



Assistant Professor Cathy Snelson detonates a seismic “shot” on the flanks of Erebus in January 2008. In the distance looking across McMurdo Sound are the 14,000 foot high Transantarctic Mountains.

Imaging a Volcano’s Conduit: Tomo-Erebus *by Philip Kyle, Professor of Geochemistry*

Magma chambers are widely believed to lie at the hearts of volcanoes. But do they really exist? Volcanologists all over the world speculate about the presence of large storage volumes in and below volcanoes. The magma in these chambers can erupt quiescently, as lava flows, or violently as huge towering eruption columns—some going to the stratosphere where they can cause changes in the

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global climate. It is rare that one has an opportunity to see a magma chamber at work, but this is why I return to Erebus volcano in Antarctica every austral summer. Erebus is like a magnet for me. Since we discovered a permanent convecting lake of phonolite magma in Erebus in the early 1970s we have asked ourselves, “What is the conduit like that feeds the lake? How deep is the magma chamber, and what is its geometry?” We consider the lake to be a window into the chamber, but we still want to know where the bulk of the convecting magma resides within the volcano.



Pnina Miller from the IRIS PASSCAL Instrument Center at NMT servicing a seismic station 11,000 feet high near the summit of the active Erebus volcano in early November 2008. The background plume of volcanic gas being emitted from the phonolite lava lake, located 250 meters below the crater rim.

To understand the inner workings (or “guts”, as some of us prefer to say) of Erebus volcano, we undertook an ambitious seismic tomography experiment. This involved deploying over 120 seismometers and detonating 4000 kg of explosive (ANFO: ammonium nitrate fuel oil). Such an experiment is no small undertaking in a temperate climate, but on Erebus we knew it would take the luck of the gods to get it done. Things did not start well as the 2007–08 field season was one of the worst weather years in dec-

ades. I guessed this in July 2007 even before leaving for the ice when I learned it was a La Niña year. During such times the storm tracks that roar around the Antarctic continent in the Southern Ocean circulate into the Ross Sea and stall and blast winds and cloudy conditions over Erebus. After dealing with harsh weather for 2.5 months, by early January 2008 we eventually got 23 broadband seismographs installed around the flanks and over the summit of Erebus. The stations were to run over the winter so they had solar panels and semi-permanent installations. Now it was time for the fun part. While teams did the installations another team learned how to drill holes in the snow and ice, fill them with 100s of kg of ANFO, and detonate these—sometimes in spectacular ways. We were able to detonate a number of shots in January 2008 and found that it was possible to get sufficient seismic energy to the 23 stations. The season was a success despite great adversity from the weather.

The luck of the gods was with us in the 2008–09 austral summer field season when we were blessed by weeks of great weather. Our plans were even more ambitious than the previous year. Early in November 2008 we were able to service the 23 stations installed the previous season and make repairs as necessary. Several stations placed on the snowy south flank of Erebus were buried under meters of snow, and much effort was spent in digging them out. We then temporarily deployed (for a month or so) 100 three-component short-period seismic stations in 2 arrays. The first 20-station array was deployed along an 80 km east-west line across Ross Island. This was especially fun to site as it involved many hours of helicopter flights around Ross Island. I got to see many places I had only seen from a distance while walking around the crater rim of Erebus. Data from this array will examine the deeper crustal structure under Ross Island and Erebus. To examine the conduit under the lava lake, a further 80 seismic stations were deployed in a 3-by-3 km grid around the summit crater. Postdoc Daria Zandomenighi led the charge with the summit team and the 80 stations were deployed by foot and on snowmobile over the summit plateau within days. Over a frantic 2-week period just before Christmas, 16 shots ranging from 75 to 600 kg of ANFO were detonated. Then it was time to recover the 100 short-period stations and 23 broadband stations, pack, and head to the sunny shores of New Zealand for a little R&R.

Now the most important part of the project remains to be done: turning digital seismograms into images of the interior of Erebus. Hard at work making the records come alive are Hunter Knox and Julien Chaput—both PhD students working with geo-

physics professor Rick Aster. A new MS student, Shoba Maraj who heralds from Trinidad, is working with Cathy Snelson to look at the deep crustal structure under Erebus. I hope in a year's time these 3 students will enlighten us and tell us all about the magma chamber and what lies beneath it.

This project, funded by the National Science Foundation, was an ambitious and unique undertaking to examine the conduit of an active volcano. It is amazing that we managed to pull this off as well as we did. Great work team! An experiment of this magnitude takes a lot of people and team effort. We had immense amounts of support from the US Antarctic Program and from IRIS PASSCAL at NMT, who designed the instrumentation and assisted with the deployment and retrieval of the seismometers. The team on Erebus included many graduate students, ice core drillers, scientists, cooks, mountaineers, a teacher, and explosives experts. The helicopter pilots from PHI, Inc. contributed greatly to the success of the project. Now it is time to dream of new experiments to help understand this unique and southernmost active volcano in the world and to inspire a new crop of graduate students.

For more information on this year's activities, see:
<http://www.nmt.edu/antarctic-expedition-to-erebus-volcano>



An Erebus fumerolic ice tower photograph by alumnus Kyle Jones (BS Earth Science-Geophysics, 2007; MS Geophysics, 2009), who has worked as a research assistant in Antarctica since 2003. He exhibited his photographs at NMT's Macey Center in January 2009.



Richard C. Aster
 Department Chairman
 Professor of Geophysics

Note from the Chair

Dear Friends,

I hope that you enjoy this year's edition of **TECHtonics**, and hearing about some of the many exciting activities of our department. We are very fortunate to have an astonishingly accomplished, broad, and collegial department that continues to advance unique and internationally recognized research and education in so many cutting-edge areas of Earth science. A fabulous example is recent work on Erebus volcano spearheaded by professor Phil Kyle highlighted in our lead article.

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Along with continued successes, 2009 was also challenging in a number of ways. Most poignantly, we lost one of our strongest (in every way) faculty members, Rob Bowman. A tribute to him and his career begins on the next page. New Mexico Tech and our department are also of course feeling the effects of the "great recession" in the form of state budget cuts and frozen faculty positions. We have high hopes that the economic situation will improve this coming year, and are working diligently to sustain our activities through other funds, including our many generous and continuing donations from alumni.

We always look forward to hearing from our alumni and other friends (see recent alumni news at www.ees.nmt.edu/alumni), and will continue to hold our alumni events at GSA and AGU meetings (and of course during 49ers). Keep in touch!

December 2009

Robert Bowman, 1950–2009

*by Jan Hendrickx, Mark Person, Fred Phillips, and John Wilson,
Professors of Hydrology*



The EES Department mourns the loss of one of our dearest colleagues, Rob Bowman, who died at his home in Polvadera after a battle with cancer. He is survived by his wife, Karen Bailey-Bowman, and his son, Danny.

Rob joined the department in 1987 as an assistant professor following postgraduate work at the US Department of Agriculture. He left his mark on the department in many ways. Rob had an exceptional record of innovation in soil and environmental science research.

His major early contribution was the development of a new class of water tracers for use in soils and groundwater investigations. Rob introduced the use of fluorinated derivatives of benzoic acid (FBAs) as nonreactive tracers. These tracers have become standard tools for soil physicists, soil chemists, and hydrologists. Rob also showed many important new applications of natural zeolites for removing chemical contaminants and toxic organisms from contaminated water. While known to be excellent sorbents for cations, zeolites have little affinity for anions or neutral molecules. Rob's research group found that simple treatment with a surfactant such as hexadecyltrimethyl ammonium reverses the charge on the zeolite surface and imparts hydrophobic properties. The resultant surfactant-modified zeolites (SMZs) are capable of simultaneously sorbing anions (e.g., chromate and arsenate) and neutral organics (such as petroleum hydrocarbons and chlorinated solvents) from water, while retaining much of their ability to retain cations. SMZs are now used for treating solvent-containing exhaust gases, oilfield water discharges, and removal of nitrate and phosphate in storm-water runoff. At the time of his death he was working on the application of treated zeolites to remove arsenic from drinking water, an issue of great concern in the southwestern United States and elsewhere in the world.

During his scientific career, Rob published over 70 scientific papers and book chapters and acquired 3 patents. He was internationally known as one of the leading researchers on the application

of zeolites to water-quality remediation. In 2006 he received NMT's Distinguished Research Award, in 2007 he was elected a Fellow of the Soil Science Society of America, and in 2008 he received NMT's Distinguished Faculty Award and the New Mexico Earth Science Award for outstanding contributions advancing the role of Earth science in areas of applied science and education in New Mexico.



Rob in the early 90s with students at Las Nutrias, NM, studying nutrient and water movement below irrigated fields.

Rob's service record to the hydrologic community was equally impressive. As a supervisor for the Socorro Soil and Water Conservation District, he provided soil and hydrologic expertise on technical questions related to soil and water management, as well as legislative issues affecting the local agricultural community. Rob organized several national and international scientific meetings, including serving as host of Zeolite '06: The 7th International Conference on the Occurrence, Properties and Utilization of Natural Zeolites which was held in Socorro in July 2006. He served on the Steering Committee of the Socorro-Sierra Counties Regional Water Plan and on the Technical Steering Committee for the Middle Rio Grande Water Supply Study, was director of New Mexico Tech's Hydrology Program, the 4th-ranked program nationally (*US News and World Report*), from 1995–2004, and chaired the EES De-

partment from 2005 to 2008. He also held numerous leadership positions within NMT, including being elected to all of the senior positions of the Faculty Senate. As Chair of that body from 2002–2004 he was the primary spokesperson to the administration and Regents on faculty concerns. He also served as secretary of the Faculty Presidents Council of New Mexico Public Universities—the voice of University faculty in the state—and in that role met regularly with the governor and legislative leaders to present the academic viewpoint.

Perhaps the most important legacy of Rob Bowman was his mentoring of students. The door was always open, and Bowman always greeted students and colleagues with warmth and respect. He served as the academic and research advisor to 6 PhD and 34 MS students, and supervised 4 post-doctoral associates. His PhD and post-doctoral advisees have gone on to important positions in academia and national laboratories. Perhaps Enid “Jeri” Sullivan (PhD Hydrology '97) summed it up best at this year’s WRRRI Symposium when she shared **Rob’s Rules of Mentorship**:

1. Do your research in small bites. Always have a goal for each bite.
2. Look for the non-obvious problems or issues.
3. Get a paper out of it!
4. Get out. In the field, at meetings or conferences, whatever.
5. Greet your colleagues with exuberance. Let them know how glad you are to see them.
6. Write well and often. Practice your talks. Practice some more.
7. Take your students with you when you travel. Introduce them to your colleagues and to folks they can look up to. Show them how to build a network.
8. Take your students to lunch, or dinner. Or out for a beer at the brewpub. (See #4, above....)
9. Keep your dignity and grace through difficult times.
10. Be Brave.
11. Love your family and live Life well.



EES Alumni Relations and Fundraising

by Andrew R. Campbell, Professor of Geology



Our main fundraising effort in the past year has been the Dave Norman endowment for support of research in ore deposits. That fund is at nearly \$40K now, thanks to your donations. We hope to add to that fund in the coming years as well as to the Clay Smith fund for student field research, which has not yet reached the point that we can turn it into an endowment.

This year our main fund raising activity will be in memory of Rob Bowman, who passed away this past summer. This fund will support Graduate Fellowships for students in Hydrology. Rob cared deeply about the educational experience students received from our department. As Department Chair, he was the driving force that encouraged us to start an active departmental effort in fundraising in order to be able to offer more (fellowships, travel, field trips, research expenses, social events, etc.) to our students.

There are many student needs that our departmental budget or research funding cannot cover. We hope that during a student's time in here, we can make them feel at home and can provide for their diverse needs. We hope you, our alumni, had that sense of departmental commitment when you were here and are now willing to help us support efforts for our current and future students.

Again this year we hosted an alumni reception at GSA in Portland, Oregon on Monday, October 19. We are also hosting an alumni reception at AGU in San Francisco on Tuesday, December 15th, at the Marriott Marquis (55 Fourth Street) in Room Sierra E. Both receptions are joint with the University of New Mexico, New Mexico State University, and the University of Texas at El Paso, and are listed as "Rio Grande Universities Alumni" Receptions. You don't have to be registered for the meetings to attend the receptions. Check the alumni website (www.ees.nmt.edu/alumni) for details on these and other events as they become available.

EES Alumni Fund Donors

We would like to thank the following people who have generously donated to the EES Alumni Fund during the 2009 fiscal year (July 1, 2008 – June 30, 2009) We would also like to give a special tribute to Mike Fitzgerald, a generous contributor to New Mexico Tech and the EES Department, whose memorial follows the donor list.

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Kenneth Minschwanner

Cheryl Passalaqua

Vanetta Perry

Marion Richter

William Stone

Gregory Titos

Steve West

Dan & Carolyn Weider

Elizabeth Yost

Michael J. Fitzgerald 1934–2009

by William X. Chavez and Andrew R. Campbell

Mike J. Fitzgerald was born on August 5th, 1934 in Minneapolis, Minnesota, the second oldest of eight children. Mike attended the University of Minnesota, where he graduated with a BS in Geological Engineering in 1957. Upon graduation Mike accepted a position

as Mine Geologist with the Phelps Dodge Corporation at their Morenci mine in Southern Arizona. From Morenci, Mike and his family moved to Tucson, Az. where he joined the Kerr-McGee Corporation as a Senior Geologist; he worked as Senior Geologist until 1968, when he was transferred to Denver, Co. as their District Geologist in the Copper Exploration Department. In 1970 he moved to Vancouver, Ca. as Sr. Staff Geologist for Donaldson Securities. Two years later he formed his own geological consulting and exploration company, Min-Ex Services Ltd.

A major event occurred in Mike's life in 1975. Min-Ex Services Ltd., in conjunction with Henry W. Ranspot, acquired mineral claims in the Carlin gold district of Eureka County, Nevada. Exploration of these claims found what would become the western extension of Barrick's Betze gold deposit, and eventually part of the Goldstrike mine. These claims were sold to the Franco-Nevada Mining Corp. in 1993. Following the success of the exploration program in the Carlin Trend, Mike was for ten years the President of Metal Ex-Management Inc., and later became a consulting geologist in Bellingham, Washington.

Mike loved to travel, and in 1992 in Guatemala he met the woman who soon would become his third wife, Marisa. Both enjoyed many trips together, and Spain, Marisa's country of origin, became his second most-loved country. Mike and Marisa settled in the Tucson area, from which Mike continued his interests in exploration, economic geology, and investment opportunities within the minerals industry.

Mike Fitzgerald loved his profession. He took advantage of any opportunity to read and to learn everything about mineral exploration, and he loved to be in contact with anyone who could enrich his life. He especially enjoyed being with students, and he took notes about each student's project so he could follow-up the next time he saw them. Students whom Mike's contributions supported often commented that his interest in their work gave them a sense of importance, and that their choice in mining geology carried career-long responsibilities.

He was very thankful for everything he received in his life and he wanted to give back to society. Mike contributed to the John P. Fitzgerald Endowed Memorial Scholarship Fund (in honor of his father) at Saint John's University in Minnesota. He established the Don Yardley Fellowship Fund at New Mexico Tech and the Don Yardley Endowment in Economic Geology at the University of Nevada, Reno in recognition of his favorite Professor from the University of Minnesota. In the past 5 years, 5 graduate students at New Mexico Tech have been supported from the fellowship he

established. In addition, his support of field programs at New Mexico Tech allowed students to travel internationally to visit some of the most important mining districts in the world, as well as to travel within the southwest US to perform mapping exercises in geologically spectacular areas.

Mike also supported the Society of Economic Geologists by contributing to the Discovery Fund, the Hugo Dummett Fund, and the Alberto Terrones L. Fund. He also supported the Economic Geology Scholarship Fund at the University of Arizona, the Saint Thomas Academy in Minnesota, and Maryknoll Fathers and Brothers in the Republic of Korea. His concern for the homeless, and drug- and alcohol-addicted men and women, was evident in his support of the Gospel Rescue Mission and the Casa Maria Soup Kitchen—both in Tucson.

Mike suffered from COPD and, although full of hope until the last moment, he came to the end of his journey on August 11th, 2009 in Tucson.

On behalf of past and future students who have benefited from Mike's generosity and encouragement, we thank him for his support of our students and programs. Donations in his name can be made to New Mexico Tech and will benefit the Don Yardley Endowment, which Mike established in support of students interested in ore deposits.

Alumni Spotlight

Stavros S. Papadopoulos (MS Hydrology '62)



The National Academy of Engineering (NAE) elected alumnus Stavros Papadopoulos as a new member in February 2009 for pioneering contributions to statistical methods for estimating groundwater flow and contaminant transport.

Election to NAE is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to “engineering research, practice, or education, including, where appropriate, significant

contributions to the engineering literature,” and to the “pioneering

of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education.”

Stavros Papadopoulos is the founder and senior principal of S. S. Papadopoulos & Associates, Inc., an environmental and water-resources consulting firm established in 1979. He received his BS degree in Civil Engineering from Robert College, Turkey in 1959, his MS degree in Ground-Water Hydrology from the New Mexico Institute of Mining and Technology in 1962, and his MA and PhD degrees in Civil Engineering from Princeton University in 1963 and 1964, respectively. He is a registered Professional Engineer in the District of Columbia.

Prior to founding S. S. Papadopoulos & Associates, Inc, Dr. Papadopoulos conducted research at the US Geological Survey, taught at the University of Minnesota and the University of Illinois-Chicago Circle, and served as the Head of Hydrology Department for Harza Engineering Company in Chicago. His areas of expertise include the evaluation of the hydraulic properties of aquifers, the assessment of groundwater resources and of hydrogeologic and water-quality conditions at hazardous waste sites, and the design of monitoring and of extraction well systems for water supply or groundwater remediation projects.

During his career of more than 45 years, Dr. Papadopoulos has been involved in the evaluation of the hydrologic effects of groundwater development and of the impacts of the subsurface migration of contaminants at numerous sites in the United States, and in the assessment of the development potential of aquifers in Indonesia, Saudi Arabia, Oman, Portugal, Guatemala, and Argentina. He has also served on advisory panels for corporations (Kodak, Ciba-Geigy) providing technical advice on environmental issues, and for the U. S. Department of Energy reviewing the hydrologic characterization of the Yucca Mountain, Nevada Site which is considered as a repository for radioactive waste. He often provided testimony in court proceedings and/or administrative hearings as an expert witness on environmental issues related to groundwater contamination and/or remedial actions for mitigating groundwater contamination. He is the author and co-author of numerous publications on well hydraulics, aquifer test methodology, groundwater resource evaluations, and subsurface waste disposal.

Dr. Papadopoulos is a Life Member of the American Society of Civil Engineers, a Fellow of the Geological Society of America, and a member of the American Geophysical Union, the Association of

Ground Water Scientists and Engineers, the International Association of Hydrogeologists, and of Sigma Xi. He served on Advisory Councils to Engineering Departments at Princeton University and on the Geotechnical and Water Science and Technology Boards of the National Research Council of the American Academy of Science. He is the recipient of the US Department of Interior's Meritorious Service Award, the US Geological Survey's Special Achievement Award, the New Mexico Institute of Mining and Technology Alumni Association's Distinguished Achievement Award, the National Groundwater Association's Life Member Award, and of several other honors.

Alumni News



Amber McIntosh (MS Geology 2004) and Rob Sanders (MS Geology 2005, PhD Geochemistry 2008) recently moved to a cabin on 13 acres in Datil, NM. They are currently contracting for a Canadian junior mining company in a remote fly-in camp in northern Ontario, logging core to assess the potential for development of gold resources. Above is a picture of Amber and Rob logging core at Springpole Camp, northern Ontario. The smoke is to keep the mosquitoes down.

Amanda Rowe (MS Geology 2005) wrote in August 2009:

In 2007, I began working as a Production Geologist for the Phelps Dodge (now Freeport-McMoRan) Henderson Mo Mine, in Empire, CO. Henderson is an underground mining operation where I was involved in ground control and exploration. In 2009, I transferred to the Freeport-McMoRan Sierrita open pit Cu-Mo mine in Green Valley, AZ, where I took over for the Senior Mine Geologist who retired after 35 years of service at Sierrita. In this position, I wear many hats and am delighted to add open pit mining operations and copper to my economic geology experience. I am currently in the end stages of completing my PhD at NMT, which is on the Questa Climax-type Porphyry-Mo system in New Mexico.

Mathew A Tilman (BS Geology 1989, [mattilman at gmail.com](mailto:mattilman@gmail.com)) wrote in January 2009:

I now work for the State of Oregon's Department of Geology and Mineral Industries (DOGAMI), based out of their Portland state building. My position is as a GIS Analyst/Cartographer. My current project is the creation of a new topologic base map of the Portland Metro area based on LiDAR imagery at 1m resolution. The area encompasses 40 quadrangles and will involve creating new contours, stream channels, water bodies, roads and all other infrastructure. Concurrently I am helping in a project to redelineate FEMA DFIRM maps for the Coos County, Oregon area. I started my new job with DOGAMI on December 12, 2008.

Todd A. White (MS Geophysics-Solid Earth 2005, [toddwhi at hot-mail.com](mailto:toddwhi@hotmail.com)) writes:

I just recently quit my job working as a scientist for Schnabel Engineering near Philadelphia, PA to return to school. I had worked for this company upon graduation, and I was employed there for about 4 years. I will be attending the Medical University of Ohio in Toledo starting this month for Radiation Oncology Physics, in their two year graduate program. Upon completion, I hope to pass the licensing exam, and work as a radiation physicist in the northwest Ohio/southeast Michigan area.

Diane Y. Hattler (BS Geology; BS Technical Communication 1985) [dhattler at comcast.net](mailto:dhattler@comcast.net) wrote in April 2009:

I was going through the list of fellow classmates and seem to be one of the few that have gotten out of the geology field. I worked as a geologist in Nevada for SAIC 9 years at the Nevada Test Site and loved it. But I am now a licensed professional counselor (LPC)

and the Assistant Director of The House of Mercy helping the poor and homeless with clothes, food, and financial assistance.

EES Department News

Professor of Geophysics and EES Chair Rick Aster was elected 2009–2011 president of the Seismological Society of America. SSA was founded in 1906 following the San Francisco Earthquake, and is the leading U.S. and international professional organization for earthquake science and engineering.



Professor of Hydrology Mark Person is the PI on a project to drill a 1500-foot-deep geothermal well at the base of M-Mountain. The US Department of Energy is funding the project, which will provide heat to the NMT campus. Drilling began on October 21, 2009. As of November 30th, the well is at 419 feet, and the water temperature is 41°C with a flow rate of 1000 gpm. *For more information, see*

<http://www.nmt.edu/news/3579-tech-geothermal-project-bolstered-by-department-of-energy>

EES members Andy Campbell, Peter Mozley, and Mark Person and Stacy Timmons from the Bureau participated as NMT Team Rock in the grueling Mt. Taylor Winter Quadrathlon (biking, running, skiing, and snowshoeing). EES solo participants were Rick Aster, Matt Earthman, Kyle Rybacki, and Russell White.

An interview with **Assistant Professor of Geophysics Jeffrey Johnson** aired on the radio program National Geographic Weekend.

NMT/EES alumna and employee Jana Stankova-Pursley (MS Geophysics 2009) was selected to receive an Outstanding Student Paper Award for her presentation at AGU's 2008 Fall Meeting in San Francisco.

Hydrology PhD Candidate Jason Heath's photograph of the Chafin Ranch CO₂ Geyser, Utah, made the cover of *Nature*.

Matt Zimmerer, PhD Student in Geology, was selected by the New Mexico Geological Society (NMGS) to receive the 2009 Kottlowski Fellowship for his proposal “U-Pb and Ar/Ar dating of New Mexico mid-Tertiary plutons: using the plutonic record to understand caldera volcanism, mineralization, and crustal processes.”

Professor of Geophysics and EES Chair Rick Aster spoke at the New Mexico Museum of Natural History and Science in Albuquerque tonight as part of his 2009 IRIS/SSA Distinguished Lectureship series. Aster will continue to give this lecture throughout the year at major national and international venues (Long Beach, New York City, Atlanta, Stanford, Seattle, etc.)

Professor of Geochemistry Kent Condie, the lead author of an article published in *Earth and Planetary Science Letters* with **Rick Aster**, is garnering international notice for his comprehensive studies of radiometrically dated zircons and their implications for the history of plate tectonics.

Associate Professor of Geology Peter Mozley became Chair of the Geological Society of America’s Publications Committee. This committee oversees all GSA journals, books, editors, and other activities of the over 21,000 member society.

IRIS and NMT received funding for Greenland Ice Sheet Monitoring. IRIS was awarded \$1.9M in funding from the NSF to develop a seismic monitoring network on the Greenland Ice Sheet. **PhD Candidate in Geophysics Kent Anderson** is a co-director of the project. NMT’s IRIS PASSCAL Center (PI is **Rick Aster**) will be working on the engineering and technical side of the project.

The Socorro area experienced a flurry of felt seismic activity in August and September 2009. Dubbed the Lemitar Swarm, it was preceded by a 2.3 quake a few miles NE of Escondida on the east side of the Rio Grande. Within a few days, numerous small events punctuated by a few larger quakes (1.9–2.6) occurred a few miles NE of Lemitar, also east of the Rio Grande.

In May 2009, NMT graduated over 280 students, including 10 bachelors degrees, 17 masters degrees, and 1 PhD degree in the EES department. **Shasta Marrero, MS graduate in Hydrology**, and currently a PhD candidate in Hydrology, received the Founder’s Award, the top award given to a graduate student at NMT.

Below are graduates from the Hydrology Program. (Photo courtesy Fred Phillips, Professor and Directory of Hydrology Program)



New PhD Option in Geobiology

The PhD options that have long been offered by the EES Department include Geology, Geochemistry, Geophysics, and Hydrology. In addition to these classical topical areas of the Earth sciences, we have recently added a new option on the cutting edge of the interaction of geoscience with biology: a PhD in Geobiology.

This new collaborative degree option created jointly by EES and the Biology Department and approved in spring of 2009 straddles the many interactions between the processes of life with the lithosphere and atmosphere of Earth. PhD research projects appropriate for this degree can include geomicrobiology, biogeochemical cycling, biologically mediated diagenesis, biological mineral precipitation and dissolution, isotopic geochemistry of biologically mediated processes, origin and early evolution of life, paleobiology, paleontology, and astrobiology. Practical applications of geobiological studies include bioremediation of environmental contaminants, biobeneficiation and other mining related microbial topics, microbial indicators of petroleum properties, pharmaceutical and industrial compounds from geomicrobial communities, and many other new arenas.

The program has two coordinators, Penelope Boston in EES and Tom Kieft in Biology. In addition, we have a roster of Geobiology Associates, faculty that have interests across aspects of Geobiology. They include Dave Johnson, Kent Condie, and Peter Mozley in EES and Mike Pullin in the Chemistry Department.

As the field of geoscience broadens and evolves, we hope to be able to serve a new generation of student needs in these emerging cross-disciplinary fields. We are encouraging interdisciplinary programs broadly across the Earth science fields to help position our students for future careers that will require flexibility and breadth of background.

Student Spotlights

Katrina Koski, PhD Candidate in Hydrology



Katrina Koski, pictured above at the entrance to Vaca Ha, Tulum, Mexico, won the Ralph Stone Award from the National Speleological Society in August 2009. Each year, the NSS awards two Ralph W. Stone Graduate Fellowships for cave-related thesis research. NSS members currently pursuing graduate studies anywhere in the world are eligible to apply. Past recipients are Diana Northup at UNM, who collaborates with EES Associate Professor of Caves and Karst Penny Boston on the SLIME team, and George Veni, head of the National Cave and Karst Research Institute. *(Photo courtesy of Tanja Pietrafesa)*

Katrina and Professor of Hydrology John Wilson are studying the exchange of water between the conduit (underwater cave) and matrix (rock) in a karst aquifer. Because she is a certified cave diver (and rumor is John is going to become one!), they are able to take observations and place instruments inside the conduit and the matrix adjacent to the conduit. One variable they have to quantize to fully understand the conduit-matrix coupling is how and when the sediment moves through the conduit. Katrina's Ralph Stone Award proposal detailed a simple experiment to release tagged, artificial sediment in a karst conduit and track its movement.

Shasta Marrero, PhD Candidate in Hydrology



In Fred Phillips' research group, we are working towards a new chlorine-36 production rate. For years, researchers have been working to accurately calibrate the production rates of cosmogenic nuclides, which can be used as

useful tools in geologic work due to their ability to date exposure ages on surfaces as well as providing other information like erosion rates. An NSF-funded project called CRONUS-Earth is attempting to create a uniform platform for all cosmogenic nuclides and provide the best production rates possible for each of the commonly-used nuclides. As part of this project, we are using a new set of geological sites of known age in order to calibrate chlorine-36 production rate parameters and improve the technique.

Recently, we (Michelle Hinz and I) went to the Big Island of Hawaii as part of a larger group to collect samples for this project. Lava flows provide ideal calibration locations due to the numerous flows of known age thanks to ubiquitous radiocarbon dates. Learning the technical aspects of how to walk on aa (sharp, spiny pieces of basalt that roll under your feet) was a prerequisite to sampling for the project, and we all took our fair share of missteps before we figured it out. We worked all day every day, although we managed to squeeze in time to swim with sea turtles and see the glowing vent at night. We were very selective in our sampling, picking only the best original surfaces, such as lava balls and pa-hoehoe ropes. We also had our share of excitement in patching two flat tires using pieces of plastic salvaged from the jeep, duct tape (of course!), and gum someone found in the bottom of a field pack from an MRE from prior field work! In the end, we collected 41 great samples for the project, all of which will be shared among all the investigators working towards the calibration of cosmogenic nuclides on the CRONUS-Earth project.

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