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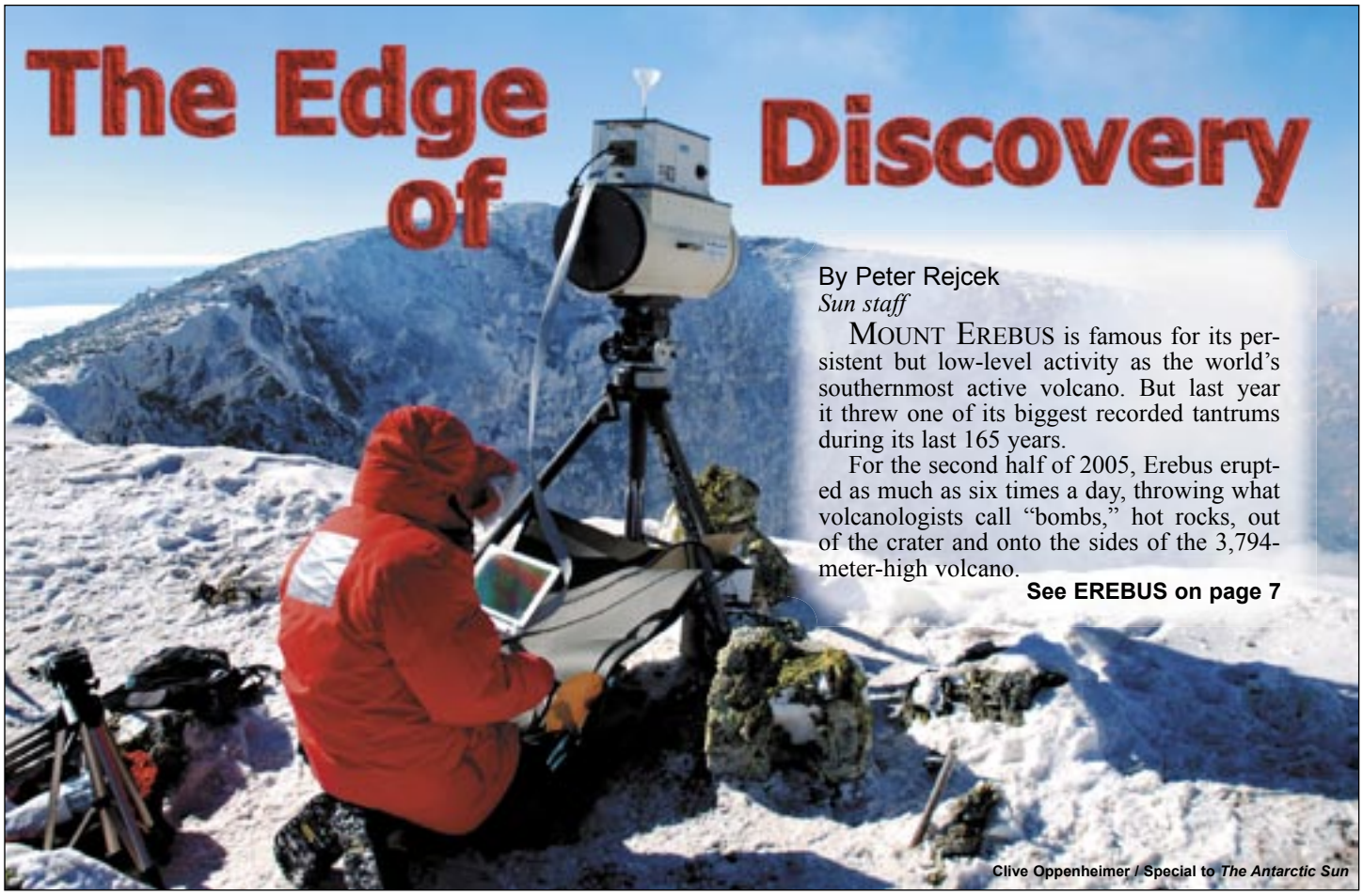

The Edge of Discovery

By Peter Rejcek
Sun staff

MOUNT EREBUS is famous for its persistent but low-level activity as the world's southernmost active volcano. But last year it threw one of its biggest recorded tantrums during its last 165 years.

For the second half of 2005, Erebus erupted as much as six times a day, throwing what volcanologists call "bombs," hot rocks, out of the crater and onto the sides of the 3,794-meter-high volcano.

See EREBUS on page 7

Clive Oppenheimer / Special to *The Antarctic Sun*

Reaching Out

Scientists go online to educate public

By Steve Martaindale
Sun staff

The Web site of veteran Antarctic researcher Sam Bowser sums it up well:

"Science is useless unless it's shared, and most kids are born scientists. (What do you expect from a species that's asking 'Why?' by the time they turn 3?) We believe in getting people involved with science, no matter their age or experience level" (bowserlab.org).

From small-scaled and personal methods, such as Bowser's offer to speak to school

See EDUCATIONAL on page 10

ANDRILL completes first core recovery

By Peter Rejcek
Sun staff

The field season may be over for the ANtarctic geological DRILLing program, but the work is only really beginning for the scores of ANDRILL scientists who will study the sediment core that was extracted from under the Ross Ice Shelf over the last two months.

"There's quite a wide range of information that we'll be able to put together into a detailed and unique story," said ANDRILL co-chief scientist Ross Powell a day after the drilling operation ended on Dec. 26.

The long mosaic of glacial rock types, diatomite, volcanic ash, siltstone and mudstone will tell scientists much about the variability of Antarctica's paleoclimate and how the continent's ice sheets, ice shelves and glaciers behaved over the last 5 to 10 million years in response to

See ANDRILL on page 9

Quote of the Week

"They should put a story about us in the paper."

– Burger bar cook impressed with the speed at which his crew turned out grub on a recent night.

Inside

Photos by Steven Profaizer / *The Antarctic Sun*

Breaking ice

Icebreakers have opened the 2007 shipping channel and gained access to McMurdo Station. At right, the Swedish icebreaker Oden *sits in the foreground as the U.S. Coast Guard's* Polar Sea *moves through the sea ice channel. In the photo above, a* Polar Sea *crew member conducts a tour for McMurdo residents. Crew members of both ships also received opportunities to visit the station.*

Cold, hard facts

Icebreaker *Polar Sea*

Commissioned: **1978**

Homeport: **Seattle**

Overall length: **399 feet**

Extreme breadth: **83 feet, 6 inches**

Full load draft: **31 feet, 10 inches**

Full load displacement: **13,190 tons**

Top of mast above waterline: **138 feet, 2 inches**

Maximum sustained water speed: **17 knots**

Available berthing: **180**

Number of internal laboratories: **5**

Potential number of additional portable laboratories on deck: **7**

Number of Coast Guard Unit Commendations and Meritorious Unit Commendations: **3 of each**

Source: www.uscg.mil

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Level 1 Comix **Matt Davidson**

Couriers keep the mail moving

By Steven Profaizer
Sun staff

Working as a courier at McMurdo Station transforms all of town into a circuit workout.

Get out of the truck. Walk into the building. Climb up the stairs. Drop the envelope. Climb down the stairs. Walk out of the building. Get into the truck. Drive to the next building. Repeat.

"We're basically moving mail from place to place and getting a lot of exercise in between," said LaVonne Hynes Weber, who has spent her last three seasons as a courier and her first season as a dining attendant. "That's one of the fun parts of the job."

She said another highlight of her experience is working alongside the other courier – Lorraine Weber, her roommate and sister.

"LaVonne's my best friend as well as my sister," said Lorraine, who is in her first season on the Ice. "We have a lot of fun together, and we complement each other well."

The two women rotate weekly between the task of shuffling packages among work centers and the task of distributing mail in the station's mail room.

The couriers make the circuit of stairs climbs and brisk walks several times each day, checking drop boxes for new items that need to be moved around town.

"It's nice being helpful to the community. It's time out of their day that they are able to do what they need to be doing instead of running all over town," LaVonne said. "Parts, paperwork, pagers – we're the movement of it all."

McMurdo offices generate as much paperwork as any organization, but they are sprawled out like a town instead of gathered together in a centralized location, which means some paperwork needs to be moved more than a mile on its path to completion. LaVonne said the forms organizing each person's departure from the continent have to make three courier stops before they gain the necessary signatures and arrive at the right location. With almost 1,000 people leaving at the end of each summer season, there's plenty of work to be done this time of year.

Rivaling the leg workout the courier job provides is the exercise it gives facial muscles from imparting a smile and a greeting toward almost everyone the couriers pass. The sisters are two of the most recognizable people on station as they can be regularly seen walking the halls of every building.

Photos by Steven Profaizer / *The Antarctic Sun*

LaVonne Hynes Weber, left, and her sister Lorraine Weber work as McMurdo's couriers. They rotate weekly between running local mail around town and distributing mail in the mail room.

Both of the couriers agree that giving out package mail is one of the most enjoyable parts of their job. On a continent that is far away from everyone's home, U.S. Antarctic Program participants regularly search the posted list of package mail hoping for a box from friends and family.

"People come into the mail room smiling and leave smiling," Lorraine said. "We have a service that makes people smile."

LaVonne added that one of the most enjoyable parts of walking around station as courier is getting to tell people they have packages as she passes by them. But keeping people's names, faces and packages straight with a large population like McMurdo can be a challenge.

"Most of the time I get it right, but sometimes I'm a little off," said LaVonne. "You get to know people's names because of the time in the mail room. And after I leave the Ice, they're still swirling about in my mind."

The alternate weeks in the mail room are not as aerobic as delivering packages around all day, but LaVonne said it's a nice breather before the next go around.

"The two jobs together just make the perfect job," she said.

Even on their weeks as courier, the women serve a vital role in assisting the other person in the mail room. The sister on courier duty is responsible for covering the mail room while the other goes to lunch and helps to alphabetize incoming mail and packages. Without assistance, one person could never keep the mail room open to the community all day, which LaVonne said is important with the multitude of work schedules.

Despite the mail room support role, the weekly courier's primary duty is to make laps on the stationwide circuit, answering pages for immediate pick-ups, gathering mail and redistributing it with each tour of McMurdo.

"It feels good to see town and catch up with people all around station," LaVonne said.

One of the sisters' nicest parts of a day spent as courier is the two-mile drive to New Zealand's Scott Base that they normally make once in the afternoon.

"It's wonderful, and you get a view of Mount Erebus. It kind of refreshes the spirit just seeing that mountain," LaVonne said. "After four seasons, I'm still in awe of this place."

Courtesy of NASA

Understanding our sun

A science team plans to use the never-setting summer sun to examine its atmosphere, dynamics and structure.

By Steven Profaizer
Sun staff

Imagine walking away from a fire and getting hotter with each of the first few steps. This example may sound strange, but it illustrates a real and little-understood phenomenon that occurs near the sun.

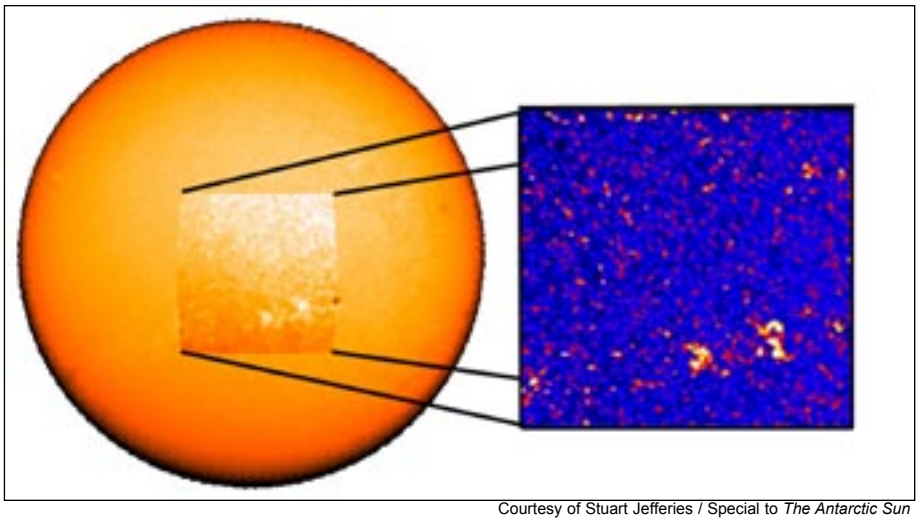
"If you're at the center of the sun, the temperatures are close to 13 million degrees Celsius. As you move out toward the visible surface of the sun, the temperature drops to about 6,000 degrees," said Scientist Stuart Jefferies. "But what happens is that as you move further away into the sun's atmosphere, the temperature starts to go up again – up to 10,000 degrees and then up to a couple of million."

Jefferies is searching for the mechanism by which the solar atmosphere is heated and studying the sun's dynamics and structure. He said he suspects that the strange pattern of heating is caused by a complicated process that starts with convective motions near the solar surface. Here, hot gas rapidly cools as it rises from deep inside the sun, producing plumes of cooled gas that then plummet back into the sun's surface.

"The gas starts traveling faster than the local sound speed and causes what's basically a sunquake or a sonic boom," he said. "These sunquakes generate millions of sound waves that then go on to travel throughout the sun's interior."

Most of the waves remain trapped there, reflecting repeatedly off the density change at the sun's surface; however, some escape.

"As these waves travel through the atmosphere, they eventually travel fast enough that they basically shock and deposit all their energy into the atmosphere," Jefferies said. "In that way, they can take energy from just beneath the solar surface and bring it up through the solar atmosphere. This energy can then be used for heating."



Courtesy of Stuart Jefferies / Special to *The Antarctic Sun*

This image of the sun at a very narrow wavelength was taken at the South Pole in 2003. The contrast in the central square region has been enhanced to better show surface details. The box to the right of the main image shows a map created through the observation of low-frequency sound waves to reveal the energy flow in the central square region.

The group will take images of the sun from the South Pole next season and employ the use of a telescope fitted with special equipment to filter the light, allowing the team to look at narrow parts of the light spectrum and detect the small changes in the sun's brightness caused by the passage of the sound waves.

"We go to the South Pole because we need long stretches without any interruptions from seeing the sun," Jefferies said. "Of course any low-latitude sites have day-night cycles that would put an automatic crimp in the data."

He said he hopes the project will not only illuminate the sun's processes but also its relationship to Earth.

"There's a very large sun-Earth connection," he said. "The sun is one of the most important things in our existence. Move Earth just a little bit either toward or away from the sun, and we wouldn't be here. It is easy to imagine that things that happen on the sun can have a large impact on Earth."

One of the most troublesome ways the sun influences the Earth is the effect of increased solar activity on communications. Jefferies hopes that his project may offer some assistance in that area.

"We're also looking to see whether we can find anything at all that could give us a predictive ability of when disruptive solar phenomena are going to happen," Jefferies said. "This would give people the chance to safeguard satellites and other affected equipment to minimize the problems."

NSF-funded research in this story: Stuart Jefferies, University of Hawaii.

around the continent

PALMER

LTER cruise now under way

By Kerry Kells
Palmer correspondent

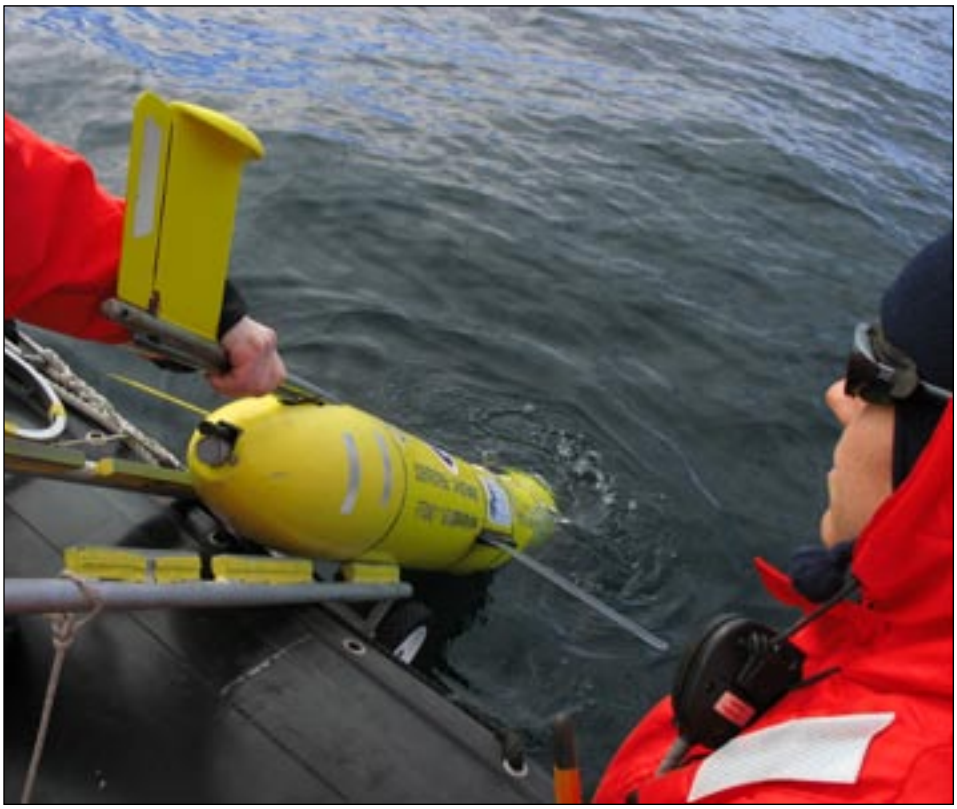
This past week, the research vessel *Laurence M. Gould* returned to Palmer Station with a change of personnel. Several scientists boarded the *LMG* for the Palmer Long Term Ecological Research (LTER) cruise. Palmer residents also welcomed two cruise ships, the *Rotterdam* and the *Corinthian II*, and the sailing yacht *Sarah W. Vorwerk*.

One of these arrivals is the entomology group led by Principal Investigator Richard Lee and Co-Principal Investigator David Denlinger. They are here to study the four insects that inhabit the Antarctic Peninsula – a wingless midge, a springtail, a mite and a tick.

The annual Palmer LTER science cruise will take a group of scientists along the peninsula south to Adelaide Island and Rothera Station, the British Antarctic Survey research station. The four components of the Palmer LTER project include microbial biogeochemistry (bacteria), phytoplankton, zooplankton (krill) and seabirds.

Hugh Ducklow is the chief scientist for the cruise. The cruise operation includes sampling at 70-plus stations on the water, which are along the same LTER grid transecting the peninsula. The key feature of the LTER cruise is to sample at the same stations the same way each year, and this is the 15th consecutive year of that sampling.

The cruise operation includes 140 net tows for krill, a seabird census, sampling at Marguerite Bay and stations along the southernmost line of the grid. Different groups will deploy near-shore CTDs (conductivity, temperature, depth) and study water column characteristics, weather, particle counts and conduct bird and mammal observations. A sediment trap deployed on last year's LTER cruise will be retrieved and replaced by another. Surface drifters that measure the currents in the grid area are also deployed.



Phil Spindler / Special to *The Antarctic Sun*

A science team lowers an autonomous underwater vehicle called a Slocum Glider into the water near Palmer Station. It will conduct oceanic measurements for 15 to 30 days.

New this year is the deployment of an AUV (autonomous underwater vehicle) called a Slocum Glider, operated by Rutgers University. It will measure depth, time, temperature, salinity, fluorometry and possibly take particle counts.

The glider will be deployed for 15 to 30 days. It is versatile, maneuverable and powered by alkaline batteries. The glider propels itself through the water by altering its buoyancy instead of using motors and has been used for oceanographic measurements all over the world. This will be its first deployment in Antarctic waters. While the *LMG* was at the Palmer pier, the glider was successfully tested, adjusted and deployed.

The seabird researchers spend much of their time on the *Gould* doing seabird survey observations from the bridge of the ship. They will track all the seabird species spotted on the grid.

In past years, this has included black-browed albatross, wandering albatross, white-chinned petrels, blue petrels, Antarctic prions, light mantled sooty albatross and Southern fulmar.

They will try to reach seven local islands near Renaud Island. There they will take penguin censuses and attach satellite transmitters to two males and two females (with chicks) to better understand Adélie

See CONTINENT on page 6

the week in weather

McMurdo Station
High: 48 F / 9 C
Low: 25 F / -4 C
Min wind chill: 9 F / -13 C
Max sustained wind: 38 mph / 61 kph

Palmer Station
High: 45 F / 7 C
Low: 30 F / -1 C
Max sustained wind: 27 mph / 44 kph
Melted precipitation: 5 mm

South Pole Station
High: -12.1 F / -24.5 C
Low: -19.1 F / -28.4 C
Peak wind: 23 mph / 37 kph
Max. physio altitude: 3,168 m

Continent From page 5

foraging patterns. They will also conduct censuses, study adult diet samples and collect other samples for lab analysis.

The birders will camp at Avian Island, a specially protected area that is home to a large Adélie penguin colony, as well as blue-eyed shags and giant petrels. The projects at Avian Island include censuses of Adélies, giant petrels and shags; the use of transmitters for the penguins; tracking chick weights; and obtaining adult diet samples. Researchers can then make geographic comparisons among the Palmer local islands, Renaud Island and Avian Island.

The *LMG* will not return to Palmer until after the LTER cruise in early February. Each LTER component retains one or two researchers on station who will periodically get assistance from the Palmer community. There are also now four seabird researchers at Palmer studying the growth of the Adélie chicks, and the hatching of giant petrel, brown skua and South Polar skua chicks.

SOUTH POLE

Preparing for winter

By Charles Redell
South Pole correspondent

The end of the austral summer season is nigh at the South Pole, and the attention of Polies has turned to all of the things that need to get done before a smaller winterover crew takes over.

Although time is running short to complete the season's projects at the bottom of the planet, folks are optimistic about getting it all done since the weather has cooperated all summer long, allowing crews to complete more sooner than expected.

Topping the list of ahead-of-schedule departments is cargo. The South Pole reached 200 flights before Christmas for the first time ever.

Even with a New Year's weekend devoid of flights due to bad weather in McMurdo, cargo is experiencing a comfortable cushion so far in 2007. The season's 261st flight was scheduled to land at Pole on Saturday, barring any adverse weather conditions.

The majority of the flights coming in during the year's first month are bringing fuel to the station to keep it heated during the upcoming winter.

At the same time, outgoing flights are full of items being sent for retrograde (retro) as the station's various departments are trying to get as much as possible off station and to McMurdo Station before the re-supply vessel leaves. Retro items heading north this month include the infrastructure for two old telescopes. The AST/RO telescope retro was completed earlier this month.

The VIPER telescope infrastructure is currently heading north. It is slated to end up in Berkeley, Calif., where the parts will be re-used in another telescope.

Earlier this week, the South Pole was visited by four helicopters, all of which were traveling between the North and South Poles. One team, made up of two helicopters, is an American-based private expedition. The second, also consisting of two helicopters, is based in Russia.

Even with all that is going on, recreation at the South Pole never takes a holiday, and this week was no exception. The season's second edition of James Brown bingo – hosted by none other than the station's executive chef, James Brown – was held on Saturday night. Polie Teresa Eddington won the big prize this time.

We also enjoyed an open house hosted by the meteorological department and a 30th birthday celebration for one of the station's general assistants.

SHIPS

NBP

Compiled from reports by Jim Dolan
Marine project coordinator

The R/V *Nathaniel B. Palmer* continued to operate near the Adare Trough this week. A science team on board is conducting a geological study of the seafloor.

One of the staff became ill, and the decision on Jan. 7 was made to transport the patient to a hospital.

The *NBP* proceeded to a rendezvous point at the fast ice edge near Italy's Mario Zucchelli Station at Terra Nova Bay, where it was met by a helicopter with onboard medical staff from McMurdo Station.

Mario Zucchelli Station provided the operation with logistical and communications support, and the patient was successfully transferred to McMurdo and on to Christchurch, New Zealand.

LMG

Complied from reports by Andrew Nunn
Marine projects coordinator

The R/V *Laurence M. Gould* arrived at Palmer Station on Jan. 5 and immediately commenced cargo operations. The next morning, an onboard science team deployed an autonomous underwater vehicle (AUV) called a Slocum Glider by Zodiac.

The ship then departed Palmer Station but received a transmission from the AUV the next morning indicating it had detected a leak.

The *LMG* returned to the AUV for testing and repairs, and the science team redeployed the instrument on Jan. 9, after which the *LMG* resumed normal operations.

Continental Drift — What is the best meal at your station?

"Thanksgiving was great, Thai food makes for a nice change, and the bread at dinner is always super!"

Michiel Gitzels
McMurdo Station
system administrator
Hope, Alaska
second season

"Crown roast of veal with mushroom duxelle stuffing and black truffle-studded madeira sauce."

Bob DeValentino
Palmer Station
cargoperson
St. Louis, Mo.
fifth season

"Grilled cheese and tomato soup."

Amnesty Kochanowski
South Pole
cargo handler
Grand Lake, Colo.
second season

Erebus activity third highest recorded last season

From page 1

"A bomb hit one of our [geophysical] stations," said Phil Kyle, a volcanologist with the New Mexico Institute of Mining and Technology who leads a team of scientists and students attempting to find out what makes Erebus tick.

Last year's anomalous activity followed about three years of uncharacteristic silence, according to Kyle. Eruptions returned in 2004, and by the middle of 2005, the scientists knew something was up thanks to data received from a suite of about 10 seismometers located on the volcano, mostly around the rim, that operate year-round.

Capt. James Ross provided the first historical record of Erebus (which he named after one of his vessels) when his log recorded lava flows on the side of the volcano. Sketches at the time even showed eruptions, Kyle said.

"We've not seen anything like that in our time," he added, noting that it is hard to determine the exact level of activity based on Ross' notes. The only other time the volcano has kicked up such a storm occurred in 1984, when Erebus launched bombs measuring 10 meters wide and slung them as far as 3 kilometers away from the crater. Kyle said 2005 appears to be the third most volatile period on record for the volcano, which has been active for about 1.3 million years.

"Erebus is less active this year than last year," he said. "We don't know why it starts and stops like this." But the answers are coming.

Pooling it together

For more than three decades, Kyle and colleagues have explored Erebus, a "special" volcano with a number of features that make it particularly appealing to study.

Topping that list is its permanent lake of molten lava, only one of three known to exist in the world, Kyle said. The other two are located in Africa: Erta Ale in Ethiopia and Nyiragongo in the Democratic Republic of Congo. The lake is a result of natural convection that continuously cycles magma from a chamber deeper inside the volcano to the surface.

"This is a very rare feature in volcanoes. You just don't see these lakes," Kyle said. "It's a window into the magma chamber, [and] it can help us understand what's going on."

The 30-meter-wide lake has at least been in existence since its discovery in 1972 and aerial photographs from the 1960s indicate it was around before then, Kyle said. He believes – based on accounts from the heroic age of exploration – that the lava lake has likely been percolating for the past century. Explorers like Robert Falcon Scott and Ernest Shackleton apparently reported seeing a red glow above the volcano's cone during the dark winter months. What they probably saw, Kyle said, was the reflection of the lava lake on the clouds.

Clive Oppenheimer / Special to *The Antarctic Sun*

Georgina Sawyer, left, uses an infrared spectrometer to identify the gases emitting from Mount Erebus earlier this season on the rim of the volcano. Melissa Lindholm monitors a suite of other instruments such as a sunphotometer, which is used for atmospheric monitoring.

"I think it's a persistent, long-lived feature. It varies, and it's dynamic. … Each year is different for us," Kyle explained. "Each year we don't know what we're going to find."

The lava itself is also rather rare. Most volcanoes contain basalt lava but the fiery liquid bubbling in Erebus is phonolite lava. The composition is particularly interesting because phonolite is more explosive than basalt. Mount Vesuvius, the infamous volcano that leveled Pompeii in 79 AD, also contained phonolite lava, according to Kyle.

Such a catastrophic explosion from Erebus is extremely unlikely, however, because the magma column is exposed and not capped like Vesuvius, so there is no way for pressure to build. Also, early indications suggest there is less gas in the Erebus magma, which is the driving force of violent eruptions.

One of the goals of the team next season will be to discover more about the volcano's plumbing, particularly the magma chamber inside Erebus that feeds the lake and the conduit that connects the two. The researchers will install about 25 additional seismometers on the volcano next year. Seismometers measure and record the size and force of seismic waves.

By studying seismic waves, the scientists can map the interior of the volcano, much as a CAT scan images the inside of an object using X-rays.

"We can use incoming earthquakes from different places to see what happens as they pass through the volcano," Kyle said, adding that the seismic waves produced by eruptions from the volcano itself will also be helpful for such imaging. "Hopefully we'll get a good look at what's inside there."

What a gas

Volcanologists are also interested in learning more about what comes out of the volcano to understand Erebus' effects on the atmosphere and environment.

That's more the specialty of volcanologist Clive Oppenheimer, from the University of Cambridge, who is in his fourth straight field season on Erebus. Using an infrared spectrometer and other instruments, Oppenheimer has identified the composition of the ever-present gas plume that billows out of the volcano's cone.

Like the lava boiling within Erebus, the makeup of the gases emitted from the volcano is also fairly uncommon. Evaporated water and carbon dioxide comprise about 99 percent of the gas, approximately in even proportions, Kyle said. The Antarctic volcano also emits a number of other gases in minute amounts including sulfur dioxide and carbon monoxide.

"I don't think anyone's measured levels of carbon monoxide that we've seen here," Kyle said. "[Erebus is] putting out a gas of very unusual composition."

Last year's spike in activity also revealed a unique signature in the gas bubbles that

See VOLCANO on page 8

Photos by Clive Oppenheimer / Special to *The Antarctic Sun*

Researcher Melissa Lindholm watches Harry Keys and Karen Williams climb down from the volcano's smoking crater, home to a lava lake, pictured at right.

Volcano acts as natural environmental polluter

From page 7

exploded at the lake's surface, according to Oppenheimer, speaking from the team's hut outpost on the flanks of Erebus.

It turns out the proportion of carbon dioxide is much higher at the point of the explosion. Oppenheimer said it's likely that the source of these gas bubbles is far deeper in the volcano than the gas normally emitted from the lava lake.

"The geochemistry of the gases is telling us something about the depth and the plumbing system and where those gases are coming from," Oppenheimer said.

In addition, some of the elements in the volcano's magma are very volatile and escape in a gas form. These include elements such as lead, arsenic and mercury. The scientists believe trace amounts of these elements could be drifting at least as far as the South Pole, which sits at a fairly high altitude.

"We can see Erebus in the snow at South Pole," Kyle said. "People have seen lead in ice cores."

Oppenheimer said one challenge is to determine how big of a natural polluter Erebus is to the Antarctic environment. He said current research suggests the perpetual output of certain Erebus gases such as bromine into the troposphere, the layer of atmosphere closest to the earth, could affect ozone. (The scientists say the volcano has no effect on the ozone layer higher up in the stratosphere, where annual depletion caused by anthropogenic chemicals makes a hole form over the Antarctic around August.)

"I think it's likely that Erebus has some kind of regional impact on the atmosphere, possibly on the ozone, but it will be another year or two of modeling to discern that," Oppenheimer said.

There are a number of questions the scientists want to answer about the effects of the gas plume, which issues non-stop from the volcano. Where does the gas plume go? How does it affect the snow and ice? How long does the gas stay in the atmosphere?

"Because it's so clean down here, that stuff does get spread out, and Erebus does have an impact on the environment," Kyle said. "We're trying to assess that."

In the field

A typical field season lasts about four to six weeks, with the team a mix of scientists and students. This season is no different, with one undergraduate and three graduate students from New Mexico Tech along with a fifth student from the University of Cambridge.

This is Christine Kimball's second year on Erebus. A New Mexico Tech graduate student working on her master's degree, Kimball said her fieldwork on the volcano has definitely influenced her future plans.

"It has been a really amazing experience so far," Kimball said from the on-site laboratory on the volcano shortly before Christmas. "Antarctica is really why I went to graduate school at Tech in the first place to work with Phil. I think I'd like to continue to work in Antarctica in the future, and it's really made me want to go for that PhD in the future and stay in research."

Kimball's specific project involves studying the geochemistry of the so-called Erebus crystals, a mineral called anorthoclase, a type of feldspar that consists of aluminum silicate. The ones ejected out of Erebus from the lava lake are highly unusual because of their size. Kimball is studying and collecting the crystals to learn more about their growth.

"It's not well understood," said Kimball, who plans to finish her thesis this coming summer back in the United States.

"Erebus is a great training ground for students … and I've made a great effort to bring students down here," said Kyle, who estimated at least 20 students have written their theses on Erebus over the years.

One of the team's primary missions each season is to repair and upgrade equipment. Storms packing winds in excess of 150 kilometers per hour can cause significant disruptions to year-round observation. The group relies on wind generators to power equipment during the winter but just such a storm trashed five of the generators this past year.

In addition to the seismometers, other instruments include microphones around the crater rim that detect explosions and earthquakes as well as high-precision GPS units that measure any deformation of the volcano. The latter occurs if additional magma comes into the system, causing the volcano to swell, a possible indication of a change in activity and eruptions. So far, the volcanologists have only detected slight variations, less than 5 millimeters per year.

"The thing about Erebus is it's amazingly stable," Kyle said. "It's out there doing its thing with relatively unchanged behavior since the '70s."

The volcano, which bears the name of the son of the Greek god of Chaos, may be relatively static since scientists began studying it in earnest 35 years ago, but today's technology is helping them change their ideas about its role in the ecosystem.

"We used to have our hammer banging on the rocks. Now we have sophisticated instruments. We've got one of the better instrumented volcanoes in the world," Kyle noted. "We're doing front-line science, where in the past we were doing exploration."

NSF-funded research in this story: Phil Kyle, New Mexico Institute of Mining and Technology, www.ees.nmt.edu/Geop/Erebus/erebus.html.

ANDRILL core called 'unique'

From page 1

global temperature changes. That information is important for understanding how Antarctica and its ice mass will respond to climate change in the next century when temperatures are expected to rise to levels similar to those in the past.

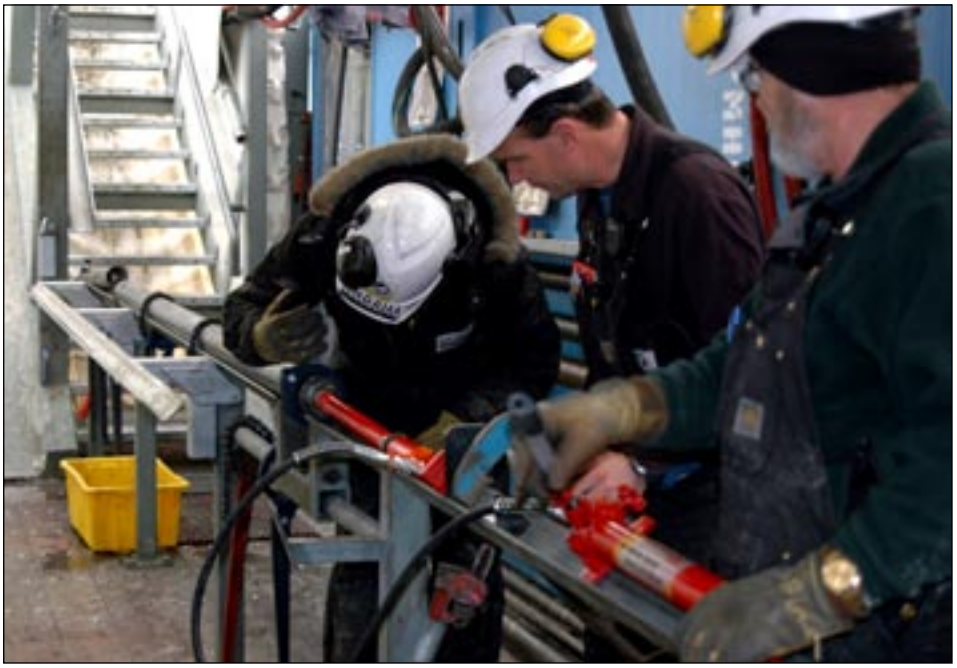
"To actually see the variability in that core is incredible," exclaimed Tim Naish, ANDRILL's other co-chief scientist. "To see the glacial world be replaced so abruptly by the non-glacial world in a stratigraphic sense is just amazing – and to see it happening repeatedly through time."

The sedimentologists, who describe the core's characteristics, identified more than 50 cycles when ice sheets or glaciers advanced and retreated across McMurdo Sound. The scientists are able to determine such variability based on the material found in the core. For example, glacial rock types represent periods when the ice sheets were large, while the presence of diatoms (planktonic algae) indicate marine conditions when ice sheets had retreated. The thickness of each type of material can give some indication of the length of time each condition existed in the past, according to Powell.

For instance, one interval of diatomite – a soft, chalk-like sedimentary rock composed of fossilized diatoms – is continuous for about 100 meters in the upper section of the core.

"The age information we're getting now, in that upper five or six hundred meters, is a unique record for the Antarctic margin," said Naish, with the Institute for Geological and Nuclear Sciences and Victoria University of Wellington.

The data from the core could also help settle some "raging debates" about just how warm the middle Pliocene, a period from about 3 to 3.5 million years ago, really got, according to Naish. One hypothesis states that at this time there was a major deglaciation of the interior of East Antarctica that created a marine basin, representing a sea level rise of up to 40 meters, he said.



Photos by Peter Rejcek / *The Antarctic Sun*

ANDRILL drillers from New Zealand use a small hydraulic ram to pump a section of the sediment core out of the inner core tube and core catcher at the drill site on the Ross Ice Shelf earlier this season.

"That's a major deglaciation," Naish noted. "This [core] gives us an important reference record. … Whether we'll get the definitive answer, we don't know."

Near the bottom of the core, the scientists discovered a layer of volcanic ash, which should help them put an end date for the epilogue to the core's story.

Both scientists say the recovery of such a continuous core record is due to the work done by the team of drillers who worked on the ice shelf around the clock with nary a day off since October.

"It's just a real credit to the operations side," Naish said.

The New Zealand-based drill team surpassed all expectations, removing a sediment core 1,284.87 meters below the seafloor, a record depth for Antarctic rock core drilling. The record had been 999.1 meters below the seafloor by the Ocean Drilling Program in 2000.

"You couldn't ask for anything better," noted Powell, from the Department of Geology and Environmental Geosciences at Northern Illinois University. "[This] is definitely the deepest record, and it's by far the longest core. … The total record that we have is incredible. It is unique."

ANDRILL officials are tentatively pegging the total core recovery rate at between 97 and 98 percent.

"It's a super recovery rate by anyone's reckoning," said Jim Cowie, ANDRILL project manager.

Cowie and the scientists said the feat is particularly remarkable because this is the first time anyone has attempted to drill continuously through an ice shelf, with a thickness of about 85 meters. A new hot water drilling system allowed the crew to punch through the ice shelf and maintain the hole throughout the operation.

A sea riser was then lowered down the ice hole and through about 840 meters of water to the sea floor, where it was embedded about 17 meters below the surface in later October. The crew then began drilling operations, with the drill encased in the sea riser, only losing the top 20 meters or so of the core.

Cowie said the operation "worked almost beyond our expectations. … We're pretty pleased with the whole kit."

The $30 million program is an international collaboration between the United States, New Zealand, Italy and Germany. It is also one of the premiere projects of the International Polar Year, which offi-

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The flags of the four countries involved in the ANDRILL program – Germany, the United States, Italy and New Zealand – fly at the drill site on the Ross Ice Shelf. Next season, the operation will move to the sea ice in McMurdo Sound.

Educational outreach takes many different forms

From page 1

classes, to sites such as penguinscience.com that allows students to watch nesting penguins and submit their observations online, numerous Antarctic projects are reaching out to spread the excitement of research.

The massive ANtarctic geological DRILLing project known as ANDRILL, in addition to providing outreach programs, arranged for educators to do a little reaching in.

The program known as ARISE – ANDRILL Research Immersion for Science Educators – provided six educators from four countries with the opportunity to work alongside the scientists in the field. (See Nov. 26, 2006, issue at antarcticsun.usap.gov.) They are not only able to transfer that firsthand experience to their students but are also preparing projects to be shared with other teachers through Project Iceberg (www.andrill.org/iceberg).

Another example of programs that bring in educators for a first-hand look at field work is the McMurdo Dry Valleys Long Term Ecological Research project led by Peter T. Doran of the University of Illinois at Chicago (mcmlter.org).

His study included upgrading and maintaining long-term automated lake monitoring equipment in the Dry Valleys. The study's dive master was Robin Ellwood, a middle school teacher in New Hampshire, who said the experience enhances her ability to share with students how questions and problems are addressed in the field.

Courtesy of Exploratorium / Special to *The Antarctic Sun*

High school docents at the Exploratorium in San Francisco sit in on a Webcast featuring scientists from the South Pole Telescope project, seen on the left monitor.

"Students have a direct connection with people in the field – having a primary source typically increases motivation and curiosity," she said by e-mail after returning home. "Having a field location in Antarctica sparks the interest in students even further; Antarctica seems to ignite a natural curiosity for students. My experiences have improved my understanding of current research, which allows me to pass on more accurate and current information to my students."

She added that following "real time" studies was more interesting for students

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Sea ice site offers shorter timeframe for operations

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cially begins in March. It involved nearly 60 scientists and support staff on the Ice, not including the drill team, which accounted for another 25 or so people.

Next season, the project will move onto the sea ice, at a location about 30 kilometers from the current operation. That phase of the program will offer its own challenges because of the much thinner, impermanent sea ice that could start deteriorating by the end of November.

"Everybody is going to be moving much faster," Cowie said. "We won't be able to linger on that sea ice."

There is a chance that the spot targeted for drilling will consist of multi-year ice, which may be seven or eight meters thick compared to a couple of meters of new ice. That's good and bad, according to Cowie. The thickness offers additional stability and will allow the team to locate the camp next to the drill rig. The negative is that the surface is honeycombed with melt pools and other irregularities that will require extensive grooming of the top meter or so before the drill team arrives in October.

"On balance, we would prefer the multi-year ice," Cowie said.

Cowie said the ANDRILL team will monitor the sea ice during the austral winter using satellite imagery. A program developed by Alex Pyne, ANDRILL drill site manager, can produce a realistic behavioral model of the sea ice based on the imagery. The team will know as early as June 1 whether the sea ice will be stable enough for the upcoming operation.

The second field season will include many new faces on the science side, but Cowie hopes to return most of the drill crew next year, with a tentative target depth of 1,000 meters, a sediment record that may go back 17 million years.

"The crew is almost as essential as the equipment," Cowie said.

The majority of this year's science team left the Ice on Jan. 5, though additional science activities continued for another week as researchers deployed several instruments down the borehole to map additional properties, including a televiewer, a special camera that uses sound waves to produce an image.

It will take about five days to then plug and abandon the hole, according to Cowie.

"If we keep going like this, we're going to get a lot of great science out of ANDRILL in the next few years," he said.

NSF-funded research in this story: David Harwood, University of Nebraska-Lincoln, www.andrill.org. Also, see the Nov. 26, 2006, issue of The Antarctic Sun *at antarcticsun.usap.gov for more information about the science and drilling technology behind ANDRILL.*

Students head into the field via the Web

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than learning about past studies from textbooks.

Getting back

While the objectives of outreach programs are to enhance education and foster enthusiasm about the sciences, the researchers stand to gain from the interaction themselves.

Bowser, of the New York State Department of Health's Wadsworth Center, said that it's a lot of fun keeping in touch with the K-12 students and that it helps boost morale at the research camp.

"The funniest thing I ever heard from a kidlet was this," he related by e-mail. "A first-grade girl asked me how mommy penguins were able to find their babies after they go hunting for food. I honestly didn't know the answer, so I said, 'I don't know, but I am friends with one of the world's experts, and he would love it if you called him and asked that question.'"

Bowser said that his response evoked a look of horror from the youngster and he thought she was intimidated by the idea of speaking to an expert on penguins. He learned of her real concern, though, when she asked, "Is it a 1-800 number?"

Tom Crawford, a post-doctoral fellow from the University of Chicago who is working with the installation of the new South Pole Telescope, is collaborating with other team members to provide regular Webcasts through the Exploratorium of San Francisco (www.exploratorium.edu/poles).

"We were a bit apprehensive when we signed on with the Exploratorium," Crawford said, "because of the significant time commitment we knew the Webcasts would involve, particularly at this critical juncture for the project. And while we have indeed spent significant time preparing for and participating in the Webcasts, it has generally turned out to be both enjoyable and not a strain on the progress of the telescope."

The program is enjoying success, too, according to Robyn Higdon of Exploratorium, who said that archived programs online are viewed by 3,000 to 4,000 people a day.

Looking toward IPY

"We are planning to continue the collaboration with the Exploratorium through the International Polar Year," which begins in March, Crawford added. "One of our long-term outreach goals is to produce a series of short videos answering some basic questions about cosmology as a whole and our project in particular."

Crawford and others on the South Pole Telescope project also are contributing to a blog, a popular tool with many of the research projects. Often, they are used to convey the experiences of the writer, relating encounters with penguins and extreme weather, for instance. Many will delve into the research a bit, too.

Courtesy of Sam Bowser / Special to *The Antarctic Sun*

Flags provided by students in the United States fly above Sam Bowser's camp at New Harbor. He said they provide wind information for helicopter pilots.

Mak Saito, an assistant scientist with Woods Hole Oceanographic Institution, was recently deployed aboard the research vessel *Nathaniel B. Palmer* as part of a study called CORSACS: Controls on Ross Sea Algal Community Structure (www.whoi.edu/sbl/liteSite.do?litesiteid=2530). His Nov. 27 blog entry was titled, "The Algae Need Their Flintstones Too."

In it, he related that when researchers added both iron and B12 they observed that phytoplankton in the Ross Sea greatly increased in biomass.

"This is one of the first findings that phytoplankton can be influenced by a vitamin in the natural environment, and suggests that this vitamin could be quite important in controlling the ecology of this marine ecosystem," Saito wrote.

And, thus, students were able to follow along with the findings of scientists in the field.

In touch with the field

That same sense of being close to the research led Bowser to another aspect of his relationship with students back home. His team flies the flags of several classrooms on the roof of his remote camp, called Camp New Harbor.

"It helps give the students a more direct sense of involvement because their flags are helpful to the helicopter pilots [to determine wind direction for landing], and they help us by making a terrible racket when the wind kicks up at night," he said. "On more than one occasion I had to get out of my toasty sleeping bag and tie something down outside. The kids also get to see what the environment has done to their flags once the season is over."

Some Web sites include fully developed lesson plans for teachers to incorporate into their classes.

The Laboratory for Ecophysiological Cryobiology at Miami University of Ohio has several plans on its Web site (www.units.muohio.edu/cryolab/education), such as one called, "Who Eats Who in Antarctica?" It is designed to be modified for kindergarteners to eighth-graders and teaches about Antarctic food chains, featuring the more photographic animals of the continent.

Steve Padin, a cosmologist from the University of Chicago who will spend the austral winter working with the new South Pole Telescope, knows why outreach is important. He said that his interest in astronomy was sparked as he followed the Apollo program that first put men on the moon.

"I remember watching the first moon landing, and all the ones that followed, and I remember reading all about the program in the [London] *Sunday Times*. It must have caught my imagination because I don't remember reading much else in the Sunday paper.

"I'm pretty sure I didn't spend much time wanting to be an astronaut, but I did start to think of science, particularly physics, as cool. ... Now I'm here at the South Pole building the SPT. And I still think physics is cool."

Researchers include planned education and outreach aspects of their programs in their proposals to the National Science Foundation.

Profile *Climbing to the top*

By Peter Rejcek
Sun staff

As the conversation starts to wind down, Cece Mortenson asks what the angle of this article is going to be. It's the sort of candid question you would expect from someone whose livelihood – not to mention her life – depends on good communication and being blunt.

The 31-year-old head of the Field Safety Training Program (FSTP) at McMurdo Station doesn't want to be pigeonholed as "just a climber," though she readily and passionately admits it is part of her identity. She even took an extra year to finish her master's degree in geography at Simon Fraser University near Vancouver, British Columbia, so she could continue mountain guiding.

Mortenson's road to climbing and adventure began not too long after she learned to walk. Her parents started her in gymnastics at the age of 3 because, as Mortenson tells the story, "I was a horribly klutzy, awkward, hyperactive child, and my parents were worried that I would kill myself."

She learned mental toughness and developed physical strength through the sport, which she worked on relentlessly as an adolescent, competing in national competitions with several private organizations. It's also the time when she started doing handstands, an acrobatic feat that has earned her a little local fame at the station.

"Pretty early on I learned that by winning handstand contests I got a lot of candy given to me, and I've always been good at handstands," says Mortenson, who performs a handstand every time she can safely do so after summiting a mountain. She also cartwheeled across the finish line during last year's marathon here.

Her father instilled a love of the outdoors during canyoneering trips, rock climbing adventures ("He somehow didn't kill us because he had no idea what he was doing," she inserts) and expeditions to the Grand Canyon. Those early adventures, combined with her skills as a gymnast, served as a natural segue into mountaineering. Only a year after she seriously started climbing, at age 19, Mortenson was climbing technical routes.

"It's a really natural progression because gymnastics requires very high physical competence and strength as well as mental focus and fortitude," she explains, "so a lot of gymnasts get bored with many other sports because they don't have the mental component.

"I dove into mountaineering very hard," she adds. "I got lucky. I had the great fortune of having very good mentors very early on in my climbing and mountaineering career.

Courtesy of Cece Mortenson / Special to *The Antarctic Sun*

Cece Mortenson does an extreme version of a handstand. The gymnast-turned-mountain guide does a handstand whenever possible after climbing a mountain.

"It quickly became my passion. It's what I did. I loved it. I love traveling. I love adventure."

That passion has taken her around the world and back again a few times over for the last decade, from the mountains of Bolivia to the dizzying peaks of the Himalaya. She managed to juggle all that globetrotting while finishing a bachelor's degree in environmental science and then her master's thesis, which she wrote while living on a sailboat and bike commuting an hour to the university.

Mortenson's academic interests naturally gravitated toward environmental science but with a twist: she studies how science influences public policy and resource management. For her thesis, she looked at how science was used to strike a balance between conservation practices and logging demands at Great Bear Rainforest, a Pacific temperate rain forest located in southwestern British Columbia. Earlier this year, the provincial government there and a broad coalition of competing interests agreed to establish a park twice the size of Yellowstone and designate nearly 12 million acres for sustainable forestry.

"It doesn't relate to the work I do down here," Mortenson concedes, "but I find the science down here really interesting. … In many ways, I see the work I'm doing down here in context – working with the National Science Foundation, understanding how to plan grants and how science gets done on the ground."

As a member of FSTP, McMurdo's corps of wilderness experts and mountaineers, she gets a chance to experience Antarctic science up close, whether it's helping track down seals among pressure ridges in the sea ice or rappelling down ice cliffs to help collect core samples.

"There's a lot of science happening in a very dynamic mountain environment here," she says. "It can be a pretty high-risk environment and that's when we [at FSTP] get pulled in to handle risk."

But the job is not all about adventure: Mortenson spends much of her time as an instructor teaching various outdoor courses or organizing training exercises for the station's search and rescue teams. And, she says, most of the fieldwork here is akin to car camping, with relatively comfortable facilities and tremendous support from a central location.

The risks are certainly higher elsewhere trying to bag peaks. In the last year, Mortenson says she's lost three close friends. It's a subject she's not terribly keen to discuss – even her own narrow escapes, including a very lonely week in the Himalaya at 7,000 meters where she thought she might not survive.

"This is not ladder safety," she says. "When you're out climbing a big mountain, you're really vulnerable. Making good decisions and having some safety net is really paramount. I've certainly had some close calls when climbing."

Despite the risks – or perhaps because of them – Mortenson has no plans to give up her lifestyle any time soon, though she claims that she has no desire to continue guiding when she turns 40.

That zest for life comes as no surprise to Traci Macnamara, Mortenson's friend and roommate.

"She really lives and follows her passions – whether that means she's studying science and politics or mountain guiding in Alaska," Macnamara said. "One of the things that cracks me up – she'll come back from the field dog-tired – maybe she hasn't eaten in the galley for days, or maybe she's only slept for four hours, but if the weather is good, she's almost panting with excitement to go out and ski or run.

"Of course, I love it because I like to do those things, too, so we do it together, but any 'ordinary' person would take a nap. Cece's extraordinary like that."