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Turbidites and megaturbidites of Ecuadorian subduction trench: paleoseismologic indicators?

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The North-Ecuadorian convergent margin (0º-1º30'N) is characterized by tectonic subduction erosion with nearby-starved slopes and seven confined trench basins fed by rare but prominent sediment gravity flows (debris flows, slumps, megaturbidites and turbidites) encased in hemipelagites. This setting, although fed by limited sediments, most likely records earthquake-triggered gravity flows, and thus discard the influence of climatic deposits complicating the interpretation of the sedimentary archives. The completeness of the earthquake record needs however to be tested.

In northern Ecuador, a preconditioned lower slope sources the sediment in two domains where long-term tectonic processes change the morphology, the distribution and the styles of the slope failure. The southern domain (0º-0º40'N) is affected by seamount subduction, where pervasive slope fracturation and fluid circulation weaken the margin resulting in the collapse of numerous homogeneous, thin and localized gravity-driven deposits. The northern domain (0º40'N-1º30'N) is driven by regional fault controlling the linear geometry of the lower slope, where the non-pervasive and poorly fractured margin generates thick, heterogeneous deposits in front of the liner scarp.

The detailed description of cores and seismic chirp data collected in the trench basins during the ATACAMES-2012 campaign shows cm-scale turbidites and m-thick debrites interbedded with over 35m-thick megaturbidites. The latter are exceptional events composed of (a) a set of graded and amalgamated sandy layers of quasi-synchronous turbulents flows; (b) an homogeneous over-thickened mud tail; and (c) soft sediment deformation structures. Additionally, some thin-bedded classical turbidites might also be amalgamated, which content shows sources that could come either from the margin or from the pelagic cover of the Nazca plate that give more calcitic turbidites. Since their source is much below the depth where large storm waves affect the seafloor, they are likely triggered by earthquake shaking. Moreover, recently, amalgamated-base turbidites were recognized as the signature of paleo-earthquakes in the Esmeraldas Canyon. Our megaturbidites provided by the inner wall of the trench might relate as well as the calcitic turbidites to co-seismic ground shaking with the deposition of a quasi-synchronous sandy turbidites during the main shocks and aftershocks, the suspension and decantation of a large amount of mud in the oscillating water column and post-depositional liquefaction during episodes of ground acceleration.

In the southern domain, age dating and core-to-core correlation of the sedimentary events show that the mean recurrence interval of turbidites is 189yr while in the northern domain the average recurrence interval is 600yrs similar to the regional seismic supercycles. However, megaturbidites are very scarce and probably correspond to exceptionally large events sources where the slope has been preconditioned by successive ground shaking. Only some hemipelagites are interbedded between turbidites, suggesting that turbidites have probably eroded part of the sediment during their emplacement, and artificially decreasing the calculation of the recurrence interval.