

Researchers Study Missing Links between Seismic Data, Reservoirs

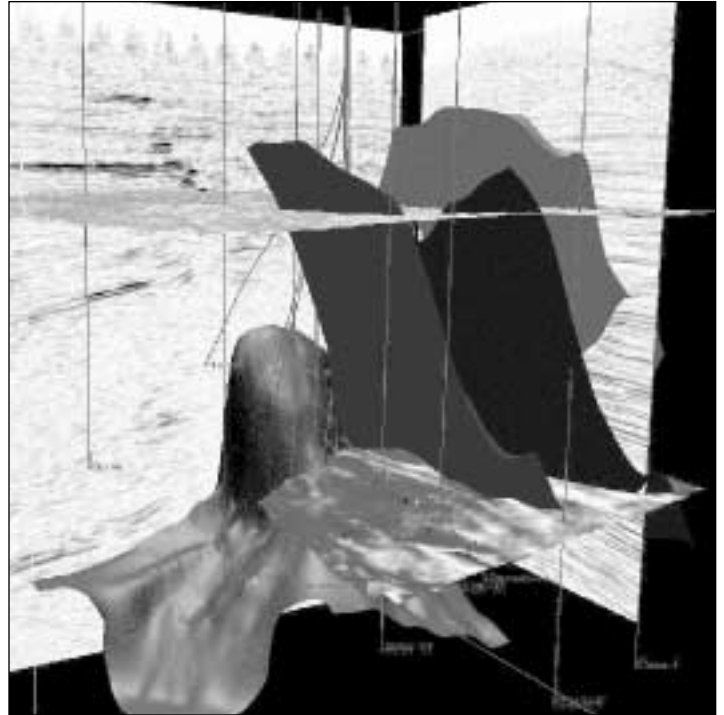
When geologists and geophysicists use seismic attributes to characterize reservoirs, they quickly learn that when they see certain features in the data, they can make some good, educated guesses about the reservoir. Yet the rationale behind these relationships may remain a mystery.

Often the professionals involved wish they could spend more time looking into the cause of those relationships, but don't have time. "That's where we come in," says Professor Wayne Pennington.

With the help of a \$927,000 Department of Energy contract, Pennington and a team of graduate students, including Russian emigré Anastasia Minaeva, are discovering that these relationships are anything but straightforward.

"We're finding that a lot of the specific attributes, most commonly seismic amplitude, have indirect relationships to reservoir properties, but they aren't always the direct relationships that people assume," Pennington said. "For example, you may need to include the effect of interference due to reflections from neighboring beds to characterize the entire wavelet," in order to reach the most accurate determinations about reservoir properties.

The researchers are relying on 3D software packages provided by Schlumberger-GeoQuest, Landmark Graphics, Jason Geosystems, Paradigm,



GeoQuest software reveals a salt dome, deviated wells, faults, and productive interval in an oil field under study by department researchers.

Hampson-Russell, Scott Pickford, and Mercury International. "We use all of the high-end software packages we have in our arsenal," Pennington said.

They are analyzing data from four different fields, some from the public domain and the balance provided by private industry.

"Using the seismic and well-log data from these

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Does This Bring Back Memories?

by Buddy Wylie, PhD student

Members of the geology club left from Dillman Hall on Sunday at 10:08 AM in their quest for rock clock material. The weather was overcast with a temperature of roughly 50 degrees F. First stop was the Copper Harbor Conglomerate rock pile near Bumbletown Hill. Chrysocolla was abundant on the fractured surfaces, and occasional copper was seen in the matrix material between the clasts in the

conglomerate. A black mineral in the fractures was also seen, but identification was not made. Several chunky pieces of the conglomerate were captured for rock clocks and several more for some steps a club member is building. After a rest stop at the Amoco station, the group blazed onward to the Ojibwa rock pile, where Angela Matelski submitted the rock pile and promptly dislodged a big boulder

that rolled down the side of the dump. "Rock!" was yelled. Copper was found and abundant epidote and calcite; two rocks were seen with partial drill holes but none worth hauling home. Rock clock material was scarce, and the group, with some reservation, decided to move northward. On the way to stop three, the group passed many trees from which the leaves had completely fallen

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From the Chair: By Ted Bornhorst



Ted Bornhorst

Greetings from Houghton. As I write, the snow is falling outside my window and Mt. Ripley is in a snowy haze. This is winter in the Keweenaw, and I expect that each of you have memories of winter while you were a student at Michigan Tech. It is my impression that very few people are indifferent about winter here. I also expect that you have many memories of your experiences in the department. In my conversations and communications with a number of you, I have heard of how faculty inside and outside the department had a profound influence on you. I have heard of that special field trip you took, or of your experiences in summer field camp, slogging in cold water while doing mapping or being eaten by mosquitoes while trying to read the magnetometer. I am especially gratified by how highly most of you view the department, and it is clear that you are willing to help the department in many ways. Within the past year, increasing numbers of you have notified the department about job openings, and this really helps us help our students find their first geo job. Please keep sending these notices. We would like to have more undergraduate majors to fill those job openings you send us, so if you know of high school students who might be interested in a high-quality education, please send them our way.

The winter and the department are just two in a long list of things that were a part of your education at Michigan Tech. Not long ago, the department produced new text for the undergraduate catalog. Jimmy Diehl, professor of geophysics, suggested a phrase be added that was and continues to be a hallmark of this department. He said that the faculty “take a personalized approach to the education of undergraduate students.” The same could be said for graduate students.

Just like the constantly changing weather outside of my window (in the past 20 minutes from light snow to white-out snow conditions and back to light snow), the University and department continue to change. The department takes great pride that one of our alumni, Ted Rozsa, a '36 graduate, was instrumental in elevating the status of arts at Michigan Tech through his generous gift in support of the Rozsa Center for the Performing Arts. Michigan Tech recently completed its first semester, a change from your days at Michigan Tech, and at the department level, we are in a new building and the faculty are more active in research and scholarly activities (involving graduate and undergraduate students, too). Regardless of change, we unrelentingly do our best to provide students an excellent education. There is one thing that will not change: “Our department’s greatest asset: the students we graduate.” ■

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fields, we’re trying to find the true, physical causes of the relationships between the seismic attributes and the reservoir property,” Pennington said. For instance, in a field under study by graduate student Shawn Len, seismic amplitudes mapped on “phantom horizons” (ones that parallel easily tracked seismic horizons) have been used to identify channel locations and reservoir compartments. “Our work has revealed that the amplitude relationship is simply a spurious result of a stratigraphic thickening that wasn’t accounted for in the creation of the phantom horizon,” Pennington said. “In effect, the amplitudes were indicating the changes in thickness between the easily tracked horizon and the horizon of interest.”

A key player in this research is Minaeva.

Now in her second year at Michigan Tech, Minaeva came to the University from Ekaterinburg, Russia, where she had earned her undergraduate degree at the Urals Academy of Mining and Geology. She had been working with Dr. Vladimir Pisetski, one of Pennington’s research partners, and during a three-month visit as an exchange student her abilities became evident. Both men encouraged her to attend graduate school at Michigan Tech, largely because it provided huge educational advantages over most Russian schools.

“She’s taking the results from work performed by several students on three of the four oil fields in our study, and applying them to the fourth field—the one that contains the most challenging problems,” Pennington said. “The field has plenty of data, but it also has many thin beds of alternating high-velocity sandstone and low-velocity coal; that tends to confuse the interpretation tremendously,” he noted.

Despite the difficulties, her work has been exemplary, and she’s proved a boon to the entire project. “Every student relies on Nastia for advice and assistance,” Pennington said.

Her talent has not gone unnoticed outside the department. Minaeva begins a job with Shell next September, after she finishes her master’s degree. The only problem with that, Pennington notes, is that she’ll have to leave Michigan Tech. ■

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and noted all the roadside signs had hibernated for the winter. Stop three found the group heading to the Centennial rock pile where wonderful chlorastrolites were had by all! Beautiful, velvetine-lined amygdules full of fibrous green Chlorastrolite or greenstone were found, as was Thomsonite (a whitish variety found by Angela) and, of course, copper. Rock clock material was abundant, and several prospective chunks would find their way home. The weather cleared at this stop, and the day became clear and mild; wayward

black flies were even seen. The group split up after this stop, with some heading toward Mt Bohemia to reconnoiter its new slopes and the others heading over the Centennial to Copper Falls seasonal road, where squirrels and deer and hunters were abundant. This group had great views of Lake Superior and stopped near Copper Falls to capture a last rock clock protolith of crystalline datolite with brecciated basalt clasts. Rocks and geology club members arrived safe and sound home by 5:00 PM. ■

Seaman Mineral Museum Back in the Department

by Ted Bornhorst

Since I became chair two years ago, the Seaman Mineral Museum has been administratively joined to the department.

The Seaman Mineral Museum was an integral part of the department in its early days, but for the past 30 years or so it has been administratively separated. About 10 years ago, Professor Bill Rose, then department chair, began working to bring the museum back. Bill's efforts resulted in creating a tenured faculty position for the then-unnamed curator of the museum. Dr. George Robinson was hired as museum curator and now holds the title of professor of mineralogy. His primary responsibilities are in the museum. In addition, Seaman Mineral Museum Director Stan Dyl also reports to me. For the past two years, I have worked with Stan as the museum plans for the future, and we continue on the path to closer ties that Bill Rose began years ago.



Mineral Museum returns to the fold

The Seaman Mineral Museum, home to a spectacular collection of rocks and minerals from Michigan and almost everywhere else, is once again part of the Department of Geological Engineering and Sciences.

New Academy Members Inducted

The Academy of Geological Engineering and Sciences is composed of distinguished alumni, friends, and emeritus professors of the department elected by the faculty of the department. On a regular basis, we induct new members into the Academy during a ceremony held on campus. The pictures of Academy members and their citations hang on the wall near the main department offices as an inspiration to our current students. The department is fortunate to have had many successful and distinguished graduates. We continually seek new candidates for induction into the academy. Send your nominations of others or even yourself to Ted Bornhorst (tjbornho@mtu.edu).

Congratulations to those recently inducted into the Academy:

1999 Inductees

Ronald J. Christie—President & Chief Operating Officer, Cockrell Oil Corporation

Rebecca L. Smits—President & Managing Engineer, Inland Seas Engineering, Inc.

Harold R. Fitch—Chief of the Geological Survey Division, Michigan Department of Environmental Quality

Peter J. Van Altna—Vice President of Exploration, Dome Petroleum Limited

2000 Inductees

Michael T. Reblin—Independent Consultant

Leslie S. Hahn—Vice President, manages the corporate contracts department, URS Corporation

W. Glen Zinn—President & Chief Operating Officer, AMT (USA), Inc.

Patricia L. C. Henderson—President & CEO, Cygany

Jeffery C. Nuttall—President & Owner, Vicksburg Petroleum, Inc.

Joseph A. Mandarino—Curator-in-Charge of Mineralogy, Royal Ontario Museum

Department Funding

by Ted Bornhorst

You do not need to be a retired millionaire to become a philanthropist and donate to the department. An increasing number of you are finding the means to give a little back, and you are really helping us in a big way. We can accomplish much more together with you than by ourselves. There are little and big things that are only possible by your gifts. In the past

year, Professor Jimmy Diehl's efforts and donations to the department made it possible for us to install a local GPS base station and to purchase GPS receivers for use in the field camps, other classes, and research. A generous gift to the department from Gerald Van Voorhis, Class of 1960, and a gift to the department from Shell Oil Company were combined with matches from the Michigan Tech Fund, other departments and research institutes, the US Forest Service, and UP Engineering of Houghton to make

this acquisition possible. For the high-quality educational experience we strive for, it is a must that our students are exposed to GPS locational technology. This is but one example of what great things your donations make possible. It also illustrates how the department honors its pledge to be good stewards of your investment in us. I have told you before that the support you provide is critical for the department to reach excellence.

Every little bit helps and is appreciated. ■

McCarthy Retires

Anyone who has been part of the department during the past 31 years would have likely known Facilities Manager Bob McCarthy. Bob served students and faculty in many ways. He made some of the best thin and polished sections that could be made. He was a drilling assistant, he cut many a rock, he built shelves, he coordinated the moving of the entire department into the new Dow building, and more. Bob retired July 31, 2000, to his home in Hancock.

National Geographic Web Citation

National Geographic listed the department's Volcanoes Page as a great resource for satellite images of volcanoes in the November 2000 issue. The site is maintained by department Senior System Administrator Mike Dolan. You can visit the site at <http://www.geo.mtu.edu/volcanoes/>

Secretary's Efforts Pay Off for Student

Senior Secretary Amie Ledgerwood deals daily with students one-on-one and truly provides a personal touch. But it was her efficiency that earned one undergraduate an unexpected bonus. Amie was the first department secretary at Michigan Tech to turn in her faculty's list of course books for the semester. As a result, The Book Concern, of Hancock, gave away a semester's worth of textbooks to a student of Amie's choosing. She named Jason Grubb, a geophysics major, as The Book Concern's scholarship recipient.

Wood's Research Focuses on Redeveloping Oil Reservoir

Professor James Wood, in combination with Western Michigan University and Jordan (Cronus) Explorations, is studying ways to economically redevelop the Vernon Field oil field in Isabella County, Michigan. The project,

funded in part by a \$1.5 million grant from the Department of Energy, aims to recover new and bypassed oil and prevent the field's abandonment.

"Our research and Jordan's drilling is part of a nationwide pilot project to revitalize the oil industry," said Wood.

This is one of seven national projects approved by Department of Energy to keep oil reservoirs flowing as long as possible.

Department Faculty in MTU Alumnus Magazine

Professors Sue Beske-Diehl and Jimmy Diehl's new magnetic research lab was highlighted in a feature article in the January 2001 issue of the Michigan Tech *Alumnus*. If you plan to visit Houghton, drop us a line and we can arrange a personal tour for you. Professor Alex Mayer's AQUA3 project involving Mexico and Canada was highlighted in the July 2000 issue. Alex's research takes on an increasing international flavor, as he is on sabbatical leave this year in the Netherlands.

Professor Ruotsala Passes Away

The department is saddened to report that former Professor Al Ruotsala passed away in April 2000. Al spent his last years in retirement living in Escanaba and helping his son run a bakery.

Industry Donates Software

The department continues to acquire software through donations from industry.

Landmark Graphics, a subsidiary of Halliburton, made the most recent gift. Its Landmark software is used primarily for the processing and interpretation of seismic data in research projects and in preparation of course materials. We particularly want to thank Ted Rozsa Jr. (son of Ted '36 and Lola Rozsa) for helping make this donation possible.

New Faculty and Staff

Research Professor Roger Turpening came to the department this year from MIT. Roger works closely with Professor Wayne Pennington in the petroleum geophysics area. This year, Roger is on assignment with the Department of Energy in Washington, DC.

Research Assistant Professor Matt Watson recently began to work with Professors Bill Rose and Gregg Bluth doing volcano research.

Tianxu Yu recently completed his doctoral degree in the department and is continuing to do research in the area of remote sensing as a postdoctoral research associate under Professor Bill Rose and Research Assistant Professor Judy Budd.

The department replaced Bob McCarthy, who retired as facilities manager, with Bob Barron. Barron was previously manager of the Seaman Mineral Museum. His responsibilities expanded in his new position to cover both the department and mineral museum's needs.

Department Receives Fellowships

The department has received funding under the US Department of Education Graduate Assistantships in Areas of National Need (GAANN) program.

The successful proposal focused on the area of computational geological sciences and engineering. The proposal was a department team effort led by Dr. Alex Mayer and assisted by Drs. Gregg Bluth, Judy Budd, John Gierke, Jackie Huntoon, Wayne Pennington, Bill Rose, and James Wood.

Job Announcements Appreciated

Many of you regularly send us job announcements that are very beneficial to our students. We want to thank you and encourage you to continue sending them. With another group of students getting ready for graduation this May, I can't tell you how important this is to them.

Faculty Focus

Learning Water Management in the Mexican Desert

When Dr. Alex Mayer wrote the proposal for his \$213,800 AQUA3 project, he focused on its technological benefits. Starting this fall, AQUA3 will give dozens of students broad-based training in sustainable water management. Students from six universities, two each in Canada, the US, and Mexico, will gain new skills and insights through international exchange programs and internships.

"Now," says Mayer, "that may not be the most important result of AQUA3," the North American Alliance for Sustainable Water Resources. After returning home with MTU students from a spring-break field trip to the state of Sonora, in Mexico, he thinks that what AQUA3 students learn outside the classroom may be even more important than the technical skills they acquire.

"The students were blown away by the fact that they were in a city that hasn't had rain in five years, where crops are growing in the desert," he said. "I learned how important cultural education is. I've come back convinced that it's a really good idea to take students to places like Mexico that have a completely different culture. You have the added bonus of opening their eyes."

This two-week trip is typical of the

latest trend in international education. Students who shy away from spending a year or even a semester abroad can usually cram in a week or two in a foreign country,

particularly if they get credit for it. Mayer, an associate professor in the Department of Geological Engineering and Sciences, was impressed by what a difference a fortnight can make. "Their level of awareness was shifted by orders of magnitude," Mayer said. "That's probably what I am proudest about."

"It was great," said Heidi Sherman, a PhD student in geology who went on the February trip. "We learned a lot about water resources and a lot about Mexico."

Randy Tufts, a master's student in geological engineering, explains. Sonora, which hasn't seen rain in years, is nonetheless a garden spot because of irrigation. However, the groundwater supply may be running out.

"The water table is 60 meters below sea level," Tufts said. "It's getting to the



MTU students studying in Mexico were stunned to find irrigation water salty enough to harbor shrimp.

point that they are drawing salt water in from the ocean. . . . It's so bad, shrimp live in the irrigation ditches."

The students got to do more than work in Mexico. They scampered around on a hydroelectric dam, ate fresh fish and perfect fruit in the dead of winter, and were treated to roses on their breakfast table. And they also received some cultural insights that you'd be unlikely to find in a guidebook.

"Mexican dogs aren't like American dogs," said Corrina Nelson, a senior in geoenvironmental engineering. "They don't come right up to you."

Their hosts, however, were more than welcoming. "I didn't realize they'd be so nice," said Laura Arlt, a senior in environmental engineering. "They took us everywhere. I hope they come up to visit us."

Undergraduate Student Focus

Undergraduate Assists with Research Work

Her fledgling academic career started in high school, when she ended up between a rock and a hard place.

"I was on the Science Olympiad team and part of the competition was identifying rocks and minerals," she relates. "No one wanted to do it, so I got stuck in there. It just so happened that I liked it, and it grew from there. After that, I did all of the competitions in the geology and earth science sort of things."

So began the career of budding geological engineer Mellisa Le (pronounced "lay"), who has just finished her second year at Michigan Tech. Le wasted no time getting involved in the department and landed an undergraduate research project working with Associate Professor

John Gierke.

"My work is part of Dr. Gierke's research in soil contamination," she said. Gierke does a partitioning test, injecting alcohol-based tracers into the ground. The tracers are extracted "downstream" from the suspected contaminated area, where the researchers measure how much of the substance is left.

"We inject them into one set of wells and extract them from another set, so there is a delay," Gierke explained. "We



At the chromatograph, undergrad Melissa Le tracks down soil contaminants.

then backtrack, based on the length of the delay, to determine what contaminant is there."

Le determines how the tracers interact with different contaminants, arriving at what is called a partitioning coefficient.

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"When we know this, we can go backwards and figure out what contaminant is there," Gierke said.

"I'm using a chromatograph, which is something a sophomore normally wouldn't get to use," Le said.

She became interested in Gierke's research project pretty much by just paying attention.

"The department is really good about sending their students e-mail about co-ops and different opportunities," she said. "I saw the posting for this research and went to one of my professors. He took me to see Dr. Gierke, and I got the job," she said.

As a result of this work, she also entered MTU's undergraduate research poster competition and took the grand prize.

This summer, Le will get two field classes out of the way in June and July, then return to the partitioning project in August.

Le said she came to Michigan Tech because of the environment—both locally and on campus.

"I pretty much had two choices: Michigan or Michigan Tech," she said. "I visited both schools and I liked the environment here, and I liked the smaller school. I got a scholarship from Tech and, as far as I could tell, the engineering programs are comparable."

Prior to arriving at Tech for her first year, Le had the opportunity to travel to Vietnam and visit her extended family.

"My dad is Vietnamese and came to the U.S. in 1975 during the fall of Saigon," she said. "My dad's whole family is over there, and we had never seen them before. It was quite an experience—a whole different culture."

When she's not testing tracers or studying the Keweenaw's geology, Le spends her time on the MTU dance squad that performs during home basketball games.

"We do both men's and women's games, so that's a lot of routines. We make up our own dances, and we don't like to repeat them too often, so that takes a lot of time." ■

Geo Alum Endows SEG Student Chapter

Bill Barkhouse '76, an applied geophysics graduate, has created an endowment to support the MTU student section of the Society of Exploration Geophysicists (SEG). The endowment has been earmarked to support the annual membership dues to SEG for a faculty sponsor and ten or more student members.

While he was a student in 1974, Barkhouse was instrumental in starting the Michigan Tech Student Section of SEG. He recently completed a one-year term as president of the National SEG, which has 16,000 members in 105 countries. Barkhouse is the coordinator of Global Strategic Directions, Geoscience Technology Development of ExxonMobil Exploration Company.