



Past, present, and future mesophotic reef shelf accretion potential: A carbonate budget approach

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Heterogeneous geomorphology in mesophotic reefs promotes high biodiversity and refuges for commercially important fish. Yet little data are available to understand the geological history and structural sustainability of the underlying architectural framework supporting these deep systems. To address these concepts, the first mesophotic reef carbonate budget model was used in the U.S. Virgin Islands at four upper mesophotic reef habitats with different structural characteristics. Combining bioerosion and calcification measurements, coral cover and rugosity surveys, and sediment composition analyses showed that coral growth did not always dominate gross carbonate production but all mesophotic reef habitats had positive net carbonate production rates. Rates were within the range measured by other studies for shallow-water reefs throughout the Caribbean but were lower than those estimated from mesophotic sites nine years earlier, suggesting mesophotic reef structure is not completely spared from climate change processes degrading shallow-water reefs. Still, net positive rates imply these mesophotic reefs are able to maintain and build structural complexity. Reef accretion and sea-level models suggest that variable net carbonate production rates were not the main driver of complex, shelf-wide geomorphology. However, assuming relatively continuous accretion rates since the stabilization of present-day sea level, results indicate net carbonate production variability greatly contributed to the habitat-scale structural complexity differences that help maintain high biodiversity.