The geodynamic evolution of the Mexican subduction zone as an effect of the movement of the Chortís Block

*Erika Moreno[1,2], Marina Manea[2,1], Vlad Manea[2,1]

1. Kobe University, 2. Centro de Geociencias, Universidad Autónoma de México

The tectonic evolution of the Chortís block represents a central piece of information in the quest of understanding the geodynamic evolution of Southern Mexico and Central America. Previous studies (Pindell and Dewey,1982; Mann 1999, 2007; Rogers, 2003; Rogers et al., 2007; Silva-Romo and Mendoza-Rosales, 2009; Ferrari et al., 2014; Molina Garza et al., 2019) have proposed that the Chortís Block was part of the North America plate in the southern Mexico during during the Cretaceous. This continental block was dragged along the South Mexican trench and after 20 Ma was captured by the Caribbean plate. Other studies, such as those of Keppie and Morán-Zenteno (2005) and Morán-Zenteno (2009), argue that the Chortis block separated from the Pacific plate and was pushed by the subduction of Farallon plate towards the East where it docked to its current position. Additional works, such as those of Meschede and Frisch (1998) and James (2006), suggest that the Chortís block is actually autochthonous to the Caribbean plate and moved little compared to its present position.

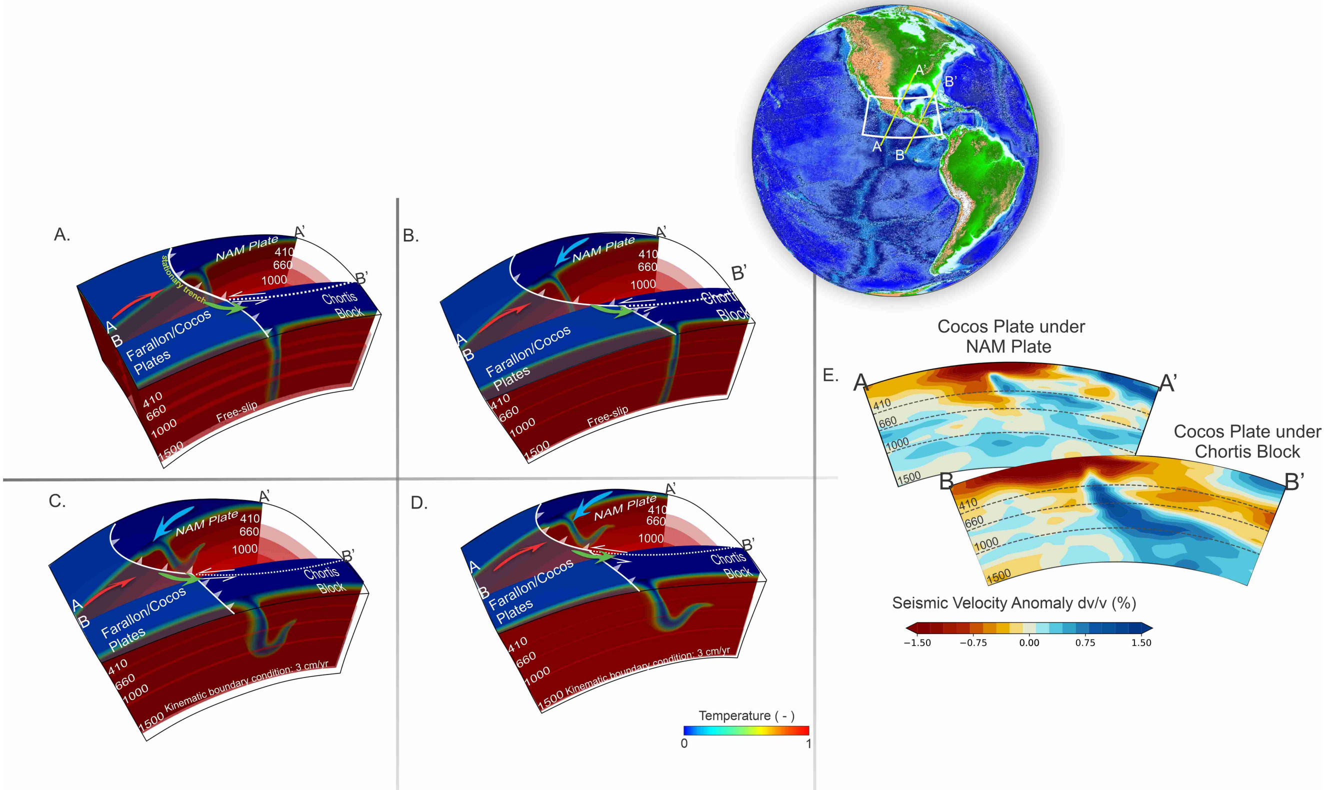
Currently, it is not clear if Chortis Block is autochthonous to the Caribbean plate or if, at some point in time, it moved from somewhere else and was captured by the Caribbean plate.

Likewise, it is not clear how the different motions proposed affected the geometry of the subducted plate. We reproduced numerically each of the aforementioned hypotheses and reveal how the different movements proposed for the Chortis block affect the dynamic subduction of Farallon-Cocos subduction system. We constructed 3D kinematic time-depended numerical models and determined which of the three hypotheses produced slab geometries that are consistent the observations provided by seismic tomography of the study area.

Our models evolved during 45 Ma and revealed that, at high trench advance motion, the plate has negative dip below 660 km in the lower mantle. Therefore, such high trench motion for the Chortis Block as proposed by Keppie and Morán-Zenteno (2005) are not viable. Likewise, the high erosion rates for southern Mexico as proposed in the Pacific hypothesis are also not feasible because this inhibits the formation of flat subduction specific for central Mexico. Therefore, the Pacific hypothesis generated plates that are not congruent with what is observed in seismic tomography studies of the region.

Moreover, our numerical simulations show that flat subduction for central Mexico is not a consequence of sliding along the South Mexican trench of the Chortis Block but rather a consequence of the interaction between the retreat of the Middle America Trench, the advance of the North American plate, and the accommodation of the Cocos plate.

Our numerical results that best reproduce plate shapes comparable with seismic tomography of the study area, are those that incorporate the hypothesis that Chortis Block was adjacent to southern Mexico during the Cretaceous or relatively close to its present position.



Temperature profiles for the movement of the Chortis Block under the hypothesis that it was adjacent to southern Mexico. In this case, the Chortis Block moves along the South Mexican trench for 45 Ma. In Fig. you can see the different behaviors of the subducted plate when subjected to rotation angles between 30° and 20°. **A.** The trench on the Chortis Block rotates at an angle of 30° to the southeast while the trench on the Northamerican plate remains stationary. **B.** The trench in the Chortis Block rotates at an angle of 30° to the southeast while the trench in the Northamerican plate recedes at 1 cm/yr. **C.** The Chortis Block trench rotates at an angle of 30° to the southeast as the Northamerican plate trench recedes at 1 cm/yr and the lower domain changes from a free-slip condition to a kinematic boundary condition. **D.** the trench angle of the Chortis Block decreases to 20° while maintaining the same conditions as C. **E.** The seismic tomography are based on the GAP_P4 Global P wave tomography model of Obayashi et al. (2013)