Geophysical Research Abstracts
Vol. 12, EGU2010-10198, 2010
EGU General Assembly 2010

Megasplay fault and forearc deformation in Ryukyu subduction zone

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Great earthquakes associated with the deep crustal structures in Ryukyu subduction zone are poorly known. However, a subduction earthquake in 1771 generated a great tsunami, struck south Ryukyu islands and killed ∼12000 people. The mechanism for the great earthquake is still enigmatic. Here we show a megasplay fault system existing along the south Ryukyu forearc. Analyses of deep multi-channel seismic reflection profiles indicate that the megasplay fault system is rising from the summit of a ∼1 km high ridge situated at a ∼5° landward dipping plate interface. The fault system is very active in terms of widespread normal faults and warping in the inner wedge. The along-trench length of the megasplay fault system is estimated to be ∼450 km. In addition, the forearc has been uplifted and displayed extensively normal faults. The origin of this south Ryukyu megasplay fault system is probably due to the subduction of elevated ridges parallel to the fracture zones. In contrast, no similar splay fault is found in the west of 125.5°E where the oblique subduction has produced shear zones along the south Ryukyu forearc. We infer that the megasplay fault system is responsible for the 1771 south Ryukyu tsunami. Likewise, after a quiescence of ∼240 years, a future great earthquake and tsunami is anticipated in the south Ryukyu forearc.