

Seismic potential along the Caribbean subduction zone northwestern Colombia revealed by GPS data

*Sindy Carolina Lizarazo¹, Takeshi Sagiya², Hector Mora-Paez³

1. Graduate School of Environmental Studies - Nagoya University, 2. Disaster Mitigation Research Center - Nagoya University, 3. Geological Survey of Colombia - GeoRED Project

Colombia is characterized by the complex interaction among the Caribbean, Nazca and South American plates, as well as the North Andean and Panama blocks. This setting causes intense seismicity and faulting along the collision and subduction regions whose natures are not well understood. Under these conditions, the current GPS network becomes an important tool to study the regional kinematics, understand the observed crustal deformation and evaluate the seismic potential in the country.

We analyzed data from 87 continuous GPS stations during the period 2008-2017 obtained by the GeoRED project from the Geological Survey of Colombia and the COCONet project (Continuously Operating Caribbean GPS Observational Network). Daily coordinates of the GPS sites were calculated using the GAMIT/GLOBK software v.10.7 under the ITRF2014 reference frame. Then, average displacement rates were calculated by using HECTOR software considering seasonal components and offsets due to instrumental changes (Bos et al., 2013). Finally, a geodetic inversion analysis following Yoshioka et al. (1993) was performed in order to evaluate the interplate coupling and the seismic potential along the Caribbean subduction zone.

Along the Caribbean subduction zone, we identified an isolated fully locked patch south of the city of Cartagena extending from 5km to 20km depths. The origin of this asperity is enigmatic and it allows us to propose two possible interpretations. The first one is elastic deformation able to generate a Mw 8.2 earthquake. We obtained a seismic moment accumulation rate of assuming an average slip deficit rate of 9.9 mm/yr and consequently, we estimate an average recurrence interval of ~540 years. Although there is no record of giant earthquakes in this area, we cannot reject this scenario because the historical record is too short to register the past event. The second one is that the whole deformation is inelastic. Estimates of long-term shortening based on seismic cross sections do not support this hypothesis because it is too small compared with the geodetic rate. However, still this possibility holds since there is a possibility of an accelerated deformation during the last 1 Ma. To discern between both scenarios, it is essential to conduct a careful geological investigation to identify recent evidence of crustal shortening or paleotsunami along northwestern Colombia.

Keywords: Seismic potential, Interplate coupling, Caribbean subduction zone, GPS data, Colombia