

Petrological crustal structure model of the northeast Honshu arc, Japan

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After the 2011 Tohoku-Oki M9 earthquake, numerous crustal earthquakes occurred beneath the northeast Honshu arc. However, crustal earthquakes following the 2011 Tohoku-Oki M9 earthquake is not homogeneously distributed throughout the northeast Honshu arc. For example, seismicity rate increase around Iwaki after the 2011 Tohoku-Oki M9 earthquake, and the 11 April 2011 M_j=7.0 Iwaki earthquake, which is one of the biggest crustal earthquakes, produced over 10km of normal faulting along Shionodaira fault in the Abukuma metamorphic belt. The 2011 Tohoku-Oki M9 earthquake induces large stress over a very broad region of northeast Honshu arc, and the relaxation of this stress causes prolonged crustal deformation far away from the rupture zone of the 2011 Tohoku-Oki M9 earthquake.

Because mineral chemistry and rock composition are important factors to control rheological strength of the arc crust, inhomogeneous distribution of the crustal earthquakes is expected to reflect deep crustal inhomogeneity. Our previous study of petrological crustal structure model of the northeast Honshu arc showed that; (1) the high-V_p and V_s regions beneath the To-bishima Basin consist of hornblende-pyroxene gabbro, (2) hornblende gabbro is a predominant rock type beneath the Dewa Hills and Ou Backbone Range, (3) the low-velocity anomalies beneath the active volcano areas may be caused by the existence of partial melts of hornblende gabbro, and (4) the low-V_p and high-V_s regions beneath the Kitakami Mountains consist of quartz-plagioclase-bearing rocks. The study demonstrated that the heterogeneity of seismic velocity in the lower crust of the northeast Japan arc reflects variations in rock composition and temperature that are related to the regional geological history. Thus, we propose to build a new petrological crustal structure model across the northeast Honshu arc from Japan trench to Japan Sea. In order to evaluate the postseismic crustal deformation of the arc in terms of stress relaxation of the arc crust and mantle, it is necessary to estimate the deep crustal viscosity of the northeast Honshu arc.

Keywords: crust, elastic wave velocity, seismic velocity, Tohoku, island arc