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Geometry of Moho, crustal seismicity and volcanic reservoir beneath Ecuador

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We present a model of the Moho discontinuity beneath Ecuador based on the seismic tomography performed with a dataset of the records of 62,551 earthquakes by the Ecuadorian seismic network (RENSIG). To obtain this model, we first determine at each latitude and longitude the depth corresponding to the maximum of the norm of the P-velocity gradient, in the range of velocity between 7.2 km/s and 7.4 km/s. It corresponds to a trade off between two strategies: the first one consisting in identifying the Moho discontinuity with an iso-velocity surface, and the second one in taking as depth of Moho the one at which the norm of P-velocity gradient reaches its maximum.

The resulting topograghy is relatively rough and suffers from a lack of resolution on its boundaries. The smoothing combination of this topography with results of seismic profiles obtained by the marine SISTEUR and SALIERI experiments at West over the margin, and isostasy considerations at North allows us to compensate these deficiencies for our final model. This model allows the clear identification of the sedimentary basins in the coastal region, and mainly displays a dramatic transition between the coastal plains and the Cordilleras.

The results of the seismic tomography also helped us to improve the localization accuracy of the shallow seismicity. In the Cordilleras, apart the volcanic crisis that occurred during the study period, the intense seismic activity around volcano edifices along the western Cordillera must be related to the Quito-Latacunga fault system down to its connection, South of Chimborazo, with the Chingual-Cosanga-Pallantaga-Puna (CCPP) fault system. There are also several large shallow clusters that could be relocated by double difference, and which are related to tectonic deformations, as the ones of Pisayambo related to the CCPP fault system, of Macas, and of Reventador also partly related to the volcanic activity.

Finally, tomographic study of the shallower structures allows a clear identification of the deep feeding reservoir of the volcanic range through large values of the ratio of P- over S-velocity, corresponding to partial melting that produces low rigidity with respect to bulk modulus. Our tomography model displays large values of this ratio within an elongated zone between 2°S and 0.5°N at depths ranging from 35 to 75 km at the base of the crust beneath the western Cordillera. We can also observe that the southern limit of this zone coincides with the latitude of the Sangay volcano that is the southernmost volcano of the arc.