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Revisiting beachrock cementation processes

Villaneda-van Vloten, I.F.¹, Gonzalez, L.A.² and Roberts, J.A.² Tsoflias, G.P.²

¹University of Kansas-Geology, 1475 Jayhawk Blvd., Lawrence, KS 66045, isabelvvv@gmail.com

²University of Kansas-Geology, 1475 Jayhawk Blvd., Lawrence, KS 66045

Beachrock refers to multigenerational layers of shoreface beach sediments that have been cemented (most commonly by calcium carbonate). Beachrock provides protection from beach erosion, has been used to date sea level changes, and provides a protective layer against cementation to adjacent or underlying sand units. Beachrock porosity and permeability is variable but seems to be less porous and permeable at the surface. Shoreface cemented sand bodies often extend parallel to shore for kilometres at a time.

Multiple mechanisms have been proposed to drive cementation, including 1) CO₂ degassing of pore fluids; mixing of marine and meteoric waters; 3) evaporation pore fluids; and 4) biological activity [1]. There is, however, no consensus as to whether there is a single prevailing mechanism or whether any biological process necessary for cementation. We address four major questions regarding beachrock cementation: 1) Is cementation at a given site or region a process driven by a unique fluid or fluid mixture or are diverse fluids carrying out cementation?; 2) Is evaporation a necessary process?; 3) Is microbial activity vital to cementation?; and 4) What generalities can be made concerning beachrock geometries?



Figure 1: Laterally extensive beachrock exposure in Hatillo, PR.

We have sampled three mixed system, open ocean, high energy, normal salinity beachrock sites in Northwestern Puerto Rico in order to conduct an extensive study including geophysical mapping of deposits, petrographic analyses, and geochemical analyses. Preliminary results from one site show that carbonate cements along a transect perpendicular to shore vary distinguishably. Carbonate cement's isotope values reflect proximity to shore with differing degrees of marine vs. fresh water influence.

This research will define the fluid conditions conducive to cementation of beachrock. It will provide a predictive framework for geometry based on cement isotope data. It will examine the role of biota and biota diversity on cementation. It will also provide a better understanding of beachrock geometries that are vital for construction of accurate models.

References:

- [1] Voudoukas M, Velegrakis A, and Plomaritis T (2007) *Earth-Science Reviews* 85(1-2), 23-46
- [2] Kaye C, and Altschuler Z(1959) *USGS Professional Paper* 317-B, 49-139

