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Spatiotemporal variation of crustal deformation in northeast Japan estimated from GPS data

Kazuhiro Ozawa[1*], Takeshi Sagiya[1]

[1]Nagoya University

Crustal deformation along the plate subduction zone contains both of the long-term intraplate deformation and the short-term elastic deformation caused by plate interactions on the plate boundary surface. To separate these two contributions and presume both quantitatively are necessary for understanding the deformation physics along the plate subduction zone. It has been clarified that intermittent slip phenomena are generated on the plate boundary surface during interseismic period, for example the slow slip event and the low frequency tremor (e.g. Obara et al., 2002; Ozawa et al., 2002). Thus, it has to be considered for understanding quantitatively how strains are accumulated in seismic cycle to estimate the temporal variation of interplate locking after the separation of two deformation signals mentioned above.

In northeast Japan, the 1993 Hokkaido Nansei-oki (M7.8), 1994 Sanriku-oki (M7.6), and 2003 Tokachi-oki (M8.0) earthquakes have occurred since nineties, when the nationwide continuous GPS observation network was installed. Coseismic and postseismic deformations are observed at these GPS sites (e.g. Nishimura et al., 2004; Ozawa et al., 2007). We focus on time variations of interplate locking, which is like stress accumulation -> coseismic slip -> postseismic slip -> locking recovery -> stress accumulation. On the other hand, Kimura and Kusumoto (1997) suggested that the Chishima forearc region along the Chishima Trench behaves like a block and it migrates to westward with respect to Japan arc. It implied the possibility of intraplate deformation in upper plate along the Chishima Trench.

We analyze the crustal deformation in northeast Japan using block fault model to estimate contributions of the intraplate deformation and plate interaction, quantitatively. We use the dairy coordinate solution (F3) of nationwide continuous GPS network from 1996 to 2010 operated by the Geospatial Information Authority of Japan. We divided whole coordinate data into every two years, and then estimated the average displacement rate at each period. We used the block fault model developed by McCaffrey (2002) in our analysis. Using this model, we simultaneously estimated the rigid rotation of the Chishima forearc and the contributions of the plate interaction along the Chishima-Japan Trench and the eastern margin of the Sea of Japan. In our presentation, we show the temporal variation of interplate locking distribution and discuss how interplate locking is recovered after earthquake occurred.

Keywords: GPS, block fault model, interplate earthquake, after slip, fault healing, Northeast Japan