Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SSS31-P29 Room:Convention Hall Time:May 21 18:15-19:30

Revisit of dynamic critical taper theory for the Japan trench from the topographic point of view

Hiroaki Koge[1*], Shuichi Kodaira[2], Toshiya Fujiwara[2], Tomoyuki Sasaki[3], Yohei Hamada[4], Mari Hamahashi[1], Jun Kameda[1], Gaku Kimura[1]

[1]Department of Earth and Planetary Science of the Graduate School of Science, The University of Tokyo, [2]Institute for Research on Earth Evolution Japan Agency for Marine-Earth Science and Technology, [3]Ocean Engineering & Development Corporation, [4]Japan Agency for Marine-Earth Science and Technology, [5]Atomosphere and Ocean Research Institute, The University of Tokyo

The March 11, 2011 Tohoku-oki earthquake (Mw9.0) is supposed to have fault rupture extending to the shallow part of subduction zone at the Japan Trench. Various inversion analyses by using, for example, geodetic, teleseismic body waves, strong ground motion or tsunami waveform, show large displacement near the trench axis.Moreover, bathymetric comparison between before and after the earthquake clearly demonstrated that the seafloor on outermost landward slope moved ˜50 m east-southeastward to the trench and uplifted ˜7 to 10 m. Although the mechanism of such fault rupture is not clear, revisiting the structure, deformation and friction properties at the base of the forearc will be key to elucidate this important issue.

Based on bathymetric and seismic reflection data (e.g., angle of slope, dip angle of the subducting plate) and physical states of the wedge and plate boundary (e.g., normal stress, fluid pressure, shear stress and coefficient of friction), Kimura et al. (2012) suggested that middle slope and lower slope of the Japan Trench is in a critical state. Dynamic Critical taper theory proposed by Wang and Hu (2006) improved the Mohr?Coulomb theory to show how stress state changes in terms of seismic cycle. Although the shape of the wedge in the Japan trench is consistent with this theory, stress transition in the shallow region of the trench should be reconsidered.

Because of along-trench variability in the bathymetry and the direction of plate convergence, it is very useful to reconsider relation of taper angle and the friction of the plate boundary at several profiles along the Japan Trench.

In this study, based on Kimura et al. (2012), we used a bathymetric data taken before the Tohoku-oki earthquake and re-examined the relationship between the taper angle and friction of plate boundary in shallow part of the Japan Trench. First, we divided the trench into three segments from south to north, and chose five seismic survey lines from each area, focusing on a specific range from the trench to the splay fault (˜ 20km). By applying the Critical taper theory to the individual cross-section, and based on the assumption that splay fault behaves as a backstop, we discuss stress balance between the interior and base of the wedge, fluid pressure ratio, and effective friction coefficient of the plate boundary.Dip angle of the subducting plate is obtained from images by seismic reflectance surveys, and by studying a broad range in the Japan Trench, we determine the deformation process in the shallow part of the trench.

References

Fujiwara, T. et al. The 2011 Tohoku-Oki earthquake: Displacement reaching the trench axis. Science Vol. 334,1240(2011)

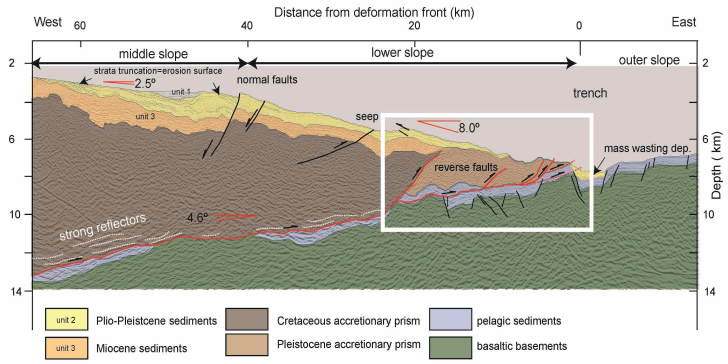
Kodaira, S et al. Coseismic fault rupture at the trench axis during the 2011 Tohoku-oki earthquake. Nature Geoscience 5, 646?650 (2012)

Kimura, G et al. Runaway slip to the trench due to rupture of highly pressurized megathrust beneath the middle trench slope: The tsunamigenesis of the 2011 Tohoku earthquake off the east coast of northern Japan, Earth and Planetary Science Letters, 339-340, 32-45. (2012)

Ito, Y et al. Frontal wedge deformation near the source region of the 2011 Tohoku-Oki earthquake, Geophysical Research Letters 38(15): L00G05.(2011)

Keywords: critical taper, slope, the Japan trench

SSS31-P29 Room:Convention Hall Time:May 21 18:15-19:30



Sesimic profile along MY 102 modified from Tsuji et al. (2011).