Inelastic strain rate and deviatoric stress field of the seismic gap in west part of Kyushu, Japan, estimated from seismic and geodetic data

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An earthquake is a phenomenon that differential stress loading on the Earth’ s crust is released. Thus, we need to know state of stress in the crust to understand the earthquake generation mechanism. The state in the crust has been investigated in many studies, based on data of the focal mechanisms and seismic moment tensors (e.g., Michael 1984; Horiuchi et al. 1995; Terakawa & Matsu’ ura 2008). However, information on the stress fields in non-active seismic areas is insufficient because accurate stress estimation requires the data from a number of earthquakes. A key factor for acquiring knowledge of the stress field in an aseismic zone is the inelastic strain, which is related to the deviatoric stress based on the flow rule in plasticity theory (Matsumoto 2016). Thus, the strain rate due to inelastic deformation source needs to be separated from the total strain rate measured via geodetic observation. Here, we propose a new method for estimation of the deviatoric stress field through inelastic strain analysis that combines the seismic moment tensor and geodetic data. In this method, the deformation source of inelastic strain in the upper crust is estimated from short wavelength component of the observed total strain rate field, and the inelastic source tensor yields tensor shape of deviatoric stress field based on the flow rule. This method is applied to data for a region in and around the aseismic zone of Amakusa located at west part of Kyushu Island, Japan. It was found that the inelastic deformation in the seismic gap exhibits either normal-fault or strike-slip type. Furthermore, the deviatoric stress field estimated from the inelastic deformation has same trend as the surroundings. In addition, the estimated stress explained slip vectors of event rarely occurring there. These results might provide us with important information regarding the origin of the seismic gap and stress concentration on the surrounding fault.

