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Slip partitioning on the Enriquillo and Lamentin faults during the 2010 Haiti earthquake

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A general consensus has emerged from the study of the 12 January 2010, Mw 7.0 Haiti earthquake: the coseismic rupture was complex, portraying both reverse and strike-slip motion, but lacking unambiguous surface break. Based on seismological, geodetic and geologic data, numerous slip models have been proposed for that event. However, using an incomplete fault map, the latter models were preliminary, proposing a rupture on unmapped buried faults. Here, using bathymetric data offshore Port-au-Prince along with a digital elevation model derived from LiDAR on-land, we identified the south-dipping Lamentin thrust in the Bay of Port-au-Prince. The fault prolongs on-land where it deforms active alluvial fans in the city of Carrefour. The geometry and distribution of the aftershocks of the 2010 earthquake and the analysis of the regional geology allow us to place constraints on the connection at depth between the Lamentin thrust and the sinistral strike-slip Enriquillo –Plantain Garden Fault (EPGF). Inversion of geodetic data suggests that both faults may have broken in 2010, consistently with the regional geodynamical setting. The rupture initiated along the Lamentin thrust and further propagated along the EPGF due to instantaneous unclamping at depth. The corals uplifted around the Léogâne Delta Fan, contributing to the build-up of long-term topography between the Lamentin thrust and the EPGF. The 2010 earthquake increased the stress toward failure on unruptured EPGF segments as well as on the thrust fault sitting in the middle of the city of Carrefour, in the direct vicinity of Port-au-Prince, thereby increasing the seismic hazard in these areas.