



The 8 September 2017 Earthquake (Mw8.2): Lithospheric Faulting in the Subducting Cocos Plate

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On 8 September 2017, one of the larger instrumental earthquakes (Mw 8.2) in the Mexican subduction zone took place in the Gulf of Tehuantepec, where no large subduction earthquakes have taken place in this seismic gap since 1902. However, the 8 September earthquake did not take place on the plate contact between the Cocos and North American plates, but within the subducting Cocos plate at a depth of 57 km, immediately beneath the interplate locked zone. The source mechanism reflects down-dip tensional faulting. The inversion of the fault process shows a rupture process that initiated at the bottom of the lithosphere and propagated upward, breaking through the entire subducted lithosphere. A maximum slip on the fault of about 15 km was observed in the upper part of the slab. InSAR observations confirm that the upper continental plate suffered subsidence of about 12 cm due to the large deformation of the slab. An unusually long, complex and copious aftershock sequence followed the main event. We relocated the aftershocks occurring within the first 20 days after the main event. The relocated aftershocks reflect a 160-km-long fault, sub-parallel to the subduction zone, immediately beneath the interplate contact. The aftershocks delineate the main fault but are distributed also in secondary faults that lay outside of the rupture, showing downdip tensional stress within the subducted slab. The observations suggest detachment of the slab, induced by its own gravitational pull, away from the strongly coupled interplate contact up-dip. The presence of other large tensional, in-slab earthquakes in the region, in 1931 (Mw 7.8) and 1999 (Mw 7.5), also reflect the detachment of the downgoing Cocos plate, suggesting that this long segment of the plate interface is locked and possibly primed for a large earthquake. In 1787, a major earthquake (Mw 8.6) took place in an adjacent segment of the Mexican subduction zone, showing that this region is not foreign to great earthquakes.