GEOHYDROLOGY PROGRAM REPORT
MARCH 1999

Abstract

The worldwide degradation of coral reefs is evident throughout the Caribbean area, including the area offshore from Akumal. Ground water draining from the interior of the peninsula crosses all ecosystems, including those in the coastal area. From its beginning, CEA has placed the protection of the reefs high on its list of priorities. Early studies demonstrated high levels of contamination in Akumal's ground water and *Environmental Report 1*, published by CEA in 1997 presents evidence that the inland drainage may follow discrete channels, rather than spread throughout a three dimensional aquifer, as had been believed previously. Also, it has been proved that inland water is trapped behind the high tide and released at low tide when it flows out over the ocean as floating streams.

Ongoing studies consist of a study of inland ground water flow and quality, mapping of hydrologic limestone units, some of which are heavily dissolved and might be recharge areas and, finally, a project to map the topography of the ocean floor within the newly proposed Marine Protected Area off Akumal. A GPS and sounder has been purchased with a PADI Foundation grant to facilitate the offshore mapping program. The results of these studies will provide scientific support for a variety of CEA projects aimed at protection of the reef system.

Introduction and Background

The geohydrology program was one of the first efforts undertaken by CEA shortly after it's founding in 1993. Aware that coral reefs worldwide were under pressure from many sources, both natural and anthropogenic, CEA early on decided that saving the reefs was a first priority of the new organization. Many of the programs that have been devloped at CEA since that time have been related to that goal in one way or another.

Ground water moves from the interior of the Yucatan Peninsula to the ocean through limestone caves. As it does so, it is a water source for all of the inland and coastal ecosystems. If anthropogenically derived contamination is introduced to into the ground water drainage at any point, it will be introduced to all downstram ecosystems, including the bays and the coral reefs. Understanding of the dynamics and rate of movement, chemistry, areas of recharge and potential and actual sources of contamination of ground water is essential to protecting all of the ecosystems from degradation.

The program began with a survey of ground water quality in 1994. A suite of some 15 samples was collected from cenotes, lagoons and near-shore subsea springs and analyzed for coliform by Alquimia, a commercial laboratory in Cancun. The results were shocking. Samples over a wide area from the Akumal water well to the south end of Yal Ku Lagoon showed coliform readings close to 2800 col/100ml of water. Mexican and US standards prohibit body contact (swimming) in waters containing more than 200 col/100ml of water. Continuing studies revealed that the problem at the Akumal well arose from incubation of coliform in the well overnight when the pump was off. Water collected at the well while it was pumping contained only 15 col/100ml. High readings in Yal Ku Lagoon were confirmed. The relationships are complex and our initial efforts led to refined methods.

At the same time, I was mapping the geology of the coastal zone which, together with new analyses, was published by CEA as Environmental Report 1. A copy is attached to this report. An important finding of this study was that, contrary to earlier ideas published in the scientific literature (see references in CEA Environmental Report 1), ground water appears to flow coastward along defined channels, not through a sponge-like interconnected aquifer, as previously believed. This opens the possibility of defining distinct drainage areas that can be managed independently of neighboring drainage areas. A second finding was that fresh water, mixed with up to 50 percent seawater is ponded in the coastal lagoons and bays behind the bulge of the high tide and released on the falling tide. Much of this water, being of lower density than sea water, can be observed to flow from bays and lagoons across the surface of the sea. This could be an important mechanism for

distributing contaminants over the reefs. The ultimate fate and degree of contamination of these waters is unknown and is the subject of a new study described below.

Present On-going Studies

The work to date has shed light on how ground water enters the coastal zone and exits to the sea, possibly carrying with it nutrients and pathogens that might contribute to degradation of the reef system. Indeed, the observed degradation of our reefs coincides precisely with the rate of coastal development for tourism. The 1998-99 explosion of new, very large developments between Cancun and Tulum without effective infrastructure to manage wastes is an ominous omen for the future of the second largest coral reef in the world that lies off our shore.

Three programs are now either on-going or in start-up to enlarge our understanding of the ground water system and its possible effects on our reefs. The first is a study of inland water quality and movement, including divides that separate flow regimes. Second is mapping of hydrogeologic limestone units through which water moves from inland to the coast. Some of these units have been heavily dissolved, allowing recharge to enter the aquifer rapidly in those areas along with contaminants from municipalities and other sources. The third is a project to map the topography offshore from Akumal in the proposed Marine Protected Area. This will provide a base the next generation of reef studies including locations of undersea springs in deep water, ocean currents, old terraces and their relation to modern and ancient reefs, locations of sampling points for corals and water for analysis, such as the floating brackish discharge mentioned above, and the plotting of data in relation to topography and reefs.

Work has begun on the geohydrologic mapping of the inland part of the peninsula using space photography from INEGI. Conclusions based on remote sensing methods must be checked in the field. Fieldwork presently is hampered by the lack of a reliable vehicle.

A line of water level recorders is planned between Akumal and Ria Lagartos in cooperation with SEMARNAP. Instruments are in place at Akumal and Ria Lagartos. Two more are needed inland, but until the transportation problem can be solved, these cannot be placed or serviced.

A grant from the PADI Foundation has allowed purchase of a GPS and sounder for the offshore mapping project. A weather station also was bought through the grant and is being installed. It is hoped that work on the bottom map will begin before the end of March.

Respectfully Submitted 15 March 1999

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