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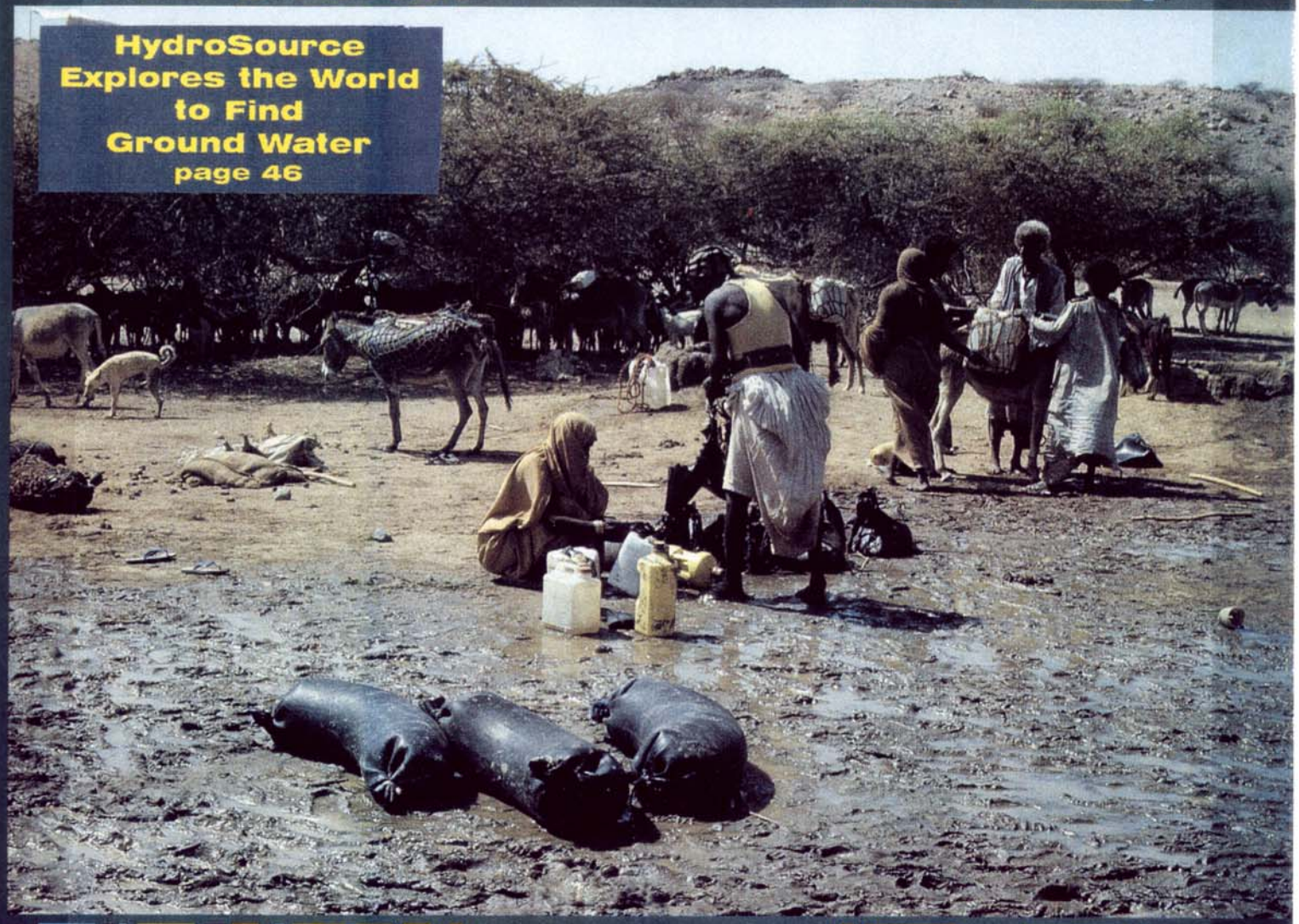

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HydroSource Explores the World to Find Ground Water

By Gloria J. Swanson

Every driller gets a rush when he or she is able to provide a customer with a clean potable water supply. Water is the essence of life, and members of our industry provide it. Most American consumers take their tap water for granted but there are areas of the United States, as well as many places around the world, that do not possess safe, ample water supplies.

Water supply shortages, particularly in developing nations, represent an untapped market for water purveyors. The intricacies and uncertainties of doing business in the international arena put many off. Still, there are ground water stalwarts who accept the cultural vagaries and complications inherent in international work because there is the opportunity for profit and the challenge of beating the odds—although international work isn't just about money and ego. Those who stick with it find great satisfaction in providing a commodity so necessary to life.

Ask anyone who has ever worked on a drilling project overseas about the problems associated with bringing it to a successful completion and they will provide you with a laundry list of horror stories. You'll hear comments such as "That was a logistical nightmare" or "The 'driller' was the water development agency manager's cousin and he needed a job." But as these individuals recall the specifics of a particular project, you'll detect a trace of humor and a good deal of pride as they remember all the little tricks they used to overcome the obstacles barring them from doing the job they came to do. These traits prompt them to keep their passports and their shot records current and their schedules flexible.

The groundwork that must be laid for an international project takes months of advance planning. In late January when I spoke to Skip Hoag, president of HydroSource Associates Inc., an Ashland, New

Bedrock test well drilling in Guarabal, Venezuela. Two test wells were drilled which produced a combined yield of more than 600 gallons per minute.

Hampshire, firm that specializes in locating ground water supplies in fractured bedrock, he was in the negotiation stage with a Middle Eastern client whom he would visit the following week. He wouldn't discuss the project because it was too early. Nothing was nailed down. "We'll let you know when we get a contract," he said.

Completed projects are a different story. HydroSource willingly shared details of overseas projects and Vice President Joe Ingari served as narrator. Hoag is the advance person in this seven-member firm, which started in 1991. He's the networker who makes the contacts and helps put the packages together. Although he spends most of his time on business development, he still occasionally gets out in the field to stay in touch with the company's technical side. But it is Joe who shoulders the primary responsibility of ground water, well siting, and exploration development. You're as likely to find him taking aerial photographs as he soars over a desert in northern Sudan as you are studying data obtained from a thermal imagery process that detects areas where ground water is near land surface in an arid province of Venezuela.

Pinpointing where ground water is likely to be found in fractured bedrock takes an array of high-tech tools, and HydroSource uses them all—both for their international projects, which comprise about 35 percent of their total workload, and for domestic work. They concentrate on locating fractured bedrock water bearing zones in areas that have good recharge. They use satellite imagery and aerial photography, as well as radar and thermal imagery, to locate fracture zones. Then they study rainfall distribution features and the water absorption rate of the rocks in and near the fracture zones. Even when HydroSource determines an area favorable for drilling, there is no guarantee that water will be available. Ingari explains that what they still don't know is if the fracture zones are permeable or clogged. So HydroSource performs geologic mapping to determine the internal structure of the rock, measuring cracks on the surface for clues as to what lies underground.

They also perform ground-based geophysics to further substantiate that the bedrock fractures are water bearing. They map outcrops and use geophysical surveys that include seismic, resistivity, ground-penetrating radar, magnetotelluric, induced polarization and transient electromagnetics, induction conductivity, radiometry, gradiometry,

Drilling Methods: Contractors Bring Expertise to HydroSource

HydroSource Associates Inc. has used just about every drilling method known for finding ground water in fractured bedrock. Whether it's a conventional method or unconventional method matters not. It's the results that count. In its quest, the company's principals have gleaned tips from numerous drilling companies as they worked together toward their common goal of providing ground water supplies.

Allan Follett, president of A & W Artesian Well, Woonsocket, Rhode Island, believes HydroSource's specialists are on the mark more than 90 percent of the time. Follett has worked with the company on several projects. "Our experience with them has been very successful," he says.

The drilling firms that have worked in concert with HydroSource have exposed them to methods that include ODEX, TUBEX, CENTREX, reverse circulation, dual tube, conventional air rotary, foam, drill and drive, mud rotary, Barber and/or dual wall, flame jet, and direct drive horizontal.

Ron Gill, president of Ron Gill Well Drilling, Chestertown, New York, introduced HydroSource to the CENTREX casing advancement system during a search for a school water supply. After HydroSource completed its studies and selected a drill site, Gill began drilling. "We didn't find anything above the bedrock," he says, but once into the bedrock, they found fractures. They continued to drill down a couple hundred more feet where they found a good water supply "exactly where they said it was," Gill says.

A.E. Drilling Inc., Greenville, South Carolina, used the TUBEX method on a project outside Atlanta where HydroSource tried to develop a well field in the saprolytic overburden. A.E. Drilling's president, Mark Lassiter, says they installed three test wells but the wells in the saprolyte did not produce sufficient yield. "We're not infallible," Ingari says.

But a 5⅞-inch well drilled into fractured bedrock by Charlton Well Drilling, Charlton, Massachusetts, using a Jaswell drill with 745 hp, a V-12 engine, and an 1100 cfm 500 psi compressor, produced almost 400,000 gallons a day, according to Pete Vigeant, Charlton's owner.

Just as HydroSource has picked up drilling method tips from its contractor partners, the drilling firms have gained respect for the high-tech instrumentation that HydroSource uses to site well locations. Mark Hubener, who runs the Atlanta Division of Middle Georgia Water Systems, says it best. "From a well driller's perspective, I think they're doing the industry a good service. I think the old method of just going out there and wildcatting in bedrock for a large yield well is just really not a good way to go when you can use some scientific expertise to minimize all those risks without perforating the ground everywhere." **WWJ**

microgravity, electromagnetic, and magnetic processes. "We've tried them all," Ingari says, "and if there's anything new, we'll try that." They used images from an LFC (large format camera), which is on the space shuttle, for a project in Sudan. This high-resolution camera produces three-dimensional images and Ingari says the detail it provides is phenomenal.

Once they've done their high-tech legwork, they are ready to drill. HydroSource has no drillers on staff, nor do they own any drilling equipment. But they have developed partner-like relationships with several U.S. drilling firms (see sidebar) where they have honed their drilling method skills, and this helps them figure out which drilling method to use on international projects. "That's half the battle," Ingari declares. "There's a whole suite of drilling techniques we're familiar with because of our association with a large number of drillers and drilling projects all over the world."

Selecting the right method is critical to the success of the drilling project. If you choose the wrong drilling method, Ingari says "you can be right on with the fracture zones and still not get the well in." To illustrate his point, he brings up a current situation. "We're doing some work right now where we're talking about drilling into a fissile shale," he explains. "It's caving and collapsing and if we go ahead and do this with conventional methods, like air or mud rotary, we're going to have problems because air drilling will collapse the formation and you won't be able to get down. With mud rotary drilling, it will clog up the fractures and we may not be able to clear them out." After considering all the options, HydroSource chose to employ dual tube sampling to test interval water quantity and quality, and to obtain unadulterated formation samples prior to installing a production well.

HydroSource brings its knowledge of drilling techniques to the table on international projects, specifying which drilling method to use. If the company is lucky, it will be able to work with a commercial drilling firm. If the HydroSource group is to work with drillers who are in the employ of a government agency, the host government provides a list and HydroSource conducts interviews, selecting the ones whose qualifications best match the skills needed. All of their international work so far has involved local drillers but this may change for an upcoming project. They have been in negotiation with John Kratz, president of Multi Water

Systems, Escondido, California, for an out-of-country project where Kratz would not only advise on drilling equipment selection and purchase but also do the work.

The drill rig operator is a vital contributor to the success of the project. "It's quite a mixed bag," Ingari says, "of what you get when you talk about drilling for foreign governments. Locating the fracture zones or the water supplies is only half the job," he says. "If you don't have someone with competence in drilling, you cannot get the amount of water you need." An inexperienced driller may inadvertently cause rig malfunctions—and he may not understand the importance of drilling a straight hole. "When you're talking about fractures that in some cases may be only a foot wide, you have to be right on target," Ingari says. "You can't be wandering with the drill bit."

Ingari speaks from experience. On one drilling job, the well sites were staked out and drilling began. Water was located but the well produced only 3 gpm. HydroSource rechecked the well's location and it was 5 feet away from where it should have been. They drilled again, this time at the stake point, and were able to produce 150 gpm. "That's how discrete these fractures are," he says, "and that's why it's so important to be able to set up right over the fracture and to be able to drill a straight hole. Not every driller can do that."

As with much overseas work, delays at the beginning of the project complicate the drilling process. Sometimes, as with a HydroSource staff job in Somalia, drilling can't get started because of power struggles among competing government agencies or officials. Ingari flew back and forth from a provincial capital to the city of Mogadishu, the nation's capital, six times to get approval for the use of a drill rig that had previously been allocated for the HydroSource project. All parties had signed a contract agreeing to the drill rig's use but when the time came to use it, it was in another province being used to drill a sheik's well. Ingari finally got additional approval by providing a drive shaft which he had to order from France for the water development agency manager's Toyota. But when he presented the manager's signature to the sheik's people, they greeted it with indifference. After four attempts to set up radio communication with the manager and the sheik failed, Ingari says he "essentially stole the rig."

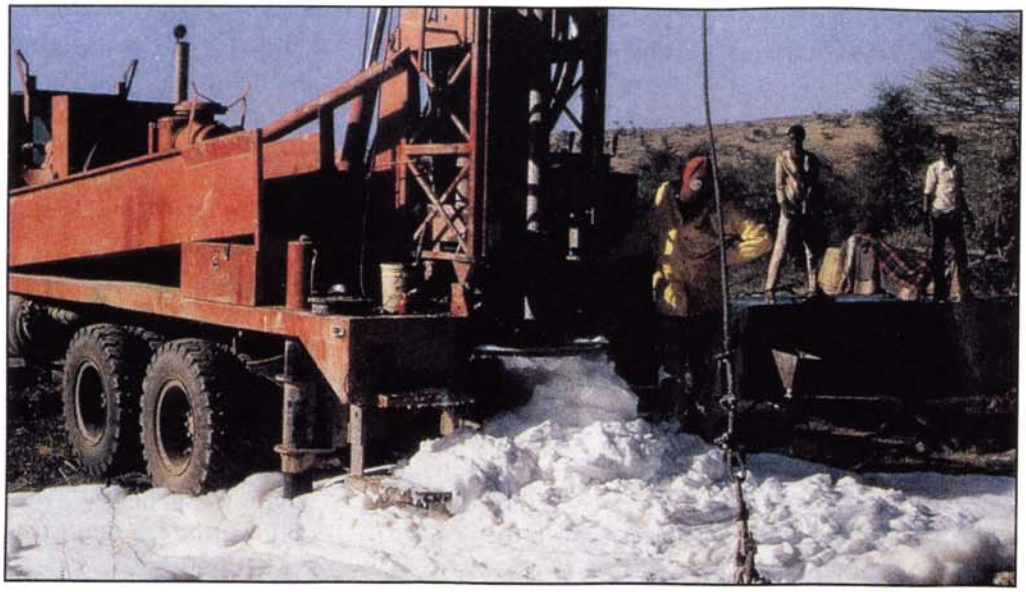
You can't conceal a drill rig in your hip pocket; Ingari and the 26-man drill crew (one driller and a lot of helpers) knew that timing their escape was essential because they had to cross a checkpoint between provinces and if the rig's disappearance were noticed before the rig reached the checkpoint, it would never make it to the other side. So Ingari and the crew practiced teardown. They had a three-hour window to take down the rig, which could be seen from a nearby town, and drive it, along with the water truck and all accessories, 70 miles to the checkpoint. They arrived with 15 minutes to spare but the guards were in no hurry and wanted to chat. Ingari was prepared. He had two cartons of cigarettes which he gave to the guards and they waved the group through. Twenty miles later, the rig broke down, but they had crossed the border and they were not pursued.

After repairs were made, they went on to drill seven wells in refugee camps and other areas of need. Six were good producers, each yielding more than 300,000 gallons a day. Ingari says the fracture zone of the seventh well was "gummed up with clay." After drilling more than 600 feet, the clay remained, so they abandoned the hole.

It was during this drilling project that Joe became aware of some confusion among the drill crew. They couldn't understand how he could order an 8-inch drill bit that would fit within 8-inch casing. "I had to take the bit out and slide it into the 8-inch casing," he says, to prove to the crew that it would really fit.

HydroSource staff members started a project in Sudan in 1990 that they're still waiting to finish. They were to locate well sites in an area of northern Sudan, near the Ethiopian border. The trouble was there was a border war going on between Sudan and Ethiopia. They performed their aerial mapping of the desert terrain, with one eye trained for military jets. They were able to complete the exploration process and they selected the drill rig but they never got to drill. "Since then there's been a big political upheaval," Ingari says, "and we don't know what's happened. We're still waiting for that project to continue."

Northern Venezuela is the site of a current HydroSource exploration project. The region's water shortages are so severe that all water must be trucked in. "We contracted with the government of Venezuela to do two things," Ingari says. HydroSource, working in conjunction with the satellite image processing firm Earth Satellite Corp., began a regionwide exploration program to identify favorable rock types and favorable areas for ground water development and locate 30 well sites. "It's in a difficult area," Ingari says, "a structural basin filled with shales and low permeability rocks and it takes a lot of interpretation and evaluation to identify those sub areas where additional water might be gotten." The average rainfall is less than 100 millimeters (4 inches) a year; recharge is scant. Dowsers had witched and priests had prayed—to no avail. Local government agencies tried a more scientific approach and they too came up dry. But Ingari and other



Using foam with air rotary to drill and clean out a well located near the Somalian/Ethiopian border.

HydroSource vice president Joe Ingari observes the orientation of a fracture contributing water to a spring in northeastern Sudan.

HydroSource staff members, using remote sensing techniques and ground geophysics, succeeded. Drilling is proceeding by a Venezuelan crew using a government-owned rig, and the first two wells drilled yielded more than 400,000 gallons per day each. HydroSource will continue ground water exploration in the region for the next year and a half.

There are a variety of other international projects in various stages on the HydroSource plate and others in the making. As Hoag points out, sometimes it takes three or four years for projects to develop. And no matter how careful the planning, events beyond the control of the ground water exploration firm can halt a project in a heartbeat. "We've had several projects where we were going to go on in future phases, like the one in Sudan," Hoag says. "There was a revolution and that was the end of that."

It is circumstances like this that give less committed companies cause to question whether the effort they put forth to obtain international work is worth it. When I suggested to Joe Ingari that HydroSource must find the work profitable since they continue to work on expanding their overseas market share, he replied, "Maybe we're just gluttons for punishment." But in truth, the feeling of satisfaction that comes from providing a life-giving commodity plays an integral role in the company's principals' decision to continue to seek international work. "Finding water is so elementary," Ingari says. "Everyone needs water. When you can find it, it makes you feel like you're doing something worthwhile."

There are other bonuses as well. Hoag likes the challenge of visiting other parts of the world and learning to cope with cultural differences. And then there is the endless supply of tales that people who work overseas always seem to possess—all those anecdotes about getting caught in flash floods in the desert, coping with equipment breakdowns and lengthy waits for spare parts, and accepting a timetable far removed from a schedule of 12-hour workdays. To some, these differences would be totally unacceptable. But to those who work regularly overseas, they are simply part of doing business in the international marketplace. "You're in their reality," Ingari points out. "They're not in your reality."

And if you need an additional bit of persuasion to plunge into the international arena, Ingari has a final piece of advice. The experiences you will have, he says, "sure make a lot of good stories for your grandkids." **WWJ**