

Seismic Imaging of the Lesser Antilles Subduction Zone with the VOILA Project

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The Volatiles in the Lesser Antilles (VOILA) project is a multidisciplinary experiment to understand the pathway of fluids and volatiles in the Lesser Antilles subduction system, where oceanic lithosphere from the slow-spreading Mid Atlantic Ridge is descending in the mantle. Here we present results from the passive seismic ocean bottom deployment of 32 instruments on the back arc and forearc regions. We use teleseismic Rayleigh wave dispersion and S-to-P receiver functions to image the slab, upper plate, and wedge structures. We calculated receiver functions using a multitaper method. We measure dispersion from 18-111 s period, which increases from 3.64 at 18 s period to 4.21 at 111 s. Receiver functions image the Moho that varies from 29 to 40 +/- 4 km depth beneath the arc. In the northern and central section of the arc we image the base of the upper plate at 73 +/- 5 km depth beneath the arc and backarc. The slab itself dips too steeply to be imaged using this method. In the southern arc we image a negative phase that may be related to a more gradually dipping slab at 101 -117 +/- 5 km. The receiver functions are in good agreement with constraints from surface waves. At 18-33 s period we observe low velocities beneath the arc across the region, with higher velocities on either side, consistent with thickened crust and possibly a low velocity mantle wedge region beneath the active arc region. At 40-81 s period a N-S trending high velocity region, ~100 km wide, is observed, which shifts position westward with increasing period, migrating from the forearc to beneath the arc, which we interpret as the slab. At longer periods (81-111s) the high velocity anomaly persists north of Guadeloupe, suggesting the slab may persist to greater depths in this region.

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