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Rheological structure around the focal area of the 2008 Iwate-Miyagi Inland Earthquake estimated by GPS time series

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The focal area of the 2008 Iwate-Miyagi Inland earthquake (IMEQ, Mj7.2) is located in Ou backbone Range, where the Volcanic front extends along northeastern Japan. Owing to the preexisting dense permanent GPS network and temporal observation sites, which were deployed immediately after the earthquake, we detected prominent postseismic deformation around the focal area.
GPS coordinate time series obtained around the focal area include coseismic step and transient postseismic deformation signal superimposed on the linear trends and annual variations. For the postseismic deformation, there are two major causes; afterslip on the earthquake fault and/or its surrounding area, and viscoelastic relaxation in the lower crust or upper mantle. Using three months GPS data after IMEQ, Iinuma et al. [2009] reported that the afterslip lasted almost two weeks. The aseismic slips were estimated on the shallower part of the earthquake fault and the Dedana fault, which is located at 20 km northeast away from the epicenter and was not displaced coseismically.
It is known that the viscoelastic deformation can last for a few to decades of years, much longer than afterslip. Therefore, we try to explain the longer GPS data (for one year after IMEQ) considering both mechanisms of the afterslip and the viscoelastic relaxation. We assume the postseismic deformation is represented by superposition of these two effects. For the data fitting, a logarithmic function proposed by Scholz [1990] for the afterslip, and viscoelastic response (e.g. Pollitz et al., 1997; Wang et al., 2006) are adopted. Since the viscoelastic deformation is controlled by the thickness of the uppermost elastic layer and viscosity of its underlying layer, we can estimate the rheological structure around the focal area. Previous seismological studies pointed out the existence of the low anomaly in seismic velocity beneath the upper crust [e.g., Hasegawa et al. 2005], and detailed heterogeneous structure [e.g., Okada et al., 2008]. By referring to those results with our geodetic study, we discuss the rheological structure around the focal area.

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