

Questioning standard models of Caribbean tectonics

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Abstract

Recent receiver function images from the VEOX seismic array on the Isthmus of Tehuantepec in southwest Mexico show an enigmatic seismic structure dipping south from the Gulf of Mexico beneath the Isthmus of Tehuantepec. Could this structure represent a slab or subduction zone antithetic to the north-dipping subduction of the Cocos Plate? Standard models of Caribbean tectonics do not support this hypothesis since, in these models, the Isthmus of Tehuantepec would only have been affected by the eastwards migration of the Caribbean plate and/or north-dipping subduction of the Cocos plate. However, the Isthmus of Tehuantepec has a number of unusual characteristics that may indicate a more complex history. First, the Isthmus of Tehuantepec is a topographic low. In this, the Isthmus of Tehuantepec is essentially unique for lithosphere sitting above western American subduction zones. Second, the north Caribbean plate boundary curves to the northwest and heads through the Isthmus of Tehuantepec. In this, the plate boundary is in conflict with the requirements of standard Caribbean tectonic models. Third, a Miocene slab window has been inferred beneath the Isthmus of Tehuantepec. Fourth, the volcanic arc associated with Cocos plate subduction is abnormal in space and time. Fifth, to the west, the South Mexico Block is decoupled from North America and, to the east, the Central America forearc sliver is decoupled from the Caribbean plate, but the motion of both microplates is not easily explained by strain-partitioning above oblique subduction. A new model of Caribbean plate evolution will be presented which explains all of these features with one basic kinematic pattern. A corollary of the new model is that the VEOX seismic structure could represent a back-dipping slab, if oceanic lithosphere lay to the northeast of the Isthmus of Tehuantepec in the Eocene.