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Variation of palaeostress patterns along the Oriente transform wrench corridor, Cuba: significance for Neogene–Quaternary tectonics of the Caribbean realm

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Abstract

In this study, we address the late Miocene to Recent tectonic evolution of the North Caribbean (Oriente) Transform Wrench Corridor in the southern Sierra Maestra mountain range, SE Cuba. The region has been affected by historical earthquakes and shows many features of brittle deformation in late Miocene to Pleistocene reef and other shallow water deposits as well as in pre-Neogene, late Cretaceous to Eocene basement rocks. These late Miocene to Quaternary rocks are faulted, fractured, and contain calcite- and karst-filled extension gashes. Type and orientation of the principal normal palaeostress vary along strike in accordance with observations of large-scale submarine structures at the south-eastern Cuban margin. Initial N–S extension is correlated with a transtensional regime associated with the fault, later reactivated by sinistral and/or dextral shear, mainly along E–W-oriented strike-slip faults. Sinistral shear predominated and recorded similar kinematics as historical earthquakes in the Santiago region. We correlate palaeostress changes with the kinematic evolution along the boundary between the North American and Caribbean plates. Three different tectonic regimes were distinguished for the Oriente transform wrench corridor (OTWC): compression from late Eocene–Oligocene, transtension from late Oligocene to Miocene (?) (D_1), and transpression from Pliocene to Present (D_2–D_4), when this fault became a transform system. Furthermore, present-day structures vary along strike of the Oriente transform wrench corridor (OTWC) on the south-eastern Cuban coast, with dominantly transpressional/compressional and strike-slip structures in the east and transtension in the west. The focal mechanisms of historical earthquakes are in agreement with the dominant ENE–WSW transpressional structures found on land.

Keywords: Transform fault; Wrench corridor; Sierra Maestra; Santiago basin; Santiago deformed belt; Palaeostress; Cuba

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1. Introduction

Transform faults play a key role in plate kinematics as they link divergent and convergent plate boundaries with each other. In theory, they represent strike-slip boundaries along which there are no major transtensional or transpressional forces as plate-driving forces, e.g., slab pull or ridge push acting parallel to it. However, many major transform faults include restraining and releasing bends imposed by strength inhomogenities of the involved lithospheric plates and oblique plate motion. Such situations create wide transform wrench corridors rather than narrow transform faults. In nature, strike-slip faults often represent wide wrench corridors, specifically when rheologically weak cover sedimentary rocks are involved (Mandl, 1988). Such wrench corridors comprise structures such as releasing and restraining bends, strike-slip duplexes, and negative and positive flower structures along fault oversteps (e.g., Sylvester, 1988; Zolnai, 1988). Classical experiments (Riedel, 1929; Wilcox et al., 1973; Mandl, 1988) show that, along seemingly straight segments of major strike-slip faults, no through-going straight segments evolve during formation of such faults. An array of en échelon arranged Riedel shears, P-shears, and antithetic Riedel shears (cross-faults) evolve along such corridors, with nearly undeformed shear lenses in between anastomosing faults. The anastomosing zones of slip are termed the "fault core" (Caine et al., 1996). A wide zone of rocks, which can be

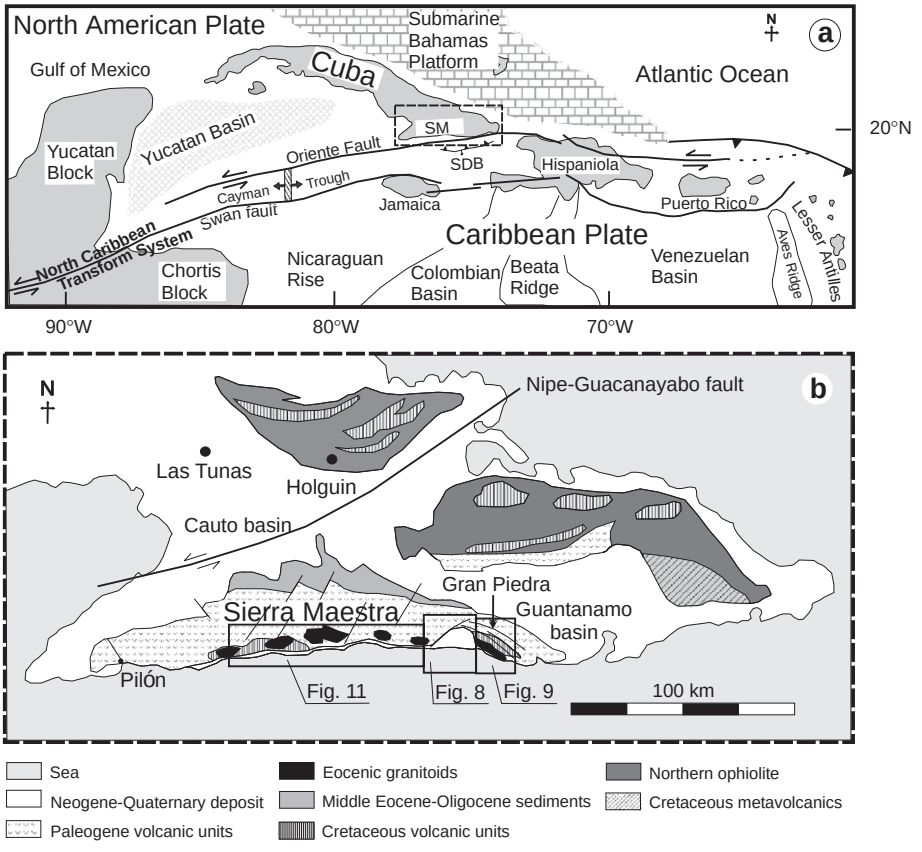

Fig. 1. (a) Simplified map of the Caribbean realm showing the location of the Oriente Fault. Dashed rectangle locates the eastern province of Cuba and is shown in detail in panel (b). SDB—Santiago Deformed Belt. SM—Sierra Maestra. (b) Geological sketch map of eastern Cuba (after Iturralde-Vinent, 1996).