Simplified motion model and simulation of oblique plate-slab subduction (2): Application to Nankai trough and Kinki district

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1. Introduction

The Southwest Japan arc is very different from other arcs of Japanese Islands (Chishima, Northeast Japan, Izu-Ogasawara and Ryukyu) in distributions of topography, Quaternary volcanoes, hypocenters and others. And, the characteristics of the Southwest Japan arc change east to west (Chubu, Kinki and Chugoku-Shikoku Zones). The subduction of the Philippine Sea (PHS) plate-slab which is probably the major cause of the characteristics of Kinki Zone has been studied using the simplified method (Shigeno, 2008b).

2. Characteristics of Kinki Zone

Kinki Zone in this abstract is roughly defined with the two parallel lines of NW-SE direction. The east and west lines run from the Tsuruga-wan (bay) - Ise-wan - Tenryu-kaiteikoku (submarine canyon), and the east sea area to Oki (islands) - Tottori City - Shionomisaki-kaiteikoku, respectively.

Structural characteristics of Kinki Zone are (1) distributions of subsided areas (Wakasa-wan, Biwa-ko, Ise-wan, Kumano basin among others) at the east part of the zone (associated with negative Bouguer gravity anomalies suggesting to be a graben zone), and (2) various active fault distributions (similar to Chubu Zone; highest density in Japanese islands), among others.

Thermal characteristics of Kinki Zone are (3) rare distributions of the Quaternary volcanoes, except basaltic monogenetic volcanoes (older than ca 200 ka) along coast of the Sea of Japan, but (4) distributions of high-temperature (higher than 90 deg C) hot springs (Arima and Yunomine; so-called non-volcanic) on a NW-SE line at the west part of the zone, among others.

Kinki Zone is also characterized by the two sets of hypocenter distributions. (5) One corresponds to the subducting Pacific plate-slab (beneath Izu-Ogasawara arc), and its deepest part (ca 450 km depth) is uniquely distributed in NW-SE trend just under the zone. (6) The other corresponds to the subducting PHS plate-slab, which is distributed through the southern part of the Southwest Japan arc (shallower than ca 50 km depth) but bent and shifted to SE direction at Kinki Zone, and the deepest group of the hypocenters (50-75 km depth) is concentrated at the southwest part of Kinki Zone.

3. Modeling, simulation, and discussion

Simplified modeling and numerical simulation method (Shigeno, 2008a) has been applied to the distributions of the slabs of the two plates. The above (6) slab-hypocenter distribution of the PHS plate could be explained by a dip angle change to ca 45 deg from the middle of the slab subducting from the southeast direction (ca 4 cm/year since ca 6 Ma) due to the oblique collision of the PHS plate to the Southwest Japan arc. The cause of this large dip-angle increase and segmentation of the slab has been estimated to be up-flowing of high-temperature material (low density causing negative buoyancy) from the deep mantle produced by the above (5) deep slab subduction of the Pacific plate.

This model of deep environment is concordant to the above (1) formation of a graben zone (a new backarc basin?) at the east part, and the (4) high-temperature anomaly at the west part of Kinki Zone. However, the problems to be solved for the distribution of thermal anomaly remain, including magma-deep fluids generation and up-flowing caused by the subduction of the fairly young and warm PHS plate-slab at the depth, and hydrology controlled regionally and locally by faults and fractures at shallow levels where meteoric water circulation is dominant.

References

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