ニュージーランド・2016 年カイコウラ地震による応力の時空間変化
Spaciotemporal Stress Change during the 2016 Mw 7.8 Kaikoura earthquake, New Zealand

佐藤 将[1]、*岡田 知己[1]、飯尾 能久[2]、松本 聡[3]、Bannister Stephen[4]、Ristau John[4]、大見 士朗[2]、三浦 勉[2]、Pettinga Jarg[5]、Ghisetti Francesca[6]、Sibson Richard[7]
Tadashi Sato[1], *Tomomi Okada[1], Yoshihisa Iio[2], Satoshi Matsumoto[3], Stephen Bannister[4], John Ristau[4], Shiro Ohmi[2], Tsutomu Miura[2], Jarg Pettinga[5], Francesca Ghisetti[6], Richard H. Sibson[7]

1. 東北大学大学院理学研究科附属地震・噴火予知研究観測センター、2. 京都大学防災研究所、3. 九州大学大学院理学研究科、4. GNS Science, New Zealand、5. University of Canterbury, New Zealand、6. Terra Geologica, New Zealand、7. University of Otago, New Zealand
1. Research Center for Prediction of Earthquakes and Volcanic Eruptions, Graduate School of Science, Tohoku University, 2. Disaster Prevention Research Institute, Kyoto University, 3. Faculty of Science, Kyushu University, 4. GNS Science, New Zealand, 5. University of Canterbury, New Zealand, 6. Terra Geologica, New Zealand, 7. University of Otago, New Zealand

New Zealand lies across the Pacific-Australia plate boundary. The northern South Island overlies a transition between subduction beneath the Hikurangi margin and dextral transpression along the Alpine fault. On November 13, 2016, the Mw 7.8 Kaikoura earthquake occurred near the east coast of the northern South Island. Ten or more faults with various geometries ruptured in a mixture of strike-slip and reverse-slip. Stress orientation and magnitude are critical to understanding this complex multiple rupture.

In this study, we determined stress tensors before and after the Kaikoura earthquake using data collected by our own temporary seismic stations (deployed more than 2 years prior to the earthquake), which recorded the earthquake and aftershocks, as well as using data recorded by the New Zealand GeoNet seismometers. We derived focal mechanisms using HASH (Hardebeck, 2002), supplementing those mechanisms with CMT solutions derived by GeoNet. The full time period covered by our analysis is from Apr. 1, 2014 to Jun. 30, 2017. We subsequently used SATSI (Hardebeck and Michael, 2006) for stress tensor inversion. To divide the focal mechanisms to form an adequate number of clusters, we used the k-means method based on hypocenter location. The number of clusters was determined by the elbow method and silhouette methods. We merged the data before and after the mainshock into one dataset and applied the k-means method, obtaining 6 clusters. Of those, 3 clusters had enough earthquakes to allow comparisons to be made before and after the mainshock.

Before the main shock, horizontal maximum compressional axis is oriented at c. 120˚, consistent with previous studies (e.g., Sibson et al., 2012; Townend et al., 2012). For the southern and central clusters, stress tensors before and after the mainshock did not change significantly. This has the implication that for this area the change in differential stress accompanying the mainshock was probably small compared with the prefailure differential stress. For the northern cluster, the axis of horizontal maximum compression seemed to rotate anticlockwise implying that there, the change in stress was probably comparable to the prefailure differential stress.