Geophysical Research Abstracts
Vol. 14, EGU2012-4208, 2012
EGU General Assembly 2012

Reactivated inland normal faults due to the 2011 Mw=9.0 Tohoku, Japan, earthquake

S. Toda (1), H. Tsutsumi (2), N. Sugito (3), and H. Yasuda (2)

(1) Disaster Prevention Research Institute, Kyoto University, Japan, toda@rcep.dpri.kyoto-u.ac.jp, (2) Faculty of Science, Kyoto University, Japan, (3) Earthquake and Volcano Research Center, Nagoya University, Japan

The devastating 11 March 2011 Mw 9.0 earthquake ruptured a 500-km-long and 200-km-wide plate interface between the overlying North American plate and subducting Pacific plate along the Tohoku coast of northeast Japan. Because of its large source area and huge amount of slip up to 50 m, the earthquake drastically changed the crustal stress state of northeast Japan and triggered widespread seismic activity as far as 450 km from the source area. There are several areas of heightened seismicity in Tohoku district where there were few earthquakes prior to the March event. Iwaki City at the southeast corner of Fukushima Prefecture is one of the areas with significantly elevated seismic activity after the March earthquake. The most striking characteristics of the seismicity in Iwaki area are that the majority of the earthquakes show normal faulting mechanisms with the T-axes trending E-W to NE-SW. This marks a significant contrast to an E-W compressional stress field of northeast Japan demonstrated by geodetic, seismological and geological data. Therefore, the E-W tensional stress regime is interpreted to be temporal due to coseismic and post-seismic eastward movement of northeast Japan arc. The largest normal faulting event of Mw 6.6 occurred on April 11 and ruptured two previously mapped faults, the NW-trending Yunodake fault and NNW-trending Itozawa fault. Clear surface ruptures $\sim$15 km long along the Yunodake fault and $\sim$15 km long along the Itozawa fault appeared during the earthquake. Seismological data and interviews to the local residents reveal that the two sub-parallel faults ruptured simultaneously. The surface ruptures exhibit predominantly normal sense of slip down to the west although the Yunodake fault has systematic left-lateral component of displacement less than 1/5 of the vertical component. The maximum vertical offset on the Yunodake fault is $\sim$80 cm whereas that on the Itozawa fault is $\sim$2 m. Coseismically exposed fault planes and fault outcrops reveal that both the Yunodake and Itozawa faults dip steeply to the west. The surface trace of the Itozawa fault is in part marked by west (upslope) facing scarps suggesting repeated normal-sense of slip on the fault. The Yunodake fault also has a Neogene-Quaternary sedimentary basin on the hanging wall side of the fault. We thus interpret that the April 11 earthquake was caused by reactivation of two sub-parallel normal faults related to transient extensional stress due to the March 11 mega-thrust earthquake. If this were the case, paleoseismic trenching across the Yunodake and Itozawa faults would reveal paleoseismic history of not only these faults but also the plate interface that ruptured during the devastating event. Our first paleoseismic trench across the Itozawa fault exposed evidence for the penultimate event occurred sometime between 17 ka and 13 ka. No evidence associated with the 869 Jogan earthquake, inferred to be the previous M$\sim$9 megathrust event, was recovered from the trench walls.