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Evidences for subduction-erosion and heterogeneity at the interplate boundary along the Central Ecuador active margin

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Subduction-erosion is believed to be a process occurring along about 50% of all convergent margins. However, while frontal erosion due to subduction of reliefs carried by the downgoing plate is widely documented, the processes that contribute to basal erosion are still poorly understood.

Based on two multichannel seismic pre-stack depth migrated (PSDM) lines (SIS-12 and SIS-64, SISTEUR cruise, 2000), we present evidence on the mechanisms of basal erosion at the convergent Ecuadorian margin. Along the study sector of the margin subducts the southern flank of the Carnegie Ridge spotted with large seamounts. The rough topography of the incoming plate produces intense deformation of the upper plate expressed both, on the margin's morphology and deep structure.

In seismic images, the margin is fronted by a narrow (5-7-km wide) sediment prism, and the basement thins from 5 km at the shelf edge to 1 km near the margin front, over a distance of less than 30 km. The rapid thinning of the margin seems to be accommodated by two different processes: (1) normal faulting that cuts the upper plate into 2-5-km-wide blocks tilted landward and with a vertical offset of few hundreds meters, and (2) a gradual thinning and progressive disappearing ($\sim$15 km away from the trench) of the lower basement, limited at its top by an intracrustal reflector. These observations strongly support basal erosion of the upper plate beneath the continental slope. The base of the lower basement consists in a $\sim$700m-thick layered zone which extends roughly parallel to the interplate boundary. This geometry suggests that the layered zone is not a pre-existing structure of the margin basement, but is more likely formed during the subduction process. The PSDM-average velocity of this layered zone ranges from 4.0 to 4.2 km/s and is similar to the velocity of the margin's lower basement. However, the layered zone velocity is locally lower (3.7 km/s), inducing a local velocity inversion. We thus interpret this layer as the result of deformation and alteration processes at the bottom of the upper plate in relation with basal erosion.

Beneath the upper plate, the geometry and the nature of the interplate boundary is highly variable, implying spatial and temporal variations of the interplate coupling: (1) A usually very thin subduction channel (under the data resolution that is $\sim$100-150m), locally thickens to form lenses few hundreds meters-thick and $\sim$7-10-km-wide. On line SIS-12, a $\sim$10km-wide lens, $\sim$10-20 km away from the trench, forms the subduction channel beneath the margin basement at a $\sim$5km depth. This lens is characterized by low PSDM-velocities (2.3$\pm$0.2 km/s), indicating undercompacted sediments, in which most of the pore water are trapped and dragged into the subduction. Occurrence of a low velocity channel in spite of the landward increase of the margin load implies overpressured fluids within the channel. Overpressured fluids at that place are moreover supported by a particularly weak decollement at the top of the lens, inferred by both a local uplift of the upper plate and enhanced extension within the overlying upper plate. (2) The subduction of seamounts without any sediment cover locally induces higher interplate coupling, as attested by compressive structures within the overriding upper plate.

The interplate heterogeneity, related to seamounts subduction, may favor basal erosion, by alternating processes which contribute either to weaken the upper plate or to drag detached parts of the weakened upper plate into the subduction: (1) the upper plate could be weakened by processes like : **-** hydrofracturation along the underside of the upper plate due to overpressured fluids within the low velocity channel, **-** enhanced deformation within the upper plate, due to both the subduction of oceanic plate relief and the variations of the interplate coupling resulting in formation of variable tectonic structures; (2) slices of the weakened zone may be dragged into the subduction by oceanic plate relief above which higher rates of coupling may occur. The layered zone at the bottom of the upper plate may correspond either to the damaged zone at the base of the upper plate, or to slices of upper plate material dragged into the subduction zone.