Recent crustal deformation and comparison among geodetic, seismological, and geological strain rate in the San-in shear zone

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Introduction

We reported that an analysis of the GEONET (GNSS Earth Observation NETwork system) data operated by the Geospatial Information Authority of Japan revealed a strain concentration zone from an eastern part of Shimane Prefecture to Tottori Prefecture in the San-in area (hereafter the San-in shear zone) and that a new dense GNSS array was constructed to clarify a detailed spatial pattern of deformation in the San-in shear zone in the past JpGU meetings. Here, we report recent crustal deformation in the San-in shear zone and comparison of strain rate estimated from geodetic, seismological, and geological data with a different time-scale in and around the shear zone.

Recent crustal deformation in the San-in shear zone

The deformation in the San-in shear zone is characterized by right-lateral strike slip movements in an E-W oriented shear zone along the coast of the Japan Sea. The deformation rate across the shear zone is approximately 4 mm/yr during 2005-2009. The shear zone almost overlaps with the San-in seismic zone. The recent velocity field including the velocities at the new GNSS stations during 2013-2015 suggests that the deformation pattern does not change significantly but that the deformation rate increases to be about 6 mm/yr. The rate increase is possibly caused by postseismic deformation of the Tohoku-oki earthquake. Because not only the broad long-wavelength increase but also that localized in the shear zone is observed, the increase may include a response of the shear zone to the external stress changes due to the postseismic deformation.

Comparison among geodetic, seismological, and geological strain rates

Geodetic strain rate is larger than geological strain rate by an order of magnitude in the Japanese Islands. The Chugoku region including the San'in region is far from subduction zones and has a relatively small strain rate. In order to compare strain rates using different time-scales and methods in such a small strain-rate region, we estimated regional strain rates in the Chugoku region. We divided a region ranging in N34.7°-35.7° and E133.2°-134.8° into 2 by 2 sub-regions and estimated strain rate of each sub-region with geodetic, seismological, and geological methods. The result suggests that the geodetic strain rate is larger than the seismological one by an order of magnitude and is larger than the geological one by two orders of magnitude in all sub-regions except for that including the Yamasaki fault. The strain rates from three methods are in the same order of magnitude in the sub-region including the Yamasaki fault. The difference of the strain rates implies that the present-day strain rate in the San'in region is much faster than the average one in the geological time-scale and that a large part of the geodetic strain rate is inelastic and aseismic deformation.

Keywords: Strain concentration zone, GNSS, San-in region

