

ID: W2542527794

TITLE: Sediment generation by Halimeda on atoll interior coral reefs of the southern Maldives: A census-based approach for estimating carbonate production by calcareous green algae

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ABSTRACT:

Methods for quantifying rates and size fractions of carbonate sand production on reefs remain limited, despite the urgent need for such data to support assessments of reef island and tropical beach-dominated shoreline resilience. Here we present a census-based approach that supports estimates of sediment generation by the calcareous green alga *Halimeda* spp., which is an often conspicuous reef and lagoon substrate coloniser. Based on data from Kandahalagala (South Huvadhu atoll, southern Maldives), we present carbonate sediment production data for the two dominant *Halimeda* spp. (*Halimeda macrophysa* and *Halimeda micronesica*) that occur on the reef flat and reef slope habitats. Whilst total mean production rates by *Halimeda* spp. are similar in both habitats (reef flat average, 67.49 g CaCO<sub>3</sub> m<sup>-2</sup> yr<sup>-1</sup>; reef slope, 70.89 g), individual species contributions differ markedly. *H. micronesica* dominates on the reef flat (annual mean 41.91 g CaCO<sub>3</sub> m<sup>-2</sup> yr<sup>-1</sup>, compared to 25.08 g by *H. macrophysa*), whilst production is dominated by *H. macrophysa* on the reef slope (*H. macrophysa* 40.49 g, *H. micronesica* 29.01 g CaCO<sub>3</sub> m<sup>-2</sup> yr<sup>-1</sup>). In terms of sediment generation we show that these species also contribute very differently to the sediment reservoir. Whilst the sedimentary breakdown products from *H. micronesica* are somewhat bimodal (~ 17% is in the medium to very coarse sand fraction, and ~ 76% in the silt and clay fraction), almost all (> 90%) of the segments produced by *H. macrophysa* rapidly degrade to silt and clay sized sediment. Based on our census data this suggests that *Halimeda* spp. will contribute only between 7 and 9 g m<sup>-2</sup> yr<sup>-1</sup> of sand grade sediment on the reef flat and shallow slope habitats, but ~ 55-60 g m<sup>-2</sup> yr<sup>-1</sup> of mud grade sediment. Scaled to the total area of combined reef habitat around Kandahalagala (~ 130,583 m<sup>2</sup>) this equates to *Halimeda* spp. producing ~ 2192 kg of sand-grade sediment, but ~ 15,181 kg of mud-grade sediment per year. However, sediment compositional data suggests that *Halimeda* sp. are actually a very minor constituent of reef and islands sediments, especially in the fine sediment fractions. This 1) suggests that much of the predominantly finer-grained sediment generated by *Halimeda* has little actual relevance to the later stages of reef island development, and 2) highlights the potential for marked discrepancies in terms of sediment generating reef species abundance and resultant sediment generation rates, especially in terms of the types and sizes of sediment that are appropriate to supply adjacent beaches and islands.

SOURCE: Sedimentary geology

PDF URL: None

CITED BY COUNT: 21

PUBLICATION YEAR: 2016

TYPE: article

CONCEPTS: ['Halimeda', 'Reef', 'Atoll', 'Sediment', 'Coral reef', 'Geology', 'Oceanography', 'Carbonate', 'Coralline algae', 'Fringing reef', 'Silt', 'Algae', 'Ecology', 'Geomorphology', 'Biology', 'Materials science', 'Metallurgy']