

### III. SUBMARINE TOPOGRAPHY BY 12kHz PDR

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The GH76-1 area covers the eastward deep sea bottom of the Magellan Rise elevated in the medial portion of the Central Pacific Basin. A previous bathymetric map by WINTERER, EWING, *et al.* (1973) demonstrated the major topography of the area which is dominated by an undulating bottom at a water depth of between 5800–6000 m and interposed by linear trough-like depressions trending in a NWW-SEE direction with some seamounts in the northeastern and southwestern parts.

Our bathymetric survey along the track lines with a NEC 12 kHz Deep Sea Precision Depth Recorder has resulted in a modification of some aspects of WINTERER *et al.*'s map.

#### **General topographic features**

Fig. III-1 shows the general topography of the GH76-1 area based on our survey results, in combination with the map of WINTERER, EWING, *et al.* (1973). Fig. III-2 shows the topographic profiles along the major survey lines.

The GH76-1 area is largely occupied by a flat to rolled bottom at a depth of between 5600–6000 m, except for seamounts elevated in the northeastern and southwestern areas. The deep sea bottom tends to be gently inclined towards the east from the abyssal plain and basins (over 6000 m at a maximum depth) and the linear trough called the GH76-1 Trough (over a maximum 6500 m depth) in the vicinity of the 174° meridian. The area is tentatively divided into several districts which are gradational into each other, based on the detailed topographic features (Fig. III-3).

*Northeastern seamount district.* A large seamount with a pointed peak at a depth of about 1500 m steeply rises between Sts. 421 and 420 in the northeastern corner of the GH76-1 area. The seamount has a relative height of about 4000 m from the deep sea floor to the west. Toward the south, it is probably continuous with other seamounts according to WINTERER, EWING, *et al.* (1973)'s map, which were not examined in our survey (Fig. III-1). These seamounts form very rugged prominent topographic highs which characterizes the northeastern seamount district. Toward the northeast, another large seamount occurs around 11°N and 170°W.

*Southwestern seamount district.* An area of three prominent steep seamounts in the southwestern part of the survey area forms the southwestern seamount district. The seamounts are arranged roughly in a NNW-SSE direction and are separated from each other by deep sea floor of over 5800 m depth. Those on the 174° meridian have two or more pointed peaks at a water depth of about 3000 m. Another one situated to the south seems to have a single pointed peak at about 1900 m depth.

*Western abyssal plain district.* To the north of the southwestern seamount district, a markedly smooth deep sea floor extends over a wide area at a depth of between 5900–6000 m. The smooth bottom well delineated by the contour line of 5900 m and is characterized by the distribution of acoustic turbidite on the seismic and 3.5 kHz

records, so that it can be referred to as an abyssal plain. The abyssal plain is very slightly inclined from its peripheral parts toward its central area around 8°N and 174°W, where the bottom reaches a maximum depth of 6000 m. The bottom is very smooth in the southern and eastern parts of the plain; while it is slightly undulating with a relief of some 10–20 meters in the northern part. The northern margin of the abyssal plain is defined by the 5900 m contour line, where the acoustic turbidite abuts against the south ridge of the GH76-1 Trough district.

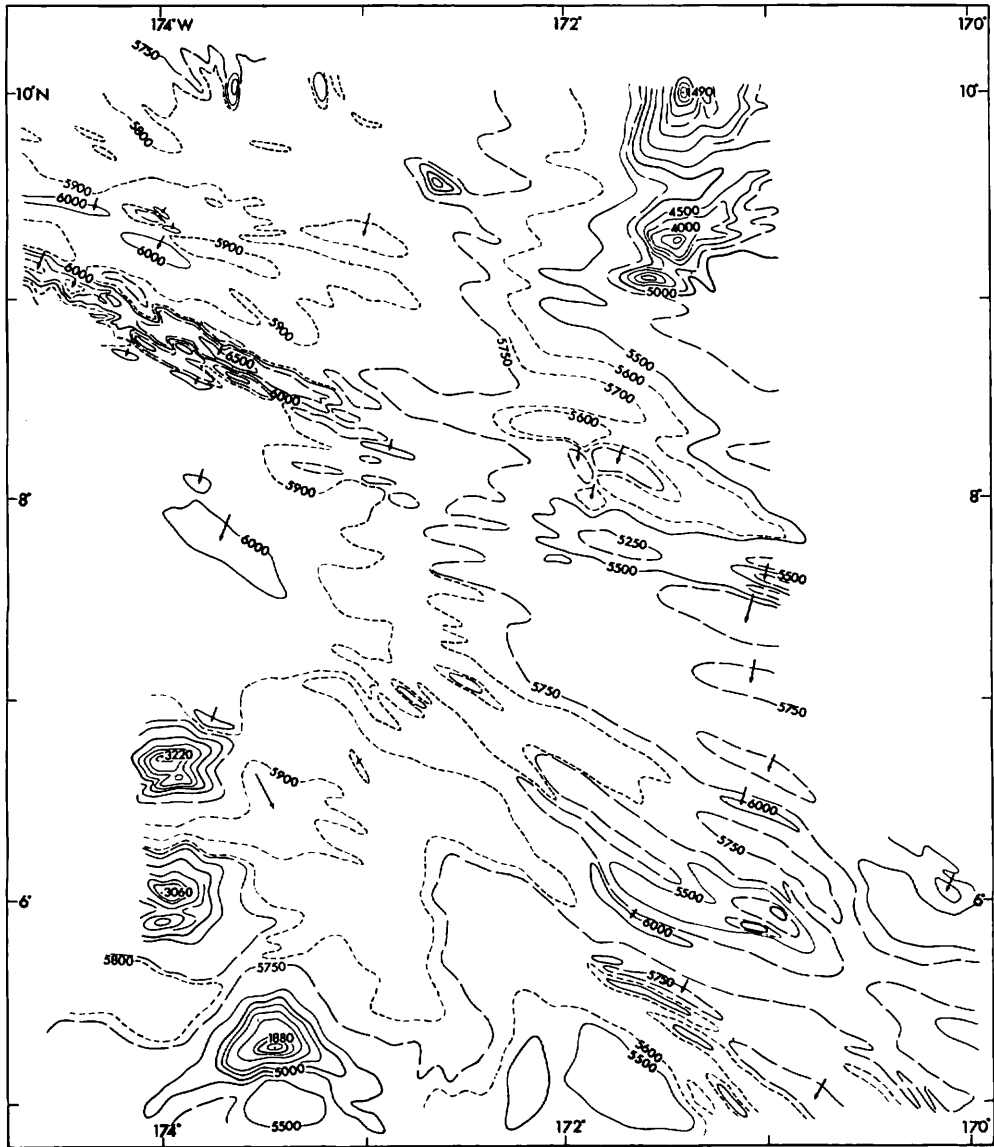


Fig. III-1 Bathymetric map of the GH76-1 area.

*GH76-1 Trough district* (Fig. III-4). A linear trough extending in a NWW-SEE direction in the northwestern part of the survey area is tentatively called the GH76-1 Trough. The GH76-1 Trough district is restricted to the NWW-trending part of the trough and its bordering ridges to the south and north. The entire length of the trough area is unknown because its western extension has not yet been surveyed. The trough extends for more than 200 km in the GH76-1 area, ending around the 173°W meridian.

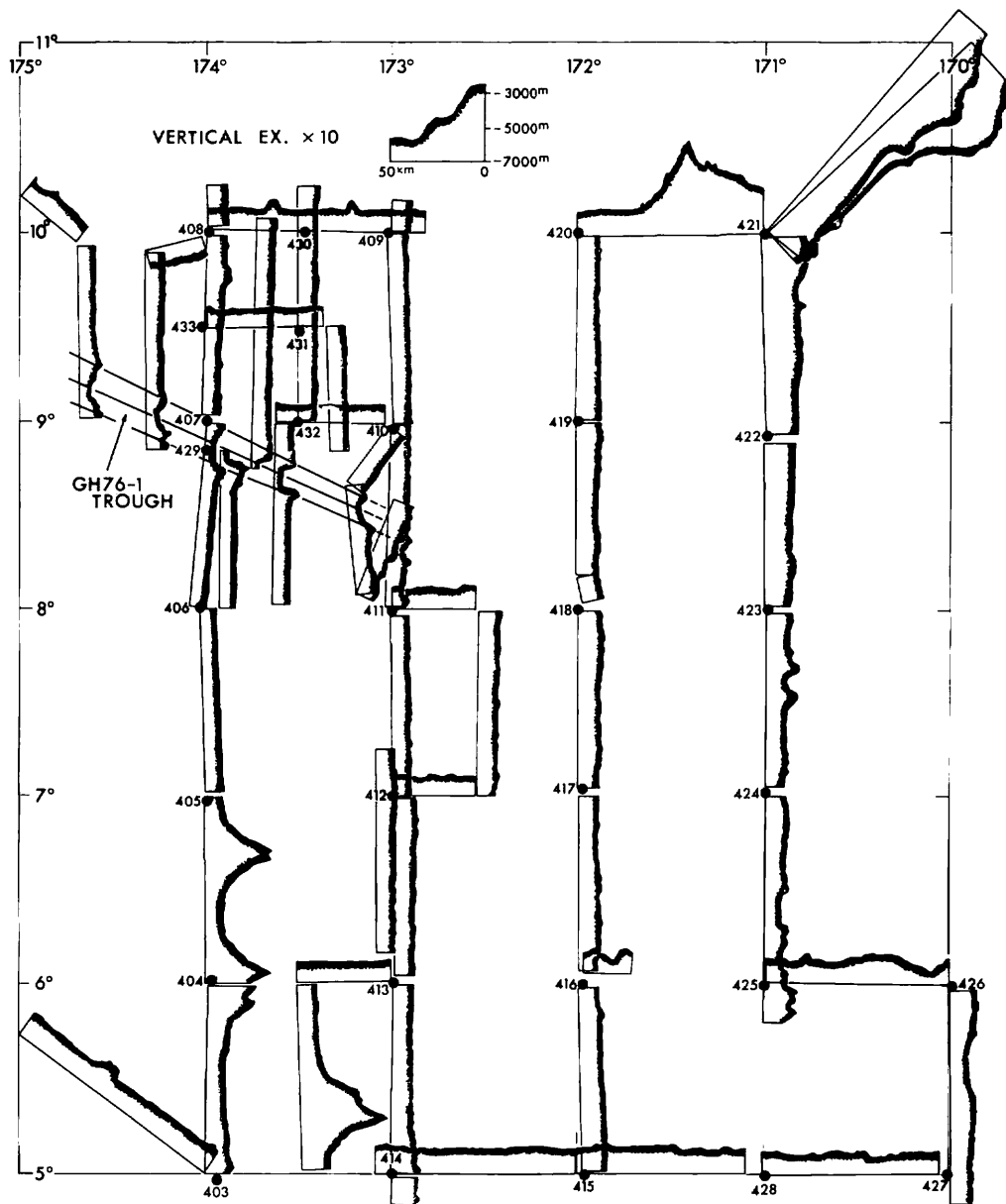


Fig. III-2 Topographic profiles along the major survey lines from NEC 12 kHz PDR data.

The trough width ranges between 5–10 km, from ridge crest-to-ridge crest between 10–18 km, and the width of the entire trough area of 20–30 km. The trough bottom depth is more than 6200 m, and attains a maximum depth of approximately 6600 m. Thus the relative depth from the surrounding deep sea bottom of the southern and northern districts is between 300–600 m. Most of the south ridge lies at a depth of 5400–5600 m with some peaks at a depth around 5300 m. The north ridge is somewhat deeper and largely at a depth of 5700 m or so with an exception of a peak at 5500 m depth. The maximum relief from the ridge crest-to-trough bottom is about 1200 m at the 173°55'W meridian.

The detailed topography is somewhat complex and is slightly different on both sides of the 174° meridian. In the eastern half, the trough set is almost linear in a NW-SEE direction with a relatively flat trough bottom of 8–10 km width. The deepest part of the trough (6580 m) is around 8°45'N and 173°45'W (western part of the eastern half). Around this area ridge slopes are about 15°. In the eastern half the trough is typified by a relatively wide bottom and gradually loses its expression in the east with lowering

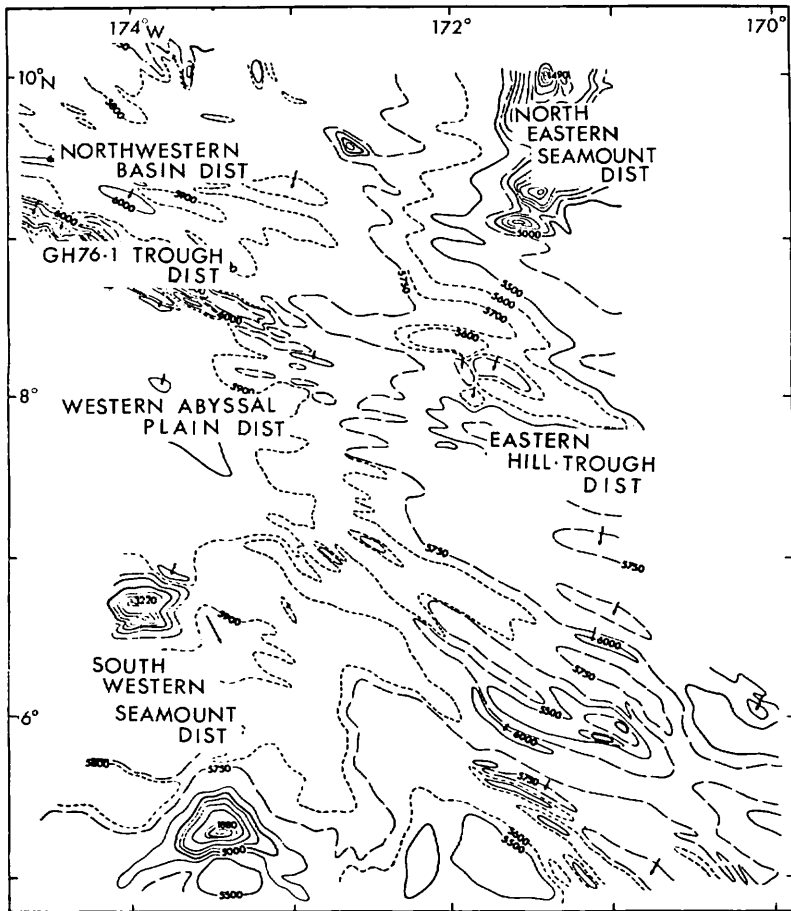


Fig. III-3 Topographic divisions in the GH76-1 area.

relative relief between trough-and-ridge. The trough terminates around the 173° meridian, merging with the rolled bottom topography to the east.

In the western half the trough axis is somewhat irregular. The trough, together with the bordering ridges, shows an offset of about 9 km in which the western segment is displaced to the south between 174°20'W and 174°30'W. The trough of the eastern segment is interposed by a small abyssal hill between 174°10'W and 174°20'W. Generally the trough bottom of the western half is narrower than that of the eastern half, and the ridge slopes of both sides are more gentle. Magnetic lineations are consistent with the topographic arrangement of the GH76-1 Trough and bordering ridges, as will be described in Chapter VI.

*Northwestern basin district.* North of the GH76-1 Trough district a deep sea basin covers a wide area, bordered by the 5800 m contour line like as a semi-basin. The basin is characterized by low relief and tends to be deeper in the south-central part where some small depressions exceeding a depth of 6000 m are present. Besides these depressions the basin bottom lies at a depth of between 5800–5900 m, interrupted by small abyssal hills in some places.

*Eastern hill-trough district.* WINTERER, EWING, *et al.* (1973)'s map shows an extensive province of NWW-trending linear hills and troughs between 170°W and 172°W. Our survey clarified a similar topography in the area to the south of the northeastern

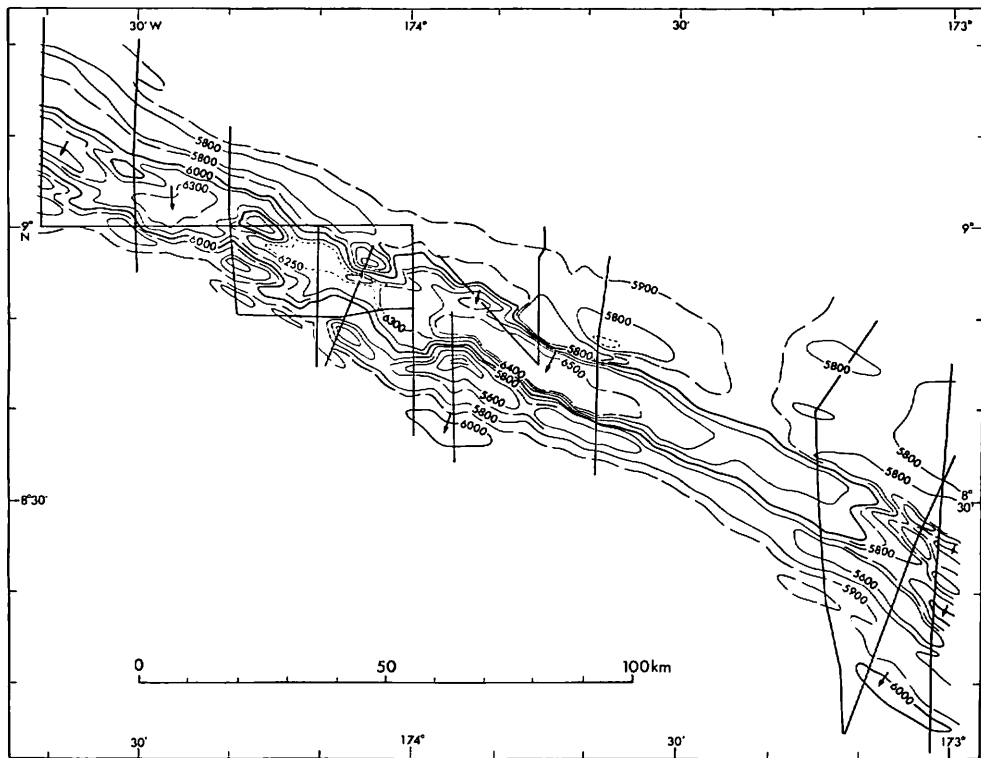


Fig. III-4 Detailed bathymetric map of the GH76-1 Trough and bordering ridges. Solid lines show the survey tracks.

seamount district. The area is called the eastern hill-trough district here for convenience.

The topography is characterized by a combination of repeated troughs and linear hills both extending in NWW-SEE direction. Their depth tends to increase from north to south. The depth is about 5100–5200 m at the hill crests and 5700–5800 m at the trough bottoms in the area north of 7°N, and 5300–5600 m at the hill crests and 5600 m to more than 6000 m at the trough bottoms in the area around 7°N. The relative relief is as large as 600 m. In comparison with the GH76-1 Trough, the troughs of this district seem to have a small extension (generally 40–70 km or so) and have an en échelon arrangement.

The area meridionally extending along 172°–173°W is a transitional zone between the western and eastern districts. In this the deep sea floor has a gently rolling topography at a depth of 5700–5800 m.

### Topography of some selected sites

The topography of the western sites where one or more stationary observations other than routine sampling by grabs were done, is described here. Figs. II-5—12 provide the recalculated positions of the sites under consideration.

*Sts. 406 and 406A* (Fig. II-5). The bathymetric data are not sufficient to deduce the general topographic features of this area, but it likely to have a nearly flat bottom at a depth of 5980–5990 m.

*St. 407 and its environs* (Fig. II-6 and Fig. III-5). Many observation points are scattered within an area of about 20 km (E-W) and 7–8 km (N-S) with a depth of 5700–6000 m, which occupies the southernmost part of the northwestern basin district.

As shown in Fig. III-5, the general topography is represented by a very gently sloped semi-basin at a depth exceeding 5900 m, which opens toward the NWW. In the northwestern part of the semi-basin, a very low relief depression with a maximum depth of 5990 m is developed, and is enclosed by the 5950 m or 5960 m contour lines.

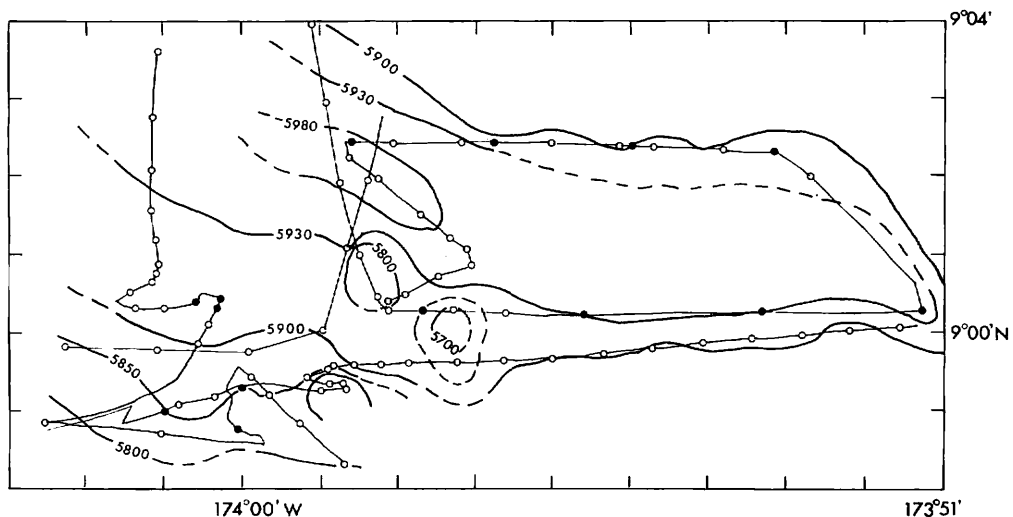


Fig. III-5 Bathymetric map around St. 407 and its environs.  
Solid and open circles connected by lines indicate the points of on-site and bathymetric observations respectively (also see Fig. II-6).

Immediately south of the depression two small abyssal hills are present; they rise to a depth of about 5700 m, and therefore have a relative relief of about 200 m with respect to the surrounding basin bottom.

FG32-1 is on the slope of a seamount immediately south of the depression in which FG32-8 is situated. The points of FG32-2-7 are on the almost flat bottom at a depth of 5900-5930 m near the semi-basin margin. FG5-1 and -2 and G171 are in its western part.

The topography tends to rise to 5820-5870 m depth in the southwestern part of the semi-basin. A seamount having a depth of about 5000 m rises in a part of the area which is characterized by a gently rolled bottom topography. C8, D137, and W8 are within this rolled area.

*St. 408 and its environs.* A perfectly flat bottom at a depth of 5820-5830 m is developed over the present area which includes a continuous observation line of the deep sea camera.

*Sts. 410 and 410A.* Bathymetric data are insufficient, but it is likely that G174 is on the top of an elevation within the rolled topography and FG8-1 and -2 and P71 are on its gently inclined slope or foot.

*Sts. 411 and 411A.* The area is likely to be a part of the slope with an inclination of 7-10° which slopes down toward the southwest. Four sampling points are on this slope.

*Sts. 412 and 412A.* The sampling points are on the slope which slopes down toward the west from 5860 m to 5950 m.

*Sts. 413 and 413A.* Three sampling points are within a very gently rolled bottom at a depth of 5810-5820 m.

*St. 414 and its environs.* The topography is rather complex within the extent of 9 km (E-W) and 6 km (N-S). The bottom is abruptly deeper (exceeding 5800 m) to the east of P67 which is from an isolated small abyssal hill of about 5380 m depth. The bottom gradually rises toward the northwest in general from the environs of P67, from around 5470 m to around 5100 m, interposing some small steep abyssal hills with relative heights of 600-700 m. The photography line (C6) is on the slope just southwest of P67. FG12-1 and -2 and FC2 are on the upper part of the slope. G193 is located on the upper part of the slope.

#### **Acknowledgment**

We are grateful to Koji ONODERA, Geological Survey of Japan, for his assistance in preparing the bathymetric maps figured.

#### **Reference**

WINTERER, E. L., EWING, J. I., *et al.* (1973) *Initial Reports of the Deep Sea Drilling Project*, vol. 17, Washington (U.S. Government Printing office), xx + 930p.