Regional Magnetic Anomaly around the Japanese Islands
Revealed in Marine Data

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By utilizing the wealth of geomagnetic maritime data collected around Japan in the past, one can compare these data obtained from the earth's surface with satellite data and thereby contribute to the study of the earth's crustal structure.

Using data measured by survey ships, NOMURA (1979) dealt with such marine geomagnetic data in order to learn the wavelengths of geomagnetic anomalies in the Western Pacific region. These data were collected by the National Oceanographic Data Center (Hydrographic Department, Maritime Safety Agency, Tsukiji 5-3-1, Chuo-ku, Tokyo 104, Japan). The total amount of available data is about 600,000, and they were acquired from 1961 to 1979. Yet in spite of Nomura's studies, more extensive analysis is necessary, taking into account new geomagnetic field models and the recent secular geomagnetic variation. The authors have attempted further analysis using the total intensity data for the region of 120°-160°E and 15°-50°N obtained by proton magnetometers.

The actual annual mean total intensity of the geomagnetic field was calculated at the three permanent observatories in Japan (Memambetsu, 43°55'N, 144°12'E; Kakioka, 36°14'N, 140°11'E; Kanoya, 31°25'N, 130°53'E) and compared with the value calculated from the DGRF (Definite International Geomagnetic Reference Field for 1965, 1970 and 1975) and IGRF (International Geomagnetic Reference Field for 1980) proposed by the IAGA WORKING GROUP I-1 on "Analysis of the main field and secular variations" (1981). Figure 1 shows the difference in the observed and calculated total intensity values at the three stations. Here it is assumed that the calculated model values change linearly with time during 5 years of successive DGRF and IGRF designations. As is shown in Fig. 1, the actual value of the geomagnetic total field intensity in Japan is 100-150 nT smaller than the model field value, and this difference decreased during 1970-1975 by more than 50 nT at Memambetsu and Kakioka, although the difference was steady during both 1965-70 and 1975-80. In other words, there was a peculiar secular variation in Japan, during 1970-75, which amounted to 50 nT, at least in the region covering Memambetsu and Kakioka. Hence the analysis of marine data in the Western Pacific region was made separately with the data obtained before 1970 and after 1976, in order to avoid a possible confusion due to the change in the secular geomagnetic variation.

The magnetic anomaly map of Fig. 2 was obtained by taking the difference between the observed data and those synthesized from the reference models; at
Fig. 1. Differences in the total intensity between the observed and the computed values from the international reference field models at three Japanese observatories, Memambetsu (MMB), Kakioka (KAK), and Kanoya (KNY).

Each observation point the difference was computed, and the difference values were averaged every 0.25° × 0.25° area, after using all the data obtained from 1965–1979. For the two stable periods of the geomagnetic secular variation, i.e. the periods 1965–70 and 1975–80, the anomalies were computed separately and compared. Although there is a tendency of the anomalies computed from the data in 1966–70 to show greater values than those in 1976–79, the general patterns of the anomalies are similar in each period. The following features can be pointed out as the anomaly of geomagnetic total intensity around Japan.

(1) There are positive anomaly belts running parallel with trenches on the continental side of the Japanese Islands, such as the anomaly along the Kuril trench, the one associated with the Japan trench, and the anomaly parallel with the Izu-Mariana trench. The anomalies along the Kuril trench and the Izu-Mariana trench are visible at the satellite altitude, whereas the anomaly running north-south in parallel with the Japan trench is not recognizable in the MAGSAT data.

(2) The southwestern part of the Japan Sea is covered with a positive anomaly, and an area of negative anomaly spreads to the north. This feature has been confirmed by the MAGSAT data. However, the marine data suggest the existence of a positive anomaly area further to the north of the Japan Sea area.

(3) A strong positive anomaly is clearly seen near 40°N and 155°E. This
Regional Magnetic Anomaly around the Japanese Islands

Fig. 2. Magnetic anomaly of total intensity obtained from the marine data for the period from 1965 to 1979. Models used are DGRF 1965, DGRF 1970, DGRF 1975 and IGRF 1980.

has not been yet confirmed by the satellite data.

(4) The positive anomaly region in the Pacific Ocean marked by "?" has not been clearly established. In the Pacific ocean it is difficult to draw a definitive anomaly pattern, due either to the complex superimposition of small-scale magnetic anomalies or to the sporadic distribution of unobserved regions. The number of data used in the calculation of average anomaly in each unit area of 0.25° × 0.25° amount to several hundreds near Japan, while only a few data are available in the Pacific Ocean far from Japan.

The marine data should reveal geomagnetic anomalies of smaller scales than the aeromagnetic survey can detect, so it is desirable to compare the past available marine data with satellite data. This short paper was written to describe an example of the utilization of marine geomagnetic data.
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