

Source processes of 2004 off Kii Peninsula, Japan, earthquakes determined by far field body wave analysis

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On September 5, 2004, two great earthquakes with magnitudes of about 7.3 occurred beneath the Nankai Trough, off Kii-Peninsula, Japan, where the Philippine Sea plate begins to subduct beneath the Eurasian plate. The focal depths and focal mechanisms suggest that they are not the interplate earthquakes but are the intraplate ones. The Nankai Trough is one of the major convergent margins where great, disastrous interplate thrusting earthquakes are known to have occurred repeatedly: e.g., the 1854 (M8.4) and the 1944 (M8.0) Tonankai earthquakes (Ando 1977). However, there are no known large intraplate earthquakes at the area beneath the trough. Therefore, these great intraplate earthquakes and the associated seismic activities give an very unique opportunity to study the stress state and the tectonics of the area.

In this paper, we determined the source locations, the focal mechanisms (moment tensors) and the source time functions by analysing the far-field, broadband body P-waveforms from four largest earthquakes occurred during the activity. In particular, we focus our attention to the location (horizontal distance from the trough and the depth) of the seismic source. Because the earthquakes occurred beneath the deep trench system, large effect of the laterally irregular structure on the P-waveforms are expected. Thus we used a very efficient finite-difference method to compute the synthetic waveforms incorporating the structural effects.

Our analysis shows that the depth of the first event is relatively deep, but the main seismic-moment of the second (largest) event released at very shallow portion of the oceanic lithosphere (around 13.5km from ocean surface). It also have a small initial rupture with a strike slip mechanism although a reverse fault mechanism dominates the entire rupture process. The two aftershocks are also very shallow. All mechanisms of these events have approximately horizontal, north-south trending P-axis. These results suggest that virtually all the lithosphere is in a stress state with horizontal (north-south) compression.