Relationship between the spatiotemporal change of the inelastic strain rate and the state of stress in the aftershock area of the 2016 Kumamoto earthquake sequence

*Ayaho Mitsuoka[1], Satoshi Matsumoto[2], Azusa Shito[2], Hiroshi Shimizu[2], Group for urgent joint seismic observation of the 2016 Kumamoto earthquake

1. Department of Earth and Planetary Sciences, Graduate School of Science, Kyushu University, 2. Institute of Seismology and Volcanology, Faculty of Science, Kyushu University

In order to understand state of stress and strength in the crust, inelastic strain and its rate is a key factor because of contributing stress relaxation. The inelastic deformation in the crust proceeds after a large earthquake occurrence, resulting change in stress field.

In this study, we investigated the spatiotemporal change in the inelastic strain due to seismic activity of the aftershock of the 2016 Kumamoto earthquake sequence, central Kyushu, Japan. The 2016 Kumamoto earthquake sequence occurred at Hinagu and Futagawa fault zones in Kumamoto prefecture, central Kyushu Island, Japan. The activity of the aftershock events of this sequence is high at the hanging-wall side rather than at the foot-wall side. These focal mechanism solutions indicate mostly either the right lateral strike-slip or normal fault types.

We estimated the inelastic strain in a spatial bin using the relationship between the moment tensor density and the inelastic strain tensor [Noda and Matsu’ura, 2010] at several lapse time windows, and calculated the inelastic strain rate with the time length of each time window. In addition, we estimated the stress field before the sequence using seismic moment tensor data and calculated the co-seismic stress change based on co-seismic rupture model [Asano and Iwata, 2016].

In the hypocentral area of the 2016 Kumamoto earthquake sequence, the inelastic strain tensors are more similar to them of the stress field than the co-seismic stress change tensors. Therefore, we could conclude the inelastic strain increased with the stress change having similar tensor to the regional stress condition. In the temporal change in the inelastic strain rate, we obtained that the inelastic strain rate around the faults of the two large earthquakes [Mitsuoka et al., 2019, JpGU Meeting 2019] more rapidly decreased than that at the southern region of the Hinagu fault.

Calculating the tensor product (dT; [Terakawa, 2017]) between the stress field before the present sequence and the co-seismic stress change tensor, we found that the region with the positive dT is correspond to the region showing fast decline in the inelastic strain rate. The positive dT value means that the co-seismic stress change strengthens the magnitude of the stress loaded on the region. This relationship implies there is potential for modeling the temporal change in the strain rate after a large earthquake, if the relationship between the pre-earthquake stress field and the stress change is known. Moreover we discuss the relationships between the inelastic strain rate and the other parameters.

Keywords: inelastic strain rate, stress field, 2016 Kumamoto earthquake sequence

