



The PALET project: Paleoseismology, paleotsunamis and uplift rates of NE Japan and their relationship to the earthquake cycle.

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The French-Japanese PALET project (ANR-JST Flash program) aims to constrain the seismic cycle and long-term faulting behaviour of the NE Japan subduction zone. The project is three fold:

I – The study of marine terraces, benches and notches along the 500 km long coastline affected by the 2011 Mw 9.0 Tohoku-oki earthquake. They indicate that uplift affects the coastline since the Mid Pleistocene. Marine terraces covering the past 124-780 ka indicate uplift rates of 0.2-0.4 mm/a and 0.1-0.2 mm/a in the northern (41.2-39.5°N) and southern (39.5-38.3°N) study area, respectively. Emerged Holocene benches and notches reveal an uplift of ~ 1.0 mm/a in northern Tohoku which denotes clear upheaval acceleration during the Late Quaternary. An elastic dislocation model reveals the pattern of vertical deformation during the co- and interseismic period. The distribution of lower uplift rates in the southern area coincides with the region of the strongest onshore coseismic subsidence during the 2011 earthquake (up to 1.2 m). All observations attest for a segmentation of the subduction zone with M9-class earthquakes on the southern segment.

II - The palaeotsunami record is well documented in the southern part of the 2011 seismic source area (e.g. Sawai et al., 2008), and in this study we focus on six locations along the northern part of the 2011 rupture. Samples are extracted in several-meter-deep sections using coring and Geoslicer techniques. Surrounded by organic rich material, the tsunami layers appear as cm-dm thick light sandy layers including mud clasts and shells. The shared ¹⁴C time ranges of tsunami inundations reveal seven well-preserved palaeotsunami horizons at the six sites during the past 6 ka, which infers a recurrence interval of 500-700 years for extremely large tsunamis.

III - The Tohoku-oki earthquake significantly impacted the stress regime within the crust (Toda et al., 2011) and resulted in reactivated onshore faulting. The 11 April 2011 Mw 6.6 Iwaki earthquake that generated up to 2.1 m normal faulting scarp along the 15-km long rupture of the subvertical Itozawa fault. Two palaeoseismic trenches revealed that a penultimate earthquake occurred between historical times and ~26 ka at the northern part of the Itozawa fault, and sometime between 12.6 and 17.4 ka at its the southern part. Hence, the recent activity of the Itozawa fault may be entirely controlled by large to giant earthquakes along the Japan Trench. However it may not be reactivated during every M9-class earthquake.

The first results of the PALET project emphasize the investigation of the long-term active tectonics in the Tohoku-oki earthquake area. The timing of past M9-class earthquakes and their impact on the Honshu Island unveiled not yet addressed seismic hazard issues. However, the combined analysis of data from (palaeo-) geodetic, palaeotsunami, and palaeoseismic investigations enables a better understanding of the earthquake cycle on the Japan subduction zone.