Earthquake Swarms and Slow Slip on a Sliver Fault in the Mexico Subduction Zone

S.L. Fasola, M.R. Brudzinski, S.G. Holtkamp, C. DeMets, E. Cabral-Cano, A. Arciniega-Ceballos

The Mexico subduction zone is an ideal location for studying subduction processes due to the shallow subduction angle and short trench-to-coast distances that bring broad portions of the seismogenic and transitional zones of the plate interface inland, in addition to its oblique convergence. A recently generated seismicity catalog from a local seismic network in Oaxaca revealed about 20 swarms of small (M<5) earthquakes from 2006-2012 with less than 50 earthquakes in each cluster mostly occurring over a few days. Swarms were identified by inspecting every burst of seismicity for 3 empirical traits of swarm sequences: no clear triggering mainshock, many events the near the maximum size, and a relatively constant seismicity rate throughout the sequence. In addition, we observed a new characteristic of SSEs where all of the 5 previously-detected SSEs in Oaxaca during our study showed a shift from trenchward motion towards an along-strike direction on coastal GPS sites. A majority of the swarms were found to correspond to the along-strike shift observed on coastal GPS sites. The swarms outline what appears to be a steeply dipping structure in the overriding plate, indicative of an origin other than the plate interface. This steeply dipping structure corresponds to the northern boundary of the Xolapa terrane based on aeromagnetic data and resistivity profiles. We propose that swarms and slow slip are occurring on a sliver fault that allows the oblique convergence to be partitioned into trench perpendicular motion on the subduction interface and trench parallel motion on the sliver fault (Fig. 1). The resistivity structure surrounding the sliver fault suggests that SSEs and swarms of small earthquakes occur due to high fluid content in the fault zone. We propose that the sliver fault provides a natural pathway for buoyant fluids attempting to migrate upward after being released from the downgoing plate. This creates drier conditions on the subduction interface trenchward of the sliver fault, promoting fast-slip seismogenic rupture behavior.

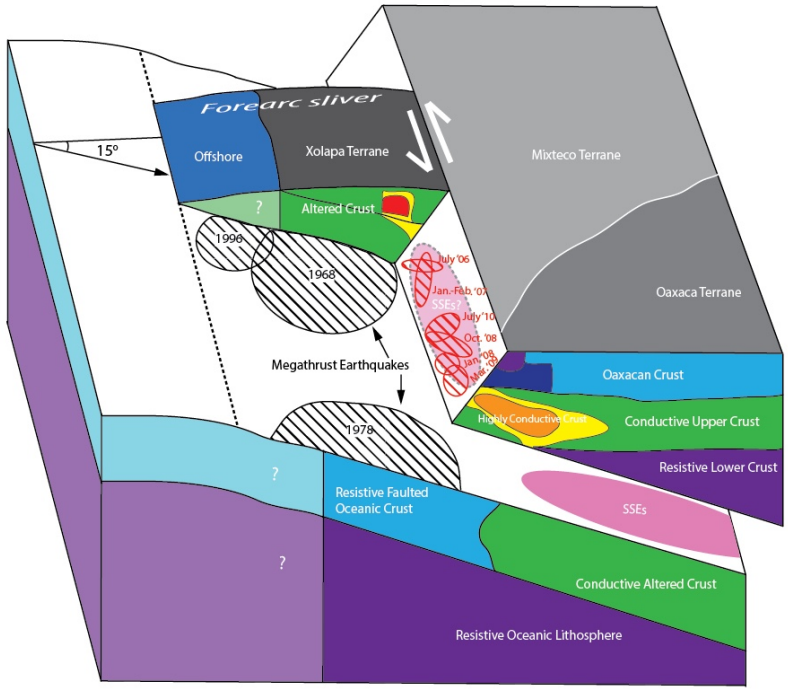

Figure 1. 3-D Diagram illustrating the occurrence of swarms (red circles) and slow slip episodes (SSEs, pink) on a forearc sliver fault at the northern boundary of the Xolapa terrane that allows the oblique convergence to be partitioned. The face of the diagram shows a simplified version of the resistivity model from Arzate-Flores et al. (2016).