Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

SSS31-06 Room:502 Time:April 30 15:30-15:45

Strain concentration zone recognized from GNSS data in the San-in region

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Introduction

In the San-in region, southwest Japan, there were many large earthquakes including the 1943 M7.2 Tottori and the 2000 M7.3 Western Tottori prefecture earthquakes in the shallow crust. It is well-known that an active zone of microseismicity exists parallel to the coastline of Sea of Japan. On the other hand, recent geodetic data acquired by the GEONET (GNSS Earth Observation Network) suggest that a rate of contemporary deformation is small in the Chugoku district including the San-in region (e.g., Sagiya *et al.*, 2000). We study a detailed pattern of crustal deformation using the GEONET data to clarify a relation between contemporary deformation and microseismicity.

Method

We used daily coordinates of the GEONET GNSS stations published by the Geospatial Information Authority of Japan (F3 solution). We fit a function of linear, annual, and semi-annual components to time-series of site coordinates relative to site 950462 (Fukue) to estimate secular site velocities. We also estimate strain distribution at grid points (Shen *et al.*, 1996) and in Delaunay triangles using the site velocities.

Result

We identify a concentration zone of deformation corresponding to the active zone of microseismicity in an eastern part of the San-in region during April 2005 and December 2009. Distribution of maximum shear strain rate shows that an eastern inland part of the Chugoku district has the lowest strain rate (10^{-8} yr^{-1}) in the Japanese Islands and that the high strain rate (10^{-7} yr^{-1}) is distributed in a band along the coast of Sea of Japan. High strain rate is also observed in a vicinity of the source area of the 2000 Western Tottori prefecture earthquake, which suggests postseismic deformation of the 2000 earthquake is still continuing.

Velocity profile across the active zone of microseismicity shows a velocity component parallel to the active zone (N80^{o}E) has an offset of 2 mm/yr in and around the active zone. Movements across the offset suggest a right-lateral strike slip, which is consistent with a typical focal mechanism of shallow crustal earthquakes in the zone. The 2011 Tohoku-oki earthquake affects crustal deformation in the San-in region. In a postseismic period from January 2012 to December 2013, the strain rate in the San-in region became twice as large as that before 2011.

The deformation can be roughly explained by a right-lateral block motion across the active zone of microseismicity. The used GNSS network is too sparse to estimate a locking depth of a fault between the blocks. A dense GPS array is necessary for more detailed analysis.

Concluding remarks

Analysis of the GEONET data identifies a strain concentration zone corresponding to the active zone of microseismicity along the coast of Sea of Japan in an eastern part of the San-in region. This zone with a width of ˜10 km accommodates right-lateral strike-slip movement of 2 mm/yr, which is concordant with a focal mechanism of shallow earthquakes. The observed strain rate doubled after the 2011 Tohoku-oki earthquake. More detailed distribution of deformation in the strain concentration zone is important to clarify the deformation mechanism. We need to study with both observation and model calculation.

Reference

Sagiya *et al*., PAGEOPH, 147, 2303-2322, 2000
Shen *et al.*, JGR, 101(B12), 27957-27980, 1996

Keywords: Crustal deformation, Strain concentration zone, GNSS, the San-in region