1. Epicenters of Earthquakes
Epicentral Distribution of Shallow Earthquakes (Focal Depth ≦ 60km)
Epicentral Distribution of Intermediate and Deep Earthquakes (Focal Depth ≧ 61km)

Japan is known to be an earthquake-prone country. The energy generated by earthquakes in Japan and the surrounding area is said to correspond to approximately 15% of the total earthquake energy generated in the world.

Shallow earthquakes with a focal depth of 60km or less are concentrated on the continental side of the sea bed; they occur sporadically in inland areas. Particularly dense epicentral distribution of shallow earthquakes is seen around the Tisima-Kamchatka Trench and the Japan Trench. Major earthquakes almost always occur at a depth of less than 60km.

The shallower the epicenter of an earthquake is, the closer to the ocean trench it occurs; the deeper the epicenter is, the nearer the continent it occurs. This trend is particularly noticeable near the northern part of Japan.

[**Salient Points of the Legend and Map Compilation**]

The epicentral distribution of earthquakes recorded by the earthquake observation network of the Japan Meteorological Agency was divided into shallow earthquakes with a focal depth of 60km and less, and intermediate and deep earthquakes with a focal depth of 61km and over.

Magnitude (M) is one way to measure the intensity of an earthquake. An increase of one in magnitude represents an increase of 32 times in earthquake energy. Near Japan, earthquakes of magnitude 5~6 occur about one hundred times a year; those of M6~7 about ten times a year; those of M7~8 about once a year and those of M8 and over about once in ten years.

2. Crustal Movement
Horizontal Strain. Maximum Shear Strain
Vertical Movement (I) (II)

Rocks which constitute the earth's crust are considered to be elastic. When a force is applied to rocks deep below the earth, elastic deformation takes place. The rocks are destroyed if the elastic deformation exceeds a given limit. At the same time, strain energy stored in the rocks is released as vibration, which is transmitted through the crust; this phenomenon is thought to be an earthquake.

As a result of breaking experiments on rocks and from crustal movement around faults associated with earthquakes, it is thought that destruction of the crust is induced if the elastic deformation reaches approximately 1/10,000 of the original form. Thus, earthquake generation can be estimated by measuring the state of crust deformation with geodetic methods.

[**Salient Points of the Legend and Map Compilation**]

Horizontal Strain

A circle drawn on the ground surface at an earlier observation time gradually changes, becoming an ellipse by the next observation time. This type of ellipse is known as a strain ellipse. At the same time, a pair of orthogonal axes exist whose angle of intersection shows no change, either before or after deformation. These are the long and short principal axes of the strain ellipse.

This map shows the direction and the expansion and contraction ratios (principal strain) of the strain ellipse calculated for each triangle, using the results from the first and second order triangulation survey (1883—1913) and the primary control survey (1973—1985).

Maximum Shear Strain

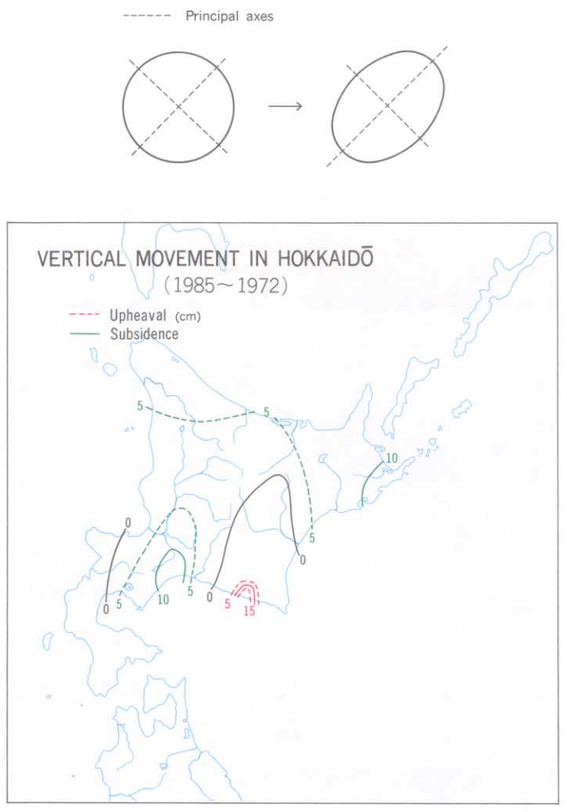
Maximum shear strain is described according to the difference in the size of the principal axes of the strain ellipse. This map shows the maximum shear strain based on the results received from surveys carried out for horizontal strain. Areas where major earthquakes have occurred show greater strain due to crustal movement. Moreover, there are areas which show great strain as a result of artificial crustal movement, such as the pumping up of ground water and natural gas, extraction of coal from mines, etc.

Vertical Movement

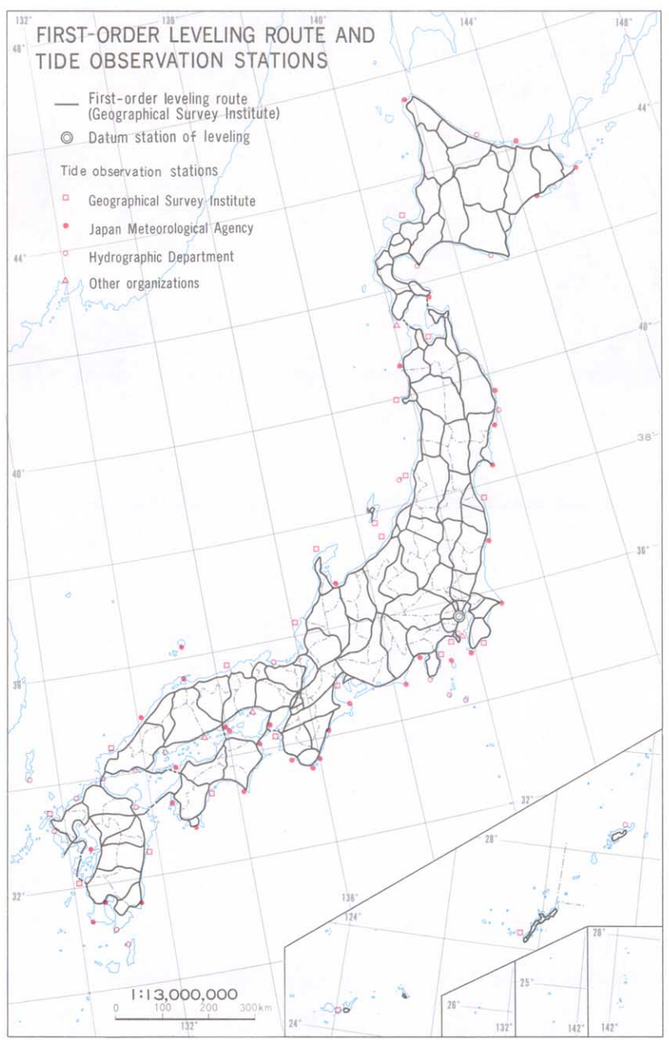
The results of first order levelling carried out from 1924—1943, 1968—1975 and 1982—1986 were arranged into three standard years: 1934, 1972 and 1984. Vertical movements between 1934—1984 and 1972—1984 are indicated by isopleths on the two maps.

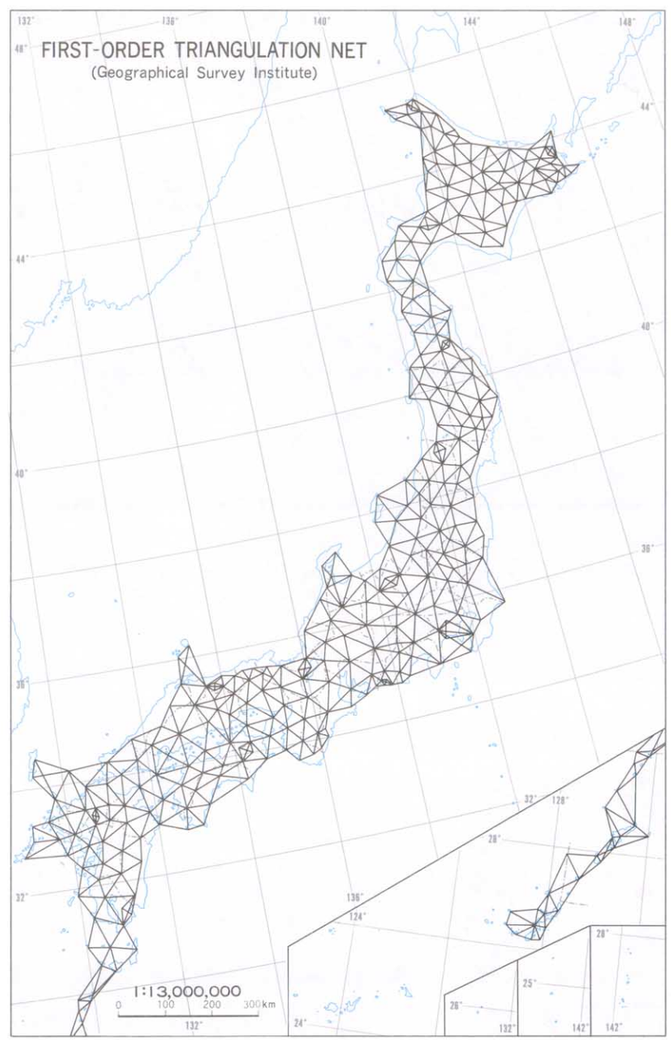
[**Sources**]

1. Japan Meteorological Agency, Earthquake Monthly
2. Geographical Survey Institute, Results of First Order Levelling
3. Geographical Survey Institute, Horizontal Strain on Crust in Japan (1985—1883), 1985



(Geographical Survey Institute)





9.1

EPICENTRAL DISTRIBUTION OF SHALLOW EARTHQUAKES (FOCAL DEPTH ≦60km)

(1926~1987)

FOCAL DEPTH OF EARTHQUAKES		MAGNITUDE
<30km	>30km	
●	●	5.0 — 6.0
●	●	6.0 — 7.0
●	●	7.0 — 8.0
●	●	8.0<

Based on the records by the Japanese seismograph stations

1:6,000,000

0 50 100 150 200 250 300km

SEA OF OKHOTSK
JAPAN SEA
YELLOW SEA
EAST CHINA SEA
NORTH PACIFIC OCEAN
Rebun Tō
Risiri Tō
Etorohu Tō
Kunasiri Tō
Sikotan Tō
HABOMAI SYOTO
Asahikawa
Kusiro
Sapporo
Okusiri Tō
Hakodate
Aomori
Morioka
Akita
Sendai
Yamagata
Hukusima
SADO
Niigata
Utunomiya
Mito
Nagano
Maebasi
Toyama
Kanazawa
Tokyo
Tiba
Yokohama
Kōhu
Hukui
OKI
Take Sima
Gihu
Sizuoka
Nagoya
Tottori
Matue
Kyōto
Kōbe
Nara
Osaka
Tu
Okayama
Takamatu
Wakayama
Tokusima
Hirosima
Yamaguti
Matuyama
Kōti
TUSIMA
Hukuoka
Saga
Ōita
Kumamoto
Nagasaki
GOTŌ RETTŌ
KOSIKIZIMA RETTŌ
Kagosima
Miyazaki
ŌSUMI SYOTŌ
Yaku Sima
TOKARA RETTŌ
NANSEI SYOTŌ
AMAMI SYOTŌ
SATUNAN SYOTŌ
Ō sima
Tokuno Sima
Okinoerabu Zima
OKINAWA SYOTŌ
Okinawa Zima
Kume Zima
Naha
SENKAKU SYOTŌ
RYŪKYŪ SYOTŌ
SAKISIMA SYOTŌ
Miyako Zima
Iriomote Zima
Isigaki Zima
Yonaguni Zima
Kita-Daitō Zima
Minami-Daitō Zima
DAITŌ SYOTŌ
Oki-Daitō Zima
IZU SYOTŌ
Miyake Zima
Hatizyō Zima
OGASAWARA GUNTŌ
Titi Zima
Haha Zima
KAZAN RETTŌ
Iō Zima
Oki-no-Tori Sima

EPICENTRAL DISTRIBUTION OF INTERMEDIATE AND DEEP EARTHQUAKES (FOCAL DEPTH≧61km)

(1926～1987)

FOCAL DEPTH OF EARTHQUAKES

- 61 — 120km
- 120 — 200km
- 200 — 300km
- 300 — 400km
- 400 — 500km
- 500km<

MAGNITUDE

5～6　6～7　7～8　8<

Based on the records by the Japanese seismograph stations

1:6,000,000

0 50 100 150 200 250 300km