Characterizing the forearc basement and subducting structures of the northern Ecuadorian margin

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Résumé

In Ecuador, the 2016 Mw 7.8 Pedernales earthquake rupture area was accompanied by aseismic slip at shallower depth such as slow earthquake and post-seismic slow slip. In addition, the relatively small forearc and shallow megathrust along the Ecuadorian margin makes it an exceptional natural laboratory to study the link between the ongoing subduction of topographic highs (Carnegie ridge) and seismic/aseismic slip behavior on the plate interface. The HIPER Project (2020-2022) which aims at better characterizing the 3D structure of this forearc domain is based on an international collaboration funded by the French Oceanographic Fleet, the French ANR, Karlsruhe Institute of Technology (KIT, Germany), American NSF and IG-EPN (Ecuador). We successfully deployed a large number of OBS (47), land stations (_˜200) and nodes (_˜500) to record both R/V L'Atalante's shots and seismic activity.

We collected a grid of five trench-parallel and nine trench-perpendicular profiles that were shot along a 150-km-long margin segment off Esmeraldas and Pedernales. Travel times of first arrivals and oceanic Moho reflections have been picked on these refraction profiles leading to a total of _˜33000 picks. The obtained dataset has been used for 2D travel time tomography (WAS) using the Bayesian approach of the Tomo2D code modified by Korenaga and Sager (2012).
P-waves velocity models have been obtained for the fourteen profiles, with a good resolution down to 12 km depth providing new information of the frontal forearc domain. Existing multichannel seismic data (MCS) along four of our profiles (2 dip-lines and 2 strike-lines) provide the position of the forearc basement acoustic reflector that is used to interpret the tomographic velocity profiles. A joint use of MCS and WAS profiles, allows the identification of a high vertical velocity gradient zone consistent with the forearc basement, from which we can derive a 3D map. We also imaged an inner margin wedge characterised by low velocities, which could affect slip propagation to the trench. In the downgoing plate, we identified a low velocity anomaly that may be related to the subduction of a fracture zone.

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Mots-Clés: Ecuadorian margin, Seismic tomography, Ocean bottom seismometers, Velocity structure, Subduction interplate, Forearc crust