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Seismic zonation of Hispaniola Island for hazard assessment purposes

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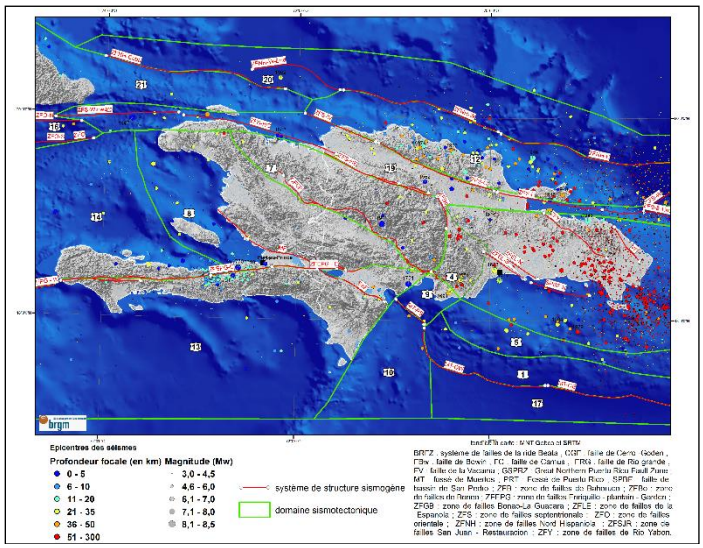
The island of Hispaniola, which includes Haiti and the Dominican Republic, is a strongly active seismic zone at the level of the island arc of the Greater Antilles, on the boundary of the North American and Caribbean plates. The geodetic data and the geological reconstructions indicate to this place a convergence of plates of the order of 2 cm per year on average. The earthquake on January 10, 2010, which has destroyed the capital of Haiti, Port-au-Prince, came to add to the long list of destructive earthquakes which hit Hispaniola during the last centuries. The seismic hazard is however marred strong uncertainties due to a complex seismotectonic environment and insufficient knowledge of the observed seismicity.

This seismic zoning is the fruit of a sismotectonique synthesis realized within the framework of assessment of hazard and seismic risk in the capital of the Dominican Republic, Santo Domingo (260 km^2; 3 million people) (project PNUD). Initially, a unified catalog of earthquakes was established, collecting historical and instrumental data. The oldest known earthquake dated 1562. More than 25 epicenters of earthquakes of magnitude Mw at least equal to 6.5 are located at the level of Hispaniola or nearby immediate, among whom the earthquakes of magnitude superior to 7.5, of 1691, on 1842, on 1887 and 1946. To best clarify the focal characteristics of historical earthquakes, the study sought to find the most contemporary documentary sources describing the seismic events. Although there are uncertainties on the magnitude and location, the catalogue of seismicity is considered complete from since 1945 for above 5.0 magnitude.



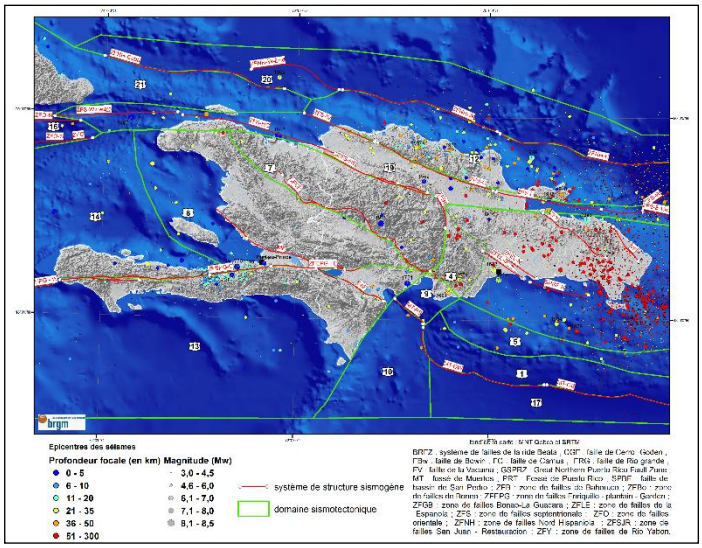


Figure 1: Seismic zonation of Hispaniola Island (Caraïbes)

Mapping active faults of Hispaniola was carried out on the basis of scientific publications, digital models of terrain, and geological maps (including maps to 1: 50 000 available on the Dominican Republic). The information on the geometry of the faults, the kinematics of their current movement, and the characteristics of their geologic evolution is integrated into the GIS. Based on this sismotectonique interpretation, we distinguish 3 types of seismic sources: intercrustaux domains, major active faults, the North American subduction zone.

Each seismic source is described according to the mechanism and current rate of deformation, the associated seismicity, the estimated maximal magnitude and the corresponding return period. The parameters of seismic activity of the sources used for probabilistic seismic hazard calculations are inferred mainly from these characteristics.

This zoning bases itself on a state of the knowledge of the active faults or potentially active of this part of the Caribbean margin in the form of synthetic seismotectonic covering the whole of the island of Hispaniola and its margins. It is applied to the evaluation of the seismic hazard of the urban agglomeration of Santo Domingo, whose results will be the subject of a later publication. This study demonstrates that a model of seismic sources based on the most complete possible description of the potentially active faults is essential in the regions where the lack of data of seismicity impacted strongly seismic hazard calculations.