

The JFAST Fault Zone Observatory: Monitoring the frictional heat from the 2011 Tohoku Earthquake

Patrick Fulton^{1*}, Emly Brodsky¹, KANO Yasuyuki², MORI James Jiro², CHESTER Fred³, KYO Masanori⁴, NAMBA Yasuhiro⁴, EGUCHI Nobuhisa⁴, TOCZKO Sean⁴, ITO Yoshihiro⁵, IODP Expedition 343 Scientists⁶

¹University of California, Santa Cruz, ²DPRI, Kyoto University, ³Texas A&M, ⁴CDEX, JAMSTEC, ⁵Tohoku University, ⁶IODP

The 2011 Tohoku Earthquake presented unique circumstances that permitted access to a fault that recently slipped tens of meters and installation of a seafloor observatory for time-sensitive temperature measurements of the frictional heat signal. These data provide insight into the stress level on the megathrust fault during slip and are crucial for building a full physical model of the earthquake cycle and characterizing tsunami hazard. The observatory consists of 55 autonomous titanium-encased temperature sensors/dataloggers (10 also measure pressure) attached to a rope and hung within 830 m of steel tubing below a seafloor wellhead. The observatory was successfully installed as part of the IODP Japan Trench Fast Drilling Project (JFAST) on 16 July, 2012 in the extreme water depth of 6910 meters, making it the deepest ocean observatory of any kind. It is estimated to intersect that plate boundary fault zone at ~809 mbsf. Sensor spacing varies from 1.5 m near the fault zone to larger intervals to characterize the background geothermal gradient. Data from the observatory is only accessible by retrieving the sensor rope. At the time of this writing, in mid-February 2013, recovery of the sensors and data is currently being attempted with the Kaiko7000II ROV. Preliminary temperature data acquired during drilling reveal very low heat flow at the site. The JFAST expedition and observatory highlights important advances in rapid response drilling capabilities and seafloor monitoring in extreme water depths and fault zones. It is expected to help provide insight into the cause of the extreme slip of the Tohoku Earthquake that contributed to such a large tsunami.

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