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Pioneering multi-proxy palaeotsunami research along the Pacific Coast of Ecuador

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Abstract

The complex environmental, vegetative, geological, geographical, and tectonic setting of Northern South America can set the stage for an elaborate and heterogeneous compilation of different marine extreme event signatures within the coastal sedimentary record. The Pacific Coast of Ecuador, between Esmeraldas and the Bay of Guayaquil has been the focus of the first multi-disciplinary palaeotsunami investigations ever conducted in the country since 2016, targeting multiple sedimentary environments from fluvial-dominated plains to sandy beaches, in both natural settings and urban areas.

Important historical earthquakes have been recorded in Ecuador since 1896, all triggered by Mw>6.9 earthquakes associated to the Nazca Subduction Zone, each producing extensive and critical damage to both the natural environment and human-made structures. Even though some of them have triggered tsunamis, very few have been evidenced geologically as not all tsunami-generated sediments are preserved due to the complex depositional settings encountered along this coastline.

The aim of this on-going investigation is to identify marine extreme event signatures in different types of sedimentary environments using a multi-proxy approach, including detailed lithostratigraphic descriptions, particle size analyses, petrophysics, mineralogy (i.e., heavy mineral assemblage characterization), analysis of morphoscopic features of sediment grains, bio-stratigraphy, dating by means of both ^{14}C and Optically Stimulated Luminescence (OSL) and luminescence signal analyses. For the latter, two novel approaches were implemented to help distinguish between tsunami and storm events: a) measurement of bulk samples using a Portable OSL Reader (PPSL) to create luminescence profiles in order to elucidate variances in stratigraphic continuity; and b) Single Grain Over-Dispersion (SG-OD) OSL analyses which allow to characterise the degree of sedimentary chaos within a deposit.

Presence of multiple potential tsunami and possible storm deposits was found throughout the numerous large trenches excavated and on exposed coastal/fluvial outcrops found along the coast, varying in thickness and sedimentological features depending on the environmental setting. On-going luminescence analyses (both PPSL and OSL) seem to be a key identification proxy to distinguish between palaeostorm and palaeotsunami units, besides the more conventional analytical techniques, also allowing to narrow the time-window for the chronology of the different events found along this coast.