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Hydration clues from the Nazca plate subduction zone in the northern part of the Ecuadorian subduction zone

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Fluid circulation through the Earth system plays a particularly important role in subduction zones, where it has a significant influence on seismic activity and metamorphic processes. Fluid circulation around the shallow seismogenic zone is considered to promote episodes of seismic/aseismic slips on the megathrust fault plane as well as on active satellite faults, leading in earthquakes, slow slips, clusters, repeaters, non-volcanic tremors activity.

Recent marine surveys conducted along the Ecuadorian margin, as part of the Fluid2Slip ANR project, have collected bathymetric dataset focusing on the Pedernales segment that ruptured during the M7.8 earthquake in 2016 (HiPER 2020 & 2022, SUPER-MOUV 2024). These data, combined with seismic reflection and refraction profiles, as well as seismological data from temporary dense deployments, provide preliminary insights on the structures potentially involved in the hydration hints of the Nazca oceanic plate.

Interpretation of MCS profiles enables the identification of the network of bending faults along the trench outer-wall and the characterization of the geometry of these faults. These faults exhibit vertical offsets of up to 300 m at the seafloor and, in some cases, shift the oceanic Moho, which may facilitate the hydration of the relatively young Nazca Plate in this area (< 15 Myr).

For the first time, a trench-normal dense OBS profile north of the Atacames seamounts characterizes the geometry and structure of the northern flank area of the Carnegie Ridge. We were able to show that the oceanic crust in this area is significantly thicker than expected (>12 km), well beyond the topographic signature of the Carnegie Ridge. By recording converted P-to-S waves along this OBS profile, we were able to quantify the P and S velocities of the oceanic crust at the trench. Local seismicity detected by the OBS refraction grid in the plate bending area close to the trench provides highlights to the in-depth crustal structure.

This work is complemented by the 3D tomographic inversion of HIPER2 cruise and by new hints on fluid pathways through the margin by the SUPER-MOUV cruise, both presented in the same session.