POLAR RESOURCES NEWSLETTER 7/5/06




A STEEP Learning Curve

Breathtaking and formidable, the St. Elias Mountains reach endlessly skyward, seeming to defy gravity. Glaciers slide from the mountainsides carrying bands of debris. In this extreme landscape Terry Pavlis (University of New Orleans) leads an ambitious study, "The St. Elias Erosion/Tecotonics Project," also known, appropriately, as STEEP. The scientists are grappling to understand the nature of competing forces compellingly evident in this region: glacial erosion and tectonic mountain-building.

The St. Elias Mountains of southern Alaska and northwestern Canada are the highest coastal range on Earth. They include Canada's highest peak, Mt. Logan (elev. 5,959 m), and the Bering Glacier, North America's largest. Want more superlatives? The area is protected by the world's largest suite of national parks and preserves, including the United States' Wrangell-St. Elias National Park and Glacier Bay National Park and Preserve, and Canada's Kluane National Park, covering more than 97,000 square kilometers. As proof of the area's ruggedness (and capriciously dangerous weather), the exact elevation of Mt. Logan remained unknown until a team from the Geological Survey of Canada scaled its summit in 1992. "I don't know of anywhere on Earth that has more spectacular scenery when the weather is nice," notes Pavlis. "But when the weather is bad, which is often, it doesn't get much worse as a place to work."

With one field season completed and four to go, Pavlis' team wants to quantify the forces that are trying to flatten the mountains (glaciers, water, and gravity), and the forces that keep the mountains standing tall. The glaciers lower the landscape by gouging, plucking, and transporting sediment to valley streams and rivers, and thence to the Gulf of Alaska. The competing upward processes involve deformation of large, spinning, broken pieces of the earth's crust floating on viscous mantle material. Not only will the study address the current state of affairs in the battle between the glaciers and the mountains, Pavlis points out that "a major effort will be made to understand how these forces have competed over the last 15-million years."

Maritime helicopter with the Bagley Ice Field and Mt. St. Elias in the background. Photo: Aaron Berger

The STEEP team uses a variety of research techniques. These include regional mapping of warped and faulted layers of sediment, taking careful measurements of ground surface elevation (geodetic measurements), monitoring of shaking of the earth's crust (seismicity), and estimating the mountain's rate of uplift. For mapping a huge area such as the St. Elias Mountains, the researchers rely on what they can see from the air.

Data are gathered by a network of 22 field stations accessible only by helicopter. Electronic surveying gear, including Geographic Positioning Systems (GPS), allows researchers to pinpoint elevation and location. The field stations also have seismographs, which measure earth tremors. Alaska is known for its humongous earthquakes, due not only to rupture and breakage along faults, but also perhaps caused by glaciers and rock-falls, as scientists have recently asserted. On September 14, 2005 (shortly after STEEP's instrumentation was installed), a large avalanche of ice and rock fell from 3,203-meter-high Mt. Steller, located in the south-central part of the study area. The impact of the debris spanked the glacier so hard that surface waves were generated equivalent to a magnitude 5.2 earthquake, enough to knock things off of shelves. But, as Pavlis explains, "The area is so remote that the shaking was not felt by many. . . fewer than 20 people live within 50 miles of the site." The avalanche was caused by oversteepened slopes carved by the glaciers, as well as by the weight of the ice and snow, and is an extreme example of how glaciers and earth dynamics occasionally interconnect.

For more information on this research:
http://www.vecopolar.com/arlss_reports/arlss_projectsdetail.asp?cbPropNum=0409009

Glaciers also appear to be a direct agent in the generation of other kinds of earthquakes. One kind may be caused by the removal of the weight of ice and debris as glaciers melt. Think of it as holding a balloon underwater: as long as your hand supplies a downward force (like the weight of the glacier), the balloon stays put. Relax your hand, and the balloon bobs up,

Continued on Page 5

ALASKA News

Toolik Field Station

"This week we had lots of rain and little flying," VPR's Bride Sweeney reported. Broxton Bird and two members of Mark Abbott's (University of Pittsburg) team continued to wait for their put-in at Summit Lake. They are set to go into the field but are, as Bride says, "hunkered down in their weatherport," waiting for conditions to improve. When they do get to their site, they'll collect lake-bottom cores for their study of regional climate history for the last 2000 years. "We're all hoping for a sunny tomorrow," says Bride.
http://www.vecopolar.com/arlss_reports/arlss_projectsdetail.asp?cbPropNum=0454941

Anne Hershey (University of North Carolina) and team were busy last week taking samples for her lake productivity study. One portion of her group has been doing some vegetation mapping and exploration in addition to the water sampling.
http://www.vecopolar.com/arlss_reports/arlss_projectsdetail.asp?cbPropNum=0516043

Around the State

"It has begun," wrote Terry Pavlis last week, and so it has. STEEP researchers convened on southern Alaska last week to begin a 5-week field study of the St. Elias Mountain range. Several team members went out to Cape Yakataga by fixed wing to begin their geology work. In addition, an estimated 20,000 pounds of seismic gear

Foul weather kept the helo grounded for most of last week. Photo: Debasish Chaudhuri

was flown into Ultima Thule from Chitina and Gulkana using a Skyvan and turbine Otter. Tracy Sheeley, VPR helicopter coordinator, spent several days in Cordova coordinating the helicopter there before flying to Ultima Thule on July 2nd. For more STEEP information, read this week's cover.

Darrell Kaufman (Northern Arizona University) arrived in the field this week, beginning a season of visiting lakes throughout Alaska, where they'll establish long-term monitoring instruments, take long and short cores, and make other measurements. This week they begin with surveys of Prince William Sound lakes.
http://www.vecopolar.com/arlss_reports/arlss_projectsdetail.asp?cbPropNum=0318341

GREENLAND News

Air National Guard Update

A wrench in the works of our well-oiled arctic logistics machine has allowed us to reexamine and even improve our support apparatus. Last week, Air Force Colonel Paul

Kangerlussuaq, Spring, 2006. Photo: Ed Stockard

Sheppard announced that the New York Air National Guard's fleet of C-130s was grounded due to maintenance concerns with the wing fuel tanks. Given the time-intensive repairs, the Guard estimates we'll turn our calendars to August before two Guard birds can again fly around Greenland. Since the program schedule showed two flight periods in July, we had to come up with Plan B.

Still, "if this had to happen, it's really not as bad as it could have been," notes VPR's Greenland manager Robin Abbott. "All the early summer researchers are either gone or where they need to be, and the late summer folks haven't deployed yet. We're in between times in terms of needing C-130 airlift."

A close look at the July manifests revealed that a large number of travelers heading to Greenland were operational or distinguished visitors heading to Summit Station: Danish dignitaries and media, U.S. embassy representatives from Copenhagen, teachers and students from Greenland and Denmark, two U.S. teachers from the Teachers and Researchers Exploring and Collaborating program, and a group from the U.S. Antarctic Program looking at the Deep

Ice Sheet Core drilling operation. Postponing or reducing these programs smarts in its own way: as NSF's Renée Crain said, the time folks from Greenland, the U.S., and Denmark spent together would have made "a really great bridge for the three countries and a memorable research experience for the educators and students going." But we were relieved to discover that Air Greenland Twin Otters could transport the few science-critical folks planning to field their projects or make site visits during July. As Renée says, "our main concern is supporting the remaining science missions and getting the flights needed to fuel Summit for science operations over the winter." Flights bringing fuel in could also remove DISC cargo as well.

VPR's Mark Begnaud caught up with former KISS manager Bent Brodersen this week in Kangerlussuaq.

Robin and Tom Quinn and others worked the phones to find out what the air capacity might be in July. And funny thing, Robin discovered Arctic Umiaq Line (which traditionally operates the ferries going between Denmark and Greenland) recently added two flights a week between Copenhagen and Kangerlussuaq. Surprise! Reasonably priced seats were available, so program folks will head to Kangerlussuaq via this operator during the second week in July. A new air provider between Copenhagen and Kanger may ease an operational strain: the increasing difficulty of finding seats on commercial flights to or from Greenland at this time of the season. As for intra-island travel, Robin estimates that three Air Greenland Twin Otter flights during the week of July 9th will suffice to transport folks to or from Summit.

Meanwhile, our colleagues in the Guard are working around the clock to get the planes back on the runway in Scotia. We look (or listen!) forward to hearing them roar into Kangerlussuaq in mid-August, or possibly during the scheduled flight period July 23-29. Stay tuned.

Around the Island

Researchers with the Genevieve LeMoine (Bowdoin College) and Christyann Darwent (University of California, Davis) archeology study put into their field site located in Inglefield Land (Northwest Greenland) July 3. Greenland activities manager Mark Begnaud sends this update: "The weather in their research area has been mostly favorable since their arrival. At today's check-in Genevieve LeMoine commented that the renewable energy solar system built by Tracy Dahl was working very well and trouble- free." http://www.vecopolar.com/arlss_reports/arlss_projectsdetail.asp?cbPropNum=0330981

Camp Raven

With the Guard off-island, we'd worry about our staff's isolation at the Guard's primary training facility. Fortunately Lou-n-Mark Albershardt are famous peas in a pod. Lou writes that last week was "beautiful! Foggy mornings would open into crisp, clear days. The overnight lows are still dipping below the minus 20 mark, cool for late June. Monday we had a wild display of cumulus clouds to the west/northwest – Tall thunderous-looking clouds that even dwarfed the DYE II Site." Thanks for minding the store, Team Albershardt!

Summit Station

Folks at the apex last week worked on adjusting their schedules (and attitudes) to the new ANG plan. But that's not all they did, says station manager Kim Wolfe: "All joined the 4th of July BBQ festivities that included a group effort Feast, complete with Special DISC Punch, and horseshoes. Others skied, walked or watched movies during this luxury of a break from work.

"Mike Town [Researcher with Eric Steig, University of Washington] presented a 'science lecture' on halos and sun dogs, complete with great photos and explanations of the physics [needed] to create such solar beauties. The entire population attended the presentation and the only complaint was that it was hard to hear him over the crackling of 27 glasses of 2500-year-old party ice. Katie Hess followed through with 2 hilarious mid-winter videos from South Pole.

"The moon is on the southern horizon, a snow bunting passed through camp, and plans to winterize Summit have already begun."

A solar halo frames DISC at night. Photo: Kim Wolfe

A DISCussion with Jay Johnson

Last week, folks doing deep drilling tests for the Ken Taylor-led plan to harvest a new deep core in West Antarctica scaled back from 24-hour operations. The effort had gone so well that had they kept it up, they'd have finished before the wigs come to inspect the operation. We caught up with Jay Johnson, operations manager for Ice Core Drilling Services (ICDS), via email to find out how he thinks it's going.

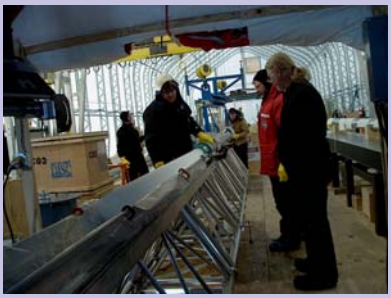
So how's the drilling going?

Over all, drilling has gone quite well. We have had our share of problems, but none of them show stoppers. I credit our ability to recover quickly from problems and breakdowns to the exceptional talent and dedication of everyone on the crew here and our technical support from back home.

The drill team: L to R, Michael Jayred, Paul Sendelbach, Kristina Dahnert, John Fowler, Bill Mason, Scott Haman. Photo: Jay Johnson

What's gone really well?

To start with, set-up at the beginning of the season went very well. Two weeks after we began assembly, the drill was set up and we were doing equipment start-ups. Core quality has been very good right from the start. I think even better than most expected. Drilling in general has gone well. Despite having a winch and drill-control system that is in its rough state we have been able to do the testing that we needed to do to characterize the system and at the same time maintain a good pace to reach our drilling goal of 700 meters by the end of the season.



The team pushes the core out of the barrel. Photo: Kim Wolfe

What hasn't?

We learned early on in drilling that the screen section of the drill—the part of the drill that collects the cuttings and filters them from the drilling fluid—can't for various reasons hold enough chips to drill a four-meter core like it was designed to do. The longest core we have been able to drill in one run was just over three meters. For this season it just means we have to drill shorter cores. For WAIS divide the necessary modifications will be made so we can collect a full four-meter core. Most of our other drilling problems have revolved around our instrument section. We had some bad solder connections and noise problems that stumped and eluded us for a while, but Paul and Nicolai, our electrical engineers on site, were able to track them down.

What are you learning about your drill? Is it operating as you expected?

One of our main goals was to learn what effects drilling speeds and drilling feed rates have on core quality and the lengths of core we can drill. We now have a good understanding of these relationships. The other half of drilling is handling and cleaning the drill components, core and screen barrels, between drilling runs. This test season has been great for testing and learning how well all of our support systems work and function in the cold. Obviously with any piece of new equipment there are things you would like to change, but given this is the first time this drill has been set up in an arctic climate and the first time it has cut ice I couldn't be happier.

How far down have you gone? What's the ice like way down there?

We are just over 700 meters deep right now. We are into what is called the brittle ice zone. Ice from this zone will break without any mechanical forces applied to it. The temperature in the DISC tent is around –7° C during the day and it's about -30° C at the bottom of the bore-hole. This temperature differential combined with high stress in the ice will cause the cores to break into pieces within minutes after being pushed out of the core barrel. Amazingly we are still able to retrieve 2.5-meter cores that have no more than one break in them.

What do you do with the cores when you bring them up?

All cores that we are drilling now are going to Geoff and Brian from NICL. They are using them to test their core handling and processing equipment. Some samples have been saved and the rest of the cores are thrown outside along with the chips generated from drilling.

What's it like to spend so much time at Summit?

With a group as big as ours staying for as long as we are, it is important that we do our best to fit in with camp and help out where we can. For a few of us who have been here from the beginning, it has been interesting to see how the dynamics of the camp have changed from April until now. Most of the camp staff has turned over, the carps have left, science groups and visitors have come and gone, and some of our group has as well. With the camp population down right now it is definitely quieter around here now than it was earlier in the season. I am very grateful for the seamless support VECO and the Summit camp staff has provided for us this season. Without it I am sure our season would have not gone as well as it has.

Continued from Page 1

and waves form in the water (like earthquake waves). In 1979, such an earthquake with a magnitude of 7.2 was felt in the St. Elias area.

Smaller but more numerous glacier-induced earthquakes are being monitored by STEEP's seismographs as well. Pavlis says these surprising, newly discovered earthquakes are apparently generated within and along the base of the large Bering glacier. The exact mechanism for these tremors is not known, but the location suggests that rock breakage along the base of the glacier may cause earthquakes, or that perhaps the glacier itself occasionally breaks along planes of weakness.

St. Elias Mountains, southwestern Alaska, under attack by glaciers. Photo: Aaron Berger

Saint Elias Mountains and Tyndall Glacier above Taan fjord, Alaska. Photo: Jamie Buscher

But earthquake monitoring is just part of the STEEP investigation. The network of geodetic stations provides ground truth for airborne LIDAR ("light detections and ranging") surveys. LIDAR measures a tightly woven matrix of spot elevations of the land surface with incredible detail and accuracy. Billions of data points are used to create a computer-generated image of the ground surface. The STEEP team will make detailed measurements of areas that have experienced ground ruptures and fissures generated by motion along faults during past earthquakes. Since the recent discovery of the relationship between glaciers and ground shaking, a theory being tested here by the STEEP team is "are glaciers agents that focus deformation of the Earth's crust?"

A specialized geochemical analysis (thermochronometry) will enable the STEEP team to assess long-term uplift and erosion rates. Through a set of complicated measurements of radioactivity and "fission tracks," geochemists will piece together how fast the mountains have been uplifted, and where the uplift has been concentrated.

These analyses have revealed some interesting preliminary results. Perhaps the most exciting one to date is the astoundingly young uplift age of the mountains adjacent to the Bering Glacier. "The dates indicate that entire 5,000-m high mountain ranges may be rapidly recycled, geologically speaking, by the glaciers," says Pavlis. "This supports one of our initial hypotheses, that glaciers and mountain-building are intimately tied together." The gargantuan landslide that ate up part of nearby Mt. Stellar last year is just part of this process. Score: Glaciers: 1, Tectonism: nil. With arctic warming, the score may change soon.

Hence, STEEP scientists are looking at the earth in new ways. By looking from a variety of perspectives, researchers hope to gain insight and discover new relationships related to two formidable Earth-shaping agents: glaciers and tectonics.

—Brandon Curry

Terry Pavlis' STEEP principal collaborators: Bernard Hallet (University of Washington), Roger Hansen (University of Alaska, Fairbanks), Jeff Freymueller (University of Alaska Fairbanks), Gary Pavlis (Indiana University), Kenneth Ridgway (Purdue University), James Spotila (Virginia Polytechnic Institute), Ronald Bruhn (University of Utah), Peter Koons (University of Maine), Peter Zeitler (Lehigh University), Sean Gulick (University of Texas at Austin).

Brandon Curry is a midwestern US geologist who specializes in geologic mapping, environmental geology, and climate change.

SCIENCE & Other News

Just in case: The Norwegian island of Spitsbergen will soon host a super-safe vault for caching millions of seeds from many edible plants.
http://www.contracostatimes.com/mld/cctimes/living/science/14859367.htm

Torre Jorgenson, Yuri Shur and others tell Ned Rozell about ice wedges, which seem to be melting in areas west of the Colville River on Alaska's North Slope. http://www.alaskareport.com/nature10035.htm

Bones from a herd of large, duck-billed dinosaurs have been excavated in Edmonton, Alberta, Canada.
http://thechronicleherald.ca/Canada/514308.html