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Nature and Architecture of the Sedimentary Deposits in the Trench of the Ecuadorian Subduction Margin

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The active margin of Ecuador is characterized by strong tectonic erosion that contributes to the formation of a deep trench filled by a complex suite of sedimentary facies. Gravity flow sedimentation is ubiquitous along the margin and facies range from laterally continuous m-thick mass transport deposits to isolated cm-thick turbidites intercalated with hemipelagite and ash layers. However, the nature and architecture of those deposits remain equivocal.

This study presents the interpretation of detailed bathymetry, high-resolution seismic profiles and sediment cores recently acquired along the 600 km-long Ecuadorian margin (ATACAMES campaign onboard the R/V L'Atalante, 2012). The margin comprises three morphological segments: (1) the central segment marked by the subduction of the Carnegie Ridge, which induced a narrow (10-30 km wide) and relatively shallow trench (3100-3700 m deep), a steep and gullied continental slope with no canyon and a 20-60 km wide shelf characterized by active subsidence, (2) the northern segment characterized by a wider ($\sim$100 km) and deeper (3800-4000 m) trench, a gentler gullied continental slope and similar shelf settings (10-50 km wide), (3) the southern segment presents a wide (20-60 km) and deep (4000-4700 m) trench, a starved continental slope with well-defined canyon systems and a wide subsiding shelf (50-100 km wide). The sedimentary dynamics along the margin is evaluated by the analysis of 15 sediment cores. High-resolution visual description of the cores, X-Ray imagery and the measurement of petrophysical properties (gamma density, magnetic susceptibility, P-wave velocity) led to the identification of 6 sedimentary facies that characterize 6 sedimentary processes: Turbidite beds (turbidity currents), Hemipelagites (continuous marine sedimentation), Tephras (airfall ash layers consecutive to volcanic eruptions), Debris flow deposits (cohesive debris flows), Megaturbidite/Homogenite (large-scale and/or hybrid gravity flows), Mass Transport Deposits (mass wasting). The chronostratigraphy of the deposits is defined by radiocarbon dating of well-identified hemipelagite sediments. Ages range from 500 to 48,000 years BP over the topmost 10m of the trench deposits.

Sedimentation patterns along the Ecuadorian trench are highly heterogeneous. Holocene sedimentation is recorded almost everywhere apart from some locations within the central segment possibly due to the presence of contour currents. However, sediment supply to the trench varies greatly between the starved central segment, where sedimentation rate and gravity flow (Turbidites, homogenites) frequency are low, and the northern and southern segments characterized by higher gravity flow frequencies (Turbidites, MTDs) and sedimentation rates. Although the northern and southern segments share similar characteristics, historic seismicity is four times higher in the North. Future work will include the identification of the mechanisms that trigger the gravity flows in order to evaluate the potentiality of the Ecuadorian margin for submarine paleoseismology studies.