Crater of Mt. Erebus, the most active volcano in Antarctica. Geologist Bill McIntosh examines fumaroles with vents of ice on the north side of the crater, just a few meters from the rim. *Photo by George Steinmetz, ASA © 2012*


NEW MEXICO TECH
SCIENCE • ENGINEERING • RESEARCH UNIVERSITY

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NEW MEXICO TECH DEPARTMENT OF EARTH AND ENVIRONMENTAL SCIENCE


# TECHTONICS

ALUMNI NEWSLETTER

*NMT hydrology students Jeff Pepin (PhD) and Matt Folsom (MS) set sail on a ten-day voyage aboard the R/V Langseth to assist in the experiment and learn more about its state-of-the-art electromagnetic methodology.*

*SEE PAGE 10.*

# A Note From the EES Department Chair

Dr. Glenn Spinelli
*Department Chair*

Dear Alumni and Friends,

It is an exciting time in the Earth and Environmental Science Department, and all across campus at New Mexico Tech.

Since the last newsletter, we have had a couple of departures from the EES faculty. Penny Boston has left for a position to lead the NASA Astrobiology Institute. Fred Phillips has retired; although the only way that you would know that around the MSEC building is based on his absence from the classroom. Fred continues an extremely active research program, with the luxury of having more time for fieldwork in the Sierras. In September Fred, along with John Wilson (another very active emeritus faculty member), and Rob Bowman (EES faculty, deceased 2009) were honored in a GSA session dedicated to their extensive contributions.

From the fall of 2015 to today, we have welcomed four new faculty to EES: Chloë Bonamici (Geochemistry), Jesus "Chucho" Gomez-Velez (Hydrology), Andrew Luhmann (Hydrology), and Deqiang Mao (Hydrology).

There have also been substantial changes in the NMT administration. Dr. Stephen Wells is now one year into his tenure as president of NMT. President Wells is geomorphologist with a long history in Earth science research and education, and numerous ties in the southwest. Prior to coming to NMT, he was a faculty member at UNM, then the director of the Desert Research Institute in Nevada. We look forward to engaging with Dr. Wells as both an administrator and an Earth scientist. In addition, Peter Mozley has moved across campus to be the Associate Vice President for Academic Affairs. So, unfortunately, we see his smiling face around the MSEC building a little less, but he continues to teach in EES and conduct research / advise graduate students.

Sadly, we need to report that Al Sanford, an iconic seismologist with a 50-year-long career at NMT, passed away in August 2016. Al's contributions to NMT and Earth science are far-reaching, including discovering the Socorro Magma Body. Al was clearly revered by his students, and through his mentorship he helped develop a generation of engaged, thoughtful citizen-scientists who are found today throughout nearly all facets of academia, government, and industry. We held a tribute to Al during the 49ers celebration (Oct. 2016). It was a touching remembrance of Al, with many alumni, colleagues, and friends in attendance.

Regards,

Dr Glenn Spinelli
*Department Chair*

*Department of Earth and Environmental Sciences*


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John Philip Ortiz—*The Role of Fault-Zone Architectural Elements and Basal Altered Zones on Downward Pore Pressure Propagation and Induced Seismicity in the Crystalline Basement*

Peter M ReVelle—*Evapotranspiration in Mountain Terrain – Applying Topographic-Based Energy Constraints to Evaluate the Distribution of Water Fluxes and Effect of Vegetation Cover Change*

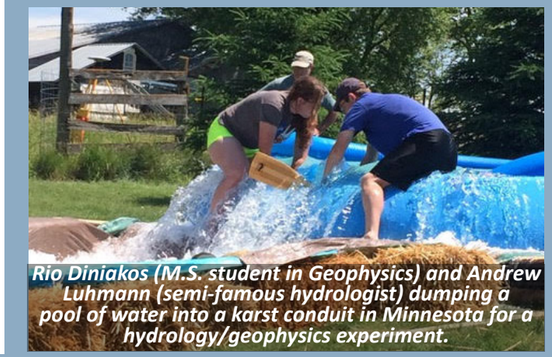
## DOCTOR OF PHILOSOPHY IN EARTH AND ENVIRONMENTAL SCIENCE WITH DISSERTATION IN GEOCHEMISTRY

Nels Anton Iverson—*Eruptive history and magmatic stability of Erebus volcano, Antarctica: Insights from englacial tephra.*

## DOCTOR OF PHILOSOPHY IN EARTH AND ENVIRONMENTAL SCIENCE WITH DISSERTATION IN GEOLOGY

Ahmadreza Malekpour Alamdarie—*Regional Tectonic and Structural Significance of Late Cretaceous-Cenozoic Extension in Iran*

Rock'n around NM 2017 @ Arroyo del Tajo



Rio Diniakos (M.S. student in Geophysics) and Andrew Luhmann (semi-famous hydrologist) dumping a pool of water into a karst conduit in Minnesota for a hydrology/geophysics experiment.

Brad Sion, M.S. in Hydrology

Heather Barnes (M.S. student in Geophysics) conducting a resistivity survey across the Loma Blanca Fault in the Sevilleta National Wildlife Refuge.

**Doctor of Philosophy in Earth and Environmental Science with Dissertation in Hydrology**

Amy B Jordan—*Multiphase, multicomponent flow and transport models for Nuclear Test-Ban Treaty monitoring and nuclear waste disposal applications*

## UNDERGRADUATE DEGREES 2017

**Bachelor of Science in Earth Science with Geochemistry Option**

Landon A Daniell

**Bachelor of Science in Earth Science with Geology Option**

Naomi Tamen Delay

Steven William Farrar

Ke Li

Ziy Liu

Joseph Henery Phillips

Jing Yuan Ren

Jason Sterling Silviria

Madison Woelfel

Fei Xu

**Bachelor of Science in Earth Science with Geophysics Option**

Cindy Gomez

Heidi Patricia Myers

**Bachelor of Science in Earth Science with Hydrology Option**

Katherine Heuser

## GRADUATE DEGREES 2017

**Graduate Certificate in Hydrology**

Heyfa Khenissi

Chaneil Jermaine Wallace

Joseph Wilch

**Masters of Science in Geology**

Dylan H Rose-Coss—*A Refined Depositional Sequence Stratigraphic and Structural Model for the Reservoir and Caprock Intervals at the Farnsworth Unit, Ochiltree County TX*

Robert Ezekiel Salaz—*Shallow geothermal investigations into the existence of the Valles Caldera outflow plume near Ponderosa and Jemez Pueblo, north-central, New Mexico*

Phillip C. Simmons—*Mineralogical constraints and the effect of fluid-ion interaction on the formation of the Jones Camp Dike and associated rocks, Socorro County, New Mexico*

**Masters of Science in Geochemistry**

Chaneil Jermaine Wallace—*Latite dikes, phyllic alteration and geochemical variations of micas at the Copper Flat Hydrothermal System, Hillsboro, Sierra County, New Mexico, USA*

**Masters of Science in Geophysics**

Abra Elizabeth Ziegler—*Adaptive Sensor Tuning for Seismic Event Detection in Environment with Electromagnetic Noise*

**Masters of Science in Hydrology**

Reid Douglas Brown

Margeaux Louise Carter—*Extending the Record of Greenland Ice Sheet Subsurface Meltwater: Exploring New Applications of Satellite Remote Sensing Data*

Frank Gambardella

Lauren Brooke Harrelson—*Implementation of Field Research for Karst Hyporheic Flow in Bedrock Streams and Phreatic Caves*

David Granger Ketchum—*High-resolution estimation of groundwater recharge for the entire state of New Mexico using a soil-water-balance model*



Spider Cave
Carlsbad Caverns National Park

# in this issue . . .

# introducing . . .

## Chloë Bonamici

I am very happy to join the Tech EES community this Fall. My teaching and research interests – geochemistry, petrology, and structural geology – place me somewhere in Kent Condie's long shadow, though I would never claim to be his replacement. I am, however, excited to take on teaching several of the department's core courses in geochemistry and petrology. My plan is to build a research program centered on applications of microanalysis (electron microscopy and in situ mass spectrometry) to petrologic and tectonic questions. I am particularly interested in the (micro)geochemical records of processes related to fluid movement in the deep crust, strain localization, rheologic evolution of deforming zones, continental extension, and tectonic exhumation. I was born and raised mostly in Flagstaff, Arizona, where I also attended Northern Arizona University for my bachelor's and master's degrees. The NAU Geology department bears many similarities to the Tech EES department, and the excellent educational experience I had at NAU has much to do with why I was eager to come to Tech. I completed my PhD in stable-isotope geochemistry at the University of Wisconsin-Madison in the summer of 2013 and moved to New Mexico to do mass-spectrometry-based postdoctoral research at Los Alamos National Lab. At LANL, I dipped my toe into the vast world of radioisotopes and gained an appreciation for the breadth of applied science happening at our national labs. While there, I did manage to sniff out a fundamentally geochemical project within the broader context of weapons research – using the major- and trace-element composition of fallout from the Trinity explosion to better understand volatility and fractionation inside the nuclear fireball.

I met many proud Tech alumni at LANL, working in a range of scientific and engineering positions, and came to understand that the Lab deeply values Tech as a local source for their skilled workforce. My time at LANL was enlightening and formative, but I am excited to return to an academic career path. As a professor at Tech, I hope that I can help our geoscience students develop scientific problem-solving skills that they can transfer successfully to many different types of career path. With that in mind, many thanks to you EES alumni for representing our institution so well and in so many professional capacities. I look forward to meeting many of you in the future.

*chloe.bonamic@nmt.edu*

## Andrew Luhman

Having lived my entire life on flat lands, I am enjoying the sights of a more rugged terrain. Over our first years, my family and I have been enjoying time in the nearby Sevilleta National Wildlife Refuge, Bosque del Apache National Wildlife Refuge, Box Canyon, and the Magdalenas (the view from South Baldy is incredible!). I also attended conferences in Farmington and Carlsbad and visited the spectacular Carlsbad Caverns this past spring. New Mexico is certainly a beautiful place, and I am looking forward to exploring more of this part of the country in the coming years.



I arrived in Socorro in July 2015, moving from Minneapolis where I had been living for the previous nine years. I spent four years working as a Postdoc/Research Associate in the Department of Earth Sciences at the University of Minnesota-Twin Cities, where my research focused on fluid-rock reactions. Most of my



# Degrees

## UNDERGRADUATE DEGREES 2016

### Bachelor of Science in Earth Science with Geology Option

Andrew Thomas Keith

Linhan Li

Ashlynne M. Winton

Zhidi Wu

Lydia Molby

### Bachelor of Science in Earth Science with Geophysics Option

Kimberley Kayle Haar

## GRADUATE DEGREES 2016

### Masters of Science in Geology

Jeffery W. Dobbins—*Structural analysis of spectacular late Eocene soft-sediment deformation in the lower Spears Group, Sawtooth Mountains, Western New Mexico*

Jenna Lee Donatelli—*Dedolomitization and other diagenesis in the backreef setting of the Permian Reef Complex in Dark Canyon, New Mexico*

Evan J. Gragg—*Petroleum System Modeling of the northwest Anadarko Basin: Implications for Carbon Storage*

Joseph J. Grigg—*Macroscopic and microscopic controls on mechanical properties of mudstones*

Emily Patricia Randall—*Characterization of ejecta erupted in 2013 and 2014 from Erebus volcano, Antarctica*

### Masters of Science in Geophysics

Steven Paul Bernsen
Stanislav S Edel—*Characterizing suspected induced seismicity in SE New Mexico in the vicinity of the Waste Isolation Pilot Plant*

Ashely C Hutton—*Geophysical modeling and structural interpretation of a 3D reflection seismic survey in Farnsworth Unit, TX*

Kyle Dennis Murray—*GPS measurements of Rio Grande rift deformation*

Mathew Robert Perry—*Modeled temperatures and fluid source distributions for the Mexican Subduction Zone: Effects of hydrothermal circulation and implications for plate boundary seismic processes*

Rosalynn Wang—*Source parameters of earthquakes in the Mexican subduction zone*

### Masters of Science in Hydrology

Amy Galante—*Distribution, transport, and accumulation of pyrogenic black carbon (PyC) in post-wildfire watersheds*

Junhao Hu—*Assessment of water table fluctuations and wetland delineation by hydrologic modelling, Bosquecito, New Mexico*

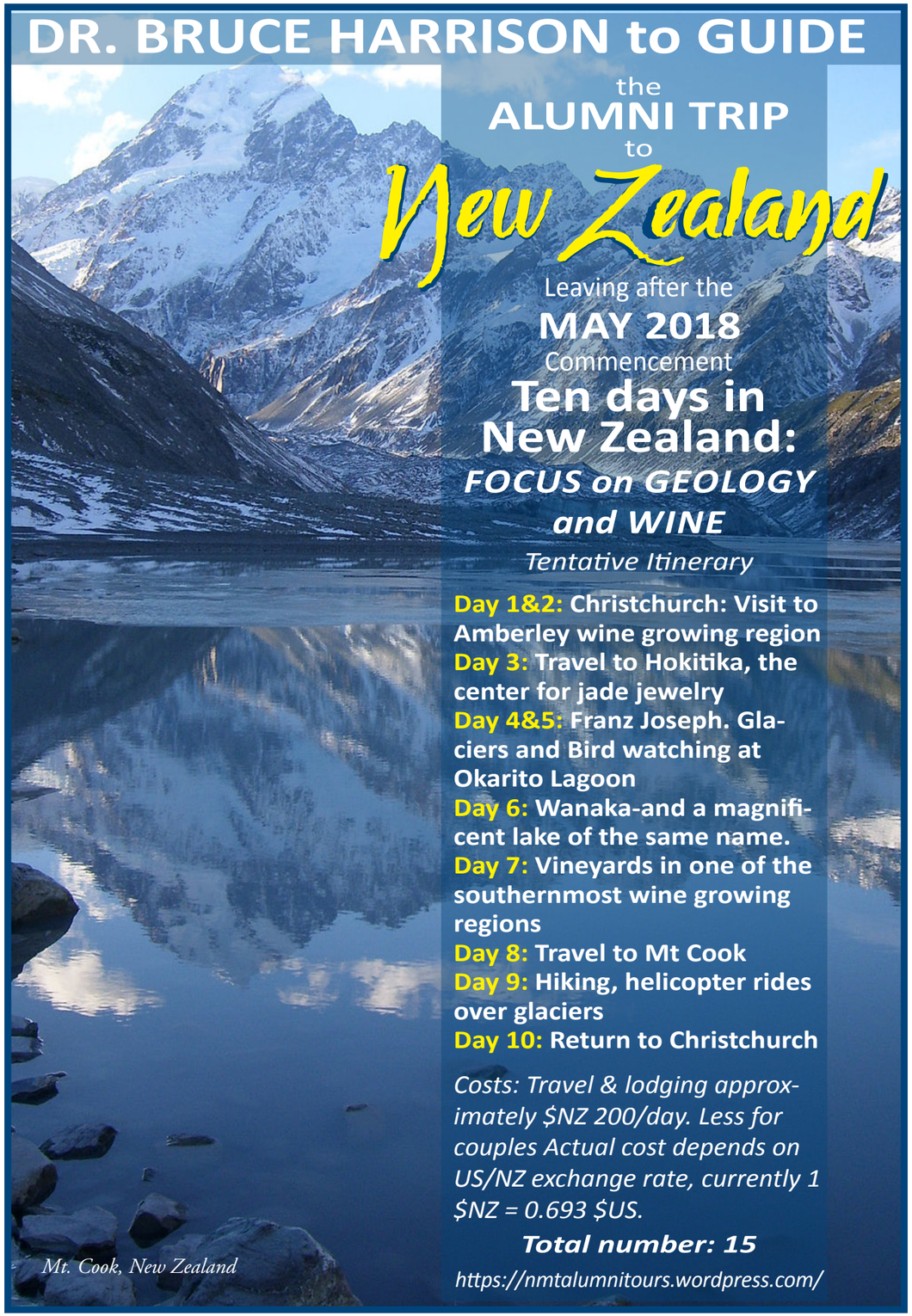
Phoebe Rubaiyat Nicholls—*Sorption characterization of environmentally relevant concentrations of arsenic and chromium to soils containing pyrogenic black carbon in watersheds affected by wildfires*

### Doctor of Philosophy in Earth And Environmental Science with Dissertation in Geochemistry

Aaron Gordon Curtis—*Dynamics and global relevance of fumarolic ice caves on Erebus Volcano, Antarctica*

### Doctor of Philosophy in Earth and Environmental Science with Dissertation in Geophysics

Rediet Avera—*Aspects of continental rifting: Insights into pull-apart rifts and sill-intrusions from numerical models and potential field data*




efforts focused on running reactive percolation experiments to simulate $CO_2$ injection scenarios.

In my final year at Minnesota, I ran serpentinization experiments in the lab and collected hydrothermal vent fluids from Axial Volcano and the Main Endeavour Field during a research cruise to the Juan de Fuca Ridge in the North Pacific. I received my PhD in Geology from the same department in 2011, studying karst hydrogeology in southeastern Minnesota, where my research focused on using heat as a tracer in karst aquifers.

Before this, I received my BS in Geology in 2006 from Wheaton College in IL, where I found my way into the field after taking an introductory geology course to fulfill a general education requirement. Don't most of us find our way into the geosciences this way (or at least those of us who didn't grow up in the beautiful West)?

At Tech, I am working on the DOE-funded Southwest Regional Partnership on Carbon Sequestration. My first two graduate students (Zhidi Wu and Lindsey Rasmussen) are conducting flow-through experiments on rock cores to assess mechanical impacts that arise due to reaction with $CO_2$-rich fluids and diagenetic

controls on relative permeability. In addition, I conducted some recharge experiments in karst this past summer with several people from Tech (Sue Bilek, Ronni Grapenthin, Glenn Spinelli, Alex Rinehart, Rio Diniakos, and Emily Morton), and we are using geophysical signals generated during the recharge events to characterize unknown karst conduits and flow conditions in the subsurface. See photos in this issue of *Tech Tonics* of fieldwork associated with this project.

Dr. Andrew J. Luhmann

So far, I have taught Hydrogeochemistry, Hydrogeology, Karst Hydrology, and Graduate Seminar at Tech. I am enjoying the classroom and appreciate the caliber of students that the program is able to attract. Next summer, the other Hydrology faculty and I will be developing and teaching a course titled Field Methods in Hydrology.

It is very exciting for me to be starting my career at Tech while working with individuals who have been instrumental in developing a phenomenal Hydrology Program and Earth and Environmental Sciences Department. Furthermore, there are many opportunities for my students and me to work with excellent colleagues in the Bureau of Geology and Mineral Resources and the Petroleum Recovery Research Center on campus as well as scientists at Sandia National Laboratories, Los Alamos National Laboratory, and the National Cave and Karst Research Institute.

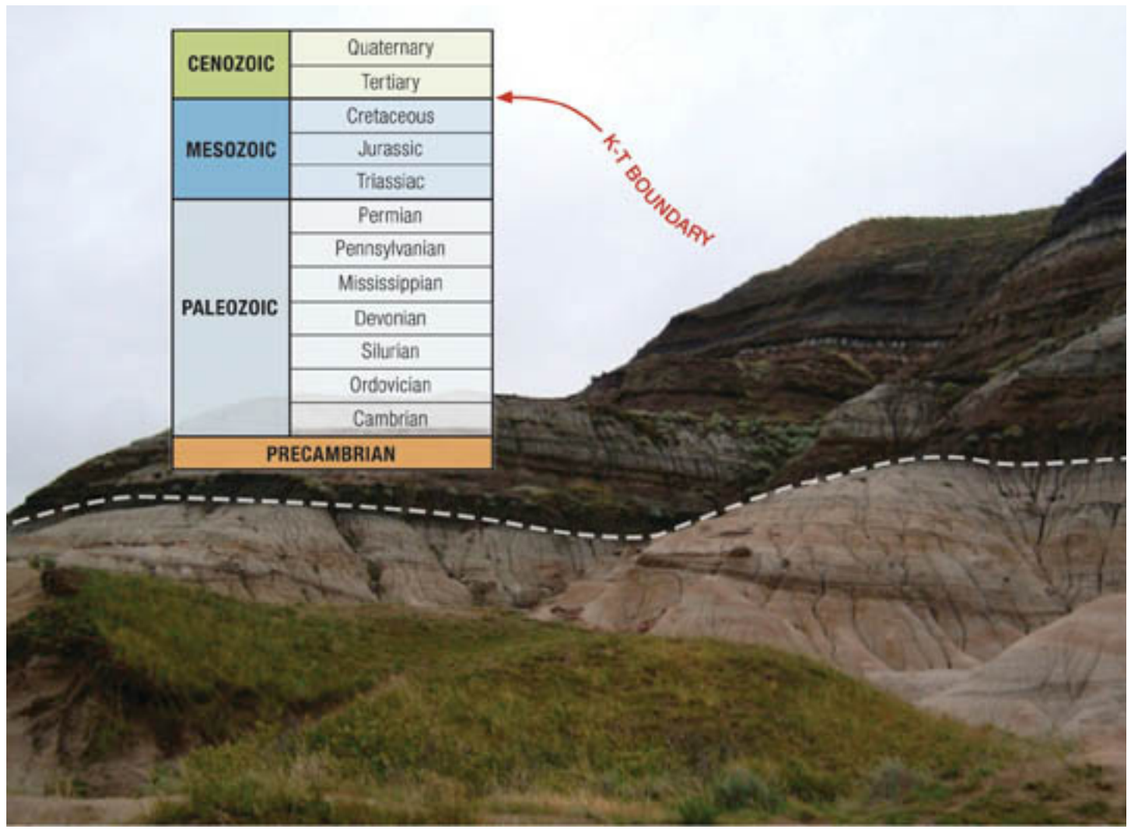
I look forward to meeting you, the alumni who have been a part of the department's history at Tech, and I hope for opportunities to work with you in the future.

*andrew.luhmann@nmt.edu*

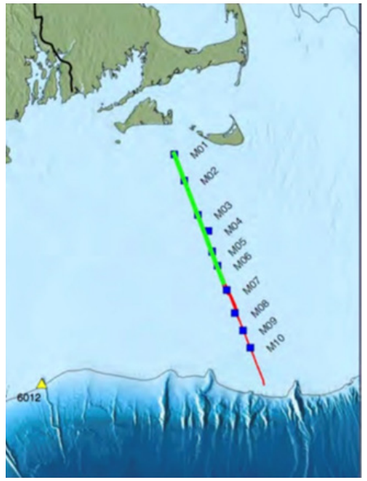
# . . . introducing

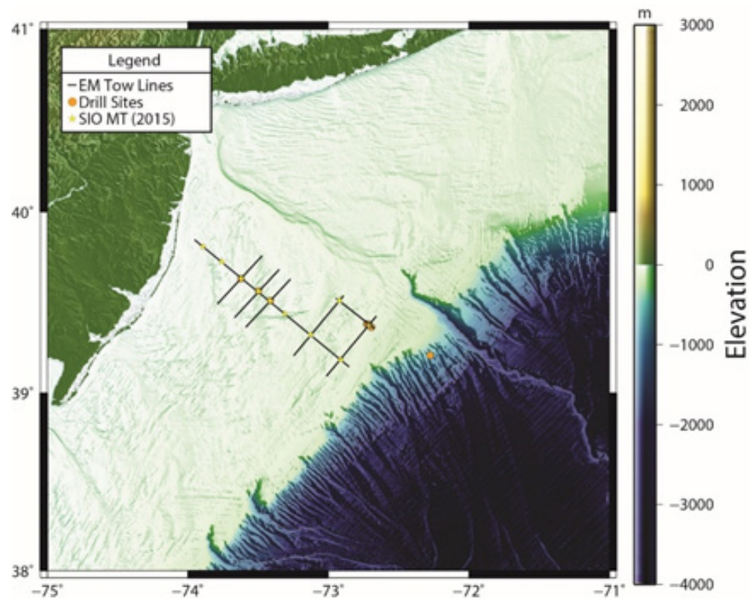
# recruiting, internships, and industry sponsors


Even though oil prices have been low for a while, the department has been successfully building relationships with industry partners in the past years. Through these contacts we have been able to place graduate students for internships and help our students find positions after graduation. The companies also advise our students on CV's and interview skills. One of our valuable industry sponsors is Pioneer Natural Resources. This company organizes a field trip every fall in the Raton Basin in Colorado exclusive for NMT's earth science grads! This photograph was taken during the field trip of fall 2016. The group is enjoying an outcrop of the famous K-T boundary.






Base maps showing locations of MT/ CSEM surveys off New Jersey and Massachusetts, courtesy of Kerry Key, Columbia University

Key from Columbia University and Dr. Rob Evans of the Woods Hole Oceanographic Institute (WHOI) on an NSF funded cruise aboard the research vessel RV Langseth. The goal of the cruise was to explore the possibility of using broadband marine magentotelluric (MT) surveys and controlled source electromagentic methods (CSEM) to image the distribution of offshore freshwater on the Atlantic continental shelf off New Jersey and Massachusetts.

The cruise departed from Woods Hole during September, 2015 and lasted about two weeks. The cruise was very successful and the team was able to image regions of offshore freshwater extending tens of kilometers from the coastline. This experience provided valuable insights for Pepin and Folsom in their own research projects using a land based MT systems to better understand the plumbing of New Mexico's crystalline basement hosted geothermal systems with may extend to depths of 8 km.

Cohen, D., Person, M., Wang, P., Gable, C.W., Hutchinson, D., Marksamer, A., Dugan, B., Kooi, H., Groen, K., Lizarralde, D. and Evans, R.L., 2010. Origin and extent of fresh paleowaters on the Atlantic continental shelf, USA. *Groundwater,* 48(1), pp.143-158.

Hathaway, J.C., C.W. Poag, P.C. Valentine, R.E. Millerk, D.M. Schultz, F.T. Manheim, F.A. Kohout, M.H. Bothner, and D.A. Sangrey. 1979. U.S. Geological Survey core drilling on the Atlantic Shelf, 1979. *Science* 206, no. 4418: 515–527.

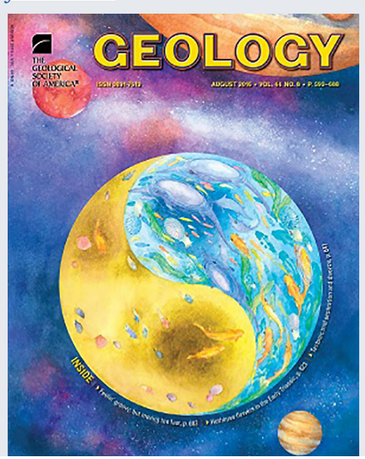
Konikow, L.F. 2002. Ground-water depletion and overexploitation; a global problem. *Geological Society of America Abstracts with Programs* 34, 229.

## Paradigm Shift in Determining Neoproterozoic Atmospheric Oxygen

Nigel J.F. Blamey, Uwe Brand, John Parnell, Natalie Spear, Christophe Lécuyer, Kathleen Benison, Fanwei Meng, and Pei Ni

*"If the analytical methods hold up, it's a game-changer."*

For more information go to the Geological Society of America's guest blog at: *https://speakingofgeoscience.org/2016/12/22/top-geoscience-papers-from-2016/*

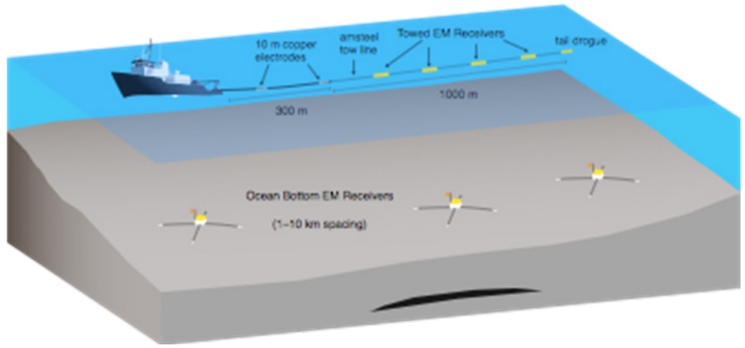


# Fresh From the Sea

by Mark Person

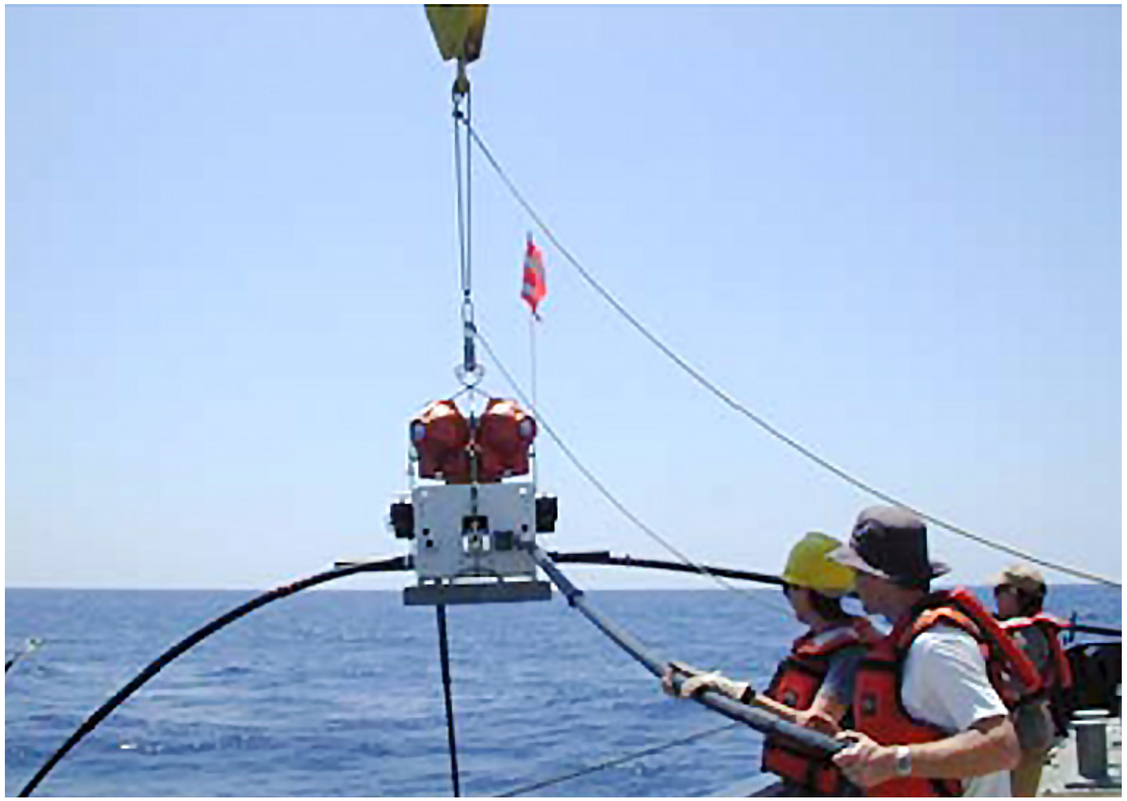
For decades, Earth scientists have known that there are vast quantities of freshwater to brackish water are sequestered below sea level in continental shelf environments (Hathaway et al. 1979).

Mark Person and adjunct professor Denis Cohen were among the first to estimate that over 10 5 km 3 of freshwater are hosted in permeable, poorly consolidated sandstone and limestone formations within 50 km of the shoreline on passive continental margins (Cohen et al. 2009). To put this number into perspective, the net withdraws of groundwater from the Ogallala aquifer is 270 km 3 (Konikow, 2002).




Schematic Diagram showing deployment of MT-CSEM equipment courtesy of Kerry Key, Columbia University

Recently, two of Person's graduate students, Matt Folsom and Jeff Pepin, co-advised by Dr. Shari Kelley, went to sea with Dr. Kerry



Marine MT system being deployed.



# ALUMNI NEWS

As you may have all gathered from reading this and the previous edition of *Techtonics* the department and the college have been going through substantial changes. Firstly, NM Tech has a new president for the first time in 23 years as well as a number of changes in the schools administration. Our new president is Dr. S. Wells, who most recently was the director of the Desert Research Institute in Reno Nevada. Interestingly his PhD adviser was Dr. L. Lattman, who was also a president of NMT. Within the department we have four new faculty that have added some youth and new directions for the department.

One of the consequences of these changes is that many alumni feel disconnected to the department as there are fewer and fewer faculty that they can recall from their student days. The Department has been considering different ways involve alumni more in departmental and school activities.

We have set up a departmental advisory board to provide an outside view into departmental activities including teaching, research and outreach programs. To help alumni keep up with the changes in faculty and their research we will post the beginning fall seminar presentations in which the faculty from the Department and the Bureau give a brief introduction and a powerpoint slide covering their research. This will be available at the department web page. We will also be instituting a distinguished alumni speaker series each fall semester, to coincide with 49er's, along with a distinguished speaker series for the spring semesters.

Other activities suggested by alumni, include: help with recruitment activities by visiting K12 and/or community college classrooms and speaking about their careers and the career opportunities available in the Earth Sciences, helping support individual students for example by buying their textbooks or helping with field work expenses and helping to develop on line videos of career possibilities.

Dr Robert Bowman
1950-2009

For those alumni who would prefer to make financial contributions, we have a number of endowed funds which primarily support graduate student research and travel. A list of these funds can be found at this site ***http://www.ees.nmt.edu/alunmi-giving.*** All endowed funds require a minimum corpus balance of $15,000 before returns will be made to the department. All of our funds except for the Robert Bowman Memorial Fund, have reached this target. To encourage contributions to this fund, to attain the threshold balance the department will match alumni contributions until it reaches $15,000.

Some alumni work for companies which will match contributions employees make alumni associations. For NMT these include the following:

The Amgen Foundation
Apache Corporation
Chevron Humankind/YourCause
Chevron Phillips Matching
Conoco Phillips
ExxonMobil Foundation
Fidelity Charitable
Freeport-McMoRan Copper
Intel Involved Matching
IBM Matching Grants
Lockheed Martin
Merck Foundation
Microsoft Matching Gifts
NPO Gateway/Visa Matching Program
Newfield Matching Gifts
Pioneer Natural Resources
PNM Resources/Community Connections
Raytheon
The Schwab Charitable Fund
United Way of Central NM

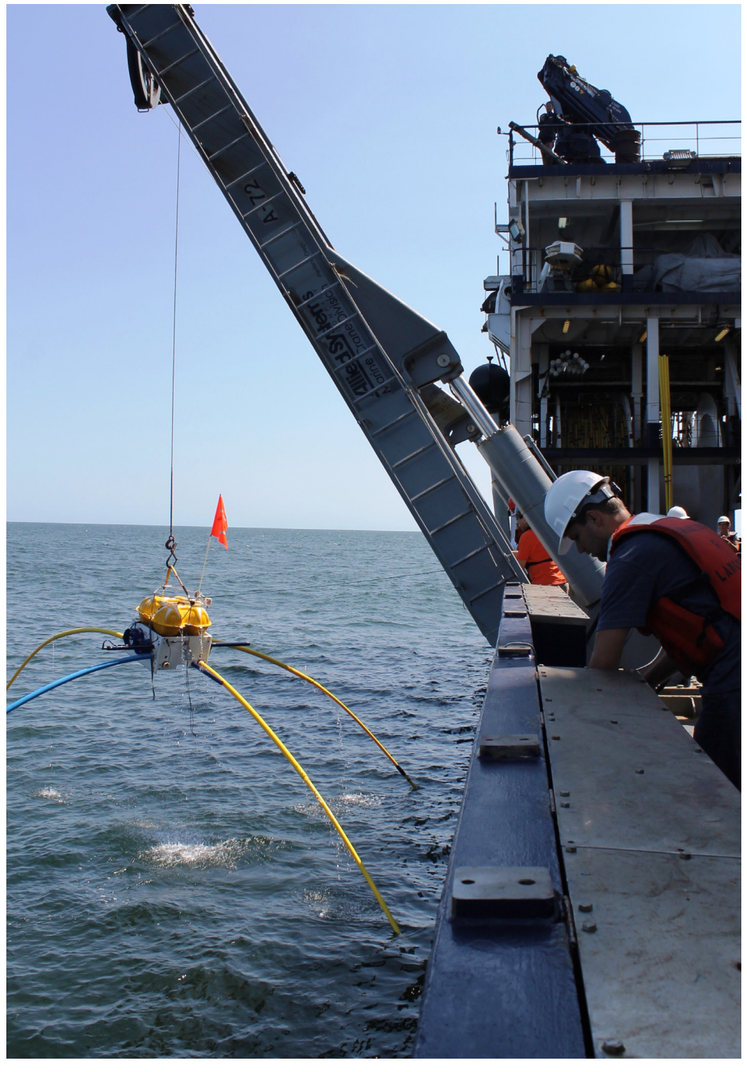
As we move forward to strengthen our ties with alumni we are very interested in any suggestions or comments you may have to help in this endeavor.

Bruce Harrison
*Associate Department Chair*
*Alumni Coordinator*

If you wish to receive the newsletter online send an email to:
***james.harrison@nmt.edu.***
It is also available on the alumni page of the department website at
***https://nmtearth.com/alumni-newsletter/***

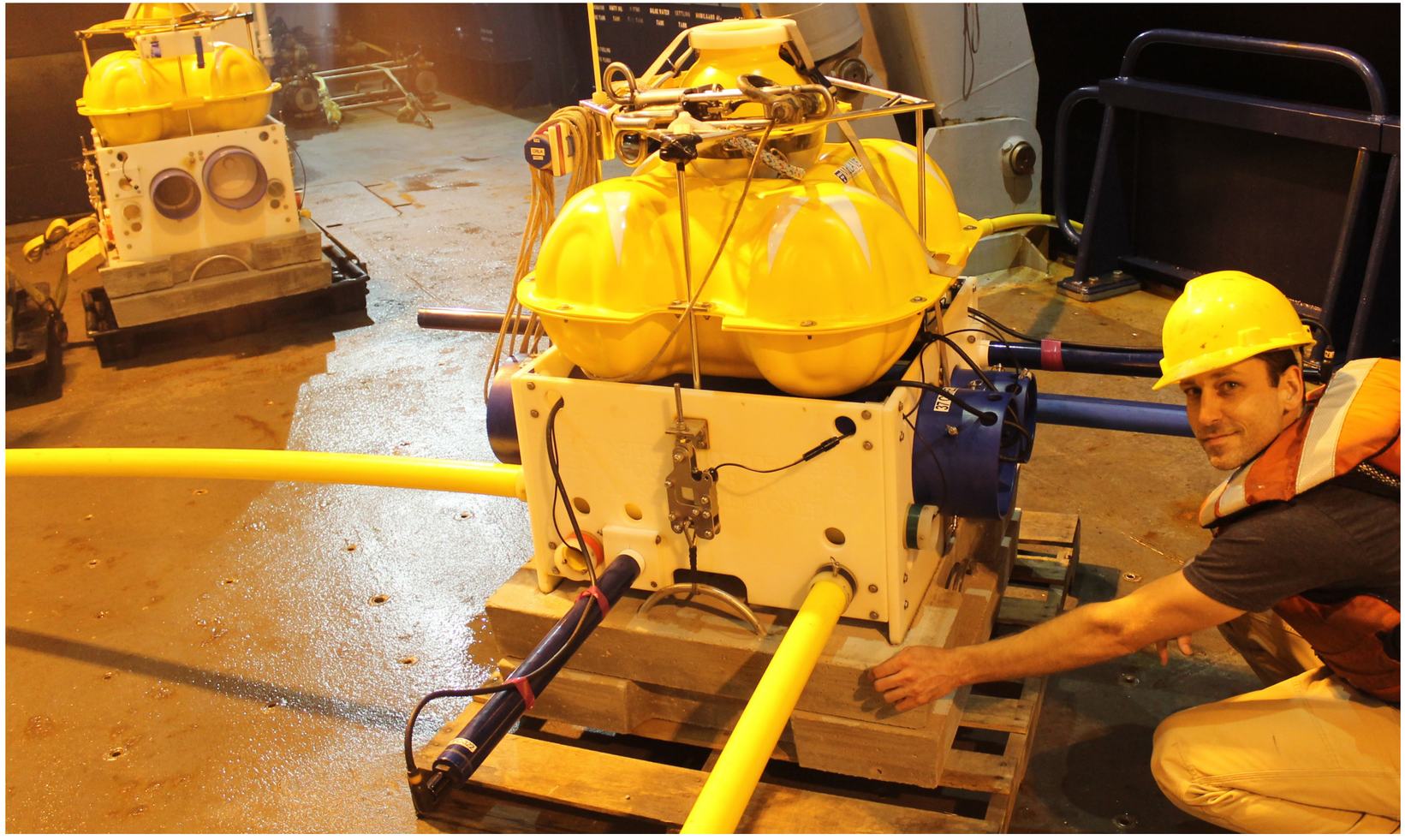
# Imaging Freshwater in the Atlantic Seafloor

Computer modeling efforts by New Mexico Tech Professor Mark Person and others have shown that there is a strong possibility that freshwater is sequestered in offshore sediments along portions of the east coast. In these models, primarily glacial melt water is believed to have infiltrated into permeable seaward-dipping sediment layers during periods of low sea level. Upon sea-level rise, mixing of the infiltrated freshwater and seawater is significantly restricted in regions where lithologies of low permeability overlie these high permeability layers.



This hypothesis was confirmed in 2009, when drillers encountered freshwater in saturated offshore sediments approximately 50 km off the coast of New Jersey.

More recently, Rob Evans of the Woods Hole Oceanographic Institution and Kerry Keys of the UCSD Scripps Research Institute acquired funding to perform a multi-method (CSEM and MT) geophysical survey over this region in an effort to electromagnetically image these zones of freshwater.



Matt Folsom with an ocean bottom EM receiver onboard the R/V Langseth

On September 3, 2015, current NMT hydrology students Jeff Pepin (PhD) and Matt Folsom (MS) set sail on a ten-day voyage aboard the R/V Langseth to assist in the experiment and learn more about its state-of-the-art electromagnetic methodology. Four additional students along with the three technicians joined the two project leads to conduct the experiment. The students were relied upon heavily to deploy, monitor and retrieve floating receivers and antennas in addition to seafloor instrumentation.

Overall, the trip was a tremendous success. Preliminary results clearly image the known freshwater supplies off the coast of New Jersey. The scientists were also able to conduct an exploratory survey off the coast of Martha's Vineyard, MA; data analysis is still ongoing.

The New Mexico Tech students that were onboard the R/V Langseth for the experiment are currently heading up land-based electromagnetic efforts to discover and further understand geothermal resources in New Mexico.

These efforts are being conducted using highly advanced electromagnetic geophysical instrumentation that was purchased in June 2014 under a grant led by NMT Professor Mark Person. The students will aim to use the resources and knowledge attained from their marine research experience to further the electromagnetic research program here at NMT. They would like to extend their sincere gratitude to the alumni donations that made this trip possible.

*By Jeff Pepin and Matt Folsom*