Origin of magnetic dipole anomaly on the Kurosegawa Tectonic Zone of Shikoku

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Several magnetic dipole anomalies have been recognized at Mt. Hanezuru in northern Shikoku and at Yaechi, Engyou-ji temple, and the Godan highlands along the Kurosegawa Tectonic Zone. We have determined the position and orientation of magnetic sources using a variety of depth-estimation methods. The results of magnetic depth estimation and 2-D forward model simulations show that (1) the distribution of eclogite facies rocks around Mt. Hanezuru is consistent with the location of the magnetic dipole anomaly, but that (2) it is difficult to explain the magnetic anomaly along the Kurosegawa Tectonic Zone based simply on the surface distribution of serpentinite. Deeper, broader magnetic roots appear necessary to build a model consistent with the magnetic data.

The identification of subducting seamounts and oceanic plateaus plays an important role in not only understanding the developmental process of great earthquakes in subduction zones but also in clarifying the evolutionary processes of island arc as a consequence of their subduction. Modern multi-channel seismic reflection/refraction technologies reveal that many seamounts and oceanic plateaus of various sizes are subducting beneath island arcs from the ocean trench and highlighted their important mechanical roles in producing great earthquakes. It is widely known that fragments of seamounts, reef limestone and island arc basalt exist in the collision zones of southwest Japan, namely the Shimanto and Chichibu belts. This is the result of ongoing subduction, scraping off, deformation and accretion. Geophysical data have produced a relatively detailed image of these bodies and deeper crustal structure. However, while gravity and geomagnetic data are of low resolution compared with seismic data, it is important for qualitative interpretation that they are not interpreted contradictorily.

Several magnetic dipole anomalies have been recognized at Mt. Hanezuru in northern Shikoku and at Yaechi, Engyou-ji temple, and the Godan highlands along the Kurosegawa Tectonic Zone. We have determined the position and orientation of magnetic sources using a variety of depth-estimation methods, namely the Werner, Euler and half-slope methods. The results of magnetic depth estimation and 2-D forward model simulations show that (1) the distribution of eclogite facies rocks around Mt. Hanezuru is consistent with the location of the magnetic dipole anomaly, but that (2) it is difficult to explain the magnetic anomaly along the Kurosegawa Tectonic Zone based simply on the surface distribution of serpentinite. Deeper, broader magnetic roots appear necessary to build a model consistent with the magnetic data.

Here we present a more extensive comparison of geological and geophysical data than has been made previously to elucidate the subduction history of the Philippine Sea plate beneath the Nankai Trough. The precise source and structure of gravity and magnetic anomalies are discussed in terms of kinematically interpreting variations in subduction style.