Gravitational rise off Cape Shionomisaki and great earthquakes along the Nankai Trough

Ryo Honda[1]; Yoshiteru Kono[2]

[1] Natural Sci. and Tec., Kanazawa Univ.; [2] nashi

The Nankai Trough is one of the most seismically active zones in the Japanese Islands. The trench-type great earthquakes have been recurrently occurring approximately every 100 years. It has long been believed that trench-type great earthquakes in the Nankai Trough generally rupture at each segment. We report about a distinct gravity feature observed off Cape Shionomisaki, which is considered to be one of the boundaries of the rupture segments proposed by Ando, M. (Tectonophysics, 27, 119-140, 1975), and discuss the relationship between the great earthquakes along the Nankai Trough. Due to dense land gravity measurement points, it is quite clear that the gravity anomalies over the Kii Peninsula become higher southward to Cape Shionomisaki. There is a high gravity anomaly of 150 mGal over Cape Shionomisaki and immediately offshore the Cape. There seems to be a regional gravity rise, which includes the southern part of the Kii Peninsula and the Off Cape Shionomisaki High Gravity Anomaly. However, the detail is not clear due to sparse distribution of marine gravity measurement points. Though there are not enough gravity measurement points, high gravity anomalies clearly appear off Cape Shionomisaki. Amplitude of the gravity anomalies is about 80 mGal, and an approximate diameter of distribution of the high anomaly is about 40 km. Center of the anomaly is 30 km south from Cape Shionomisaki. Here we assumed a Bouguer density as 2,670 kg/m^3. There is no drastic change in distribution pattern of the Bouguer anomalies by changing this assumption, since ocean bottom topography is so flat. Water depth in this region is about 2,000 m and rather flat except the Shionomisaki Canyon. From the topographic point of view, there are no distinct surface features corresponding to this high anomaly. Epicenters of the 1944 Tonankai (M7.9) and 1946 Nankai (M8) earthquakes locate around this gravitational rise. Taking into account of available information, such as recent seismic refraction survey (Kodaira, S., J.-O. Park, Y. Kaneda, and T. Iwasaki, 62-63, abstracts for 11th International Symposium on Deep Structure of the Continents and their Margins, 2004), multi-channel structure, density, and geology, the cause of gravitational rise seems to acidic rocks, which have intruded into shallow crust. This implies that the block is presumably not a seamount. Generally, seismicity is not active around Cape Shionomisaki. Particularly within the block region, the seismicity is very low. It seems only few small earthquakes are occurring at the bottom of the block. This suggests that the block is homogeneous. Slip distributions of the 1944 Tonankai and 1946 Nankai earthquakes were simulated from tsunami analyses (Tanioka, Y. and K. Satake, Geophys. Res. Lett., 28, 1075-1078, 2001; Baba, T., Y., Tanioka, P. R. Cummins, and K. Uhira, Phys. Earth Planet Inter., 132, 59-73, 2002). The estimated slip under the present block is very small in the 1944 Tonankai earthquake, while it is large in the 1946 Nankai earthquake. There are various discussions on the role of obstacles such as buried seamounts with initiation of great earthquakes (e.g., Ruff, L. J., Pure Appl. Geophys., 129, 263-282, 1989; Cools, M., Geology, 20, 601-604, 1992; McCaffrey, R., J. Geophys. Res., 98, 11953-11966, 1993; Scholz, C. H. and Small, C., Geology, 25, 478-490, 1997). The present block might be a key to understand the rupture patterns of the recurrent great earthquakes along the Nankai Trough. By carrying out more detailed and various geophysical observations in this area, more accurate distribution of the block and also precise plate boundary conditions may be revealed, which would resolve the role of the newly found block to the occurrence of great earthquakes around the Nankai Trough.