Solid Earth Physics Seminar, Harvard University

Monday, 27 March 2017, 2:00 pm
Faculty Lounge, Hoffman Laboratory, 20 Oxford Street

JFAST Project - Drilling to the Fault Zone of the 2011 Tohoku-oki Earthquake

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Abstract:

The 2011 Tohoku-oki earthquake (Mw9.0) produced the largest fault slip ever recorded for an earthquake, more than 50 meters on the shallow portion of the subduction megathrust. This region of the plate boundary was thought to be an area of aseismic slip, so the huge co-seismic displacements that caused the devastating tsunami were a shocking surprise to the seismological community. In response to the earthquake, IODP Expedition 343 (JFAST) was designed to investigate the physical conditions and rupture mechanisms that produced the large slip, using seafloor boreholes drilled to the plate boundary decollement. During April/May and July 2012, three boreholes located at a site close to the Japan Trench about 90 km east of earthquake epicenter, successfully reached the plate boundary fault at depths of about 820 meters below seafloor. These boreholes enabled geophysical logging, core sampling and temperature observations in the vicinity of the fault zone.

Analyses of core samples obtained from the plate boundary decollement show a narrow zone (less than 5 meters) of highly deformed fabric in a clay layer (Chester et al., 2013). Estimates of the level of dynamic friction during the recent earthquake were obtained from both laboratory experiments on the fault zone material (Ujiie et al., 2013) and from the temperature monitoring (Fulton et al., 2013). The two independent measurements show that the shear stress during the earthquake rupture was about 0.6 MPa. This shear stress corresponds to a coefficient of friction of about 0.08 to 0.1. This very low level of dynamic friction during the earthquake helps to explain the mechanism for the huge fault displacement.