Geophysical Research Abstracts
Vol. 21, EGU2019-11660-2, 2019
EGU General Assembly 2019
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Quantifying the crustal deformation across the active fault in the southern part of the Sendai Plain, fore-arc region of the Northeast Japan arc

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The Northeast Japan (NEJ) arc had experienced strong extension in associated with Japan sea opening in Early to Middle Miocene (25 - 13 Ma). After ∼10 Myr of tectonic quiescence, positive tectonic inversion has occurred and the NEJ arc has experienced contractive deformation since 3.5 Ma. In our previous our study (Okada and Ikeda, 2012, J. Geophys. Res., doi:10.1029/2011jb008355), strong extension (Maximum ∼56 km) and the shortening (10-15 km) were estimated along the back-arc region by area-balancing restoration based on the seismic reflection, gravity and surface geological data. And, we suggested that these deformations were resulted from faulting in the gently east-dipping detachment fault at a mid-crustal depth. Also, in the fore-arc region, some of the normal faults which are originally generated in Miocene age reactivated as a reverse fault under the compressional stress regime since Pliocene (e.g. Western Boundary Fault Zone of the Kitakami Lowland; Nagamachi-Rifu Fault Zone). The amount of extension (∼5 km) and shortening (∼ 1 km) in the fore-arc region were smaller than that in the back-arc region, which is directly revealed only in the existing study (Kato et al., 2006, J of Struct. Geol., vol. 28, pp. 2011-2022) across the Western Boundary Fault Zone of the Kitakami Lowland, Northern part of the NEJ fore-arc region. To compere the amount of crustal deformations along the NEJ arc (between northern part and southern part of the NEJ arc), we calculated the extension in Miocene and shortening since Pliocene around the Sendai Plain, southern part of NEJ fore-arc region. At the start, we estimated the amount of deformations across the active fault of the southern part of the Sendai Plain. This area is near the junction of the Nagamachi-Rifu Fault Zone in north and the Futaba Fault Zone in south. We found north-south trend concealed active fault about 3-4 km away from the Futaba geological fault to the east, by using seismic reflection survey and gravity survey. Considering with another deep seismic profile conducted in the south of our survey, deeper extension of this concealed active fault seems to be converged with the deeper extension of the Futaba geological fault that is originally formed with left lateral slip in Cretaceous and activated with normal faulting in Miocene. The deeper part of the Futaba fault reactivated as a reverse fault (with left lateral slip) since Pliocene. On the other hand, the shallower part migrated from the normal fault to the east and forming the subparallel concealed active fault that we revealed. The estimation of the crustal deformations plays important role in considering subduction tectonics and also in considering the process of the strain build and release across the island arc.