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36. *Variation of Earthquake Energy Release with Depth Part 1.*

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Summary

The world-wide and regional earthquake energy release in relation to focal depth are calculated based on the data of the Preliminary Determination of Epicenters (PDE) of USCGS for the period of January 1963–June 1966. Number of earthquakes are listed according to their magnitudes and depths, with 0.5 magnitude unit and 30 km depth range classifications. Three apparent discontinuities of frequency at 30–60, 270–300 and 420–480 km depths allow us to classify the earthquakes into the shallow (<60 km), intermediate (<300 km), transient (<450 km) and deep (≥450 km) focus groups. Energy depth frequency is calculated for various different seismic regions which show, firstly, very clear regional characteristics with minima at the depth of 100–200 km corresponding to the asthenosphere low velocity layer. The second minima, found at the depth of 210–330 km in both Kamchatka-Kuril Islands and Japan-Bonin Islands Regions, are generally at the depth of 300–450 km in the other seismic regions separating the intermediate and deep focus earthquakes. The shape of the energy-depth curve is interpreted in terms of the structure, physical conditions and intensity of the strain accumulation.

1. Introduction

Calculations of earthquake energy or related strain release characteristics of the earth's interior have been made by different authors based mainly on the material of Gutenberg and Richter's monumental work "Seismicity of the Earth and Associated Phenomena" (1949, 1954). However, the materials used in the earlier studies included inhomogeneous sets of data both in time and space. Recently S. J. Duda (1965) made a remarkable contribution in providing a more complete list of the large earthquakes with $M \geq 7.0$.

On the other hand, development of world seismological network and

international data processing services, in particular the work of USCGS in the last several years, is marvellous and we are able to decrease the magnitude limit for the study of global seismicity to $m=5$ or less, which was only attainable in the very restricted period and regions in the statistics given by Gutenberg and Richter.

Thus, the distribution of earthquake energy release as a function of depth is investigated for various different seismic regions in the world on the light of the new data of USCGS. The present paper is concerned with the problem of clarifying the existence of weak layers with increased plastic flow which would show up as minima in the curve relating energy release to focal depth.

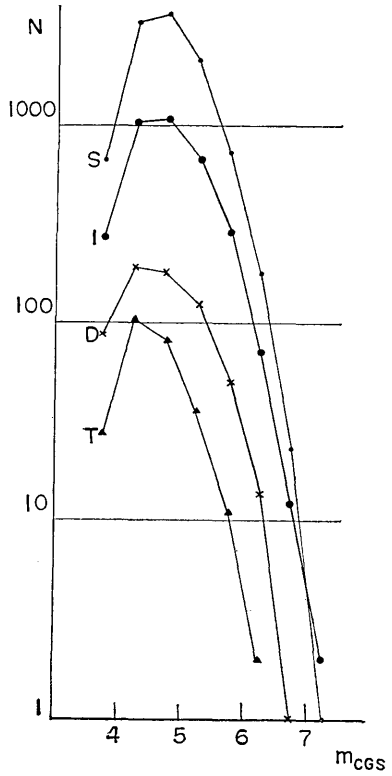


Fig. 1. Magnitude frequency of earthquakes of the world for the period from January 1963 to June 1966, after the monthly PDE summaries of USCGS. S: Shallow, I: Intermediate, T: Transient, D: Deep

2. Material used

Preliminary Determination of Epicenter (PDE) or Earthquake Data Report (EDR) of USCGS is used, which includes the magnitude m calculated by the maximum ground amplitude of the P wave group and its period at different stations from 1963 to date (Fig. 1). It seems to supply homogeneous data over the whole world for magnitude $m \geq 5$, except for the Antarctic regions (Fig. 2). PDE also contains many epicenters of earthquakes with magnitude $m<5$ for various regions and even down to $m=4$ for some regions (Fig. 3).

3. Depth Classifications

Three apparent discontinuities of depth frequency at 30–60, 270–300 and 420–480 km allow us to classify the earthquakes into shallow (<60 km), intermediate (<300 km), transient (<450 km) and deep (≥450 km) focus groups. The classification differs slightly from the traditional definitions, *e.g.* Gutenberg and Richter (1954) and Båth and Duda

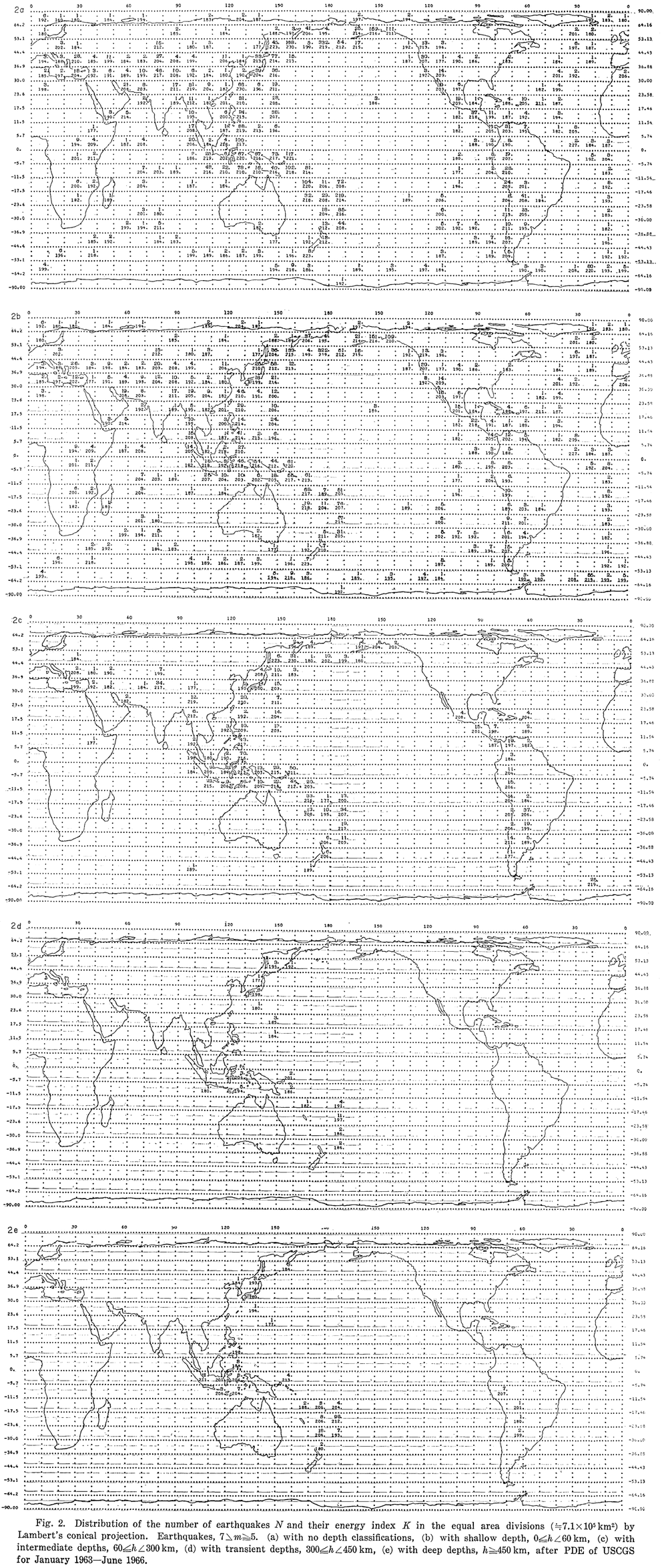


Fig. 2. Distribution of the number of earthquakes N and their energy index K in the equal area divisions ($\fallingdotseq 7.1\times10^5$ km^2) by Lambert's conical projection. Earthquakes, $7\backslash m\geqq 5$. (a) with no depth classifications, (b) with shallow depth, $0\leqq h\angle 60$ km, (c) with intermediate depths, $60\leqq h\angle 300$ km, (d) with transient depths, $300\leqq h\angle 450$ km, (e) with deep depths, $h\geqq 450$ km, after PDE of USCGS for January 1963—June 1966.

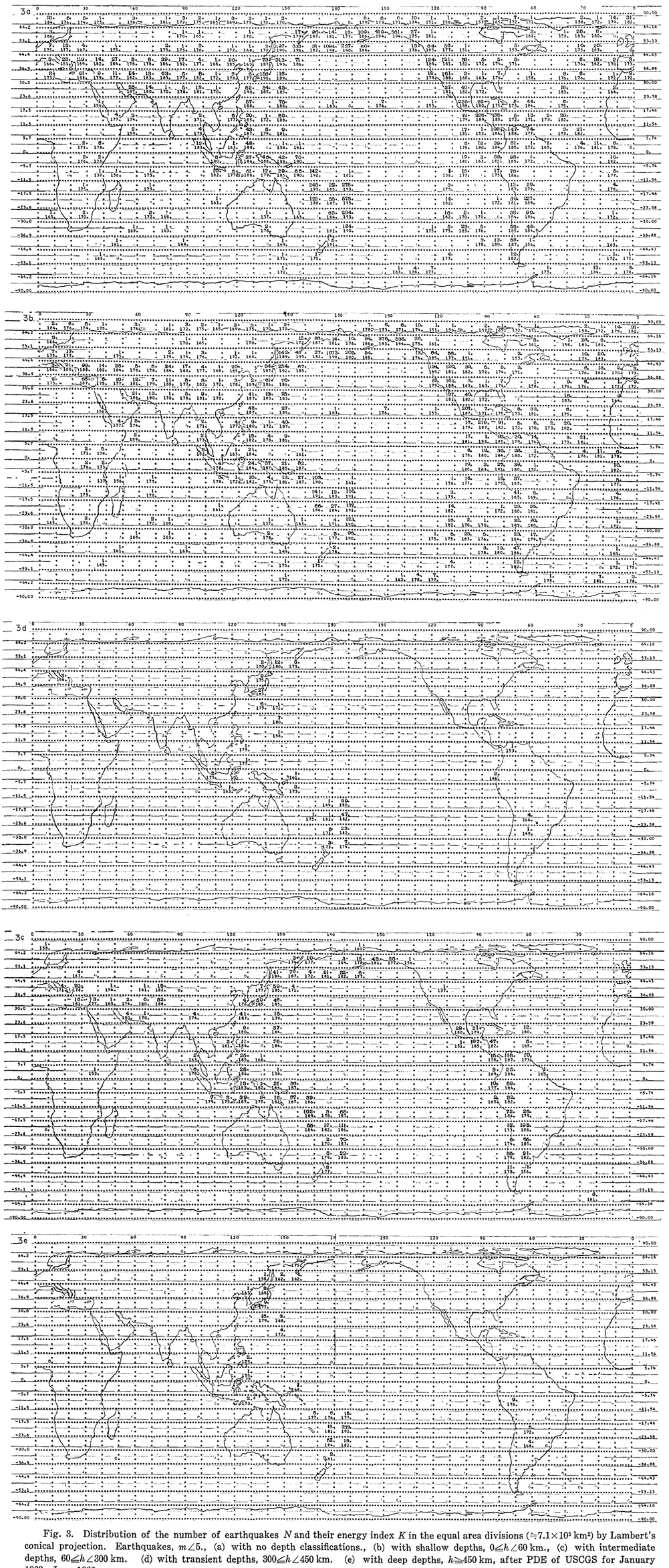


Fig. 3. Distribution of the number of earthquakes N and their energy index K in the equal area divisions ($\fallingdotseq 7.1\times10^5$ km^2) by Lambert's conical projection. Earthquakes, $m \angle 5.$, (a) with no depth classifications., (b) with shallow depths, $0 \leqq h \angle 60$ km., (c) with intermediate depths, $60 \leqq h \angle 300$ km. (d) with transient depths, $300 \leqq h \angle 450$ km. (e) with deep depths, $h \geqq 450$ km, after PDE of USCGS for January 1963—June 1966.

(1963). As the depth accuracy seems larger than 30 km, the maximum at 30–60 km depth may not be real, but the division into shallow and intermediate at 60 km depth is adopted, in order to bring no drastic change in the definitions of shallow and intermediate earthquakes. The minimum at 420–480 km seems to be very important as Duda emphasized in his paper (1965). However, he ignored the minimum at 270–300 km, which corresponds to the traditional boundary of intermediate and deep shocks. The present author believes that this boundary also cannot be disregarded. Thus the four depth ranges mentioned above are introduced, separating the traditional deep focus earthquakes (>300 km) into transient (quasi-deep) and deep groups. This classification is applicable to all deep focus earthquake regions with a slight shift of boundary depth as described by S. Miyamura (1966).

4. Seismicity Maps

Geographical distributions of the earthquakes of these four depth groups are represented in the maps in Figs. 2 and 3. The maps are the print out of number N of earthquakes and the corresponding total energy index K in 36×20 equi-areal divisions bounded by the 36 meridians of every 10 degrees and 21 appropriately separated parallels. The maps are the same as Lambert's conical projection map and N and K correspond to the values in the area of each division, approximately 7.1×10^5 km^2. The energy index K is given by the formula $K=10\log E$, where $E=\sum E_i$ and E_i is the energy of the individual earthquake. For the calculation of energy the relation $\log E_i = 11.8+1.5\,M_i$, given by B. Gutenberg (1956), was adopted. We tentatively applied the relation between M and the unified magnitude m given by B. Gutenberg (1957), *i.e.* $M=1.59\mathrm{m}-3.97$ to calculate the energy from USCGS magnitudes. Unified magnitude and USCGS magnitude are not equal. While the latter is calculated only from the P group amplitude and is written strictly as m_{PZ}, the former is defined as the weighted mean of m_{PZ}, m_{PPZ}, m_{SH} etc., according to the definition given by B. Gutenberg (1956). However, we ignore this difference and use the above cited relation between M and m, as we have no authentic relation between M and m_{PZ} at present.

Moreover, there seems to be significant and consistent differences in magnitudes, determined at different centres and supposedly in the same scale. For example, M. Båth (1966) pointed out that the USCGS

magnitudes are about 0.7 unites lower than those determined at a number of stations, as Pasadena, Berkeley, Palisades, Strasbourg, Prague, Uppsala, Kiruna, Moscow, Rome, etc., the latter usually agreeing within error limits. The correction 0.7 to be added to the USCGS magnitues corresponds to the correction of 1.67 to be added to our energy index K.

5. Seismicity Tables

To facilitate investigations of seismicity, Gutenberg and Richter (1954, with map on p. 12) divided the surface of the earth into regions numbered 1 to 51. For our present study, the world is divided into 65 regions bounded by meridians and parallels, as in Fig. 4, from the view points of seismicity and seismotectonics. The data are tabulated, as in Table 2, for all regions as shown in Table 3 and they are summarized in Table 4 for the 6 different seismotectonic region groups, *i.e.* 1) Oceanic stable region, 2) Oceanic seismic zone, 3) Circum-Pacific seismic zone, 4) Alps-Himalayan seismic zone, 5) Continental Seismic zone and 6) Continental stable region. In the seismicity tables, numbers of earthquakes are listed according to their magnitudes and depths, with 0.5 magnitude unit and 30 km depth range classifications.

The number of earthquakes with undefined magnitude listed in the column of UNDF in the seismicity tables is 13.5% of all reported earthquakes and it reaches 20% for some depth levels, including very shallow levels. An increase of the number of earthqukes with decreasing magnitude is seen down to $m=4.5$ for the depth level shallower than 120 km and to $m=4.0$ for the level deeper than 120 km, except for a few narrow depth ranges. In PDE (EDR) of USCGS, restrained depths frequently occur in the following cases. If at any point in the computation the depth becomes negative (above the mean sphere), the computation is automatically restricted to the 33 km level and indicated by "DEPTH NORMAL*." A computation may be held at 33 km, if, in the judgment of the geophysicist, the earthquake is probably shallow and the unrestrained depth computation yields a greater depth than seems reasonable. These are indicated by "DEPTH NORMAL." Considering these circumstances, a number of earthquakes with depth 33 km are listed separately.

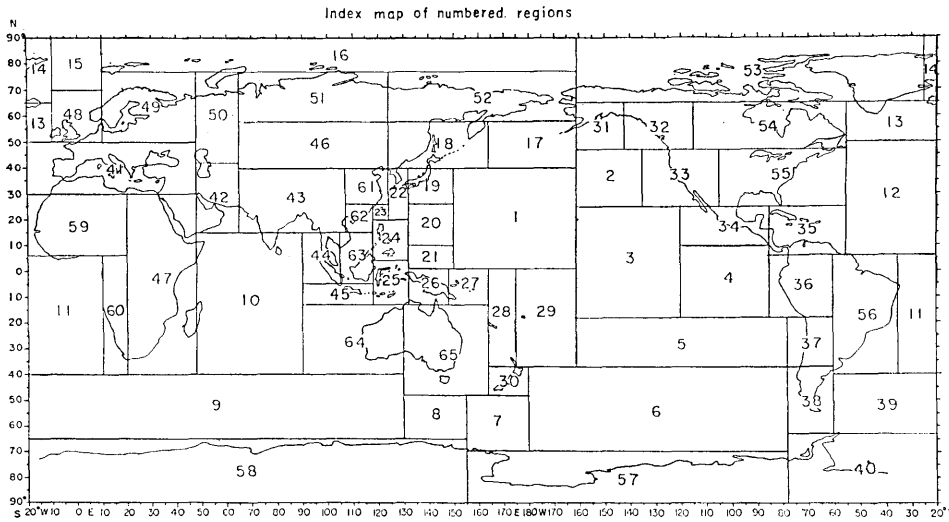


Fig. 4. Regions bounded by meridians and parallels for the study of world seismicity. 1) Oceanic stable regions are Nos. 1-3; 2) Oceanic seismic regions are Nos. 4-16, except No. 7; 3) Circum-Pacific seismic regions are Nos. 17-40 and No. 7; 4) Alps-Himalayan seismic regions are Nos. 41-45; 5) Continental seismic regions are Nos. 46-47; and 6) Continental stable regions are Nos. 48-65. Boundaries of the regions are as follows:

Index Number	Region	Boundary			
1	NW. PACIFIC OCEAN	1N	40N	150E	161W
2	NE. PACIFIC OCEAN	25N	47N	161W	135W
3	CENTRAL PACIFIC OC.	18S	25N	161W	120W
4	E. PACIFIC OCEAN	18S	10N	120W	85W
5	SE. PACIFIC OCEAN	37S	18S	161W	78W
6	PAC. ANTARCTIC OCEAN	70S	37S	180E	78W
7	MACQUARIE IS. RIDGE	70S	48S	155E	180E
8	IND. ANTARCTIC SWELL	65S	48S	130E	155E
9	AFR. AUSTRA. ANTAR. OC.	65S	40S	20W	130E
10	INDIAN OCEAN	40S	15N	48E	90E
11	S. ATLANTIC OCEAN	40S	6N	35W	10E
12	N. ATLANTIC OCEAN	6N	50N	55W	20W
13	REYKJANES R.-S. ICEL.	50N	65N	55W	10W
14	N. ICEL.-E. GREENLAND	65N	90N	25W	10W
15	GREENLAND SEA	70N	90N	10W	10E
16	EURASIAN ARCTIC OC.	77N	90N	10E	161W
17	ALEUT. IS.-KOMAND. IS.	40N	58N	164E	161W
18	KAMCHATKA-KURIL IS.	40N	58N	124E	164E
19	JAPAN-BONIN IS.	26N	40N	132E	150E
20	MARIANA IS.	10N	26N	132E	150E
21	CAROLINE IS.	1N	10N	132E	150E
22	KYUSHU-RYUKYU IS.	20N	40N	124E	132E
23	TAIWAN	20N	26N	118E	124E
24	PHILIPPINE IS.	4N	20N	118E	132E
25	CELEBES-BANDA SEA	13S	4N	118E	132E

Index Numbe	Region	Boundary			
26	NEW GUINEA	13S	1N	132E	148E
27	NEW BRIT.-SOLOMON IS.	13S	1N	148E	164E
28	NEW HEBRIDES IS.	37S	1N	164E	175E
29	TONGA-KERMADEC IS.	37S	1N	175E	161W
30	NEW ZELAND	48S	37S	164E	180E
31	S. ALASKA	47N	65N	161W	142W
32	W. CANADA	47N	65N	142W	115W
33	W. UNITED STATES	25N	47N	135W	105W
34	CENTRAL AMERICA	10N	25N	120W	85W
35	ANTILLES IS.	6N	25N	85W	55W
36	COLOMBIA-PERU	18S	6N	85W	60W
37	N. CHILE	37S	18S	78W	60W
38	S. CHILE	63S	37S	78W	60W
39	S. ANTILLES IS.	63S	40S	60W	20W
40	PALMER PENINSULA	63S	90S	78W	20W
41	MEDITERRANEAN REGION	30N	50N	20W	48E
42	IRAN-TURKMENIA	15N	42N	48E	65E
43	PAMIR-INDIA-BURMA	15N	40N	65E	107E
44	ANDAMAN IS.-SUMATRA	5S	15N	90E	105E
45	JAVA	13S	5S	90E	118E
46	TIEN SCHAN-BAIKAL	40N	58N	65E	124E
47	E. AFRICA	40S	30N	20E	48E
48	NORW. SEA-BRITISH IS.	50N	70N	10W	10E
49	N. EUROPE	50N	77N	10E	48E
50	URAL-KAZAKHSTAN	42N	77N	48E	65E
51	N. SIBERIA	58N	77N	65E	124E
52	E. SIBERIA-NW. ALASKA	58N	77N	124E	161E
53	ARCTIC CANADA-GREENL.	65N	90N	161W	25W
54	E. CANADA	47N	65N	115W	55W
55	E. UNITED STATES	25N	47N	105W	51W
56	BRAZIL	40S	6N	60W	35W
57	W. ANTARCTIC/PAC. SIDE	90S	70S	155E	78W
58	E. ANTARCTIC/AFR. SIDE	90S	65S	20W	155E
59	W. AFRICA	6N	30N	20W	20E
60	SW. AFRICA	40S	6N	10E	20E
61	N. CHINA	26N	40N	107E	124E
62	S. CHINA	15N	26N	107E	118E
63	BORNEO-S. VIET NAM	5S	15N	105E	118E
64	W. AUSTRALIA	40S	13S	90E	130E
65	E. AUSTRALIA	48S	13S	130E	164E

Table 1. Depth range with energy release minimum in the various tectonic regions.

Region No.	Region Name	Depth Range with Energy Release Minimum
18	Kamchatka-Kuril Is.	90–150 km
19	Japan-Bonin Is.	90–150
20	Mariana	90–150
22	Kyushu-Ryukyu Is.	90–180
23	Taiwan Is.	90–180
24	Philippine Is.	60–120
25	Celebes-Banda Sea	60–180
28	New-Hebrides Is.	60–120
29	Tonga-Kermadic Is.	60–150
30	New Zealand	60–180
34	Central America	60– 90
35	Antilles Is.	60– 90
39	South Antilles Is.	60–120
41	Mediterranean Region	90–120
45	Java	90–210

Table 2. Seismicity table showing magnitude depth frequency and energy depth relation of world earthquakes for the period from January 1963 to June 1966 after the PDE of USCGS. K: Energy index.

SEISMICITY TABLE

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	UNDF	SUM	K
0--	1	7	76	518	691	456	172	56	2	0	490	2469	22.6
30--	0	23	597	2837	3172	1559	547	119	21	1	1255	10131	23.4
60--	0	2	51	311	407	247	109	28	1	2	178	1336	23.4
90--	0	3	48	229	256	155	72	18	3	0	128	912	22.6
120--	0	0	42	181	143	123	43	11	3	0	109	655	22.3
150--	0	1	49	133	128	69	23	4	3	0	71	481	22.1
180--	0	1	25	88	69	38	13	8	0	0	34	256	21.5
210--	0	1	16	52	58	27	19	2	1	0	45	221	21.7
240--	0	1	21	46	30	9	4	1	1	0	15	128	21.5
270--	0	1	14	27	20	8	3	0	0	0	10	83	19.8
300--	0	0	6	21	16	10	1	1	0	0	4	59	20.7
330--	0	0	5	17	22	7	0	0	0	0	4	55	19.2
360--	0	0	6	21	19	6	4	1	0	0	9	66	20.3
390--	0	1	4	25	13	7	3	0	0	0	4	57	19.9
420--	0	0	7	21	12	6	3	0	0	0	5	54	20.0
450--	0	0	8	25	19	10	6	0	0	0	3	71	20.1
480--	0	0	14	21	27	10	1	3	0	0	12	88	20.8
510--	0	1	14	22	38	23	4	0	1	0	19	122	21.4
540--	0	0	23	43	39	27	19	4	0	0	24	179	21.2
570--	0	1	10	28	23	20	12	1	0	0	13	108	20.9
600--	0	3	14	40	22	21	7	4	0	0	14	125	21.3
630--	0	1	4	12	9	10	2	2	0	0	6	46	21.2
660--	0	0	0	1	5	1	0	0	0	0	1	8	18.6
690--	0	0	0	0	0	2	0	0	0	0	0	2	18.5
SUM	1	47	1054	4699	5238	2851	1067	263	36	3	2453	17712	23.8
33	0	21	513	2016	2063	874	277	57	8	0	909	6738	23.0
0--	1	30	673	3355	3863	2015	719	175	23	1	1745	12600	23.4
60--	0	10	266	1047	1111	676	286	72	12	2	590	4072	23.5
300--	0	1	28	105	82	36	11	2	0	0	26	291	20.9
450--	0	6	87	192	182	124	51	14	1	0	92	749	22.0
SUM	1	47	1054	4699	5238	2851	1067	263	36	3	2453	17712	23.8

Table 3. Seismicity tables showing magnitude depth frequency energy depth relation of earthquakes for numbered regions during January 1963–June 1966 after the PDE of USCGS. K: Energy index. (One earthquake in region No. 1 (Jan. 27 1965, LAT=18.9N, LONG=176.6E, DEPTH=33KM, MAG=4.4) is excluded.) No earthquakes are found in the regions Nos. 2, 40, 57, 58, 60 and 62.

REGION NO. 3 CENTRAL PACIFIC OC.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	3	3	2	0	0	0	0	8	0	8	18.3
30--	0	0	0	2	0	1	0	0	0	0	3	1	4	18.5
SUM	0	0	0	5	3	3	0	0	0	0	11	1	12	18.7
33	0	0	0	2	0	1	0	0	0	0	3	1	4	18.5
0--	0	0	0	5	3	3	0	0	0	0	11	1	12	18.7
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	5	3	3	0	0	0	0	11	1	12	18.7

REGION NO. 4 E PACIFIC OCEAN

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	1	3	0	1	0	0	0	5	0	5	19.7
30--	0	0	2	49	41	7	2	0	0	0	101	3	104	19.5
SUM	0	0	2	50	44	7	3	0	0	0	106	3	109	19.9
33	0	0	2	49	40	7	2	0	0	0	100	3	103	19.5
0--	0	0	2	50	44	7	3	0	0	0	106	3	109	19.9
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	2	50	44	7	3	0	0	0	106	3	109	19.9

REGION NO. 5 SE PACIFIC OCEAN

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	1	0	1	1	0	0	3	0	3	20.3
30--	0	0	0	16	51	20	6	1	0	0	94	2	96	20.8
SUM	0	0	0	16	52	20	7	2	0	0	97	2	99	20.9
33	0	0	0	16	51	19	5	1	0	0	92	2	94	20.8
0--	0	0	0	16	52	20	7	2	0	0	97	2	99	20.9
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	16	52	20	7	2	0	0	97	2	99	20.9

REGION NO. 6 PAC.ANTARCTIC OCEAN

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	1	1	1	0	0	0	0	3	0	3	18.5
30--	0	0	0	10	24	15	8	0	0	0	57	12	69	20.2
SUM	0	0	0	11	25	16	8	0	0	0	60	12	72	20.3
33	0	0	0	10	24	15	8	0	0	0	57	11	68	20.2
0--	0	0	0	11	25	16	8	0	0	0	60	12	72	20.3
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	11	25	16	8	0	0	0	60	12	72	20.3

REGION NO. 7 MACQUARIE IS.RIDGE

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	0	2	0	0	0	2	1	3	19.8
30--	0	0	0	0	0	5	3	1	3	0	12	23	35	22.5
SUM	0	0	0	0	0	5	5	1	3	0	14	24	38	22.5
33	0	0	0	0	0	4	3	1	3	0	11	22	33	22.5
0--	0	0	0	0	0	5	5	1	3	0	14	24	38	22.5
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	0	0	5	5	1	3	0	14	24	38	22.5

REGION NO. 8 IND.ANTARCTIC SWELL

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.
30--	0	0	0	0	2	11	2	0	0	0	15	22	37	20.1
SUM	0	0	0	0	2	11	2	0	0	0	15	23	38	20.1
33	0	0	0	0	2	9	2	0	0	0	13	20	33	20.1
0--	0	0	0	0	2	11	2	0	0	0	15	23	38	20.1
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	0	2	11	2	0	0	0	15	23	38	20.1

REGION NO. 9 AFR.AUSTRA.ANTAR.OC.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	2	0	0	0	0	2	2	4	18.4
30--	0	0	0	1	7	19	13	0	1	0	41	29	70	21.9
60--	0	0	0	0	0	0	1	0	0	0	1	0	1	19.0
SUM	0	0	0	1	7	21	14	0	1	0	44	31	75	21.9
33	0	0	0	1	7	19	12	0	1	0	40	28	68	21.9
0--	0	0	0	1	7	21	13	0	1	0	43	31	74	21.9
60--	0	0	0	0	0	0	1	0	0	0	1	0	1	19.0
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	1	7	21	14	0	1	0	44	31	75	21.9

REGION NO. 10 INDIAN OCEAN

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	1	1	1	0	0	3	2	5	20.2
30--	0	0	0	4	8	18	8	7	1	0	46	31	77	21.8
SUM	0	0	0	4	8	19	9	8	1	0	49	33	82	21.8
33	0	0	0	4	7	17	8	6	1	0	43	30	73	21.7
0--	0	0	0	4	8	19	9	8	1	0	49	33	82	21.8
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	4	8	19	9	8	1	0	49	33	82	21.8

REGION NO. 11 S ATLANTIC OCEAN

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	1	1	1	0	0	0	3	2	5	19.2
30--	0	0	0	5	38	30	3	1	0	1	78	8	86	22.8
SUM	0	0	0	5	39	31	4	1	0	1	81	10	91	22.8
33	0	0	0	5	38	29	2	1	0	0	75	8	83	20.5
0--	0	0	0	5	39	31	4	1	0	1	81	10	91	22.8
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	5	39	31	4	1	0	1	81	10	91	22.8

REGION NO. 12 N ATLANTIC OCEAN

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	2	4	3	1	0	0	10	2	12	20.4
30--	0	0	0	46	73	16	4	1	0	0	140	5	145	20.6
SUM	0	0	0	46	75	20	7	2	0	0	150	7	157	20.8
33	0	0	0	45	66	16	4	1	0	0	132	5	137	20.6
0--	0	0	0	46	75	20	7	2	0	0	150	7	157	20.8
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	46	75	20	7	2	0	0	150	7	157	20.8

REGION NO. 13 REYKJANES R.-S.ICEL.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	1	0	0	0	1	0	0	2	0	2	20.2
30--	0	0	0	18	32	6	2	0	0	0	58	11	69	19.7
SUM	0	0	0	19	32	6	2	1	0	0	60	11	71	20.3
33	0	0	0	18	29	4	2	0	0	0	53	11	64	19.7
0--	0	0	0	19	32	6	2	1	0	0	60	11	71	20.3
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	19	32	6	2	1	0	0	60	11	71	20.3

REGION NO. 14 N ICEL.-E GREENLAND

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	1	0	2	0	0	0	0	0	3	0	3	17.7
30--	0	0	0	7	4	2	1	0	0	0	14	9	23	19.3
SUM	0	0	1	7	6	2	1	0	0	0	17	9	26	19.3
33	0	0	0	6	4	2	1	0	0	0	13	8	21	19.3
0--	0	0	1	7	6	2	1	0	0	0	17	9	26	19.3
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	1	7	6	2	1	0	0	0	17	9	26	19.3

REGION NO. 15 GREENLAND SEA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	2	1	1	0	0	0	0	4	4	8	18.1
30--	0	0	2	30	25	6	0	0	0	0	63	11	74	19.3
60--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.9
SUM	0	0	2	33	26	7	0	0	0	0	68	15	83	19.3
33	0	0	2	30	25	6	0	0	0	0	63	11	74	19.3
0--	0	0	2	32	26	7	0	0	0	0	67	15	82	19.3
60--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.9
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	2	33	26	7	0	0	0	0	68	15	83	19.3

REGION NO. 16 EURASIAN ARCTIC OC.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	1	2	0	0	0	0	3	0	3	18.7
30--	0	0	0	6	12	2	1	1	0	0	22	3	25	20.4
SUM	0	0	0	6	13	4	1	1	0	0	25	3	28	20.5
33	0	0	0	6	12	2	1	0	0	0	21	3	24	19.5
0--	0	0	0	6	13	4	1	1	0	0	25	3	28	20.5
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	6	13	4	1	1	0	0	25	3	28	20.5

REGION NO. 17 ALEUT.IS.-KOMAND.IS.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	6	93	107	74	26	4	0	0	310	8	318	21.4
30--	0	0	87	659	514	244	63	11	2	0	1580	43	1623	22.2
60--	0	0	3	19	26	11	1	1	0	0	61	6	67	20.4
90--	0	0	1	6	4	2	1	0	0	0	14	1	15	19.7
120--	0	0	1	6	1	1	0	0	0	0	9	1	10	18.0
150--	0	0	1	2	2	2	0	0	0	0	7	1	8	18.8
180--	0	0	0	1	1	0	0	0	0	0	2	0	2	16.6
210--	0	0	0	0	1	0	0	0	0	0	1	0	1	17.5
240--	0	0	0	2	0	0	0	0	0	0	2	0	2	16.2
270--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.

(to be continued)

SUM	0	0	99	788	656	334	91	16	2	0	1986	61	2047	22.3
33	0	0	65	453	272	69	9	3	0	0	871	29	900	21.5
0--	0	0	93	752	621	318	89	15	2	0	1890	51	1941	22.3
60--	0	0	6	36	35	16	2	1	0	0	96	10	106	20.5
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	99	788	656	334	91	16	2	0	1986	61	2047	22.3

REGION NO. 18 KAMCHATKA-KURIL IS.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0---	0	0	0	27	45	28	7	2	0	0	109	6	115	20.9
30--	0	0	20	442	496	165	57	10	1	0	1191	35	1226	21.9
60--	0	0	3	51	42	25	7	2	0	1	131	10	141	23.0
90--	0	0	1	16	13	8	5	0	1	0	44	0	44	22.3
120--	0	0	1	12	11	3	5	0	0	0	32	2	34	20.2
150--	0	0	0	10	4	2	0	1	0	0	17	0	17	20.6
180--	0	0	0	2	3	1	0	1	0	0	7	0	7	20.6
210--	0	0	0	2	0	2	2	0	0	0	6	0	6	19.3
240--	0	0	0	4	1	0	0	0	0	0	5	1	6	17.4
270--	0	1	0	5	2	0	0	0	0	0	8	0	8	17.5
300--	0	0	0	0	4	1	0	0	0	0	5	0	5	18.6
330--	0	0	1	0	3	0	0	0	0	0	4	0	4	17.7
360--	0	0	2	1	1	0	1	0	0	0	5	0	5	19.0
390--	0	0	0	1	0	0	1	0	0	0	2	1	3	19.4
420--	0	0	2	5	2	0	1	0	0	0	10	0	10	19.2
450--	0	0	1	2	1	3	0	0	0	0	7	0	7	18.9
480--	0	0	1	1	1	0	0	0	0	0	3	0	3	16.7
510--	0	0	1	1	1	1	0	0	0	0	4	0	4	18.0
540--	0	0	1	1	0	1	0	0	0	0	3	0	3	18.5
570--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
600--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
630--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
660--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	1	34	583	630	240	86	16	2	1	1593	55	1648	23.1
33	0	0	11	206	230	76	24	4	1	0	552	22	574	21.6
0--	0	0	20	469	541	193	64	12	1	0	1300	41	1341	21.9
60--	0	1	5	102	76	41	19	4	1	1	250	13	263	23.1
300--	0	0	5	7	10	1	3	0	0	0	26	1	27	19.8
450--	0	0	4	5	3	5	0	0	0	0	17	0	17	19.1
SUM	0	1	34	583	630	240	86	16	2	1	1593	55	1648	23.1

REGION NO. 19 JAPAN-BONIN IS.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	9	15	17	5	1	0	0	47	4	51	20.5
30--	0	1	4	90	87	27	15	2	1	0	227	15	242	21.7
60--	0	0	4	28	31	13	6	1	0	0	83	5	88	21.2
90--	0	0	1	17	16	5	1	0	0	0	40	2	42	19.6
120--	0	0	1	9	4	1	1	0	0	0	16	1	17	19.0
150--	0	0	1	5	5	1	0	1	0	0	13	1	14	20.9
180--	0	0	1	1	1	0	0	0	0	0	3	0	3	17.1
210--	0	0	1	0	1	0	1	0	0	0	3	0	3	19.2
240--	0	0	0	2	0	2	0	0	0	0	4	0	4	18.8
270--	0	0	0	1	0	1	0	0	0	0	2	1	3	18.7
300--	0	0	0	1	1	0	0	0	0	0	2	1	3	17.3
330--	0	0	2	2	5	2	0	0	0	0	11	2	13	18.5
360--	0	0	2	5	4	0	1	0	0	0	12	1	13	19.2
390--	0	0	0	3	4	3	0	0	0	0	10	0	10	18.7
420--	0	0	1	5	3	1	1	0	0	0	11	1	12	19.7
450--	0	0	2	6	5	1	0	0	0	0	14	0	14	18.2
480--	0	0	3	3	3	0	1	0	0	0	10	1	11	19.4
510--	0	0	1	0	1	0	0	0	0	0	2	1	3	17.5
540--	0	0	0	1	1	0	0	0	0	0	2	0	2	17.1
570--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
600--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
630--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
660--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	1	24	188	187	74	32	5	1	0	512	36	548	21.9
33	0	0	3	60	50	7	4	0	0	0	124	9	133	19.9

(to be continued)

0--	0	1	4	99	102	44	20	3	1	0	274	19	293	21.7
60--	0	0	9	63	58	23	9	2	0	0	164	10	174	21.4
300--	0	0	5	16	17	6	2	0	0	0	46	5	51	19.9
450--	0	0	6	10	10	1	1	0	0	0	28	2	30	19.5
SUM	0	1	24	188	187	74	32	5	1	0	512	36	548	21.9

REGION NO. 20 MARIANA IS.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	10	11	1	0	0	0	22	0	22	19.6
30--	0	0	0	15	53	24	5	2	1	0	100	8	108	21.5
60--	0	0	0	4	11	5	2	1	0	0	23	4	27	20.4
90--	0	0	0	6	11	2	2	0	0	0	21	2	23	19.5
120--	0	0	0	5	12	9	0	1	0	0	27	1	28	20.4
150--	0	0	0	5	3	2	0	0	0	0	10	2	12	19.0
180--	0	0	0	2	4	0	0	0	0	0	6	4	10	17.7
210--	0	0	0	5	0	1	1	0	0	0	7	1	8	19.0
240--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
270--	0	0	0	3	1	1	1	0	0	0	6	0	6	19.0
300--	0	0	0	3	4	3	0	0	0	0	10	0	10	18.6
330--	0	0	0	0	0	1	0	0	0	0	1	0	1	18.5
360--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
390--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
420--	0	0	0	0	1	0	0	0	0	0	1	0	1	17.5
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
480--	0	0	0	0	1	0	0	0	0	0	1	0	1	17.1
510--	0	0	0	1	1	0	0	0	0	0	2	0	2	16.7
540--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
570--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
600--	0	0	0	0	0	1	0	0	0	0	1	0	1	17.8
630--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.4
660--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	50	112	60	12	4	1	0	239	22	261	21.6
33	0	0	0	10	33	12	0	1	0	0	56	4	60	20.2
0--	0	0	0	15	63	35	6	2	1	0	122	8	130	21.5
60--	0	0	0	30	42	20	6	2	0	0	100	14	114	20.8
300--	0	0	0	3	5	4	0	0	0	0	12	0	12	18.9
450--	0	0	0	2	2	1	0	0	0	0	5	0	5	17.9
SUM	0	0	0	50	112	60	12	4	1	0	239	22	261	21.6

REGION NO. 21 CAROLINE IS.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	1	1	0	0	0	0	2	0	2	17.9
30--	0	0	0	2	6	2	0	0	0	0	10	1	11	18.6
60--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.9
SUM	0	0	0	3	7	3	0	0	0	0	13	1	14	18.7
33	0	0	0	2	5	2	0	0	0	0	9	1	10	18.6
0--	0	0	0	2	7	3	0	0	0	0	12	1	13	18.7
60--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.9
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	3	7	3	0	0	0	0	13	1	14	18.7

REGION NO. 22 KYUSHU-RYUKYU IS.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	1	2	4	0	0	0	0	7	2	9	18.8
30--	0	0	1	8	28	15	5	0	0	0	57	5	62	20.1
60--	0	0	0	1	6	4	0	1	0	0	12	0	12	20.2
90--	0	0	0	4	5	1	2	0	0	0	12	2	14	19.7
120--	0	0	0	2	2	3	1	0	0	0	8	3	11	19.5
150--	0	0	1	1	0	0	0	0	0	0	2	1	3	15.9
180--	0	0	0	1	0	0	2	1	0	0	4	0	4	20.4
210--	0	0	0	0	1	0	0	0	0	0	1	0	1	17.5
240--	0	0	0	2	0	0	0	0	0	0	2	0	2	16.4
270--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
330--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
360--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
390--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
420--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.

(to be continued)

480--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
510--	0	0	0	1	0	0	0	0	0	0	1	0	1	16.3
540--	0	0	0	0	0	1	1	0	0	0	2	0	2	19.3
570--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
600--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
630--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
660--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	2	21	44	28	11	2	0	0	108	13	121	20.8
33	0	0	1	4	21	10	4	0	0	0	40	3	43	20.0
0--	0	0	1	9	30	19	5	0	0	0	64	7	71	20.1
60--	0	0	1	11	14	8	5	2	0	0	41	6	47	20.7
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	1	0	1	1	0	0	0	3	0	3	19.3
SUM	0	0	2	21	44	28	11	2	0	0	108	13	121	20.8

REGION NO. 23 TAIWAN

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	4	8	5	3	1	0	0	21	5	26	20.7
30--	0	0	0	8	38	28	13	2	0	0	89	15	104	21.2
60--	0	0	0	1	18	5	2	0	1	1	28	3	31	23.0
90--	0	0	0	2	4	1	0	0	0	0	7	0	7	18.0
120--	0	0	0	1	2	0	0	0	0	0	3	0	3	17.4
150--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
180--	0	0	0	0	1	1	0	0	0	0	2	0	2	18.7
210--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
240--	0	0	0	0	0	1	0	0	0	0	1	0	1	18.0
270--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	16	71	41	18	3	1	1	151	23	174	23.1
33	0	0	0	3	21	15	6	1	0	0	46	10	56	20.7
0--	0	0	0	12	46	33	16	3	0	0	110	20	130	21.3
60--	0	0	0	4	25	8	2	0	1	1	41	3	44	23.0
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	16	71	41	18	3	1	1	151	23	174	23.1

REGION NO. 24 PHILIPPINE IS.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	1	4	7	1	2	0	0	15	4	19	20.7
30--	0	0	0	5	40	33	23	6	1	0	108	27	135	21.8
60--	0	0	0	4	17	14	12	1	0	0	48	17	65	20.9
90--	0	0	0	1	10	16	6	2	0	0	35	6	41	21.3
120--	0	0	1	1	5	4	5	0	1	0	17	7	24	21.6
150--	0	0	0	1	0	8	2	1	0	0	12	1	13	20.4
180--	0	0	0	0	2	0	1	0	0	0	3	2	5	19.0
210--	0	0	0	1	0	0	0	0	0	0	1	0	1	16.3
240--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.
270--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.9
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
330--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
360--	0	0	0	0	2	0	0	0	0	0	2	1	3	17.8
390--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
420--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
480--	0	0	0	0	0	1	0	0	0	0	1	0	1	17.8
510--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
540--	0	0	0	0	2	1	1	0	0	0	4	0	4	19.3
570--	0	0	0	0	0	1	1	0	0	0	2	0	2	19.7
600--	0	0	0	0	0	1	0	0	0	0	1	0	1	18.5
630--	0	0	0	1	0	0	0	0	0	0	1	0	1	16.3
660--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	1	16	82	86	52	12	2	0	251	66	317	22.1
33	0	0	0	4	17	15	12	1	0	0	49	7	56	20.8
0--	0	0	0	6	44	40	24	8	1	0	123	31	154	21.8
60--	0	0	1	9	34	42	26	4	1	0	117	34	151	21.9
300--	0	0	0	0	2	0	0	0	0	0	2	1	3	17.8
450--	0	0	0	1	2	4	2	0	0	0	9	0	9	19.8
SUM	0	0	1	16	82	86	52	12	2	0	251	66	317	22.1

REGION NO. 25 CELEBES-BANDA SEA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	2	8	8	4	0	1	0	23	17	40	21.6
30--	0	0	2	16	38	41	26	10	1	0	134	77	211	22.1
60--	0	0	0	4	14	16	8	1	0	0	43	15	58	21.0
90--	0	1	1	3	15	20	14	2	0	0	56	17	73	21.3
120--	0	0	1	2	10	24	17	2	0	0	56	18	74	21.1
150--	0	0	0	1	16	9	4	1	1	0	32	13	45	21.5
180--	0	0	0	2	6	8	1	0	0	0	17	5	22	19.9
210--	0	0	0	1	3	4	4	0	0	0	12	11	23	20.2
240--	0	0	0	0	2	1	1	0	0	0	4	1	5	19.7
270--	0	0	0	1	3	2	0	0	0	0	6	2	8	18.7
300--	0	0	0	0	0	0	0	1	0	0	1	1	2	20.6
330--	0	0	0	0	0	1	0	0	0	0	1	1	2	18.5
360--	0	0	0	0	0	2	1	0	0	0	3	3	6	19.3
390--	0	0	0	0	0	1	1	0	0	0	2	1	3	19.5
420--	0	0	0	0	0	1	0	0	0	0	1	0	1	18.0
450--	0	0	0	1	0	0	1	0	0	0	2	2	4	19.4
480--	0	0	0	0	1	1	0	1	0	0	3	0	3	20.4
510--	0	0	0	0	0	1	0	0	0	0	1	1	2	18.2
540--	0	0	0	0	0	3	0	0	0	0	3	1	4	19.0
570--	0	0	0	0	0	0	2	0	0	0	2	2	4	19.8
600--	0	0	0	0	0	0	0	1	0	0	1	0	1	20.6
630--	0	0	0	0	0	1	0	0	0	0	1	0	1	18.7
660--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	1	4	33	116	144	84	19	3	0	404	189	593	22.4
33	0	0	1	12	22	28	13	6	1	0	83	53	136	22.0
0--	0	0	2	18	46	49	30	10	2	0	157	94	251	22.2
60--	0	1	2	14	69	84	49	6	1	0	226	82	308	21.9
300--	0	0	0	0	0	5	2	1	0	0	8	6	14	20.7
450--	0	0	0	1	1	6	3	2	0	0	13	7	20	20.9
SUM	0	1	4	33	116	144	84	19	3	0	404	189	593	22.4

REGION NO. 26 NEW GUINEA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	3	11	7	1	0	0	22	9	31	20.8
30--	0	0	0	6	37	45	25	4	0	0	117	36	153	21.6
60--	0	0	0	2	8	11	11	0	0	0	32	15	47	20.5
90--	0	0	0	1	9	6	3	4	1	0	24	7	31	21.7
120--	0	0	0	0	3	4	0	1	0	0	8	5	13	20.9
150--	0	0	0	1	4	3	2	0	0	0	10	1	11	20.0
180--	0	0	0	0	2	1	1	1	0	0	5	1	6	21.1
210--	0	0	0	1	0	2	2	0	0	0	5	0	5	19.7
240--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	11	66	83	51	11	1	0	223	74	297	22.1
33	0	0	0	5	26	22	16	4	0	0	73	22	95	21.6
0--	0	0	0	6	40	56	32	5	0	0	139	45	184	21.7
60--	0	0	0	5	26	27	19	6	1	0	84	29	113	21.9
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	11	66	83	51	11	1	0	223	74	297	22.1

REGION NO. 27 NEW BRIT.-SOLOMON IS

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	1	7	14	7	5	0	0	34	7	41	21.6
30--	0	0	0	16	112	104	40	12	2	0	286	37	323	22.2
60--	0	0	0	4	53	46	22	4	0	0	129	16	145	21.5
90--	0	0	0	2	20	15	4	2	0	0	43	11	54	20.8
120--	0	0	0	5	4	8	3	1	0	0	21	7	28	20.4
150--	0	0	0	2	5	5	3	0	0	0	15	5	20	19.8
180--	0	0	0	2	2	2	0	0	0	0	6	1	7	18.5
210--	0	0	0	0	2	1	1	0	0	0	4	0	4	19.0
240--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.
270--	0	0	0	0	0	0	1	0	0	0	1	0	1	19.0
300--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.9
330--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
360--	0	0	0	0	0	1	0	1	0	0	2	0	2	20.2
390--	0	0	0	1	0	1	0	0	0	0	2	0	2	18.0
420--	0	0	0	0	1	1	0	0	0	0	2	0	2	18.5
450--	0	0	0	0	1	0	2	0	0	0	3	0	3	19.3

(to be continued)

480--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
510--	0	0	0	0	0	1	0	0	1	0	2	0	2	21.3
540--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
570--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
600--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
630--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
660--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	34	207	199	83	25	3	0	551	85	636	22.4
33	0	0	0	7	44	30	16	2	0	0	99	8	107	21.1
0--	0	0	0	17	119	118	47	17	2	0	320	44	364	22.3
60--	0	0	0	15	86	77	34	7	0	0	219	41	260	21.6
300--	0	0	0	2	1	3	0	1	0	0	7	0	7	20.2
450--	0	0	0	0	1	1	2	0	1	0	5	0	5	21.4
SUM	0	0	0	34	207	199	83	25	3	0	551	85	636	22.4

REGION NO. 28 NEW HEBRIDES IS.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	1	26	38	21	10	4	0	0	100	26	126	21.3
30--	0	0	6	71	138	49	17	5	3	0	289	108	397	22.1
60--	0	0	1	10	27	13	3	0	0	0	54	17	71	19.9
90--	0	0	1	15	15	7	2	0	0	0	40	25	65	19.7
120--	0	0	2	14	15	9	0	2	1	0	43	21	64	21.7
150--	0	0	2	13	7	5	2	0	0	0	29	14	43	19.9
180--	0	0	2	7	13	4	3	1	0	0	30	3	33	20.4
210--	0	0	1	8	15	6	2	0	0	0	32	6	38	19.7
240--	0	0	2	5	13	2	0	1	0	0	23	5	28	20.6
270--	0	0	1	1	3	0	0	0	0	0	5	2	7	17.4
300--	0	0	0	0	1	1	0	0	0	0	2	0	2	18.3
330--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
360--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
390--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
420--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
480--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
510--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
540--	0	0	0	0	0	0	0	1	0	0	1	0	1	20.6
570--	0	0	1	0	0	0	0	0	0	0	1	0	1	14.7
600--	0	0	0	2	1	1	0	0	0	0	4	0	4	18.0
630--	0	0	0	1	3	3	0	1	0	0	8	4	12	20.6
660--	0	0	0	0	2	0	0	0	0	0	2	0	2	17.1
690--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	20	173	291	121	39	15	4	0	663	231	894	22.3
33	0	0	5	41	81	24	8	3	0	0	162	68	230	21.4
0--	0	0	7	97	176	70	27	9	3	0	389	134	523	22.2
60--	0	0	12	73	108	46	12	4	1	0	256	93	349	21.7
300--	0	0	0	0	1	1	0	0	0	0	2	0	2	18.3
450--	0	0	1	3	6	4	0	2	0	0	16	4	20	20.9
SUM	0	0	20	173	291	121	39	15	4	0	663	231	894	22.3

REGION NO. 29 TONGA-KERMADEC IS.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	1	14	40	23	5	0	0	0	83	8	91	20.3
30--	0	0	5	142	323	159	38	3	1	0	671	86	757	21.7
60--	0	0	2	21	39	24	5	2	0	0	93	8	101	20.9
90--	0	1	3	12	23	13	3	1	0	0	56	3	59	20.7
120--	0	0	4	11	14	5	2	0	0	0	36	8	44	19.8
150--	0	0	3	14	18	2	5	0	1	0	43	3	46	21.4
180--	0	0	3	13	12	7	1	0	0	0	36	7	43	19.5
210--	0	0	1	18	11	5	4	0	0	0	39	7	46	20.1
240--	0	0	3	18	9	1	1	0	0	0	32	1	33	19.3
270--	0	0	6	12	9	2	1	0	0	0	30	2	32	19.5
300--	0	0	4	12	6	4	1	0	0	0	27	2	29	19.4
330--	0	0	1	12	12	3	0	0	0	0	28	1	29	18.9
360--	0	0	2	15	12	3	1	0	0	0	33	4	37	19.2
390--	0	1	3	20	9	2	1	0	0	0	36	2	38	19.2
420--	0	0	3	11	5	3	1	0	0	0	23	4	27	19.3
450--	0	0	5	15	11	6	3	0	0	0	40	1	41	19.8
480--	0	0	10	17	21	8	0	1	0	0	57	9	66	20.2
510--	0	1	11	18	34	20	4	0	0	0	88	16	104	20.1
540--	0	0	19	40	36	21	17	2	0	0	135	22	157	21.0
570--	0	1	8	26	21	15	7	0	0	0	78	11	89	20.4
600--	0	2	14	36	20	16	5	2	0	0	95	12	107	21.0

(to be continued)

630--	0	1	4	9	6	6	1	0	0	0	27	2	29	19.5
660--	0	0	0	1	3	1	0	0	0	0	5	0	5	18.5
690--	0	0	0	0	0	2	0	0	0	0	2	0	2	18.5
SUM	0	7	115	507	694	351	106	11	2	0	1793	219	2012	22.1
33	0	0	4	106	266	123	26	2	0	0	527	58	585	21.4
0--	0	0	6	156	363	182	43	3	1	0	754	94	848	21.7
60--	0	1	25	119	135	59	22	3	1	0	365	39	404	21.6
300--	0	1	13	70	44	15	4	0	0	0	147	13	160	19.9
450--	0	5	71	162	152	95	37	5	0	0	527	73	600	21.4
SUM	0	7	115	507	694	351	106	11	2	0	1793	219	2012	22.1

REGION NO. 30 NEW ZEALAND

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	0	1	2	0	0	3	0	3	20.9
30--	0	0	0	0	3	1	4	1	0	0	9	3	12	20.7
60--	0	0	0	0	0	0	2	0	0	0	2	1	3	19.8
90--	0	0	0	0	0	0	1	0	0	0	1	2	3	19.0
120--	0	0	0	0	3	0	0	0	0	0	3	0	3	17.8
150--	0	0	0	0	0	0	1	0	0	0	1	2	3	19.7
180--	0	0	0	0	0	0	0	1	0	0	1	0	1	20.2
210--	0	0	0	0	0	0	0	1	0	0	1	0	1	20.4
240--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	0	6	1	9	5	0	0	21	8	29	21.2
33	0	0	0	0	3	1	1	0	0	0	5	2	7	19.2
0--	0	0	0	0	3	1	5	3	0	0	12	3	15	21.1
60--	0	0	0	0	3	0	4	2	0	0	9	5	14	20.7
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	0	6	1	9	5	0	0	21	8	29	21.2

REGION NO. 31 S.ALASKA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	16	127	177	94	34	7	0	0	455	3	458	21.4
30--	0	0	130	293	171	93	27	1	1	0	716	22	738	21.5
60--	0	0	9	9	12	1	1	2	0	0	34	6	40	20.7
90--	0	0	6	15	5	3	1	0	0	0	30	4	34	19.4
120--	0	0	2	4	0	2	0	0	0	0	8	2	10	18.8
150--	0	0	2	3	1	0	0	0	0	0	6	2	8	16.7
180--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	165	451	366	193	63	10	1	0	1249	39	1288	21.8
33	0	0	120	256	128	51	13	1	0	0	569	16	585	20.7
0--	0	0	146	420	348	187	61	8	1	0	1171	25	1196	21.8
60--	0	0	19	31	18	6	2	2	0	0	78	14	92	20.7
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	165	451	366	193	63	10	1	0	1249	39	1288	21.8

REGION NO. 32 W.CANADA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	1	8	6	7	1	0	0	0	23	3	26	19.5
30--	0	2	23	37	22	4	1	0	1	0	90	7	97	21.4
60--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.6
90--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	2	24	46	28	11	2	0	1	0	114	10	124	21.4
33	0	2	20	32	20	3	0	0	0	0	77	7	84	19.1
0--	0	2	24	45	28	11	2	0	1	0	113	10	123	21.4
60--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.6
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	2	24	46	28	11	2	0	1	0	114	10	124	21.4

REGION NO. 33 W.UNITED STATES

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	1	7	38	116	81	21	6	3	0	0	273	302	575	21.1
30--	0	14	84	142	93	36	10	1	0	0	380	221	601	20.7
60--	0	1	0	0	0	0	0	0	0	0	1	0	1	13.7
90--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	1	22	122	258	174	57	16	4	0	0	654	523	1177	21.2
33	0	14	81	137	90	35	10	1	0	0	368	190	558	20.7
0--	1	21	122	258	174	57	16	4	0	0	653	523	1176	21.2
60--	0	1	0	0	0	0	0	0	0	0	1	0	1	13.7
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	1	22	122	258	174	57	16	4	0	0	654	523	1177	21.2

REGION NO. 34 CENTRAL AMERICA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	4	16	10	4	3	0	1	0	38	1	39	21.8
30--	0	3	187	255	109	30	9	1	0	0	594	24	618	20.6
60--	0	0	23	38	19	10	3	0	0	0	93	3	96	20.0
90--	0	1	15	28	13	6	3	1	0	0	67	5	72	20.9
120--	0	0	10	21	11	2	0	0	0	0	44	1	45	18.8
150--	0	0	6	7	4	2	0	0	0	0	19	2	21	18.4
180--	0	0	4	3	0	0	0	0	0	0	7	1	8	16.5
210--	0	0	1	1	1	0	0	0	0	0	3	0	3	16.8
240--	0	0	2	1	0	0	0	0	0	0	3	0	3	16.0
270--	0	0	0	0	1	0	0	0	0	0	1	0	1	17.5
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	4	252	370	168	54	18	2	1	0	869	37	906	21.9
33	0	2	167	194	76	16	0	0	0	0	455	19	474	19.7
0--	0	3	191	271	119	34	12	1	1	0	632	25	657	21.9
60--	0	1	61	99	49	20	6	1	0	0	237	12	249	21.0
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	4	252	370	168	54	18	2	1	0	869	37	906	21.9

REGION NO. 35 ANTILLES IS.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	2	8	8	7	5	2	0	0	32	8	40	20.5
30--	0	0	19	94	34	20	6	2	0	0	175	18	193	21.2
60--	0	0	2	11	5	3	1	0	0	0	22	5	27	19.2
90--	0	0	8	11	5	1	1	1	0	0	27	3	30	20.4
120--	0	0	4	21	10	7	1	0	0	0	43	4	47	19.6
150--	0	0	16	19	26	12	0	0	0	0	73	10	83	19.5
180--	0	1	4	2	3	1	0	0	0	0	11	0	11	18.1
210--	0	1	2	0	0	0	0	0	0	0	3	0	3	14.9
240--	0	0	1	0	0	0	0	0	0	0	1	0	1	14.7
270--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.4
330--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	2	58	167	91	51	14	5	0	0	388	48	436	21.4
33	0	0	14	58	14	9	2	0	0	0	97	9	106	19.8
0--	0	0	21	102	42	27	11	4	0	0	207	26	233	21.3
60--	0	2	37	64	49	24	3	1	0	0	180	22	202	20.5
300--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.4
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	2	58	167	91	51	14	5	0	0	388	48	436	21.4

REGION NO. 36 COLOMBIA-PERU

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	1	14	12	11	2	1	0	0	41	6	47	20.5
30--	0	0	3	116	79	21	7	1	0	0	227	23	250	20.6
60--	0	0	2	28	18	3	1	1	0	0	53	2	55	20.2
90--	0	0	5	34	24	13	1	2	0	0	79	5	84	20.6
120--	0	0	7	23	13	14	0	1	0	0	58	3	61	20.4
150--	0	1	17	23	12	5	1	0	0	0	59	2	61	19.6
180--	0	0	2	7	5	4	0	1	0	0	19	0	19	20.2
210--	0	0	6	4	0	0	0	0	0	0	10	0	10	16.6

(to be continued)

240--	0	1	8	1	1	1	0	0	0	0	12	0	12	17.8
270--	0	0	4	1	0	0	0	0	0	0	5	1	6	15.6
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
330--	0	0	1	0	0	0	0	0	0	0	1	0	1	14.2
360--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
390--	0	0	1	0	0	0	0	0	0	0	1	0	1	14.4
420--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
480--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
510--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
540--	0	0	3	1	0	0	0	1	0	0	5	1	6	20.2
570--	0	0	1	0	1	1	0	1	0	0	4	0	4	20.6
600--	0	1	0	1	1	2	2	0	0	0	7	1	8	20.0
630--	0	0	0	0	0	0	1	0	0	0	1	0	1	19.2
660--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	3	61	253	166	75	15	9	0	0	582	44	626	21.4
33	0	0	2	77	41	5	0	1	0	0	126	14	140	20.2
0--	0	0	4	130	91	32	9	2	0	0	268	29	297	20.8
60--	0	2	51	121	73	40	3	5	0	0	295	13	308	21.0
300--	0	0	2	0	0	0	0	0	0	0	2	0	2	14.6
450--	0	1	4	2	2	3	3	2	0	0	17	2	19	20.8
SUM	0	3	61	253	166	75	15	9	0	0	582	44	626	21.4

REGION NO. 37 N.CHILE

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	6	15	7	1	3	0	0	32	1	33	21.3
30--	0	0	1	54	61	17	4	1	0	0	138	10	148	20.5
60--	0	0	1	45	22	12	6	3	0	0	89	7	96	21.3
90--	0	0	5	45	53	16	7	0	0	0	126	5	131	20.3
120--	0	0	7	35	11	10	1	1	0	0	65	8	73	20.4
150--	0	0	0	20	11	2	1	0	0	0	34	3	37	19.2
180--	0	0	8	20	6	4	1	0	0	0	39	1	40	19.2
210--	0	0	4	10	4	1	0	0	0	0	19	3	22	18.0
240--	0	0	5	7	1	0	0	0	0	0	13	2	15	17.1
270--	0	0	3	2	1	1	0	0	0	0	7	0	7	18.0
300--	0	0	2	1	0	0	0	0	0	0	3	0	3	15.8
330--	0	0	0	0	1	0	0	0	0	0	1	0	1	16.6
360--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
390--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
420--	0	0	1	0	0	0	0	0	0	0	1	0	1	14.9
450--	0	0	0	1	1	0	0	0	0	0	2	0	2	17.1
480--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.
510--	0	0	1	1	1	0	0	0	0	0	3	0	3	16.7
540--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
570--	0	0	0	2	1	1	2	0	0	0	6	0	6	20.0
600--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.6
630--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
660--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	38	250	189	71	23	8	0	0	579	41	620	21.7
33	0	0	0	35	34	5	1	0	0	0	75	5	80	19.3
0--	0	0	1	60	76	24	5	4	0	0	170	11	181	21.3
60--	0	0	33	184	109	46	16	4	0	0	392	29	421	21.4
300--	0	0	3	1	1	0	0	0	0	0	5	0	5	16.7
450--	0	0	1	5	3	1	2	0	0	0	12	1	13	20.0
SUM	0	0	38	250	189	71	23	8	0	0	579	41	620	21.7

REGION NO. 38 S.CHILE

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	1	3	3	1	1	0	0	9	1	10	20.2
30--	0	0	0	12	38	12	4	2	0	0	68	8	76	21.1
60--	0	0	0	5	3	1	0	0	0	0	9	0	9	18.0
90--	0	0	0	0	1	0	0	0	0	0	1	0	1	17.3
120--	0	0	0	1	1	0	0	0	0	0	2	0	2	16.8
150--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	19	46	16	5	3	0	0	89	9	98	21.1
33	0	0	0	6	34	9	2	1	0	0	52	7	59	20.5
0--	0	0	0	13	41	15	5	3	0	0	77	9	86	21.1
60--	0	0	0	6	5	1	0	0	0	0	12	0	12	18.1
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.

(to be continued)

450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	19	46	16	5	3	0	0	89	9	98	21.1

REGION NO. 39 S.ANTILLES IS.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	2	2	5	0	0	0	9	0	9	20.4
30--	0	0	0	1	5	20	22	10	0	0	58	29	87	21.6
60--	0	0	0	0	2	2	3	1	0	0	8	0	8	20.3
90--	0	0	0	1	1	4	4	2	0	0	12	2	14	20.9
120--	0	0	0	0	1	2	2	1	1	0	7	1	8	21.8
150--	0	0	0	0	1	3	0	0	0	0	4	0	4	18.8
180--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	2	12	33	36	14	1	0	98	32	130	22.1
33	0	0	0	1	5	17	18	9	0	0	50	25	75	21.5
0--	0	0	0	1	7	22	27	10	0	0	67	29	96	21.6
60--	0	0	0	1	5	11	9	4	1	0	31	3	34	21.9
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	2	12	33	36	14	1	0	98	32	130	22.1

REGION NO. 41 MEDITERRANEAN REGION

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	1	22	34	15	6	2	0	0	80	21	101	20.9
30--	0	0	9	83	130	31	9	2	0	0	264	62	326	20.8
60--	0	0	0	16	13	5	1	1	0	0	36	7	43	20.9
90--	0	0	0	6	3	1	0	0	0	0	10	4	14	18.6
120--	0	0	1	5	0	2	0	0	0	0	8	3	11	18.6
150--	0	0	0	1	2	1	1	0	0	0	5	1	6	19.2
180--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
210--	0	0	0	0	0	0	1	0	0	0	1	0	1	19.2
240--	0	0	0	2	0	0	0	0	0	0	2	0	2	16.5
270--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.
300--	0	0	0	2	0	0	0	0	0	0	2	0	2	16.5
330--	0	0	0	1	0	0	0	0	0	0	1	0	1	15.9
360--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	11	138	182	55	18	5	0	0	409	99	508	21.3
33	0	0	5	57	70	16	5	0	0	0	153	46	199	20.2
0--	0	0	10	105	164	46	15	4	0	0	344	83	427	21.1
60--	0	0	1	30	18	9	3	1	0	0	62	16	78	20.9
300--	0	0	0	3	0	0	0	0	0	0	3	0	3	16.6
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	11	138	182	55	18	5	0	0	409	99	508	21.3

REGION NO. 42 IRAN-TURKMENIA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	4	1	1	2	0	0	8	2	10	20.8
30--	0	0	0	5	38	21	8	0	0	0	72	36	108	20.4
60--	0	0	0	0	6	4	0	0	0	0	10	8	18	18.8
90--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	5	48	26	9	2	0	0	90	46	136	20.9
33	0	0	0	3	24	12	2	0	0	0	41	18	59	19.8
0--	0	0	0	5	42	22	9	2	0	0	80	38	118	20.9
60--	0	0	0	0	6	4	0	0	0	0	10	8	18	18.8
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	5	48	26	9	2	0	0	90	46	136	20.9

REGION NO. 43 PAMIR-INDIA-BURMA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	1	6	6	21	4	3	0	0	41	1	42	21.0
30--	0	0	0	15	55	59	21	6	0	0	156	40	196	21.5
60--	0	0	1	2	10	6	4	1	0	0	24	7	31	20.6
90--	0	0	1	4	5	7	4	1	1	0	23	10	33	21.6
120--	0	0	0	3	7	7	3	0	0	0	20	10	30	20.1
150--	0	0	0	4	5	5	1	0	1	0	16	2	18	21.0
180--	0	0	1	5	7	4	3	2	0	0	22	9	31	20.9
210--	0	0	0	1	19	5	1	1	1	0	28	11	39	21.7

(to be continued)

240--	0	0	0	1	3	1	1	0	0	0	6	3	9	19.2
270--	0	0	0	0	0	1	0	0	0	0	1	0	1	17.8
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	4	41	117	116	42	14	3	0	337	93	430	22.3
33	0	0	0	7	39	37	10	1	0	0	94	20	114	20.8
0--	0	0	1	21	61	80	25	9	0	0	197	41	238	21.6
60--	0	0	3	20	56	36	17	5	3	0	140	52	192	22.2
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	4	41	117	116	42	14	3	0	337	93	430	22.3

REGION NO. 44 ANDAMAN IS.-SUMATRA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	5	2	0	0	0	7	6	13	19.6
30--	0	0	0	1	12	27	10	5	1	0	56	16	72	21.9
60--	0	1	0	3	1	4	4	1	0	0	14	4	18	21.0
90--	0	0	0	0	1	5	1	0	0	0	7	5	12	19.8
120--	0	0	0	0	1	3	0	0	0	0	4	2	6	19.1
150--	0	0	0	0	1	0	0	0	0	0	1	0	1	16.8
180--	0	0	0	0	0	1	0	0	0	0	1	0	1	18.7
210--	0	0	0	0	0	0	0	0	0	0	0	2	2	0.
240--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
270--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
330--	0	0	0	0	1	0	0	0	0	0	1	0	1	17.5
360--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
390--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
420--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
480--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.
SUM	0	1	0	4	17	45	17	6	1	0	91	36	127	22.0
33	0	0	0	1	9	23	7	3	1	0	44	13	57	21.9
0--	0	0	0	1	12	32	12	5	1	0	63	22	85	21.9
60--	0	1	0	3	4	13	5	1	0	0	27	13	40	21.0
300--	0	0	0	0	1	0	0	0	0	0	1	0	1	17.5
450--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.
SUM	0	1	0	4	17	45	17	6	1	0	91	36	127	22.0

REGION NO. 45 JAVA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	1	0	0	0	0	1	1	2	18.0
30--	0	0	0	0	5	31	10	3	0	0	49	14	63	21.0
60--	0	0	0	0	3	7	3	4	0	0	17	11	28	21.2
90--	0	0	0	0	0	3	6	0	0	0	9	7	16	20.3
120--	0	0	0	0	2	3	2	1	0	0	8	1	9	20.3
150--	0	0	0	1	1	0	0	0	0	0	2	5	7	17.5
180--	0	0	0	0	1	0	0	0	0	0	1	0	1	17.1
210--	0	0	0	0	0	0	0	0	0	0	0	4	4	0.
240--	0	0	0	1	0	0	1	0	1	0	3	0	3	21.4
270--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	1	0	0	0	0	1	0	1	18.0
330--	0	0	0	2	0	0	0	0	0	0	2	0	2	16.5
360--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
390--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
420--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
480--	0	0	0	0	0	0	0	1	0	0	1	0	1	20.2
510--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.
540--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
570--	0	0	0	0	0	2	0	0	0	0	2	0	2	18.4
600--	0	0	0	0	0	0	0	1	0	0	1	1	2	20.6
630--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
660--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	4	12	48	22	10	1	0	97	45	142	21.8
33	0	0	0	0	5	17	5	1	0	0	28	9	37	20.6
0--	0	0	0	0	5	32	10	3	0	0	50	15	65	21.0
60--	0	0	0	2	7	13	12	5	1	0	40	28	68	21.6
300--	0	0	0	2	0	1	0	0	0	0	3	0	3	18.0
450--	0	0	0	0	0	2	0	2	0	0	4	2	6	20.8
SUM	0	0	0	4	12	48	22	10	1	0	97	45	142	21.8

REGION NO. 46 TIEN SCHAN-BAIKAL

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	4	7	10	3	0	0	24	1	25	21.3
30--	0	0	0	2	34	13	1	1	0	0	51	6	57	20.9
60--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.
SUM	0	0	0	2	38	20	11	4	0	0	75	8	83	21.4
33	0	0	0	1	28	13	1	0	0	0	43	5	48	19.6
0--	0	0	0	2	38	20	11	4	0	0	75	7	82	21.4
60--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	2	38	20	11	4	0	0	75	8	83	21.4

REGION NO. 47 E AFRICA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	3	3	2	2	0	0	10	4	14	21.0
30--	0	1	0	4	12	11	8	2	0	0	38	21	59	21.2
60--	0	0	0	1	0	1	0	0	0	0	2	0	2	17.8
SUM	0	1	0	5	15	15	10	4	0	0	50	25	75	21.4
33	0	1	0	3	8	10	8	1	0	0	31	19	50	21.2
0--	0	1	0	4	15	14	10	4	0	0	48	25	73	21.4
60--	0	0	0	1	0	1	0	0	0	0	2	0	2	17.8
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	1	0	5	15	15	10	4	0	0	50	25	75	21.4

REGION NO. 48 NORW.SEA-BRITISH IS.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	0	0	0	0	0	0	1	1	0.
30--	0	0	0	3	4	1	0	0	0	0	8	0	8	18.3
SUM	0	0	0	3	4	1	0	0	0	0	8	1	9	18.3
33	0	0	0	3	3	0	0	0	0	0	6	0	6	17.8
0--	0	0	0	3	4	1	0	0	0	0	8	1	9	18.3
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	3	4	1	0	0	0	0	8	1	9	18.3

REGION NO. 49 N.EUROPE

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
30--	0	0	0	3	1	1	0	0	0	0	5	1	6	18.0
SUM	0	0	0	3	1	1	0	0	0	0	5	1	6	18.0
33	0	0	0	3	1	1	0	0	0	0	5	0	5	18.0
0--	0	0	0	3	1	1	0	0	0	0	5	1	6	18.0
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	3	1	1	0	0	0	0	5	1	6	18.0

REGION NO. 50 URAL-KAZAKHSTAN

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	1	1	0	0	0	0	0	2	0	2	17.5
30--	0	0	0	0	0	1	0	0	0	0	1	0	1	18.5
SUM	0	0	0	1	1	1	0	0	0	0	3	0	3	18.5
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
0--	0	0	0	1	1	1	0	0	0	0	3	0	3	18.5
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	1	1	1	0	0	0	0	3	0	3	18.5

REGION NO. 51 N.SIBERIA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	1	0	0	0	0	0	1	0	1	17.1
30--	0	0	0	2	0	0	0	0	0	0	2	0	2	16.5
SUM	0	0	0	2	1	0	0	0	0	0	3	0	3	17.2
33	0	0	0	1	0	0	0	0	0	0	1	0	1	16.1
0--	0	0	0	2	1	0	0	0	0	0	3	0	3	17.2
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	2	1	0	0	0	0	0	3	0	3	17.2

REGION NO. 52 E SIBERIA-NW ALASKA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	1	0	0	0	0	0	1	0	1	17.1
30--	0	0	0	1	2	2	1	0	0	0	6	0	6	19.3
SUM	0	0	0	1	3	2	1	0	0	0	7	0	7	19.3
33	0	0	0	1	2	2	1	0	0	0	6	0	6	19.3
0--	0	0	0	1	3	2	1	0	0	0	7	0	7	19.3
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	1	3	2	1	0	0	0	7	0	7	19.3

REGION NO. 53 ARCTIC CANADA-GREENL

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	1	1	0	1	0	0	0	0	3	0	3	18.2
30--	0	0	6	16	7	0	1	0	0	0	30	2	32	19.5
SUM	0	0	7	17	7	1	1	0	0	0	33	2	35	19.5
33	0	0	5	15	7	0	1	0	0	0	28	2	30	19.5
0--	0	0	7	17	7	1	1	0	0	0	33	2	35	19.5
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	7	17	7	1	1	0	0	0	33	2	35	19.5

REGION NO. 54 E.CANADA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	0	0	0	0	0	0	2	2	0.
30--	0	0	2	4	2	0	0	0	0	0	8	0	8	17.2
SUM	0	0	2	4	2	0	0	0	0	0	8	2	10	17.2
33	0	0	2	4	2	0	0	0	0	0	8	0	8	17.2
0--	0	0	2	4	2	0	0	0	0	0	8	2	10	17.2
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	2	4	2	0	0	0	0	0	8	2	10	17.2

REGION NO. 55 E.UNITED STATES

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	2	5	19	5	0	0	0	0	31	15	46	19.0
30--	0	1	3	8	4	1	0	0	0	0	17	13	30	18.2
SUM	0	1	5	13	23	6	0	0	0	0	48	28	76	19.0
33	0	1	3	6	3	0	0	0	0	0	13	12	25	17.6
0--	0	1	5	13	23	6	0	0	0	0	48	28	76	19.0
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	1	5	13	23	6	0	0	0	0	48	28	76	19.0

REGION NO. 56 BRAZIL

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
30--	0	0	0	0	0	1	0	0	0	0	1	0	1	18.5
60--	0	0	0	0	1	0	0	0	0	0	1	0	1	16.6
SUM	0	0	0	0	1	1	0	0	0	0	2	0	2	18.5
33	0	0	0	0	0	1	0	0	0	0	1	0	1	18.5
0--	0	0	0	0	0	1	0	0	0	0	1	0	1	18.5
60--	0	0	0	0	1	0	0	0	0	0	1	0	1	16.6
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	0	1	1	0	0	0	0	2	0	2	18.5

REGION NO. 59 W AFRICA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	1	2	0	0	0	3	1	4	19.8
30--	0	0	0	2	0	0	0	0	0	0	2	0	2	16.5
SUM	0	0	0	2	0	1	2	0	0	0	5	1	6	19.8
33	0	0	0	1	0	0	0	0	0	0	1	0	1	15.9
0--	0	0	0	2	0	1	2	0	0	0	5	1	6	19.8
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	2	0	1	2	0	0	0	5	1	6	19.8

REGION NO. 61 N CHINA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	0	0	1	0	0	1	0	1	20.2
30--	0	0	0	3	19	6	4	1	0	0	33	1	34	20.4
SUM	0	0	0	3	19	6	4	2	0	0	34	1	35	20.6
33	0	0	0	3	19	5	2	1	0	0	30	1	31	20.3
0--	0	0	0	3	19	6	4	2	0	0	34	1	35	20.6
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	3	19	6	4	2	0	0	34	1	35	20.6

REGION NO. 63 BORNEO-S VIET NAM

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	0	1	0	0	0	1	0	1	19.9
30--	0	0	0	0	0	2	0	0	0	0	2	1	3	18.8
60--	0	0	0	0	0	1	0	0	0	0	1	0	1	18.2
630--	0	0	0	0	0	0	0	1	0	0	1	0	1	21.1
660--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	0	0	3	1	1	0	0	5	1	6	21.1
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
0--	0	0	0	0	0	2	1	0	0	0	3	1	4	20.0
60--	0	0	0	0	0	1	0	0	0	0	1	0	1	18.2
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	1	0	0	1	0	1	21.1
SUM	0	0	0	0	0	3	1	1	0	0	5	1	6	21.1

REGION NO. 64 W.AUSTRALIA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
30--	0	0	0	1	0	1	0	0	0	0	2	3	5	18.7
SUM	0	0	0	1	0	1	0	0	0	0	2	3	5	18.7
33	0	0	0	1	0	1	0	0	0	0	2	2	4	18.7
0--	0	0	0	1	0	1	0	0	0	0	2	3	5	18.7
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.

(to be continued)

300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	1	0	1	0	0	0	0	2	3	5	18.7

REGION NO. 65 E. AUSTRALIA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	SUM	UNDF	TSUM	K
0--	0	0	0	0	0	1	0	0	0	0	1	1	2	17.8
30--	0	1	1	1	2	2	0	0	0	0	7	8	15	18.4
SUM	0	1	1	1	2	3	0	0	0	0	8	9	17	18.5
33	0	1	0	1	2	2	0	0	0	0	6	8	14	18.4
0--	0	1	1	1	2	3	0	0	0	0	8	9	17	18.5
60--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	1	1	1	2	3	0	0	0	0	8	9	17	18.5

6. Interpretations

It is a well known fact that regional variations exist in the pattern of earthquake energy release with depth connected with the structure and tectonic processes in the interior of the earth. However, both the lack of data and insufficient accuracy of them makes it difficult to get reliable results. To our knowledge, the only earlier investigation of the regional variation of the energy-depth relations of earthquakes was the one published by Gutenberg (1957). Obviously, the variation of energy release with depth depends on the following two factors as pointed out by Båth and Duda (1963).

a) *The strain accumulation.*

Without accumulation, there will naturally be no release. The strain accumulation depends on slow relative motions in the earth's interior, the reasons for which we do not need to consider in this connection.

b) *The mode of strain release.*

The rocks are able to store larger or smaller amounts of strain depending on their physical condition. With increasing depth, plastic flow processes will become more and more important. Ultimately, they are prevailing and no strain can be stored for any length of time of importance for earthquake generation.

The large energy release within the crust and upper mantle down to about 60 km depth is explained by large strain accumulation confined with large ability of strain storage. According to Gutenberg and Richter (1954), "isostacy and post-glacial uplift indicate that the strength (resistance to plastic flow) below 80± kilometers is less than 1/100 of

Table 4. Seismicity tables showing magnitude depth frequency and energy depth relation of earthquakes for different tectonic region groups during January 1963-June 1966 after the PDE of USCGS. K; Energy index. (1) Oceanic stable regions, (2) Oceanic seismic regions, (3) Circum-Pacific regions, (4) Alps-Himalayan seismic regions, (5) Continental seismic regions, and (6) Continental stable regions.

STATISTICAL TABLE FOR REGION NO. 1 NW PACIFIC OCEAN 3 CENTRAL PACIFIC OC.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	UNDF	SUM	K
0--	0	0	0	3	3	2	0	0	0	0	0	8	18.3
30--	0	0	0	3	0	1	0	0	0	0	1	5	18.5
60--	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	6	3	3	0	0	0	0	1	13	18.7
33	0	0	0	3	0	1	0	0	0	0	1	5	18.5
0--	0	0	0	6	3	3	0	0	0	0	1	13	18.7
60--	0	0	0	0	0	0	0	0	0	0	0	0	0.
300--	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	0	6	3	3	0	0	0	0	1	13	18.7

STATISTICAL TABLE FOR REGION NO. 4 E PACIFIC OCEAN 16 EURASIAN ARCTIC OC.

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	UNDF	SUM	K
0--	0	0	1	5	12	12	7	4	0	0	12	53	20.9
30--	0	0	4	192	316	152	50	11	2	1	146	874	22.9
60--	0	0	0	1	0	0	1	0	0	0	0	2	19.0
SUM	0	0	5	198	328	164	58	15	2	1	158	929	22.9
33	0	0	4	190	304	145	47	9	2	0	140	841	22.2
0--	0	0	5	197	328	164	57	15	2	1	158	927	22.9
60--	0	0	0	1	0	0	1	0	0	0	0	2	19.0
300--	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	0	5	198	328	164	58	15	2	1	158	929	22.9

STATISTICAL TABLE FOR REGION NO. 7 MACQUARIE IS.RIDGE 40 . PALMER PENINSULA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	UNDF	SUM	K
0--	1	7	70	474	602	380	137	39	2	0	422	2134	22.5
30--	0	20	572	2484	2525	1195	424	88	18	0	881	8207	23.1
60--	0	1	50	287	373	219	96	21	1	2	140	1190	23.4
90--	0	3	47	219	247	139	61	17	2	0	102	837	22.5
120--	0	0	41	173	133	108	38	10	3	0	93	599	22.3
150--	0	1	49	127	119	63	21	4	2	0	63	449	21.9
180--	0	1	24	63	61	33	10	6	0	0	25	223	21.4
210--	0	1	16	51	39	22	17	1	0	0	28	175	20.8
240--	0	1	21	42	27	8	2	1	0	0	12	114	20.7
270--	0	1	14	27	20	7	3	0	0	0	9	81	19.8
300--	0	0	6	19	16	9	1	1	0	0	4	56	20.7
330--	0	0	5	14	21	7	0	0	0	0	4	51	19.2
360--	0	0	6	21	19	6	4	1	0	0	9	66	20.3
390--	0	1	4	25	13	7	3	0	0	0	4	57	19.9
420--	0	0	7	21	12	6	3	0	0	0	5	54	20.0
450--	0	0	8	25	19	10	6	0	0	0	3	71	20.1
480--	0	0	14	21	27	10	1	2	0	0	11	86	20.6
510--	0	1	14	22	38	23	4	0	1	0	18	121	21.4
540--	0	0	23	43	39	27	19	4	0	0	24	179	21.2
570--	0	1	10	28	23	18	12	1	0	0	13	106	20.9
600--	0	3	14	40	22	21	7	3	0	0	13	123	21.2
630--	0	1	4	12	9	10	2	1	0	0	6	45	20.7
660--	0	0	0	1	5	1	0	0	0	0	1	8	18.6
690--	0	0	0	0	0	2	0	0	0	0	0	2	18.5
SUM	1	43	1019	4239	4409	2331	871	200	29	2	1890	15034	23.7
33	0	18	494	1709	1533	588	188	41	5	0	609	5185	22.8
0--	1	27	642	2958	3127	1575	561	127	20	0	1303	10341	23.2
60--	0	9	262	989	1019	599	248	60	8	2	472	3668	23.5
300--	0	1	28	100	81	35	11	2	0	0	26	284	20.9
450--	0	6	87	192	182	122	51	11	1	0	89	741	21.9
SUM	1	43	1019	4239	4409	2331	871	200	29	2	1890	15034	23.7

STATISTICAL TABLE FOR REGION NO. 41 MEDITERRANEAN REGION 45 JAVA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	UNDF	SUM	K
0--	0	0	2	28	44	43	13	7	0	0	31	168	21.4
30--	0	0	9	104	240	169	58	16	1	0	168	765	22.1
60--	0	1	1	21	33	26	12	7	0	0	37	138	21.6
90--	0	0	1	10	9	16	11	1	1	0	26	75	21.6
120--	0	0	1	8	10	15	5	1	0	0	16	56	20.5
150--	0	0	0	6	9	6	2	0	1	0	8	32	21.8
180--	0	0	1	5	8	5	3	2	0	0	9	33	20.9
210--	0	0	0	1	19	5	2	1	1	0	17	46	21.7
240--	0	0	0	4	3	1	2	0	1	0	3	14	21.4
270--	0	0	0	0	0	1	0	0	0	0	1	2	17.8
300--	0	0	0	2	0	1	0	0	0	0	0	3	18.0
330--	0	0	0	3	1	0	0	0	0	0	0	4	17.6
360--	0	0	0	0	0	0	0	0	0	0	0	0	0.
390--	0	0	0	0	0	0	0	0	0	0	0	0	0.
420--	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0.
480--	0	0	0	0	0	0	0	1	0	0	1	2	20.2
510--	0	0	0	0	0	0	0	0	0	0	1	1	0.
540--	0	0	0	0	0	0	0	0	0	0	0	0	0.
570--	0	0	0	0	0	2	0	0	0	0	0	2	18.4
600--	0	0	0	0	0	0	0	1	0	0	1	2	20.6
630--	0	0	0	0	0	0	0	0	0	0	0	0	0.
660--	0	0	0	0	0	0	0	0	0	0	0	0	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	1	15	192	376	290	108	37	5	0	319	1343	22.6
33	0	0	5	68	147	105	29	5	1	0	106	466	21.9
0--	0	0	11	132	284	212	71	23	1	0	199	933	22.2
60--	0	1	4	55	91	75	37	12	4	0	117	396	22.4
300--	0	0	0	5	1	1	0	0	0	0	0	7	18.2
450--	0	0	0	0	0	2	0	2	0	0	3	7	20.8
SUM	0	1	15	192	376	290	108	37	5	0	319	1343	22.6

STATISTICAL TABLE FOR REGION NO. 46 TIEN SCHAN-BAIKAL 47 E AFRICA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	UNDF	SUM	K
0--	0	0	0	0	7	10	12	5	0	0	5	39	21.4
30--	0	1	0	6	46	24	9	3	0	0	27	116	21.4
60--	0	0	0	1	0	1	0	0	0	0	1	3	17.8
SUM	0	1	0	7	53	35	21	8	0	0	33	158	21.7
33	0	1	0	4	36	23	9	1	0	0	24	98	21.2
0--	0	1	0	6	53	34	21	8	0	0	32	155	21.7
60--	0	0	0	1	0	1	0	0	0	0	1	3	17.8
300--	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	1	0	7	53	35	21	8	0	0	33	158	21.7

STATISTICAL TABLE FOR REGION NO. 48 NORW.SEA-BRITISH IS. 65 E.AUSTRALIA

DEP./MAG.	1.0-	3.0-	3.5-	4.0-	4.5-	5.0-	5.5-	6.0-	6.5-	7.0-	UNDF	SUM	K
0--	0	0	3	7	22	8	3	1	0	0	20	64	20.5
30--	0	2	12	44	41	18	6	1	0	0	29	153	20.5
60--	0	0	0	0	1	1	0	0	0	0	0	2	18.3
600--	0	0	0	0	0	0	0	0	0	0	0	0	0.
630--	0	0	0	0	0	0	0	1	0	0	0	1	21.1
660--	0	0	0	0	0	0	0	0	0	0	0	0	0.
690--	0	0	0	0	0	0	0	0	0	0	0	0	0.
SUM	0	2	15	51	64	27	9	3	0	0	49	220	21.3
33	0	2	10	39	39	12	4	1	0	0	25	132	20.4
0--	0	2	15	51	63	26	9	2	0	0	49	217	20.8
60--	0	0	0	0	1	1	0	0	0	0	0	2	18.3
300--	0	0	0	0	0	0	0	0	0	0	0	0	0.
450--	0	0	0	0	0	0	0	1	0	0	0	1	21.1
SUM	0	2	15	51	64	27	9	3	0	0	49	220	21.3

that near the surface." There is little doubt that on the average, in nearly all regions, the maximum energy release of earthquakes occurs at depths shallower than 60 km, except for several regions.

Several independent items of evidence from wave propagation now support the idea of a low-velocity layer or asthenosphere at depths around 100–200 km. It is considered as a weak zone, where one should expect plastic flow processes prevail. In general the elasticity of any material decreases as its temperature approaches the melting point. But an increase in pressure raises the melting point and elasticity. Below the surface of the earth both temperature and pressure increase with depth, having opposing effects on the melting point as well as on the elastic strength of rock. Presumably at a depth of about 60 km temperature takes the upper hand and rock begins to approach its melting point, growing weaker as the depth increases. This trend continues down to some 200 km, where it reverses. Båth and Duda (1963) investigated the world-wide strain depth curve and gave special reference to this point. However, their curve seems to exhibit no clear minimum to be ascribed to the asthenosphere low-velocity layer. There is only a small superimposed minimum between the depths 100 km and 225 km.

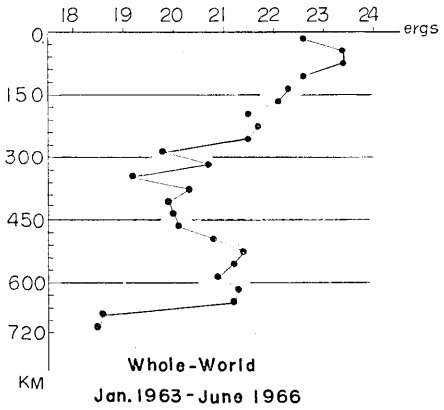


Fig. 5. Earthquakes energy release with depth for the whole world after PDE of USCGS for January 1963—June 1966.

Our energy release curve with depth for the whole world illustrated in Fig. 5 also shows similar result to that of Båth and Duda (1963). As can be seen in Fig. 5, a small relative minimum, ranging at depths between 90 km and 210 km, seems to exist. However, there is little doubt that from the regional statistics the clear minimum of the energy release of earthquakes occurs at depths between about 60 and 180 km for many different regions, as illustrated in Fig. 6 and Table 1.

In some of the circum-Pacific and Alps-Himalayan seismic regions, where shocks occur below 60 or 90 km, the average energy release decreases with increasing depth and reaches a minimum at a depth of about 270 and 300 km. In most of regions where earthqukes occur at depths over 300 km a secondary but definite maximum of energy release

exists at depths between about 540–600 km. On the other hand, in the next two regions, *i.e.*, No. 18: Kamchatka-Kuril Islands Region and No. 19: Japan-Bonin Islands Region, maxima are found at depths be-

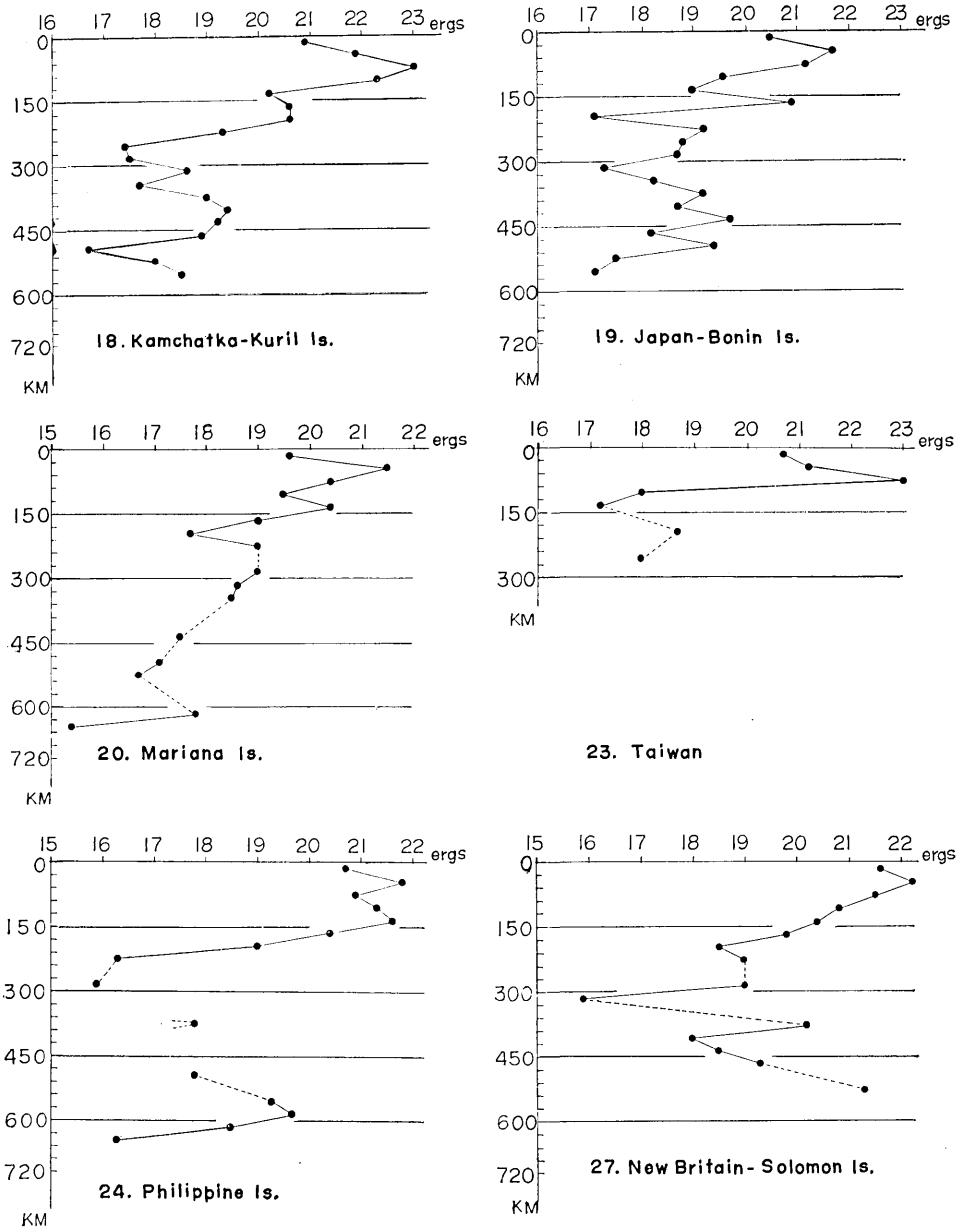
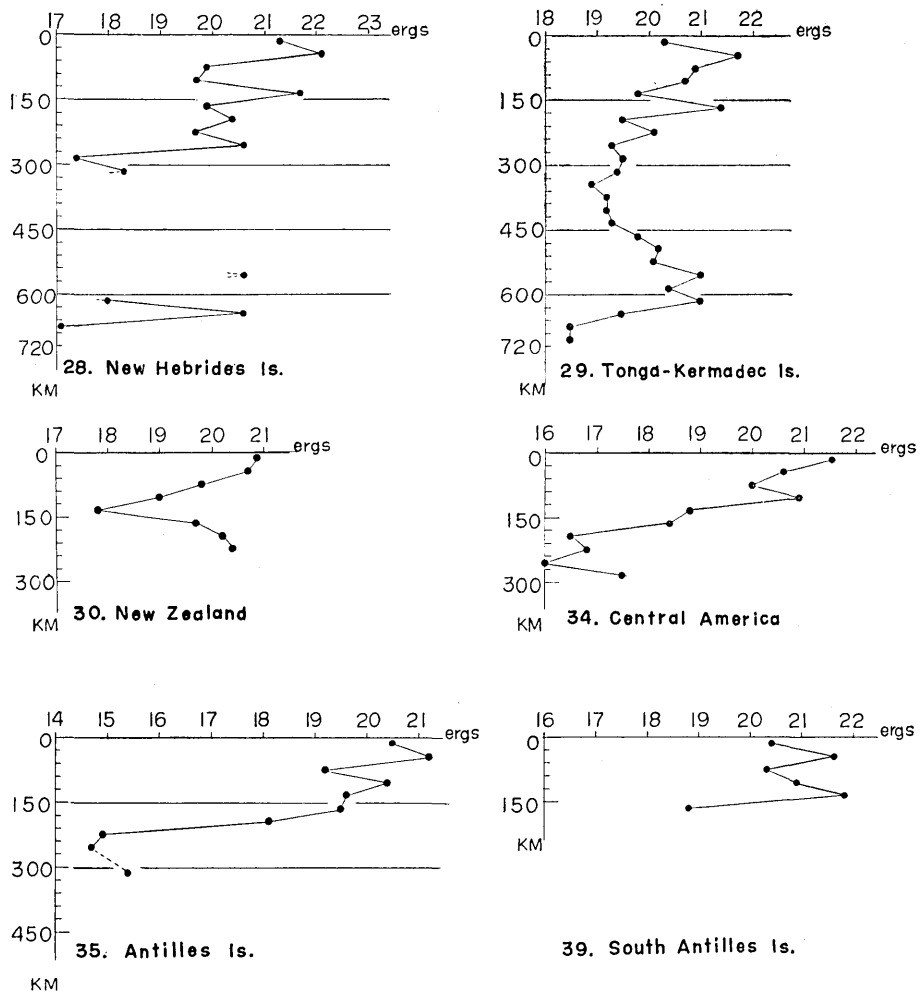


Fig. 6 (a)



(b)

Fig. 6. Earthquake energy release with depth in the various tectonic regions after PDE of USCGS for January—June 1966.

tween about 360–480 km. Everywhere except for these two regions very little energy is released at depths between about 300 and 450 km during the period concerned. These remarkable regional characteristics found in the Japanese Islands and its surroundings suggest that the earthquakes at this depth range occur associated with depth variation of pressure and temperature, in combination with a possible phase change

such as the "olivine to spinel transition". There is no shock with $m \geq 5.5$ at depths deeper than 660 km and the energy release disappears completely at depths below 720 km. Quantitative discussion of these problems will be reserved for future studies.

7. Conclusions

More information concerning longer series of earthqauke data is required to draw more definite conclusions. However, the world-wide and regional earthquake energy release with depth in the interval January 1963–June 1966 has revealed the following features.

(1) In nearly all regions, the maximum energy release occurs at depths shallower than 60 km.

(2) In many regions a clear minimum of energy release, which seems to correspond to the mantle low velocity layer, occurs at depths between 60 and 180 km.

(3) The second minima are found at depth 210–330 km in Kamchatka-Kuril Islands and Japan-Bonin Islands Regions, while they are generally found at depth 300–450 km in the other seismic regions.

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36. 地震による放出エネルギーの深さ別分布について (I)

地震研究所　溝　　上　　恵

USCGS の PDE (Preliminary Determination of Epicenters) にもとづいて1963年1月から1966年6月までの3.5年間に発生した地震による放出エネルギーの深さ別分布を，世界全体ならびに地域別にしらべた．その結果世界の平均としては地震による放出エネルギーの分布は震源の深さによつて，Shallow (<60 km), Intermediate (<300 km), Transient (<450 km) および Deep (≥450 km) の4層に分類されるべきであることが示される．

この分類に従つて CGS Magnitude $m \geq 5.0$ の地震と $m < 5.0$ の地震とにわけて世界全域の Seismicity Map を Lambert's Conical Projection により作成した．さらに Seismo-tectonics による情報にもとづいて世界を65の地域に区分し，おのおのの地域についての地震による放出エネルギーの深さ別分布の表を作成した．

その結果以下のことが指摘される．

(1) 地震による放出エネルギーは，ほとんどすべての地域において 60 km より浅いところで最大の値をとる．

(2) 多くの地域において 60-180 km の深さで地震による放出エネルギーが極小となる．これはいわゆる低速度層の存在と密接な関係があるものと思われる．

(3) カムチャッカー千島列島および日本小笠原諸島をかこむ地域では 200km よりも深いところに発生する地震による放出エネルギーの分布に著しい異常がみいだされる．すなわちこれらの地域をのぞいた他の地域においては地震による放出エネルギーが 300～450km の深さで極小となり 540～630km で極大となるのにたいし，これら2地域では 210～330km の深さで極小，360～450 km の深さで極大となる．なお Båth (1966) の指摘するところによれば CGS Magnitude は Pasadena, Berkeley, Palisades, Strusbourg, Prague, Uppsala, Kiruna, Moscow, Rome などできめられた Magnitude m よりも 0.7 だけ小さい．もしこのことが正しいとするならば本論文で与えられた Energy Index K には 1.67 を加えるべきである．