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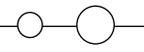
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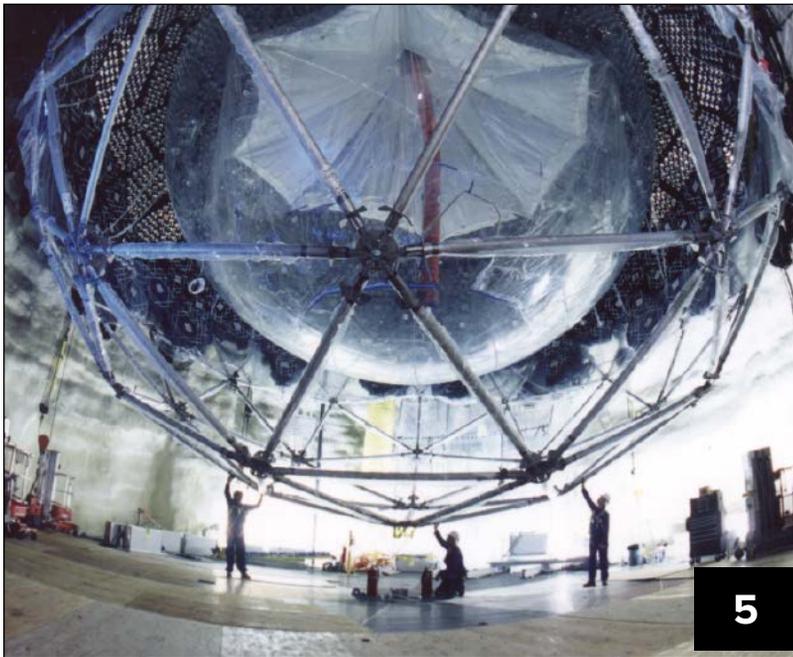
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EOS

Editor in Chief

Barbara T. Richman: AGU, Washington, D. C., USA; eos_brichman@agu.org

Editors

Christina M. S. Cohen
California Institute of Technology, Pasadena, Calif., USA; cohen@srl.caltech.edu

Wendy S. Gordon
Ecologia Consulting, Austin, Texas, USA; wendy@ecologiaconsulting.com

Carol A. Stein
Department of Earth and Environmental Sciences, University of Illinois at Chicago, Chicago, Ill., USA; cstein@uic.edu

José D. Fuentes

Department of Meteorology, Pennsylvania State University, University Park, Pa., USA; juf15@meteo.psu.edu

David Halpern

Jet Propulsion Laboratory, Pasadena, Calif., USA; davidhalpern29@gmail.com

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Advertising: Christy Hanson, Manager; Tel: +1-202-777-7536; Email: advertising@agu.org

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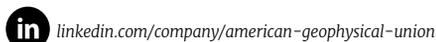
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Christine W. McEntee, Executive Director/CEO



Mysterious Boulders Suggest Ancient 800-Foot-Tall Tsunami

What kind of force could lift almost 50 van-sized boulders and hurl them 220 meters (720 feet) above sea level onto a volcanic plateau?

This question puzzled geophysicist Ricardo Ramalho since 2007, when he first came across the mysterious boulders on Santiago Island—a small Atlantic island almost 1000 kilometers due west of Senegal. But it wasn't until some colleagues found evidence of tsunami deposits on the island in 2011 that Ramalho made the connection—perhaps these boulders are remnants of an extraordinarily huge tsunami, also known as a “megatsunami.”

After dating the boulders, Ramalho realized there was only one event in the area that was possibly capable of triggering such a towering wave—the Fogo volcano flank collapse, where 160 cubic kilometers (40 cubic miles) of rock from the nearby volcano slid off into the ocean. If that collapse, or part of it, had taken place suddenly, the mountain of rock hitting the sea could have triggered a tsunami 240 meters (800 feet) high, Ramalho and his colleagues report—roughly 8 times higher than the greatest peak of the 2004 Sumatra tsunami that killed more than 225,000 people. The largest tsunami ever witnessed by humans was 526 meters (1724 feet) high in Alaska's Lituya Bay in 1958—but it was able to get that high because it was in a confined space.

“There was no other explanation than a very large tsunami that would have been able to carry the boulders from the cliff edge and cliff face and bring them to the top of the plateau,” said Ramalho, an assistant professor at the University of Bristol in the United Kingdom. He and his team published the research on 2 October in *Science Advances* (<http://bit.ly/megatsunami>).

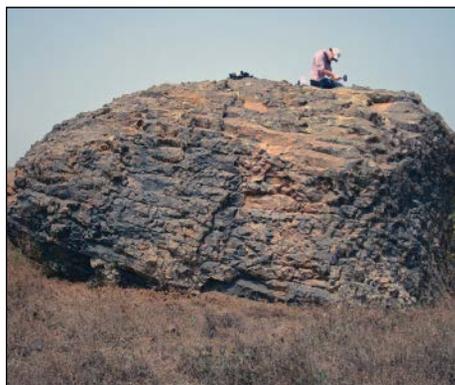
Volcanic Collapse

By studying the tsunami deposits around the Fogo volcano—which is one of the largest and most active volcanoes in the world—previous scientists had dated the collapse to sometime between 65 and 124 thousand years ago. But deposits left over from the collapse tell two different stories.

Some researchers concluded that the Fogo flank collapse happened gradually, with multiple events occurring over days or

weeks. However, because a megatsunami is the only explanation for the huge boulders littering Santiago's plateau, a large collapse must have happened at least initially, Ramalho said.

“We are not the first study to suggest this can happen; we are just providing another line of evidence that actually confirms that this flank collapse might happen suddenly and catastrophically and generate giant tsunamis,” he continued.



A member of a research team hammers the surface of a huge rock on Santiago Island, which lies off the west coast of Africa. The team published new evidence on 2 October that an enormous tsunami may have carried this and many other hefty boulders high up onto the island.

The Boulders

Every one of the 49 boulders that Ramalho and his team found is composed of the same material that makes up the cliffs hundreds of meters below. To find out how long the boulders had been sitting on the plateau, the researchers measured a helium isotope produced in the boulders' olivine minerals at a known rate by exposure to cosmic rays.

Ramalho explained that the amount of the isotope in the boulders' top surfaces—which would not have been exposed prior to the rocks' displacement—told his team that the boulders had been sitting atop the plateau for about 73,000 years, which falls within the estimated dates of the Fogo flank collapse.

The researchers also found deposits containing marine jetsam such as shells so high above sea level that the only explanation was an enormous tsunami, Ramalho said.

However, Peter Talling, an expert in sedimentology and geohazards at the National Oceanography Centre in Southampton, U.K., who wasn't involved in the research, said that he wasn't fully convinced that a megatsunami is the only explanation for the boulders' location.

“It has always been problematic to prove that boulders on land are emplaced by tsunamis,” Talling said. “This is simply because such boulders can also be placed by a range of less exotic processes.”

If the boulders did come from below, a strong storm wave could have done the heavy lifting, Talling said. Or the boulders could have simply rolled from above. Talling suggested that a more thorough mapping of the island is needed to confirm the origins of the boulders.

Gradually or All at Once?

Scientists are not entirely sure what triggers one of the huge volcanic collapses that might have produced a megatsunami, Ramalho said, and there is also controversy surrounding whether the collapses happen in one catastrophic event or gradually, over days or weeks.

Evidence from the Hawaiian Islands in the Pacific Ocean and Canary Islands off the coast of Spain points to megatsunamis created by volcanic flank collapses that happened in one catastrophic event, dumping hundreds of cubic kilometers into the ocean and generating unimaginably large waves. One study even claimed that the Canary Islands are at a huge risk today from a volcano collapse. But these studies were met with a lot of skepticism. More likely, those skeptics say, these volcanic flanks collapse in multiple, smaller landslides that create tsunamis that are less spectacular but still hazardous.

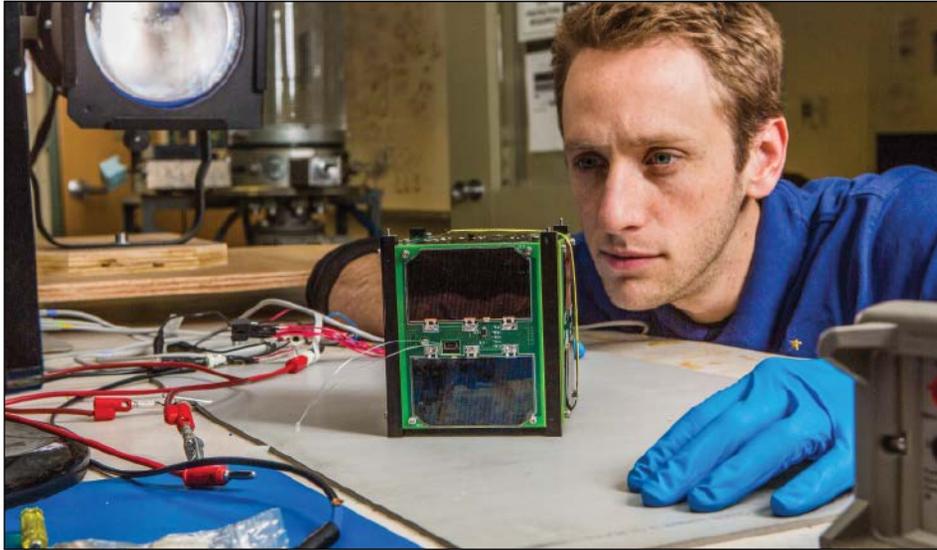
In the new study, the authors concede this point and offer a solution—that the Fogo volcano flank collapse occurred initially as one large event, spurring the 240-meter-high wave, followed by multiple, smaller events.

Modern-Day Risks

Ramalho stresses that although these events can occur and have occurred in the past, they are very rare, so there is little risk. Studying these events should inform our understanding of the hazards associated with large ocean volcanoes, but there is no evidence that a volcano flank collapse is imminent, Ramalho said, at Fogo or elsewhere.

By **JoAnna Wendel**, Staff Writer

U.S. Launches 13 New Minisatellites



UAF/Todd Paris

Patrick Wade, a mechanical engineering major at the University of Alaska Fairbanks, inspects the Alaska Research CubeSat 1, which he helped design and build.

A classified U.S. satellite mission that launched on 8 October deployed more than just a spy satellite. It also released into orbit 13 miniature CubeSats, which hitchhiked aboard the flight.

In a growing trend, space agencies in the United States and elsewhere are turning to such nanosatellites, each built of one or more $10 \times 10 \times 11$ centimeter cube-shaped units, as a compact, low-cost means to conduct scientific research, Earth observation, technology development, and student experiments.

Student Training

Students contributed to several projects that flew aboard the Atlas V rocket launched from Vandenberg Air Force Base in California.

The first CubeSat from Alaska, the Alaska Research CubeSat 1 (ARC-1), was meant to measure the thermal environment inside the launch vehicle, among other tasks. The device began as a training project in space system engineering at the University of Alaska Fairbanks. Graduate student Morgan Johnson, who was team lead on the project, found it “interesting to take this project from what we are learning in school and have it launch in space.”

The October launch also marked the first time a CubeSat from a Native American tribal college went to space. The 1-kilogram

BisonSat includes a camera for Earth observation. “A number of tribal governments are active in using space-based imagery for land decisions,” said principal investigator Tim Olson at an 8 October NASA news briefing. “We hope that our mission is able to contrib-

ute to the data sets tribes use.” Students at Salish Kootenai College in Montana helped to develop the satellite.

Demonstrating Data Transfer Rates

Several industry-developed CubeSats also rode into space aboard the rocket. Aerospace Corporation built AeroCube-5c and AeroCube-7 to demonstrate increased data transfer rates by laser, said John Serafini, vice president of Allied Minds, a company working with Aerospace Corp. “We demand immediate access to our data here on Earth,” Serafini noted at the briefing. “Why don’t we demand the same of data that has originated from low Earth orbit?”

NASA sponsored four of the CubeSats deployed by the October mission. The U.S. National Reconnaissance Office sponsored the other nine CubeSats that accompanied the surveillance agency’s classified NROL-55 mission.

By sponsoring CubeSats, NASA aims “to promote small spacecraft as a paradigm shift for NASA and the larger space community,” Steve Jurczyk, NASA associate administrator for Space Technology, said at the briefing.

By **Randy Showstack**, Staff Writer



NASA

Two tiny satellites, known as NanoRacks CubeSats, speed through space last year after their February 2014 release from the International Space Station. On 8 October of this year, the U.S. National Reconnaissance Office (NRO) launched 13 NRO- and NASA-sponsored CubeSats into space aboard a rocket.

Physics Nobel Winners Also Solved Solar Mystery

Physicists Takaaki Kajita from the University of Tokyo in Japan and Arthur B. McDonald of Queen's University in Kingston, Ontario, Canada, received the Nobel Prize in Physics on 6 October for their pioneering discovery that neutrinos, elusive subatomic particles that are constantly streaming through all of space, even straight through the Earth, can change from one form to another. This finding in turn proved that the tiny particles have mass—a discovery that challenges the prevailing theory of particle physics, known as the standard model.

In the process of discovering the neutrino's changeable nature, the scientists also solved a decades-long mystery about the Sun: the case of the “missing” neutrinos.

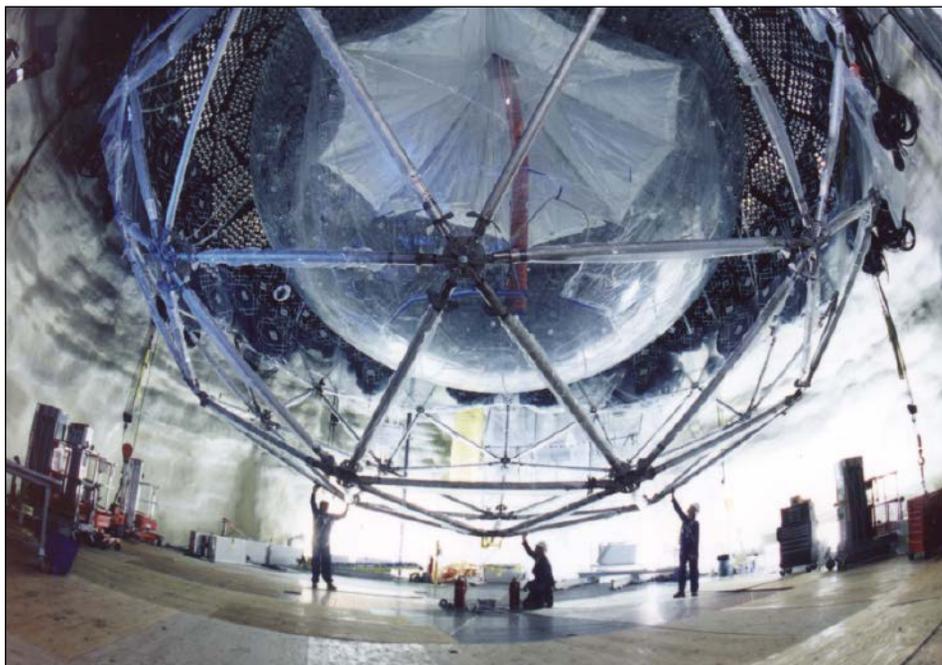
There are three kinds of neutrinos penetrating the Earth from every direction: electron, tau, and muon. Some of these neutrinos have been around since the big bang; some were released by supernovas. Neutrinos also come from the Sun and from radioactive decay on Earth, cosmic rays hitting the Earth's atmosphere, and even radioactive materials within our own bodies, among other sources.

In the 1960s, scientists were investigating the theory that the Sun's energy comes from nuclear fusion of hydrogen into helium deep within its core—a reaction that releases neutrinos, which zip through the Sun toward Earth. Because the reaction happens so frequently, scientists expected to find a vast number of neutrinos hitting the Earth. However, their models disagreed with experimental evidence—they found only a third of the neutrinos they expected. So where were the missing neutrinos?

Mystery Solved

It turns out that the neutrinos were there, but some had morphed. In the experiments that helped secure their Nobel Prize, both McDonald and Kajita helped make this discovery.

In 1998, Kajita and his team at the Super-Kamiokande Neutrino Detector deep below Gifu, Japan, noticed that the number of muon neutrinos coming from the atmosphere above was different from the number traveling through the Earth. Because the Earth does not present any obstacle to neutrinos, these numbers should be the same. They concluded that the muon neutrinos



The detector at the heart of the Sudbury Neutrino Observatory, shown under construction in the mid-1990s, used a clear tank filled with heavy water surrounded by a shell of photodetectors to record neutrinos emitted by the Sun. The observatory's measurements showed that the Sun was generating as many neutrinos as predicted but that most of the particles were transforming from one kind of neutrino into another as they sped to Earth.

that had traveled farther—through the Earth—underwent an “identity” change and transformed into tau neutrinos, which weren't detectable by their instruments.

Meanwhile, McDonald and his team at the Sudbury Neutrino Observatory 2 kilometers underground in Ontario were also investigating the “missing neutrino” problem. Their experiments featured two ways of counting neutrinos—one for counting only electron neutrinos and one for counting all three types as a lump sum. When counting only electron neutrinos, the scientists found only a third of the expected number. But when counting the lump sum of neutrinos, the expected number was there. That meant that the neutrinos emitted by the Sun can change into muon and tau neutrinos during their 150-million-kilometer journey toward Earth.

“The solution of the mystery of the missing neutrinos is an important triumph for astronomy,” John Bahcall, a Princeton University astrophysicist who pioneered the original solar neutrino research in the 1960s,

wrote in 2004 about McDonald's and Kajita's work for NobelPrize.org, the prize's official website. “This shows that we understand how the Sun shines, the original question that initiated the field of solar neutrino research.” Bahcall died in 2005.

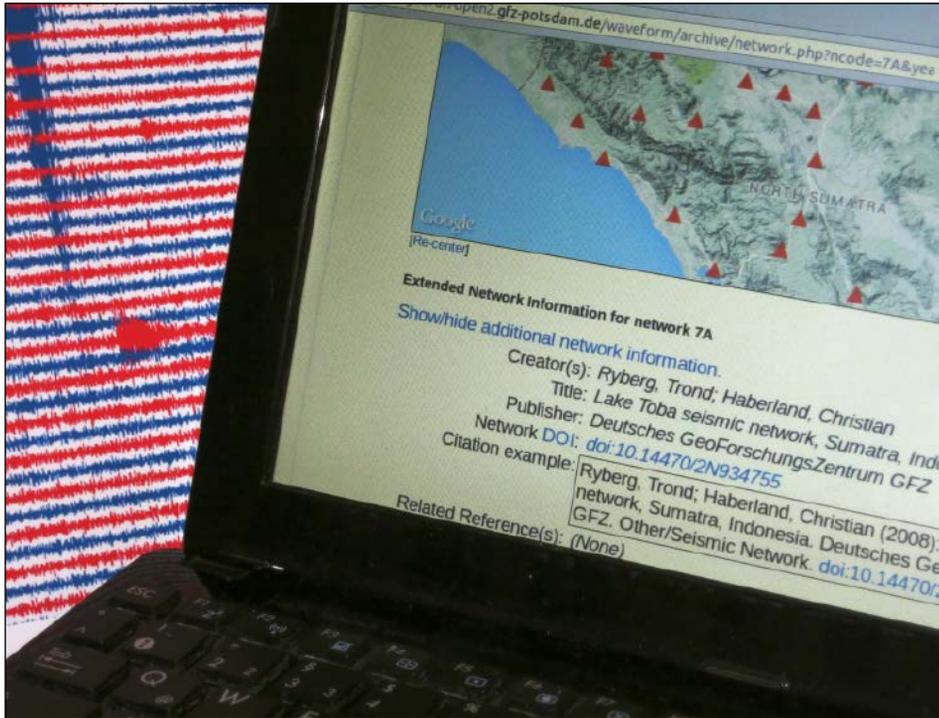
The Bigger Picture

“Trying to answer a question that we find right here in our own neighborhood” led to the discovery of neutrino mass, noted Georgia de Nolfo, an astrophysicist at NASA's Goddard Space Flight Center in Greenbelt, Md., who was not involved in the prize-winning research.

“We're trying to understand the Sun, and in doing that discovered something much bigger,” de Nolfo continued. The fact that neutrinos can switch types and have mass “affects the evolution of the universe and the structure of matter as we understand it.”

By **JoAnna Wendel**, Staff Writer

Why Seismic Networks Need Digital Object Identifiers



A new system of digital object identifiers will bring long-overdue recognition to scientists providing data through seismic networks.

In science, peer-reviewed, published journal articles are the fundamental measure of output and the primary means of career advancement. As scientists, we all absorb, as part of our professional training, a nuanced understanding of what it means to publish and be cited in different journals and how to evaluate metrics like h-indices and impact factors to assess our and other scientists' prestige and productivity.

However, not all scientists have equal access to this publication-driven reward system. In particular, data providers are often left out. Data almost always serve as crucial components of any scientific study, and transparent, reproducible research requires open, permanent access to these source data.

Producing and making available such data are legitimate and important scientific activities, yet data providers do not receive the same recognition as data users, with traceable citation information facilitating measurement

of the impact of their data for their funding providers, tenure and promotion committees, and others [*Data Citation Synthesis Group*, 2014]. We hope that assigning seismic data networks a universal and easily cited digital identity—

We hope that assigning seismic data networks a universal and easily cited digital identity will help bring data providers the recognition they deserve.

the digital object identifier, or DOI—will help bring data providers the recognition they deserve [*International DOI Foundation*, 2012]. We believe that such a step is long overdue.

Unheralded but Critical

As seismic networks become larger and more numerous, they increasingly provide the seismology community with ever-growing troves

of waveform data. These data form the basis of important studies and thus need treatment as independently citable objects.

The good news is that the scientific community generally recognizes this. The bad news is that current citation and acknowledgment practices vary widely, often omitting data providers, and it is often unclear which reference, if any, is preferred for a given network.

The Community Responds

In response to this murky situation, which often prevents seismic data providers from receiving recognition, the International Federation of Digital Seismograph Networks (FDSN) has recommended the attribution of a digital object identifier to each seismic network [*International Federation of Digital Seismograph Networks*, 2014]. This recommendation follows discussion between the seismological data centers within the European Integrated Data Archive and Incorporated Research Institutions for Seismology Data Management Center about possible methods for the generation, maintenance, and promotion of persistent identifiers (PIDs) for seismic networks.

Unique PIDs make consistently citing and acknowledging seismic networks easier for users of seismological data. PIDs offer network operators, data centers, and individual scientists a straightforward way to measure the scientific impact of the data they produced, archived, and distributed.

DOIs are a popular type of PID, and we considered them most suitable for acknowledging seismic networks properly at present because they are already in operation: DOIs are well known in the scientific community and widely accepted by publishers. Moreover, good DOI metadata, describing geolocation, time frames, and data types in a generic format, assist users outside seismology to discover data using search tools such as the DataCite service (<http://search.datacite.org/ui>).

How It Will Work

Since 2014, FDSN and data centers have linked DOIs to individual temporary experiments and named permanent seismic networks having FDSN-allocated

network codes. Seismic network operators can choose for their network a DOI issued by any DOI-minting agency, such as a national library, their hosting data center, or the FDSN.

The FDSN recommendation requires that author, publication year, title, and publisher information be included in DOI metadata, following the DataCite model of data sets [*DataCite Metadata Working Group*, 2013]. This

basic information is needed for citing an object, whether it be a data set or traditional article, in a published scientific article.

The citation text should be prepared automatically from the DOI metadata in a consistent format. As examples, we are now able to cite existing networks [GEOFON Data Centre, 1993; Asch *et al.*, 2011; Scripps Institution of Oceanography, 1986] in AGU's house style with their functioning DOIs, as shown in the reference list to this article.

Additional generic metadata, including geographical information, organizations and individuals involved in the distribution chain, and links to resources such as publications and technical reports can be provided in the DOI metadata for a particular network. The best-known use of the DOI system is termed "resolution," which takes users to a landing page on the Internet that houses metadata along with some pathway to the data themselves.

For a seismic network, FDSN recommends that a landing page include at least a station list with locations, channel information, periods of data collection, and information on how to retrieve the data (see http://bit.ly/GEOFON_example for the GEOFON network, a German global seismological broadband network). FDSN has created a public DOI registry that will assist authors in finding DOIs associated with one or more specific network codes.

Another FDSN service will prepare standard citation texts for networks (see <http://www.fdsn.org/networks/citation/>). DOIs and other persistent identifiers are being included in seismological metadata (StationXML), making discovery of seismic network DOIs easier and supporting future persistent identifier usage.

A Cultural Change

We encourage network operators to consider the implications for their networks and to ensure, with the possible assistance of FDSN, that DOIs are issued with associated landing pages and helpful metadata, facilitating their discovery. We expect that citation of seismic network DOIs will gain steam as more operators provide DOIs and produce high-quality landing pages. Authors can then cite seismic data as they do traditional articles.

In practice, authors need only provide a list of network codes and years for the seismological data used to the FDSN-operated Web service. The resulting citation list can be included in the scientific paper reference list. The next steps required remain largely cultural, as scientists learn to cite data sources as standard practice.

Editors and referees should check that submitted manuscripts reference seismic

networks appropriately, ideally using a data citation as outlined above, just as they presently check that literature is cited correctly. Journals are encouraging data citations and should drop arbitrary restrictions on the maximum number of allowed references. Online-only citations could help avoid unwieldy reference lists.

A Huge Step Forward

Assigning DOIs for seismic networks and project deployments is a major step toward agreement within the seismology community on common standards for acknowledging large data objects in seismology. Reproducible, verifiable research requires precise identification of the data used.

Seismic networks will be the parent objects needed for more finely grained citation of specific channels and time windows in the future. We anticipate that the growing availability of DOIs for seismic networks will assist the seismology community and encourage other geoscience groups to create citable source data sets.

Ultimately, the new practice will give data providers long-overdue credit for their scientific contributions. Such change can only encourage the generation of more high-quality data.

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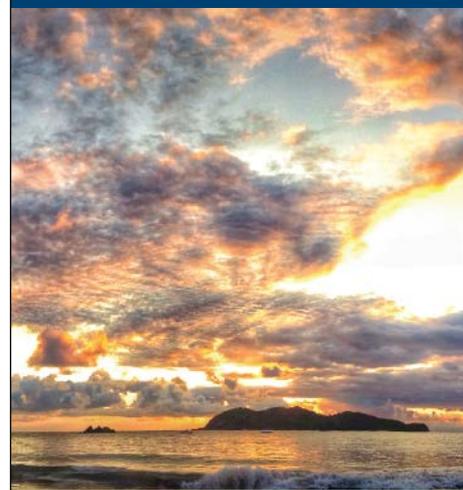
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By **P. L. Evans** and **A. Strollo**, Deutsches GeoForschungsZentrum GFZ, Potsdam, Germany; email: pevans@gfz-potsdam.de; **A. Clark**, **T. Ahern**, and **R. Newman**, Data Management Center, Incorporated Research Institutions for Seismology, Seattle, Wash.; **J. F. Clinton**, Swiss Seismological Service, Eidgenössische Technische Hochschule (ETH) Zürich, Zurich, Switzerland; and **H. Pedersen** and **C. Pequegnat**, University of Grenoble Alpes, ISTerre, Grenoble, France; also at Centre National de la Recherche Scientifique, ISTerre, Grenoble, France



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On the Rocks

The Challenges of Predicting Sea Level Rise

By David Holland and Denise Holland





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One of the most devastating potential impacts of global climate change is a large global sea level rise over the coming century and beyond. This would inundate heavily populated, low-lying coastal areas worldwide—more than 1 out of every 100 people on the planet live less than 1 meter above sea level. The main root of this threat is the potential collapse of West Antarctica’s marine-based ice sheets—massive expanses of glacial ice that rest not on land but the ocean floor—in particular, those where warm ocean waters circulate nearby [Intergovernmental Panel on Climate Change (IPCC), 2013].

Thwaites Glacier in West Antarctica fits this profile (Figure 1). Over this past year, both observational [Rignot *et al.*, 2014] and modeling [Joughin *et al.*, 2014] studies suggest that this collapse has already begun. Against this backdrop, there is a pressing need to calculate robust, credible projections of sea level rise from outlet glaciers such as Thwaites.

However, the unique nature of the West Antarctic physical environment presents both logistical and technical challenges that have held back progress. Here we provide a brief overview of the field of glacier–ocean interaction and suggest steps to advance the projections of sea level change for Thwaites and other key outlet glaciers.

A Rising Tide

Natural and human causes both contribute to global climate change, and it is sometimes challenging to discern whether observed changes are due to one or the other. In the case of glaciers affecting global sea level, however, the IPCC concluded that anthropogenic forcing played a statistically significant role in the retreat of glaciers during the late 20th century [Church *et al.*, 2013]. The regional climate change now occurring in West Antarctica is a pressing concern as collapsing ice shelves, like those on the Antarctic Peninsula, could lead to a larger rise of several tens of centimeters in this century [IPCC, 2013]. Taken together, these IPCC conclusions are a wake-up call.

Projecting sea level change arising from West Antarctica is a challenging science problem and is an equally important societal problem, having deep ramifications for governmental policy on greenhouse gas emissions. A West Antarctic meltdown would transform coastlines, affecting infrastructure and livelihoods in megacities and other densely populated areas around the world. The deluge would also threaten fragile ecosystems such as mangroves, coral reefs, sea grass meadows, and salt marshes—all of which provide the livelihood of many coastal communities.

Sea Level Change Factors

This rise in sea level has already begun. Prior to the 1990s, sea level was largely recorded by tide gauges fixed to coastal structures grounded in the solid Earth, showing over the past 2 centuries a rise of just over 1 millimeter per year. Beginning in the 1990s, satellites have provided near-global altimetry coverage of the ocean. Since then,

Melting icebergs in the Southern Ocean near the Antarctic Peninsula, West Antarctica.

both satellites and tide gauges have indicated a rise of about 3 millimeters per year. Taking into consideration all sea level observations, the seas are not only rising, but that surge is accelerating [IPCC, 2013].

To date, the land ice of West Antarctica has made a small contribution, by way of outlet glaciers, to the observed global rise. But going forward, outlet glaciers, such as Thwaites, are likely to rapidly make large contributions, drowning out all other sources [Mooney, 2015].

Although this meltwater would spread around the globe, the amount of actual sea level rise for a given region depends on many factors. Gravitational changes and effects due to changes in water temperature and salinity lead to nonuniform regional sea level rise. A retreating glacier reduces the burden on the solid Earth below, causing crustal deformations that produce variations in the vertical movement of the Earth's surface, especially near the ice sheets.

Dynamical effects arising from changes in atmospheric pressure also play a role in distributing meltwater, as do geostrophic ocean currents that flow along the lines where pressure gradients are counterbalanced by the Coriolis effect associated with the Earth's rotation.

All of these factors affect the projections of local sea level change that coastal planners must prepare. Planning for a large sea level change, perhaps on the order of 1 meter in a century, requires reliable projections of the contributions from land ice. But the future climate of West Antarctica is uncertain, and the physical factors that govern the collapse of outlet glaciers like Thwaites are poorly understood—in particular, a peculiar glacier instability mechanism likely triggered by warming ocean waters in a changing climate.

Marine Ice Sheet Instability

A marine ice sheet is grounded on bedrock, below the surface of the sea. An ice sheet grows by receiving more snowfall at its surface than it loses by melting and outflow. As it grows in bulk, gravity begins to pull it downslope and into the ocean. Eventually, the leading edge forms a cantilevered ice shelf that floats on the water but remains attached to the anchored part of the ice sheet.

The transition from grounded ice to a floating ice shelf is the grounding line. Inland ice and meltwater that flows seaward past the grounding line make a direct contribution to sea level rise. (Ice that melts or calves from the ice shelf makes effectively no contribution to sea level because the ice is already floating.)

Recent research has revealed a complex situation, as stabilizing and destabilizing factors come into play. For example, gravitational effects close to the grounding line can stabilize the ice sheet. Also, as an ice shelf grows in area and thickness, it can buttress the inland ice, stemming its outflow. If this happens, the grounding line can stabilize or advance, thereby slowing sea level rise. But if the grounding line retreats, sending inland ice further afloat, the shelf may begin a runaway collapse.

Going forward, outlet glaciers, such as Thwaites, are likely to rapidly make large contributions, drowning out all other sources.

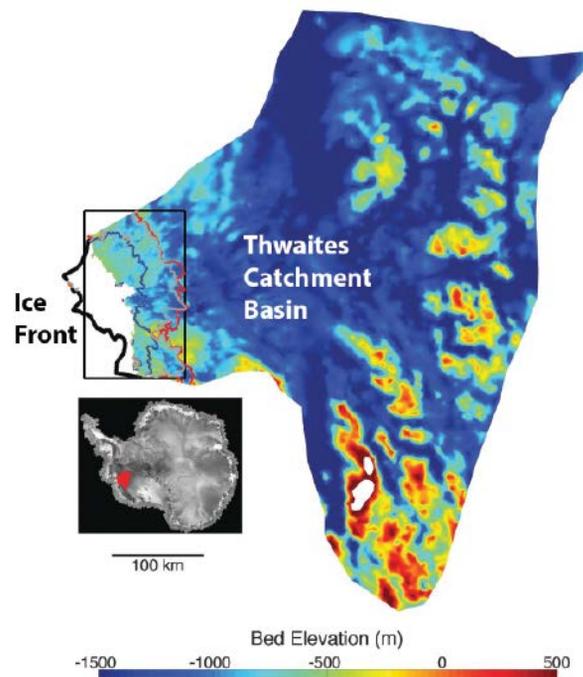


Fig. 1. Subglacial elevations of the bed beneath the Thwaites Glacier, West Antarctica, covering the area shown in red in the inset map in lower left. North is to the left. The thick black outline at center left of the main image indicates the present-day ice shelf front. The dark blue colors indicate the presence of a remarkably deep, marine-based ice sheet, reaching from the ocean to far inland.

As the grounded surface area of the outflowing glacier decreases, so does its friction against the bedrock, allowing it to flow with greater ease. It may also shorten as icebergs begin to calve off, possibly leading to complete shelf disintegration. This allows the inland ice to accelerate its flow into the ocean—and accelerate sea level rise. Indeed, when Antarctica's Larsen B Ice Shelf collapsed in the early 2000s (see http://bit.ly/Larsen_collapse), the inland ice flow sped up nearly tenfold, proving that a mechanical link exists between ice shelf and inland ice sheet.

Some areas of the West Antarctic Ice Sheet are particularly vulnerable to a runaway collapse, where the bedrock deepens inland [Mercer, 1968; Weertman, 1974]. This means the grounding line retreats underneath inland ice that is increasingly thicker, leading to an increase in the volume of ice that flows past the grounding line.

This marine ice sheet instability may have already initiated on Thwaites Glacier [Joughin et al., 2014], as well as on the neighboring Pine Island Glacier [Favier et al., 2014], leading to abrupt and irreversible ice loss, possibly as a response to climate forcing. The Thwaites Glacier (Figure 1) sits over a bowl-shaped depression, or catchment basin, in the ocean floor. The deepest part of this depression is more

Modified from Joughin et al. [2014]. Reprinted with permission from AAAS.

than 1500 meters below the surface of the sea. Thus, the grounding line of the glacier could retreat to this depth if the glacier retreats far enough.

An Ocean Trigger

Amplifying this threat is a potential trigger for this instability that surrounds the region: a mass of warm water known as Circumpolar Deep Water (CDW). Circling the continent via the Antarctic Circumpolar Current, the CDW carries the potential to melt an ice shelf at its base. This would weaken the ice shelf's ability to buttress the inland ice, destabilizing the grounding line and initiating a large-scale collapse [Alley *et al.*, 2015].

At many locations along the continental shelf break, cold polar water pushes back against the CDW, creating a barrier (analogous to an atmospheric weather front) known as the Antarctic Slope Front, which blocks CDW from getting onto the shelf. But this barrier may be ephemeral: Simulations suggest that under some models, climate change may breach it within this century, rapidly melting the ice shelf base [Hellmer *et al.*, 2012] and eventually leading to its collapse. In other locations, such as in front of Thwaites Glacier, the Antarctic Slope Front is already absent, and warm waters flood the shelf, coming in direct contact with the glacier and rapidly melting it [Thoma *et al.*, 2008].

Challenges to Coupled Modeling

Given the potential importance of West Antarctica to future global sea level and our current knowledge of glacier instability, why is there so much uncertainty about its future? The main reason is that there is still no robust, credible model for the interaction of melting ice sheets with the ocean. Scientists have made significant progress in sea level research in general but less so regarding the contribution of glacier-ocean interaction, as the IPCC [2013] report points out.

One reason is the incompleteness of observational data sets upon which such a coupled model could be constructed. Satellite remote sensing has revolutionized the ability to monitor the surface of West Antarctica in recent decades, providing unprecedented streams of data on glacier volume and velocity. But detailed information about the nature of the bed upon which the ice sheet rests has been less forthcoming, and observations of the ocean waters at the periphery [Jacobs *et al.*, 1996] and beneath have been challenging to acquire.

Another gap is theoretical. Outlet glaciers reaching the ocean can disintegrate in two principal ways: melting by warm waters or by calving ice into the ocean. Although there is arguably a reasonable understanding of how outlet glaciers melt, there is a major gap in knowledge concerning the physics of calving. As a rough estimate, half of the current ice loss in West Antarctica is by melting where the glaciers meet the ocean, and half is by calving. In a scenario of rapid retreat, it is conceivable that a large fraction of the loss would be due to calving.

The process of calving is poorly understood; thus, models of that process are dubious, and resulting sea level projections are uncertain. Understanding calving might turn out to be as difficult as understanding earthquakes: a quasi-analogous fracture process that is a notoriously difficult problem.

Another roadblock is the technical and software engineering burden of coupling glacier and ocean models. In almost all IPCC models under climate change forcing, the ocean occupies a fixed geographical volume. This is a historical artifact dating back to the models' formation, when scientists did not envision the need to change ocean volume. Clearly, to simulate ice sheet retreat, simulated oceans must change their vertical and horizontal extents as the ocean invades the space occupied by the ice sheet and receives meltwater from the glacier. This requires extensive reengineering of global climate models.

Improving Sea Level Projections

This reengineering can happen only with cooperation between disciplines. By and large, glaciological modelers have worked on glacier codes using specified ocean forcing, and ocean modelers have worked on ocean codes using specified glacier forcing. These discipline-specific activities serve an important role as international forums for developing and comparing models in the individual fields of glaciology and oceanography. But to arrive at credible projections of global sea level, these two activities must forge an overlap going forward to carry out an interdisciplinary comparison of coupled glacier-ocean models.

To provide coastal planners with credible projections of the rising seas, scientists will need to develop and validate coupled glacier-ocean models, forced under various climate change scenarios. Such models in turn require augmenting observations via both sustained remote sensing and in situ measurements on the glacier and in the water.

To move toward coupled, interactive glacier-ocean models, the Climate and Cryosphere (CLIC) project of the World Climate Research Programme (WCRP) launched a targeted activity focused on modeling of West Antarctica at a meeting held 27–29 October 2014 at New York University in Abu Dhabi. The 30 participants represented a crosscut of glaciological and ocean modelers spanning the international community.

The meeting resulted in the establishment of the Marine Ice Sheet–Ocean Model Intercomparison Project (MISOMIP). This project aims to develop a suite of coupled glacier-ocean model benchmark tests in idealized model configurations, followed by regional simulations of specific outlet glaciers, such as the Thwaites. Further technical details for those interested in participating in the activity are found at <http://bit.ly/MISOMIP>.

Achieving credible projections of sea level change will likely require international cooperation between science and space agencies. This will be a lengthy activity, taking decades to arrive at credible results and requiring significant investment. Given the potential threat to the coastal

Achieving credible projections of sea level change will likely require international cooperation between science and space agencies.

environment, however, there may be little choice other than to move forward with an accelerated, coordinated, and sustained international effort.

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and Xylar Asay-Davis, Potsdam Institute for Climate Impact Research, Potsdam, Germany.

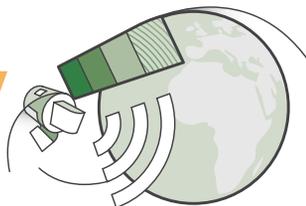
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Author Information

David Holland and **Denise Holland**, Center for Global Sea-Level Change, New York University, Abu Dhabi, UAE; email: david.holland@nyu.edu

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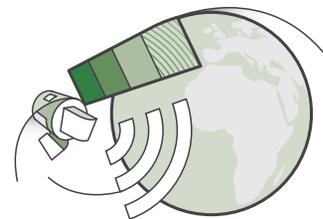
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Urbanization Affects Air and Water in Italy's Po Plain

By Marco Masetti, Son V. Nghiem, Alessandro Sorichetta, Stefania Stevenazzi, Paolo Fabbri, Marco Pola, Maria Filippini, and G. Robert Brakenridge

Satellite and ground-based measurements show a correlation between urban growth and increased levels of pollutants.

Urbanization of a natural landscape can lead to increased levels of pollution—this is well known. However, haphazard development may also produce far-reaching effects, not only in the immediate vicinity but also across regional and perhaps global scales. This presents a potential problem for several eastern and western European countries, where the urbanization rate is 3 times greater than their population growth rate [European Environment Agency, 2006]. Such disproportional changes may have major environmental, socioeconomic, and geopolitical impacts.

We studied the Po Plain region in northern Italy, one of the most populated and urbanized areas in Europe, as a “pilot area” to investigate the environmental effects of urbanization. The Po Plain region (47,000 km²) covers 15% of the surface of Italy and hosts 34% of the country’s total population.

Mountainous topography around the Po Plain limits air circulation with the surroundings. The region is one of the most polluted in Europe, with the city of Milan being a

Urban smog colors the dawn sky over Milan, Italy.

POPLEX's methodologies and results are being published in scientific journals and made available through its website to make the campaign more visible and to encourage a wider community to make use of the newly developed approaches and findings. (More information on this study is available at <http://bit.ly/Masetti>.)

Water Quality and Quantity

Using the QuikSCAT-DSM satellite data, we were able to detect various urban changes—even in areas where urban growth occurred at a relatively low rate. When we used QuikSCAT-DSM data to analyze nitrate in groundwater, we were able to identify a clear, direct relationship between urbanization and nitrate contamination trends.

An analysis of urban and agricultural nitrate sources indicates urban nonpoint sources of contamination as the main cause of groundwater quality deterioration in the area. The data enable a suitable approach to identify and characterize areas showing groundwater quality deterioration—a requirement of European Union Groundwater Directive 2006/118/EC [Stevenazzi *et al.*, 2015a]. On a local scale, we looked for impacts on water quality and water quantity in two case studies in an urbanized area of the eastern Po Plain. The city of Ferrara shows scattered groundwater contamination by chlorinated aliphatic hydrocarbons, caused by improper disposal of petrochemical wastes during the 1970s. We found groundwater contamination below newly developed neighborhoods as a result of the urban sprawling that occurred during the past decade.

These findings help to address human health problems in several ways. For example, deep aquifers used for drinking water can be contaminated because dense nonaqueous-phase liquids tend to migrate through hydraulic barriers like aquitards (underground water barriers made of clay, silt, or rock). Contaminated groundwater can also emit volatile compounds into the air, which can affect indoor air quality of the buildings above the contaminated area.

The Euganean Geothermal Field, one of the largest thermal areas in Europe, demonstrates effects of urban sprawl on water demand. Since the 1950s, more than 400 wells, some as deep as 1000 meters, have been drilled to exploit the warm groundwater for therapeutic and recreational tourism. Increasing demand by spa facilities in the past 40 years has proportionally stressed the thermal groundwater quantity in the region.

Urbanization and Air Pollution

We also investigated how urbanization affects air quality. We carried out analyses to cross compare NO₂ levels taken by the Ozone Monitoring Instrument aboard the NASA

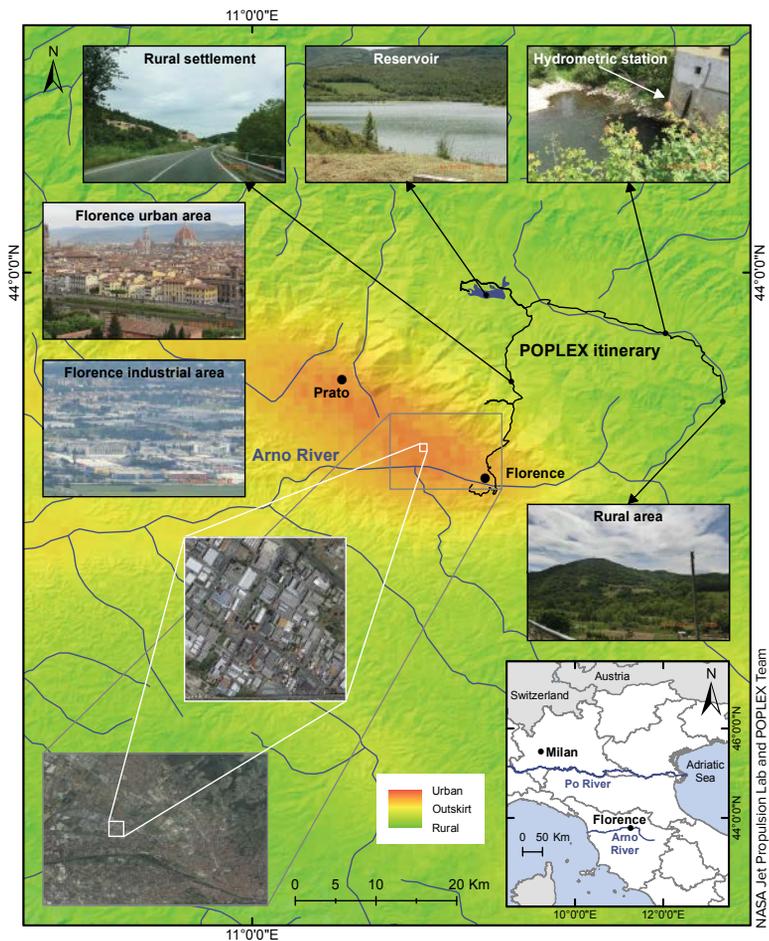


Fig. 2. The POPLEX study covered the central eastern part of the Po Plain, with an extension to Florence in Tuscany (shown here). We plan to use QuikSCAT-DSM observations and field survey in the Florence-Prato Plain to characterize the pattern of newly built-up pockets of urbanization.

Aura satellite with ground-based measurements [Stevenazzi *et al.*, 2015b].

Air pollution seems to be less affected than water pollution by the growth of urban areas, indicating the efficacy of environmental policies adopted in the past 20 years to improve air quality. On a large scale, we observed fair agreement between satellite NO₂ data and observations taken from ground stations, far from NO₂ point sources, that measured the background value.

An analysis of urban and agricultural nitrate sources indicates urban nonpoint sources of contamination as the main cause of groundwater quality deterioration in the area.

On a local scale, areas characterized by the most extensive sprawl showed an increase in air pollution along main roads, related to the increase in vehicle traffic. On weekdays, the highest pollution values are around large cities, where many industries are located, people go to work, and freight traffic is heavy. During weekends and holidays, when commercial activities and traffic are reduced, NO₂ concentration decreases, especially around large cities.

What's Next?

We plan to use satellite and on-the-ground measurements of river discharge along the Po River to investigate how changes in land use influence surface water availability and river regime (a measure of the changes in river discharge). This knowledge could improve our ability to forecast flood hazards exacerbated by urban change.

We will use QuikSCAT-DSM observations and field survey in the Florence-Prato Plain (Figure 2) to characterize the pattern of newly built-up pockets of urbanization. We believe that our study is a successful example of how satellite data tracking land surface changes can be used innovatively in assessing many environmental issues such as groundwater quality and quantity and air quality.

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Author Information

Marco Masetti, Università degli Studi di Milano (UNIMI), Milan, Italy; email: marco.masetti@unimi.it; **Son V. Nghiem**, Jet Propulsion Laboratory, California Institute of Technology, Pasadena; **Alessandro Sorichetta**, University of Southampton, Southampton, U.K.; **Stefania Stevenazzi**, UNIMI, Milan, Italy; **Paolo Fabbri** and **Marco Pola**, Università degli Studi di Padova, Padua, Italy; **Maria Filippini**, Alma Mater Studiorum Università di Bologna, Bologna, Italy; and **G. Robert Brakenridge**, Community Surface Dynamics Modeling System, Institute of Arctic and Alpine Research, University of Colorado, Boulder



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CIDER announces their annual summer program on behalf of the geosciences community (<http://www.deep-earth.org/>). *Organizers:* Michael Manga, Matt Jackson, Abby Kavner, Thome Lay and Barbara Romanowicz.

Geological activity, such as mountain building and volcanism, is ultimately the consequence of the convective mass transport in the Earth's interior. Indeed, the grand unifying theory in geophysics and Earth science—plate tectonics—fundamentally depends on the still poorly understood mechanisms that permit the Earth's interior to flow beneath tectonic plates. Deciphering the three-dimensional structure and time dependence of this flow provides a framework for unraveling the complex, nonlinear interplay of processes that shaped the long-term evolution of Earth. The purpose of CIDER 2016 is to bring together junior and senior scientists from different disciplines to cross-educate each other and help advance this inherently multi-disciplinary question.

The program includes a tutorial program for about 40 advanced graduate students and post-doc (June 27–July 23), while scientists at the assistant professor/researcher level are welcome at any point in the program.

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Celebrating the 2015 Class of Fellows



The new class of AGU Fellows has been selected and will be recognized at the upcoming Fall Meeting in San Francisco, Calif., during the Honors Tribute. The newly elected class will be presented by President-elect Eric Davidson during the Honors Ceremony on Wednesday, 16 December 2015. A brief statement of the achievements for which each of the 60 Fellows has been elected is provided below.



Geoff Abers

For outstanding contributions to our understanding of the subduction process.



Charles J. Ammon

For innovative studies of crustal structure with receiver functions, seminal studies of large earthquakes, and unselfish dissemination of software for seismic analysis.



Gregory P. Asner

For advancing ecology to a continental scale and key contributions in biogeochemistry, biodiversity, and carbon accounting.



Lawrence E. Band

For pioneering digital topographic analysis at multiple scales and leading the interfacing of hydrology and ecology.



Paul Bates

For innovation in two-dimensional hydraulic modelling and its practical applications.



Thorsten Becker

For outstanding contributions to geodynamics at global and regional scales using innovative and interdisciplinary approaches.



Jim Best

For pioneering the investigation of fluid flow and bedforms and field quantification of large rivers, their morphology, and flow structure.



Michael Bevis

For the seminal work in applying geodesy to solving geodynamic problems and for pioneering work that helped establish the new field of GPS meteorology.



Amitava Bhattacharjee

For seminal contributions to our understanding of reconnection processes and turbulence in the solar corona, interplanetary medium, and planetary magnetospheres.



Tami Bond

For outstanding contributions in analyzing black carbon emissions, properties, and distribution and their impacts on climate.



Christopher Bretherton

For fundamental contributions to the understanding of cloud processes and their role in the climate system.



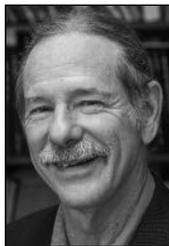
Suzanne Marie Carbotte

For seminal contributions to understanding the global mid-ocean ridge system and the formation and evolution of the oceanic crust.



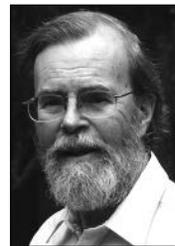
Robert Carlson

For pioneering work in spectroscopy and fundamental contributions toward understanding the compositions and processes of planetary atmospheres and surfaces.



Jeffrey P. Chanton

For contributions in understanding linkages between methane cycling, emissions, and oxidation.



Michael Church

For ground-breaking insights and sustained contributions to fluvial geomorphology and providing a strong foundation for the intelligent management of rivers and watersheds.



Olaf A. Cirpka

For major breakthroughs in the study of mixing-controlled reactive transport and the development of methods for subsurface characterization.



Allan J. Clarke

For pioneering highly influential theoretical and practical contributions in coastal oceanography and tides, equatorial ocean dynamics, and climate.



Todd E. Dawson

For pioneering contributions in ecohydrology and for advancing our understanding of plant, soil, and atmosphere interactions in the hydrologic cycle.



Imke de Pater

For far-seeing discoveries and cutting-edge visions of the dynamic outer solar system made from Earth at nearly every wavelength of light.



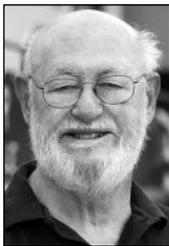
Mark J. Dekkers

For fundamental work on the understanding of experimental rock magnetism, paleointensity, and interpretation of magnetic properties in terms of geological processes.



Georgia (Gia) Destouni

For groundbreaking contributions to transport phenomena in the hydrological cycle at multiple scales.



John W. Farrington

For fundamental work on the biogeochemistry of natural organic chemicals and on the long-term fate of petroleum inputs in the marine environment.



Peter Fox

For fundamental contributions and impact in science knowledge representation and establishing the Earth and space science informatics discipline.



George Gehrels

For transformative development and application of high-bandwidth uranium-lead zircon geochronology to Earth science.



Sarah T. Gille

For exceptional contributions to advancing the understanding of the dynamics of the Southern Ocean and its role in the climate system.



Alex Guenther

For leadership in atmospheric and terrestrial ecosystem biogeochemistry and fundamental contributions on biogenic volatile organic compound emissions, biosphere-atmospheric interactions, and their roles in atmospheric photochemistry.



Jennifer W. Harden

For fundamental contributions to quantitative understanding of soils in global change and carbon cycling.



Mike Jackson

For fundamental discoveries in mineral and rock magnetism and pioneering applications to paleomagnetic and paleoenvironmental research.



José-Luis Jiménez

For shifting the paradigm of formation and chemical evolution of atmospheric organic aerosol.



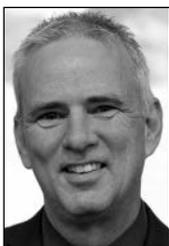
Ian Joughin

For developing and applying new techniques to document, explain, and project changes of the great ice sheets.



Praveen Kumar

For pioneering the field of “hydrocomplexity” to understand the emergent behaviors in multiscale water, climate, and vegetation interactions.



Glen Michael MacDonald

For seminal discoveries on patterns, causes, and impacts of long-term environmental change, especially in North America and the Arctic.



Hugh O'Neill

For measurements of the thermodynamic properties of oxides and silicates and their application to understanding the origin and evolution of the Earth.



Bette L. Otto-Bliesner

For fundamental contributions and expertise in using computer-based models of Earth's climate system to investigate past climate change and climate variability across a wide range of time scales.



Jonathan Taylor Overpeck

For increasing our understanding of paleoclimate through multiproxy approaches and integrating of paleoclimatic perspectives in global change assessment.



Hans W. Paerl

For work on the causes and consequences of key biogeochemical and ecological changes impacting estuarine and coastal ecosystems.



William K. Peterson

For fundamental contributions to understanding the ionization and escape of planetary atmospheres and their involvement in space plasma dynamics.



Robert Pinkel

For outstanding ocean observations and scientific interpretations based on innovative sensors and analyses.



Fred F. Pollitz

For original contributions to understanding the processes responsible for transient deformation following large earthquakes.



Jay Quade

For trailblazing field studies and novel use of stable, radiogenic, and cosmogenic isotopes to age, reconstruct, and understand surficial processes across six continents.



William Randel

For outstanding contributions in understanding the physical mechanisms behind observed variability and change in stratospheric composition and dynamics.



Philip John Rasch

For significant contributions to climate modeling and advancing the understanding of impacts of climate change on the Earth's system.



Lorraine A. Remer

For pioneering a global view of aerosols in our atmosphere and sustained leadership in quantifying aerosol interactions with clouds, climate, and our ecosystem.



Michael Roderick

For seminal contributions to the science of evaporation and transpiration, including interpretation of changes in evapotranspiration under global environmental change.



Daniel Rosenfeld

For seminal advances in discovering and understanding aerosol-cloud-precipitation-climate interactions.



Cynthia Rosenzweig

For fundamental advances in exploring and assessing climate change impacts on the natural and urban environments.



Roger M. Samelson

For insightful use of mathematical methods to elucidate the physics of observed ocean variability and air-sea interaction.



Martha Kane Savage

For groundbreaking work using seismic anisotropy to determine tectonic deformation in the crust and mantle and active deformation of volcanoes tied to their eruptive cycles.



Barbara Sherwood Lollar

For outstanding contributions to understanding the subsurface carbon systems and energy sources required for sustaining life in extreme environments.



Laurence C. Smith

For transformative research in Arctic hydrology, cryosphere processes, climate change, and its societal impacts.



Michael J. Thompson

For seminal advances in understanding the structure and dynamics of the solar interior through application of helioseismology.



Axel Timmermann

For major contributions to the understanding of the El Niño phenomenon, the Atlantic Ocean Circulation, abrupt climate change, and ice ages.



Larry D. Travis

For pioneering excellence in satellite observations of planetary atmospheres and fundamental advances in radiative transfer and multiple-scattering theory.



Peter A. Troch

For groundbreaking contributions to understanding hillslope to landscape-scale hydrological processes.



Scott W. Tyler

For fundamental advancements of desert, river, lake, and glacial processes through novel measurement, theory, and international collaboration.



Jean-Pierre Vilotte

For significant work in introducing quantitative numerical methods from continental collision to seismic wave propagation and rupture dynamics using consistent mechanical and finite-element methods.



Martin Visbeck

For outstanding contributions to ocean circulation and mixing and the role of the oceans in climate.



Yanbin Wang

For pioneering work on synchrotron high-pressure mineral physics.



Guoxiong Wu

For seminal contributions to the understanding of subtropical and monsoon dynamics and the impacts of the Tibetan Plateau on circulation and climate change.



Ping Yang

For significant work on light scattering properties of atmospheric particles, radiative transfer, terrestrial thermal emission, and remote sensing of cloud properties.

Meet the 2015–2016 Congressional Science Fellows

AGU is excited to introduce its 2015–2016 Congressional Science Fellows, Timia Crisp McClain and Michael Glotter. Timia and Michael began their fellowships in September and will work in congressional offices through August 2016.

AGU has supported fellows for the past 38 years, as they use their broad scientific background and their unique knowledge of issues such as climate, energy, and resource management to inform and guide policy makers on science issues. Through the fellowship program, which is administered by the American Association for the Advancement of Science (AAAS), fellows gain firsthand knowledge of the legislative process and explore career paths outside of academia. Although some fellows return to research following their time on the Hill, many stay on as full-time staffers or take on other policy-related roles at think tanks and executive agencies.

Timia Crisp McClain

Timia recently completed her Ph.D. in chemistry at the University of California, San Diego (UCSD). Her dissertation consisted of multiple field studies that analyzed the reactivity of halogenated and acidic gases in the marine boundary layer of the atmosphere. In addition to her academic work, Timia worked with UCSD's Scripps Institution of Oceanography in La Jolla, Calif., to create science exhibits, enhancing communication of current research to the general public. Timia believes that communicating science to a wide audience, includ-



ing policy makers, is necessary for effective policies. Her passion for policy lies in environmental conservation and science education, and she believes that strong STEM (science, technology, engineering, mathematics) education "is essential not only for developing the future scientists of America, but also to create a more science-literate society."

Michael Glotter

Michael received his Ph.D. in geophysics in June from the University of Chicago (UC). While at UC, Michael was able to create a unique doctoral program by taking courses in business and law alongside traditional science coursework. This interdisciplinary approach is important to him because of the varied interests and perspectives needed to solve complex problems like climate change. His dissertation topic, how climate change impacts the global food supply, aptly demonstrates his ability to connect science to societal issues. Michael aspires to work "at the intersection of academia and public policy and help decision makers adapt to new challenges from a changing world."

AGU members interested in applying for next year's AGU Congressional Science Fellowships should visit http://bit.ly/AGU_CSF. Applications for the 2016–2017 term opened on 1 November 2015 and will close on 1 February 2016.



By **Alison Evans**, AGU Public Affairs Intern; email: aevans@agu.org

Visit eos.org/agu-news to read announcements of AGU section and focus group awards.

Donors Can Help AGU Climb to Greater Heights



Adobe Stock

AGU brings many resources to bear on finding solutions to our world's most pressing problems. Foremost are our members, who represent the full breadth of the Earth and space sciences. Aiding those members and other researchers in their work, our highly cited journals reflect the expansive range of cutting-edge research. Our meetings and conferences bring together the brightest minds to share critical new information with one another and to identify areas ripe for collaboration.

With those resources, AGU

- promotes the wise management of our planet based on scientific knowledge,

- builds an inclusive global community of Earth and space scientists who share ideas and solve important problems,
- gives decision makers and the general public sound scientific information to inform the debate on societal issues,

- improves the scientific literacy of the next generation of citizens, and
- develops a continuing flow of the highest-quality scientists to tackle the problems of the future.

Pressing Need

To enable these endeavors, AGU has revitalized its approach to development. Members and donors have stepped up to aid our work, but the need continues to grow.

Last year, our Voluntary Contribution Campaign raised nearly \$400,000 to support programs and initiatives across AGU. A look at who contributed shows that AGU has a very strong base of

Just 37 donors made gifts of \$1000 or more in 2014, equating to 1 out of roughly every 1600 AGU members.

donors. Those supporting AGU with gifts of \$500 or more made up just over 2% of donors and contributed a total of nearly \$200,000 (see Figure 1). Just 37 donors made gifts of \$1000 or more in 2014, equating to 1 out of roughly every 1600 AGU members. Nearly

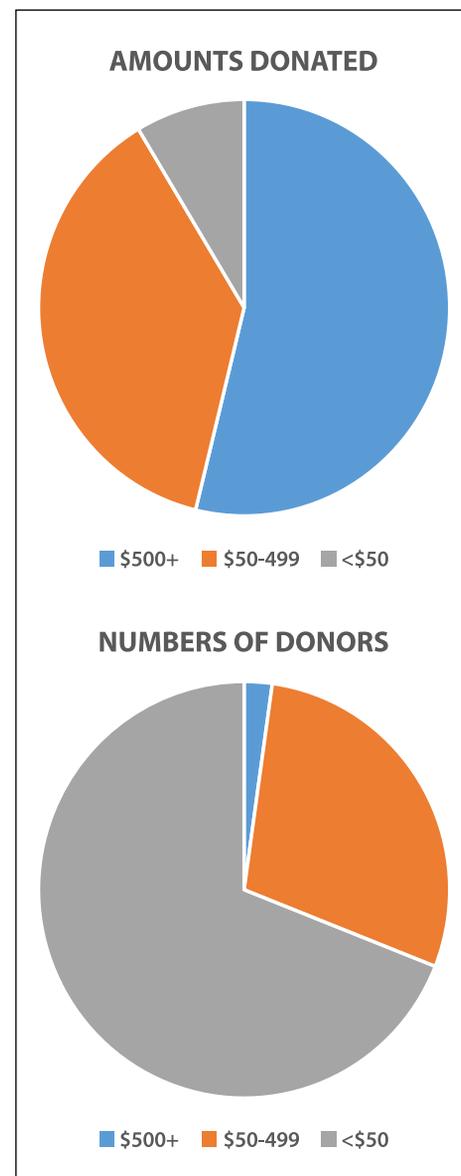


Fig. 1. Most of last year's 4400 donors to AGU gave less than \$50 (gray), providing only 8.6% of total funds received by the organization. The 2.2% of donors who gave more than \$500 each (blue) contributed greater than half (53.80%) of the value of all 2014 donations.

69% of our 4400 donors gave less than \$50, totaling almost \$32,000.

Even with more than 4000 donors, only 7% of AGU members supported AGU with charitable gifts in 2014. What's more telling is that the number of donors has fallen at a

significant rate since 2011, when there were nearly 7500 donors (see Figure 2).

Help us reverse this declining trend! Support AGU and make a difference today. The participation goal for 2015 is 12%, or 7200 donors.

What Can You Do Now?

Supporting AGU programs makes a demonstrable difference in the lives and careers of our members and in the global understanding of scientific advancements and issues.

Student Travel Grants support AGU's student members as they attend and present at their first Fall Meeting. This experience opens the door to fruitful and long-lasting careers, feeding the talent pipeline and ensuring that the next generation of great scientists is well trained and ready for the field. Gifts of \$500 and \$1000

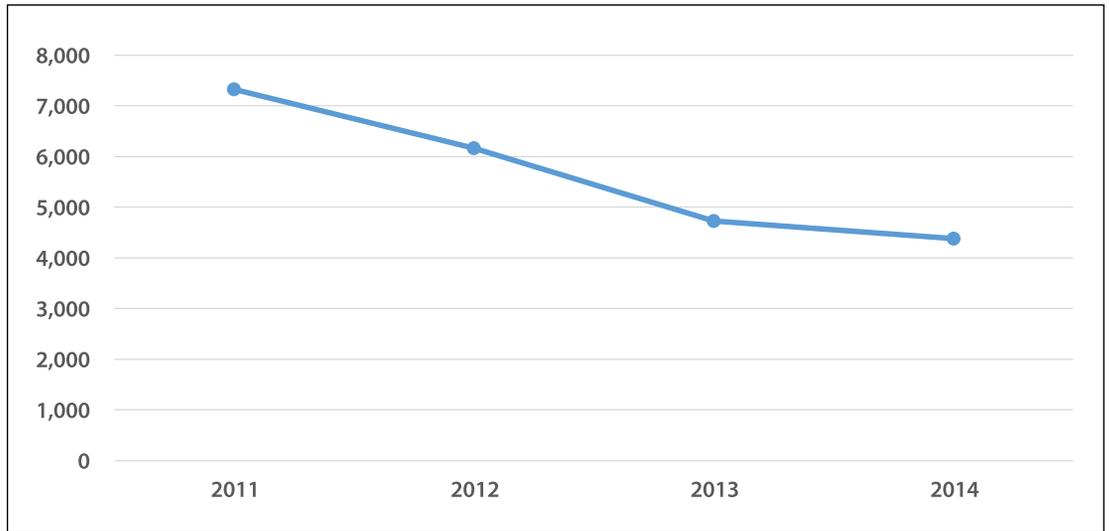


Fig. 2. Following a decline in donor numbers since 2011, when 7500 AGU members donated to the organization, only 7% of members currently support AGU with charitable gifts. AGU has established a new goal for 2015 of 12% of members giving donations. Please support AGU with a gift of any size.

can fund one domestic or international student's attendance, respectively, at a Fall Meeting.

ence in the use of technical information in policy decisions.

AGU's 23 sections and focus groups create and facilitate opportunities for AGU members to network with colleagues in their field, honor luminaries, support the next generation by mentoring students and early-career scientists, and foster scientific discussion and collaboration among their affiliates.

The 2015 Challenge

Many individuals give, but at very modest levels. We challenge all members to consider at least a \$50 contribution in 2015. We realize everyone has different financial situations—some can give more, others less—but we encourage all to make meaningful contributions to ensure the future of our organization and the next generation of Earth and space science leaders.

When you make a contribution, encourage others to contribute as well. If every donor encourages one colleague to follow suit, 2015 will be the most successful fundraising year in AGU's history! To make your gift, visit <http://giving.agu.org>.

By **Jeff Borchardt**, Development Director, AGU; email: jborchardt@agu.org

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Multiple models optimized for ecological, meteorological, solar energy, plant research, and underwater measurements.

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- Water-shedding design
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LI-COR

The Mass Media Fellowship and Congressional Science Fellowship place highly qualified, accomplished scientists and engineers in assignments where they can learn about science communication or policy making and contribute their expertise to those areas. At reputable and well-known media outlets, Mass Media Fellows learn to communicate about science like professional journalists while contributing their expertise to news media coverage. In the offices of members of Congress or committees, Congressional Science Fellows enable more effective use of scientific knowledge in government and get firsthand experi-

Go to Eos.org for the latest news and perspectives.

Probing for Earthquakes' Origins

New Zealand's Alpine Fault, which runs for hundreds of kilometers along the length of the country's South Island, is one of the globe's major geological features. Geological evidence indicates that the fault produces an earthquake of about magnitude 8 every 330 years on average. Given that the most recent earthquake was in 1717, the region is due for another.

A new analysis by *Bourguignon et al.* gives insight into why these earthquakes happen by determining how often and where small temblors occur near the fault. After analyzing data from a network of seismographs— instruments that measure the ground shaking intensity, direction, and duration—along the fault's central portion, the team calculated that the depth distribution and frequency of earthquakes vary consistently with distance from the fault. Quakes that occur just below the fault are scant and deep; those that erupt farther out are more frequent and shallow.

The team detected more than 1300 earthquakes between 2008 and 2010 near the townships of Harihari and Ross. They used these data and seismological techniques similar to those used to produce magnetic resonance imaging (MRI) and computerized tomography (CAT scan) images of human bodies to detail the structure of the Earth's crust next to the Alpine Fault. They concluded that variations in temperature across the Alpine Fault affect the depths of earthquakes and that variations in the rates at which the rocks are deforming control the frequency of earthquakes. Such studies are crucial for understanding the processes and factors that trigger earthquakes. (*Geochemistry, Geophysics, Geosystems*, doi:10.1002/2014GC005702, 2015) —**Julia Calderone, Freelance Writer**



In this true-color satellite photo, snow delineates the escarpment along the Southern Alps on New Zealand's South Island. This escarpment was formed by the Alpine Fault.

Jacques Descloîtres, NASA

International Ocean Discovery Program

CALL FOR APPLICATIONS

Apply to participate in
JOIDES Resolution Expeditions

Application deadline: 15 January 2016

SOUTH CHINA SEA RIFTED MARGIN EXPEDITIONS 367 and 368

7 February - 9 April and 9 April - 9 June 2017

The two South China Sea (SCS) Rifted Margin Expeditions (based on IODP Proposals 878-CPP and 878-Add) aim to understand the mechanisms of lithosphere extension during continental breakup at a non-volcanic rifted margin.

The SCS margin shows similarities to the hyper-extended Iberia-Newfoundland margins, possibly including exhumed and serpentinized mantle within the Continent-Ocean-Transition (COT). However, modeling studies suggest that there can be mechanisms of plate weakening other than serpentinization of sub-continental lithospheric mantle. Two competing models for plate rupture (in the absence of excessively hot asthenospheric mantle) have widely different predictions for development of the SCS margin.

To discriminate between these models, a series of deep-penetration sites will be drilled across a 150–200 km wide zone of highly extended seaward-thinning crust with a well-imaged COT zone. Coring and logging deep/basal sediments and the underlying basement is the primary objective.

The proposed drill sites determine the nature of crust within the COT and constrain (a) post-breakup crustal subsidence, (b) how soon after breakup igneous crust started to form, (c) timing of rifting, and (d) rate of extension. The science objectives can be effectively addressed at these drill sites because of the existing constraints on SCS formation and stratigraphy that include industry drilling, ODP Leg 184 and IODP Expedition 349 drilling, as well as due to the young (Paleogene) rifting of the margin and absence of excessively thick post-rift sediments.

For more information about the expedition science objectives and the JOIDES RESOLUTION Expedition Schedule see <http://iodp.tamu.edu/scienceops/> - this includes links to the individual expedition web pages that provide the original IODP proposal and expedition planning information.

WHO SHOULD APPLY: Opportunities exist for researchers (including graduate students) in all specialties – including but not limited to sedimentologists, structural geologists, petrologists, paleontologists, biostratigraphers, paleomagnetists, petrophysicists, borehole geophysicists, microbiologists, and inorganic/organic geochemists. For shipboard scientist responsibilities see http://iodp.tamu.edu/participants/scientist_jobs.html

WHERE TO APPLY: Applications for participation must be submitted to the appropriate IODP Program Member Office – see <http://iodp.tamu.edu/participants/applytosail.html>

RESEARCH SPOTLIGHT

Cave “Breathing” Affects Mineral Growth and Climate Clues



University of Texas researchers collect a glass substrate used to measure the amount of calcite deposited by cave drip water in Natural Bridge Caverns, Texas.

The impressive mineral deposits that decorate cave interiors contain important proxies for understanding past climate. These upward growing stalagmite columns, icicle-like hanging stalactites, and flowstones (collectively called speleothems) form when water dissolves limestone above the cave and then redeposits it as the mineral calcite in the cave. Scientists are especially interested in these layered deposits because their carbon and oxygen isotope composition and growth rate can reflect past changes in temperature, rainfall, and vegetation above the cave.

Many climate analyses have assumed that speleothem growth is constant throughout the year. Recent research, however, indicates that their growth rates vary seasonally with changing environmental conditions such as temperature, calcium concentration in the water, and concentration of carbon dioxide (CO₂) in cave air. Such seasonal changes in growth may introduce bias into records of past climate.

James *et al.* introduce a new global model that predicts how seasonal cave air flow patterns can influence the growth rates of speleothems. By mapping yearly temperature fluctuations around the world, the team found regions where seasonal ventilation, and thus CO₂ accumulation in cave air, may affect speleothem growth rates. Middle- to high-latitude regions, as well as continental interiors, experience stronger seasonal ventilation patterns than those at lower latitudes and in maritime settings. The model also suggests that as long as water, calcium, and CO₂ inputs remain constant, speleothems in middle- to high-latitude caves will grow more during well-ventilated cool seasons and less during the more stagnant, warm seasons when CO₂ accumulates. In contrast, speleothems in the tropics should grow year-round. These results suggest that the dynamics of cave ventilation should be examined to gain the most accurate climate information from speleothems. (*Geochemistry, Geophysics, Geosystems*, doi:10.1002/2014GC005658, 2015) —Julia Calderone, Freelance Writer

AGU's Career Center is the main resource for recruitment advertising.

All Positions Available and additional job postings can be viewed at <https://eos.org/jobs-support>.

AGU offers printed recruitment advertising in *Eos* to reinforce your online job visibility and your brand.

Contact advertising@agu.org for more information about reserving an online job posting with a printed *Eos* recruitment advertisement.

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STUDENT OPPORTUNITY RATES:

- > No Cost up to 500 characters
- > \$0.16 per character over 500 characters for first issue of publication
- > \$0.16 per character for each additional issue of publication

EMPLOYMENT DISPLAY ADVERTISING RATES (OPEN RATE, BLACK AND WHITE):

- > Full Page: \$5,500.00 net
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- > Third Page: \$1,450.00 net
- > Quarter Page: \$1,090.00 net
- > Sixth Page: \$730.00 net
- > Eighth Page: \$590.00 net
- > To view all employment display ad sizes, visit <http://sites.agu.org/media-kits/files/2014/12/Eos-Employment-Advertising.pdf>

COLOR RATES:

- > One Color: \$315.00 net
- > Full Color: \$980.00 net

- > *Eos* is published semi-monthly on the 1st and 15th of every month. Deadlines for ads in each issue are published at <http://sites.agu.org/media-kits/eos-advertising-deadlines/>.
- > *Eos* accepts employment and open position advertisements from governments, individuals, organizations, and academic institutions. We reserve the right to accept or reject ads at our discretion.
- > *Eos* is not responsible for typographical errors.

* Print-only recruitment ads will only be allowed for those whose requirements include that positions must be advertised in a printed/paper medium.

Atmospheric Sciences

Assistant Professor at Texas A&M University

The Department of Atmospheric Sciences at Texas A&M University is seeking applications for a tenure-track position at the assistant professor level in the field of physical meteorology, with an emphasis on radiative transfer and atmospheric remote sensing. Candidates are sought with research expertise in one or more of the following areas: radiative transfer, atmospheric remote sensing, and applications of remote sensing observations to broader areas such as climate study, physical meteorology, and atmospheric chemistry. A Ph.D. in atmospheric sciences or a related field is required at the time of appointment. Postdoctoral experience is desirable but is not required. The successful candidate will be expected to maintain a prominent research program and to teach courses at the undergraduate and graduate levels.

The Department of Atmospheric Sciences is one of the largest such departments in the U.S., offering degree programs at all levels and research activities across the full spectrum of the atmospheric sci-

ences. Resources available for teaching and research include the Texas A&M Super-computing Center; the Center for Geospatial Sciences, Applications, and Technology; the Texas Center for Climate Studies; and the Center for Atmospheric Chemistry and the Environment.

The Department of Atmospheric Sciences is part of the College of Geosciences, which also includes the Departments of Geology and Geophysics, Geography, and Oceanography. Texas Sea Grant, the Geochemical and Environmental Research Group, and the International Ocean Discovery Program are also part of the College of Geosciences. Texas A&M University, a land-, sea-, and space-grant university, is located in a metropolitan area with a dynamic and international community of over 250,000 people. Texas A&M University is an affirmative action/equal opportunity employer committed to excellence through the recruitment and retention of a diverse faculty and student body and compliance with the Americans with Disabilities Act. We encourage applications from minorities, women, veterans, and individuals with disabilities. Texas A&M University also has a policy of being responsive to the needs of dual-career partners.



Berkeley

University of California

Two Faculty Positions in Earth and Planetary Science

The University of California, Berkeley Department of Earth and Planetary Science invites applications for two positions at the Assistant Professor level with an expected start date of July 1, 2016. We seek outstanding candidates from any area of Earth and planetary science, with an emphasis on climate science, biogeochemical cycles, or Earth surface processes. Candidates whose research falls into one of these broad areas or their disciplinary interfaces are invited to apply.

Applicants are asked to provide their most recently updated curriculum vitae, statement of research interests, statement covering experience and goals in teaching and any experience or aspirations relevant to campus goals for diversity and inclusion, and the names and contact information for three to five referees. Letters of reference will only be solicited for those under serious consideration. A PhD or equivalent degree is required by the date of hire. All applications should be submitted online through <http://apptrkr.com/678813> by December 4, 2015. For questions please contact Crysthel Catambay, HR Analyst, Department of Earth and Planetary Science, e-mail: epsfacultysearch@berkeley.edu.

For more information about the position, including required qualifications and application materials go to <http://apptrkr.com/678813>

The University of California, Berkeley is an AA/EEO employer.

To apply, please send a CV, statement of research and teaching interests, and names and contact information for at least three references to:

Prof. Kenneth P. Bowman
Chair, Faculty Search Committee
Department of Atmospheric Sciences
Texas A&M University
College Station, TX 77843-3150
Email: k-bowman@tamu.edu

The position will remain open until a suitable candidate is found. Initial review of applications will begin on December 1, 2015.

Land Surface Research Scientist

The Jet Propulsion Laboratory, California Institute of Technology, located in Pasadena, California invites applications for a full-time scientist to join the Carbon Cycle and Ecosystems group to manage and conduct research on land surface temperature and emissivity projects and their use of thermal infrared datasets in land surface, atmospheric and climate investigations.

The incumbent will be expected to fulfill a project manager role in leading a NASA MEaSURES project, including assisting with product development and testing. The incumbent is expected to collaborate with other researchers and analyze and interpret data from an array of thermal infrared satellite instruments used to measure land surface parameters, with a particular emphasis on land surface temperature

and emissivity retrievals, and participate in establishing the science foundation and requirements for future space missions. Full salary support is expected to be available for up to three years, during which time the successful applicant is expected to develop an externally funded research program.

Requires a Ph.D. in Physics, Chemistry Atmospheric Science, Planetary Science or related technical degree. An additional three years of related experience is strongly preferred, along with an established reputation as evidenced by a significant record of peer-reviewed publications. Emphasis will be given to scientists with experience in using multi-sensor, multi-platform satellite thermal infrared data from both geostationary and low Earth orbit platforms, and with analysis of the data they produce to carry out investigations of land surface processes and/or climate studies related to the hydrologic cycle. The ideal candidate will have experience with MODIS imaging sensors and other related sensor systems and data sources, such as GOES, VIIRS, ASTER, SEVIRI and other correlative data sets. Experience in organizing airborne deployments and analysis of thermal infrared data acquired from airborne platforms is desirable. Experience in scientific programming, radiative transfer modeling, and statistical analysis is highly desirable.

To view the full job description and apply, visit: [http://Careerlaunch.jpl.](http://Careerlaunch.jpl.nasa.gov/)

nasa.gov/ (Job ID #2015-5691). Applications will be reviewed as they are received, and should include a curriculum vitae, list of peer-reviewed publications, names and contact information of three references, and a statement of research interests. JPL/Caltech is an equal opportunity/affirmative action employer.

The Atmospheric and Oceanic Sciences Program at Princeton University, in association with NOAA's Geophysical Fluid Dynamics Laboratory (GFDL), seeks two postdoctoral or more senior researchers:

1) To analyze observational datasets, including satellite data, airplane reconnaissance data, and reanalysis data, to validate the tropical cyclones (TCs) in weather-scale and subseasonal-to-seasonal (0-90 day) simulations of GFDL HiRAM, of resolutions ranging from 25 (global) to 1 km (refined grid). Topics of interest include the TC thermodynamic structure, rainbands, eyewalls, and convective elements; TC rainfall studies; TC extratropical transition; the interaction between TC and large-scale circulation? short-term forecasts to seasonal predictability.

2) To conduct frontier studies on the genesis mechanism and predictability of severe convective storms over the continental United States using available satellite and radar observations and a newly-developed global cloud-resolving model with refined-

grid capability, for the validation and the ultimate goal of transitioning the prediction capability into operational forecasting.

Each selected candidate must have a Ph.D. in meteorology, atmospheric sciences, or a related field. The candidates will have substantial backgrounds in observations, theory, and/or modeling in tropical meteorology (e.g., tropical cyclones), convective-scale storms (e.g., supercell), and associated analysis skill, to develop tools to aid GFDL model developers in building a next generation multi-scale prediction system for high impact weather events.

The positions are for one year renewable for up to three years pending satisfactory progress and continued funding. Interested candidates should contact Shian-Jiann Lin (shian-jiann.lin@noaa.gov), Jan-Huey Chen (jan-huey.chen@noaa.gov), and/or Lucas Harris (lucas.harris@noaa.gov) for further information.

Complete applications, including a CV, publication list, 3 letters of recommendation, and a one-to-two page statement of research interests should be submitted by December 1, 2015 for full consideration, though evaluation will be ongoing until suitable candidates are identified. Applicants should apply online to <http://jobs.princeton.edu>, Requisition #1500814. This position is subject to the University's background check policy. Princeton University is an equal opportunity employer



Faculty Position in Quaternary Environmental Change

Young and research-intensive, Nanyang Technological University (NTU Singapore) is ranked 13th globally. It is also placed 1st amongst the world's best young universities. The Asian School of the Environment (ASE) at NTU invites applications for a professor (open rank) in Quaternary Environmental Change. The successful candidate would share our interest in quantifying Quaternary and modern sea level variability and environmental change.

Candidates should have an exceptional capacity to characterise and document Quaternary environmental changes using a variety of techniques, for example stratigraphy, geomorphology, micropaleontology, and geochronology. Specific areas of interest include (but are not limited to) quantitative methods to estimate relative sea level and environmental changes, characterizing the relations between climate and sea level change, developing new approaches to reconstructing sea-level motions, and/or relations between long- and short-term sea level change using field and analytical methods. Strong interdisciplinary links with the Earth Observatory of Singapore, the Singapore Centre on Environmental Life Sciences Engineering, and the Complexity Institute provide a community for tackling large, cutting-edge research questions.

Responsibilities include teaching undergraduate and graduate courses and build an extraordinary research program. The person holding this position will play an important role in the expansion of the Asian School of the Environment.

Applications, including the applicant's experience/ philosophy of research, teaching, a CV and contact information for four professional references should be sent to Chairman of Search Committee, NTU, at ASE_EnvChg@ntu.edu.sg

Review of applications will begin on 1 January 2016 and will continue until the position is filled. NTU offers highly competitive salaries and on-campus housing. A start-up package will be available. NTU is an equal opportunity employer.

More information can be found at www.ase.ntu.edu.sg

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Graduate Student Opportunities in Earth, Ocean, and Atmospheric Sciences

Rutgers University's new Institute of Earth, Ocean, and Atmospheric Sciences (EOAS) offers an exciting, interdisciplinary environment for the integrated study of our planet's atmosphere, oceans, cryosphere, solid Earth and biosphere. EOAS's strong research programs include focuses on global climate change, ocean modeling and observations, paleoceanography and Earth history, planetary science, geobiology, marine ecology, molecular ecology, and environmental biophysics. EOAS welcomes applications for graduate study toward a Ph.D. degree in Atmospheric Science, Ecology and Evolution, Geography, Geological Sciences, and Oceanography. For more information and to apply, please visit our website at <http://eoas.rutgers.edu>.

Rutgers is an Equal Opportunity/
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and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability status, protected veteran status, or any other characteristic protected by law.

UNIVERSITY OF NORTH DAKOTA, Atmospheric Sciences, Post-Doctoral Research Associate, Position #24433

The Department of Atmospheric Sciences invites applications for a postdoctoral/research associate position to work on aerosol satellite products, modeling & data assimilation. Applicants should have a Ph.D. in atmospheric science or related areas. Experiences in remote sensing/radiation, Chemical Transport Modeling, or data assimilation are desirable. Knowledge in FORTRAN, C, & IDL are required. The initial appointment is one year and is renewable based on performance & funding availability. Please send your CV, & contact information for at least three references to Dr. Jianglong Zhang (jzhang@atmos.und.edu).

The University Of North Dakota is an Affirmative Action/Equal Opportunity Employer. All qualified applicants will receive consideration for employment without regard to race, color, religion,

sex, sexual orientation, gender identity or national origin. Women, minorities, veterans and individuals with disabilities are encouraged to apply. Applicants are invited to provide information regarding their gender, race and/or ethnicity, veteran's status and disability status on the form found at <http://und.edu/affirmative-action/apcontrolcard.cfm>. This information will remain confidential and separate from your application.

The University of North Dakota determines employment eligibility through the E-Verify System.

North Dakota veterans' preference does not apply to this position.

This position is subject to a criminal history background check.

The University of North Dakota complies with the Jeanne Clery Disclosure of Campus Security Policy & Campus Crime Statistics Act. Information about UND campus security and crime statistics can be found at http://und.edu/discover/_files/docs/annual-security-report.pdf.

North Dakota veterans claiming preference must submit all proof of eligibility by the closing date. Proof of eligibility includes a DD-214 and if claiming disabled status, a current letter of disability (less than one year old) from the Veterans' Administration.

LSU

**ASSISTANT PROFESSOR (TENURE-TRACK)
GEOLOGY AND GEOPHYSICS
COLLEGE OF SCIENCE**

The Department of Geology and Geophysics at Louisiana State University seeks an outstanding individual with expertise in the broad area of geophysics. The specific geophysical research area is open to all subdisciplines of geophysics. However, the individual should be able to work on problems that either build on existing strengths in the Department or advance science in fields that complement these strengths. The position is responsible for teaching undergraduate and graduate courses, and supervising graduate student's research. These courses and research experiences for undergraduate and graduate students may include day-long excursions, weekend trips, and in some cases, trips over extended periods of time at locations that are not on the LSU Main Campus and that these locations might include rugged conditions. Also responsible for service to the Department, College and LSU.

This tenure-track position at Assistant Professor level is intended to complement our existing research strengths, such as Coastal Resilience and Near Surface Processes, Evolution of Sedimentary Basins, Earth Materials and Processes, Planetary Science, Climate and Tectonics, Tectonometamorphism, and Polar Studies. Research in this sub-discipline may also build strength in the LSU campus-wide research focus areas of "Coastal Sustainability and Environment" (CS&E), "Conventional and Renewable Energy" (C&RE), "Core Computing/High Performance Computing" (CC/HPC), and "Materials Science and Engineering" (MS&E). Nominations or inquiries should be directed to Geophysics Search Committee, at 225-578-3353 or geology@lsu.edu.

LSU is designated a Carnegie Research I University and one of a handful of distinguished universities to enjoy Land, Sea, and Space Grant status. The Department of Geology and Geophysics currently consists of 17 tenure-track faculty members having a wide range of geoscience expertise covering field, experimental, analytical and theoretical components. We offer degrees in Geology at the B.S., M.S., and Ph.D. levels. The Department has a strong record of success in research and graduate training, synergistic interactions with other academic units at LSU, federal and industry-funded research and teaching programs, and a large and active alumni base. (See <http://geology.lsu.edu> for more information.) Opportunities for a broad range of research interactions are available within the department and throughout the university. The university actively promotes interdisciplinary research clusters including coastal sustainability and environment, conventional and renewable energy, core computing / high performance computing, and materials science and engineering. (See: <http://research.lsu.edu> for more information).

Required Qualifications: Ph.D. in Geology, Geophysics or other relevant disciplines. The successful candidate will be in the process of developing an internationally recognized scientific reputation, and will be expected to maintain a high-level, externally funded research program, mentor and support graduate students, publish in highly ranked journals, and provide leadership both on campus and beyond. A.B.D. candidates will be considered as long as the degree is conferred by the effective date of the appointment, August 2016.

Special Requirements: Willingness and ability to travel internationally or domestically.

Applications are to be submitted on-line. The application package should contain an application letter, a CV, a teaching statement, a research statement, and the names and contact information of at least three persons who can provide letters of reference to lbond3@lsu.edu.

Applicants for this position should articulate in their application letter how they will help LSU attain its goals as stated in Flagship 2020:

Discovery: Expand discovery through transformative research and creative activities addressing contemporary and enduring issues that shape the way we live in the world

Learning: Enhance a faculty-led and student-centered learning environment that develops engaged citizens and enlightened leaders

Diversity: Strengthen the intellectual environment by broadening the cultural diversity of the LSU community

Engagement: Promote engagement of faculty, staff and students in the transformation of communities

Offer of employment is contingent upon verification of individual's eligibility for employment in the United States. All offers of employment, oral and written, are contingent on the university's verification of credentials and other information required by federal law, state law, and LSU policies/procedures, and will include the completion of a criminal history check. The review process will begin January 8, 2016, and continue until a candidate is selected. Apply online and view a more detailed ad at: <https://lsusystemcareers.lsu.edu> Position #030923.

LSU IS COMMITTED TO DIVERSITY AND IS AN EQUAL OPPORTUNITY/EQUAL ACCESS EMPLOYER

Quick link at ad URL:
<https://lsusystemcareers.lsu.edu/applicants/Central?quickFind=59923>

UNLV

**Sedimentary Geology
Assistant Professor**

The University of Nevada, Las Vegas invites applications for a Sedimentary Geology, Assistant Professor (16096).

UNLV is a comprehensive research university of approximately 29,000 students and 3,300 faculty and staff dedicated to teaching, research, and service. The university has internationally recognized programs in hotel administration and creative writing; professional degrees in law, architecture, and dental medicine; and leading programs in fine arts, sciences and education. UNLV is located on a 332-acre main campus and two satellite campuses in dynamic Southern Nevada. For more information, visit us on-line at: <http://www.unlv.edu>.

For this tenure-track position, preferred research areas include, but are not limited to, sedimentary basin evolution with applications to tectonics or Earth-life-environment interactions across critical transitions in Earth history. We are particularly interested in individuals who integrate field investigations with innovative geochemical, geochronological, or other analytical techniques to pursue interdisciplinary research. The successful candidate is expected to establish a vigorous externally funded research program; teach effectively at both undergraduate and graduate levels including undergraduate field courses; and perform service duties at all levels.

This position requires a Ph.D. in Geology from a regionally accredited college or university by the start of the appointment.

For a position description and application details, please visit <http://jobs.unlv.edu> or call (702) 895-3504.

EEO/AA/Vet/Disability Employer

Please submit a copy of the DD-214 and other veterans' preference qualifying documentation to the Office of the Provost.

Biogeosciences

We are seeking a postdoctoral scholar to work with Dr. Elisabeth Hausrath at UNLV on algae-microorganism-mineral interactions. Responsibilities of the position will include:

- Sampling in remote field environments of mineral, snow, algae, and bacteria,
- Analysis of collected biological and geologic samples
- Growth experiments of snow algae and microorganisms in the presence of minerals
- Presenting work at conferences and writing manuscripts for publication in peer-reviewed journals

Desired attributes include significant experience performing laboratory and field work, a strong geochemical and microbiological background, and experience with fine scale analytical techniques, with experience with synchrotron techniques a plus. The ideal candidate will also have strong critical thinking, problem solving and communication skills, with the ability to work both independently and collaboratively. Requirements include a PhD at the time of appointment. The successful candidate will receive mentoring in scientific skills, manuscript and proposal writing, teaching, and other career skills. Competitive salary and benefits. For information about our ongoing research programs please see our website here: <http://faculty.unlv.edu/hausrath/index.htm>.

To apply, please submit by December 18, 2015: a cover letter describing research experience and interests, a detailed CV listing qualifications and experience, and the names, addresses,

and telephone numbers of at least three professional references who may be contacted. Materials should be addressed to Dr. Elisabeth Hausrath, postdoctoral mentor, and are to be submitted via on-line application at <https://hrsearch.unlv.edu>. For assistance with UNLV's on-line applicant portal, contact UNLV Employment Services at (702) 895-3504 or applicant.inquiry@unlv.edu. EEO/AA/Vet/Disability Employer

Geochemistry

Postdoctoral Fellowship Positions in Geochemistry, Cosmochemistry, and Astrobiology

Carnegie Institution, Department of Terrestrial Magnetism, Washington, DC

Openings are available beginning Fall 2016 for postdoctoral fellowships in the fields of geochemistry, cosmochemistry, and astrobiology that provide support for creative independent research of the applicant's choosing. Details on DTM research staff, laboratory facilities, and ongoing research can be found at dtm.carnegiescience.edu. Fellowships are for one year and are normally renewable for a second year.

Applications should be submitted online at <https://jobs.carnegiescience.edu/jobs/dtm> and should include a curriculum vitae and list of publications, description of thesis research, a short (2-3 page) statement of research plans for the fellowship period, and three letters of recommendation by those familiar with your work. Submission details are available when you click on "Apply Now." Creativity in the proposed research figures heavily in the evaluation of the application. Review of the applications will begin on December 1, 2015. Address any questions you have to [\[dtm.ciw.edu\]\(mailto:dtm.ciw.edu\). Carnegie Institution is an Equal Opportunity Employer. All qualified applicants will receive consideration for employment and will not be discriminated against on the basis of race, gender, race/ethnicity, protected veteran status, disability, or other protected group status.](mailto:geochemfellowship@</p>
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W. O. Crosby Postdoctoral Fellowship, MIT

The Department of Earth, Atmospheric and Planetary Sciences at the Massachusetts Institute of Technology (MIT) invites applications for the W. O. Crosby Postdoctoral Fellowship. The fellowship supports exceptional early-career scientists with research interests in the fields of geology, geochemistry, or geobiology. Crosby Fellows pursue independent research but are encouraged to collaborate with one or more researchers in the department. A faculty mentor hosts each fellow. Prospective fellows are encouraged to contact members of the department to discuss possible collaborations. The fellowship term is two years, contingent on good progress during the first year, and includes an annual stipend of \$62,000 plus an allowance of up to \$7,000 per year for research, relocation and health care expenses. Fellows are eligible to participate in MIT's Affiliate health plan. The start date of the fellowship is flexible, but should ideally fall between June 1, 2016, and January 31, 2017. Applicants must have obtained a Ph.D. by the start date, but not more than three years before the start date.

Applications are due by December 1, 2015, and must include a curriculum vitae, a list of publications, a two-page plan of research to be conducted during the fellowship, and three reference letters. A description of the application process is at <http://eapsweb.mit.edu/crosby>

MIT is an equal employment opportunity employer. All qualified applicants will receive consideration for employment and will not be discriminated against on the basis of race, color, religion, sex, sexual orientation, gender identity, national origin, veteran status, or disability.

Hydrology

Postdoctoral Scholar, Soil Moisture Remote Sensing

The California Institute of Technology (Caltech), Postdoctoral Scholars Program at the Jet Propulsion Laboratory (JPL) invites applications for a postdoctoral research position in JPL's Surface Hydrology Group in its Earth Science Section.

The research will involve conducting research using data from the recently launched Soil Moisture Active Passive (SMAP) mission. Dr. James Famiglietti, Senior Water Scientist in JPL's Earth Science Section, will serve as JPL postdoctoral advisor to the selected candidate. The appointee will carry out research in collaboration with the JPL advisor, resulting in publications in the open literature.

Candidates should have a recent PhD in Hydrology/Remote Sensing or related sciences with a strong background in water-related modeling, remote sensing and analyses of hydrologic data. Experience with soil moisture remote sensing data, hydrological modeling and their integration is highly desirable. Candidates who have received their PhD within the past five years since the date of their application are eligible.

Postdoctoral Scholar positions are awarded for a minimum of one-year period and may be renewed up to a maximum of three years.

Please email a statement of research interests, a curriculum vitae



Be inventive.

Looking for a postdoctoral or sabbatical research opportunity? The CIRES Visiting Fellows Program attracts scientists from around the world. Many postdoctoral Fellows have gone on to careers at CIRES, NOAA, and other prestigious academic, government, and private institutions. We select Visiting Fellows who work on a wide range of environmental science topics, and we place great value on interdisciplinary research. Candidates are strongly encouraged to contact CIRES in advance of the January 11, 2016 deadline.

More: <http://cires.colorado.edu/visiting-fellows>

Lindsay Chipman
Postdoctoral Visiting Fellow, 2012-2013
Center for Limnology,
Cooperative Institute for Research in Environmental Sciences

Be Boulder.
University of Colorado Boulder

and the names and contact information for three references to

Name: James Famiglietti

E-Mail: James.Famiglietti@jpl.nasa.gov

Review of applications will begin on November 15, 2015.

Caltech and JPL are equal opportunity/affirmative action employers. Women, minorities, veterans, and disabled persons are encouraged to apply.

TENURE TRACK POSITION IN HYDROLOGY/SURFACE PROCESSES INDIANA UNIVERSITY

The Department of Geological Sciences at Indiana University invites applications for a tenure-track faculty position in hydrology or surface processes at the rank of Assistant Professor. Applicants' areas of research expertise may include, but are not limited to: fluid processes within the critical zone, surface and groundwater flow, catchment-scale hydrology, landscape evolution, physical surface processes on earth and other planets, tectonic geomorphology, computational modeling in any of these fields and the study of their connections to global climate. We seek individuals whose research complements one or more of our strengths in sedimentation and stratigraphy, near-surface processes and environmental geosciences, geophysics and tectonics, geochemistry, and atmospheric sciences. Our departmental research and teaching resources include a premiere Geologic Field Station and the instrumented Willow Creek Watershed in Montana, extensive analytical instrumentation, GIS and remote sensing facilities, coupled with exceptional campus infrastructure for high performance computing, and engagement with the Integrated Program for the Environment. Successful candidates, who must hold a PhD degree by the time of appointment, are expected to develop a strong, collaborative, externally funded program, to supervise research by graduate and undergraduate students, and to teach both undergraduate and graduate courses in their fields of expertise.

Please submit a cover letter, a curriculum vitae, statements of teaching and research interests, the names and email addresses of three individuals willing to provide reference letters, and electronic copies of up to five relevant publications. General inquiries should be addressed to search_geol15@indiana.edu and specific questions should be referred to the Chair of the Search Committee, Professor Simon Brassell (simon@indiana.edu) or sent to Geology, 1001 E. Tenth Street, Bloomington, IN 47405. Applications should be completed online via <http://indiana.peopleadmin.com/postings/1924>. Review of applications will begin November 1, 2015, and continue until the position is filled.

Indiana University is an equal employment and affirmative action employer and a provider of ADA ser-

vices. All qualified applicants will receive consideration for employment without regard to age, ethnicity, color, race, religion, sex, sexual orientation or identity, national origin, disability status or protected veteran status.

Ocean Sciences

Environmental Science/coastal processes and sustainability.

The Department of Earth and Environmental Sciences at California State University East Bay invites applications for an assistant professor tenure-track position in Environmental Science to begin in Fall 2016. The successful candidate will be broadly trained in Environmental Science with a specialization related to sustainability and coastal systems, such as effects of climate change, sea level rise, coastal/marine renewable energy, etc. The person filling this position should be qualified to teach a range of undergraduate courses in the department's growing Environmental Science program, and courses in the candidate's area of expertise. Candidates with expertise and advanced degrees in Earth science, environmental science, oceanography, atmospheric science, climatology, etc. are strongly encouraged to apply. Applicants should have a Ph.D., outstanding teaching skills, and a commitment to pursue an active research and teaching program in partnership with other faculty engaged in sustainability issues at CSUEB. Review of applications will begin October 15, 2015, and the position will be considered open until filled (applications after October 15 will be accepted). Please see the full position announcement at the department's web site: www20.csueastbay.edu/csci/departments/earth/index.html. CSUEB is an Equal Opportunity Employer.

Marine Microbiologist - Florida International University

The Department of Biological Sciences at Florida International University (<http://biology.fiu.edu/>) in Miami, FL is seeking applicants for a tenure track Assistant Professor position. The successful candidate will be expected to maintain an externally funded research program, supervise graduate students in our Ph.D. program, and teach upper level undergraduate and graduate level courses in areas of expertise in addition to rotation in teaching General Microbiology. Candidate will also be expected to conduct research including but not limited to: bacterial pathogenicity, virology, microbial genomics, and environmental microbiology. Position requires a Ph.D. in Oceanography, Microbiology or a closely related field. To apply, please send a cover letter, curriculum vitae, a summary of research interests and teaching goals to Wilma Dagdag (dagdagw@fiu.edu). Applications should be received by December 15, 2015 to ensure full con-



UMASS
AMHERST

Tenure-Track Faculty Position – Assistant Professor – Hydrology and Water Resources

UMass Amherst, located in Amherst, Massachusetts, sits on nearly 1,450-acres in the scenic Pioneer Valley of western Massachusetts, 90 miles from Boston and 175 miles from New York City. The campus provides a rich cultural environment in a rural setting close to major urban centers.

The Department of Civil and Environmental Engineering at the University of Massachusetts Amherst invites applications for a tenure-track faculty position at the assistant professor level in the area of Water Resources. The appointment is expected to begin September 1, 2016. We seek an individual who can provide innovative solutions to national and international issues of concern including: environmental data science, systems analysis, hydrologic applications of remote sensing, hydroclimatology and adaptation to climate change, risk assessment, environmental restoration, and sustainable water infrastructure.

The Department of Civil and Environmental Engineering has 27 full-time, tenure track faculty members and approximately 120 graduate students and 330 undergraduates. The department's research expenditures exceed \$8 million/year. Additional information about the department can be obtained at cee.umass.edu.

The successful candidate will be responsible for establishing and maintaining a program of externally funded research. We anticipate the successful candidate will build research collaborations within the department as well as throughout the campus, including with the Department of Interior Northeast Climate Science Center housed at UMass. The candidate should have graduate and undergraduate teaching interests that draw from one or more of the following areas: mathematical modeling, statistics, systems analysis, environmental fluid mechanics, hydrology and hydraulics. Applicants must have a Ph.D. in a civil engineering or a closely related field or anticipate such a degree by August 2016. Salary will be commensurate with qualifications and experience.

Candidates should provide the following in their application package:

- (1) statement of interest, teaching and research qualifications, description of research goals and how the candidate's expertise would successfully integrate with department and University strengths;
- (2) current Curriculum Vitae;
- (3) three original research articles or equivalent;
- (4) full contact information for at least four references; and
- (5) a brief abstract for a potential research seminar.

Review of applications will begin on December 15, 2015, and continue until a suitable candidate is identified.

Submit your application materials to:

<http://umass.interviewexchange.com/candapply.jsp?JOBID=64499>

The University is committed to active recruitment of a diverse faculty and student body. The University of Massachusetts Amherst is an Affirmative Action/Equal Opportunity Employer of women, minorities, protected veterans, and individuals with disabilities and encourages applications from these and other protected group members. Because broad diversity is essential to an inclusive climate and critical to the University's goals of achieving excellence in all areas, we will holistically assess the many qualifications of each applicant and favorably consider an individual's record working with students and colleagues with broadly diverse perspectives, experiences, and backgrounds in educational, research or other work activities. We will also favorably consider experience overcoming or helping others overcome barriers to an academic degree and career.

We are seeking talented applicants qualified for an assistant professor position. Under exceptional circumstances, highly qualified candidates at other ranks may receive consideration.



The International Continental Scientific Drilling Program (ICDP) Call for Proposals

The International Continental Scientific Drilling Program, ICDP coordinates and supports multinational endeavours in continental scientific drilling. The program focuses on challenging themes of global geoscientific and socio-economic relevance, including, but not limited to, active faulting, earthquake processes, heat and mass transport, global cycles, cataclysmic events, and the hidden biosphere.

With this announcement, the ICDP invites Earth scientists to submit project proposals in which drilling is required to achieve critical research goals. This call is open to investigators from ICDP member countries (Austria, Belgium, Canada, China, Czech Republic, Finland, France, Germany, Iceland, India, Israel, Italy, Japan, New Zealand, Norway, Poland, South Africa, South Korea, Spain, Sweden, Switzerland, The Netherlands, United Kingdom, United States of America) as well as from countries considering membership in the ICDP. Please note that ICDP provides operational support and allocates co-funding for drilling-related costs only; research grants for the project should be sought from other funding agencies. This concept of commingled funding and international cost sharing, in addition to an exchange of technological capabilities and know-how, has proven very successful over the years.

PROPOSAL PREPARATION

The submission of proposals to the ICDP is normally handled in a 2-step procedure. The first step is the submission of a *pre-proposal* in which a request to hold an ICDP-funded workshop is submitted. The proposal should outline the main objectives, the scientific importance of the planned project, details of the proposed drill site, the expertise of the group of proponents and envisaged international collaboration. The workshop serves to bring together a competitive international research team which can develop a *full drilling proposal*. Principal Investigators should note that they are responsible for planning and running pre-site surveys needed to facilitate the choice of an appropriate drill site. Following a successful pre-proposal and workshop a full proposal can be submitted in a second step.

PROPOSAL EVALUATION

All proposals are evaluated by the Science Advisory Group (SAG) of the ICDP, which makes recommendations to the Executive Committee (EC) based on scientific quality and priority. The EC then reviews technical and financial issues in order to ensure that projects are feasible within the constraints of ICDP's annual and long-range plans. The EC informs the Principal Investigator(s) of the outcome of the evaluation, and states whether further development of the proposal is to be encouraged or not.

ICDP aims to foster joint projects with the International Ocean Discovery Program, IODP. We therefore cordially invite project proposals in which coordinated drilling on land and at sea is required or land-sea transect drilling series are planned ("amphibious projects"). Joint project proposal submission will be accepted by both programs and jointly evaluated.

The deadline for proposal submission to the ICDP, including those for amphibious projects, is **January 15, 2016**. Please submit a digital copy via email of the preliminary or full proposal to:

Uli Harms, GFZ German Research Centre for Geosciences, Telegrafenberg, D-14473 Potsdam, Germany, phone +49-331-288-1085, fax: +49-331-288-1088, E-mail: u.harms@icdp-online.org

Detailed information on the scope of the ICDP, the submission of proposals, proposal format, and the process for development of a successful proposal is available on the ICDP home page at:

<http://www.icdp-online.org/proposals>.

sideration. Position is contingent on funding.

West Chester University of Pennsylvania Assistant Professor in Marine/Coastal Systems Science

Department of Geology and Astronomy invites applications for a tenure-track assistant professor beginning August, 2016 in coastal and marine systems science with expertise in oceanography, coastal/freshwater hydrology, and/or the impact of climate change on coastal and marine systems. The successful candidate is expected to teach graduate, upper-level undergraduate, and general education courses in oceanography and earth systems, and will have the opportunity to develop new courses in the fields of marine geology, coastal and estuarine processes and hydrology. Refer to our complete advertisement at <http://agency.governmentjobs.com/wcupa/default.cfm> (Job# 16-88).

Solid Earth Geophysics

Department of Geography University of Alabama

ALABAMA, TUSCALOOSA 35487-0322. The University of Alabama, Department of Geography invites applications for a tenure-track (9-month) faculty position in physical geography at the rank of Assistant Professor, start date August 16, 2016. This new position will support the continued expansion of our Department including our recent initiative to develop a Ph.D. program. Successful candidates will demonstrate excellence in teaching and research, as well as potential for developing robust, externally-funded research programs that complement one or more of the department's broader research foci including: climatology, coupled human-environment systems, environmental management and change, and human impacts on the environment (see geography.ua.edu). A Ph.D. in Geography or closely related discipline at time of appointment is required. The University of Alabama is rapidly growing (over 37,000 students) and provides excellent faculty support and many opportunities to collaborate with scientists on the Tuscaloosa campus including the new NOAA National Water Center www.nws.noaa.gov/oh/nwc/. Formal Review of applications will begin October 12, 2015, and will continue until the position is filled. Apply online at <https://facultyjobs.ua.edu/postings/37569>. Applicants should be prepared to attach a cover letter, CV (including contact information for at least three references), and statements of research and teaching interests. For additional information, contact the Search Committee Chair, Jason Senkbeil (jcsenkbeil@ua.edu). The University of Alabama is an Affirmative Action/Equal Opportunity Employer and actively seeks diversity among its employees. Minority and

women candidates are especially encouraged to apply.

Position Announcement Department of Marine, Earth, and Atmospheric Sciences

Assistant/Associate Professor- Sedimentary Basin Analysis

The Department of Marine, Earth, and Atmospheric Sciences (MEAS) at North Carolina State University (NC State) intends to fill a junior (Assistant I Associate Professor) tenure-track faculty position in sedimentary basin analysis. Possible research areas include, but are not limited to, the relationship of basin evolution to

mantle processes, linkages of stratigraphy to landscape evolution as a function of tectonics, climate, and sea-level change, the prediction of sub-surface porosity and permeability to model the movement of water and hydrocarbons, and the use of stratigraphy in paleo-environmental and paleo-biological studies. The starting date for this position is 15 August 2016. Candidates that combine surface and/or subsurface observations with numerical simulations, analogue models, or laboratory experiments to investigate the geologic history of sedimentary basins are preferred, and applicants should have a strong interest in interdisciplinary collaborations across and beyond the geosciences.

Applicants must hold a Ph.D. degree in the geosciences or a related field. Postdoctoral experience is preferred, but not required. The successful candidate must demonstrate strong potential for outstanding accomplishments in research, research supervision, and teaching. The successful applicant will be expected to teach an undergraduate-level course in stratigraphy, as well as other undergraduate and graduate classes commensurate with the candidate's interest and expertise. An interest in participating in the Department's capstone undergraduate geology field course also is desirable. MEAS places a high value on excellent instruction and the use of innovative teaching methods.

Affiliated with the College of Sciences at NC State, MEAS is one of the largest interdisciplinary geoscience departments in the nation. Opportunities exist for disciplinary and interdisciplinary interactions with more than 30 marine, earth, and atmospheric scientists. Additional information about the department and its facilities can be found on the web page: <http://www.meas.ncsu.edu>.

Review of applications will begin on 15 November 2015; the position will remain open until filled. Applications, including cover letters, curriculum vitae, teaching and research statements, and contact information for three references must be submitted online at <http://jobs.ncsu.edu/postings/57829>

Founded in 1887, NC State is a land-grant institution distinguished by its

exceptional quality of research, teaching, extension, and public service. Located in Raleigh, North Carolina, NC State is the largest university in North Carolina, with more than 34,000 students and 8,000 faculty and staff. National rankings consistently rate Raleigh and its surrounding region among the five best places in the country to live and work, with a highly educated workforce, moderate weather, reasonable cost of living, and a welcoming environment. A collaborative, supportive environment for business and innovation and research collaborations with area universities and the Research Triangle Park are compelling reasons for relocation to the area. NC State is an equal opportunity and affirmative action employer. All qualified applicants will receive consideration for employment without regard to race, color, national origin, religion, sex, sexual orientation, age, veteran status, or disability. Applications from women, minorities, and persons with disabilities are encouraged.

Tenure-track Assistant or Associate Professor in Economic Geology at the University of Nevada Las Vegas.

The successful applicant will have an active research program that includes a field component that complements existing departmental strengths, and will have a strong commitment to teaching at both graduate and undergraduate levels. The candidate is expected to investigate scientific questions related to economic geology, mineral resources, and/or fluid-rock interaction; to develop new experimental or analytical techniques for ore deposit exploration and genesis; and to communicate results internationally. The candidate is also expected to develop (Assistant), or show evidence for (Associate) a rigorous externally-funded research program and to supervise MS and PhD students. Preference will be given to applicants with research interests in one or more sub-disciplines including high temperature and/or isotope geochemistry, geochemical modeling, experimental petrology, and/or geochronology as they relate to ore deposit genesis. The UNLV Geoscience department has 21 Faculty, more than 50 MS/PhD students, and hosts laboratory facilities including stable isotope, argon geochronology, fluid inclusions, XRF/XRD, ICP-MS, soils, and electron microprobe/SEM labs. Materials should be addressed to Dr. Matthew Lachniet, Search Committee Chair, and are to be submitted via on-line application at <https://hrsearch.unlv.edu>. Review of application materials will begin on 12/11/15 and continue until filled. UNLV is an Affirmative Action / Equal Opportunity educator and employer committed to excellence through diversity.

Two Tenure-Track Assistant Professor Positions in Radiogenic Isotope Geology and Energy Geoscience

The Department of Geological Sciences at The University of Alabama invites applications for tenure-track faculty positions in radiogenic isotope geology and energy geoscience, beginning August 2016, to be filled at the assistant professor level.

Radiogenic Isotope Geology: We seek a candidate whose research focuses on development of radiogenic isotope techniques for geochronology and/or development of non-traditional isotope techniques, particularly using transition metals. Minimum qualifications are a Ph.D. degree in geosciences or related discipline at the time of appointment. The successful candidate will be expected to: (i) build on existing isotope geochemical facilities to develop state-of-the-art laboratories; (ii) institute a vigorous externally funded research program; (iii) develop and teach courses in introductory geology and at the undergraduate and graduate levels in their field of expertise; and (iv) supervise student research projects at the master and doctoral levels.

The Department has a wide variety of analytical equipment, including a fully operational VG Sector 54 TIMS (UA RadIs lab - <http://radis.as.ua.edu>), electron beam instruments, XRD, XRF, ICP, ICP-MS, and an advanced stable isotope laboratory with two CF-IRMSs. Information about the Department is available on our web site at <http://geo.ua.edu>. Applications, which must be submitted electronically at <https://facultyjobs.ua.edu/postings/37452>, will be reviewed beginning January 15, 2016 and will be accepted until the position is filled. Candidates must provide a research statement, teaching statement, and CV with contact information for at least three referees. For inquiries regarding the position, contact Dr. Harold Stowell, Chair of RIG Search Committee (hstowell@geo.ua.edu).

Energy Geoscience: Candidates are invited to apply who have specialties within any field of geoscience pertaining to energy exploration. Scientists with industry experience are encouraged to apply. Candidates must have a strong record of research and must have received a Ph.D. in geology, geophysics, or a related field at the time of appointment. The successful candidate will establish a vigorous, externally funded research program, develop relationships with the energy industry, work closely with the Center for Sedimentary Basin Studies, and attract and advise high-quality graduate students. Teaching responsibilities will include undergraduate and graduate courses in her/his specialty and introductory geology. The department has a broad range of geophysical, geochemical, and computational facilities, in addition to University shared facilities, including the Dauphin Island Sea Lab. Departmental software includes industry standards such as ProMAX, Petrel, TechLog, PetroMod, Move, Petra, Geosoft, ArcGIS, and Matlab. Details

regarding existing research programs, equipment and facilities, and departmental activities are at <http://www.geo.ua.edu>. Questions about this position should be directed to Dr. Fred Andrus (fandrus@ua.edu).

Applicants should go to <https://facultyjobs.ua.edu/postings/37457> to electronically apply for this position. When submitting an application, candidates must provide a cover letter, CV, research and teaching statements, and a list with the contact information for at least three referees. Applications will be reviewed beginning December 7, 2015, and will continue until the position is filled.

The University of Alabama is an equal-opportunity/affirmative-action employer and actively seeks diversity in its employees.

Space Physics

Assistant Professor in Engineering Physics

The Department of Physical Sciences at the Daytona Beach campus of Embry-Riddle Aeronautical University invites applications for a Tenure-Track faculty position in areas of space or ground-based instrumentation & space systems engineering with applications to space, atmospheric, planetary, or earth sciences.

The successful candidate is expected to pursue an actively funded experimental research program, and to teach

and mentor undergraduate/graduate students. The Physical Sciences Department has 30+ faculty members and has expanded its space/upper atmospheric research activities over the past decade. This increased research activity has recently culminated in the founding of the Center for Space and Atmospheric Research. The department is home to one of the leading ABET-accredited undergraduate Engineering Physics programs in the US, as well as expanding BS Space Physics, BS Astronomy & Astrophysics, MS and PhD Engineering Physics programs.

Candidates must have a Ph.D. in engineering, physics, or a related discipline and be available by August 2016. Review of applications will begin in January 2016. Applications should be submitted online at <http://eraucareers.erau.edu>; click on "career search" and search for faculty positions in Daytona Beach. Please refer to job announcement for required materials. All inquiries should be addressed to search chair: Matthew Zettergren, zettergm@erau.edu

Faculty Position in Space Physics at University of Delaware The University of Delaware Newark, Delaware

The Department of Physics and Astronomy (web.physics.udel.edu) invites applications for a position in the field of Space Physics (solar and



Professorship (all levels) in the Biogeochemistry of the Earth Surface System

The Faculty of Geosciences and Environment at the University of Lausanne invites applications for a Professorship in the Biogeochemistry of the Earth Surface System with a particular focus upon biogeochemical cycles at the Earth's surface and their relationships with Earth surface processes. We expect the successful applicant to have:

- a focus on terrestrial and/or freshwater systems, working on processes and timescales that relate to the Present, through the Holocene, to any period during the Quaternary; and
- a multi-method approach including one or more of laboratory based research, field data collection and biogeochemical modelling.

The candidate must have a strong commitment to developing excellence in teaching environmental biogeochemistry at both the undergraduate and graduate levels. Teaching activities will also include participating in doctoral programs and supervising Master and Ph.D. theses and the candidate should have a track record in this area. A good command in English is required and a capacity to teach in French will be required after two years in post.

The successful candidate is expected to have the potential to develop an internationally competitive research program in the field of biogeochemistry, and to interact and create synergies with researchers of the Faculty of Geosciences and Environment.

Appointment is expected at the Assistant Professor level (tenure track), with Associate or Full Professor status within 5-6 years. Direct appointment at the Full Professor level may be considered under exceptional circumstances. The University of Lausanne is an equal opportunity employer. Applications from women are particularly encouraged.

Application deadline: November 30, 2015

Starting date: August 1, 2016 (or to be agreed upon)

Applications are to be submitted by e-mail only in a single pdf file to the Faculty of Geosciences and Environment (bess.gse@unil.ch). An automatic reply will acknowledge reception of the file. In case of problem, please contact gaetan.bertholet@unil.ch. The application material should include:

- a letter explaining the reasons for applying
- a full Curriculum Vitae including the year of birth and the date of thesis with its title
- a list of publications
- a statement of research and teaching goals and interest (not exceeding 3 pages)
- pdfs files of the five most significant publications
- the names and contact information of five referees.

Please note that the maximum file size that can be received by the University of Lausanne e-mail system is 30 Mb. Larger files should be split accordingly and sent sequentially.

For any specific enquiries, please contact Prof. Stuart Lane (stuart.lane@unil.ch) Director of the Institute of Earth Surface Dynamics. Further information about the Faculty is available at www.unil.ch/gse and the Institute at www.unil.ch/idyst.

Faculté des géosciences et de l'environnement
Décanat Géosciences et de l'Environnement

Tél.+41 21 692 35 01 | Fax.+41 21 692 35 05 | francois.busby@unil.ch | www.unil.ch/gse

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Kiel University
Christian-Albrechts-Universität zu Kiel

The Kiel University wants to attract more qualified women for professorships.

The Faculty of Business, Economics and Social Sciences of Kiel University invites applications for the position of a

W2 Professorship (for 5 years) for Political Science with Focus on International Maritime Policy

The professorship shall strengthen the social science competence of Kiel Marine Science (KMS) and will collaborate with the center for interdisciplinary marine research Kiel Marine Science KMS.

Besides internationally visible, peer-reviewed publications and excellence in empirical social research methods, we expect a research focus on maritime questions, such as provision and control of, or conflicts about, international public goods, marine environmental protection, international resource and trade policy, maritime claims, security of international trading routes, marine spatial planning.

The proven ability to do interdisciplinary research and the willingness to cooperate with the Kiel center for interdisciplinary marine research KMS are expected.

The professorship comes with a reduced teaching load of 6 SWS/semesters. The professorship is limited in time for 5 years.

The position is opened with respect to Art. § 61 and § 63 Section 1 of the Higher Education Act of the State of Schleswig-Holstein. For additional information, please refer to the website www.berufungen.uni-kiel.de.

The Kiel University aims to increase the share of female scientists in research and teaching. It thus strongly encourages women with appropriate qualifications to apply for the position. Women with equivalent qualifications, competence and expertise will be given preference. The university also supports the employment of disabled persons. Persons with disabilities will be employed preferentially, if they have appropriate qualification and aptitudes. We explicitly welcome applications from candidates with a migration background. Please refrain from submitting photographs.

Applications (including CV, list of publications and teaching, copies of academic certificates, as well as private and workplace addresses, phone numbers, and e-mail address) are to be sent until **December 11th, 2015** both by regular mail and by e-mail to the Dean of the Faculty of Business, Economics and Social Sciences of Kiel University, 24098 Kiel, Germany (dekanat@wiso.uni-kiel.de)

heliospheric) in the Department of Physics and Astronomy. Applications will be considered for appointment at the level of Assistant Professor (tenure-track) up to Associate Professor with tenure, as determined by experience and qualifications. Experience with observational analysis of space physics phenomena is preferred but not required. Priority will be given to candidates who can complement existing research programs, which include solar, interplanetary, magnetospheric, and cosmic ray physics. The successful candidate will be expected to establish a significant externally funded research program and teach at the undergraduate and graduate levels. Applicants must include a curriculum vitae, publication list, research plan, teaching statement, and arrange for three letters of reference. Review of applications will begin on December 1, 2015 and continue until the position is filled.

Located in scenic Newark, Delaware, within 2 hours of New York, Philadelphia, Baltimore, and Washington, D.C., the University is one of the oldest land-grant institutions in the nation, one of 19 sea-grant institutions, and one of only 13 space-grant institutions. With external funding exceeding \$200 million, the University ranks among the top 100 universities in federal R&D support for science and engineering and has nationally recognized research (Carnegie rated, very high research activity). With 23 academic departments, 27 interdisciplinary programs and centers, and more than 10,000 students, the College of Arts and Sciences is the largest college on campus (www.cas.udel.edu). The University of Delaware is an Equal Opportunity Employer and encourages applications from minority group members and women.

For a complete list of requirements and job duties and to apply online, please visit the UDJOB website at <http://apply.interfolio.com/32054>.

Equal Employment Opportunity
The University of Delaware is an Equal Opportunity Employer which encourages applications from minority group members, women, individuals with a disability and veterans. The University's Notice of Non-Discrimination can be found at <http://www.udel.edu/aboutus/legalnotices.html>. Employment offers will be conditioned upon successful completion of a criminal background check. A conviction will not necessarily exclude you from employment.

TENURE-TRACK ASSISTANT PROFESSOR FACULTY POSITION IN THEORETICAL AND COMPUTATIONAL PLASMA PHYSICS Department of Physics and Astronomy, Dartmouth College

Applications are invited for a faculty position in Theoretical and Computational Plasma Physics, with a preferred starting date of Fall 2016. Consideration will be given to applicants at the

assistant professor level, as well as to more senior exceptionally qualified candidates for appointment at higher ranks. We are interested in a broad spectrum of computational plasma physics areas, including fundamental plasma physics, geospace, solar, heliospheric and astrophysical plasma physics, plasma fusion, and plasma device modeling. Candidates are sought who combine an outstanding research record with a strong commitment to undergraduate and graduate teaching and mentoring. The successful candidate is expected to complement and expand existing theoretical and experimental efforts; please visit physics.dartmouth.edu for additional information. Application material (including: cover letter; current CV with publication record; statement of research interests and plans; statement of teaching interests; complete contact information of at least three professional references) should be submitted electronically to apply. interfolio.com/31594. Application review will begin on January 11, 2016, and continue until the position is filled. Dartmouth College is an equal opportunity/affirmative action employer with a strong commitment to diversity. In that spirit, we are particularly interested in receiving applications from a broad spectrum of people, including women, minorities, individuals with disabilities, veterans or any other legally protected group.

Interdisciplinary/Other

Assistant Professor of Geology and Geophysics Missouri University of Science and Technology

The Department of Geosciences and Geological and Petroleum Engineering invites applications for a full-time tenure-track faculty position in Geology and Geophysics at the Assistant Professor level in petroleum geology with expertise in carbonate reservoirs and basin analysis to begin in August, 2016. Review of applications will begin in November and continue until the search is completed. The successful candidate will be expected to develop an externally-funded research program integrated with excellence in teaching at both the graduate and undergraduate levels with a commitment to interdisciplinary work. Teaching responsibilities will include courses as part of degree requirements as well as in the candidate's area of expertise. The Department currently has 20 full-time faculty, and 371 undergraduate and 309 graduate degree-seeking students with established B.S., M.S., and Ph.D. programs in Geology & Geophysics, Petroleum Engineering, and Geological Engineering. Closely associated departments include Environmental Engineering and Mining Engineering. Local area establishments with active research include the U.S. Geological Survey (Mid-continent Geospatial Mapping Center), Missouri Department

of Natural Resources, Fort Leonard Wood, the Missouri S&T Rock Mechanics and Explosives Research Center, Materials Research Center, and Energy Research and Development Center. Interested applicants should submit a cover letter, a current curriculum vitae, a statement of research and teaching interests and experience, and complete contact information for four references electronically to the Missouri University of Science and Technology's Human Resource Office at <http://hr.mst.edu/careers/academic/>. Applicants should ask for Position Number 00031149 to be included on each reference sent directly to the chair of the search committee, Dr. Wan Yang (yangwa@mst.edu). The final candidate is required to provide copies of official transcript(s) for any college degree(s) listed in application materials submitted, prior to the start of employment. In addition, the final candidate may be required to verify other credentials listed in application materials. Failure to do so may result in the withdrawal of the job offer. All job offers are contingent upon successful completion of a criminal background check. The University of Missouri is an equal access, equal opportunity, affirmative action employer that is fully committed to achieving a diverse faculty and staff. Equal Opportunity is and shall be provided for all employees and applicants for employment on the basis of their demonstrated ability and competence without unlawful discrimination on the basis of their race, color, national origin, ancestry, religion, sex, sexual orientation, gender identity, gender expression, age, genetic information, disability, or protected veteran status.

Assistant Professor, Sedimentary Geology/Paleoclimate

The Department of Geology at Occidental College invites applications for an Assistant Professor in sedimentary geology with a research focus in paleoclimate, paleoenvironmental change, and/or fluvial - coastal processes. Occidental is a nationally ranked liberal arts college recognized for its diverse student body and outstanding undergraduate research program. We seek a colleague who values undergraduate teaching and can sustain an active research program involving undergraduates. In addition to courses related to specialty, the successful candidate will contribute to teaching introductory geology, support the Environmental Science concentration, engage undergraduates in research, and mentor students through completion of senior theses.

Applications should include a statement of teaching and research interests in the context of a liberal arts college. Candidates should specifically address their ability to 1) teach in a socioeconomically, ethnically and culturally diverse environment, and 2) engage students in an ongoing

research program. Submit statement, curriculum vitae, 1-3 significant publications, and contact information for three referees to Dr. Margi Rusmore, Search Committee Chair, at geosearch1@oxy.edu. Members of underrepresented groups are especially encouraged to apply. Review of applications will begin October 15, 2015, and will continue until the search closes on December 22, 2015. Search committee members will meet interested candidates at the GSA and AGU meetings; email the committee to make arrangements.

Postdoctoral Fellowship Positions in Geophysics, Volcanology, Planetary Science

Carnegie Institution, Department of Terrestrial Magnetism, Washington, DC

Openings are available beginning Fall 2016 for postdoctoral fellowships in the fields of terrestrial or planetary geophysics and volcanology. These fellowships provide salary, travel, and research support for creative independent research of the applicant's choosing. Details on DTM research staff, laboratory facilities, and ongoing research can be found at dtm.carnegiescience.edu. Fellowships are for one year and are normally renewable for a second year.

Applications should be submitted online at <https://jobs.carnegiescience.edu/jobs/dtm> and should include a curriculum vitae and bibliography, description of thesis research, and a short (2-3 page) statement of research plans for the fellowship period. Applicants are also encouraged to contact a current staff member to discuss research plans. Creativity in the proposed research figures heavily in the evaluation of the application. Three letters of recommendation by those familiar with your work should also be submitted online. Submission details are available when you click on "Apply Now." Review of the applications will begin on December 1, 2015. Please email any questions you have to geofellowship@dtm.ciw.edu. Carnegie Institution is an Equal Opportunity Employer. All qualified applicants will receive consideration for employment and will not be discriminated against on the basis of gender, race/ethnicity, protected veteran status, disability, or other protected group status.

The O.K. Earl Postdoctoral Fellowship and the Texaco Postdoctoral Fellowship

The California Institute of Technology announces two one-year fellowships in Geological and Planetary Sciences beginning with the 2016-17 Fall term. The O.K. Earl and Texaco Postdoctoral Fellowships are awards funded by endowments from Orrin K. Earl, Jr. and the Texaco Philanthropic Foundation. Each fellowship carries an annual stipend of \$62,000 plus a research expense fund of \$5,000, and one-way travel costs to Pasadena. Completion of

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Kiel University
Christian-Albrechts-Universität zu Kiel

The Kiel University wants to attract more qualified women for professorships.

The Kiel University invites applications for the following position to be filled as soon as possible:

W2 Professorship for Social Science (for 5 years) with Focus on Social Dynamics in Coastal and Marine Areas

Kiel University is establishing a new professorship with a research focus on coastal and marine topics, dealing with societal processes and spatial human-environment-relations. Candidates should be social scientists coming from the fields of Sociology, Human Geography, or related disciplines. His/her work should be based on empirical social research methods.

Fields of research may include: analysis of socio-ecological systems, assessment of vulnerability and resilience of coastal and marine communities, conflict analysis, social inequality, risk management, studies in ecosystem services, marine spatial planning.

The professorship will cooperate in the center for interdisciplinary marine research Kiel Marine Science (KMS). Therefore, the applicant should have experience in conducting interdisciplinary research.

The professorship comes with a reduced teaching load of 6 SWS/semesters. The professorship is limited in time for 5 years.

The position is opened with respect to Art. § 61 and § 63 Section 1 of the Higher Education Act of the State of Schleswig-Holstein. For additional information, please refer to the website www.berufungen.uni-kiel.de.

The Kiel University aims to increase the share of female scientists in research and teaching. It thus strongly encourages women with appropriate qualifications to apply for the position. Women with equivalent qualifications, competence and expertise will be given preference. Applications from scientists with disabilities will be treated with priority in case of equal qualifications. We explicitly encourage candidates with a migration background to apply. Please refrain from submitting photographs.

Applications in English including CV, certificates of academic degrees, a list of publications, copies of up to five of the most important publications, a list of third-party funds raised during the last five years, information about teaching experiences, and a statement about previous and future research interests together with private and academic postal and e-mail addresses and telephone numbers should be submitted by **December 11th, 2015** to the Dean of the Faculty of Mathematics and Natural Sciences, Kiel University, 24098 Kiel, Germany.

the Ph.D. is required. Fellows are eligible to participate in Caltech's health and dental program.

For fellowship details and to apply online, please visit: <https://applications.caltech.edu/job/gpspd>

Materials in support of an application should include curriculum vitae, list of publications, a one-page statement of research interests, and three letters of reference. Applications and references are due by December 1, 2015.

EOE of Minorities/Females/Protected Vets/Disability

The Roy M. Huffington Department of Earth Sciences at SMU announces a search to fill a named tenure-track or tenured professorship (the rank is open) honoring WB Hamilton.

We solicit nominations and applications from earth scientists who maintain vigorous and sustainable research programs and who have a commitment to full participation in the educational mission of the department to provide professional training in a liberal arts environment. As the fourth holder of the chair established in 1921, the successful candidate will extend existing departmental strengths in earth science. The department's focus is on pure research to understand Earth history and geologic processes with applied research on problems in the national interest such as climate and environmental change, earthquake seismology including induced seismicity, natural hazards, nuclear test ban monitoring and resources including geothermal energy. The expected start date is August 1, 2016.

Applications can be submitted electronically to sschwob@smu.edu or in writing to:

Professor John Walther
Search Committee Chair, Department of Earth Sciences,
Southern Methodist University, P.O. Box 0395
Dallas TX 75275

Applicants should include curriculum vitae, statements of research and teaching interests, and contact information for three references. To insure full consideration applications must be received by December 5, 2015, but the committee will continue to accept applications until the position is filled. The committee will notify applicants of its employment decisions after the position is filled.

Southern Methodist University will not discriminate in any program or activity on the basis of race, color, religion, national origin, sex, age, disability, genetic information, veteran status, sexual orientation, or gender identity and expression. The Executive Director for Access and Equity/Title IX Coordinator is designated to handle inquiries regarding nondiscrimination policies and may be reached at the Perkins Administration Building, Room 204, 6425 Boaz Lane, Dallas, TX 75205, 214-768-3601, accessequity@smu.edu.

Hiring is contingent upon the satisfactory completion of a background check.

Two Tenure-Track Assistant Professor Positions in Basin-modeling/Solid Earth Geophysics and Sedimentology

The Department of Geology at Kansas State University invites applications for two tenure-track faculty positions at the assistant professor level beginning in August 2016 in the areas of: (1) sedimentology and/or stratigraphy, (2) basin-scale modeling or solid earth geophysics. A detailed advertisement for both positions is located at www.ksu.edu/geology. Screening of applications begins December 21, 2015 and continues until the position is filled. Full consideration will be given to applications received by December 1, 2015. Kansas State University is an EOE of individuals with disabilities and protected veterans. Kansas State University actively seeks diversity among its employees. Background check required.

West Virginia University, Department of Geology & Geography: Three Assistant Professor Positions

The Department of Geology and Geography at West Virginia University seeks to fill three geology faculty positions. Applicants should have a PhD or equivalent degree in geology, earth science or related field by the start date. Review of applications for all positions will begin January 15, 2016 and continue until each position is filled; start date for all positions is August 15, 2016.

Paleobiology: We seek to hire a full-time (9-month), tenure-track Assistant Professor specializing in Paleobiology, which could include expertise in Invertebrate or Vertebrate Paleontology, Micropaleontology, Paleogeology, Paleobotany/Palynology, Ichnology, or related fields. The successful candidate will be expected to develop a vigorous externally-funded research program, teach core undergraduate classes in paleontology, graduate courses in the area of his/her expertise, and mentor graduate and undergraduate students. Candidates should demonstrate potential to establish a strong externally-funded research program, publish in peer-reviewed journals, and excel in teaching at the undergraduate and graduate levels. To apply, please visit jobs.wvu.edu and navigate to the position title listed above. Upload (1) a single PDF file containing a curriculum vitae, statement of research interests, statement of teaching philosophy, and names, titles, and full contact information for 3 references; and (2) PDF files of up to 3 publications. In addition, arrange for 3 letters of reference to be sent to Paleobiology@mail.wvu.edu. For additional information, please see pages.wvu.edu/Paleobiology or

contact the search chair, Amy Weislogel, at Paleobiology@mail.wvu.edu or (304) 293-6721.

Quantitative Structural Geology or Geomechanics: We seek to hire a full-time (9-month), tenure-track Assistant Professor specializing in quantitative structural geology with interests in the study of fractured reservoirs and geomechanics. The successful candidate will be expected to develop a vigorous externally-funded research program, teach undergraduate classes in structural geology or geomechanics, teach graduate courses in the area of his/her expertise, and mentor graduate and undergraduate students. Candidates should demonstrate potential to establish a strong externally-funded research program, publish in peer-reviewed journals, and excel in teaching at the undergraduate and graduate levels. To apply, please visit jobs.wvu.edu and navigate to the position title listed above. Upload (1) a single PDF file containing a curriculum vitae, statement of research interests, statement of teaching philosophy, and names, titles, and full contact information for 3 references; and (2) PDF files of up to 3 publications. In addition, arrange for 3 letters of reference to be sent to Geomechanics@mail.wvu.edu. For additional information, please see pages.wvu.edu/Geomechanics or contact the search chair, Dengliang Gao, at Geomechanics@mail.wvu.edu or (304) 293-3310.

Teaching Assistant Professor of Geology: We seek to hire a full-time (9-month), non-tenure track Teaching Assistant Professor. The successful candidate will teach a variety of undergraduate courses, including both large introductory and smaller upper-division classes, in the classroom and online, and the field component of the B.S. capstone course, Geology Field Camp (the last with an additional summer stipend). Specialty area is open. Teaching Assistant Professors at WVU are eligible for promotion; however, promotion to senior ranks is not a requirement for institutional commitment and career stability. This position is a nine-month renewable appointment (no maximum number of terms) and includes full benefits. The position carries an 80% teaching (4 courses per semester) and 20% service assignment. The successful candidate will join a faculty that takes great pride in having members recognized at the university, state, and national levels for excellence in teaching. The Department occupies the recently renovated Brooks Hall with state-of-the-art teaching technologies and facilities. To apply for this position, interested candidates should visit jobs.wvu.edu and navigate to the position title listed above. Upload a single PDF file containing a curriculum vitae, statement of teaching

interests and philosophy, teaching evaluations as available, and full contact information for 3 references. In addition, please arrange for three letters of reference to be sent directly to GeologyTAP@mail.wvu.edu. For additional information, please see pages.wvu.edu/GeologyTAP or contact the search chair, Thomas Kammer, at GeologyTAP@mail.wvu.edu or (304) 293-9663.

WVU is an EEO/Affirmative Action Employer and welcomes applications from all qualified individuals, including minorities, females, individuals with disabilities, and veterans. For additional information about the department visit www.geo.wvu.edu.

Student Opportunities

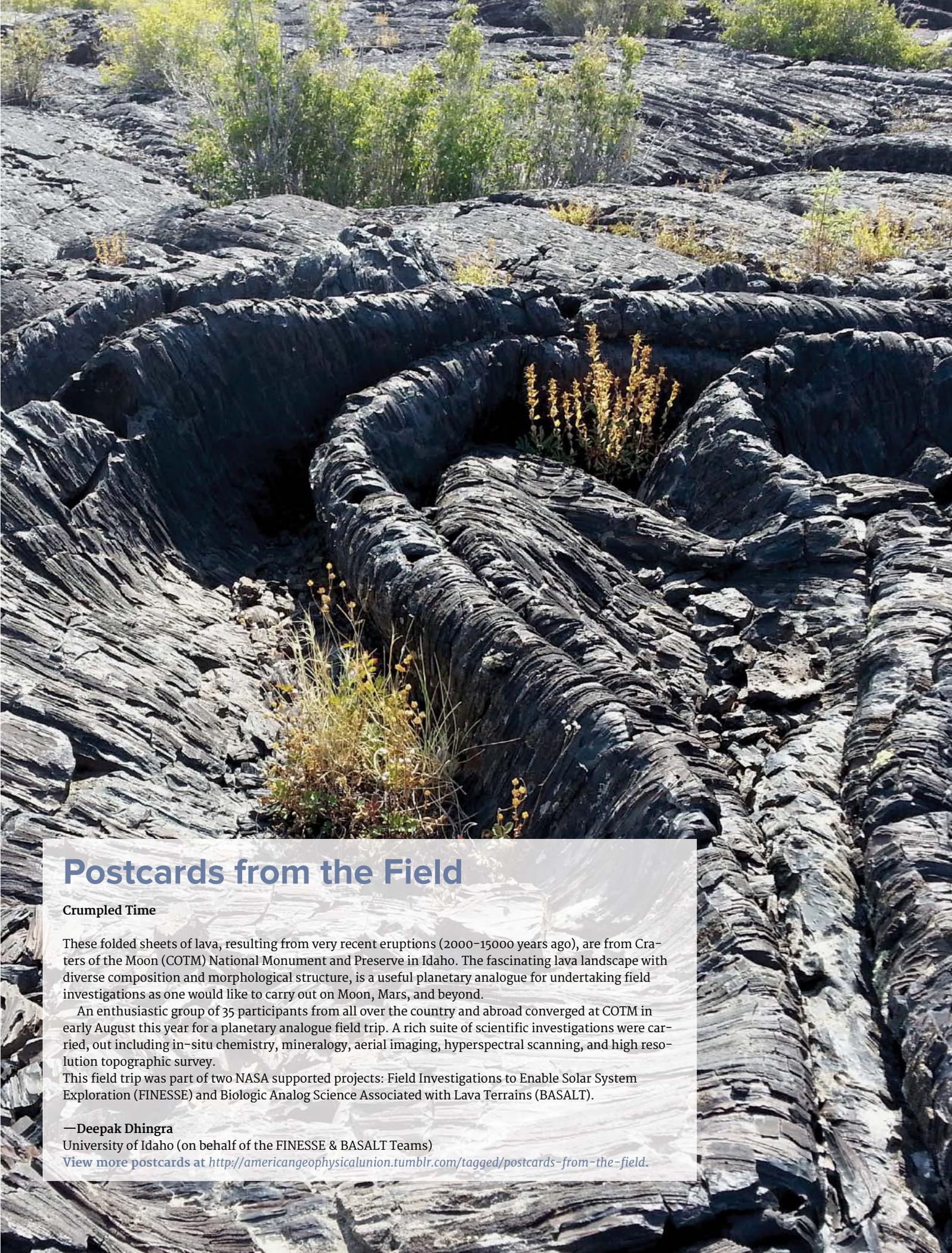
EarthCube's Visiting Scientist Program offers up to \$2000 each to support five graduate students and early career scientists for travel and related expenses incurred while incorporating EarthCube technologies and capabilities in their own research agendas.

For more information or to apply for funding, please go to: <http://earthcube.org/info/visiting-scholar-program>

Lindahl Ph.D. Scholarships: The University of Alabama, Department of Geological Sciences seeks highly qualified Ph.D. students with specializations in topics that complement faculty research interests. Exceptional students will receive Research or Teaching Assistantships and a Lindahl Scholarship totaling \$22,000 for a nine month appointment. The University of Alabama covers the cost of non-resident tuition and fee waivers. Funding is renewable for at least 4 years if expectations are met. Other fellowships are available from the Graduate School on a competitive basis. Further details are at <http://www.geo.ua.edu/>. Applicants should contact Dr. Delores Robinson (dmr@ua.edu) to express interest. Review of applications for Fall 2016 admission will begin January 15, 2016.

PhD Student Opportunity in Hydrology, Washington State University

Four year RA available for student to work with an interdisciplinary team to understand the interactions between drought, forest management, and wildfire on forest ecosystem resilience. Students experienced with Linux/programming and/or ecohydrology will be competitive. The student will be co-advised by Jennifer Adam (WSU) and Christina Tague (UCSB). Interested students should contact jcadam@wsu.edu for more information. Fall semester applications to WSU are due on 10 January for priority consideration.



Postcards from the Field

Crumpled Time

These folded sheets of lava, resulting from very recent eruptions (2000–15000 years ago), are from Craters of the Moon (COTM) National Monument and Preserve in Idaho. The fascinating lava landscape with diverse composition and morphological structure, is a useful planetary analogue for undertaking field investigations as one would like to carry out on Moon, Mars, and beyond.

An enthusiastic group of 35 participants from all over the country and abroad converged at COTM in early August this year for a planetary analogue field trip. A rich suite of scientific investigations were carried out including in-situ chemistry, mineralogy, aerial imaging, hyperspectral scanning, and high resolution topographic survey.

This field trip was part of two NASA supported projects: Field Investigations to Enable Solar System Exploration (FINESSE) and Biologic Analog Science Associated with Lava Terrains (BASALT).

—Deepak Dhingra

University of Idaho (on behalf of the FINESSE & BASALT Teams)

View more postcards at <http://americangeophysicalunion.tumblr.com/tagged/postcards-from-the-field>.

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21–26 February • New Orleans, Louisiana, USA



Housing and Registration Now Open



It's time to register and reserve your hotel in New Orleans for the 2016 Ocean Sciences Meeting, 21-26 February.

**Early Registration Deadline:
31 December 2015**

**Housing Deadline:
28 January 2016**

osm.agu.org/2016/