Slow Slip Events and Nonvolcanic tremor in the Mexican Subduction Zone

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Last decade was remarkably fruitful in discovering new seismotectonic phenomena: Slow Slip Events (SSE) and Nonvolcanic Tremor (NVT) in different active plate boundaries, particularly in subduction zones. Pioneering studies of SSE (*Dragert et al*., 2001) and NVT (*Obara*, 2002) awaken a concentrated quest in seismology and geodesy for the SSE and NVT detection and localization technique (*Schwartz and Rokosky,* 2007), space-time distribution and relation between SSE and NVT, physical explanation of the both and their importance for the earthquake hazard mitigation (e.g., *Beroza and Ide,* 2009).

Several large SSE (1998, 2001-2002, 2006, 2009-2010) of the equivalent seismic magnitude Mw~7.5 have been detected and studied in the Mexican subduction zone using GPS records (Figure 1). Since 2005, when continuous seismic data became available the NVT studies started in Mexico, a strong modulation of the tremor activity by the SSE was determined (*Payero et al.,* 2008, *Kostoglodov et al.,* 2010).

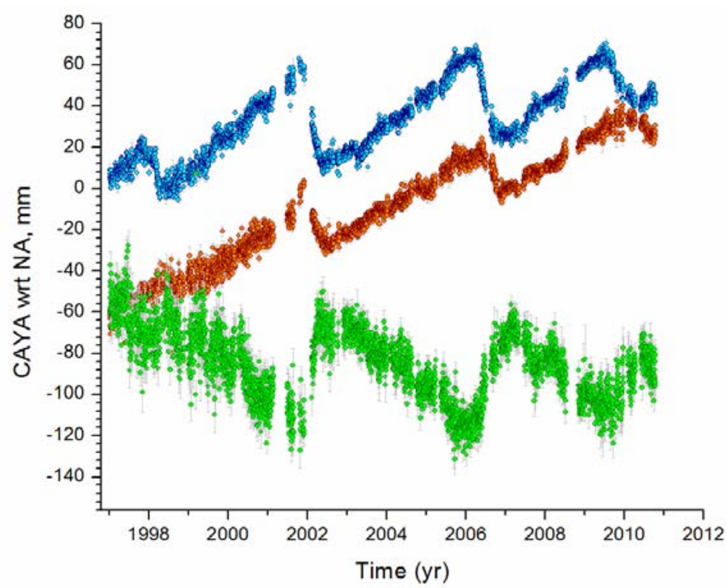

Figure 1. Time series (with respect to the fixed North America) at the Cayaco permanent GPS station, located on the Pacific coast of Mexico, ~60 km NW from Acapulco City. Several large anomalous surface displacements can be observed, which correspond to the 1998, 2001-2002, 2006, and 2009-2010 SSE. Upper curve is NS component, EW component is in the middle, and the bottom curve is the vertical component. Secular compression occurs in the direction of the plate convergence, and the long-term subsidence of the coast is about 2 mm/vr.

Detailed analysis of the NVT epicenters distribution (2005-2007, MASE project) and modeling of the 2006 SSE in Mexico show that the NVT bursts with a duration of a few weeks occur periodically every 3-4 months without clear GPS indication of large concurrent slow events. These NVT were localized over the plate interface in a band of 170-240 km from the trench, further than the SSE dislocation area (80-170 km). Then the 2006 SSE excited several repeated strong episodes of tremor which extended trenchward and partly populated downdip portion of the SSE zone (Figure 2).

We observed also a fixed spot along the plate interface, ~210 km from the trench, over which the tremor occurs almost continuously. This “sweet spot” of NVT surprisingly well coincides with the maximum of modeled metamorphic dehydration of the subducted oceanic plate crust (*Manea et al.,* 2004).

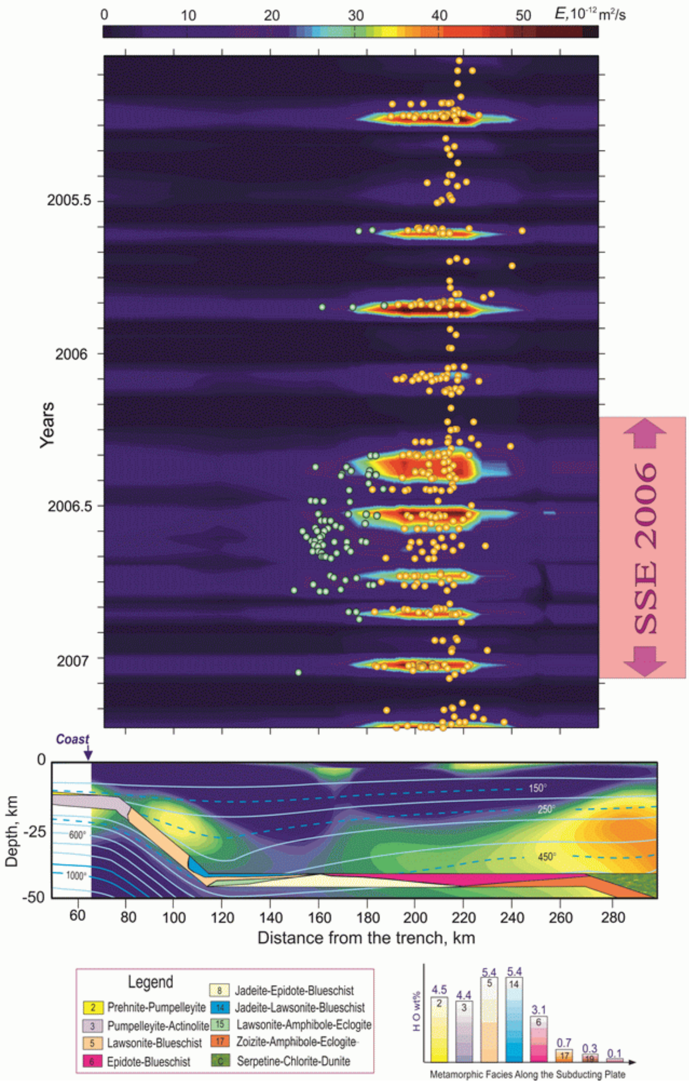

Figure 2. The NVT energy and epicenter locations. In the top panel the background color is the NVT seismic energy measured at the surface. The dots are the epicenters of the NVT from the inversion. The green dots are the trenchward, updip, low energy epicenters. The y-axis is the time and the x-axis is distance from the trench. The cross-section of the crust and slab in the lower panel (profile MASE) aligns with distance from the trench (x-axis) in order to demonstrate the details from the phase transitions in the slab [*Manea et al.*, 2004] and the conductivity measured in the crust [*Jödicke et al.*, 2006]. Blue in the background image of cross-section represents high resistivity and low conductivity, and red is the opposite. Temperature contours from *Manea et al.* [2004] are also shown in the cross-section. The legend at the bottom details the metamorphic phase transitions as noted in the different colors within the slab in the cross-section. The numbers listed within the bars in the bar graph note the phase transition in the legend. Numbers above the bars are the maximum wt per cent H_2O, which can be released by the metamorphic dehydration.

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