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Petrographic criteria for distinguishing tropical versus arid laminated calcrete deposits, Puerto Rico

Kuklewicz, K.B.¹, and Gonzalez, L.A.¹

¹Department of Geology, University of Kansas, Lawrence, Kansas, U.S.A, kkuklewicz@ku.edu

Although calcretes have been extensively studied, there is considerable uncertainty on the role of hydrology and biological processes on calcrete formation. Commonly cited controls that govern the creation of calcrete include [1]; parent material, hydrology, evaporation, evapotranspiration, vegetation dynamics, and microbes. Although laminated calcretes have been documented in areas with precipitation of up to 800 mm/year [2] all too often they are interpreted as arid (e.g. low precipitation) climate indicators. This study investigates the controls of calcrete formation by comparing textures, fabrics, morphological characteristics, petrophysics (i.e. NMR and geoelectrical methods), geochemistry, and biogeochemistry of calcrete from regions with high and low precipitation. The objectives of the project are to: 1) characterize similarities/differences in the petrography of humid vs. arid zone calcretes; 2) determine factors that result in similar/different textures and chemistry; 3) establish if the resulting textures and chemistry are reflective of climatic differences, distinct biological processes, or a complex interaction of multiple controls. Results of the project will establish diagnostic criteria that allow identification of the hydroclimatic conditions under which calcrete formed.

Puerto Rico, located in the northeastern Caribbean, is an excellent location to study Quaternary calcrete deposits due to the abundant calcrete crusts present on both the northern (high precipitation) and southern (low precipitation) coastal plains. The regional climate of Puerto Rico is mainly controlled by the easterly trade winds. The majority of annual precipitation falls during the months of May through December (Figure 1A; [3]). Due to Puerto Rico's small size, the latitudinal and longitudinal range is narrow, thus the temperature differences between the north and south coast are minimal (Figures 1B, 1C). Calcrete samples are being collected from multiple sites along both the northern and southern coast to capture the diversity of textures, surficial geometries, and associated biota differences.

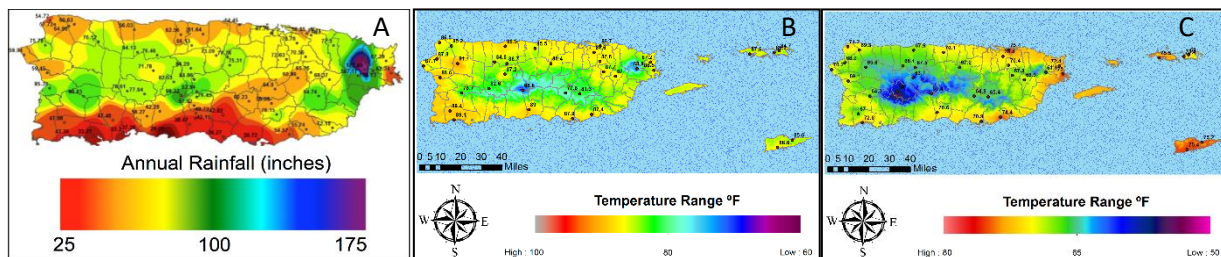


Figure 1: NOAA 30 year mean climatology for Puerto Rico, 1981-2010. A) Mean annual rainfall. On the tropical northern coast precipitation ranges from 1422 to 1650 mm/yr. On the dry southern coast precipitation ranges from 736 to 1120 mm/yr. B) Annual average maximum temperature. North coast average maximum temperature ranges from 29 to 32°C. South coast average maximum temperature is less variable and slightly warmer, roughly 32°C. C) Annual average minimum temperature. North coast average minimum temperature ranges from 19 to 22°C. South coast average minimum temperature

ranges from 19 to 23°C, roughly the same as that of the north coast. Images generated at http://www.srh.noaa.gov/sju/?n=pr_usvi_normals. January 14, 2016.

References:

- [1] Alonso-Zarra A and Wright V (2009) *Developments in Sedimentology* 61: 255-267
- [2] Semeniuk V and Searle D (1985) *Journal of Sedimentary Petrology* 55: 86-95
- [3] Larsen M and Simon A (1993) *Geografiska Annaler* 75: 13-23

