Relative Motion between the Rivera and North American Plates: Constraints from Focal Mechanisms

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The direction and velocity of the Rivera Plate in western Mexico relative to the North American plate has been a source of controversy. The southeastern segment of this plate boundary has been the site of one of the largest subduction events observed in Mexico during the last 100 years: the 3 June 1932 earthquake (Mw 8.2). To the northwest of the rupture zone of the 1932 event, however, there are no other known large subduction events, either from the historical or instrumental record. We analyze all focal mechanisms in this northern segment of the plate boundary to define the direction of relative motion between these two plates. The largest event occurred beneath the Tres Marias Escarpment, the earthquake of 4 December 1948. The recomputed magnitude yields Mw 6.4. This event caused widespread damage in a penal colony on the Tres Marias Islands. Although the focal mechanism of the 1948 event is not well constrained, the first arrival data collected shows reverse faulting with P axes oriented in a NE-SW direction. This mechanism coincides with other two fault plane solutions of more recent events. These mechanisms indicate reverse faulting beneath the Tres Marias Escarpment. To the northwest of the Islas Marias, in area where no clear physiographic feature defines the plate limits, we identify a group of strike-slip events, where the E-W trending nodal plane indicates right-lateral motion. These mechanisms suggest that the relative motion between Rivera and North America may be taken up by right-lateral strike slip motion. The accuracy of the locations does not allow to define in detail the geometry of this plate boundary. The slip vectors determined from these focal mechanisms are compared with the flow lines resulting from the various poles of relative motion between Rivera and North America to constrain its location.