GEOPHYSICAL INSTITUTE QUARTERLY

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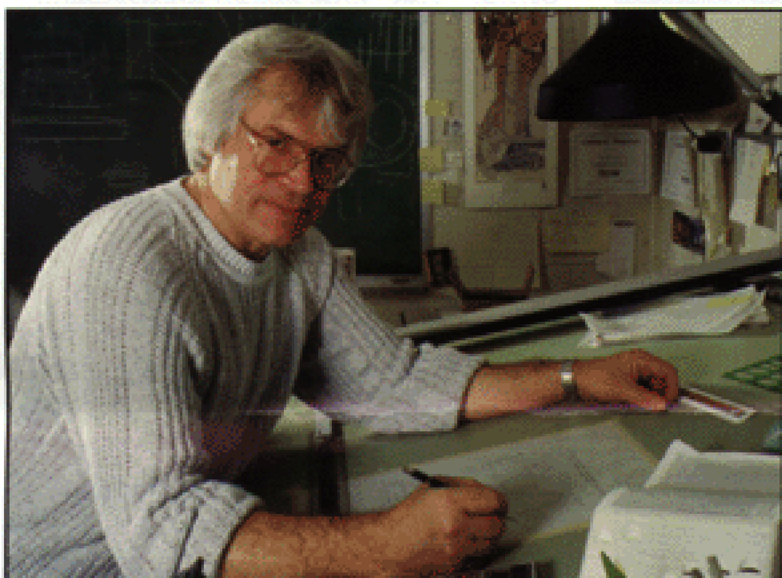
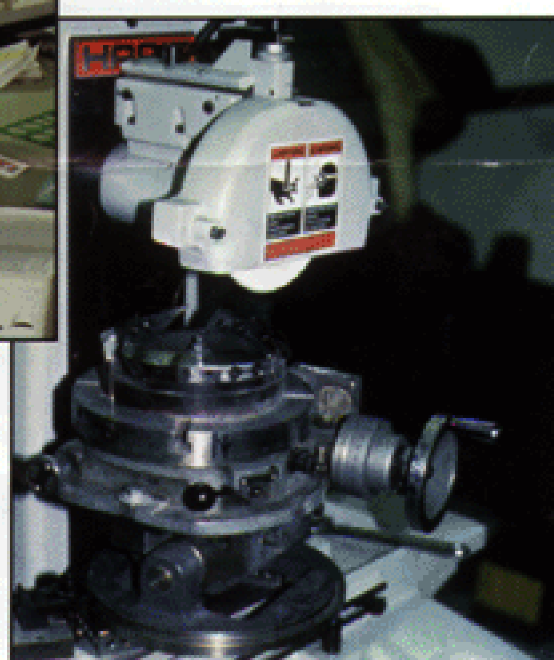
Designing the Drill That Made History

When scientists from the University of Alaska Fairbanks hit bedrock under Greenland's ice cap for the first time in history this summer, the event made newspaper headlines around the country. The drill cut through 10,015 feet of glacial ice to grab a sample of bedrock and to pull out a core of ice more than 250,000 years old.

D. SIGLER



From the drawing board to the test site— *Larry Kozycki of the Geophysical Institute Machine Shop designed the drill that hit bedrock.*



K. STANFORD

That ice core is a frozen record of ancient weather patterns and its analysis already has shed light on dramatic shifts in past climates. Scientists also will use the crystalline core to advance research on potential global climate changes in the future, and to learn more about glacial physics.

Baxtor Burton, assistant director of the university Polar Ice Coring Office, said obtaining the ice sample was as great a feat as getting the first rocks from the surface of the moon. And the similarities between the two ventures don't end there.

Engineers and mechanics tried for years to put a man on the moon. They designed one rocket after another, adjusting bolts here and engine parts there, until they found the perfect combination. When the astronauts finally made it, there was a great deal of celebrating down below. We made a hero of Neal Armstrong, the first man to walk on the moon, but can anyone remember the name of the engineers that designed the rocket to get him there?

Five years ago, shortly after UAF was awarded the PICO contract, Larry Kozycki was asked to design and develop a drill that would bore through ice in Greenland. Kozycki, supervisor of the Geophysical Institute Machine Shop, luckily has never been one to run from a challenge, because walk into a challenging situation he did. The drill used previously for the PICO project was inadequate and there was little money available for research into better drill design or for a test well in which to try it out. Kozycki had to start from scratch.

The design of the drill that eventually hit bedrock started on a chalk board in his office and progressed to stacks of paper on his desk. "The design did not come from intuition," he said. "The whole process was like putting together a puzzle."

It fit together one piece at a time. The first step was to build the drill in the machine shop. Then, without many preliminary tests, it was sent on a plane to Greenland four years ago. Once there, the 80-foot drill worked, but not perfectly.

To make the necessary changes, Kozycki visited the field site, which he describes as a barren, white place where temperatures average about 20 degrees below zero, the wind rarely stops

Continued on page 7

B. KOCI

UNIVERSITY OF ALASKA FAIRBANKS

Launching the Alaska Space Academy

Alaska's first space academy for kids was launched this summer by Assistant Professor of Geophysics Neal Brown and a host of dedicated volunteers. More than 100 students from around Alaska and as far away as Russia and Canada attended the week-long camp at Lost Lake, a boy scout recreation area off the Richardson Highway.

At the camp, students built and launched rockets, and mapped the bottom of Lost Lake in much the same way the Magellan space craft mapped the surface of Venus. They also used a television-equipped submersible to view fish underwater as if they were alien beings from another planet. Computers and laser disc machines, housed in a rustic cabin, were used to analyze the data.

The purpose of the camp was to keep students in grades 5 through 8 interested in learning about science. "Kids in middle school are dropping out of math and science; they're losing interest in it because they don't see how it's relevant for their lives," said Brown, who directed the camp. The camp was sponsored mainly by the Geophysical Institute, the Alaska Space Grant Program, and the College of Natural Sciences in association with the Midnight Sun Council of the Boy Scouts of America.

The study of space stimulates kids' natural curiosity about the world around them, Brown said, and the course curriculum at the camp incorporated practical lessons in other scientific areas including electronics, biology, mapping, gridding, and sonar technology.

The students also learned about teamwork. Led by an adult and a high-school age assistant, the students worked in groups of ten to build high-powered rockets that were later launched at Poker Flat Research Range. The students also learned something about politics when Lt. Governor Jack Coghill made a special trip out to the range to meet them. After the students toured launchers and watched their six-foot rockets soar high above them, Coghill presented each one with an official certificate of appreciation.

DOUG SIGLER

DOUG SIGLER

DOUG SIGLER

DAVID SANCHES

DAVID SANCHES

Discoveries*—Students at the camp learned about space through a variety of techniques ranging from viewing the sky overhead to searching for fish underwater.*

The students attending the camp represented a cross section of arctic culture. About 50 percent of the registrants were from Fairbanks; 10 percent came from Anchorage and 40 percent flew in from rural areas around Alaska including Nome, Eagle, King Cove, Allakaket, Anaktuvik Pass, Nenana, Delta Junction, Homer, Valdez, and Anderson. Twenty-four of the participants were Alaska Natives; two teachers and four students who attended the camp were from Krasnoyarsk, Russia, and seven students were from Whitehorse, Canada. Nearly a third of the camp participants were girls.

The students selected to attend the camp were those who expressed an enthusiasm for learning on their applications, not necessarily those who maintained the highest grades in school. "I targeted the kids who were undecided about science; the kids who were interested and motivated, but still on the edge," Brown said.

Students learned by attending outdoor classes, by doing deep-water tests from canoes on Lost Lake, by designing their own rockets, by experimentation through trial and error, and, mostly, by having fun. "I'm convinced fun is one of the most important ingredients in getting any kid to want to learn anything," Brown said.

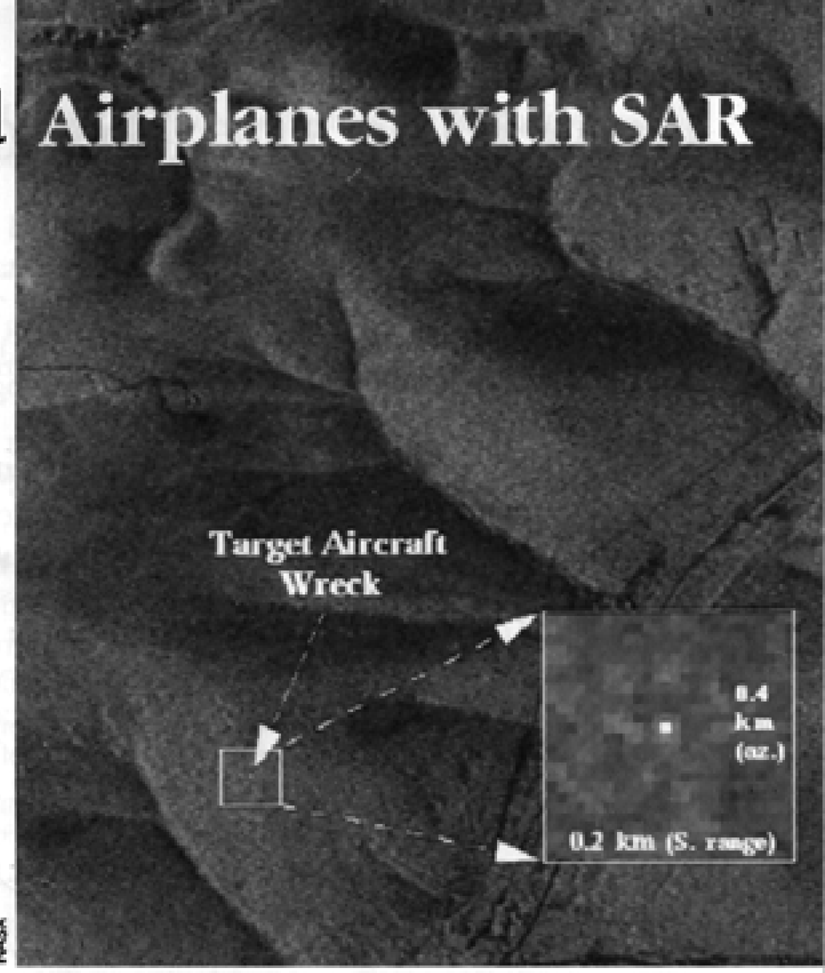
Lance Andree, a UAF senior journalism major, was one of several members of the media who attended the camp to produce free-lance stories about it. He captured Brown's warm and energetic teaching philosophy at the end of a Heartland feature he wrote for the Fairbanks Daily News-Miner:

"On closing night, when campers gathered around the fire one last time, Brown did not give a motivational speech. He didn't encourage them to hit the books or make grim references to their roles in the planet's future. He just had one question:

'Did you have fun?' he yelled.

The campers' enthusiastic response was all he needed to hear."

Looking for Lost and Wrecked Airplanes with SAR



Zeroing In—*Aircraft wreckage is shown on this airborne radar image taken near Gilmore Creek, Alaska.*

A research aircraft equipped with radar that can see plane wreckage through thick vegetation, bad weather, and darkness was tested in Interior Alaska this summer.

The experiments were conducted as part of the NASA Goddard Space Flight Center Search and Rescue Mission at two sites near Fairbanks: the Gilmore Creek Tracking Station and the Bonanza Creek Research Area.

The DC-8 aircraft used to carry the synthetic aperture radar (SAR) over the Fairbanks sites also has flown for a variety of projects and experiments around the world to conduct sea ice studies, ozone monitoring, and forestry research. Several agencies split the cost of bringing the plane to the Interior for two weeks in July.

Finding a wrecked plane in the vast, remote, unpopulated areas of Alaska usually takes a tragically long time. The search for downed aircraft sometimes is aided by signals from emergency locator beacons, which planes are required by law to carry, but all too often these signals are weak or nonexistent. That's why, in a large majority of cases, visual searches must be launched.

Most visual searches in remote areas of Alaska are plagued with problems: bad weather can cause delays; crashed aircraft can be hidden under trees; night falls just as a promising site is located.

FRANK DEMMERLE

Radar—*This side panel on NASA's DC-8 aircraft contains the antenna used to search for wrecked airplane parts positioned in the study areas by researchers.*

Too often, wrecked planes in Alaska are found years later by hikers or other ground parties. The experiments conducted by NASA offer hope of significantly shortening the search time.

To set up the test sites, NASA employees used salvaged parts of aircraft that had crashed in Alaska. These pieces were placed in positions typifying actual crashes under trees within the selected test sites.

Jason Williams, a calibration engineer with the institute's Alaska SAR Facility, helped the Goddard Space Flight Center team set up four radar corner reflectors at the test sites. The reflectors were placed at known distances from the wreckage so they could be used as position reference points and for standard calibration. "The reflectors return a predictable signal," Williams said. "They can be used to validate and correct SAR data."

When used in rescue operations, SAR is able to precisely map large areas of terrain along the search plane's flight path. SAR is valuable for search and rescue applications because it can be flown at night and at high altitudes above adverse weather conditions. It also can penetrate foliage, which means it can "see" through the tree canopy to the ground.

Multipolarization SAR, the type used on the DC-8 aircraft, is also useful for search and rescue because it tends to make a distinction between manmade and natural objects.

The SAR data of the Fairbanks test areas was flown to the Jet Propulsion Lab in Pasadena, California, where images will be produced and forwarded to the Goddard Space Flight Center for enhancement and analysis.

To the layperson, those black-and-white images look like aerial photographs of the ground. On those images, the wrecked airplane parts appear as bright dots against a gray background. Those dots indicate radar returns, which can be can be classified as known or unknown targets. The known targets, such as buildings, junk yards, and railroad tracks, can be eliminated through map comparison, while the location of unknown returns or targets can be given to search teams for investigation.

The technique has the greatest promise in uninhabited areas.

In a developed area, the plane wreckage would be lost in a mirage of bright spots representing all kinds of manmade structures, but in remote areas of Alaska, where houses are sparse and manmade structures are few and well documented, the bright spots on the SAR image have a good probability of representing plane wreckage.

The SAR-dedicated aircraft also has been used to find airplane wreckage at test sites in remote areas in North Carolina, Maine, Pennsylvania, California, and Michigan.

The results are promising. Goddard Space Flight Center officials say their near-term goal is to fine tune the SAR to make it even better at detection. Others hope that one day a SAR-carrying plane will be dedicated solely to search and rescue efforts.

"It's a great goal," said ASF Data Manager Tom George. "I hope a cost-effective way can be found to do it."

Unveiling the History of the Arctic Basin

An investigative mission to find out how islands, mountains, and rocks formed in a remote part of Russia has uncovered information that may reveal, for the first time, a complete picture of the geologic history of the massive Arctic Basin.

For three years, scientists at the Geophysical Institute have worked with Russian colleagues to ferret out information about how different masses of land ended up in the polar north. Most of the research has been funded by the National Science Foundation and the Russian Academy of Sciences, but some funding has come from oil companies, which hope the clearer picture will reveal more potential oil and mineral reservoirs.

Scientifically, the results of the study should contribute greatly to what is known about continental drift, or the theory of plate tectonics, which assumes the surface of the earth is composed of large, semirigid plates that shift position by floating across weaker rocks in the mantle. Heat from the earth's interior drives the movement, which prompts earthquakes and volcanic eruptions in active zones around the globe.

As recently as 10 years ago, scientists began to believe that much smaller parts of the earth's surface, called terranes, also move relative to each other. Terranes are typically identified as packages of rocks that are fault bounded and seem to have quite different geologic histories than their neighbors.

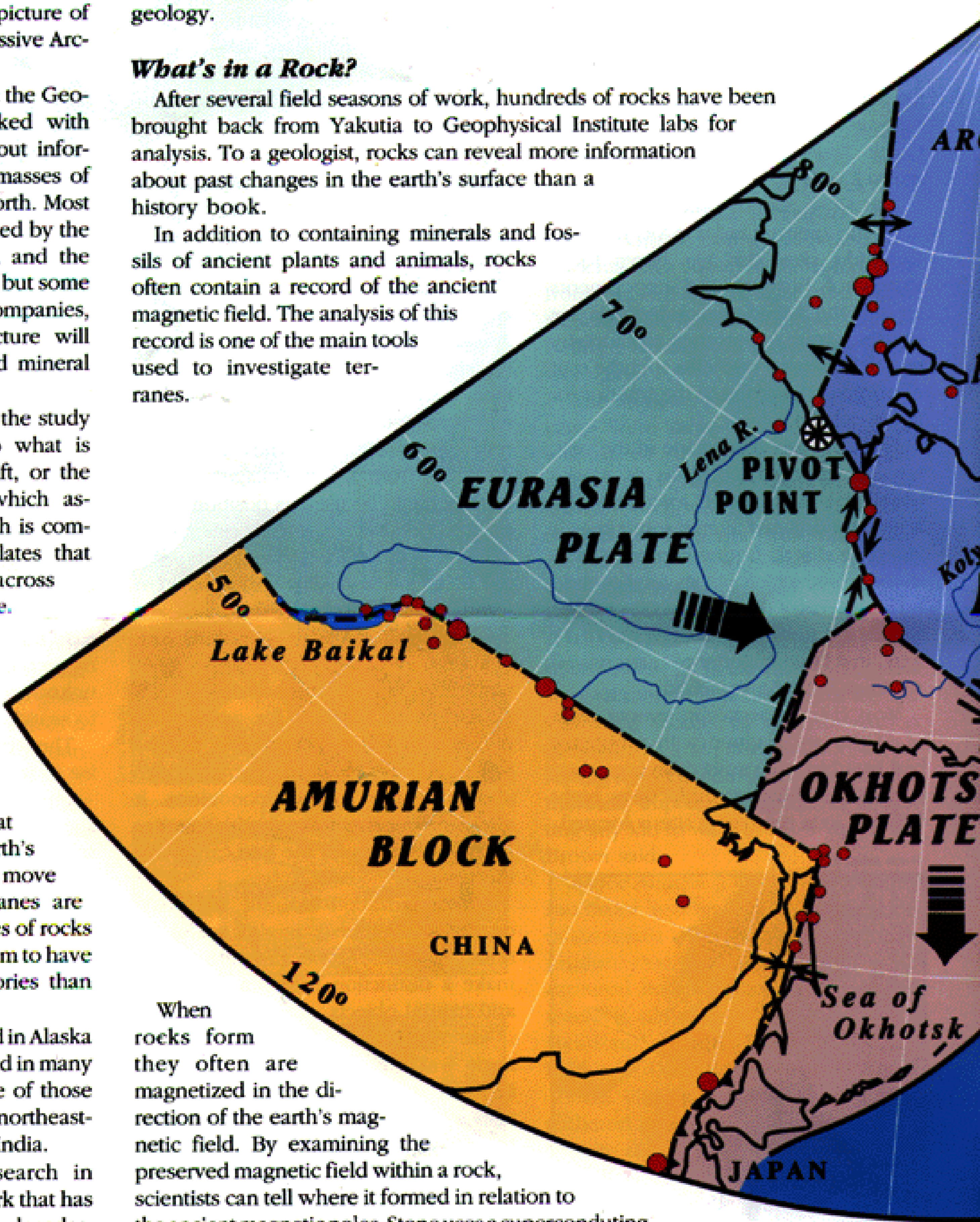
Terranes were first identified in Alaska but since have been recognized in many other parts of the world. One of those areas is Yakutia, a region in northeastern Russia about the size of India.

Geophysical Institute research in Yakutia is an extension of work that has been done in Alaska for two decades. Before free access into Russia was permitted, studies of terranes and other geologic features had to be cut off at the Bering Sea. "Going to Russia was the logical next step," said Professor of Geophysics David Stone, the principal investigator involved in the international research. Stone and Research Professor Kazuya Fujita, co-principal investigator, started the collaboration with Russian scientists at the Yakut Science Center in 1990. The cooperative study is interdisciplinary and involves interlocking investigations in the fields of seismology, paleomagnetism, geochronology, tectonics, and geology.

What's in a Rock?

After several field seasons of work, hundreds of rocks have been brought back from Yakutia to Geophysical Institute labs for analysis. To a geologist, rocks can reveal more information about past changes in the earth's surface than a history book.

In addition to containing minerals and fossils of ancient plants and animals, rocks often contain a record of the ancient magnetic field. The analysis of this record is one of the main tools used to investigate terranes.



When rocks form they often are magnetized in the direction of the earth's magnetic field. By examining the preserved magnetic field within a rock, scientists can tell where it formed in relation to the ancient magnetic poles. Stone uses a superconduting magnetometer at the Geophysical Institute to test the stability of the magnetic field within rocks collected from Yakutia. The sample is considered stable if the magnetic field within it remains unchanged after being heated in steps to 500°C, or more.

In another lab at the Geophysical Institute, Assistant Professor of Geophysics Paul Layer determines the age of the rock samples. Layer, another co-principal investigator for the study, dates rocks using a derivative of the potassium-argon method, which assigns years to the measured radioactive decay of potassium in a rock. Using equipment in institute labs, scientists have dated volcanic rocks as young as 50,000 years and metamorphic rocks as old as 1.8 billion years.

A New Plate and a Pivot Point

By figuring out the age of rocks and their position relative to others in a given area, the investigators have pieced together theories that explain how terranes ended up in Yakutia.

Research reveals that the oldest rocks in Russia lie in its interior and that these rocks move together as a unit known as the Eurasian plate. The Pacific edges of the Eurasian plate are composed of terranes that appear to have traveled much greater distances and to have arrived at their current locales more recently than their interior cousins. Rock samples provide convincing evidence that terranes in the southernmost part of northeastern Russia arrived at their current positions by rafting across the Pacific Ocean; some appear to have come from as far away as equatorial latitudes.

Theories that explain the arrival of the northernmost terranes in Yakutia are less definitive. However, many scientists believe that at one time they rotated away from the Canadian Arctic Islands by pivoting around a point in the Makenzie Delta near the Alaska-Canada border. It's theorized that this movement formed the Arctic Ocean basin sometime between 100 million and 200 million years ago.

Based on this theory, it seems possible that some of Yakutia's northernmost terranes could be geologic sisters to terranes in arctic Alaska, which include the oil-rich North Slope. Studies also have revealed that a huge continental shelf lies under the Eastern Siberian Sea, north of Yakutia. Oil has been discovered on a similar, but smaller shelf, existing off the north coast of Alaska. However, oil exploration in Yakutia so far has been limited.

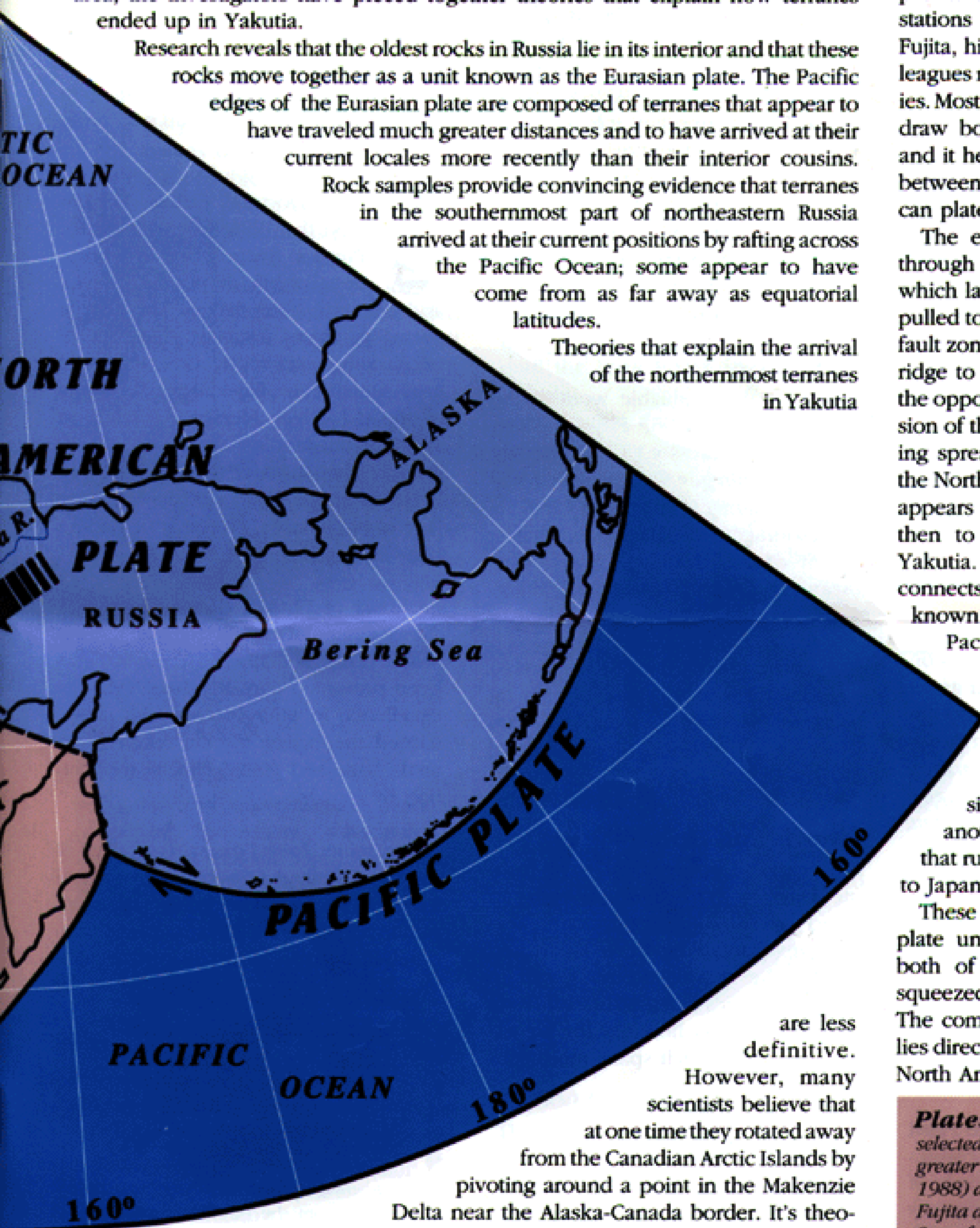
Research into the ancient travels of terranes naturally led to studies of present-day plate boundaries. "What is going on today is an indicator of what may have happened in the past," Stone said.

After analyzing Russian records on past earthquakes and setting up seismic stations to assess present-day activity, Fujita, his students, and his Russian colleagues made some interesting discoveries. Most important, their research helped draw boundaries around a new plate and it helped pin down the pivot point between the Eurasian and North American plates.

The earth's plates connect together through a series of active fault zones in which land masses are pushed apart or pulled together. Fujita set out to find the fault zone that connects the mid-Atlantic ridge to areas of plate convergence on the opposite side of the globe. An extension of the mid-Atlantic ridge, the opening spreading center that pushes apart the North American and Eurasian plates, appears to cross the Arctic Ocean and then to come on shore in northern Yakutia. What was not clear is how it connects to the well-defined and well-known plate boundaries of the North Pacific.

Fujita and his colleagues discovered two connections: a curved fault zone that connects the mid-Atlantic ridge in northern Yakutia to the Russian Kamchatka Peninsula, and another relatively straight fault zone that runs from northern Yakutia south to Japan.

These two boundaries define a new plate underlying the Sea of Okhotsk, both of which appear to be getting squeezed out toward the Pacific Ocean. The compression indicates that the sea lies directly behind the pivot point of the North American and Eurasian plates.



Plates in Motion—*Shown are selected earthquakes with magnitudes greater than 5 on the Richter scale (1960-1988) and plate boundaries proposed by Fujita and others. Research indicates the Sea of Okhotsk is being "squeezed out" into the Pacific Ocean because it lies behind the pivot point of the North American and Eurasia plates. On the opposite side of the pivot point, the two plates are moving apart and enlarging the Arctic Ocean (graphic adapted from Fujita et al, 1993, by Deborah Coccia, Geophysical Institute).*

GI NOTES

Nearly 100 Doctorates

As of this summer, 96 students have earned their doctorate degrees from UAF through the Geophysical Institute. Institute graduate students who recently earned the title of Ph.D. are *William Bristow, Arve Kylling, Ming-Chi Lu, Yu Lin, M. Geoff McHarg, Qilong Min, Jih-Hong Shue,* and *Robert H. Wade.* Graduating recently from the Geophysical Institute with Masters of Science degrees are *Santanu Bhattacharyya, Eric Breitenberger, Tong Fei, Thomas Homza, Andrea Krumhardt, Kim Morris, Jeffrey Rogers, Matthew Bierer, Carl Byers, Bianca Cerundolo, Stephen Crumley, Carrie Decker, Andrew Goodliffe, Ming-Shuai Hu, Zhijian Li,* and *Andrew Nicholas.*

Summer Interns

Working under faculty supervision, 20 undergraduate students got hands-on research experience this summer as interns. Participating in the program were *Eric Bass, Daniel Berman, Stefan Biene, Jeffrey Bishoff, David Blankenship, Charles Bradford, Jeremy Bricker, Dorothy Buck, Patrick Buller, Matthew Campbell, Valerie Clote, Anil Gopie, Phaedra Green, Jennifer Hooker, Geoffry Meek, Jennifer Newbury, Jason Parsons, Philip Valek, Mark Wieczorek,* and *Petra Wilm.*

Congratulations:

Emeritus Status

Former Professor of Geophysics ***Fred Rees*** and former Professor of Physics ***Juan Roederer*** received the rank of professor emeritus from the University of Alaska this summer. Emeritus is a status given to retirees who served UA with distinction in teaching and research; it is bestowed to symbolize the university's desire to maintain a relationship with outgoing faculty.

Rees has made significant research contributions in auroral and space physics to the international scientific community since joining the institute in 1975. His graduate-level textbook *Physics and Chemistry of the Upper Atmosphere* promises to affect graduate training in space physics around the world.

During his tenure at UAF, Roederer served as the director of the Geophysical Institute and the dean of the College of Environmental Sciences. Since he joined the institute in 1977, Roederer has played an important role in developing state, national and international science policy. He has been the president of the International Association of Geomagnetism and Aeronomy, the chairman of the U.S. Arctic Research Commission, and a member of many prestigious organizations.

Promotions

To reward their valuable work at the institute, Professor of Physics ***John Craven*** and Professor of Volcanology ***John Eichelberger*** were awarded tenure this summer. Both were hired as professors at the institute two years ago; Craven came from the University of Iowa and Eichelberger came from Sandia National Laboratories in New Mexico. ***Dan Jaffe*** and ***Doug Christensen*** also were awarded tenure and promoted to associate professors. Jaffe is now an associate professor of chemistry and Christensen is an associate professor of geophysics.

Awards and Honors

The Japanese government gave Institute Director ***Syun-Ichi Akasofu*** an award this summer for promoting academic exchanges between Japan and Alaska. The award was presented in Tokyo by Japan's Foreign Minister Muto. Akasofu also was honored for his auroral research, which spans more than 30 years.

Associate Director for Institute Relations ***Merritt Helfferich*** received the 1993 Alumni Achievement Award for Professional Excellence this summer. Created three years ago, the award is designed to recognize outstanding contributions to the community and the university by former UAF students. Helfferich graduated from UAF with a BA in English in 1966, the year he gained employment at the Geophysical Institute as an engineering aide. He later advanced into a variety of positions including head of Technical Services at the institute, Interim UA Associate Vice President for Human Resource Development, Assistant to the Chancellor, and Assistant, then Associate Director for Administration of the institute. Helfferich has a long history of involvement with community affairs, including membership in a wide range of borough and non-profit service organizations.

Post Doctoral Fellow ***Yu Lin*** won the 1993 Ed Hones Space Physics Award for her exceptional work in plasma physics and numerical simulation. The $1,200 award is given annually to recognize outstanding research by a space physics graduate student. Lin also received one of the C.T. Elvey Memorial Awards in 1992 for outstanding academic performance. This summer, Lin received her Ph.D. in Space Physics under the tutelage of her advisor, Professor of Physics Lou-Chuang Lee.

Professor of Physics ***Glenn Shaw*** was the recipient of the Terris and Katrina Moore Prize for 1993. The award has been presented annually since 1987 for excellence in scientific research. Shaw earned the honor for his research on arctic haze and global climate modulation by clouds.

This summer ***Jack Townshend***, chief of the USGS College Observatory, received a legislative citation honoring 50 years of public service in Alaska and special recognition from USGS for 30 years of service at the College Observatory. Over the

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Editor/Writer: Kathy Berry
Publications Asst.: Jan Dalrymple
Graphic Artist: Deborah Coccia

Designing the Drill

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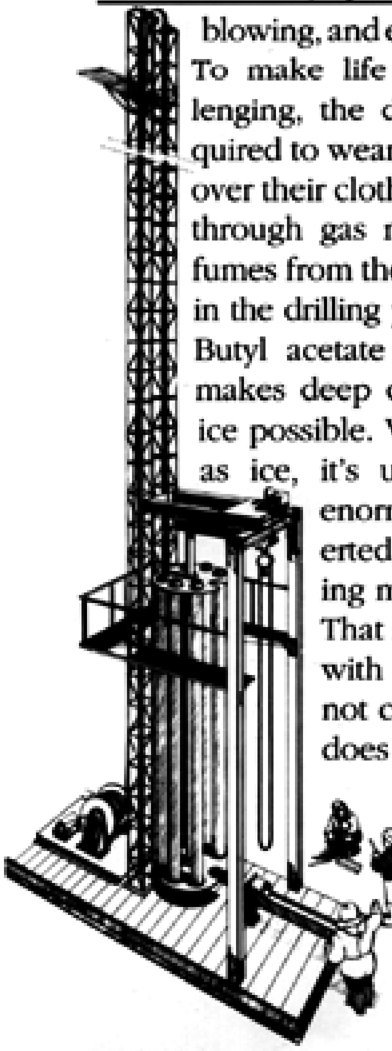

blowing, and everyone has a cold. To make life additionally challenging, the drilling crew is required to wear protective slickers over their clothing and to breathe through gas masks to ward off fumes from the butyl acetate used in the drilling process.

Butyl acetate is the liquid that makes deep drilling into glacial ice possible. Weighing the same as ice, it's used to offset the enormous pressures exerted by the surrounding mass of the ice cap. That means a hole filled with butyl acetate will not collapse. Because it does not dissolve the ice and does equalize the pressures in the hole, butyl acetate also helps keep the recovered ice cores intact, even those taken from deep within the glacier. Consequently, a drill using butyl acetate can pull up complete cores of ice from over 3,000 meters deep, while dry coring without butyl acetate can only bring up complete ice cores from about 300 meters. Ice cores brought up from greater depths usually crack because the bubbles of air trapped within them expand at the surface, an effect similar to what happens when a can of soda goes aloft in an unpressurized airplane.

When his experience in the field came to an end, Kozycki came back to the machine shop to make revisions that enabled the drill to work better the following season. During that 1991 field season, drilling went smoothly until the crew began having engine trouble.

Back at the drawing board, Kozycki designed a power pack that could withstand well over 5,000 pounds of pressure per square inch; the power pack was at the bottom of the 10,000-foot hole when the drill bit hit bedrock this summer. The third season, work slowed because the drilling cable showed signs of wear and needed to be replaced, but this summer all the effort paid off. A special diamond-tipped rock-core drill built by the machine shop descended into previously unchartered territory below the Greenland ice cap to grab more than a meter of bedrock. Descending to such great depths was a victory for the National Science Foundation, which has funded the project since 1988.

NSF was impressed enough to ask the machine shop to build a duplicate drill for research in Antarctica, but later decided it was more cost effective to move the existing Greenland drill instead.

The drill is just one of many projects undertaken by the machine shop, where all levels of work are performed, from designing and building high-tech equipment to hanging bookshelves. Just the other day, a request came through from the Department of Transportation. It seems they want the shop to design a machine that will graphically illustrate the way studded tires wear down a road surface. Kozycki already has ideas about how to make the machine work, and a stack of working designs on his desk.

GI NOTES

Continued from page 6

years, institute scientists have worked often with Townshend, who records measurements of the earth's magnetic field.

Addition Gets $800,000

An $800,000 capital appropriation for continuing the building design for a new addition to the Geophysical Institute was approved by Governor Walter Hickel in June. The appropriation brought Alaska's investment in the proposed project to $1.1 million. A portrait of the architect's original building design hangs in Merritt Helfferich's office and a model of that rendition resides in the Globe Room. Although useful for funding efforts, that original design—one large, ornate building—may not represent the final product. The current plan is to phase in construction of the addition by building a group of smaller facilities joined by atriums. The first of these smaller buildings is scheduled to be ready for occupancy by the National Weather Service in December 1996. The Atmospheric Science Group, the Keith B. Mather Library, and the GeoData Center and associated archives also are expected to move into that building, which architects envision will be three stories tall.

10,000 Orbits

The European Remote Sensing satellite (ERS-1) completed 10,000 orbits of the earth on June 14. The Alaska Synthetic Aperture Radar Facility within the GI is the only center in the U.S. to receive data from ERS-1, which was launched by the European Space Agency in July 1991. From 490 miles above the earth, ERS-1 transmits data used by scientists around the world to research sea ice and other oceanic phenomena.

Golden Days

The Geophysical Institute's Golden Days fund raiser netted $1548.52 for the GeoCare employee assistance fund. Festivities included the traditional sourdough pancake breakfast, the mouth-watering BBQ beef lunch and an afternoon ice cream social. New events featured this year included a sidewalk chalk art contest, a water balloon toss, and live music by *Sara Shaw, Peter Hallinan, Bev Frey, Liz Engle, Susie Cox,* and Arctic Winds (*Jim Slusser, Kathy Berry, Terry Norman,* and *Jerry Stansel*).

Big Al—*Allen Chadwick won first place and a $60 gift certificate for dinner at a local hotel for creating a chalk drawing of Albert Einstein during the Golden Days Sidewalk Art Contest.*

Geo-Odyssey Art on Outside Walls

A colorful art piece designed by Anchorage resident Keith Appel was hoisted up onto the exterior walls of the Geophysical Institute in July. The art piece is composed of large, 1/4-inch steel segments coated in blue, red, white, and silver porcelain enamel. Together they form a design that portrays the diverse disciplines of research conducted at the institute. Spread across four concrete panels, the display stands 16 feet tall and 40 feet wide.

The red pieces in the display represent a volcanic eruption and magma at the earth's core. The black areas signify subsurface oil deposits, aggregate, and a fault line along which earthquakes occur. The blue strata shows subsurface water emerging as an ocean, lake, or river and the sun and moon depict the gravitational force that governs tidal activity. The lunar emblems also symbolize GI research in atmospheric and space physics; the dramatic snow-capped peak and nearby receding glacier indicate snow, ice, and permafrost studies at the institute. A colorful aurora is planned to complete the design.

Funding for the "Geo-Odyssey" display came from the Alaska One Percent for Art in Public Places Program, financed by the Alaska State Council on the Arts. Appel's work was chosen after an extensive review by the Geophysical Institute and the UAF Art in Public Places Committee.

Appel is an accomplished artist who was chairman of the art department at the University of Alaska Anchorage until 1980. His artwork has been displayed in many Alaskan communities as well as in New York, Hawaii, Washington, Minnesota, and California. He has won numerous awards, commissions, and art competitions from around the United States.

Going Up—*A multipiece steel mural designed by Anchorage artist Keith Appel is hoisted up on the exterior wall of the C.T. Elvey building, home of the Geophysical Institute. The durable artwork stands 16 feet high and 40 feet wide.*

ROB STAPLETON / FAIRBANKS DAILY NEWS-MINER

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University of Alaska Fairbanks
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