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Subduction of the Tehuantepec oceanic fracture zone and the relationship with a seismic gap in southern Mexico

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It is accepted that key constraints on the size and recurrence time of large subduction earthquakes originate from the degree of locking between the subducting and overriding plates. Since the interseismic locking degree is influenced by the rheological properties of crustal and mantle rocks, any variations along strike will result in significant changes in seismic behavior due to a change in frictional stability. Additionally, recent seismic studies show that the subduction of hydrothermally altered oceanic fracture zones induces strong pore-fluid pressure variations that control the degree of interseismic locking. The Mexico Subduction Zone (MSZ) is characterized by major along-strike changes in subduction geometry, as well as important structural variations of the incoming oceanic plate. One of the main tectonic features of the Cocos plate is the Tehuantepec fracture zone (FZ) that is currently subducting beneath southern Mexico. The analysis of seismicity revealed that the area around where Tehuantepec fracture zone is currently subducting is conspicuously quiet and considered a seismic gap. Here, no significant quake (Ms $\geq$ 7.0) has occurred in more than 100 years, and the origin of Tehuantepec Seismic Gap (TSG) has not been elucidated yet. Based on the dimensions of the Tehuantepec gap (125 km length and 80 km width), an earthquake of Mw = 8.0 may be possible. This study aims to shed some light on the relationship between the TSG with the subduction of Tehuantepec oceanic fracture zone. Previous studies show that the uppermost oceanic lithosphere beneath the Tehuantepec FZ is partially serpentinized due to seawater infiltrations along faults. Using high-resolution three-dimensional coupled petrological-thermomechanical numerical simulations specifically tailored for the subduction of the Tehuantepec FZ at MSZ we show that the weakened serpentinized fracture zone is partially scraped out in the forearc region because of its low strength and positive buoyancy. The presence of serpentinite in the fore arc lowers the degree of interseismic locking, producing the TSG in southern Mexico.