Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)
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SSS31-17 Room:302 Time:May 22 10:00-10:15

Spatiotemporal relation of inland earthquakes in southwest Japan to interplate earthquakes along the Nankai trough

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There are many inland active faults in and around the Kinki region. The earthquakes on the faults are mainly generated by the E-W compression caused by the relative motion between North American and Eurasian plates (Sagiya, 2004). However, because inland earthquakes increases in the period from 50 years before to 10 years after the occurrence of great interplate earthquakes along the Nankai trough (Utsu, 1974; Hori & Oike, 1996), earthquake generations on inland faults are affected by the interplate earthquakes. We have evaluated stress change on many inland faults in this region. Our result predicts reverse faulting increases before interplate earthquakes along the trough, and strike-slip faulting increases after the interplate earthquakes. In this presentation we examine the validity of the prediction by spatiotemporal pattern of historical earthquakes.

In the computation we obtained quasi-static viscoelastic slip response functions in an elastic-viscoelastic stratified medium by Fukahata & Matsu'ura (2006). We employed plate interface of Philippine Sea plate subduction by Hashimoto et al. (2004). Amount of slip is set by Time or Slip Predictable models (Shimazaki & Nakata, 1980). The relative motion is after Heki & Miyazaki (2001). The compressive strain rate due to EW compression is 0.3×10^{-7} (yr^{-1}) with the direction of N100E. The geometries of inland faults are after HERP.

The results already presented are summarized as follows. The E-W compression is the primary cause of the long-term stress changes in this region, and forms general trend of strike of inland faults. The elastic changes in Coulomb Failure Function (dCFF) due to interplate earthquakes are mostly negative on reverse faults and mostly positive on strike-slip faults. This is because this region dragged to the SSE direction due to interplate earthquakes. As a result, dCFF are negative on N-S trending reverse faults and positive on NW-SE trending left-lateral and NE-SW trending right-lateral strike-slip faults. The calculated dCFF on source faults of 9 historical inland earthquakes at last 500 years are consistent with the historical records, because dCFF are the highest-ever at the occurrence in most cases. The computed dCFF on 73 inland faults are consistent with the historical earthquake pattern, presented in the first paragraph. These results suggest the inland reverse faulting increases before interplate earthquakes, whereas strike-slip faulting increases after interplate earthquakes. Recently, this relation is obtained in the seismic observation in the northern Tohoku region before and after the 2011 great Tohoku-oki earthquake (Asano et al., 2011).

Focal mechanism of inland earthquakes corresponds to the fault mechanism in and around the Kinki region, as a reflection of the local stress fields (Townend & Zoback, 2006; Terakawa & Matsu'ura, 2010). That is, there occur reverse earthquakes in the SW Chubu and central Kinki regions, and strike-slip earthquakes in the western Chubu and NW Kinki regions, corresponding to the fault mechanism. Conversely, mechanisms of inland earthquakes in a certain region can be roughly assumed by fault mechanisms. With our prediction, we can expect the inland earthquakes increases in the reverse fault region before interplate earthquakes, whereas the inland earthquakes increase in the strike-slip fault region after interplate earthquakes.

Based on the concept, we examined the spatiotemporal pattern of inland earthquakes. The expectation is notably consistent with the earthquake occurrence in the reverse fault region. On the other hand, in the strike-slip fault region, consistency of expectation is good in the western Chubu region (occurrence rate increases after interplate earthquakes) and not good in the NW Kinki region (occurrence rate increases before interplate earthquakes). As a whole, our result for inland earthquake occurrence is supported by the spatiotemporal pattern of historical inland earthquakes.

Keywords: subduction zone, the Kinki region, interplate earthquake along the Nankai trough, Coulomb failure function, historical earthquake, inland earthquake