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Importance of seamounts subduction on frontal erosion of active margins. Example of the large submarine landslides of the Ayampe region of the Ecuadorian margin

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High convergence rate and fluid pressure, low sediment supply and roughness of the subduction plate are the main driving mechanisms of frontal and basal erosion (i.e. loss of material) of an overriding plate due to subduction. During frontal erosion, faulting and tilting of large blocks and submarine landslides, which are progressively subducted, consume the outer margin. Submarine landslides are far larger than any terrestrial landslides (110 to 3000km3) and among the most efficient sediment transport mechanisms to the deep ocean as they can occur on gradients as low as 1-2°. Submarine landslides represent a significant geohazards that may cause damage to the environment, human beings and infrastructures.

The trench fill in Ecuador is less than 500m-thick and the margin is erosive. In our Ayampe study area, at the southern edge of the subducting Carnegie Ridge, the oceanic plate is spotted by nx100m-high, 3-4km-large conical and 10-15km-large multipeak seamounts. In this area, subduction erosion is enhanced by subduction of seamounts and the slope experiences an overall gravitational collapse. Numerous small scars (nx100m to km-wide) affect the slope in its lower part and three large ones (scars S1, S2, S3; nx10-km-wide) in its middle to upper part staggered in quincunx at 8, 16 and 32km from the trench. Three especially large landslides carved the largest scar S2 by the successive rotational ablations of the slope along large normal faults rooted in the acoustic basement. From base to top, the landslides are 850m, 250m- and 950m-thick. The lower landslide slides down the slope for 30km in a seaward direction while the upper one truncates the other two landslides. Turbidites and mass transport deposits seals the foot of the landslides while contourite drifts and hyperpicnites fill the tilted block basins just beyond the platform edge, at their top. The landslides are encased in the climatically controlled sediment-fill of the Ayampe basin, which provides a provisional age for the three landslides at c.1031, 790 and 712ka.

By comparing the distance of the scars from the trench, the age of the gravitational events and the location of recognized seamounts on the plate interface we propose that the large scars observed today on the slope might have been carved or re-activated by the subduction of seamounts at 57-130ka (S1), 337-424ka (S3) and 620-712ka (S2, reactivated). Landslides are much older and no trace of seamounts of these ages can be depicted anymore on the deep plate interface and at the seafloor.