S-wave reflectors and aftershock activity in the 2016 Kaikoura, New Zealand earthquake hypocentral area

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Geometries of the fault plane of an earthquake and S wave reflectors beneath the fault provide important information for considering earthquake genesis at the fault. Especially, fluid distribution inferred from S wave reflectors around an earthquake fault could play an important role for initiation of the earthquake rupture as a mechanism for reducing fault strength. The location and geometry of the reflector can be determined from the travel time of the reflected phases. For detecting the reflections, we need to observe at stations located close to the hypocenter, so that there is a sufficient phase separation between the direct S wave and the reflected phases. In this study, we attempted to detect reflected waves in observed seismograms at seismic stations in and around the 2016 Kaikoura, New Zealand earthquake (Mw7.6). Seismic records were obtained from the permanent GeoNet stations as well as from seismic stations deployed before the Kaikoura earthquake in the northern South Island. We applied reflection seismology techniques to the data obtained by the network. We detected several reflectors in the mid and lower crust from the sections. Strong reflected phases were observed at the southern edge of the focal area (from a reflector with depth about 20 km). Weak reflectors were detected in/beneath the aftershock area (in the mid- to lower-crust). Comparing aftershock distribution obtained from the dense seismic network data, the geometrical relation to the reflectors suggests initiation of the earthquake occurred where fluids were present.

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