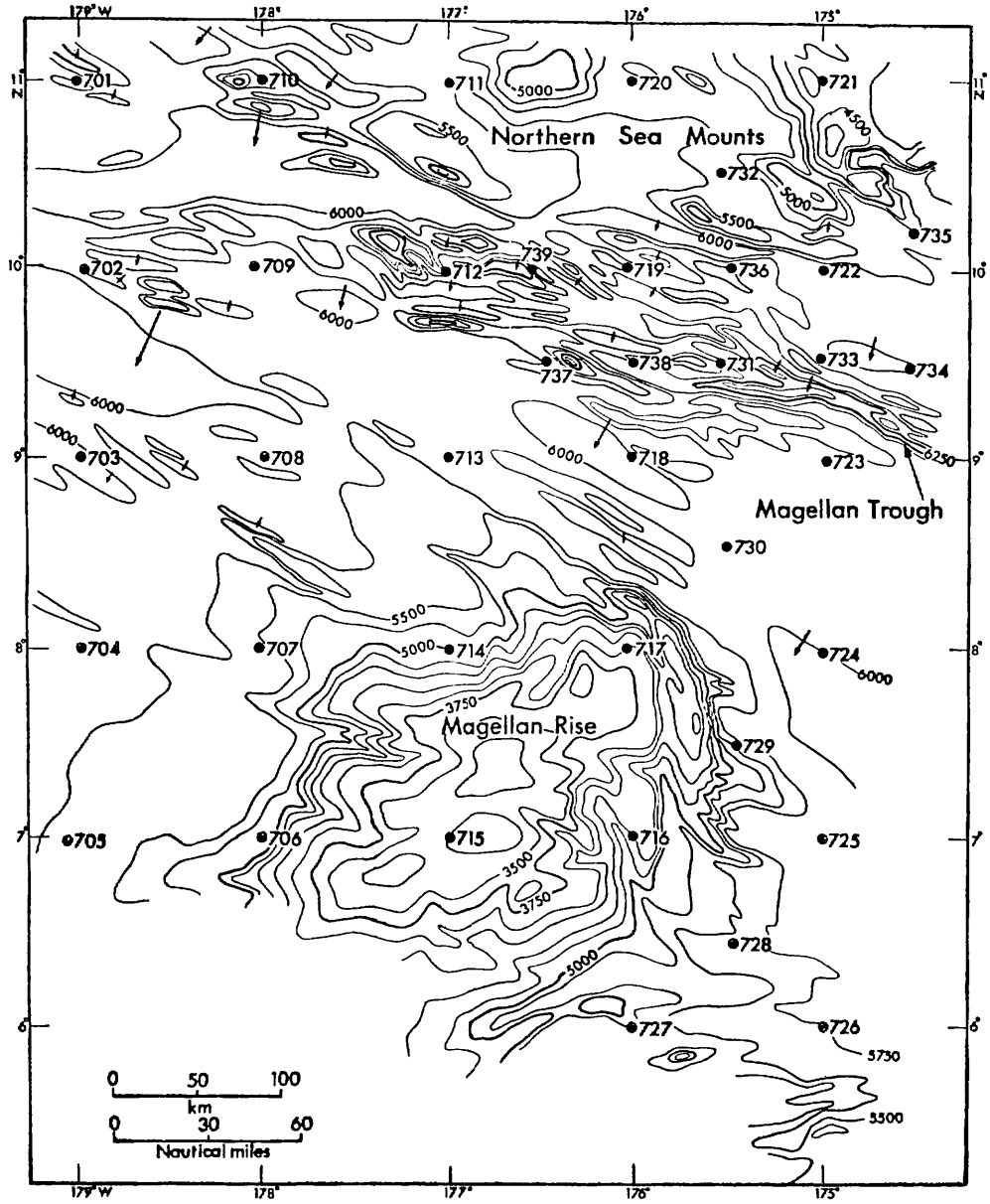


Fig. III-1 Bathymetric map of the GH77-1 area.

Deep sea basin

Abyssal plain As shown in the bathymetric map (Fig. III-1) and the profiles (Fig. III-2), the deep sea basin area is represented generally by the extensive abyssal plain especially to the west and east of the Magellan Rise. But, there often protrude linear deep sea hills with the WNW general trend, and this tendency becomes more conspicuous appearing as the repeated troughs and hills topography along the broad NNE

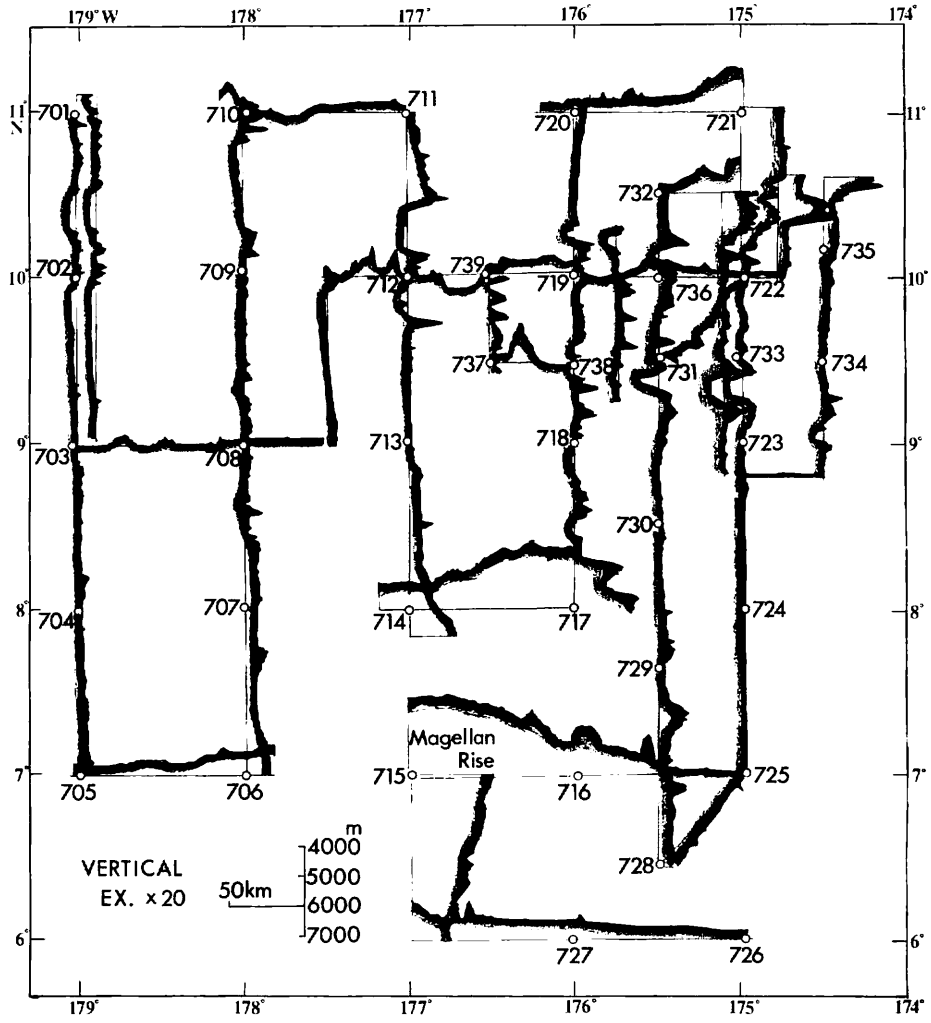


Fig. III–2 Topographic profiles along the major survey lines from NEC 12 kHz data.

trending raised zone and towards the margin of the northern seamounts area, along the southeastern part of which the Magellan Trough develops as the largest scale trough topography in this GH77–1 area.

Broad raised zone As already said, this zone is recognized as a rather ambiguous raised topographic area, trending in NNE direction and connecting the Magellan Rise area and the northern seamounts area. Therefore the structures of the individual hills and troughs or depressions within the zone have the WNW general trend instead of NNE direction of the zone itself. This means that the hills or troughs within the zone become steeper as compared with the western and eastern sides of the basin area. This may be either the crest zone of large scale undulating structure with the axis of NNE trend of the original oceanic crust, or any kind of transform fault zone perpendicular to the spreading center of the Magellan Trough, though we have no definite data for that inference at

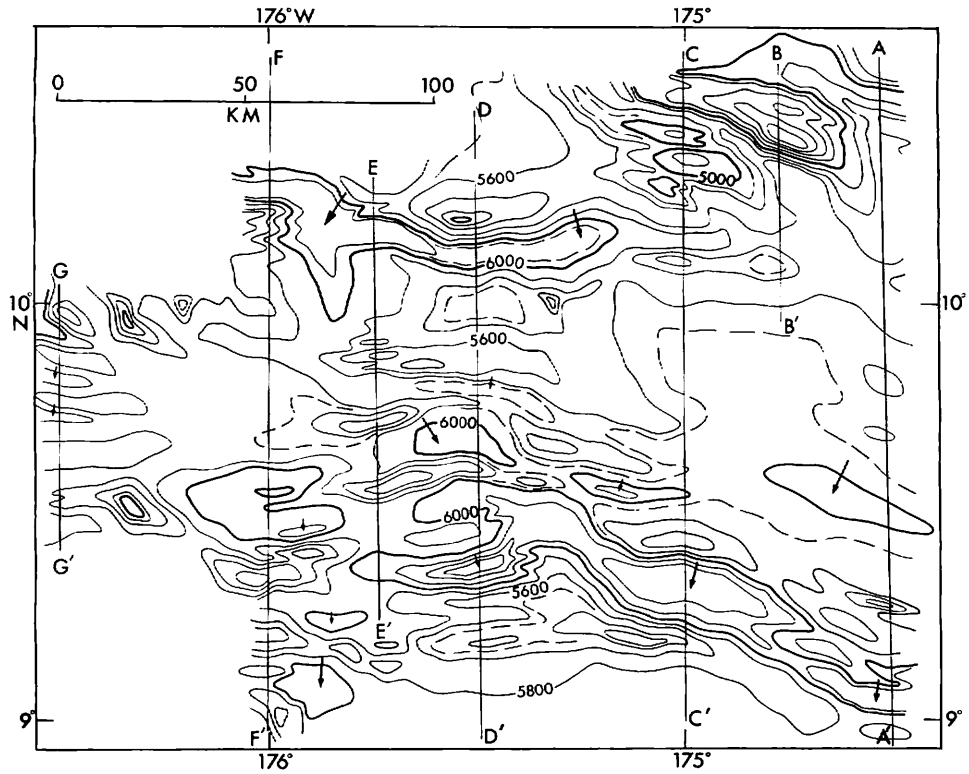


Fig. III-3 Detailed bathymetric map of the westward extension of the Magellan Trough and its environs. Solid lines show the survey tracks.

present.

Magellan Trough Lineated topographic feature of the Magellan Trough is most remarkably represented in the east neighboring GH76-1 area, and it was successfully determined as the remanent spreading center of Early Cretaceous age from the symmetrical magnetic anomaly pattern (TAMAKI, 1977; TAMAKI *et al.*, in press; and MIZUNO *et al.*, 1977).

However, as already mentioned, the trough loses its clear lineated WNW trending character in the present GH77-1 area. The detailed bathymetric map (Fig. III-3) and several profiles (Fig. III-4) in the vicinity of the trough show the tracing of the trough in the area. The extension of the trough at a depth deeper than 6,000 m and, in some places, deeper than 6,500 m, and bordered by the walls of both northern and southern ridges of a relative height as 1,000-1,200 m at the maximum can be tracable from the east up to around 175°30'W meridian. However, here it attains to the deepest depth below than 6,500 m, and then further westwards it branches and becomes a little shallower, losing its clear linear trough character. This tendency is also recognized on the pattern of magnetic anomaly (See Chap. V, in this report). It is interesting fact that this disappearance of the clear character of the trough occurs just around where the trough comes across the NNE trending broad raised zone, and this may reflect any tectonic struc-

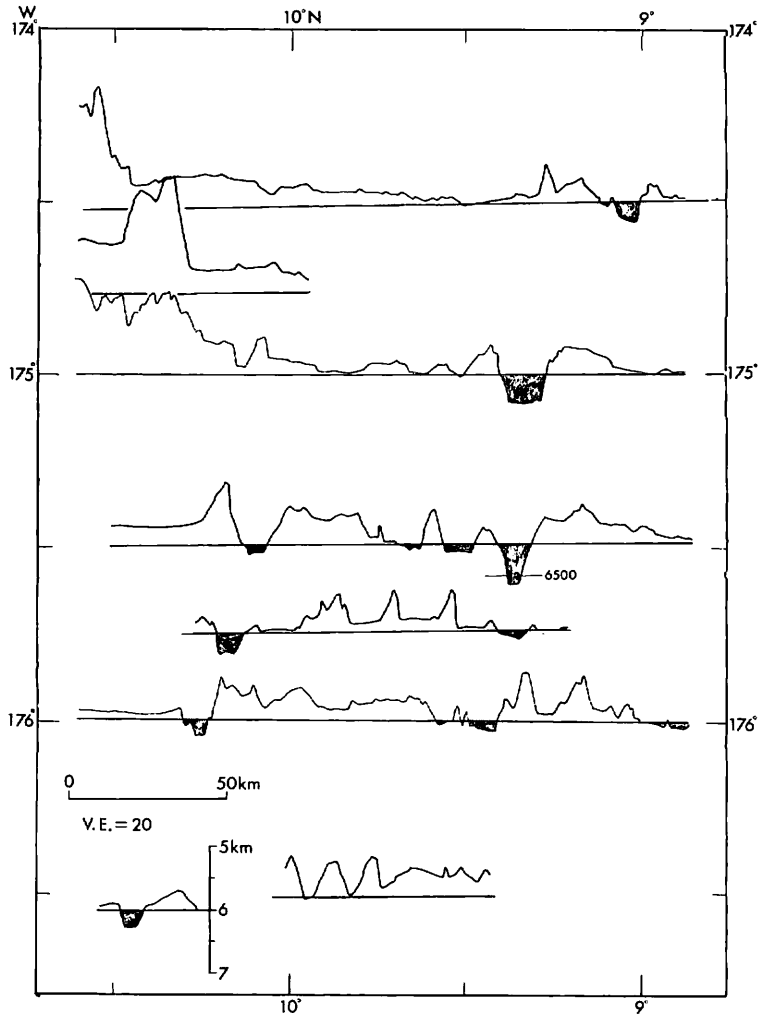


Fig. III–4 Topographic profiles of the Magellan Trough.

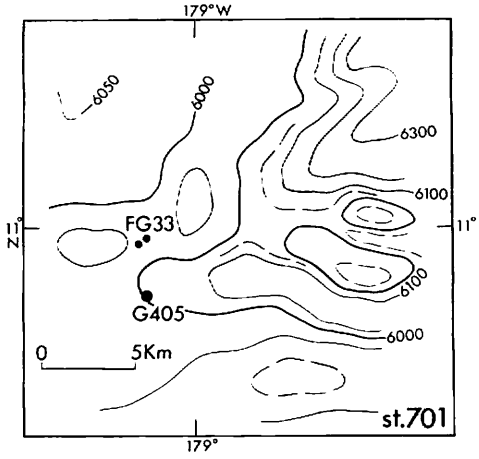
tures of the original oceanic crust.

Northern seamounts

This area occupies the northern end of the area, and is characterized by the chain or group of seamounts with the tops at a depth of 4,250–5,000 m, and with the relative height of more than 1,000 m from the surrounding ocean floor. Though it is not so clear as in deep sea basin area and the tops of these seamounts are covered with calcareous sediments, the arrangement of these seamounts also represents the general trend of WNW direction, indicating probably similar basement structure of oceanic crust as in the basin area.

Magellan Rise

Fig. III-5(1-19) Bathymetric maps around each station and its environs. Solid circles show the points of on-site sampling and observations, together with their numbers (G=grab, FG=freefall grab, D=dredge, P=coring).



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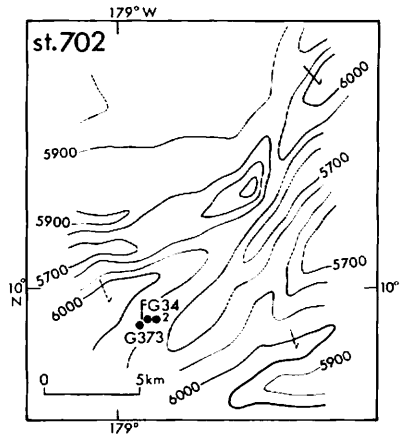

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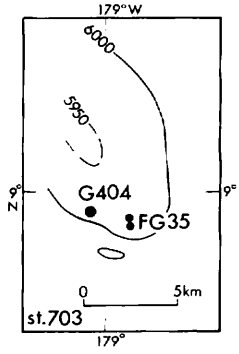

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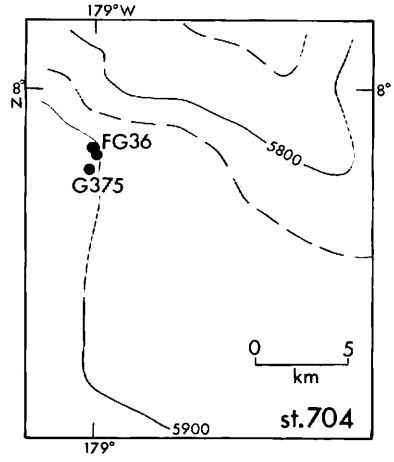

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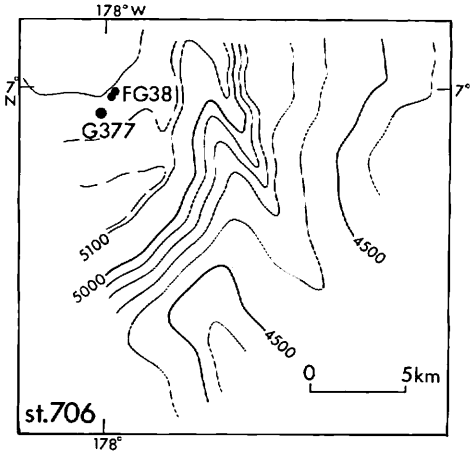

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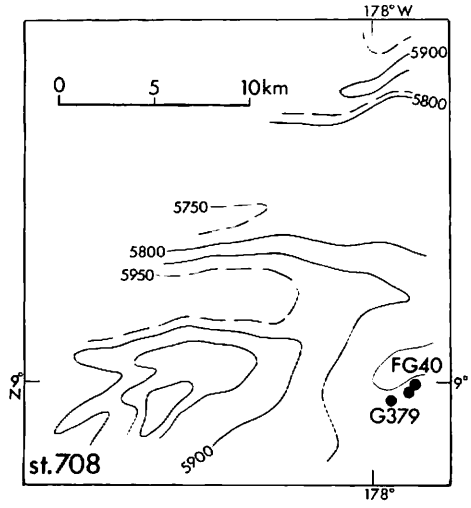

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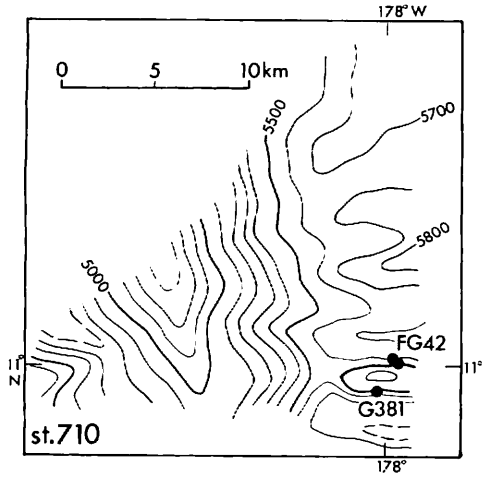
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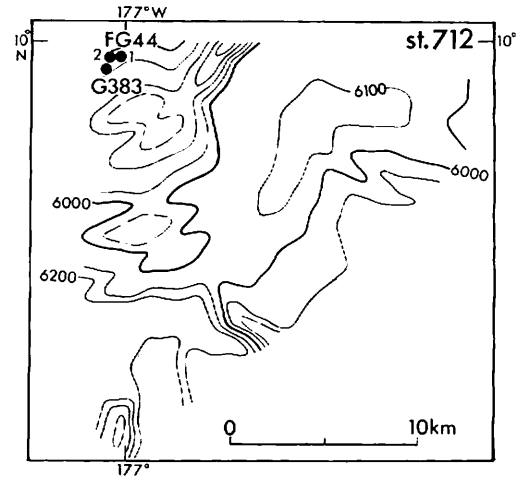
0 5 10km
5500
5700
5800
5000
FG42
G381
st.710
11°N
178°

(7)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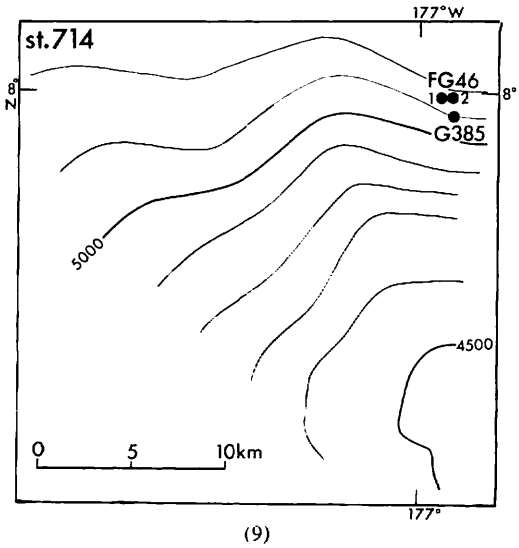
FG44
2 1
G383
st.712
10°N
6100
6000
6000
6200
0 10km
177°

(8)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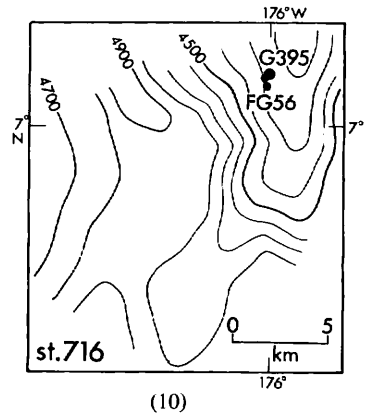
8°N
FG46
1 2
G385
5000
4500
0 5 10km
177°

(9)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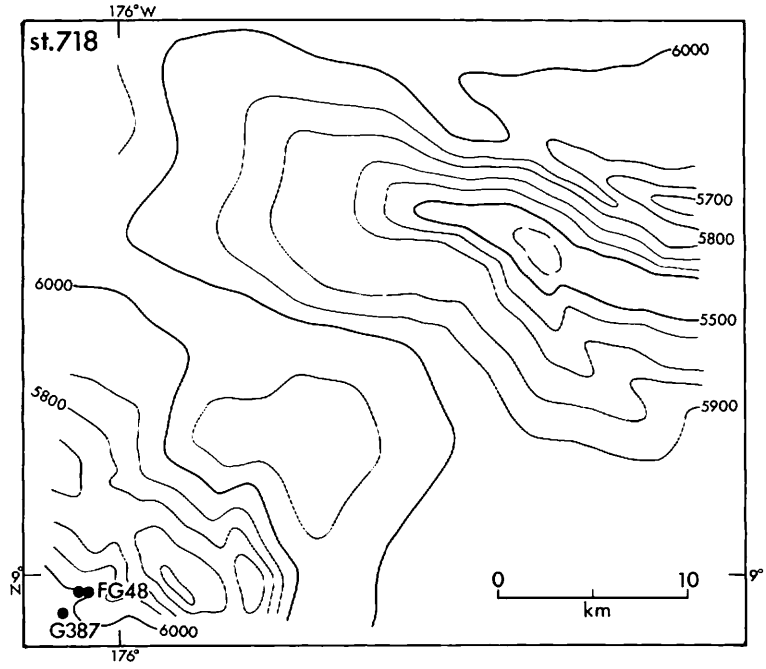
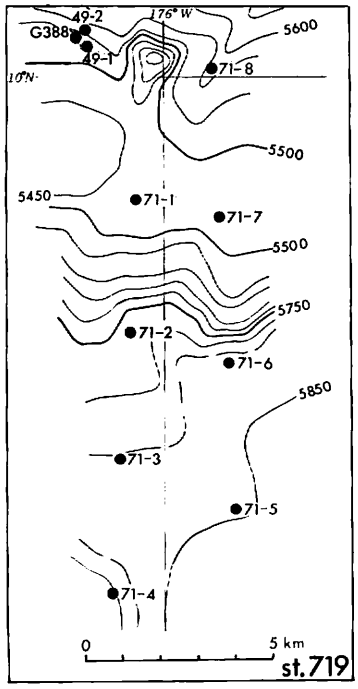
4900
4500
G395
FG56
4700
7°N
7°
0 5
km
st.716
176°

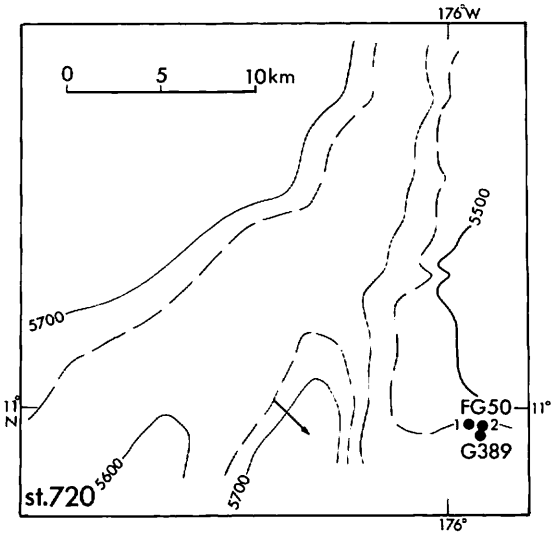
(10)


176°W
st.718
6000
5700
5800
5500
5900
6000
5800
9°N
FG48
G387
6000
176°
0
10
km
9°

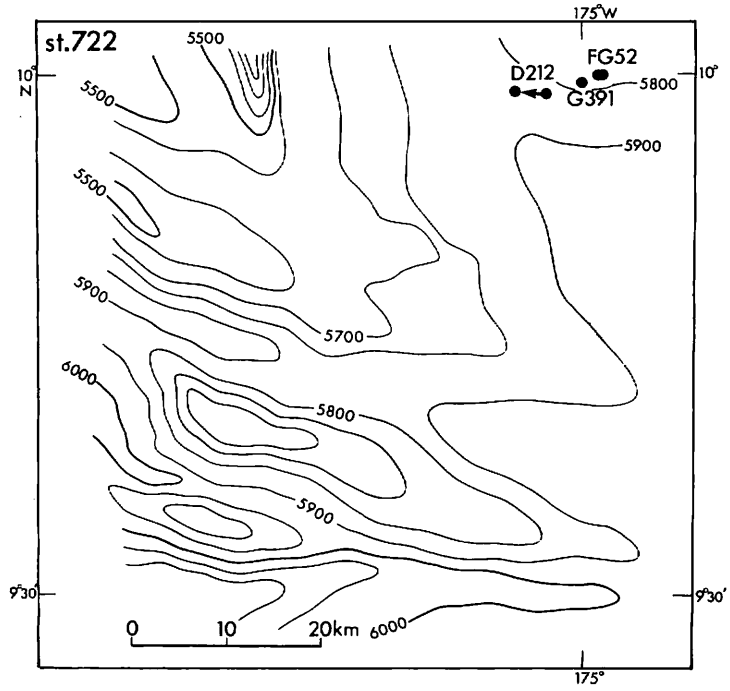
(11)


49-2
176° W
G388
49-1
5600
10°N
71-8
5500
5450
71-1
71-7
5500
5750
71-2
71-6
5850
71-3
71-5
71-4
0
5 km
st.719

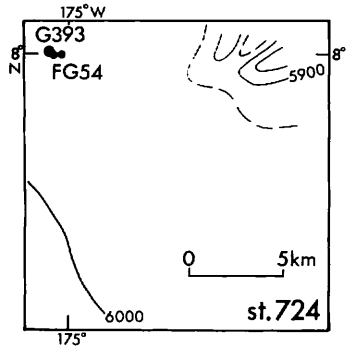
(12)


176°W
0
5
10km
5500
5700
11°N
FG50
1
2
G389
st.720
5600
5700
176°
11°

(13)


st.722
175°W
10° N
5500
5500
5500
5900
5700
6000
5800
5900
5900
D212
FG52
G391
5800
10°
9°30'
9°30'
0
10
20km
6000
175°

(14)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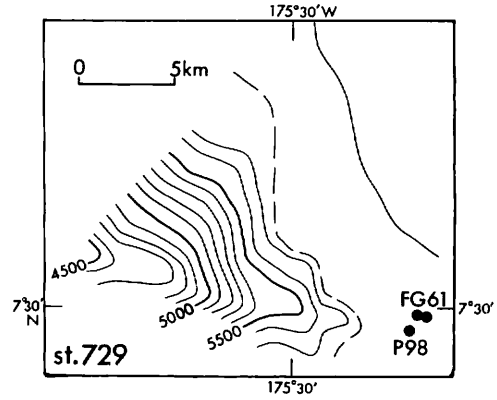
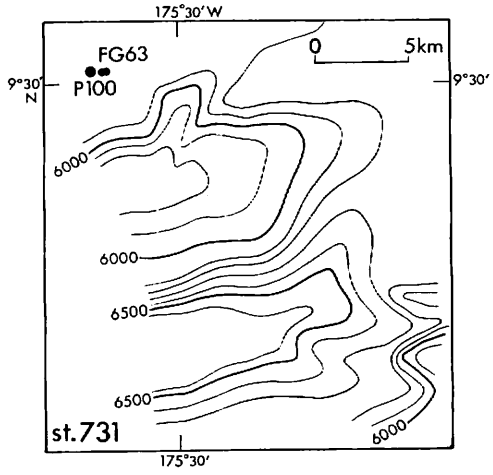
G393
8° N
FG54
5900
8°
0
5km
6000
st.724
175°

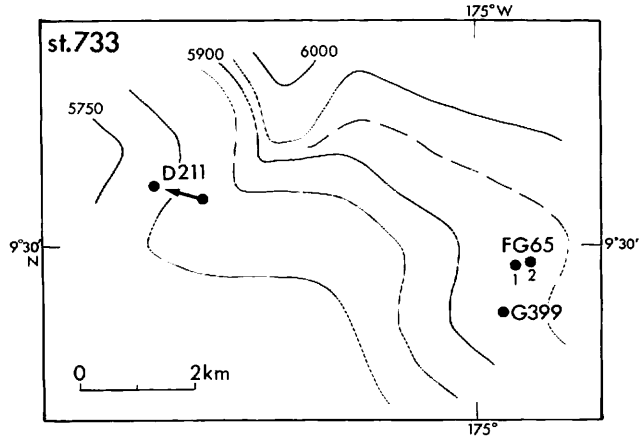
(15)


175°30'W
0
5km
4500
5000
5500
7°30' N
FG61
7°30'
P98
st.729
175°30'

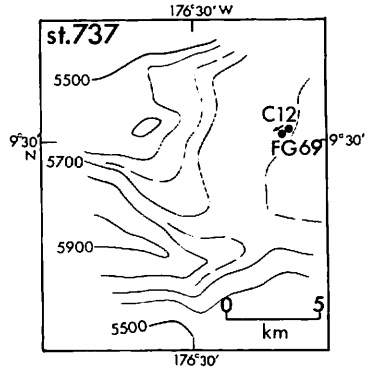
(16)


175°30′W
FG63
P100
0
5km
9°30′
N
9°30′
6000
6000
6500
6500
6000
st.731
175°30′

(17)


175°W
st.733
5900
6000
5750
D211
9°30′
N
FG65
1 2
9°30′
G399
0
2km
175°

(18)


176°30′W
st.737
5500
C12
FG69
9°30′
N
5700
9°30′
5900
0
5
km
5500
176°30′

(19)

The Magellan Rise occupies almost a quarter of the GH77-1 area in the central southern part, forming an independent large plateau of elliptical shape with the axis of NNE direction and the relatively flat top at a depth of about 3,200 m. The Rise is covered by the thick accumulation of sedimentary formations of about 1,000 m and some eroded features are observed at the outer edges (See Chap. VI, in this report). The origin of such large scale topographic high standing from the deep sea floor is quite interesting problem. One interpretation is that the original raised basement higher than the surrounding area was formed in relation to the evolution of the triple junction of the Pacific-Phenix-Farallon plates boundary in Early Cretaceous age (TAMAKI *et al.*, in press), and then it has been the place for the later predominant sedimentation of biogenic materials above the carbonate compensation depth.

Topography at each station area

Figs. III-5 (1-19) show the details of the topography at each station marked on the bathymetric map of the whole GH77-1 area (Fig. III-1). The description of the topography of each site is given in the summarized table of the results of on-site observations (Table I-5).

References

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