Chemoautotrophy in the redox transition zone of the Cariaco Basin: A significant midwater source of organic carbon production

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ABSTRACT: During the CARIACO time series program, microbial standing stocks, bacterial production, and acetate turnover were consistently elevated in the redox transition zone (RTZ) of the Cariaco Basin, the depth interval (~240-450 m) of steepest gradient in oxidation-reduction potential. Anomalously high fluxes of particulate carbon were captured in sediment traps below this zone (455 m) in 16 of 71 observations. Here we present new evidence that bacterial chemoautotrophy, fueled by reduced sulfur species, supports an active secondary microbial food web in the RTZ and is potentially a large midwater source of labile, chemically unique, sedimenting biogenic debris to the basin's interior. Dissolved inorganic carbon assimilation (27-159 mmol C m^{-2} d^{-1}) in this zone was equivalent to 10%-333% of contemporaneous primary production, depending on the season. However, vertical diffusion rates to the RTZ of electron donors and electron acceptors were inadequate to support this production. Therefore, significant lateral intrusions of oxic waters, mixing processes, or intensive cycling of C, S, N, Mn, and Fe across the RTZ are necessary to balance electron equivalents. Chemoautotrophic production appears to be decoupled temporally from short-term surface processes, such as seasonal upwelling and blooms, and potentially is more responsive to long-term changes in surface productivity and deep-water ventilation on interannual to decadal timescales. Findings suggest that midwater production of organic carbon may contribute a unique signature to the basin's sediment record, thereby altering its paleoclimatological interpretation.

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