Rapid Marine Cementation Can Preserve Porosity and Permeability of Grainstones

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In modern oceans, syndepositional, submarine cementation extends from the intertidal zone to depths of the order of a thousands meters, In shallow tropical seas like those of Great Bahama Banks the cement is fibrous aragonite rimming grains. Even grain rims of only 30µ can produce submarine hardgrounds, wave resistant coral reefs and columnar stromatolites of ooid sand up to two meters tall. The annual growth rate of this cement ranges from 37 to 100 µ/yr. with an average of 30µ/yr (Grammer et al, 1993.). This amazingly rapid cementation therefore needs only a few months of sand stability to produce initial formation of limestone. Grain rims of 30+µ reduce both porosity and permeability. If the reduction in permeability is significant it limits the continued growth of fibrous aragonite cement by flushing pore water and it will result in incomplete or arrested cementation and the preservation of a still porous but rigid fabric.

The amount of carbonate in normal sea water is some 12 X 10-6 % by volume. If all the carbonate of a pore were removed some 100,000 pore volumes would be needed to fill the pore with cement. If however the amount extracted was more realistic, for example only 1%, then a million pore volumes of water would be needed to fill the pore with cement.This back-of -the-envelope estimate helps us understand why marine cementation is so widespread in areas where there is frequent flushing of interstitial pores.