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The Septentrional–Oriente strike-slip Fault Zone: polyphase deformation and fault strand switching in the Northern Caribbean plate boundary (Windward Passage)

Alana Oliveira de Sa, Elia d'Acremont, Sylvie Leroy, and Sara Lafuerza
Sorbonne Université, ISTeP, URL7193, Paris, France (alana.oliveira_de_sa@sorbonne-universite.fr)

The northern border of the Caribbean plate is characterized by the oblique collision between the Caribbean and North American tectonic plates. Increasing obliquity of the collision between these two plates lead to complex strike-slip fault zones, which successively jump southward to accommodate the eastward escape of the Caribbean plate and the collisional indentation against the Bahama carbonate platform. The present-day Septentrional–Oriente Fault zone (SOFZ) defines the northern limit of the Caribbean plate, accommodating much of the obliquity of the convergence. Since its inception, at the end of the Oligocene, the current active style of the strike-slip boundary evolves over time. We focus our study on the Windward Passage area between the south-east of Cuba and the north-west of Haiti coast. Currently crossed by the SOFZ, the tectono-sedimentary framework of this large strait displays critical evidences to constrain the Neogene evolution of the northern boundary of the Caribbean plate. Based on seismic reflection and swath-bathymetric dataset we shed light on the structure and tectonic pattern of the Windward Passage. Our study provides structural and stratigraphic insights into relative timing of deformation along the Windward Passage and new elements to constrain the southeastward shift of the north Caribbean plate boundary until its present-day position. Contrasts in patterns of deformation on the Windward Passage area reveal a polyphase tectonic history of dominant strike-slip faulting impacted by the rate and obliquity variations of the convergence. Deformation phases recorded by the offshore sedimentary cover in the Windward Passage correlate well with the major paleogeographic reorganization episodes described onland (Late Eocene, Late Oligocene, Middle Miocene and Late Pliocene). A left-lateral shift of at least ~80 km is demonstrated by the restoration of the offset of the seismic units, estimating a Pliocene age for the onset of the SOFZ segments activity in this area.