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Seismic structure of the Nicaragua convergent margin by travel time tomographic inversion of wide-angle seismic data

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We present here a seismic velocity model of the Nicaragua convergent margin, defined by the subduction of the Cocos plate under the Caribbean plate. The model is obtained by travel time inversion of wide-angle seismic data acquired in 13 OBH (Ocean Bottom Hydrophones) and 9 land stations along a 253 km-long profile in the framework of the NicSeis survey carried out in 2000 on the R/V Maurice Ewing. From each OBH record section travel time data was obtained for all relevant seismic phases which in this case were: upper and lower plate and upper mantle refractions and reflections at the intra-plate and at the oceanic Moho discontinuities. The first step of the inversion process was to obtain a reference model which roughly accounted for every pertinent phase by forward modeling. The next step was to conduct the tomographic inversion itself. Finally some modified inversions were tested using different values of the correlation length parameters to evaluate their influence on the resulting model.

The tomographic inversion procedure was divided in two phases. In the first phase only seismic refractions (first arrivals) traveling within the overriding continental plate (P1) up to the intra-plate boundary as well as the reflections at the boundary itself (P1P) were considered in order to resolve the upper plate velocity distribution and the subduction geometry. Afterwards the model was gradually extended to the full length of the profile and to the upper oceanic mantle depth by inserting and fixing the previous final model as part of the new initial model and adding the additional phases corresponding to refracted waves in the subducting oceanic plate (P2) and the oceanic mantle (P3), and the reflected waves at the oceanic Moho (P2P).

The resulting model shows three areas of well differentiated seismic velocities: at the uppermost part, the sedimentary basins limiting with the top of the basement. Below, the plate is divided into two western and eastern sides. The latter has seismic velocities characteristic of upper continental mantle at 20 km depth which indicates a thin continental crust.