

Effect of crustal partial melting on tectonics of Japan Arc: Case study in the Niigata-Kobe Tectonic Zone (NKTZ)

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Niigata-Kobe Tectonic Zone (NKTZ) is the most conspicuous tectonically active area inside the Japan arc (Sagiya et al., 2000). Large crustal deformation at NKTZ has been interpreted due to the plastic deformation of hydrated lower crust (e.g., Iio et al, 2002). We have reexamined crustal structure of this area based on seismic tomography (Nakajima & Hasegawa, 2007) and reinterpreted the crustal velocity structure based on thermal model and melting phase diagrams on crustal rocks.

In order to interpret observed low velocity in the lower crust by hydration, presence of 1~5 vol% of fluid is necessary in the grain boundary of rocks. This automatically indicates that the lower crust is under "water saturated condition". Solidus temperatures of rocks at 7-10 kbar under water saturated conditions are: granite: ~600°C, andesite & greywacke: ~650°C, basaltic rock: ~700°C, respectively). Accordingly, lower crust beneath NKTZ should be partially melted if temperature reached more than 700°C in the lower crust.

Lateral variation of the cutoff depth of shallow earthquakes has been compiled beneath the Japan Islands (Omuralieva et al., 2012). Because this depth corresponds with brittle/ductile transition which is sensitive with temperature, the lateral variation should correspond with lateral variation in crustal geotherm. The cutoff depth beneath NKTZ is similar to those beneath volcanic chain in Tohoku Japan where temperature at Moho is estimated to be higher than 800°C (Takahashi, 1978; Nishimoto et al, 2008). Accordingly, we propose that most part of the lower crust beneath NKTZ is partially molten even in the area away from Quaternary volcanoes.

Large effect of partial melting in the lower crust on the tectonics of Japan Arc has been recognized beneath volcanic belt (e.g., Hasegawa et al., 2005). We propose that crustal partial melting is taking place in much broader area than previously thought and they may have large effect on crustal deformation such as in NKTZ. In addition, presence of LF earthquakes in volcanic and non-volcanic area may be explained by the presence of wet partial melt in the lower crust in a coherent manner.

Keywords: crustal partial melting , tectonics, Niigata-Kobe Tectonic Zone