BULLETIN OF THE EARTHQUAKE
RESEARCH INSTITUTE
Vol. 48 (1970), pp. 363-379

22. *Regional Study on the Characteristic Seismicity of the World.* *Part V. Bonin-Mariana Islands Region.*

—Comparative Study on the Reliability of USCGS Seismic Data Since 1963—

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(Read February 24, 1970.—Received March 31, 1970.)

Summary

Reliability of the epicentral maps and shapes of foci zones obtained from U.S. Coast and Geodetic Survey's data since 1963 were checked through comparing them to those obtained by relocation for two regions, Bonin-Mariana Islands and Tonga-Kermadec Islands. Similarity between them were found to be fairly good. USCGS data of the events whose locations utterly disappeared or greatly deviated from the main trends on the maps of relocated data were, almost all, restricted to the smaller events which had been excluded in advance from the relocation because of the inconvenient conditions: insufficient number of stations which detected the events and/or the biassed distribution of stations around the epicenters. The above results raise an anxiety if such exclusion of smaller events leads us to a mistaken conclusion on the true seismicity of that region, though the above exclusion is unavoidable for getting the precise figure on the foci distribution.

A suggestion was made as to the cause of the vertical underthrusting of focal zone along the section perpendicular to the trend of the Mariana Trench in its central part.

§ 1. Introduction

Quite recently, M. Katsumata et al.[1] have studied the seismicity and tectonics of the Western Pacific area by relocation of the foci from the data reported in several Seismological Bulletins during the period 1961–1967. In their study, they obtained a quite interesting fact that the shape of the deep foci zone along Bonin-Mariana Islands arc changes considerably within a relatively short distance. It means that

1) M. KATSUMATA and L. R. SYKES, "Seismicity and Tectonics of the Western Pacific: Izu-Mariana-Caroline and Ryukyu-Taiwan Regions", *J. Geophys. Res.*, **74** (1969), 5923–5928.

the focal zone in this region is much distorted laterally, parallel to the trend of the trench and islands arc. Bonin-Mariana Islands region, therefore, must be ranked as one of the regions in which seismicity is specially characterized.

The present writer has been making a regional study on the characteristic seismicity of the world.[2)–5)] The purpose of the work is to reveal the general figure of the seismicity of characteristic regions in various parts of the world for which the study by using recent data has not yet been done, and through the results to call attention of other geophysicists to take further steps for connecting the seismological evidences with tectonics.

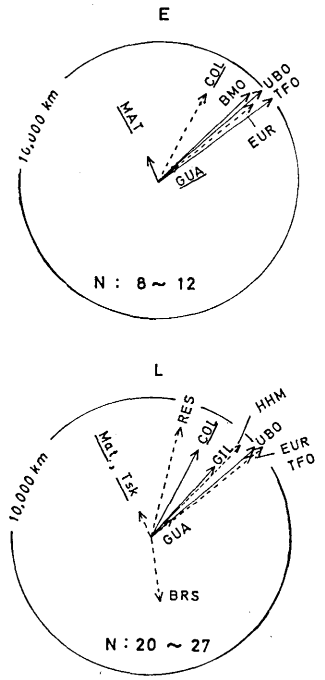


Fig. 1. Distribution of stations listed in Table 1. Solid and broken arrow means the direction of the stations belonging to groups A and B in Table 1 respectively. Length of the arrow is taken proportional to the distance.

In the series of this study, seismic data have been taken, without making any relocation, from the reports by U.S. Coast and Geodetic Survey (USCGS) since 1963. The basic idea was that the world-wide seismological net-work has greatly been progressed since around 1963 and the original data from USCGS itself are now reliable enough for fundamental purpose of the present work. As the net of the stations available by USCGS for determining the foci of an individual region, however, differs from region to region, reliability of the results was always checked by examining the distributions and the numbers of stations the data of which were often available by USCGS for determining the foci of smaller events in each region.

The results which M. Katsumata et al. obtained by relocating the foci gave the writer a good opportunity to check the reliability of the results which have been obtained from the original data by USCGS. In the following sections,

2) T. SANTÔ, "Regional Study on the Characteristic Seismicity of the World. Part I. Hindu Kush", *Bull. Earthq. Res. Inst.*, **47** (1969), 1035–1048.

3) T. SANTÔ, "Regional Study on the Characteristic Seismicity of the World. Part II. From Burma Down to Java", *Bull. Earthq. Res. Inst.*, **47** (1969), 1049–1061.

4) T. SANTÔ, "Regional Study on the Characteristic Seismicity of the World. Part III. New Hebrides Islands Region", *Bull. Earthq. Res. Inst.*, **48** (1970), 1–18.

5) T. SANTÔ, "Regional Study on the Characteristic Seismicity of the World. Part IV. New Britain Islands Region", *Bull. Earthq. Res. Inst.*, **48** (1970), 127–143.

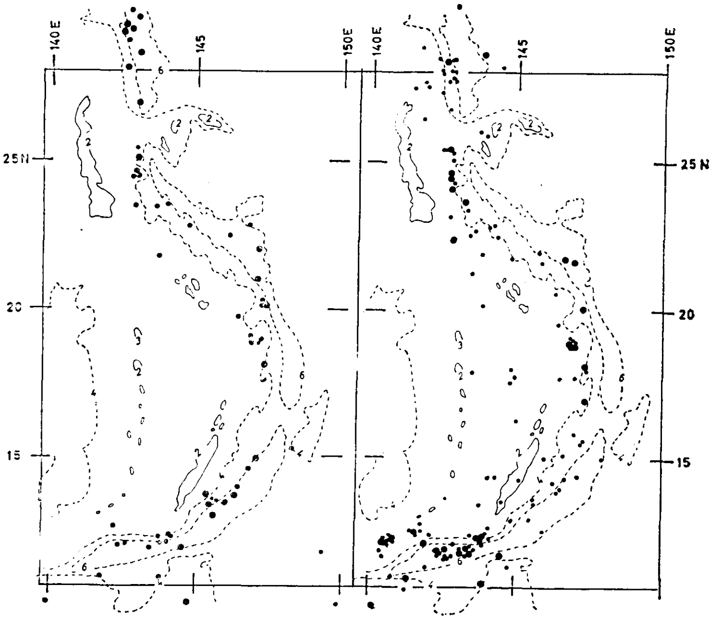
epicentral distributions and figures of the focal zones basing on the Preliminary Determination of Epicenter (P.D.E.) by USCGS in the Bonin-Mariana Islands region will be compared with the results obtained by M. Katsumata et al. based on the relocated data. Similar comparison will also be made for the Tonga-Kermadec Islands region.

§ 2. Distribution of stations

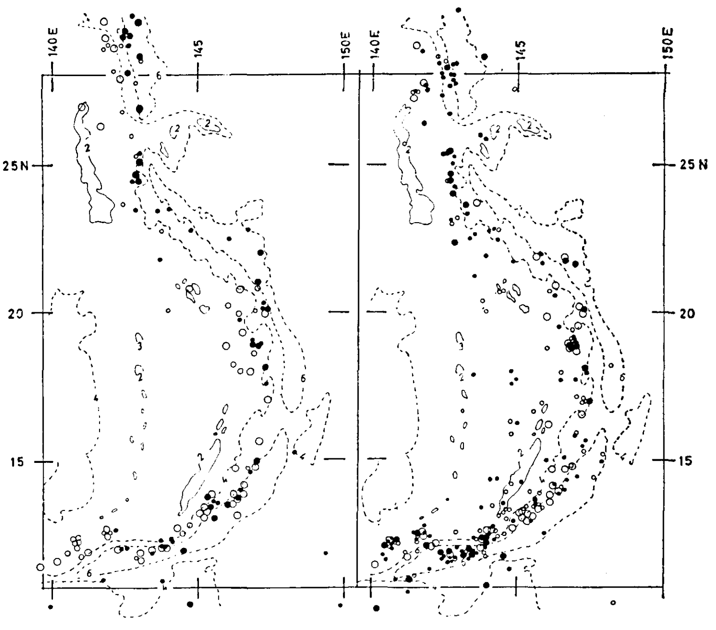
Seismic data in the area bounded by the latitude 10°N-30°N and the longitude 140°E-150°E were taken from the P.D.E. by USCGS in

Table 1. List of the stations the data of which were often used by USCGS for determining the foci of smaller shocks ($m \leqq 4.5$) in Bonin and Mariana Islands region. (E): earlier period (1964). (L): later period (1968). Underlined stations: WWSSN. A: the stations constantly used. B: the stations frequently used. N: range of the total number of stations in average.

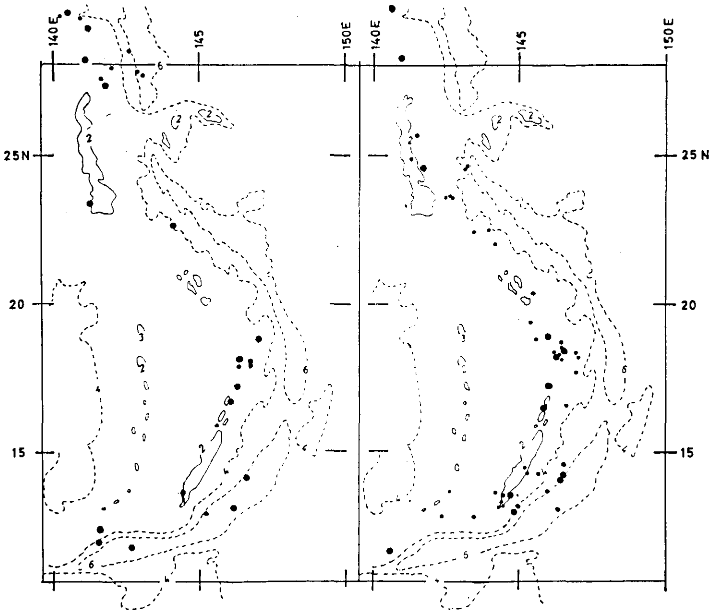
	Stations	Dist.	Azim.
(E)			
A	GUA (Guam, Mariana Islands)	1,600^{km}	470°
	MAT (Matsushiro, Japan)	1,800	340
	BMO (Blue Mountains, Oregon)	9,100	45
	UBO (Uinta Basin, Utah)	9,800	47
	TFO (Tonto Forest, Arizona)	10,000	530
B	COL (College Outpost, Alaska)	6,900	270
	EUR (Eureka, Nevada)	9,400	50
$N=8\sim12$			
(L)			
A	GUA (Guam, Mariana Islands)	1,600^{km}	47°
	GIL (Gilmore Creek, Alaska)	6,600	28
	COL (College Outpost, Alaska)	6,900	27
	UBO (Uinta Basin, Utah)	9,800	47
B	MAT (Matsushiro, Japan)	1,800	340
	TSK (Tsukuba, Japan)	1,200	355
	HHM (Hungoy Horse, Montana)	8,500	42
	RES (Resolute, Canada)	8,000	13
	BRS (Brisbane, Australia)	4,600	170
	EUR (Eureka, Nevada)	9,400	50
	TFO (Tonto Forest, Arizona)	10,000	53
$N=20\sim27$			



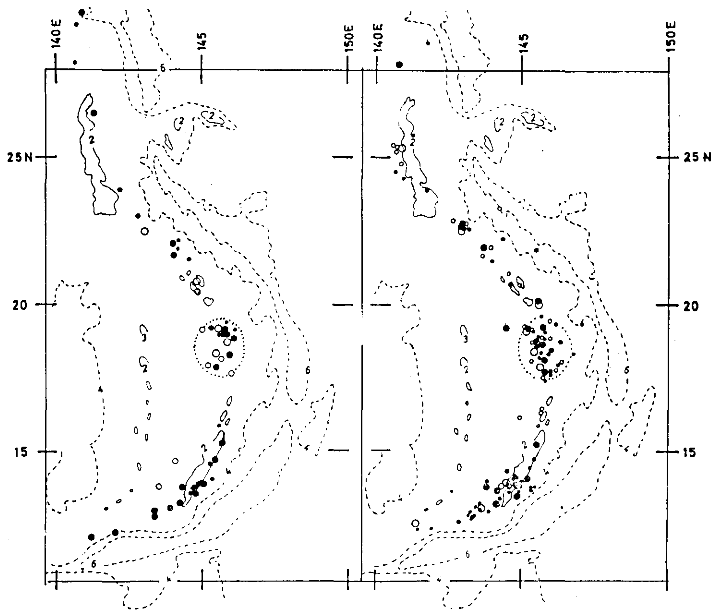
-a). $d<35$ km.



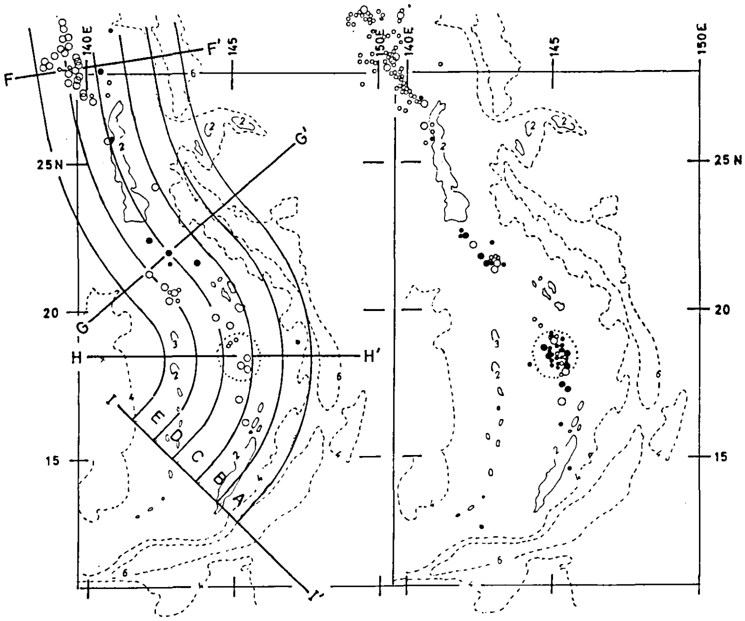
-b). Open circles: $35\,\text{km} \leqq d < 70\,\text{km}$. Filled circles: the same as above.



-c). 70 km$\leqq d<$100 km.



-d). Filled circles :100 km$\leqq d<$150 km. Open circles: 150 km$\leqq d<$200 km.



-e). Filled circles: 200 km ≦ d < 300 km. Open circles: d ≧ 300 km.

Fig. 2. Epicentral maps based on the relocated data by M. Katsumata et al. (left) and those based on USCGS data (right). On the size of circles, see the text.

the period from January 1963 to September 1969. As in previous cases, distances and azimuths of stations the data at which were constantly and/or quite often available by USCGS to determine the foci of smaller events ($m \leqq 4.5$) were examined in the earlier period E and in the later one L. These are given in Table 1 and Fig. 1. In the earlier period (1964 was taken as a representative one), the total number of stations available for detecting the smaller events (around 10 in average) is thought to be enough for determining the epicenters accurate. Their azimuthal distribution, however, is not so good being restricted in NE directions. In the later period (1968), the data at a station BRS (Brisbane, Australia) of southern direction appear to be quite valuable, and the total number in average has also increased remarkably.

§ 3. Comparison of the epicentral distributions and shapes of focal zones based on USCGS data with those based on the relocated data.

In Fig. 2, epicenters based only on the USCGS data (right) are compared to those based on the relocated data by M. Katsumata et al. (left) for various depth ranges. In the left map, small circles mean the locations of the least precise for which the authors denoted the

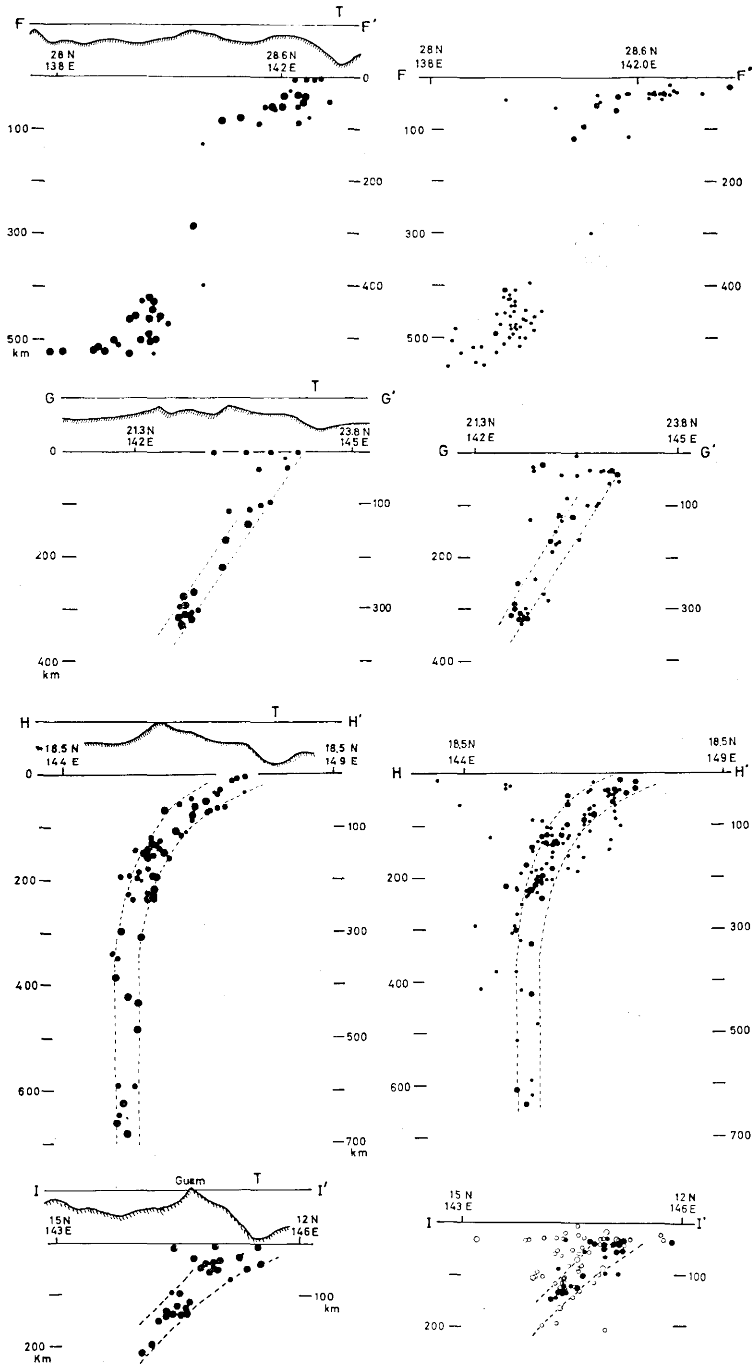


Fig. 3. Foci distributions based on the relocated data by M. Katsumata et al. (left) and those on the USCGS data (right) along the sections of FF′, GG′, HH′ and II′ which are shown in Fig. 2-e). Sizes of the circles have the same meanings as were used in Fig. 2. Broken lines in the left figures which were drawn by M. Katsumata et al. to show the thickness of the focal zone are drawn again in the right figures for comparison. Open circles in the right figure for section II′ correspond to the foci which were excluded from redetermination.

symbol C (see column Q in Table 2). The epicenters for which they denoted the symbol A (the most precise one) and B (moderate one) are indicated together by large circles in Fig. 2. In the right map, the large and the small circle corresponds to the event with m (CGS magnitude) of less than 5.0 and larger than 5.0 respectively.

As the period of the data collection is different (right map contains the data from January 1963 to October 1969, while from January 1961 to December 1967 in the left map), some temporal and regional activities which appear in the left map are missing in the right one, and vice versa. A wider scattering of shallow and small events is also seen in the right maps (see Fig. 1-a) and 1-b)). Excepting for these, there are no serious differences between these two epicentral maps.

Fig. 3 shows the foci distributions along four profiles FF′, GG′, HH′ and II′ which are presented in Fig. 2-c), based on USCGS data (right) and on relocated data (left). Scatterings of the foci in the right figures are recognized to have resulted from the smaller events of $m<$ 5.0. Even if we include these scattered foci, the general conclusions we shall make from the foci distributions in the right figures might be the same as the conclusions from the left figures by relocations, excepting the one along the profile II′.

In the process of relocation, the events for which the number of stations available were small or for which the distribution of the stations were too biassed were excluded in advance. Along the section II′ in Fig. 3, the foci of these excluded events are distinguished by open circles. The remaining foci form almost the same pattern as in the left one. It must especially be noticed that the activity of the shallow and small events in the northwestern part of the section has been neglected in the relocated foci zone.

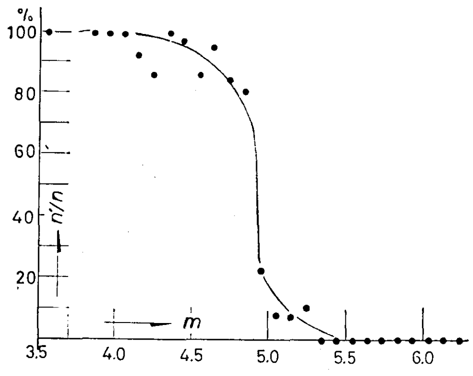


Fig. 4. Percentage of n'/n as a function of CGS magnitude m, where n' is the number of events which were excluded from relocation and n is the total number of events reported in P.D.E. Period: July 1963—December 1967.

The above result raise a question if the exclusion of these events will lead to a mistaken conclusion as to the true seismicity of the region. Fig. 4 shows the statistical figure on the ratio of the number of the events (n') excluded by M. Katsumata et al. from relocation in advance to the total one (n) reported on P.D.E. versus magnitude m. This figure indicates that equal or more than 80% of the events with $m \leqq 4.9$ were excluded from relocation.

Table 2. Original data of earthquakes (1964) reported in P.D.E. of U. S. Coast and Geodetic Survey and their residuals (Δt, $\Delta\lambda$, $\Delta\varphi$ and ΔD) from the data of relocation. Underlined residuals: Large residuals of more than $\pm 0.25°$ for epicenter and more than ± 25 km for depth.

Date	Origin Time t		Latitude λ		Longitude φ		Depth D		m	Q
1964	h m s	Δt	N	$\Delta\lambda$	E	$\Delta\varphi$	km	ΔD		
Jan. 22	17 58 16.3	2.5	20.2	0.03	147.1	−0.10	39	14	5.1	B
30	17 20 13.4	4.8	23.4	0.07	143.3	−0.14	33	33	4.7	B
Feb. 18	04 45 42.0	1.0	14.2	0.14	146.5	−0.06	78	2	5.0	B
29	19 42 43.9	−1.4	29.9	−0.06	139.1	−0.16	322	− 8	4.4	A
Mar. 14	02 51 04.1	0.3	18.7	−0.06	145.6	−0.01	136	0	5.0	A
19	11 50 54.2	−0.9	28.4	0.11	139.6	−0.05	450	−13	4.4	A
21	07 46 39	1.6	12.1	0.19	141.9	−0.01	33	4	5.2	C
26	02 04 20.2	−4.7	11.3	−0.26	142.0	−0.64	33	−48	4.9	B
Apr. 10	13 10 05.4	1.0	13.5	−0.05	144.9	0.25	101	1	5.4	B
13	08 45 24.6	−1.4	22.3	0.07	142.1	−0.17	309	−19	5.1	A
May 10	05 39 42.6	1.6	29.0	−0.14	141.5	−0.47	62	8	5.3	A
18	17 38 25.5	2.7	18.2	0.00	147.3	0.11	19	19	5.1	B
23	11 22 33.3	−1.2	28.6	0.03	139.4	−0.29	409	−23	5.1	A
26	09 40 57.9	0.5	16.5	−0.02	145.9	−0.85	94	− 3	5.5	B
June 16	17 08 30.8	−0.02	15.6	0.04	147.2	0.10	33	− 3	4.8	B
25	22 19 38.2	0.01	16.1	−0.04	145.3	−0.17	293	1	4.9	A
July 04	10 49 28.8	3.3	11.7	−0.02	144.5	−0.13	33	23	6.0	B
05	17 57 30.9	−4.2	11.9	0.06	142.4	−0.21	20	−36	5.0	B
11	18 53 15.8	−0.9	12.2	−0.10	141.6	0.02	61	−22	4.7	B
16	09 19 45.8	−1.0	29.9	−0.03	138.0	−0.28	461	−11	4.1	A
24	10 54 52.5	−1.2	13.1	−0.08	145.0	−0.17	43	−16	5.6	A
Aug. 27	01 34 26.7	2.4	23.7	0.28	143.6	−0.20	39	7	5.1	B
Sept. 06	18 41 01.8	4.2	10.0	0.02	140.2	0.18	33	33	5.1	B
09	06 06 18.4	7.6	26.2	−0.17	143.7	−1.01	33	33	4.9	C
17	05 56 31	−0.4	28.3	0.44	143.4	0.72	33	−43	4.5	C
20	14 36 05.3	−0.16	30.0	0.02	138.8	0.39	520	46	4.9	A
24	14 34 48.0	−0.5	20.7	−0.05	144.6	−0.22	146	0	4.8	B
Oct. 09	12 43 04.5	−0.1	28.4	0.13	138.8	−0.06	520	−11	4.9	A
Nov. 17	19 00 10.4	−0.6	12.7	−0.06	144.9	0.22	43	4	5.1	B
21	15 34 13.2	−4.3	12.8	−0.10	145.2	−0.07	35	−35	5.2	C
Dec. 14	06 41 23.1	−0.9	28.2	−0.01	140.8	0.18	115	−15	5.0	C
17	04 03 45.7	0.6	27.6	0.28	140.0	−0.04	468	− 3	4.6	A
30	13 08 50.2	−0.8	12.4	−0.04	142.0	−0.09	100	− 9	4.9	A

§ 4. Statistical distributions of the difference of the locations between USCGS data and the relocated ones.

The relocated data calculated by M. Katsumata et al. are listed in the microfiche version. From these materials, the differences between the focal locations being reported in P.D.E. by USCGS and those by redeterminations are found for each event in the overlapped period from January 1963 to December 1967. These differences in 1964 are given in Table 2 as examples, and their frequency distributions are shown in Fig. 5 for the longitude ($\Delta\lambda$), latitude ($\Delta\varphi$) and depth (ΔD) separately. Columns of frequency for the differences of more than ± 0.24 degrees in epicenter and more than ± 25 km in depth are hatched. These frequencies are summed up to be 10, 58 and 41 for $|\Delta\lambda|$, $|\Delta\varphi|$ and $|\Delta D|$, which corresponds to 4.7%, 16.3% and 19.2% of the total frequency. Means of the differences are $|\overline{\Delta\lambda}|=0.067°\pm0.061°$, $|\overline{\Delta\lambda}|=0.151°\pm0.098°$ and $|\overline{\Delta D}|=14.18\text{ km}\pm9.92\text{ km}$. The remarkable large value of $|\overline{\Delta\varphi}|$ compared with $|\overline{\Delta\lambda}|$ may be due to comparatively poor data from the stations in E-W direction.

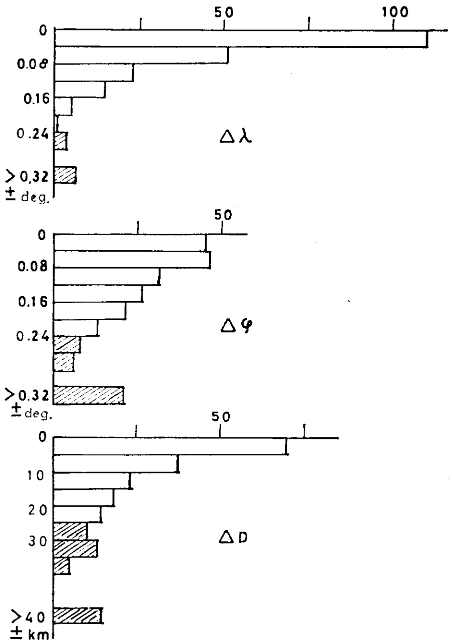


Fig. 5. Frequency distributions of the differences of epicenter ($\pm\Delta\lambda$, $\pm\Delta\varphi$) and depth ($\pm\Delta D$) between the USCGS data and relocated ones.

§ 5. Further study on the regional change of the shape of focal zone.

As was seen in Fig. 3, the focal zone along the section HH′ perpendicular to the central part of the Mariana Trench only has a special feature of vertical underthrusting into the mantle. In order to make the situation clearer, lateral distributions of the relocated foci by M. Katsumata et al. were studied along five profiles which are parallel to the trend of Islands arc (see Fig. 3-e). The results (Fig. 6) show that the vertical distribution of foci along HH′ section is revealed also as a vertical one in the hand C. Moreover, if we take several foci in both sides of this down-going seismic space into consideration, they in all

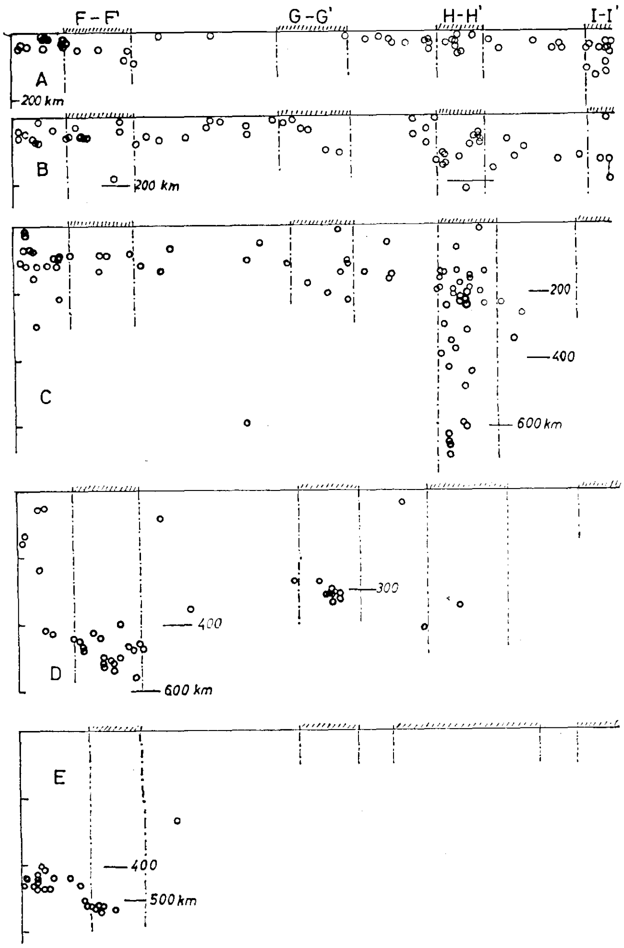


Fig. 6. Foci distributions along the five bands from A to E (see Fig. 2-e)). Portions included in the radial profiles in Fig. 2-e) are hatched being bounded by vertical dash-dotted lines.

seem to form, as it was in the case of the Hindu Kush region,[6] a funnel-shaped seismic pocket. The horizontal projection of the axis of this pocket corresponds to the group of epicenters which are indicated by the dotted area in Figs. 2-d) and -e). They are much more conspicuous in the right figures based on USCGS data. It must be noticed that the very group is situated almost at the center of the greatest curvature of the islands-trench arc.

These facts may give such a supposition as follows.

The "Pacific plate" moving almost to the west in the present region must change its direction into two after underthrusting into the

6) *ibid.*, 2).

mantle. Its northern part must go down south-westerly, and its southern part northwesterly. The plate, then, has to be folded somewhere. The funnel-shaped seismic pocket revealed in the band C above given might be the reflection that this folding is concentrated into the central part (see Fig. 7).

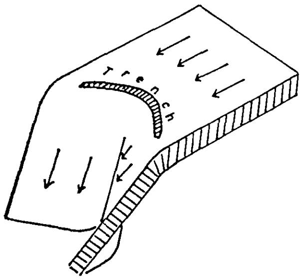


Fig. 7. Schematic figure of the folded lithosphere slab.

A simple test on a model showed, however, that the above supposition is not sufficient. Because the axis of the bottom of this folding along which the stress is maximum and therefore along which earthquakes will actively occur was still not found to have so vertical a trend as was shown in Fig. 3.

Nevertheless, as far as we adopt the plate theory, it is hard to disregard the idea that the special shape of the deep focal zone along the central profile HH′ of Mariana Trench may mainly be related with the concentrated folding of the lithosphere slab in the mantle. The above idea is required to be checked by studying the earthquake mechanism for the events inside the pocket.

The apparent difference of the focal zones along the profiles FF′ and GG′ (see Fig. 2-e)), on the other hand, is not so important. Because if we put these foci together, the results becomes such as is shown in Fig. 8. It forms one slab straightly underthrusting with an angle of around 45°. The difference of the pattern in the above two

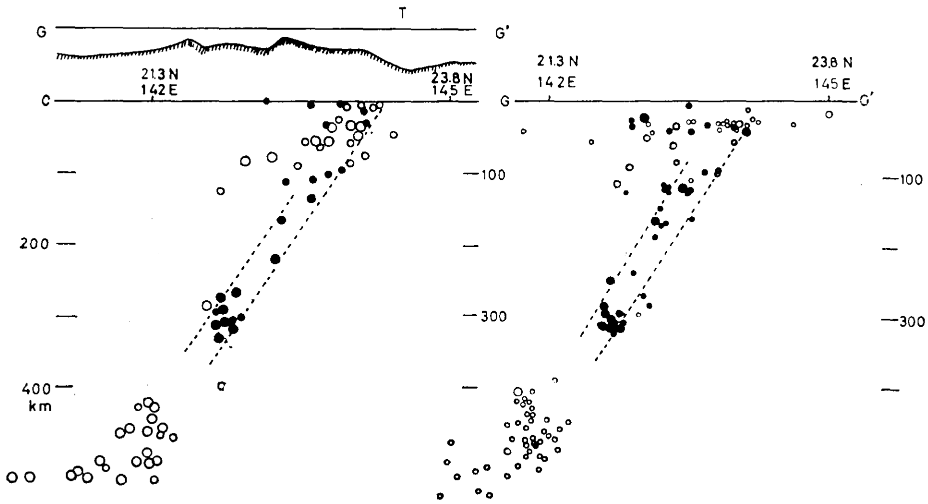


Fig. 8. Shape of the focal zone being a combination of the foci distributions on FF′ (open circles) with those on GG′ (filled circles). Left: based on relocation. Right: based on USCGS data.

figures of Fig. 3 is only that the former has a less seismic depth range from 100 km to 400 km, while the latter penetrated only to the depth of around 300 km with a small active group in its bottom. This small group appears in the foci distribution along band D in Fig. 7 around a depth of 300 km. The deep foci group along FF′ section, on the other hand, corresponds to those which appeared in bands C and D in Fig. 7, which look like distributing northward with a slight angle of elevation. These differences may be due to the regional variation of the condition in the upper mantle. It is unnecessary, therefore, to suppose any lateral distortion on the lithosphere slab either in the

Table 3. List of the stations the data of which were often used by USCGS for determining the foci of smaller events ($m \leqq 4.5$). A: the stations constantly used. B: the stations often used. Underlined: WWSSN. N: range of the total number of stations used in average.

Earlier period (1964)			
	Stations	Dist.	Azim.
A	CTA (Charters Towers, Australia)	3,800 km	263°
	BMO (Blue Mountains, Oregon)	9,300	38
B	AFI (Afiamalu. Samoa)	860	47
	TOO (Toolangi, Australia)	4,100	233
	TUC (Tucson, Arizona)	9,100	52
	TFO (Tonto Forest. Arizona)	9,100	50
	UBO (Uinta Basin, Utah)	10,300	46
	WMO (Wichita Mountains, Oklahoma)	10,700	55
N:9~13			

Later period (1968)			
A	TFO (Tonto Forest, Arizona)	9,100 km	50°
	BMO (Blue Mountains, Oregon)	9,300	38
	UBO (Uinta Basin, Utah)	10,300	46
B	BRS (Brisbane, Australia)	2,700	258
	CTA (Charters Towers, Australia)	3,800	263
	PMG (Port Moresby, New Guinea)	4,300	285
	WRA (Warramunga Array, Australia)	5,000	261
	SPA (South Pole, Antarctica)	7,900	180
	EUR (Eureka, Nevada)	9,100	43
	TUC (Tucson, Arizona)	9,100	52
	COL (College, Alaska)	9,600	12
N:13~20			

northern or southern part itself, excepting the central part which we have already discussed.

§ 6. Another comparison of epicentral and foci distributions based on USCGS data with those based on relocated data in Tonga-Kermadec Islands region.

By means of relocating the hypocenter, L. R. Sykes and his collaborators have studied the seismicity of various regions; Africa, Gulf of Adens and Red Sea,[7] the Arctic,[8] the Caribbean region,[9] Mid-Atlantic Ocean,[10] Tonga-Kermadec and Kurile-Kamchatka.[11] In the last one above given, L. R. Sykes stated that the thickness of the focal zone underthrusting into the mantle beneath the Tonga-Kermadec region was not more than 50 to 100 km.

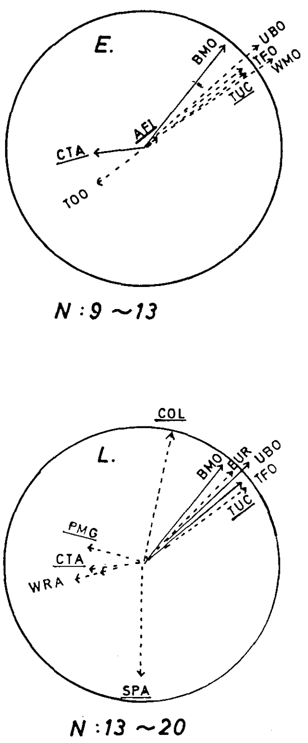


Fig. 9. Distribution of the stations which are listed in Table 3.

Epicentral maps and the shapes of focal zones he obtained would also be used for checking the reliability of the results based only on the data in P.D.E. by USCGS. This check was made in the area of 23.5°S–16°S, 173°W–178°E.

Table 3 gives the list of the stations the data of which were constantly (A) and often (B) used for determining the foci of smaller events ($m \leqq 4.5$) by USCGS. As is seen in Fig. 9, these stations distribute fairly well around the center of the seismic area we are now concerning, and the total number is also sufficient, especially in the later period, for determining the foci with high reliability. In Fig. 10, epicentral distributions based on the USCGS data (B) are compared to those

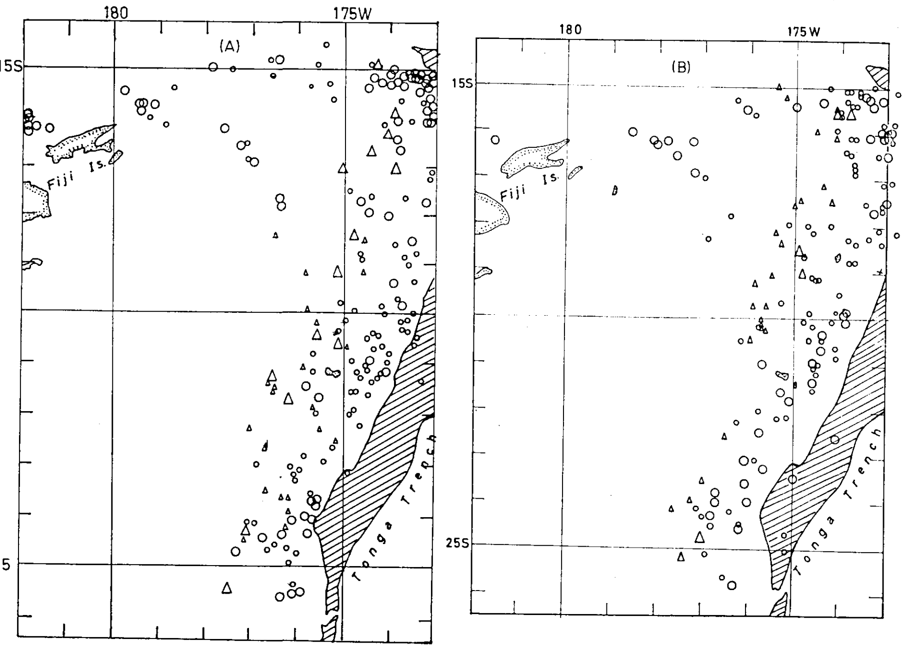
7) L. R. SYKES and M. LANDISMAN, "The Seismicity of East Africa, the Gulf of Aden and the Arabian and Red Seas", *Bull. Seism. Soc. Amer.*, **54** (1964), 1927–1940.

8) L. R. SYKES, "The Seismicity of the Arctic", *Bull. Seism. Soc. Amer.*, **55** (1965), 519–536.

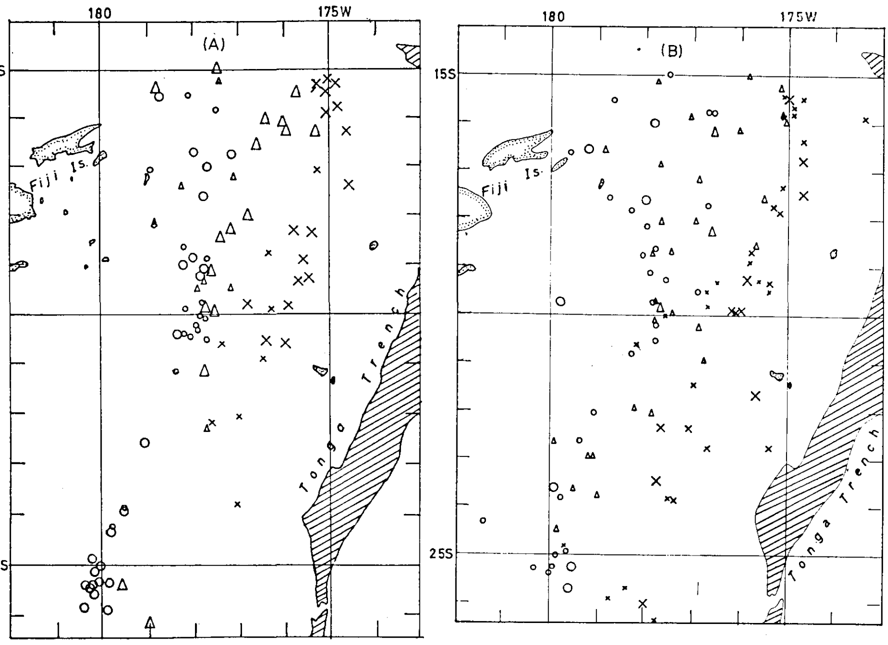
9) L. R. SYKES and M. EWING, "The Seismicity of the Caribbean Region", *J. Geophys. Res.*, **70** (1965), 5065–5074.

10) L. R. SYKES, "Mechanism of Earthquakes and Nature of Faulting on the Mid-Oceanic Ridges", *J. Geophys. Res.*, **72** (1967), 2132–2153.

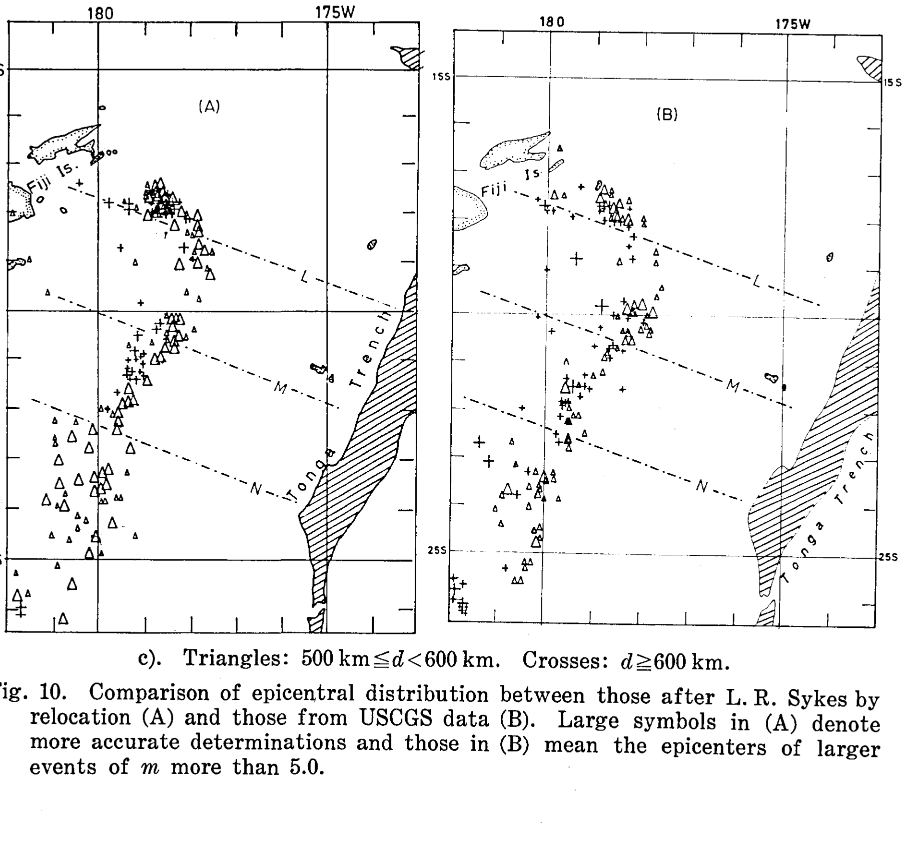
11) L. R. SYKES, "The Seismicity and Deep Structure of Island Arcs", *J. Geophys. Res.*, **71** (1966), 2981–3006.



a). Open circles: $d<100$ km. Triangles: $100\text{ km}\leqq d<200$ km.



b). Crosses: $200\text{ km}\leqq d<300$ km. Triangles: $300\text{ km}\leqq d<400$ km.
Open circles; $400\text{ km}\leqq d<500$ km.



c). Triangles: $500\text{ km}\leqq d<600$ km. Crosses: $d\geqq 600$ km.

Fig. 10. Comparison of epicentral distribution between those after L. R. Sykes by relocation (A) and those from USCGS data (B). Large symbols in (A) denote more accurate determinations and those in (B) mean the epicenters of larger events of m more than 5.0.

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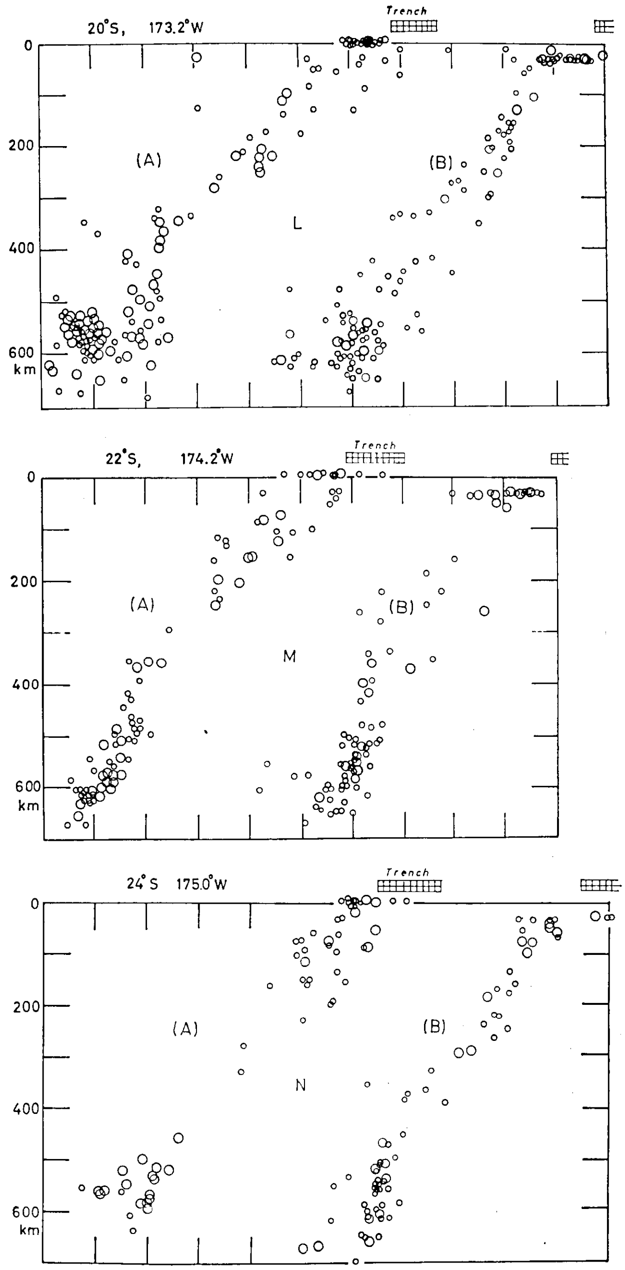

Fig. 11. Comparison of focal distributions between those after L. R. Sykes by relocation (A) and those from USCGS data (B) along three sections *L*, *M* and *N* which are presented in Fig. 10. Sizes of the symbols have the same meanings as were used in Fig. 10.

basing on the relocated data (A) by L. R. Sykes. In order to make the amount of data of (B) nearly equal to that of (A) and to mix the data in earlier and later periods equally, USCGS data were taken from January to September in 1964 and 1969, 18 months in total.

Though the period of the data collection is different with each other (in (A), the period was from January 1959 through February 1962), epicentral maps based on P.D.E. data do not have any serious difference to those based on relocated ones. Similarity between (A) and (B) is particularly good for deep earthquakes.

A similar conclusion may be made in Fig. 11 in which focal zones along three profiles L, M and N in Fig. 10-c are presented. A remarkable foci group between 500 km and 600 km which appeared in (A) of the uppermost figure in Fig. 11 will be due to the special activity during the period from 1959–1962 which was not used in our case (B).

§ 7. Conclusions

Reliability of the foci determination has regionality, depending upon the station distribution available around the seismic region. It can be concluded, however, through the present study, that as far as the station distribution available by USCGS around a certain seismic region is checked and found to be almost equivalent to those in the cases of Bonin-Mariana and/or Tonga-Kermadec Islands regions at least, the USCGS data since 1963 can be used with sufficient reliability for studying the character of seismicity in the region in question.

In the process of the relocation, it is unavoidable to exclude the smaller events in advance when they are detected by a relatively poor number of stations and/or by stations with too biassed distribution. Activity of these smaller events, however, must also be commenced when they gather into another space apart from the main trend of the relocated foci distributions.

It was suggested that exceptional vertical underthrusting of deep focal zone along the profile perpendicular to the central part of the Mariana Trench may be related to the sharp folding of the lithosphere slab in the mantle.

22. 世界の特殊な地震地域の活動について

(その五) 小笠原列島からマリアナ諸島周辺にかけて
—USCGS の資料にもとづく震源分布の信頼度—

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小笠原列島からマリアナ諸島にかけての地震活動は，勝又，サイクスによって震源の再決定がなされたうえで行われている．そこで本篇では，震源位置についての USCGS のなまの資料 (1963 年以降) を用いた震源分布と，上述の再決定による分布との比較をまず行つてみたが，両者は予想以上によく合つていた (第2, 3図). しかも，なまの資料を用いたばあいに見られる震源のばらつきは，ほとんど全部が小さい地震に限られ，これらの地震は，記録できた観測点の数が少ないか，またはその分布が偏つているかの理由から，再決定の材料からあらかじめ除外されたものばかりであった (第3図). これらの除外された地震は当然小さい地震ほど多く，m が 4.8 前後のものはその 90% 内外が，そして 4.5 以下はほとんど全部が再決定から除外されている (第4図). しかしこれでは，ある程度以下の小さい地震の活動は，震源再決定という手段のために消え去ってしまうことになる．だから，震源を決め直して活動を調べるばあいには，参考としてこれら除外された地震の震源分布にも同時にふれておくことが必要であろう．

小笠原列島からマリアナ諸島にかけての島弧系に属する震源層で注目されるのは，弧の中央部を東西に切る断面にそつた震源層だけが，マントルに垂直に入りこんでいることである (第3図). この事実に対して，プレート説を用いたひとつのモデルを提出した (第7図).

再決定された震央や震源分布と，USCGS の資料をそのまま用いたばあいのそれらとの比較は，トンガーケルマデック諸島周辺の地震につても行われたが，このばあいでも両者の一致はきわめて良かった (第10,11図). USCGS が決めている震源の精度は，むろん地区ごとに多少ちがうから一般的なことはいえなないけれども，本篇の結果からみて，あらかじめそれぞれの地区の地震の震源決定に関与した観測点の数や分布を検討し，それが本篇で扱つたマリアナやトンガ近辺のそれ以下でなければ，少くとも統計的な取り扱いをする限り，1963 年以降の USCGS の震源資料は，そのままで十分使える程度の信頼度をもつていると判断される．