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Photo by Kristan Hutchison/The Antarctic Sun

Bella Bergeron, a driller with the Ice Core Drilling Services, guides the drill out of one of three holes they are drilling for the South Pole Remote Earth Science Observatory. Two of the holes are complete and the seismic instruments are expected to be operating in January.

SPRESO serves up seismic holes

By Kristan Hutchison
Sun staff

"SPRESO camp" may sound like a roadside java stand but the specialty at this scattering of mountain tents and Weatherhavens is drilling holes for seismic instruments.

SPRESO is short for South Pole Remote Earth Science Observatory, a new seismic monitoring facility five miles (8 km) from Amundsen-Scott South Pole Station.

Despite the project acronym, the drillers don't have much time to stop for more than a cup of regular coffee, tea or cocoa, as they drill three of the deepest cored holes ever punched at the South Pole. An espresso maker tucked in a corner under the table is saved for special occasions.

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Looking for pebbles from the heavens

By Mark Sabbatini
Sun staff

This year's search for rocks from space may help efforts to travel there.

A longtime meteorite-gathering project in Antarctica will explore a new icefield this season, deploying a team that includes U.S. space program officials. Among this season's goals is studying the efficiency of working in extreme environments, in the hope the results can help plan future space missions such as work on the International Space Station and manned flights to Mars.

"How many hours in a given day do we actually get to do science?" said Dean Eppler, senior scientist for Science Applications International Corp., which works with the Johnson Space Center in Houston. He said knowing how much time is consumed by everyday living tasks such as cooking and cleaning is important when making space plans because "we don't want to oversell the program."

"There may be pieces of Venus or Mercury out there."
— Dante Lauretta, member of meteorite team

Eppler is part of a four-person team that will explore the western end of the Transantarctic Mountains as part of this season's Antarctic Search for Meteorites (ANSMET) program. An eight-person team will return to Beardmore South Camp to search the second half of a site where more than 400 meteorites were recovered during the 1999-2000 season.

More meteorites have been recovered from Antarctica than all other places on Earth combined. About 12,000 meteorites ranging from pea-sized to more than 1,000 pounds have been recovered and categorized since 1976 by the National Science Foundation-funded ANSMET project. Another 20,000 have been recovered by Japanese teams working separately, but

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Quote of the Week

"Where did we put baby Jesus?"

— Comment made while searching for Nativity figurine during midnight Mass at the Chapel of the Snows, McMurdo

Spreso

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"It's more symbolic," said Terry Gacke, lead driller with Ice Core Drilling Services of the University of Wisconsin at Madison.

SPRESO is a quiet place. From SPRESO the South Pole station can be seen but not heard. About a 25-minute snowmobile ride away, the new, elevated station and old silver dome flicker on the horizon like a mirage in the desert. The rest of the view from SPRESO is flat, white and very still.

SPRESO is the first experiment in the newly formed "Quiet Sector," an area set aside for experiments that need a location free from the ground vibrations caused by activities at and around the South Pole Station.

"The problem is the station at the South Pole is getting noisy to the point where the data is less and less useful, so we had to move to where we could actually hear earthquakes again," said Kent Anderson, a seismologist with the U.S. Geological Survey.

The South Pole seismometers are part of a Global Seismographic Network of 126 stations. Each station on the network contains multiple sensors with the capability of measuring the motion of the ground from very long period changes, such as the deformation of the Earth caused by the orbit of the moon, up to high frequency motion, like a recent quake in the older snow at SPRESO.

By having sensors on every continent and in every ocean, the network can record smaller earthquakes and more precisely determine their location, size and learn more about the path seismic energy travels between an earthquake and the receivers. The waves from the quakes run through the Earth, giving researchers a way to understand the Earth's interior in the same way a CAT scan shows doctors the inside of the brain.

"We can start piecing together a three-dimensional image of what the inside of the Earth looks like," Anderson said.

After 40 years collecting data with the same network of stations, seismologists are beginning to notice some changes inside the Earth. The seismic waves from earthquakes recurring in the same spots as they did decades ago are following different paths, indicating the Earth's inner core may not be spherical, Anderson said. Instead, it may be a faceted, crystalline structure that is rotating separately from the spinning of the Earth's crust. This could help explain why the wandering magnetic poles sometimes wander to the other side. The polarity of the Earth's magnetic field has changed about 170 times in the past 100 million years and may change again in the next few thousand years, so a north-pointing magnet would aim south instead.

Photo by Kristan Hutchison/The Antarctic Sun

Denise Braun works the drill controls as Bella Bergeron helps guide it down. Below, a rope disappears into the 270 meter deep hole.

> "That's what makes this station important. We can kind of listen to the Earth ringing without the spinning corrupting the signal."
>
> — Kent Anderson, seismologist

Photo by Kristan Hutchison/The Antarctic Sun

"We speculate it's not like a switch flip. It's a more gradual thing," Anderson said.

The five Global Seismographic Network stations in Antarctica - at the South Pole, Palmer Station, Scott Base, the Dry Valleys and Casey Station - are also important because of their location on the Earth's most sparsely populated continent. The South Pole Station is unique in that it is on the axis of rotation of the earth.

Large seismic events of magnitude 8 or higher can set the Earth into an oscillation, like the vibrations of a bell after it's been struck very hard. These oscillations can continue for several days.

"Just by listening to the bell, you can figure out something about its shape," Anderson said. "The problem is, the bell (Earth) is also spinning."

Because of the spinning, it's difficult to sense the pure oscillation.

"There's only two places you can hear the bell ringing clearly without the effects of the spinning globe, and those are the axes of rotation," Anderson said.

The northern axis, at the North Pole, is a floating ice pack, making it difficult to put a seismic station there. That leaves the South Pole as the best place to listen to the Earth vibrating.

"That's what makes this station important," Anderson said. "We can kind of listen to the Earth ringing without the spinning corrupting the signal."

But recently interference from activity at South Pole station has been disrupting the Earth's signal.

When the first seismometers began recording data at the South Pole in 1957, it was a quiet place. The first station had just been built and only 18 men spent the winter. Since that initial installation, there have been three other upgrades, moving the seismic equipment from the old pole station closer to the newer dome, upgrading equipment and then changing to a safer vault at the current V1 location about 980 feet (300 meters) from the dome. SPRESO will be the fifth generation of seismic stations at the pole.

"The current station at V1 was an appropriate distance when the station was not as busy," Anderson said, "but now we've found it's more of a cultural sensor than a seismic sensor. We can see every tractor moving around."

Now bulldozers, tractors and other heavy equipment rumble around the station 24 hours a day, pushing snow, moving supplies, and helping build the new ele-

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vated station building. The ice-shaking vehicle traffic shows up in the seismic record, drowning out smaller earthquakes. Anderson can tell when lunch and dinner breaks are, just by looking at the seismic record.

The USGS started planning to move the seismic equipment in 1994, in collaboration with the National Science Foundation and the Incorporated Research Institutions for Seismology. First the USGS did a survey, setting instruments every mile away from the station, up to 25 miles (40 km) out, Anderson said. The instruments stopped picking up the station activity at mile 10 (16 km), but that was too far to bring power from the station.

Further analysis with the assistance of the Cold Regions Research and Engineering Lab determined that burying the seismometers 800 to 1,000 feet (240-300 meters) under the ice would be the same as going out 10 miles, Anderson said.

Burying seismometers isn't unusual, but placing them in ice is.

"We put them deep in rock all over the world, but these instruments are made to run at room temperature," Anderson said. "We'll have to heat it."

The 6-inch (15 cm) instruments will be in a 10-inch (25 cm) casing, filled with perlite insulation and heat tape.

The new seismometers have been running for a year at the V1 site near South Pole station to test them. By mid-January, Anderson expects to move them to the new holes at SPRESO.

"We'll put our instruments down at the bottom, fill in with sand, and hopefully never see them again," Anderson said.

Photo by Kristan Hutchison/The Antarctic Sun

AT SPRESO camp, 8 km from Amundsen-Scott South Pole Station, the drillers live in mountain and Scott tents in temperatures always below freezing.

A small building will be buried in the ice nearby to hold the computers and data recorders.

Just drilling the 885 feet (270 meter) holes is a bit of an engineering feat. The holes must be at least 12 inches (30 cm) in diameter and need to have flat bottoms for the instruments to sit on. The coring drill creates a 6-inch (15 cm) diameter hole.

The solution was to drill 6-inch holes, then shave away the sides. The difficulty has been keeping the ice chips from filling the hole as they are shaved off. Mark Wumkes of Glacier Data in Fairbanks, Alaska, designed a reamer to scrape the sides of the borehole and catch the chips in its barrel. Every 3 to 6 feet (1 to 2 meters), the drill barrel has to be pulled to the surface and emptied.

"This reamer system is an experimental engineering project in progress," said Gacke, lead driller for ICDS.

He and five other drillers - Lou & Mark Albershardt, Denise Braun, "Bella" Bergeron and Matthew Pender - are working on the project, all with many years of experience in the Antarctic, Arctic and Greenland.

"All these people are competent and talented drillers," Gacke said. "It takes a unique individual to come out here and deal not only with cold weather camping issues, like sleeping in unheated tents at -40, melting snow for our water supply, and cooking our own food, but (also) all the mechanical problems that come using this kind of experimental equipment at these temperatures."

The first two holes were drilled quickly, going down about 100 feet (30 meters) a day, because the cores weren't being saved. The third hole will be drilled more slowly and carefully, about 33 feet (10 meters) a day, so the drillers can save the core for the International TransAntarctic Scientific Expedition (ITASE). At more than 980 feet (300 meters), it will be the deepest ice core ever taken at the South Pole, dating to about 3,000 to 4,000 years old, Gacke said.

Cores from the first two holes were melted down as drinking water last summer. And once or twice, the SPRESO water did end up in a celebratory espresso or mixed with the camper's beverage of choice.

Photo by Kristan Hutchison/The Antarctic Sun

The drillers clean ice out of the shaft while reaming the hole to fit seismic instruments. Bella Bergeron, far left, pushes the shaft through and Terry Gacke helps from the other end as Denise Braun and Matthew Pender watch.