

Going Deep:

Exploring Alien Worlds with Cave Diving Robots



Marcus Gary (left) and the DEPTHX probe in action.

Marcus Gary first came to Cenote Zacatón in northeastern Mexico in the early 1990s as a scuba diver. What he found—the world’s deepest water filled sinkhole—enchanted him and inspired him to pursue a career in hydrogeology.

A vertical shaft more than 300 meters deep, Zacatón has been called an “upside down Mount Everest.” No human has ever reached the bottom. Gary worked on the support team for Jim Bowden, one of two divers who tried to reach the bottom. Bowden set the record for the world’s deepest scuba dive. Bowden’s good friend and deep diving mentor Sheck Exley died on the same day making the same attempt.

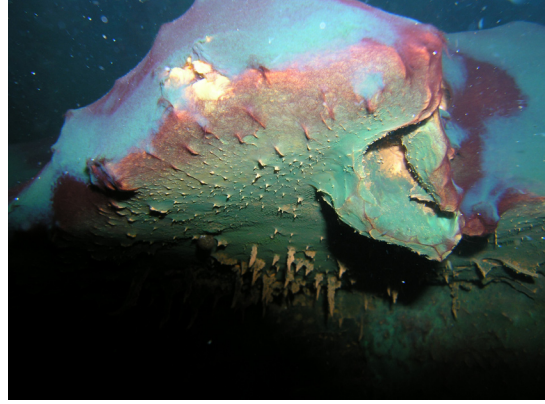
Gary has spent over 10 years studying the entire system of sinkholes that includes Zacatón and will soon complete his doctorate at the Jackson School of Geosciences. His research garnered intense media interest

thanks to a new tool that could revolutionize the way scientists explore underwater caves, shipwrecks, lakes beneath the ice in Antarctica, flooded mine shafts and even worlds beyond Earth.

At a barbecue in Austin a few years ago, Gary asked Bill Stone, a world famous cave diver and engineer, if it would be possible to build an autonomous robot to explore the underwater caves. Stone jumped on the idea and with support from NASA built DEPTHX (Deep Phreatic Thermal Explorer), the world’s only cave diving robot.

Gary, Stone and a team of engineers, computer programmers and microbiologists took DEPTHX to Mexico and released it in the sinkholes. The robot used sonar instruments to create the first ever 3D map of the internal structure of Zacatón and discovered that the floor sloped from about 290 meters to 319 meters deep, just beyond the reach of Bowden’s

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Left to right: In May 2007, Mexican reporters and local residents descended on the scene to learn about the research at Zacatón; the probe photographed microbial mats with new forms of life, such as the mat above in La Pilita, one of the sinkholes in the Zacatón complex; in addition to its great depth, Cenote Zacatón is known for its unusual floating islands of grass.

world record setting dive. The probe collected samples from the cave walls containing several microbes unknown to science. The robot also successfully demonstrated new computer technology allowing it to create maps of unexplored environments and simultaneously use the maps for navigation.

The information gathered by DEPTHX helped Gary better understand the geologic history of the sinkholes. The robot has since been reconfigured and renamed ENDURANCE to explore lakes in Antarctica sealed beneath

sheets of ice. Robots like DEPTHX and ENDURANCE are demonstrating technologies and approaches to exploring remote uncharted areas that could someday be applied to a space mission to Europa, an ice-covered moon of Jupiter with a liquid ocean that might harbor life.

IF YOU WOULD LIKE TO TALK TO MARCUS OR OTHER CURRENT OR FORMER STUDENTS AT THE JACKSON SCHOOL, CONTACT PHILIP GUERRERO, GRADUATE PROGRAM COORDINATOR, AT PHILIPG@MAIL.UTEXAS.EDU OR 512-471-6098.

DEPTHX in the News

Selections from national and international press coverage

“Mexican Sinkhole May Lead NASA to Jupiter” Washington Post, May 14, 2007

Most important, it does its own thinking. As it swims down the limestone cave, which is 367 feet wide and at least 1,000 feet deep, the vehicle will probe the most interesting areas -- namely places where temperature, oxygen levels or other characteristics change, suggesting something is happening biologically, said Marcus Gary of the University of Texas, one of the lead scientists. Using a long arm with a pinkie-size knob, Depthx can grab samples from those spots.

“Everything we’re finding there is unique and bizarre,” Gary said. In preliminary sampling, the team has collected dozens of “previously undescribed” bacteria. Those new types of bacteria could conceivably lead to medical therapies, new plastics, stronger dental materials or better manufacturing processes.

“NASA Probes Mexican Sinkhole as Proxy for Icy Moon”

Reuters, May 18, 2007

The idea of mapping Europa’s oceans with an automated robot was dreamed up by Texas scientist Marcus Gary at a barbecue in 2001. In 2003, his

team won NASA funding for the \$5.3 million project.

Gary chose El Zacatón to do the first major test run of the robot, which is about the size of a small car, because its sheer depth meant the site was an unknown quantity. A U.S. diver died trying to swim to the bottom in 1994.

“It is an ideal testing ground because we can test out the robot’s mapping powers in untried waters,” Gary said.

“Misiones en Tamaulipas”

El Universal (Mexico), May 15, 2007

Marcus Gary, investigador de la Universidad de Texas, en Austin, y líder de estas pruebas en Tamaulipas, cuenta que el robot se diseñó para territorios inexplorados, donde no hay navegación externa. El aparato cuenta con la capacidad de crear su propia ruta de exploración, identificar blancos de interés y recoger muestras.

El DepthX puede comprobar el contenido de salinidad, acidez, conductividad y productos químicos en el agua, incluso seguir la huella de alguna sustancia o microorganismo. Tiene capacidad de buscar las variaciones del color que señalan la presencia de organismos, extender su brazo mecánico y recolectar material.