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Subduction of oceanic plate irregularities and seismicity distribution along the Mexican Subduction Zone

Marina Manea (1,2), Vlad Constantin Manea (1,2), Taras Gerya (3,4), Raul-Valenzuela Wong (5), Mircea Radulian (1,6)

(1) National Institute for Earth Physics, Seismology, Magurele, Romania , (2) Universidad Nacional Autonoma de Mexico, Centro de Geociencias, Computacional Geodynamics Laboratory, Juriquilla, Queretaro, Mexico , (3) Department of Geosciences, Swiss Federal Institute of Technology (ETH-Zurich), CH-8092 Zurich, Switzerland, (4) Geology Department, Moscow State University, 119899 Moscow, Russia, (5) Universidad Nacional Autonoma de Mexico, Seismological Department, Institute of Geophysics, Mexico, (6) Academy of Romanian Scientists, 54 Splaiul Independentei, RO-050094 Bucharest, Romania

It is known that oceanic plates morphology is not a simple one, but rather complicated by a series of irregularities as seamounts, fracture zones and mid-ocean ridges. These features present on the oceanic floor form part of the fabric of oceanic crust, and once formed they move together with the oceanic plates until eventually enter a subduction zone. Offshore Mexico the oceanic Cocos plate seafloor is littered with relatively small but numerous seamounts and seamount chains, and also large fracture zones. In this study we investigate the relationship between these oceanic irregularities located in the vicinity of the trench in Mexico and the distribution of subduction seismicity, including the rupture history of large subduction zone earthquakes. 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. Our preliminary study shows a direct relationship between the presence of seamounts chains on the incoming oceanic plate and the subduction seismicity distribution. We also found a clear relationship between the subduction of the Tehuantepec fracture zone (TFZ) and the low seismic activity in the region where this fracture zone intersects the trench. This region is also long term conspicuously quiet and considered a seismic gap where no significant large earthquake has occurred in more than 100 years. Using high-resolution three-dimensional coupled petrological-thermomechanical numerical simulations specifically tailored for the subduction of the Cocos plate in the region of TFZ 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 apparently lowers the degree of interseismic locking, producing a seismic gap in southern Mexico.