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THE OCCURRENCE OF GROUNDWATER ON ISLANDS OF THE BELIZEAN BARRIER REEF

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Extended Abstract

The characteristics of three coral sand islands located along the 220 km long Belizean Barrier Reef (Figure 1) have been studied over a period of years, with a view to the long term quantity fluctuations and quality implications for the fresh water lens, from both climatic and anthropogenic effects.

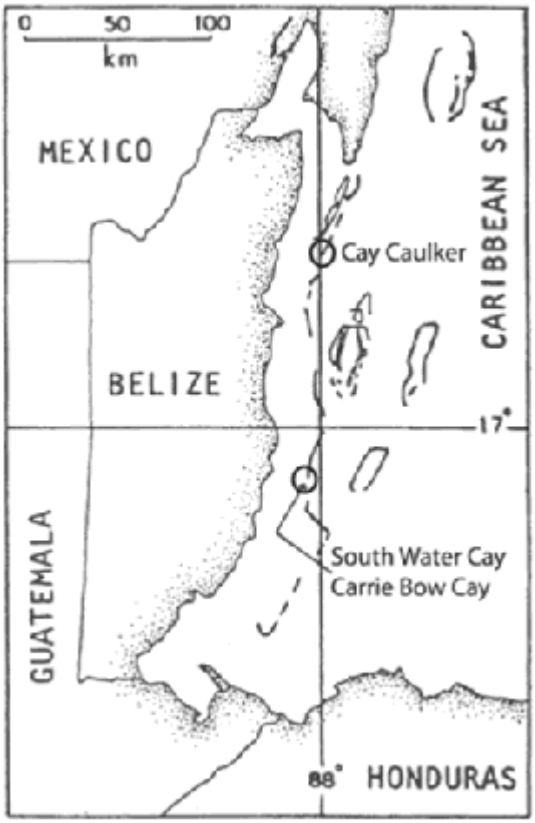

Figure 1 Location map of Belize islands.

The influencing factors for lens formation and size range from storm sea water overwash to the results of human occupation. Basic to all islands are similar hydro-geologic regimes, but with great differences in land development and natural resource use.

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The islands are all less than two m in elevation above sea level and consist of fragmented coral and sand of Pleistocene age perched on a much older shallow flooded extension of the limestone plateau of the Yucatan Peninsula. Annual precipitation ranges from about 1300 mm for the northernmost island of Caye Caulker and increases to about 2200 mm for the southerly islands of South Water Cay and Carrie Bow Cay situated at the mid-region of the barrier reef. There is a marked dry season from February through May.

The small coral reef islands of Carrie Bow Cay and South Water Cay receive sufficient groundwater recharge to develop fresh water lenses in accordance with the Ghyben-Herzberg principle. The hydro-geology, climate, and tidal conditions for both islands are the same, with the landmasses differing only in size.

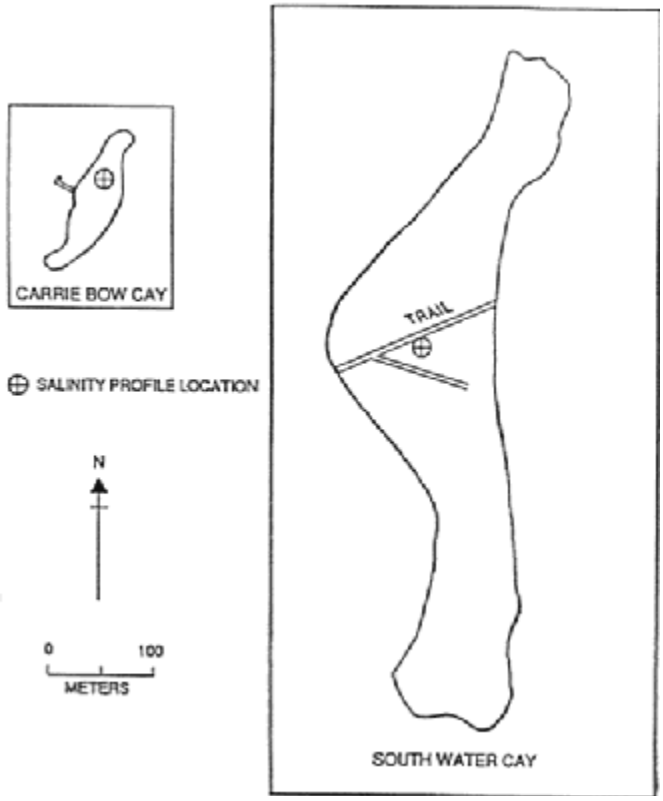

Figure 2 Plan view of Carrie Bow Cay and South Water Cay.

Thus, the effect of size on fresh water lens formation can be evaluated. Carrie Bow Cay is about 135 m long and only 38 m wide at its maximum width, while South Water Cay, lying about 1 km north, is about 600 m long and averages 100 m wide. On both islands there is little runoff, with most of the precipitation infiltrating to the water table.

As illustrated in Figure 3, on tiny Carrie Bow Cay a very thin fresh water layer of about 5 cm thick at the center of the island develops by the end of the rainy season, but by the end of the dry season the water is brackish to the surface of the lens.

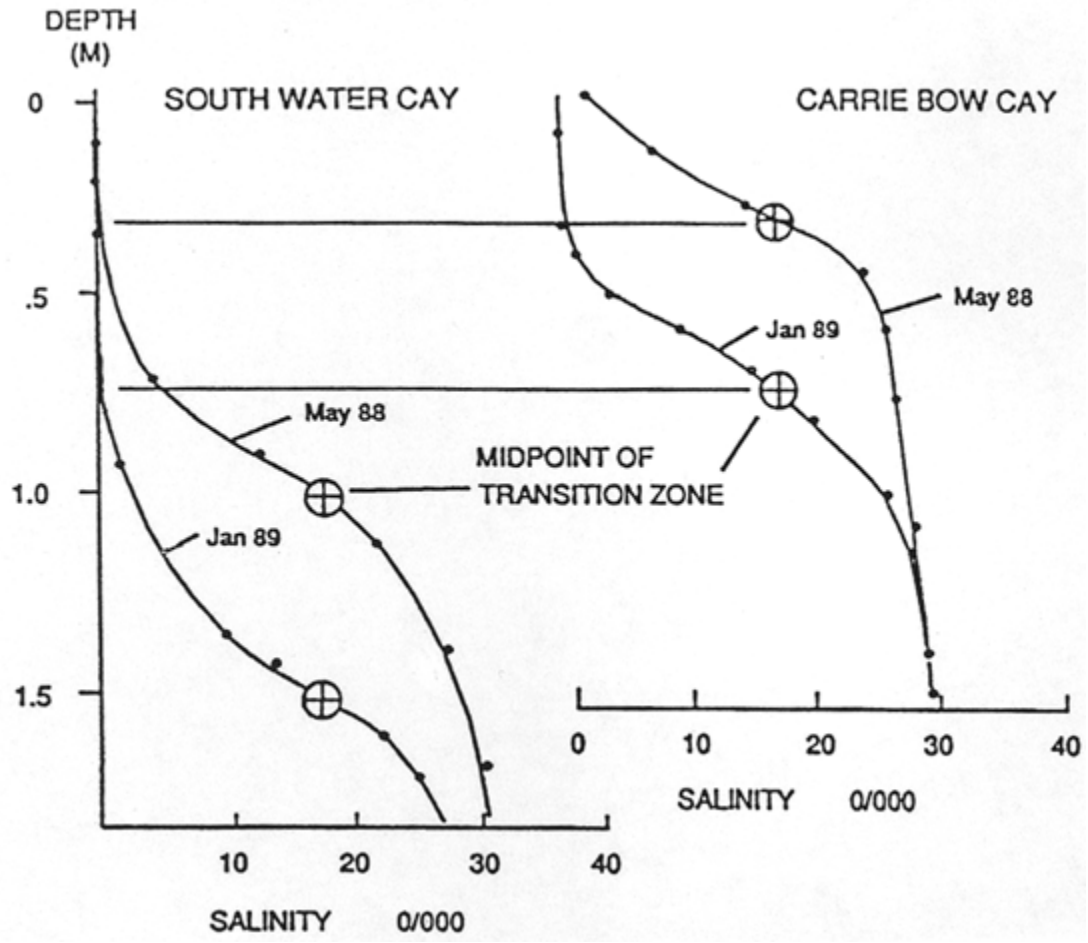

Figure 3 Vertical profiles of the freshwater lens and transition zone on South Water Cay and Carrie Bow Cay.

On South Water Cay the fresh water lens typically is about a meter thick at the end of the wet season, but shrinks to 1/2 m in thickness by the end of the dry season. Both lenses, however, have a transition zone from fresh to salt water which remains constant at about 1 m thick.

Caye Caulker is the northernmost island and largest island studied, measuring about seven km in length and averaging about 600 m wide. It is unique among the islands evaluated in that both its groundwater quantity and quality are threatened by over-development. The fresh water lens is estimated to be somewhat greater than 1 m thick at the widest part of the island, but is heavily exploited as a non-potable water supply. The density of population with associated in-ground sewage and waste disposal constitute a concern both for the public use as well as for the coastal discharge to the natural

environment. Thus, while the groundwater of Carrie Bow Cay and South Water Cay are relatively pristine, that of Caye Caulker has an impaired water quality.