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Structure of the Lesser Antilles subduction zone from wide-angle seismic tomography

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Two wide-angle seismic experiments provide new insights on the fore-arc and deep structure of the Lesser Antilles subduction zone offshore Dominica - Martinique. The region is characterized by a relatively low rate of seismicity that is often attributed to the slow (2 cm/yr) subduction of the old, 90 My, Atlantic lithosphere beneath the Caribbean Plate. Our 3D velocity model of the fore-arc region can clearly be divided between an inner fore-arc, characterised by a high velocity crust, and an outer fore-arc with lower crustal velocities. Oceanward, the outer fore-arc toe acts as a backstop on which the accretionary wedge developed. The outer fore-arc, up to 70 km wide in the northern part of the study area, is getting narrower to the south and disappears offshore Martinique, where the inner forearc acts as the backstop. The northernmost tip of Barbados accretionary wedge reaches $\sim$7 km decreasing sharply where the Tiburon Ridge enters the subduction. Based on its seismic velocity structure with velocities higher than 6 km/s the backstop consists, at least partly, of crystalline rocks. With respect to the inner fore-arc velocity structure the outer fore-arc basement could either correspond to an accreted terrane or made of highly fractured rocks. The backstop appears also highly deformed and faulted within the subducting trend of the Tiburon Ridge. On the other hand, the thick, high velocity, inner fore-arc is possibly the extension at depth of the Mesozoic crust outcropping in La Désirade Island. This crustal block tilted southward is likely very strong, less deformable and acting as a rigid buttress increasing the strain within both the overriding and subducting plates. This appears clearly in the current local seismicity affecting the subducting and the overriding plates that is located beneath the inner fore-arc. Wide-angle reflection travel times were inverted to constrain the deepest interfaces within a dense 2D velocity model and image the possible extent of the interplate contact. It appears that the overriding plate is characterized by a thick crust, the Moho interface being at $\sim$30 km depth. An intra-crustal interface 20 km deep that strikes only beneath the inner fore-arc region is also imaged separating the upper crust from the lower crust.