



Tectonic evolution and mantle structure of the Caribbean

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In the broad context of investigating the relationship between deep structure & processes and surface expressions, we study the Caribbean plate and underlying mantle. We investigate whether predictions of mantle structure from tectonic reconstructions are in agreement with a detailed tomographic image of seismic P-wave velocity structure under the Caribbean region. In the upper mantle, positive seismic anomalies are imaged under the Lesser Antilles and Puerto Rico. These anomalies are interpreted as remnants of Atlantic lithosphere subduction and confirm tectonic reconstructions that suggest at least 1100 km of convergence at the Lesser Antilles island arc during the past ~ 45 Myr. The imaged Lesser-Antilles slab consists of a northern and southern anomaly, separated by a low velocity anomaly across most of the upper mantle, which we interpret as the subducted North-South America plate boundary. The southern edge of the imaged Lesser Antilles slab agrees with vertical tearing of South America lithosphere. The northern Lesser Antilles slab is continuous with the Puerto Rico slab along the northeastern plate boundary. This results in an amphitheater-shaped slab and it is interpreted as westward subducting North America lithosphere that remained attached to the surface along the northern boundary. At the Muertos Trough, however, material is imaged until a depth of only 100 km, suggesting a small amount of subduction. The location and length of the imaged South Caribbean slab agrees with proposed subduction of Caribbean lithosphere under the northern South America plate. An anomaly related to proposed Oligocene subduction at the Nicaragua rise is absent in the tomographic model. Beneath Panama, a subduction window exists across the upper mantle, which is related to the cessation of subduction of the Nazca plate under Panama since 9.5 Ma and possibly the preceding subduction of the extinct Cocos-Nazca spreading center. In the lower mantle two large anomaly patterns are imaged. The westernmost anomaly agrees with the subduction of Farallon lithosphere. The second lower mantle anomaly is found east of the Farallon anomaly and is interpreted as a remnant of the late Mesozoic subduction of North and South America oceanic lithosphere at the Greater Antilles, Aves ridge and Leeward Antilles. The imaged mantle structure does not allow us to discriminate between an 'Intra-Americas' origin and a 'Pacific origin' of the Caribbean plate.