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Dynamic topography of a gravity-constrained crustal model across the Caribbean Region

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Debate continues on which regions of Earth surface, if any, have been warped by viscous stress induced by mantle convection (i.e. dynamic topography). Recent studies have analyzed dynamic topography within 'normal' oceanic lithosphere regions (Hoggard et al., 2016), since the topography expected from isostasy alone is more straightforward to obtain for these regions. However, areas of complex crustal structure such as the continental lithosphere and overthickened oceanic lithosphere have not been fully analyzed due to the lack of well constrained basement and Moho relief. Here we analyze whether dynamic topography exists within the Caribbean Large Igneous Province, a known area of overthickened oceanic lithosphere.

The Caribbean region has been proposed as a candidate for outflow of asthenospheric mantle, from a shrinking Pacific region to an expanding Atlantic region. This flow would produce a potentially observable dynamic topography gradient across the region. Therefore, a detailed analysis of dynamic topography can potentially indicate the direction and intensity of mantle flow. However, the dynamic topography across the Caribbean region remains unclear due to the complexities of the Caribbean crust, which is thicker than average oceanic crust of 7 km, and the lack of comprehensive and highly-resolved basement and Moho information.

We conducted a 3D structural inversion of the Moho using free air gravity anomalies with prescribed surface relief and basement relief. Published global grids of Gtopo 30 and TerrainBase were used for topography and bathymetry, respectively. The basement relief was derived by subtracting the published sediment thickness from the total surface relief. Sedimentary density was derived from empirical relations of sediment depth vs density. Lithospheric mantle density of oceanic plates was derived from relations of lithospheric age vs density. Moho depths and basement relief can be tested against independent seismic refraction and receiver function data. Discrepancies exist possibly due to uncertainty in sediment thickness. Here, we show and compare Moho depths and basement depths from our inversion, the interpolation of high-quality refraction data, and the depths from previous studies.