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Delimitation of the of Rivera-Cocos Plates along the Colima Graben by Magnetotellurics: Cortical Discontinuity and Active Zones

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The Colima Graben is located on the south western part of Mexico, and it is considered an extensional structure defining the S-SE boundary of the Jalisco Block. The Colima Graben is spatially correlated with the subducted contact zone of the Rivera and Cocos plates which has been interpreted as a zone of rupture of the oceanic crust that promotes the rising of upper mantle material. The documented differences in subducting angles not only is proven to be the origin of the large Colima volcanic complex, a Pleistocene (∼0.6 Myr) active volcanic center along the Colima graben, but it is also the cause of important variations in seismicity patterns and origin, and it is thought to be the cause of significant differences in crustal thickness and thermal characteristics. Although the rift structure that conforms the Colima graben is regarded as a single continuous structure, it has in fact different characteristics along its ∼160 km inland extension. The northern sector (∼LAT. 20.0°) follows a well-defined narrow graben structure that intersects with the NW-SE Tepic-Zacoalco and EW Chapala grabens, conforming the triple junction of Guadalajara. The central segment of the rift (∼LAT. 19.5°) is strongly influenced by the large Colima volcanic complex, which has masked the main graben features. The closest to the trench southern sector of the Colima graben (∼LAT. 19.0°), seems to widen and is quite diffuse regarding the limiting fault structures of the graben.
The present study attempts to provide a better understanding of the effects of the oceanic plate fracture on to the continental crust in this region throughout a broadband magnetotelluric study combined with available satellite gravity data models. We have completed 48 magnetotelluric soundings distributed along four ∼EW profiles that cut the Colima graben at different latitudes, including two in the southern sector parallel to the coast, one in the central segment of the rift flanking the Colima volcanic complex, and one in the northern sector close to the triple point of Guadalajara. The inverted resistivity sections were correlated with the corresponding gravimetric response from the Bouguer anomaly, which together reveal a highly fragmented lower continental crust. Most importantly though, is the existance of a located high conductivity–low density anomaly that could be extended all along the graben, which is associated to the Holocene weakened zone of the continental crust through extension faulting. Zones of low density and high conductivity are interpreted as ascendent paths poured with released oceanic upper mantle hydrated plumes.