**Tectonics and Earthquakes of HISPANIOLA (Text from the animation)**

*(link to the animation here:* <https://www.iris.edu/hq/inclass/animation/714>)

Hispaniola is one of the Greater Antilles in the northern Caribbean Sea. The island, which includes both Haiti and the Dominican Republic, is home to 22 million people. The Caribbean Plate moves east at about 2 cm/yr with respect to the North American Plate.

In this region, the Caribbean Plate is broken into at least four microplates that accommodate the transition between the major plates. Subduction of North American oceanic lithosphere beneath the Caribbean Plate changes from frontal subduction at the Lesser Antilles Trench to oblique subduction at the Puerto Rico Trench to oblique collision at the Hispaniola Trench and then to strike-slip between Cuba and Jamaica.

In order to examine how North-American-Plate motion drives deformation across the 280-km-wide Hispaniola microplate, we will hold the Caribbean Plate fixed. In general, the Atlantic Ocean crust is only 6 km thick. But at the Bahamas Carbonate Platform, limestone reef deposits up to 6-km-thick have doubled the crustal thickness with more-buoyant material making it more difficult to subduct.

This sector of the subduction zone is called an “oblique collision” zone because, as the Bahamas Platform is subducted atop the North American Plate, the high friction shoves and deforms the overriding North Hispaniola microplate like a small-scale continent–continent collision.

Subduction of this thicker crust also results in extension on the boundary between the Hispaniola and Puerto Rico – Virgin Islands microplates where the magnitude 7.5 Mona Passage earthquake occurred in 1918.

Oblique collision at the Hispaniola Trench results in “strain partitioning”. Shear strain is accommodated by the Septentrional and Enriquillo strike-slip fault zones, Compressional strain is taken up by subduction on the megathrust plate boundary at the Hispaniola Trench and by thrust faulting at the Muertos trough where the Caribbean Plate pushes back. The rate of compression is about 10 mm/yr.

In subduction zones, we expect to find shallow earthquakes near the trench and bands of deeper and deeper earthquakes as the subducting plate dives deeper into the mantle. In Hispaniola, this expected pattern is complicated by the thrust faulting at the Muertos trough.

A north – south cross section shows the Hispaniola microplate overthrusting Caribbean lithosphere at the Muertos trough presenting an earthquake and tsunami hazard to southern Hispaniola. In 1984, a M6.9 earthquake occurred on the Muertos thrust fault but did not reach the surface.

Subduction of North American oceanic lithosphere beneath northern Hispaniola is at a shallow angle then turns nearly vertical to 200-km-depth where the deepest earthquakes occur. How the two oceanic plates interact at depth is unknown. The latest major earthquake on the subduction megathrust occurred on August 4, 1946.

That magnitude 7.9 earthquake initiated at 20 km depth and ruptured up the plate boundary to the Hispaniola Trench with megathrust displacement reaching 2 meters. This is probably the largest earthquake on the Caribbean – North America plate boundary in the 500-year written historical record.

The resulting tsunami arrived on the northeast coast of the Dominican Republic with wave heights of 2 to 5 meters, and was measured by tide gauges as far north as New Jersey. Eyewitnesses, emergency managers, and relief workers reported that the tsunami ran almost a kilometer inland and swept the town of Matancitas and several villages into the ocean, resulting in 1,790 fatalities. But the Trujillo administration insisted on reporting an official death toll of 100.Left-lateral shear strain across Hispaniola occurs at a rate of 17 mm/yr. Recent GPS observations document left-lateral strike-slip rates of 9 mm/yr on the Septentrional fault zone and 11 mm/yr on the Enriquillo fault zone.

With only a few decades of seismometer recordings, we must rely on written historic records of earthquakes on these strike-slip faults over the past few centuries. A series of earthquakes on the Enriquillo Fault Zone from 1751 to 1770 was followed by the devastating magnitude 7 earthquake on January 12, 2010. This limited history suggests a recurrence interval of 240 years for major earthquakes or a series of earthquakes on the Enriquillo Fault Zone.

The earthquakes of 1842 & 1887, most likely occurred on the western Septentrional Fault Zone. However, these locations are approximate and we don’t know how far east they ruptured leaving the earthquake history along this section uncertain. Some researchers have concluded that the entire zone has a recurrence interval of ~300 years with a characteristic earthquake of magnitude 7.5 to 8 and strike-slip offset of 2 to 4 meters.

However, paleoseismic analyses from deposits in trenches across the Septentrional Fault Zone in central Hispaniola have been interpreted to indicate that the most recent earthquake in that area occurred between 1040 and 1230 AD indicating a recurrence interval of perhaps 1000 years. 5:43 It could be that 10 meters of strain has accumulated since the last earthquake and the next earthquake could exceed magnitude 8. Despite the uncertainties, it is clear that the Septentrional Fault Zone will have earthquakes equal to or larger than the 2010 Haiti earthquake.

This simplified map of population density illustrates how the Septentrional and Enriquillo fault zones pass near or through major population centers in Haiti and the Dominican Republic. In addition, megathrust earthquakes along the Hispaniola thrust fault and on the Muertos tough fault pose high earthquake and tsunami hazards to this and the surrounding areas of the Caribbean region.