Tectonics in Taiwan (1): Constraints of observed data

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Taiwan is an island located between East China Sea and South China Sea. The Ryukyu arc-trench system lies east of Taiwan, and the Manira trench and Luzon arc lies south of Taiwan. Taiwan is considered to have been formed by collision tectonics between the Luzon arc and the East China Sea continental shelf. In the tectonics of Taiwan we should note that the descending direction of the oceanic slabs is reversed; the Philippine Sea plate is descending beneath the Eurasian plate in the east of Taiwan, and the South China Sea oceanic plate, which belongs to the Eurasian plate, subducts beneath the Philippine Sea plate in the south of Taiwan. It remains an unresolved problem what the geometry of the plates under Taiwan is, and how Taiwan has grown. As a preparation of solving the problem we examined various observed data concerning Taiwan as shown in the following.

[Topography and geological structure]

Geomorphological structure in Taiwan generally runs from north to south, and it is classified into Coastal Plain, Western Foothills, Central Range, Longitudinal Valley, and Coastal Range in order from west to east. Coastal Plain consists of undeformed sediments. Western Foothills are hilly districts, which are uplifted by reversal faults. Central Range, which runs in the eastern part of Taiwan, is steep mountain ranges with many peaks higher than 3000 m above sea level. Longitudinal Valley, which is a straight valley, forms the boundary between Central Range and Coastal Range. Coastal Range is the northernmost part of the Luzon volcanic arc.

[Free-air gravity anomaly]

Free-air gravity anomalies have a clear positive correlation with topography, for example the value of them reaches +300 mgal at Central Range.

[Bouguer gravity anomaly]

A clear zone of negative Bouguer gravity anomaly up to -50 mgal runs through Western Foothills. The extension of this zone passes through the Ilan basin. No clear negative anomalies are found in Central Range, and Coastal range has positive anomalies over +50 mgal.

[Seismicity]

Deep seismic zones are observed in the southern and the northeastern parts of Taiwan. It is considered that the former corresponds to the descending slab of the South China Sea oceanic plate and the latter to that of the Philippine Sea plate. There are little deep seismicity (below 40 km) in the central part of Taiwan.

[GPS]

GPS observation revealed that Coastal Range and the Philippine Sea plate move almost uniformly and that Coastal Plain and the Eurasian plate also move almost uniformly. In brief, the relative velocity between the Eurasian and the Philippine Sea plates is consumed between Western Foothills and Longitudinal Valley.

[Uplift and erosion rates]

In the southernmost part of Taiwan and Central Range, uplift and denudation rates about 5 mm/yr has been reported from the heights of Holocene marine terraces, sediment deliverly rates, and fission track geochronology.

[Heat flow]

Taiwan has few volcanoes, but extraordinary high heat flow values (over 400 mW/m2) have been observed in Central Range. This extraordinary high heat flow can be explained by the process of uplift and erosion of the crust with 5 mm/yr during several Ma. Heat flow in Western Foothills and Coastal Plain is 50 - 100 mW/m2.

[Plate motion]

The present motion of the Philippine Sea plate relative to the Eurasian plate is about 70 mm/yr in the northwest direction. On the basis of the compiled geomagnetic data, plate motion has not been changed at least recent 15 Ma. The extension of South China Sea had been finished before 15 Ma.

Takada et al. (this meeting) have constructed an analog model with plasticine, and have succeeded in explaining uniformly various observed data stated above. This model would give the best framework about the tectonics in Taiwan.