Effects of surface roughness and oscillatory flow on the dissolution of plaster forms: Evidence for nutrient mass transfer to coral reef communities

Falter, James L., Marlin J. Atkinson, Carlos F. M. Coimbra

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ABSTRACT: We dissolved plaster forms in seawater to examine the effects of surface roughness and flow conditions on masstransfer rates. Plaster blocks with varying roughness were dissolved under both steady and oscillatory flows between 7 and 43 cm s^{-1} yielding calcium mass-transfer coefficients (S_{Ca}) that varied from 0.5 to 3 m d^{-1}. SCa measured in a flume was 30-40% greater under oscillatory flow than under steady flow at flow speeds <10 cm s^{-1}; this difference decreased with increasing flow speed. Plaster blocks with added millimeter-, centimeter-, and decimeter-scale roughness were dissolved under oscillatory flows between 2 and 26 cm s^{-1} on three different coral reef flats. Plaster dissolution rates in the field were linearly proportional to surface area regardless of the roughness scale. Variation in S_{Ca} across different reef environments was less affected by whether the flow was steady or oscillatory (a factor of 1.2-1.6) than it was by flow speed alone (a factor of 4.7).

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