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An overview of the submarine morphology of the Ecuador-South Colombia convergent margin: implication for mass transfer and age of the Carnegie Ridge subduction

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A compilation of swath bathymetric data from the Ecuador South-Colombia subduction zone allows a detailed characterization of the geomorphology of the trench and margin seafloor. These data are used together with seismic reflection profiles to evaluate the age and the effects of the Carnegie ridge (CR) subduction, and thus determine the modes of mass transfer along the margin. The outer trench wall shows a well-developed flexural bending-fault pattern that cuts across the CR, and progressively rotates clockwise from south to north, parallel to the overall trench orientation, which varies from N to NE-trending. The first order segmentation of the Nazca plate due to the Carnegie Ridge and Grijalva Fracture Zone is reflected on the inner trench wall geomorphology, thus defining southern, central and northern margin segments. Sediment is transported from the Andes to the trench along the Guayaquil canyon across the southern margin segment, and along the Esmeraldas and Patia-Mira canyon systems across the northern margin segment, thus providing 0.8 km and up to 4.8 km trench fill, respectively. In contrast, little terrestrial sediment has been deposited in the shallow trench of the central margin segment. The overall morphological character of the central margin segment, which is characterized by a generally steep slope, mass wasting and a small frontal prism is compatible with an erosive margin, thus supporting negative mass transfer. Extensive mass wasting affected specifically the region of the northern central margin segment associated with the subduction of the northern flank of the CR, and the region that straddles the central and southern margin segments related to the subduction of the Grijalva Fracture Zone. Tectonic accretion is, however, active in the southern and northern margin segments in the form of the Guayaquil and Colombia accretionary wedges, which indicate positive mass transfer. According to GPS-based plate kinematics motions, we interpret the areas of extensively eroded margin slope along both the northern and southern regions of the central margin segment to result from the southward migration of the CR. This interpretation supports that the CR has been subducting since ∼4-5 Myr.