Making Holes in Carbonate by Microbial Acid and Gas: A Case Study in the Bahamas

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The current explanation for the formation of pores, holes and caves in marine limestone, is the combination of acidic meteoric water and mixing of $CaCO_3$-supersaturated seawater with $CaCO_3$-saturated groundwater creating under saturated mixed water. We now know that the mixing of these bodies of water cannot dissolve limestone unless there is a continuous source of acids to overcome the buffering effects of the limestone. Similarly, rainwater that is slightly acidic via incorporation of atmospheric and soil CO_2 cannot remain acidic during its passage through marine-limestone.

Large numbers of interstitial bacteria are the obvious sources of acid and gas needed to initiate and maintain acidic meteoric and ground-water conditions. We have shown that rainwater over San Salvador Island before contact with the ground, has a pH of 5.6, and is buffered within three minutes to 8.6 following contact with local limestone. Buffered rainwater passing through 3 meters of limestone arrives in vadoses cave as acidified drip-water with a pH of 6.7. We hypothesize that the dissolution capacity of meteoric-water is controlled by the assimilation of bacterially generated acids and gas, produced in the pores of the host rock. Heterotrophic bacteria also produce large quantifies of gas in unconsolidated rock and can generate blisters or pores. The gas they generate is temporarily trapped in their mucilage causing a ballooning effect and subsequent displacement of the surrounding unconsolidated grains. The resulting sedimentary textures formed by microbial acid and gas, in modern carbonate rocks, appears to match textures observed in ancient carbonate cores.