

実験によって明らかになった日本海溝プレート境界断層物質の地震時すべり挙動 Laboratory experiments on the Japan Trench plate-boundary thrust material reveal very low co-seismic shear strength

氏家 恒太郎^{1*}, 田中英恵¹, 斎藤 翼¹, 堤 昭人², James J. Mori², 亀田 純³, Frederick M. Chester⁴, 江口暢久⁵, Sean Toczko⁵, IODP 第 343 次研究航海乗船研究者⁵

Kohtaro Ujiie^{1*}, Hanae Tanaka¹, Tsubasa Saito¹, Akito Tsutsumi², James J. Mori², Jun Kmeda³, Frederick M. Chester⁴, Nobuhisa Eguchi⁵, Sean Toczko⁵, Expedition 343 scientists⁵

¹ 筑波大学, ² 京都大学, ³ 東京大学, ⁴ テキサス A&M 大学, ⁵ 海洋研究開発機構

¹University of Tsukuba, ²Kyoto University, ³University of Tokyo, ⁴Texas A&M University, ⁵JAMSTEC

Widely accepted conceptual models of a seismogenic subduction zone held that shallow portions of plate-boundary thrusts slip aseismically. However, the 2011 Tohoku-oki earthquake (Mw9.0) produced unexpectedly large seismic slip of >50 m near the Japan Trench with a resultant devastating tsunami. The Integrated Ocean Drilling Program (IODP) Expedition 343, Japan Trench Fast Drilling Project (JFAST) provided an invaluable opportunity to answer why the very large slip occurred on the shallow plate-boundary thrust during the 2011 Tohoku-oki earthquake. JFAST drilled several boreholes to the plate-boundary thrust at Site C0019, located at the toe of the frontal prism near the Japan Trench. The drilling results clarified that plate-boundary faulting in this region is highly localized in pelagic clay. In order to explain the huge shallow slip, we conducted high-velocity (1.3 m/s) friction experiments on samples retrieved from the plate-boundary thrust at Site C0019 under wet conditions. The results show rapid slip weakening properties with very low peak and steady-state shear strength. The effective friction coefficient during the steady-state condition was less than 0.1, representing one of the lowest values ever measured for fault zone rocks. The low dynamic shear strength can be attributed to the abundance of smectite and thermal pressurization effects, which can enhance earthquake rupture propagation from deep depths without much resistance. This behavior may be characteristic of plate-boundary thrusts formed within smectite-rich pelagic sediments and can provide an explanation for the huge shallow slip that occurred during the 2011 earthquake.

キーワード: 東北地方太平洋沖地震調査掘削, プレート境界断層, スメクタイト, 摩擦発熱による流体圧上昇
Keywords: Japan Trench Fast Drilling Project, plate-boundary deollement, smectite, thermal pressurization