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Seismic anisotropy in the crust may be caused by stress that aligns microcracks, strain that aligns minerals or structural effects. Recently both anisotropic and isotropic velocity changes have been determined after large earthquakes, and are often considered to be related to cracks that heal with time. In 2016, large earthquakes in Japan (April, Kumamoto, Kyushu) and in New Zealand (November, Kaikoura) caused widespread disruption, and also produced data with which to test some of these theories. Here we use shear wave splitting to study the seismic anisotropy before and after the 2016 Kumamoto and the Kaikoura earthquakes to study the phenomena.

In Kyushu, measurements from NIED stations between 2004-2012 yielded fast anisotropic directions that align well on average with the maximum horizontal stress from focal mechanism inversions and the maximum horizontal strain rate as measured by the GNSS system. We measured shear wave splitting on these same stations during 2016 to determine whether shear wave splitting changed over time after the Kumamoto earthquake. A few stations yielded different fast directions or increases in delay times. We are checking whether those changes are due to structural changes or can be explained by changing earthquake locations.

In New Zealand, we have measured shear wave splitting and Vp/Vs ratios on permanent stations near the Kaikoura earthquake rupture region between 2013 and 2018. Some stations exhibit apparent changes in fast direction, but spatial averaging does not yield strong changes in fast directions with time. Delay times and Vp/Vs ratios both increased after the M=6.5 and M=6.6 Cook Strait earthquakes and after the M=7.8 Kaikoura earthquake. After the Cook Strait earthquakes, measurements returned to background levels within several months. But by the end of 2017 the measurements had not yet returned to normal. Laboratory measurements suggest that crack healing should yield more rapid recovery, and we are exploring whether aftershocks help to keep the cracks open.

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