

東北日本弧不均質粘性構造を考慮した東北沖地震の2次元余効変動解析 Viscous relaxation after the Tohoku Oki Earthquake by heterogeneous rheological structure of the NE Japan

武藤 潤^{1*}, 芝崎 文一郎², 大園 真子³, 矢部 康男⁴, 伊藤 喜宏⁴, 飯沼 卓史⁵, 松本 拓己⁶, 岡田 知己⁴

Jun Muto^{1*}, Bunichiro Shibazaki², Mako Ohzono³, Yasuo Yabe⁴, Yoshihiro Ito⁴, Takeshi Iinuma⁵, Takumi Matsumoto⁶, Tomomi Okada⁴

¹ 東北大学大学院理学研究科地学専攻, ² 建築研究所国際地震工学センター, ³ 北海道大学大学院理学研究院附属地震火山研究観測センター, ⁴ 東北大学大学院理学研究科附属地震・噴火予知研究観測センター, ⁵ 東北大学災害科学国際研究所, ⁶ 防災科学技術研究所

¹Dept. Earth Sci., Tohoku University, ²International Institute of Seismology and Earthquake Engineering, Building Research Institute, ³Institute of Seismology and Volcanology, Graduate School of Science, Hokkaido University, ⁴Research Center for Prediction of Earthquakes and Volcanic Eruptions, Tohoku University, ⁵International Research Institute of Disaster Science, Tohoku University, ⁶National Institute for Earth science and Disaster Prevention

Deployment of dense network of geodetic observations has illuminated the heterogeneous crustal deformation associated with the Mw 9.0 2011 Tohoku Oki earthquake. Ohzono et al. (2012) showed the heterogeneity of coseismic strain fields likely reflecting heterogeneity in rheological (viscoelastic) properties of the NE Japan lithosphere (Yabe et al., in prep). Moreover, viscoelastic relaxation after the earthquake that lasts longer than other mechanisms (e.g., afterslip and poro-elastic rebound) has also known to be affected by viscosity structures of the island arc-trench system such as elastic thickness variation, spatial and depth-dependent viscosity. Therefore, the viscosity structure of the NE Japan trench-arc system must be estimated in order to evaluate the viscous relaxation component accurately in the observed post-seismic deformation field. To this end, two-dimensional viscosity profiles of the northeastern (NE) Japan island arc-trench system were created using laboratory derived constitutive laws of various minerals. The calculated profiles based on temperature, pressure and water contents dependent rock rheology predict viscosities of the mantle wedge and oceanic mantle to be 10^{19} Pa s and 10^{20} Pa s, respectively. These values agree well with the recent estimate of the viscosities after the post-seismic deformation of the 2004 Sumatra earthquake (Mw 9.2). This indicates that the steady-state flow laws of rocks can be used to infer post seismic deformation field. However, our calculations reveal significant lateral variations in viscosities across the northeastern Japan arc: thick, high viscous lithosphere in the colder forearc and thin and low viscous lithosphere in the hotter volcanic front. Preliminary two-dimensional finite element modeling (FEM) on post-seismic deformation of the Tohoku Oki earthquake revealed that the incorporation of the lithosphere structures have significant effects to the stress relaxation process compared with widely used uniform layered model. In the presentation, we will furthermore examine stress relaxation process of the lithosphere from FEM modeling taking into account of temperature- and depth-dependent heterogeneous rheology.

References: [1] Muto, J. (2011) *Tectonophysics*, 503, 201-206. [2] Ohzono, M., Y. Yabe, T. Iinuma, Y. Ohta, S. Miura, K. Tachibana, T. Sato, and T. Demachi (2012) *Earth Planets Space*, 64, 1231-1238.

キーワード: 余効変動, 粘性緩和, 地殻マントルレオロジー, 東北地方太平洋沖地震, 東北日本, 島弧-海溝系

Keywords: Post-seismic deformation, Viscous relaxation, Rheology of crust and mantle, Tohoku Oki Earthquake, Northeastern Japan, Arc-trench system