ニュージーランド南島北部における、2016年Mw 7.8 Kaikoura 地震前後での発震機構解の応力テンソルインバージョンを用いた、広域応力場の変化

Spatiotemporal distribution of regional stress field associated with the 2016 Mw 7.8 Kaikoura earthquake estimated by stress tensor inversion of focal mechanisms in the northern South Island, New Zealand

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The northern South Island and the southernmost North Island of New Zealand occupy the transition region between subduction and transform tectonics along the Pacific-Australia plate boundary, with the Pacific plate subducting beneath the Australian plate obliquely from the northeast. Active seismicity in the northern South Island results from a combination of subduction and transform tectonics. An Mw 7.8 earthquake involving a combination of reverse and mostly dextral strike-slip faulting occurred in the Kaikoura region of northern South Island at 11:02.56 am (UT) on 14 November 2016. In this study, we estimated the spatio-temporal variation of the crustal stress field by stress tensor inversion using focal mechanisms obtained from micro- to moderate-sized earthquakes.
We analyzed the data acquired by a dense seismic array which has been recording over 2 years from 1 April 2013 to April 2015. We determined focal mechanisms using the HASH program (Hardebeck, 2002; 2003) and estimated the spatiotemporal variation of the crustal stress field using SATSI algorithm (Hardebeck and Michael, 2006). During that time period, there were two major seismic clusters; the first, consisting of aftershocks of the 1990 Lake Tennyson earthquake, occurred in the center of the northern South Island, while the second, consisting of aftershocks of the 2013 Cook Strait earthquakes, occurred in the northeast of the northern South Island. For shallow earthquakes, strike-slip type focal mechanisms were dominant. P axes were oriented ~N120E, similar to that found in previous studies (Reyners et al., 1997; Balfour et al., 2005; Sibson et al., 2011; Townend et al., 2012). T axes were oriented NE-SW. For intermediate-deep earthquake, normal, strike-slip, and reverse faulting seems to be mixed. Most of the P axes were oriented NE-SW, which is also consistent with previous studies (Reyners et al., 1997; Townend et al., 2012).
Next, we conducted stress tensor inversion using SATSI algorithm by dividing the earthquakes into three groups; 0-27km depth, 27-40km depth and deeper than 40km. On the 0-27km depth, the σ_1 axis was oriented ~N120E with high accuracy, while for earthquakes deeper than 40km, the σ_1 axis was oriented

˜N60E with high accuracy. Therefore the shallow crustal stress orientation differed from the deep orientation which corresponds to the condition within the subducting Pacific plate.
For the 2016 Kaikoura earthquake, we also used the GeoNet CMTs in the period of approximately three months from 14 November 2016 to 31 January 2017 to estimate the regional postseismic stress field using the SATSI algorithm. The GeoNet CMTs show, that most of the events were shallower than 30 km, with event depths increasing northeast from the mainshock hypocenter. There have been almost three major clusters: the first (the C cluster) is almost in the center of the aftershock area, the second (the NE cluster) is northeastern margin of the aftershock area, and the third (the SW cluster) is around the main shock hypocenter. P axes were oriented to E-W in the NE cluster, while oriented to N120E in the C and SW clusters. T axes were oriented to N-S in the NE cluster and oriented to NE-SW in the C and SW clusters.
We conducted stress tensor inversion using the SATSI algorithm for the events in the 0-27km depth The σ_1 axis was oriented E-W in the NE cluster while σ_1 axes were oriented N120E in the C and SW clusters. We compare the stress tensor solutions before and after the Kaikoura earthquake, The orientations of σ_1 axes are similar, but the 95 % confidence range became wider. This reflects a decrease in the magnitude of σ_1 because of the earthquake, with it becoming closer to the magnitude of σ_2.

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