

Tectonics, seismicity, and strain rate in the NA-CA-CO triple junction in Guatemala

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In the Cocos-North America-Caribbean (CO-NA-CA) triple junction, located in west-central Guatemala, the Cocos plate is subducted beneath the other two plates along the Middle America trench (MAT). Transform motion along the Central American Volcanic Arc (CAVA) and the Polochic-Motagua Fault System (PMFS) allows the CA plate to escape from between the NA and CO plates. The PMFS is a complex multi-fault system that transitions to a simple single-fault system offshore, the Swan Fault, which intersects the Mid-Cayman Spreading Center (MCSC) in the Caribbean Sea. Max shear strain rates calculated from GNSS velocities (Ellis et al., 2019; Figure 1) clearly demarcate the triple junction to be located in the Guatemala City Graben, consistent with geologic evidence from Garnier et al. (2021). This triple junction configuration may be the result of progressive suturing of the forearc to the NA continent from northwest to southeast (Authemayou et al., 2011), which has now intersected with the basin-and-range province in the far western CA plate. Estimated total moment deficit in the region based on spatially integrating strain rates (Kostrov, 1974; Savage and Simpson, 1997) is $\sim 3\text{-}3.5 \times 10^{18}$ N m/yr (assuming 11 km seismogenic depth and 30 GPa for shear modulus), equivalent to a \sim Mw6.3 annually or a Mw7.4 since 1976. Seismicity patterns are generally consistent with the tectonic picture, with the largest earthquake in the region being the left-lateral 1976 Mw7.6 Guatemala earthquake on the Motagua Fault. Seismicity in the CAVA region is primarily right-lateral strike-slip, consistent with its role as a conjugate strike-slip fault to the PMFS. In central Guatemala and Honduras, earthquakes are primarily along normal faults, consistent with the Basin-and-Range tectonic setting. Recent normal faulting seismicity on the PMFS (Figure 1) is unusual and may reflect the large stress drop in the crust that would have happened following the 1976 Mw7.6 earthquake.

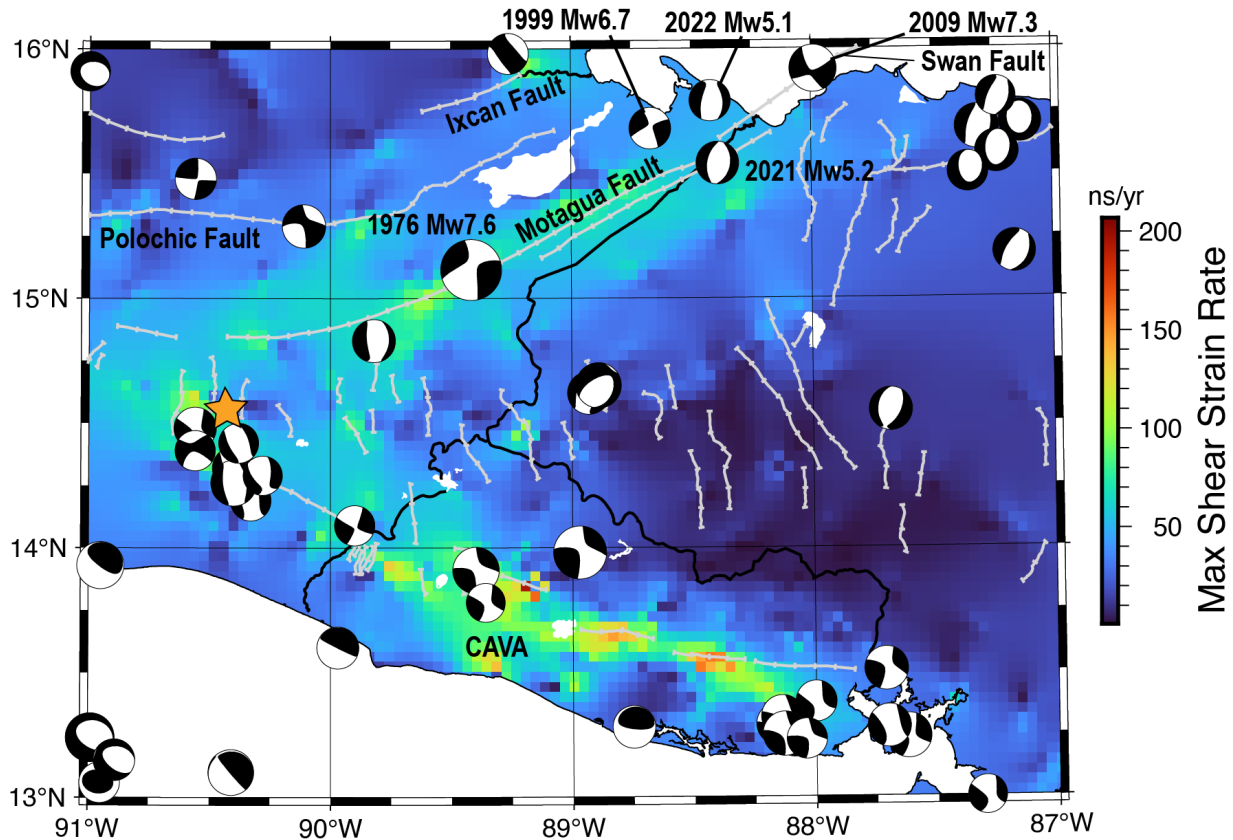


Figure 1. Seismotectonic context of the CO-NA-CA triple junction in Guatemala. Background color is the maximum shear strain rate calculated using the gpsgridded method (Sandwell and Wessel, 2015). Earthquake moment tensors are from the Global CMT catalog (globalcmt.org) for all events available for the area since 1976. Fault traces in hatched light gray lines are from Bird (2003). Orange star is Guatemala City.