



Geophysical evidence of trench-breaching slip along megathrust plate interface in the Japan Trench

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Repeated bathymetry and seismic surveys along a profile in the central part of the rupture of the 2011 Tohoku-oki earthquake show that a co-seismic fault reaches the trench axis, forming a deformed sediment mass seaward of the frontal prism above a graben, probably due to large trench-ward movement of the hanging wall block. If the seismic structures we observed in the trench axis represent a structural proxy showing trench-breaching slip, it can be possible by using seismic data, to map an area where co-seismic slip reaches the trench axis. In order to test this hypothesis, we have started a high-resolution seismic imaging project along the entire Japan Trench axis, and the survey has been completed from 38 N to 40 N by the summer of 2013. Based on preliminary results from the survey, we found along the trench axis continuation of key structures which consist of a small-scale fold-and-thrust zone at the trench axis and seismically transparent zone at the landward, except 39.5 N to 40 N where extremely thin incoming sediments are observed due to rough geometry of the top of the igneous crust. Those structures are interpreted to be formed by overprinting “basal friction-driven thrust fault” and “gravity-driven normal fault” that alternatively occurred during an earthquake cycle with slip to the trench. Although we believe that the high-resolution seismic data have a potential to define the spatial distribution of slips to the trench, those data do not yield any information about temporal variations of the slip. In order to examine the temporal variation of slip to the trench, we will therefore integrate the seismic images with geological studies, such as piston-coring. Furthermore, in order to know even longer records of earthquake slips and evidences of seismic fault motions (i.e. high velocity slip) along megathrust interface at the trench axis, we proposed a new ocean drilling project, called JTRACK, which consists of along-and-across trench axis drilling transect in the Japan Trench.