

Past slip to the trench recorded in Central America and its global significance

*Paola Vannucchi¹, Elena Spagnuolo², Kohtaro Ujiie³, Akito Tsutsumi⁴, Stefano Aretusini², Yuka Namiki⁴, Giulio di Toro⁵

1.Royal Holloway University of London, 2.INGV, 3.Tsukuba University, 4.Kyoto University, 5.Manchester University

The 2011 Tohoku Earthquake revealed that co-seismic displacement along the plate boundary megathrust can propagate to the sea floor. Co-seismic slip to the trench amplifies hazards at subduction zones and its potential occurrence should be investigated globally also addressing past events. A geologic record of past slip to the trench is preserved offshore SE Costa Rica, where an old, < 1.9 Ma, frontal megathrust detached along biogenic oozes. Low- to high-friction experiments (slip-rates of $10 \mu\text{ms}^{-1}$ to 1ms^{-1} and normal stresses up to 5 MPa) were performed on sediments representing the megathrust's hangingwall, the biogenic oozes, and its footwall, silty clays, to investigate the velocity dependence of friction and the micromechanical foundation of strain localization within the frontal megathrust. Both silty clays and biogenic oozes are velocity-weakening at low $\sim 1 \text{cm/s}$ and high velocity $\sim 1 \text{m/s}$, with the silty clays much weaker than the oozes at low velocity, and similarly weak at high velocity. So, while the silty clays form weak layers at both low and high velocities, especially when in the presence of water, the biogenic oozes only become as weak as silty clays at higher velocity. The implication is that the geological structures found in the forearc to offshore SE Costa Rica were formed by high velocity slip-to-the-trench events, because during aseismic creep, deformation should have always localized in the silty-clays, and not in the oozes as seen in the drilled hole.

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