Assessing the geodynamics of strongly arcuate subduction zones in the eastern Caribbean subduction setting

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The eastern Caribbean Lesser-Antilles subduction system is a strongly arcuate subduction system. We have investigated the dynamics of this system through numerical modelling, demonstrating the developed capabilities and computational feasibility for assessing the 3D complexity and geodynamics of natural subduction systems and applied this to the eastern Caribbean region. We show the geodynamic feasibility of westward directed trench-parallel slab transport through the mantle, i.e. slab dragging, on the northern segment of the slab, while the eastern segment of the slab is subducting by a mantle-stationary trench. The resistance of the mantle against slab dragging by the North American plate motion, as well as the deformation associated with the arcuate geometry of the slab, creates a complex 3D stress field in the slab that deviates strongly from the classical view of slab-dip aligned orientation of slab stress. More generally this means that the process of slab dragging may reveal itself in the focal mechanisms of intermediate and deep earthquakes. The characteristics of the arcuate subduction such as slab dragging and a complex 3D stress field as studied in the Caribbean region can be more generically applied to other arcuate subduction systems as well, such as the Izu-Bonin-Marianas or the Aleutians-Alaskasystems, where anomalous focal mechanisms of slabs are observed.