1. GRAVITY ANOMALIES
   BOUGUER ANOMALIES.
   FREE AIR ANOMALIES
2. MAGNETISM
   TOTAL FORCE.
   HORIZONTAL COMPONENT.
   DECLINATION.
   INCLINATION

1. Gravity Anomalies (Bouguer Anomalies). (Free Air Anomalies)

Gravity is the force of the earth to gravitate objects stationary on the ground. It is a resultant force of the universal gravitation between objects and the whole earth and the centrifugal force generated by the rotation of the earth.

In view of the facts that the tectonic features of the inside of the earth are uneven, that the measuring points are different in latitude and altitude, and that the earth is not shaped like a full globe, gravity differs, depending on the location. Conversely, therefore, it would be feasible to realize the tectonics of the inside of the earth by calculating the difference between the value obtained after a variety of adjustments from an actually measured gravity value, on the one hand, and normal gravity, on the other—or, in other words, by computing the gravity anomalies.

When the gravity anomalies are analyzed regionally, the belts of negative gravity anomalies extending in trenches and along the land sides are conspicuous, insofar as the free air anomalies are concerned. Positive anomalies, well matched to the landform, conspicuously appear in high mountains. Insofar as the bouguer anomalies are concerned, the negative anomalies in mountains of the Tyūbu Region are conspicuous.

Salient Points of the Legend and Map Compilation

Free air anomaly : The difference between the value obtained by adding the elevation correction to the actually measured value of gravity, on the one hand, and normal gravity, on the other. The correction for elevation is done to compute the value of gravity on the sea surface on the assumption that there are no objects between the measuring point and sea level. In terms of computation, it is said that the gravity drops by 0.3086 mgal per 1 meter of elevation.

The normal gravity represents the standard gravity of the surface (which corresponds practically to sea level) of the earth ellipsoid. For its computation, the International Gravity Formula (1930) was used.

The measurement period extended from 1952 to 1969 on the land and from 1960 to 1971 on the sea.

Bouguer anomaly : In the strict sense, this expression represents the difference between the value obtained by adding the elevation correction, bouguer correction and topographic correction to the actually measured value of gravity, on the one hand, and normal gravity, on the other. For this map, the topographic correction was omitted. Bouguer correction is done to eliminate the influences produced by any matter existing between the measuring point and sea level. For this map, the computation was made on the assumption that the density of matter on the sea level is 2.67 g/cm^3. The bouguer anomalies are considered purely to reflect the distribution of densities inside the earth.

The measurement period extended from 1952 to 1969.

The unit used for these maps is mgal (10^{-3} cm/s^2).

Sources

1. Geographical Survey Institute, 1 : 2,000,000 scale Free Air Anomalies in Japan and Bouguer Anomalies in Japan, 1970.
2. Yoshibumi TOMODA, 1 : 3,000,000 scale Free Air Anomalies, Ocean Research Institute, University of Tokyo, 1973.

2. Magnetism (Total Force). (Horizontal Component). (Declination). (Inclination)

If a magnetic needle is suspended at an optional point on the earth in such a manner that enables it to revolve without restraint, it will stand still, pointing to a fixed direction. This phenomenon suggests the formation of a geomagnetic field near the surface of the earth.

The intensity of the geomagnetic field is called total intensity ; the component in the horizontal direction, the horizontal component ; and the component in the vertical direction, the vertical component. The angle of the direction of the geomagnetic field to the horizontal plane is called inclination, whereas the angle of the direction of the horizontal component to the meridian is called declination. To determine the geomagnetic field there is need for three independent components. In normal circumstances, the horizontal intensity declination and inclination are used.

The declination indicates the extent to which the north (magnetic north) pointed by a magnetic needle deviates from true north. When the orientation is to be measured with a compass for surveying and navigation, it is necessary to know the value of deviation of that particular point in advance. The conventional compasses are so designed that their magnetic needles are horizontal, thus making it impossible to realize the inclination. In areas adjacent to Japan, the declination deviates westward and the inclination northward.

In terms of time, the geomagnetic field changes at all times, and it is necessary to conduct an epoch reduction of the values measured at different times for an analysis of the geographical distribution of factors of magnetism. This reduction is conducted on the basis of the data available from the Geomagnetic Observatory of the Japan Meteorological Agency, and the Kanōzan Geodetic Observatory of the Geographical Survey Institute.

Regional anomalies extending as far as thousands of kilometers in wave length and local anomalies, smaller in scale, are observed in the geomagnetism field. Underground tectonics and lithologic character are responsible for local anomalies, which are generally conspicuous in volcanic areas and also in the peripheries of iron ore deposits. This character is put to use in magnetic prospecting. It is also possible to realize electrical features of the inside of the earth with changes in geomagnetism.

Salient Points of the Legend and Map Compilation

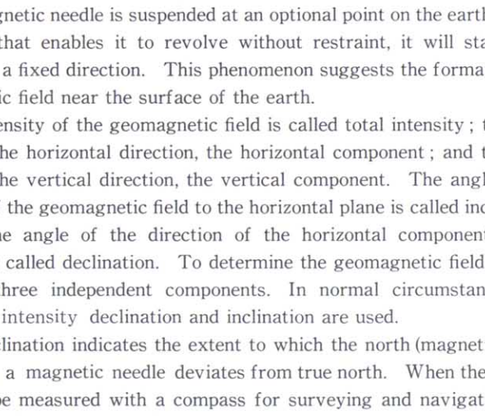
The Geographical Survey Institute has distributed about 100 first-order magnetic points and about 800 second-order magnetic points throughout the nation for magnetic surveys. A wide variety of observations are carried out by the Japan Meteorological Agency, Hydrographic Department of the Maritime Safety Agency, and universities.

The black isopleths in these maps were prepared on the basis of the findings of the measurements done at the first-and second-order magnetic points and all other data accessible, excluding the isolated points of magnetic anomalies. The isopleths for Izu Hantō (Peninsula), Izu Syotō (Archipelago), etc., had to be omitted, partially or totally, due to extremely conspicuous magnetic anomalies.

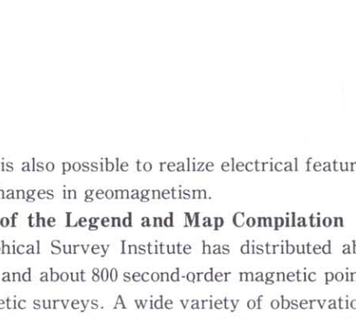
The red isopleths in the maps were drawn on the basis of the computation (according to the quadratic formula) of the findings obtained from the first-order magnetic points to illustrate the average distribution of each factor.

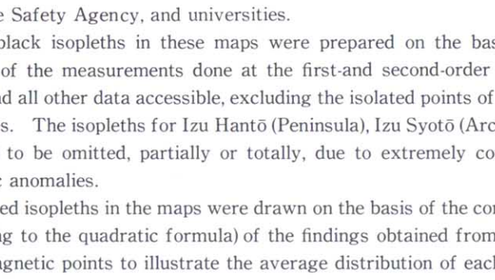
Sources

1. Geographical Survey Institute, 1 : 2,500,000 scale Magnetic Charts, 1972.
2. Shuiti IMAMITI, Secular Variation of the Magnetic Declination in Japan, Memoirs of the Kakioka Magnetic Observatory, Vol. 7, No. 2, 1956.



(IMAMITI, 1956)





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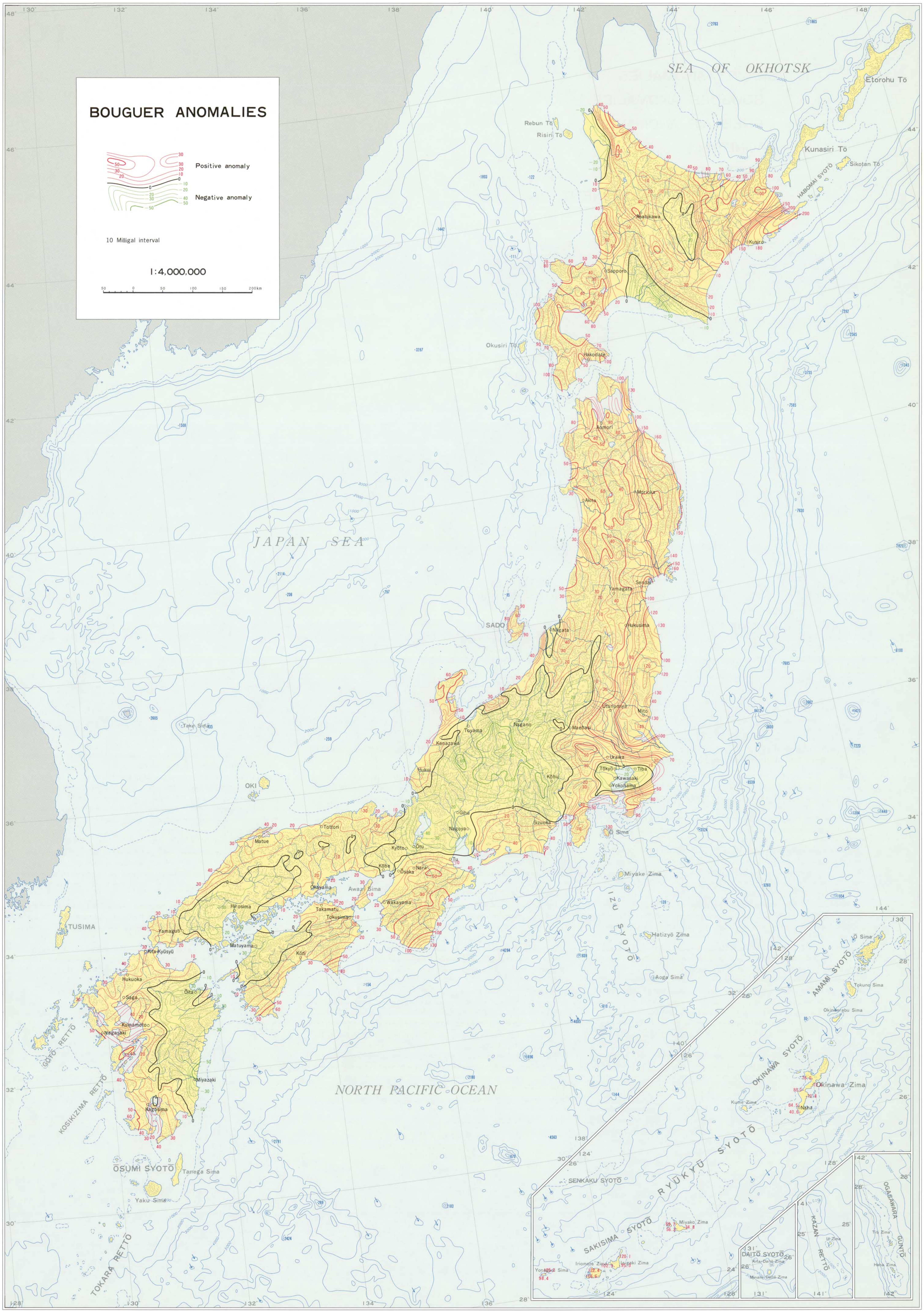
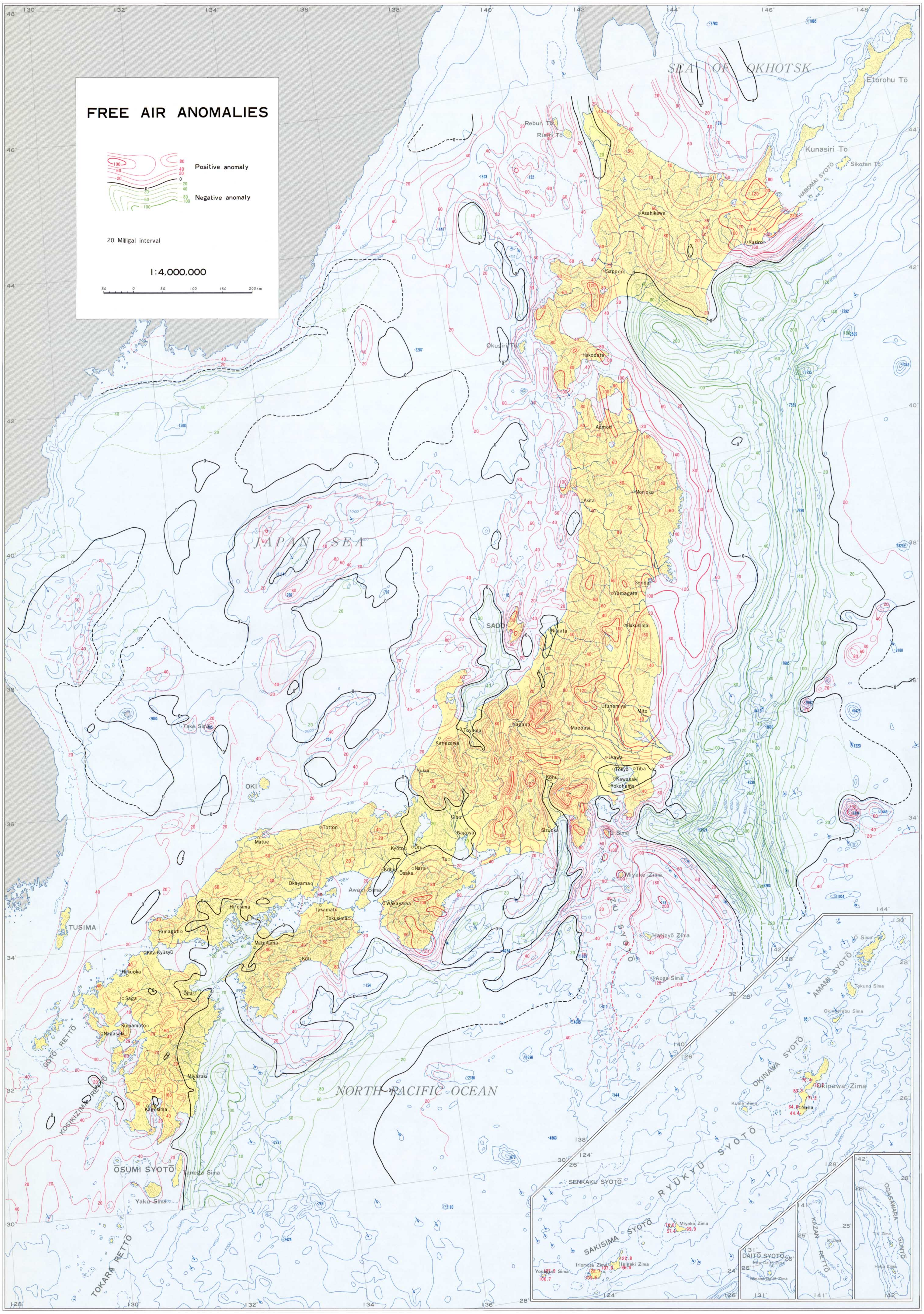

BOUGUER ANOMALIES
Positive anomaly
Negative anomaly
10 Milligal interval
1:4,000,000
50 0 50 100 150 200km
SEA OF OKHOTSK
JAPAN SEA
NORTH PACIFIC OCEAN
Etorohu Tō
Kunasiri Tō
Sikotan Tō
HABOMAI SYOTO
Rebun Tō
Risiri Tō
Okusiri Tō
SADO
OKI
TUSIMA
Take Sima
GOTO RETTO
KOSIKIZIMA RETTO
ŌSUMI SYOTŌ
Tanega Sima
Yaku Sima
TOKARA RETTO
IZU SYOTŌ
Ō Sima
Miyake Zima
Hatizyō Zima
Aoga Sima
Asahikawa
Sapporo
Kusiro
Hakodate
Aomori
Morioka
Akita
Sendai
Yamagata
Hukusima
Niigata
Utunomiya
Mito
Maebasi
Urawa
Tōkyō
Tiba
Kawasaki
Yokohama
Kōhu
Nagano
Toyama
Kanazawa
Hukui
Gihu
Nagoya
Sizuoka
Tu
Ōtu
Kyōto
Kōbe
Ōsaka
Nara
Wakayama
Tottori
Matue
Okayama
Awazi Sima
Hirosima
Takamatu
Tokusima
Yamaguti
Matuyama
Kōti
Kita-Kyūsyū
Hukuoka
Saga
Ōita
Kumamoto
Nagasaki
Miyazaki
Kagosima
AMAMI SYOTŌ
Ō Sima
Tokuno Sima
Okinoerabu Sima
OKINAWA SYOTŌ
Okinawa Zima
Kume Zima
Naha
RYŪKYŪ SYOTŌ
SENKAKU SYOTŌ
SAKISIMA SYOTŌ
Miyako Zima
Isigaki Zima
Iriomote Zima
Yonaguni Sima
DAITŌ SYOTŌ
Kita-Daitō Zima
Minami-Daitō Zima
KAZAN RETTŌ
Iō Zima
OGASAWARA GUNTŌ
Titi Zima
Haha Zima


FREE AIR ANOMALIES
Positive anomaly
Negative anomaly
20 Milligal interval
1:4,000,000
50 0 50 100 150 200km
SEA OF OKHOTSK
JAPAN SEA
NORTH PACIFIC OCEAN
Etorohu Tō
Kunasiri Tō
Sikotan Tō
HABOMAI SYOTO
Rebun Tō
Risiri Tō
Okusiri Tō
Asahikawa
Sapporo
Kusiro
Hakodate
Aomori
Morioka
Akita
Sendai
Yamagata
Hukusima
Niigata
SADO
Utunomiya
Mito
Nagano
Maebasi
Toyama
Kanazawa
Hukui
Urawa
Tōkyō
Tiba
Kawasaki
Yokohama
Kōhu
Gihu
Nagoya
Sizuoka
Ō Sima
Miyake Zima
Hatizyō Zima
Aoga Sima
IZU SYOTO
Tu
Ōtu
Kyōto
Nara
Kōbe
Ōsaka
Wakayama
Awazi Sima
Tottori
Matue
OKI
Take Sima
Okayama
Hirosima
Takamatu
Tokusima
Yamaguti
Matuyama
Kōti
Kita-Kyūsyū
Hukuoka
Saga
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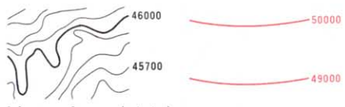
Kumamoto
Nagasaki
Miyazaki
Kagosima
TUSIMA
GOTO RETTO
KOSIKIZIMA RETTO
ŌSUMI SYOTO
Tanega Sima
Yaku Sima
TOKARA RETTO
AMAMI SYOTO
Ō Sima
Tokuno Sima
Okinoerabu Sima
OKINAWA SYOTO
Okinawa Zima
Kume Zima
Naha
RYŪKYŪ SYOTO
SENKAKU SYOTO
SAKISIMA SYOTO
Miyako Zima
Iriomote Zima
Isigaki Zima
Yonaguni Sima
DAITO SYOTO
Kita-Daitō Zima
Minami-Daitō Zima
KAZAN RETTO
Io Zima
OGASAWARA GUNTO
Titi Zima
Haha Zima

10.2

TOTAL FORCE

(1970)



Lines of equal total intensity — general distribution

Represented in gamma (1 gamma = 10^{-5} gauss)

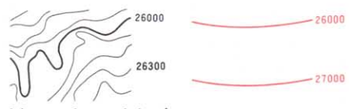
A value reduced to the beginning of 1970 was used

1:8,000,000

100 0 100 200 300km

HORIZONTAL COMPONENT

(1970)



Lines of equal horizontal intensity — general distribution

Represented in gamma (1 gamma = 10^{-5} gauss)

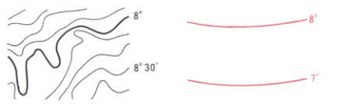
A value reduced to the beginning of 1970 was used

1:8,000,000

100 0 100 200 300km

DECLINATION

(1970)



Isogonic lines (Westward) — general distribution

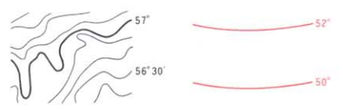
A value reduced to the beginning of 1970 was used

1:8,000,000

100 0 100 200 300km

INCLINATION

(1970)



Isoclinic lines (Northward) — general distribution

A value reduced to the beginning of 1970 was used

1:8,000,000

100 0 100 200 300km