New device offers a peek at our deeply buried past

BY MARTIN MERZER
mmerzer@herald.com

Mark Grasmueck can see underground and, without hardly anyone noticing, he has been peeping below downtown Miami.

Grasmueck, a University of Miami geophysicist, is quietly working with archaeologists on the planned One Miami development in the heart of Miami just north of the Dupont Plaza hotel — a site that almost certainly harbors ancient treasure.

What he sees as far as 20 feet under the asphalt — and how he sees it — could revolutionize archaeology, help experts assure the purity of our drinking water.

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To see a movie of ground-penetrating radar images from under the heart of downtown Miami, go online to www.herald.com/news.

and reveal new details of South Florida's 120,000-year-old limestone foundation.

"The deeper you go, the more back in time you go," said Grasmueck, a slim, bespectacled assistant professor who was born and

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educated in Switzerland.

So you can see underground? "Yes," he said.

You are Superman? "Well, not exactly."

Grasmueck, 36, has developed a device that he slowly and methodically pulls backward like a reverse lawn mower, each time targeting a four-inch strip of ground.

A particularly sophisticated form of ground-penetrating radar, the device visually slices the earth into fine layers. When reassembled, the exquisitely thin images create a movie that takes the viewer on an underground tour.

He tested his ground-breaking technology two years ago near Coconut Grove, creating a one-minute subterranean view of Ingraham Terrace Park.

FINE-TUNING

Now, he and noted archaeologist Robert Carr are fine-tuning the device in downtown Miami, hoping it will help them find ancient pottery, primitive tools and other artifacts below the six acres of parking lots north of the Dupont Plaza.

A 24-second movie produced by Grasmueck already has identified promising archaeological targets there—perhaps evidence left by the now extinct Tequesta Indians who carved the Miami Circle on the other side of the Miami River.

The film shows a possible pattern of post holes and even possible burial sites, though other explanations—including natural solution holes—are possible. More precise analysis of the images is under way, and Carr is preparing to "ground-truth" the findings by digging up areas pinpointed by the film.

"I was stunned when I saw this," Carr said. "He produces what appears to be an X-ray movie of what's below the ground. It's like the greatest science fiction film you ever saw. Nothing like this has ever been done in the history of archaeology."

Now destined to become A MAN AND HIS MACHINE: Geophysicist Mark Grasmueck pulls his ground-penetrating radar device over the One Miami site.

the site of luxury condominiums, stores and offices, the land once was covered by the main Tequesta village. Also here over past centuries were a Tequesta burial mound, early Spanish forts, the 19th century Fort Dallas and the Royal Palm Hotel.

Under one corner of the site, Carr and his team already have found pottery shards, musket balls and discarded animal bones and shells.

"We haven't found anything highly unusual yet, but we know we're on the right track," he said.

That exploration was conducted the way archaeology always has been conducted by guessing and digging. But the need to perform labor-intensive, large-scale excavations might be eliminated—if Grasmueck's technology works.

On May 25, he and a team of four scientists methodically pulled his device through 200 passes—called transects—over a 66-foot-by-76-foot grid in a parking lot between Southeast Second and Third streets and Second and Third avenues. It took them all day.

Basically, the machine and its antennae transmit electromagnetic pulses that can penetrate the ground. Return echoes, collected by a receiver, appear slightly different at each survey location, depending on the precise nature of the material they intercept.

When assembled by a sophisticated computer program and analyzed by Grasmueck and his team, the data can point archaeologists to the most promising areas for limited excavation.

The computer "stacks" the images in a cube, then slices the cube horizontally, providing the viewer with the illusion of embarking on an underground trip.

"As the voyage unfolds, anomalies—small circles that might be post holes, oblong shapes that could be graves, and other irregularities—come into view."

"What gives us echoes are changes in soil type and moisture content, and rocks and pipes and artifacts," Grasmueck said. "Everything that is different from the surrounding material gives a return, an echo."

Some antennae can send waves as deep as 100 feet under Florida's soil, but at a cost in clarity. Such penetrations might soon be used to track salt-water intrusion into South Florida's water table and to help reconstruct the formation of the region's foundations.

For the One Miami site, Grasmueck chose antennae that balanced depth with clarity, providing what laymen might consider a somewhat muddy image but one that he and other experts consider remarkably clear.

"Here you see the asphalt," Grasmueck said, looking at the film in his office at UM's Rosenstiel School of Marine and Atmospheric Science on Virginia Key, "and then they put in a bit of crushed rock and the soil and the midden deposits that Bob Carr is after and then the Miami oolite limestone."

TREASURE CHEST

Midden is the black, earth-like substance formed by the debris of ancient cultures. It is the treasure chest of local archaeologists.

Carr and Grasmueck have formed a symbiotic professional relationship, who helped discover the Miami Circle and often conducts urban archaeology as bulldozers lurk close, needs tools that will make his work more efficient. Grasmueck must rely on Carr to help him test or "ground-truth" his device by seeing what is really under the site.

In about a month, Carr plans to use photos and maps developed by Grasmueck as an underground guide to the One Miami site.

Said Carr: "This is very exciting. We're developing the language of how to interpret this kind of data. Nothing like this has ever been done in archaeology."

Grasmueck, asked whether he plans to be on site when Carr tests the new system, said: "Yes, of course. I'm very curious to see what comes out of that ground."