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Unfolding the Mysteries of the Lisburne Group

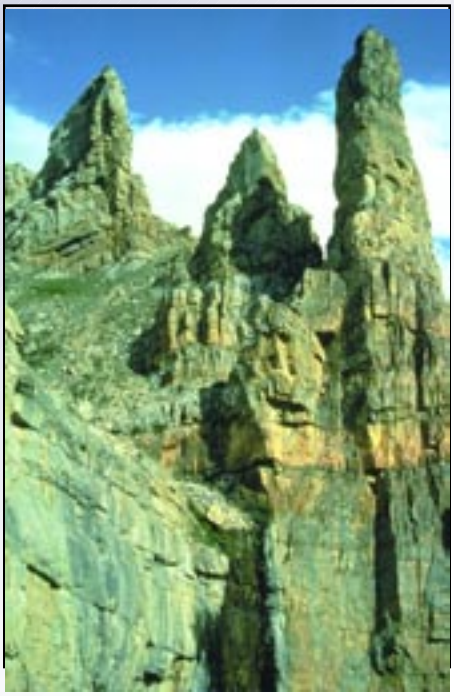


PHOTO BY KEITH

Drilling for oil is a hit-and-miss proposition. To improve the odds of success, oil companies seek seismic, geologic and geo-chemical clues from oil-rich areas.

"Nobody wants to drill a $20 million well that's not in the right place," said Cathy Hanks, a research assistant professor at the Geophysical Institute. "You want to have as many pieces of the puzzle in place as possible before you drill."

Geologists plan to work on a piece of Alaska's petroleum puzzle during a three-year project scheduled to begin this spring in Alaska's Brooks Range.

Hanks and Professor of Geology Wes Wallace, Assistant Professor of Geology Mike Whalen, and Jerry Jensen, an associate professor of petroleum engineering from Texas A&M University, will study the Carboniferous Lisburne Group. This rock unit, which is found throughout the northeastern Brooks Range, also resides under the surface of the coastal plain of the Arctic National Wildlife Refuge, where oil exploration is being considered.

In the northeastern Brooks Range, the Lisburne consists of white, rigid limestones that form dramatic peaks. The rock that makes up the Lisburne was formed by the calcified remains of creatures that lived in a shallow ocean covering the area about 300 million years ago.

Carbonate reservoirs similar to the Lisburne hold much of the oil in Middle East fields and tantalize petroleum geologists with the possibility of huge undiscovered oil accumulations in the Lisburne of northern Alaska.

In Lisburne reservoirs, oil is often hidden within folds and cracks, the very features that make predicting the presence and magnitude of an oil deposit difficult.

The researchers' mission is to find a predictable pattern between the folds and fractures of the Lisburne.

Detachment folds, which are rumples of rock layers that resemble a pushed-up carpet, are common in the Lisburne of the northeastern Brooks Range. The geologists will look in detail at detachment folds to see how tightly the rocks are folded, how intensely the rocks are fractured, and where fractures are located to determine if there is a detectable relationship between the folds and the number, size, and direction of the fractures.

The petroleum engineer will use the geologists' observations to create a model showing how movement of fluids through the rock is affected by changes in the tightness of folds and the related fracture pattern.

The ultimate goal is to design a model showing how detachment folds form, how rocks in detachment folds fracture, what kind of oil reservoirs are formed by the folds, and how fluids move through them. Oil companies will be able to use the information to help them drill in the right place the first time.

"If you can drill one well instead of 10, that's very cost effective," Hanks said.

Knowledge gained from study of the Lisburne will be applicable to similar carbonate reservoirs and fold traps elsewhere in the world.

The study, which is funded by the U.S. Department of Energy, also will reveal basic geologic information.

"We're interested in the basic scientific questions," Wallace said. "The fact that people want oil from these rocks helps to pay for that science."

PHOTO BY WES WALLACE

Top—A vertical fracture created when rocks were buried and later exposed by erosion is pictured in this Lisburne limestone formation located in the northeastern Brooks Range.

Left—A Lisburne detachment fault that has been cut by a thrust fault is pictured in these mountains near the Aichilik River.

Poker Flat Marks 30 Years of Rocket Launches

Poker Flat Research Range began its 30th year of operation with a new leader and four successful rocket launches in January and February of 1999. The launches were the first at Poker Flat since March of 1997.

The first rocket of the season, a 73-foot long Black Brant XII, was part of a joint experiment between the Applied Physics Lab of Johns Hopkins University and the Russian Academy of Science.

The firing of the rocket was timed to coincide with an orbiting satellite while clear skies were present over Poker Flat and a ground observatory in Kaktovik, Alaska. Principal investigator Ching-I Meng, of Johns Hopkins University, said the rocket was used to create disturbances in the upper atmosphere so effects on plasma could be noted.

The second set of rockets were launched by Andrew Christensen, with the Space and Environment Technology Center at the Aerospace Corporation in California, and Miguel Larsen, of Clemson University in South Carolina. The scientists waited nine days at Poker Flat without experiencing ideal conditions of clear skies and an aurora active enough to cause significant heating of the ionosphere.

The researchers had planned to launch four rockets—three chemical release rockets and one containing instrumentation—but launched only two because skies were not clear over Coldfoot. The Black Brant V, which contained Christensen's instruments designed to make rapid measurements of the aurora, was launched first. That launch was followed 11 minutes later by one of Larsen's rockets, which released two trails of trimethyl aluminum.

Range personnel, including the new range manager Greg Walker, flew to Alaska's North Slope to find the instrument portion of Christensen's experiment, which separated from the rocket and was lowered to the ground by parachute. The other two rockets were not recovered.

The final rocket of the season was launched by Kristina Lynch, with the Institute for the Study of Earth, Ocean and Space at the University of New Hampshire in Durham. Instruments aboard Lynch's rocket captured information about an aurora display known as the "pre-midnight breakup aurora." The three-stage rocket slung out four tiny spacecraft the size of hockey pucks. The "pucks" were all equipped with magnetometers, batteries and data-processing systems in addition to transmitters, which were used to broadcast information about the magnetic character of the aurora back to Poker Flat.

The four rockets were the latest of the more than 230 high-altitude sounding rockets that have been launched from Poker Flat since its creation in 1969. In addition, more than 1,500 weather missiles have been launched from Poker Flat, which is located 30 miles north of Fairbanks on 5,132 acres owned by the University of Alaska. The range is operated by the Geophysical Institute under contract to NASA.

PHOTOS BY EVELYN TRABANT

POKER FLAT FILE PHOTO

Top Right—*A sounding rocket launches from Poker Flat Research Range.* Middle—*Poker Flat as it appears today.* Bottom—*Poker Flat as it appeared 30 years ago.*

New Manager Hopes to Attract Customers to Range

Greg Walker believes marketing is one of the most important duties he's assumed recently as the new manager of Poker Flat.

"I'm trying to learn what makes this place competitive—what the customer wants," Walker said.

Walker, 35, knows a bit about selling. Before taking over as Poker Flat Research Range manager in December 1998, he developed and ran his own company in Gloucester, Virginia. As the founder of Aerobotics Corporation, a firm that designed control systems for unmanned aircraft, Walker was awarded contracts from the Marine Corps, the Army and the Navy. The company grew from one to 16 employees in three years before Walker quit to manage Poker Flat, the only university-owned rocket range in the world.

Walker arrived in Fairbanks just prior to the 1999 rocket season, the first at the range in nearly two years. NASA switched to a biennial launching schedule to save money, Walker said, but he's not sure if they are achieving their goal.

"NASA hasn't convinced itself that they're saving money by launching from Poker Flat every other year," he said. "One of my objectives is trying to get a handle on what it costs NASA do business here."

Walker said he'd also like to get other agencies to use the range more frequently. The Ballistic Missile Defense Office, the U.S. Space Command, and the government of Canada are on Walker's list of potential users of Poker Flat.

Although the range is competing for launch contracts with others at northern latitudes, Walker said Poker Flat is unique because it boasts millions of acres of land on which scientists can make measurements from ground-based observatories and recover rockets after launch. Other northern rocket ranges launch exclusively over the ocean.

Walker came to Alaska with

Galileo Team Meets at the Geophysical Institute

Researchers involved with the Galileo spacecraft now orbiting Jupiter met at the Geophysical Institute recently to discuss a mission that has become a lesson in perseverance and creativity.

Physicist Donald Williams, of the Applied Physics Laboratory at Johns Hopkins University, spoke of the challenges Galileo scientists have overcome since the spacecraft's inception more than 20 years ago.

Williams is part of Galileo's Energetic Particle Detector (EPD) team, along with Professor Emeritus Juan Roederer, who became involved with the mission in 1976, a year before he became director of the Institute.

The EPD team first met at the Institute in 1979.

Since then, the team has struggled with challenges, often believing the mission was doomed, especially after the launch was delayed following the space shuttle Challenger disaster and later when a high-gain antenna aboard Galileo failed to deploy. The Challenger disaster forced engineers at NASA's Jet Propulsion Laboratory to find another way to get the spacecraft to Jupiter. They launched Galileo toward Venus, then programmed it for two flybys of Earth, using our planet's gravitational effect to sling Galileo to Jupiter in what Williams called "planetary ping-pong."

PHOTO BY EVELYN TRABANT

GEOPHYSICAL INSTITUTE FILE PHOTO

Top—*Professor Emeritus Juan Roederer (third from right) poses with Galileo scientists outside the Geophysical Institute this winter.*
Left—*Roederer (top row, fifth from right) poses with the Galileo planning team in 1979.*

Although data flow with the smaller antenna has been thousands of times slower, scientists have gained a tremendous amount of information. Images of Jupiter's four moons are striking, and the Energetic Particle Detector has verified their magnetic character. For example, the EPD team discovered that Ganymede, one of Jupiter's moons, supports its own magnetosphere. The team also has been able to characterize Jovian aurora and the dusty nature of Jovian rings between Jupiter and Io, another of the giant planet's moons.

In addition, the team has used trapped energetic particles as remote sensors of distant regions of Jupiter's magnetosphere, the largest object in the solar system.

Although Jupiter's incredible radiation is increasing the noise on signals sent back from Galileo and will eventually destroy the spacecraft, EPD team members are looking forward to at least one last mission.

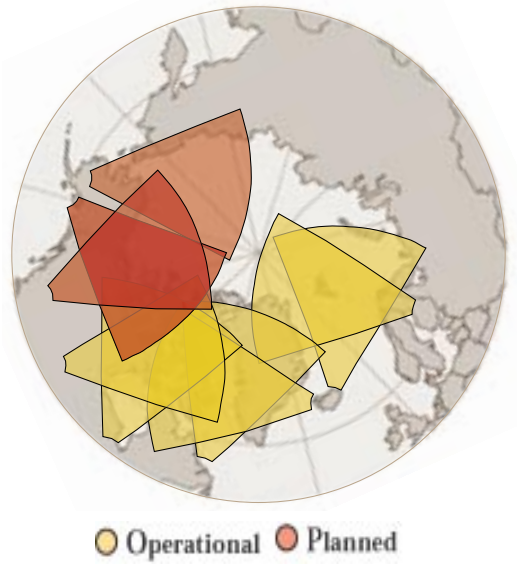
NASA's Cassini spacecraft will pass by Jupiter on its way to Saturn in February, 2001, and EPD team members hope theirs will be one of 11 projects operational during the rendezvous of the two spacecraft.

After the Cassini mission, Galileo will probably be retired, Williams said. Its eventual shutdown will mark the conclusion of an odyssey spanning three decades, and the completion of a job well done.

In addition to the Geophysical Institute and the Applied Physics Laboratory, the EPD team consists of investigators from the Max Planck Institute of Aeronomy

The Dynamic Area Where Solar Wind Meets

Alaska will join an international high-frequency radar network when new Super Dual Auroral Radar Network (SuperDARN) sites at Kodiak and King Salmon become operational this summer. The sites, maintained by the Geophysical Institute, were funded recently by the National Science Foundation, the Department of Defense, and the Communications Research Laboratory of Tokyo, Japan.



Colored regions show the scope of the SuperDARN network.

SuperDARN consists of radar systems around the globe. The radar sites are presently located in Saskatchewan, Ontario, Labrador, Iceland, Finland and Antarctica. William Bristow, a Geophysical Institute assistant professor of electrical engineering, is the principal investigator of the SuperDARN site at Kodiak and is helping Japan's Communications Research Lab build a facility in King Salmon. Formerly a graduate student at the Geophysical Institute studying under Brenton Watkins, Bristow worked at the Johns Hopkins University Applied Physics Lab, then returned to Alaska in August, 1998, to head the SuperDARN effort and to work as an interdisciplinary professor.

Twenty antennae with 16 high-frequency transmitters that operate 24 hours each day will compose the SuperDARN sites at Kodiak and King Salmon. The phased-array antennae will broadcast high-frequency signals in beams 3 degrees wide. By steering the beams, researchers will be able to cover distances of up to 3,000 kilometers. When the HF signals bounce back to receivers at the site, researchers will use the information to map convection patterns in the ionosphere, where the interaction of the solar wind with Earth's magnetic field is reflected.

The Alaska SuperDARN sites will enable researchers to produce more accurate maps of ionospheric convection patterns, which are useful for understanding the processes that couple energy and momentum from the solar wind to the upper atmosphere. Currently, the maps are made with data from existing SuperDARN sites and a model that fills in areas without coverage. The ultimate goal of the SuperDARN project is to eliminate the models and use real information from the sites to create detailed maps on the dynamic region where solar wind meets

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