

New tectonic evidence of the 1955 Cotacachi earthquake (Mw 6)

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On northwestern corner of South American (SA) plate the subduction of Nazca plate and the northeastern escape of the North Andean Block (NAB) have been generated destructive earthquakes on Ecuador. However the seismic catalog is time-restricted and provides information about few historical damaging earthquakes over a period of ~500 year; thus, a detailed investigation of such events represents an opportunity to better understand the seismic hazard and the active tectonics framework on Ecuador. In June 20th, 1955 an earthquake magnitude Mw 6 shocked Carchi, Imbabura and Pichincha provinces based on 35 high quality historiographical data from verified reports of local historians and witnesses. Our data pointed out that Cotacachi, San José de Quichinche and Quiroga on Imbabura province were the most damaged villages. The earthquake intensity assessment using the European Macroseismic Scale (EMS-98) allowed us better constrain the earthquake epicenter location and compute its magnitude following the intensity attenuation model from Beauval et al., 2010. This new epicenter location, the geomorphological analysis using a high-resolution digital elevation model and instrumental seismicity, from IGEPN, 2010 and García A., 2018 catalogs, indicates a non-previous mapped structure, here named as Cuicocha lineament, as the source of the 1955 Cotacachi earthquake. This 15-km long lineament follows a northeastern-southwestern axis and bifurcates the hydrographic network between Cotacachi volcano and Cuicocha caldera suggesting a sinistral motion. The Cuicocha fault is a horse-tail structure, which will be associated with the major strike-slip El Ángel-Otavalo fault system. This major structure is thought to accommodates the northeastward motion of the Interandean Valley (IAV) relative to the Western Cordillera (WC). Here, our preliminary GPS derived velocities of LITA, LIEC and APEC continuous GPS sites; located on the western side of the WC, relative to IBEC cGPS site located on the IAV; indicates the westward motion of the WC relative to the valley at rates of 3 to 6.1 mm/y. Thus, these GPS relative velocities appear be consistent with a major left-lateral strike-slip fault system and suggest that the motion of NAB into the Ecuadorian Andes could be accommodated along two main faults: 1) the Chingual-Cosanga-Pallatanga-Puna right-lateral strike-slip fault, as the boundary between NAB and SA, and 2) the Billecocha left-lateral strike-slip fault system between the IAV and the WC, suggesting that the northern IAV will be a deformation zone or a micro block into the NAB. Then, our results point out a 6.1 (Mw) seismic potential for the Cuicocha fault and a recurrence period in a range of 40 to 120 years. Nevertheless, it is necessary to conduct neotectonic studies and densify the GPS geodetic observations on northern Ecuadorian Interandean Valley in order to clarify the proposed kinematics of NAB.