Subducting Slab Ultra-Slow Velocity Layer Coincident with Silent Earthquakes in Southern Mexico

Teh-Ru Alex Song¹, Don V. Helmberger², Michael Brudzinski³, Rob Clayton¹, Paul Davis⁴, Xyoli Pérez-Campossi⁵, Shri.K. Singh⁶

¹Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, DC 20015.
²Seismological Laboratory, California Institute of Technology, Pasadena, CA 91125.
³Geology Department, Miami University, 114 Shideler Hall, Oxford, OH 45056.
⁴Department of Earth and Space Sciences, Center for Embedded Network Systems (CENS), University of California, Los Angeles, 595 Charles Young Drive East, Los Angeles, CA 90095-1567.
⁵Instituto de Geofísica, Universidad Nacional Autónoma de México, Circuito de la Investigación Científica sn, Ciudad Universitaria. 04510 México D.F.

1 Abstract
Great earthquakes occurring on the subduction zone interface are known to be spatially persistent in a few shallow dipping subduction zones, where the subducting and overriding plate are strongly locked in the shallow portion of the plate interface. Silent earthquakes are recently discovered at the down-dip extension of the locked zone and are potentially changing the state of stress on the locked zone. However, it is not known if the zone of slow-slip is also spatially persistent and how it changes along strike within a given subduction zone. Here we show that locally observed converted SP arrivals and teleseismic underside reflections arrivals sampling the top of the subducting plate in southern Mexico reveal a spatially varying ultra-slow velocity layer (USL) (3 – 5 km, S wave velocity ~ 2.0 – 2.7 km/s). The majority of reported slow slip patches coincide with the presence of the USL and they are bounded spatially by the absence of the USL. The persistence of the USL before, during and after the slow slip events suggests its longevity, whereas the spatial extent of the USL delineates the zone of transitional frictional behaviour. We suggest that temporal variations in the coupling of the lock zone likely dictate the occurrences of slow-slip events in the transition zone.

2 Observations of Regional Waveform Data

3 Observations of Teleseismic Waveform Data

4 Monitoring Transition Zone and Slow-Slip Events

5 Summary

6 A Perspective on Megathrusts, Intraslab Earthquakes and Slow-Slip Events