Incoming Plate Faulting at the Outer Slope of the Middle America Trench offshore Mexico

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At the northern segment of the Middle America subduction zone, the Cocos Plate subducts underneath the North America Plate. Seaward of the trench, the seafloor contains horsts and grabens. These structures are typically associated with normal faulting, but their orientation with respect to the trench are mostly parallel or sub-parallel, which suggests that they are reactivated abyssal hills faults. At other subduction zones, such as at the Kuril and the Alaska-Aleutian, the reactivation of these normal faults formed at the spreading ridge is typically attributed to bending of the incoming plate. However, compared with the outer rise at these other subduction zones, the flexural deformation of the incoming Cocos Plate offshore Mexico is less prominent. This is expected if the elastic thickness is dependent on age, since the seafloor age in this region is less than 30 Ma. Furthermore, the characteristics of the trench outer slope faults vary across the segments of the subduction zone offshore Mexico. At the northwest portion which is offshore Guerrero, the fault scarps are mostly lower than 100 meters and have strikes that tend to be parallel to the trench. Meanwhile, at the southeast portion which is offshore Chiapas, the fault scarps are a few hundred meters in height and have strikes that are slightly oblique to the trench. To better understand the connection between lithospheric flexure and the observed normal faulting at the trench outer slope, we calculated the stresses due to elastic bending, which is linearly related to the curvature of the plate. Deriving the curvature from bathymetry can be challenging because of the presence of rough seafloor topography such as seamounts. Thus, to minimize effects from the bathymetric noise, we set up a regularized parameter estimation problem to solve for the bending curvature. Our results suggest that the higher plate curvatures at the Chiapas segment compared with the Guerrero segment are consistent with the differences in observed faulting and seismicity between the two regions.

Keywords: bend faults, lithospheric flexure, subduction zones

