Letter from the Chair

Dear Alumni and Friends of the Department,

With great pleasure, I invite you to read this Newsletter from the Rice University Department of Earth Science. As you are our ambassadors, I hope that you will find herein something about your Department of Earth Science to share with others including perhaps some of the following.

The Department is thriving. As of this past fall semester we had a total of 80 graduate students and 30 undergraduate majors.

Our faculty continues to be highly recognized for its research achievements. For example since 2000, members of our faculty have received many awards: A Penrose Medal, a Day Medal, a Donath Medal, and a Woollard Award from the Geological Society of America; two Powers Medals from the American Association of Petroleum Geologists; a Shepard Medal from the Society for Sedimentary Geology; two Clarke Medals from the Geochemical Society; an Emile Wiechert Medal from the German Geophysical Society; two Kuno Awards, a Luna Leopold Award, and a Paul Silver Award from the American Geophysical Union; a Ludger Mintrop Award from the European Association of Geoscientists and Engineers; two Packard Fellowships; and three CAREER awards from the National Science Foundation. Three members of the faculty are Fellows of the American Geophysical Union. The Department is consistently ranked in the top 25 Geoscience departments in the country and the Geophysics Specialty is ranked in the top 12.

We will be holding the first Industry Rice Earth Science Symposium (IRESS), which will become an annual recurring event, on January 22 and 23 (2014). The interactions planned for the symposium will strengthen the department's relations to industry and to our many alumni in industry. Our planning and fund-raising for the symposium are moving forward with the involvement of many alumni who are making it happen. Please plan to attend IRESS I and other events including “A Taste of Rice Earth Science: A Preview of the Industry Rice Earth Science Symposia” at 4 p.m. on Friday September 27.

We look forward to seeing you soon!

Sincerely,

Richard G. Gordon
Chair, Department of Earth Science
Department News

Concurrently with the week-long celebration of the Rice Centennial, the Department celebrated its 60th anniversary this past October. It was great to see many alumni and friends of the department there.

Our number of undergraduate majors was at an all-time high this past year at 30, with 9 graduating in May. The quality of our majors is outstanding. They are highly recruited by the best graduate schools in the country. Moreover, this past spring, two of our graduating seniors, Carolyn Branecky and Michelle LaComb, received highly competitive and prestigious National Science Foundation Graduate Fellowships. We are proud of our students!

The Department continues to grow and to explore new horizons. We started the past academic year welcoming Dr. Jeff Nittrouer as a new assistant professor. Jeff’s arrival adds a new dimension to our department looking at sediment processes and hydrology of lowland river systems through field studies and theoretical characterization.

Francis Albarede and Janne Blichert-Toft, geochemists from Ecole-Normale Superieure in Lyon, France continue again this past year as our Wiess visiting professors. Ramon Carbonell from the Barcelona Center for Subsurface Imaging was a visiting professor in spring 2013 to continue working on the PICASSO project with Alan Levander.

This past fall we also welcomed Dr. Steve Danbom back to the department. Steve has contributed to our geophysics courses in the past as an adjunct faculty member, but is now contributing full time to teaching and helping Dale Sawyer to run the Professional Masters program.

In September, we had the dedication ceremony for the National Science Foundation-and Chevron-funded DAVinCI visualization wall at Rice’s Chevron Visualization Laboratory. The dedication ceremony included senior executives from Chevron as well as President David Leebron and Provost George McLendon. The center allows users to display and analyze images of all types from the nano-scale to the galaxy-scale. We anticipate users of the facility to include researchers in Earth science, biomedicine, engineering, art, architecture, and social sciences.

Also in September, Bert Bally started populating and organizing our library on the 2nd floor. Bert donated an outstanding collection of geological books to us, and then led the charge of organizing them. To that end, we are in the process of dedicating the 2nd floor reading room and library as the Albert W. Bally Library. Feel free to visit and check it out. You may even run into Bert! Bert continues to educate us as well through his Map of the Month discussion. Each month Bert posts a new map on the 2nd floor. Then one day during lunch he hosts a mini-lecture and discussion about the map.

The Department also saw changes in the NSF-GeoPRISMS office this year. Julia Morgan entered her third year as GeoPRISMS chair and it was a busy year (www.geoprisms.org). The office added new staff for scientific and program coordination. They also organized multiple planning workshops centered around the GeoPRISMS focus areas which were formulated when GeoPRISMS moved to Rice in 2010. This will be the last year for the GeoPRISMS office at Rice, as the office will move to the University of Michigan in October 2013.
Research Highlights

Our department has strengths in structure and tectonics, geodynamics, igneous and metamorphic petrology, volcanology, environmental geochemistry, paleoclimate and paleo-oceanography, hydrology, sedimentology, stratigraphy, exploration and global seismology, biogeochemistry, and planetary geology. As Earth science continues to evolve, we too continue to evolve as a department. These are exciting times. While we don’t have the space to highlight everyone, here are some snapshots of what our faculty members are doing.

Current Faculty

**John Anderson** chaired the first ever joint GSA Penrose/AGU Chapman Conference "Coastal Processes and Environments Under Sea-Level Rise and Changing Climate: Science to Inform Management" in Galveston, Texas in April 2013. Seventy scientists from eight countries participated. John is also the Academic Director for the Shell Center for Sustainability at Rice University.

**Rajdeep Dasgupta** and his research group published a paper in Nature that shows that the mantle can partially melt at depths up to 250 kilometers below the ocean floor due to the freezing point depression effect of minute quantities of oxidized carbon in the mantle. This helps explain processes related to deep silicate magmas, the asthenosphere and the bulk electrical conductivity of the oceanic mantle.

**Jerry Dickens** and colleagues at Rice led a study that demonstrated the possibility for a massive release carbon from methane hydrate 56 million years ago. This contributed to great climate change. Many are interested in this past event to understand how our modern warming climate may feedback to release of carbon that is currently stored beneath the ocean as hydrate. This work was published in Nature Geoscience.

**Andre Droxler** and Stephen Jorry (a former Rice post-doc) published a review of mixed siliciclastic and carbonate depositional systems in Annual Reviews of Earth and Planetary Science, 2013 5:165–90. They use modern depositional environments to provide quantitative evaluations of reef formation, eustatic sea level, climate changes, and tectonics. This provides a new guide for understanding sedimentary processes and carbonate platform/reef establishment, growth, demise, and rebirth along mixed siliciclastic-carbonate margins. In addition, Andre is the Director of Center for the Study of Environment and Society at Rice University.
Brandon Dugan co-authored a Reviews of Geophysics paper that summarized the history of overpressure analysis and assessed the state of the art in overpressure measurement and modeling. This work has implications for geohazards analysis such as submarine landslides and natural hydraulic fracturing and safe installation of seafloor infrastructure (wellheads, pipelines). It may help define new strategies for assessing pressure and stress related to hydraulic fracturing.

Helge Gonnermann and colleagues published a Nature Geoscience paper that discussed a deep connection (about 50 miles underground) that can explain the behavior of Hawaii’s Mauna Loa and Kilauea volcanoes. This was the first study to model the coupled interaction of these volcanoes and shows how a link in Earth’s upper mantle could account for Kilauea and Mauna Loa’s competition for the same deep magma supply and their simultaneous inflation. In addition, Helge was co-organizer of the 2012 AGU Chapman Conference "Hawaiian Volcanoes: From Source to Surface".

Richard Gordon, students, and colleagues continue to investigate global plate motions and lithospheric deformation including the mysterious deforming zones that he has dubbed “diffuse oceanic plate boundaries”. His recent work includes new determinations of global sets of the relative angular velocities of the plates, in one case determined mainly from marine geophysical data (the MORVEL set of angular velocities) and in another case solely from space geodetic data (the GEODVEL set of angular velocities), both published in Geophysical Journal International.

Cin-Ty Lee published a paper in Science, showing that most of the copper in volcanic arcs is sequestered in sulfides segregated in deep-seated cumulates and that copper deposits form when conditions are right for re-melting of these cumulates. Cin-Ty, together with Adrian Lenardic, Rajdeep Dasgupta, and Jerry Dickens, also published a paper in Geosphere suggesting that long-term climate variability is driven by secular variations in the nature of subduction zones, specifically oscillations between island and continental arc dominated states, the latter driving greenhouse conditions via magmatically induced decarbonation of crustal carbonates.

Adrian Lenardic was co-author on two papers (Geophysical Research Letters; The Astrophysical Journal) that investigated the coupling of mantle convection and planetary tectonics. This work demonstrated that we need historical planetary data to define its tectonic state because history dependence can outweigh the effects of energy content and material parameters. Adrian also published a paper in G-cubed on the role of continent assembly and dispersal in driving strong lateral temperatures differences in the mantle, which in turn generate mantle overturns that may have profound effects on the nature of subduction zones and ultimately climate. Adrian, with Geoff Winningham (Visual Arts), also received a university grant from the Arts Initiatives Fund to develop an interdisciplinary undergraduate course that combines Earth science and visual art in a study of the landscape of Galveston Island and its adjacent wetlands and bays.
**Alan Levander** is finally getting a break after serving as chairman of the department over the last decade, but he seems busier than ever. He is leading an NSF Continental Dynamics project (PICASSO) focused on seismic imaging of the lithosphere and asthenosphere beneath the western Mediterranean with the ultimate goal of constraining the nature and driving mechanisms of lithospheric instabilities. He is also leading an Earthscope project focused on seismic imaging of the volcanic plumbing system beneath the Cascades. Alan has also initiated a pilot project on developing an online undergraduate course on the physics and chemistry of the Earth.

**Carrie Masiello** - Carrie was also lead investigator for a successful Faculty Initiatives Fund proposal that is linking the physical and chemical properties of biochar with biology. Carrie is also leading the Rice Biochar Group (biochar.rice.edu) which is developing new standards and approaches to define and to understand the environmental and energy benefits of biochar.

**Julia Morgan** - The GeoPRISMS Office, under Morgan’s leadership, organized a large international conference to be held at the Te Papa Museum in Wellington, NZ in April. Morgan is also overseeing a new NSF-funded (Department of Undergraduate Education) project to develop new teaching modules for undergraduate geology courses relating to GeoPRISMS (and MARGINS) continental margins science.

**Jeff Nittrouer** published a Nature Geoscience paper where he developed an elegant model for predicting the amount of sand that can be deposited by a river in its lower reaches and how this depositional potential is controlled by the local geometry of the river. He tests this model by taking advantage of human-made spillway structures originally designed for flood control purposes. This model is essential for understanding how sand is redistributed at the mouths of rivers, which has impacts on estuarine ecosystems. This work also has practical applications for coastal subsidence and the impacts of hurricanes on the coastline.

**Fenglin Niu** is leading an NSF-sponsored project entitled NorthEast China Extended Seismic Array (NECESSArray): Deep Subduction, Mantle Dynamics, and Lithospheric Evolution beneath Northeast China. This international collaborative project deployed a total of 127 portable broadband seismographs to study deep subduction of the Pacific plate and intraplate volcanism in the Northeast China.
**Dale Sawyer** prepared and led a 3D seismic reflection and refraction seismic study of the Galicia rifted margin in the Atlantic Ocean offshore of Northern Spain. The 45-day project includes colleagues from the US, UK, Germany, Spain, and Portugal. Dale also is the track director of the Professional Master of Subsurface Geoscience program.

**Bill Symes** (joint appointment in Earth Science and Computational and Applied Mathematics) participated in the Oil and Gas HPC ([http://og-hpc.org/](http://og-hpc.org/)) and gave a detailed introduction to IWAVE. IWAVE is an open-source framework for regular grid finite difference modeling that has been developed by Symes and colleagues. This package can be used to explore new algorithms, code porting, benchmarking architectures and testing tools and new ideas.

**Colin Zelt** is continuing to work on active source seismic imaging of the Earth’s subsurface. His most recent endeavors have taken him into the field of gas hydrates and various environmental problems. He has been developing new inverse methods for obtaining near-surface seismic velocity models.

**Emeritus faculty**

**Hans Ave Lallemant** is busy wrapping up his manuscripts on the structural geology and tectonic history of Guatemala. He is also taking time to travel around the world, experiencing different cultures and history.

**Bert Bally** is busier than ever now, recently publishing a 3 volume tome published by Elsevier on Phanerozoic regional geology and tectonics, complete with a series of beautiful atlases detailing the distribution of passive margins, cratonic basins, tectonic regimes, and the principles of geologic analysis.
Bill Leeman just finished his 5 year stint as Petrology and Geochemistry program director at NSF in Arlington, VA. He is back in Santa Fe and has an adjunct faculty position at the University of New Mexico, continuing active research. Together with Cin-Ty, he recently published a paper on using cathodoluminescence to map out micron-scale spatial heterogeneities of Titanium in quartz grains to reconstruct the temperature history of in magma bodies.

Andreas Luttge is continuing his work on the kinetics of mineral dissolution and crystal growth. We will miss him as he has decided to move back to Germany.

Manik Talwani continues to be active at the intersection of academia and industry. One aspect of this in Manik's continued efforts in developing strong ties between Rice and industry through the Industry Rice Earth Science Symposia.

Adjunct faculty

Adjunct faculty members serve as a great resource to many of our students inside and outside the classroom. In the past year, the following adjuncts have actively engaged students in essential coursework.

Vitor Abreu (ExxonMobil) – Sequence Stratigraphy
Steve Danbom – Modern Exploration Technology, Seismic Reflection Data Processing
Mitch Harris (Chevron) – Industry seminars and co-leading April 2013 field trip to the Guadalupe Mountains
Alison Henning (BP) – Interpretation of Regional 2-D Seismic Data
Pat McGovern (NASA) - The Planet Mars: Formation, Differentiation, Structure and Evolution
Rusty Riese – Economic Geology-Petroleum, Petroleum Industry Economics and Management
Earth Science at Rice University

Rice launched the Energy and Environment Initiative (E2I) this year. Initiated by the provost, the initiative grew out of interest by the faculty. The initiative has goals to establish Rice as a world leader in research into how society will transition between energy resources in the coming decades, how we can advance sustainable management of hydrocarbon resources, and how we can strengthen energy ties across campus and with industry. Open communication with industry has begun through a series of workshops, and E2I has seed funds to propel research ideas from concept to fundable and sustainable research endeavors supported by outside funding. With the Department’s long-standing ties to the energy industry and research and our growth in environment and sustainability, we are well positioned to contribute to the E2I goals. More details about E2I can be found on their website (http://e2i.rice.edu/).

The Department is developing a new symposium series, the Industry Rice Earth Science Symposia (IRESS). Through the symposium we aspire to facilitate better communication between industry and the department (and cognate departments at Rice) and to provide more opportunities for interaction between students and faculty, alums, and members of our local Earth-science community. The symposium will include speakers from industry and academics, and will have a rotating theme. This format will allow us to address hot topics each year based on new research related to the energy sector. Initial funding for the symposium is partly supported by alumni donations and Department funds. Be on the lookout for a formal announcement for the inaugural symposium planned for January 22-23, 2014. For more information, see Page 22 of this newsletter.

The NSF- and Chevron-funded Data Analysis and Visualization Cyberinfrastructure (DAVinCI) visualization wall at Rice’s Chevron Visualization Laboratory was dedicated in
September. Alan Levander, Rice’s Carey Croneis Professor of Earth Science, is the principal investigator of the project. This new laboratory enables scientists to probe data sets in ways that were not possible until now. The facilities include a 25-teraFLOP computing cluster and 200-inch wall which lets users display and analyze images of all types and of all scales. The visualization center is expected to be heavily used by researchers in science and engineering, but is available for use for all including researchers from the Texas Medical Center and the greater Houston area. Contact Alan Levander (alan@rice.edu) or Erik Engquist (lab manager, erike@rice.edu) if you would like to visit the visualization laboratory.

We strive to build on the successes of recent years. High on our list of priorities are acquiring funds for building new laboratories and state-of-the art instrumental facilities, increasing our ties with the energy and environmental industries and with NASA, exploring new ways to integrate the educational experience of our undergrads into our research portfolios, and taking our students out to the field.

Ongoing Departmental Activities

Thursday Departmental Seminars: This past year, we have had talks on Mercury's magnetic field, the significance of unconformities in the stratigraphic record, the origin of plate tectonics, and much more! Please join us for yet another year of fascinating talks from all reaches of the Earth and planetary sciences. First, meet with the speaker over coffee and cookies at 3:30 in the Bally Library on the 2nd floor. The seminar is held in RM 100 from 4-5 PM, followed by beverages and conversation on the patio. Everyone is welcome. Parking can be found in the Entrance 20 visitor lot off of Rice Blvd.

Looney Noons Chalk Talks: For a whole different experience, come to the now infamous Looney Noons seminars, where faculty, students, post-docs, visitors and staff bring their lunch and interact with one of our own as he or she gives an informal, sometimes bizarre, and often improvised presentation about their latest and craziest ideas. PowerPoint presentations are not allowed, just the whiteboard. Come experience or participate yourself in the back-and-forth discussions between the audience and the speaker. You almost never know what the end-product will be as ideas seem to flow and evolve as the discussions progress. Papers have been known to arise from these friendly banters. Fridays at noon in room 327. All are welcome. To learn more or to volunteer yourself, contact the graduate student in charge of organizing, Clint Miller (cmm10@rice.edu).

Upcoming Earth Science Events
The department is embarking on a new mission – monthly activities for us to get to know ourselves better and to keep in touch with you, our extended family. Here are some of our upcoming events that we hope you may join.

• **New Student Welcome BBQ** – To kick off the new year and arrival of new students, we will have a Friday BBQ/potluck on **September 6**. Please join us to help our new students establish a connection with our alums!

• **A Taste of Rice Earth Science: A Preview of the Industry Rice Earth Science Symposia** – **September 27**, 4 p.m., Room 131 of Anderson Biological Laboratories (next door to the Keith Wiess Geological Laboratories)—Four Rice Earth Science faculty members will give brief (15 minute) talks about the research of their graduate students. The latest plans for
IRESS will be announced. To be followed by traditional Friday beverages and light snacks. Alumni, friends of the department, and Rice families are invited. This is during Rice Families Weekend, so we expect parking to be free!

- First Industry Rice Earth Science Symposium—Save the Dates—Wednesday and Thursday, January 22 and 23, 2014. For more information see Page 22 of this newsletter.

Selected Faculty Awards in the past 12 months
- Raj Dasgupta received the 2012 Kuno Award from the American Geophysical Union’s section of Volcanology, Geochemistry and Petrology. The Kuno Award is based on the quality of publications arising from work performed up to seven years past the receipt of the Ph.D. Raj was the recipient based on his outstanding contributions in the area of the deep carbon cycle, specifically investigations of the partial melting behavior of carbonated eclogite and peridotite. Raj also received an NSF CAREER award to study mantle hybridization via melt-rock reaction. This research will help understand chemical variability of oceanic basalts and lithologic heterogeneities in the Earth’s convecting mantle.
- Rajdeep Dasgupta, Brandon Dugan, and Carrie Masiello were promoted to Associate Professor with Tenure.
- Brandon Dugan was one of six Ocean Leadership Distinguished Lecturers for 2012-2013. The Consortium for Ocean Leadership’s Distinguished Lecture Series brings the scientific explorations and discoveries of the Integrated Ocean Drilling Program to graduate and undergraduate students at universities across the nation. Brandon is giving a lecture on the origin and effects of large submarine landslides at seven different institutions.
- Jerry Dickens was elected a Fellow of the Geological Society of America.
- Richard Gordon was elected to the Council Leadership Team of the American Geophysical Union (AGU) for a two-year term. The Council is responsible for the scientific leadership of the AGU. Richard also serves as the President of the Geomagnetism and Paleomagnetism section of the AGU.
- Cin-Ty Lee was a 2012 Miller Institute Visiting professor at UC Berkeley and gave the 2012 Agassiz lecture series at Harvard University.

Geounion Activities
The departmental student and post-doc group, Geounion, remains an integral part of departmental culture. While the primary focus of the students and post-docs is to improve their academic profile and achieve permanent employment (which they do quite well!), they also are the cornerstone of the departmental culture. At the start of the year, Geounion led a local field trip for all new ESCI graduate students. In the last year, the students also held a departmental T-shirt design contest and sold T-shirts with the winning geologically inspired artwork. The students and post-docs also had some good-natured fun at the departmental Enlightenment banquet by producing some video skits. To round out the year, Geounion contributed its tradition of coordinating a campus-wide Crawfish boil.

Graduate Awards and Announcements
- Alexandra Kirshner (Ph.D. candidate) and Hunter Lockhart (Professional MS student) received Calvert Scholarships from the Houston Geological Society
- Huafeng Liu received a Chevron Scholarship starting January 2013.
- Emily Chin and Michael Farner both received a grant-in-aid of research from the Geological Society of America


**Undergraduate Awards and Announcements**

- **Frasier Liljestrand** received the Houston Geological Society Undergraduate Research Foundation’s Maby scholarship for the 2012-2013 academic year. This scholarship is given to the highest ranked applicant among all of the universities participating in the program.
- **Carolyn Branecky** and **Michelle LaComb** are recipients of NSF Graduate Fellowships!
- We have a large graduating class moving on to many great things:
  - Carolyn Branecky – starting a PhD at UC Santa Cruz
  - Brandon Burke – considering graduate school at Curtin University
  - James Keenan – starting an MS at Colorado School of Mines
  - Wally Lang – will be entering the workforce
  - Savannah Ritter – working at Quorum Business Solutions
  - Ruthie Halberstadt – starting an MS with John Anderson
  - Michelle LaComb – starting a PhD at Stanford
  - Frasier Liljestrand – starting a PhD at Harvard
  - Laura Rodriguez – starting a PhD at Penn State University
  - Paige Bailey – working at Chevron
  - Michelle Alvarado – still deciding where to go next
  - Brittany Brown – still deciding where to go next

**Recent graduates**

We had large groups of students graduate in 2012 and in 2013!

**PhD**
- Rodrigo A. Fernandez-Vasquez (2012) – post-doc at the University of Texas Institute for Geophysics
- Lizette Leon-Rodriguez (2012) – geologist at ExxonMobil
- Alexandra Kirshner (2013) – post-doc at Rice University
- Huafeng Liu (2013) – geophysicist at Chevron

**MS**
- Travis Stolldorf (2012) – now a geologist at Chevron
- Xinling Wang (2012) – now working for an oilfield service company
- Nigel Watt (2012) – now in the workforce
- Mehdi Aharchaou (2013) – now at ExxonMobil
- Kelly Liao (2013) – now at Schlumberger
- Karem Lopez (2013) – now at Schlumberger

**Professional Masters of Subsurface Geoscience**
- Murtada Al-Habib (2012) – now an exploration systems analyst at ARAMCO
- Antara Goswami (2012) – now working at ION Geophysical
- Matthew Prudhomme (2012) – now a geologist/geophysicist at Shell
- Yifei Wan (2012) – now working at Parkhurst Resources
- Lisha Xie (2012) – now working at Schlumberger
- Yue Zhang (2012) – now doing microseismic analysis at Baker Hughes
- Alireza Akbarzadeh (2013) – doing an internship at ExxonMobil
- Gokay Berberoglu (2013) – doing an internship at Baker Hughes
- Gulce Dinc (2013) – doing an internship at ION Geophysical
- Kristen Frederick (2013) – now a geologist at Shell
- Martin Gibson (2013) – now an exploration geologist at Apache Corporation
- Serdar Koc (2013)
- James Hunter Lockhart II (2013) – now at BHP Billiton
- Sean Murphy (2013) – now a geologist at Southwestern Energy Company
- Daniel Weisman (2013) – now at ExxonMobil
- Mehmed Yazaroglu (2013) – now at Turkish Petroleum Corporation
- Steve Boswell (2012) – in Ph.D. program Lamont Doherty Earth Observatory, Columbia
- Victoria Chuang (2012) – received a Wagoner fellowship to complete a joint MS at the University of Natural Resources, Austria and the University of Kopenhagen, Denmark
- Christine Gerbode (2012)
- Katelyn Gray (2012) – in Ph.D. program at Yale University
- Robert Hoffman (2012)
- Jasmine Moss (2012)
- Natalya Patrikeeva (2012) – in MS program at the Colorado School of Mines
- Michelle Alvarado (2013)
- Paige Bailey (2013) – now at Chevron
- Carolyn Branecky (2013) – in Ph.D. program University of California, Santa Cruz
- Brittany Brown (2013) – groundwater specialist and incineration blend chemist at Clean Harbors, Houston, TX
- Brandon Burke (2013) – in graduate program at Curtin University, Perth, Australia
- Anna Ruth Halberstadt (2013) – in M.S. program Rice University
- James Keenan (2013) – in graduate program at the Colorado School of Mines
- Michelle LaComb (2013) – in Ph.D. program Stanford University
- Alexander Lang (2013) – entered workforce as a consultant
- Frasier Liljestrand (2013) – in Ph.D. program Harvard University
- Savannah Ritter (2013) – in energy consulting at Quorum Business Solutions
- Laura Rodriguez (2013) – in Ph.D. program at the Pennsylvania State University

Alumni Announcements
Below is a brief outline of some recent alumni accomplishments. If you have announcements to add, please email Brandon Dugan (dugan@rice.edu) and we will include it in the next newsletter.

- **Steve Boswell** (B.S., 2012) completed a year-long stint in industry and is moving to pursue a Ph.D. at the Columbia University (LDEO) starting in Fall 2013.
- **Hugh Daigle** (Ph.D., 2011) started as assistant professor of Petroleum and Geosystems Engineering at the University of Texas at Austin (http://www.pge.utexas.edu/facultystaff/profiles/daigle).
- **Rodrigo Fernandez-Vasquez** (Ph.D., 2011) is a post-doctoral scholar at the University of Texas Institute for Geophysics studying glacial erosion and sedimentation processes.
- **Janelle Homburg** (B.S., 2006) graduated from LDEO with her Ph.D. and has started a post-doctoral position at the University of Minnesota.
- **Ulyana Horodyksyj** (B.S., 2007) continues her expeditions to the Himalayas to study glacial melting processes at high altitudes as she pursues her Ph.D. at the University of Colorado, Boulder (http://colorado.academia.edu/UlyanaHorodyksyj).
- **Audrey Hucks Sawyer** (B.S., 2004) completed a post-doc at the University of Delaware and is now an assistant professor of Earth & Environmental Sciences at the University of Kentucky.
- **Priyank Jaiswal** (Ph.D., 2008) continues research in seismology and inverse methods as an assistant professor at the Boone Pickens School of Geology at Oklahoma State University.
- **Alex Simms** (Ph.D., 2006) continues to study coastal systems and Quaternary science as an assistant professor of Earth Science at the University of California, Santa Barbara.
- **Nithya Thiagarajan** (B.S., 2001) graduated from CalTech with her Ph.D. and now has a post-doctoral position at LDEO.
- **Davin Wallace** (Ph.D., 2010) finished a post-doc at the Woods Hole Oceanographic Institution, and started as an assistant professor of Marine Science at the University of Southern Mississippi in August 2013.

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**Faculty Spotlights**

**Andre Droxler**

Many of our faculty members bring research into the classroom and use their research as a foundation for outreach activities. Andre Droxler’s approach to research, teaching, and service are one of the strongest examples of this around. Andre, a full professor and director of the Center for the Study of Environment and Society, is a carbonate sedimentologist and paleoclimatologist. Much of his research has focused on sediment accumulation near coral reefs and carbonate platforms. He approaches research through ambitious field programs, use of seismic data, collection of cores, and geochemical analysis of sediment samples. He has conducted research programs in marine settings off the Bahamas, Jamaica, Belize, in the western Gulf of Mexico, in the Maldives, along the Australian Great Barrier Reef and in the Gulf of Papua. Individually, each of these research areas have their own interesting questions but integrated they have allowed Andre to understand regional and global evolution of coral reefs and the paleooceanographic/climatic and sea-level records archived in the sediments deposited around reefs and carbonate platforms. Building on this accumulation of work, Andre Droxler and Stephen Jorry (a former Rice post-doc) published a detailed review of mixed siliciclastic and carbonate depositional systems (Annual Reviews of Marine Science, 2013 5:165–90). This review uses modern depositional environments to provide quantitative evaluations of reef formation, which incorporate eustatic sea level, climate changes, and tectonics. This review is a new guide for understanding sedimentary processes and carbonate platform/reef establishment, growth, demise, and rebirth along mixed siliciclastic-carbonate margins.
But these academic endeavors and field programs are not isolated to research and graduate education. Andre leads some of the most popular courses on campus. His Belize field trip course has been oversubscribed for its 20-year lifespan. This field trip provides a living textbook for the students where they can observe interactions of geology and biology during the day, and have detailed discussions about the active processes in the evening. At the undergraduate-level, Field Trips for the Earth is consistently one of the most popular and highly rated courses by undergraduates across campus, so much so that Andre offers the class each semester. And often it attracts graduate students and post-docs who tag along. In this eye-opening experience, students get to look at deep time while floating down the Llano River near Mason, TX where they have remarkable access to bioherms and biostromes, most likely microbial in origin instead of algal as previously thought. During the weekend fieldtrip, they also look at outcrops of stromatolites and thrombolites along the San Saba and James rivers in public land and private ranches. While these field courses have evolved through Andre’s teaching at Rice, they have expanded to reach the broader Earth science community. Andre has led versions of these fieldtrips for the AAPG, the GSA, the HGS, and industry consortia. Also through his ties to the Central Texas communities he has visited over the years, Andre has gained access to new microbial carbonate outcrops that have not been previously studied. These new field sites are gaining lots of interest from industry colleagues. This typifies Andre’s ability to take one geological setting and use it across scales from undergraduate teaching to industry research. Mason, TX has welcomed Andre as well, where he has been invited to share his scientific endeavors with the local schools and community.

Andre wears yet another hat on campus as the director of the Center for Study of Environment and Society (CSES). As director, Andre has raised the visibility of the CSES across campus and broadened the environmental options for students. One aspect where Andre has linked research and teaching to the CSES is through recruitment of world-class visitors to discuss their research in an environmental manner. One example of this was bringing Richard Alley, Evan Pugh Professor of Geosciences at the Pennsylvania State University, to campus to discuss climate change. While initiated through the CSES, Richard’s primary lecture was slated as a President’s Lecture that drew an audience from across campus and Houston. In late August last year, Andre organized with colleagues at The Baker Institute and Harte Research Institute for Gulf of Mexico Studies, Texas A&M University-Corpus Christi, a workshop on The Texas Coral Reefs, Today, Yesterday, and Tomorrow (http://www.bakerinstitute.org/events/texas-coral-reefs-today-yesterday-and-tomorrow.) Earlier this year, Andre also organized a screening of Switch, a documentary on the state of energy and the processes required to sustainability alter our energy sources, followed by a question and answer session with Scott Tinker, director of the Texas Bureau of Economic Geology and narrator of the film. Again this activity drew audiences of all levels (undergrad to PhD) and from across Houston.

This is only a snapshot of Andre’s activities on and off campus. There are many more details, and new projects are evolving as he is chair of our field trip committee. To find out more about his research and teaching or to inquire about participating in a field trip with him, just send him an email (andre@rice.edu) or contact any of his students.
Rajdeep Dasgupta - the volatile man

“The Earth’s oceans, atmospheres, and biosphere exist only by permission of the deep Earth” is one of Raj’s mantras. Raj, an associate professor, arrived at Rice in 2008 and has become a major force in the department. Raj is an experimental petrologist, that is to say that he simulates the geologic conditions that make and modify rocks in the confines of his laboratory. Only the upper 10 km has been drilled into and only the upper 100 km of the Earth is regularly sampled by volcanoes. Without direct means of investigating the Earth’s deep interior, Earth scientists must use geophysical inverse methods like seismology and gravity or, in Raj’s case, develop apparatuses for simulating the extreme pressures and temperatures inside Earth’s interior. The pressures he can achieve in his world-class laboratory are more than enough to turn graphite into diamond. By loading a small area with a large force or weight in the form of a several ton press, he can achieve these high pressures, albeit confined to a small experimental charge containing the ingredients that make up the rocks Raj and his students are interested in. But from these tiny charges, Raj extracts first-order constraints on the stability fields of various phases in the Earth’s inaccessible interior, defining some of the key boundary conditions for deep Earth processes, such as the generation of magmas in the mantle and the origin of volcanoes.

Raj is particularly interested in understanding the role of volatiles like carbon dioxide, sulfur, and fluorine on the melting behavior of rocks. What motivates Raj is the desire to quantitatively describe global volatile cycles, such as the global carbon cycle. But when most of us think about the global C cycle, we are usually thinking about how C cycles between the oceans, atmosphere, biosphere, and the thin soil layer mantling the continents. For Raj, “global” means the whole Earth, from the core to the atmosphere and everything in between. On long timescales, that is, over millions of years, the carbon dioxide in the atmosphere and oceans is regulated by volcanic inputs and depositional outputs in the form of carbonates and organic-rich shales. Some of these carbonates and organic-rich sediments are returned back into the Earth’s deep interior with subducting slabs. One of the key questions that Raj is interested in is whether the whole Earth carbon cycle is at steady state and how the balance between inputs and outputs might have changed throughout Earth’s history. This is important because although too much of a greenhouse gas like carbon dioxide in the atmosphere might not bode well for human society, too little would also be bad as small quantities of greenhouse gases are needed to keep the Earth from freezing over and extinguishing most forms of life. Furthermore, photosynthesis involves the reduction of carbon dioxide to organic carbon along with the release of oxygen. It may be that life exists on Earth because of a complex interaction of the deep Earth carbon cycle with that between the oceans, atmosphere and biosphere. Thus, an important variable is whether subducted carbonates are quickly released and returned to the atmosphere through erupting volcanoes or whether they remain stable enough to be taken into the deepest parts of the Earth. With post-doctoral fellow Kyusei Tsuno and graduate student Megan Duncan, Raj is mapping how the efficiency of decarbonation in subducting slabs varies with the thermal state of the slab, sediment composition and other variables like water content and how much carbon is carried to the volcanic arc source regions via fluids and melts generated in the subduction factory. Raj has made the
provocative suggestion that earlier in Earth’s history, there may have been a net output of carbon dioxide from the mantle to the Earth’s surface, but today, with subduction zones possibly running slightly colder than in the past, decarbonation might not be so efficient, causing a net return of carbon back into the mantle.

Raj’s work also has implications for plate tectonics. Unlike all other planets in our solar system, Earth is characterized by a series of rigid plates whose relative motions are confined to narrow regions of deformation, that is, plate boundaries. These rigid plates, also known as lithospheric plates, appear to overlie a low viscosity region of the mantle called the asthenosphere. Some Earth scientists, particularly our own Adrian Lenardic, argue that a thin low viscosity layer, like the asthenosphere, may actually be essential for generating mobile plates, the key aspect of plate tectonics. But there is still no consensus on how weak and how thick the asthenospheric layer is and what dictates all its properties. One of the ideas has been that the asthenosphere is weak because it contains small amounts of partial melts mixed in with the largely solid matrix. Such melt would reduce effective viscosity and also provides a good explanation for why global seismic studies consistently see low seismic velocity zones beneath many of the lithospheric plates. The problem, however, has been that the traditional stability field of melts in the mantle is much smaller than the geophysically inferred thickness of the asthenosphere. Raj, through a series of papers, including one in the journal Nature this year, has shown that if C exists in the Earth’s interior, there is a substantial decreasing in the melting temperature of mantle rocks due to the fact that carbonate is much more soluble in melts than in silicate minerals. This freezing point depression greatly expands the stability field of carbonated silicate melts and thus provides an elegant explanation for why the Earth has an asthenosphere. The implication is that the global carbon cycle and plate tectonics might be intricately linked!

In just over 5 years, Raj has established a world-class experimental facility that is now leading the international community on the role of volatiles in deep Earth processes. In recognition for his creativity and hard work, his CV has been adorned with an NSF CAREER award, a much-coveted fellowship from the Packard Foundation, the Clarke Medal given by the Geochemical Society, and the Kuno award given by the American Geophysical Union. He has assembled a large group of students and post-doctorates, each of them working on a diverse array of problems. For example, with PhD candidate Ananya Mallik, they have explored the role of melt-rock reaction in hybridization of the Earth’s heterogeneous mantle and in generating the types of magmas seen in many volcanic provinces in oceans and on continents. With Sébastien Jego, he has been exploring the stability of sulfur in subducting slabs. With Han Chi, he explored the solubility of carbon in liquid metal alloys and silicates at high pressures and temperatures in order to better understand the very origin of Earth’s carbon when it was still accreting and condensing from the solar nebula, 4.55 billion years ago! With Shuo “Echo” Ding, he has been studying sulfur systematics in martian basalts. He has worked with a number of undergraduates, including Christine Gerbode (’11), Yang Xu (’14), Michelle Muth (’15), and Jasmine Moss (’11). To learn more about Raj, visit his webpage at http://earthscience.rice.edu/department/faculty/dasgupta/ or arrange to have a tour of his lab.
Research Group Spotlight
Rice Biochar Group

Rice ESCI has become home to a 5-department consortium of researchers, led by Carrie Masiello, in a novel area of carbon sequestration: soil biochar amendment. This carbon sequestration technique aims to simultaneously reduce atmospheric CO2 while improving crop yields globally, especially in drought-vulnerable areas. Read more at biochar.rice.edu.

Student Spotlights

Emily Chin

Have you ever wondered how geologists know what the deep crust or the Earth's mantle is made of? The person you should talk to is PhD candidate, Emily Chin. Emily came to Rice in 2008 straight from an undergraduate degree at Tulane University. She has an unhealthy fascination with xenoliths. Xenoliths are literally “foreign rocks” because they are rock fragments ripped up from the country rock and carried to the surface during volcanic eruptions. These xenoliths often derive from great depths. In some cases, they come from depths exceeding 150 km, well into the diamond stability field. The deepest hole that has ever been drilled is about 10 km, thus xenoliths give us the only other way of directly sampling the Earth at greater depths.

Emily’s research is focused on understanding what the deep roots of volcanic arcs look like. Her interest is motivated by the possibility that volcanic arcs are the dominant drivers of continental crust formation, at least for the last 500 My or so. She has been investigating crustal and mantle xenoliths in young volcanics erupted through the Sierra Nevada batholith in California, the eroded remnants of a Cretaceous continental arc associated with subduction of the Farallon oceanic plate beneath North America. The active Andean magmatic arc in South America would be a modern analog of the Sierra Nevada.

Emily’s samples are some of the most colorful rocks you will encounter. She has pyroxenites and peridotites that contain red to purple garnets, olive-green olivines and orthopyroxenes, and bottle green diopsides. These samples also have a colorful history, Emily will tell you. Based on their chemical compositions, she can tell you what temperatures and pressures they came from – 90 km depth! She has also used laser ablation ICP-MS in our department as well as the most cutting edge electron probe micro-analyzer on the market at Yale University to tease out the pressure-temperature history of these xenoliths. Although they were residing at 90 km depth just before eruption, it turns out they were originally formed at shallower depths and then transported to greater depths during the peak of arc magmatism. In other words, arc magmatism appears to have coincided with extreme thickening of the crust. Emily has also investigated a curious set of quartzite xenoliths from the same area. She showed that these metasediments were sitting in the
lower crust, some 40 km deep, even though their protoliths are Paleozoic passive margin sediments. Growing the Sierran arc thus involved simultaneous magmatic addition and tectonic thickening, but exactly why this link exists remains a mystery to Emily and her adviser Cin-Ty Lee.

Emily's work has so far been published in the Journal of Petrology and in Earth and Planetary Science Letters. She has more of the story to unravel, so stay tuned! Her research was funded by the National Science Foundation and a grant-in-aid of research scholarship from the Geological Society of America. You can learn more about Emily's research and her curious hobbies of drawing, botanicizing, and birdwatching from her webpage http://www.owlnet.rice.edu/~ejc5/Home.html.

Carolyn Branecky
Carolyn Branecky, a graduating senior, is one of our undergraduates who is blending Earth science and humanities. Carolyn entered Rice with interests in philosophy and Earth science. While she found her home in Earth science, she continues to be active in humanities, and has found ways to merge her interests.

Carolyn's entrance into Earth science research started with an NSF-REU summer project at the University of Wisconsin-Platteville. During the REU, she used sedimentological analyses and optical stimulated luminescence dating to understand the sediment flux to dune ridges along Lake Michigan due to fluctuations in glacial lake levels. She presented the dune research at the Geological Society of America annual meeting in October 2011.

To continue studying sedimentological problems, Carolyn has been working with Dr. John Anderson on data from Pine Island Bay, West Antarctica. In this project, Carolyn is using geomorphology of basins on the seafloor to constrain meltwater storage potential and glacial grounding positions on the shelf of Pine Island Bay. Carolyn has presented this research at the American Geophysical Union annual meeting in December 2011 and is currently working as a co-author on a manuscript related to the retreat history of Pine Island Glacier.

In the summer of 2012, Carolyn completed a second REU. This time she worked at the Center of Remote Sensing of Ice Sheets at the University of Kansas. Here she extended her knowledge on glaciology by creating a model for basal temperature and melting rates beneath the Greenland Ice Sheet using a geothermal heat model and SeaRISE maps as inputs. She also inferred errors in heat contributors by comparing modeled results to radar-detected wet bed locations.

But Carolyn has not forgotten her interests in philosophy. While compiling a large research portfolio and excellent track record in Earth science, she continued to explore her other interests. A few of her activities include attending a summer philosophy seminar on The Limits of Knowledge, giving a talk entitled "Creating a Space for Energy Humanities" at the Kule Institute, and participating in a Rice Humanities Research Center project on Cultures of Energy.

Carolyn is wrapping up her career at Rice, and preparing for graduate school in glaciology. Through Carolyn's experiences as an undergraduate, she has gained a full appreciation of the impact humans can have on Earth systems. This led to her primary interests in the potential
instability of modern ice sheets. In graduate school, she intends to use sedimentary and geomorphic evidence and empirical and theoretical developments to understand subglacial processes and their effects on ice sheet dynamics. She hasn’t made a final decision on where she will pursue these studies, but keep an eye out for her research and her outreach activities, as one of her other goals is to help better inform society about Earth system dynamics.

Field Trips

Over the last year, our students have traveled all over the world for classes and for research projects. Our field mapping class, taught by Helge Gonnermann, has moved from its traditional site on Mariscal Mountain in Big Bend National Park to the edge of the San Juan Basin in north-central New Mexico. In this new spot, they mapped a doubly plunging anticline and also had the opportunity to examine the Nacimiento Fault, the Great Unconformity, and large rhyolitic ignimbrites of the Bandelier tuff. They even ended their week of mapping with the Harlem shake!

John Anderson took his sedimentology class out to the Texas coast and then to the San Juan Basin, teaching students about the basic principles of sequence stratigraphy. For many students, this was the first time to see delta formation up close and personal. This past year, Cin-Ty Lee and Rajdeep Dasgupta took ESCI 322 students through New Mexico (seems like our favorite state is New Mexico), showing them the famous Harding pegmatite with 6 feet long spodumene crystals, the Picuris metamorphics, and a tour through the Valles Caldera, though next year, they will return to California. Andre Droxler continued with his popular course on coral reefs and carbonate sedimentology, flying down with students to visit the coral reefs of tropical Belize. Andre also continues to run the freshman field trip class, where he and students canoe down the Llano River in search of stromatolites! Closer to home, Carrie Masiello taught a global biogeochemical cycles class and incorporated local field trips to different waterways in the Houston area. Graduate students Ben Slotnick and Jake Siegel helped coordinate an AAPG Student Chapter field trip to the southern California coast to look at shallow and deep water marine facies, tectonically controlled basin evolution, and current petroleum production facilities (http://aapg.rice.edu/Welcome.html).

But the crowning field trip last year was our type-locale field trip to Chile, co-led
by John Anderson and Rodrigo Fernandez (former PhD student, now post-doctoral fellow at UT Austin). The Chile trip encompassed a diversity of geologic environments, ranging from the salt flats of the Atacama Desert, to a drive up into the High Andes reaching elevations higher than 14,000 feet, and back down to sea level observing coastal processes along the beaches. Research and conferences took graduate students Emily Chin and Monica Erdman to Papua New Guinea and Australia, Brandon Harper to the Great Barrier Reef of Australia and CEREGE in Aix en Provence (France), Ben Slotnick to New Zealand, Sally Thurner to Morocco and southern Spain as part of Alan’s PICASSO continental dynamics project. We hope this next year will be just as exciting for all our students, faculty and staff!

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**Special thanks to our staff!**

We continue to be fortunate to have departmental staff who offer outstanding service and support. Our department would simply not operate without our talented and hard-working staff. We are grateful to Lee Willson for overseeing our department’s main administrative tasks, Sookie Sanchez for consistently holding up our frontline, Mary Ann Lebar for coordinating our graduate program and recruiting efforts, Martha Lou Broussard for keeping tabs on our alums and arranging alumni events, Pat Jordan for maintaining our research budgets, Roger Romero for taking care of everything from the rock saws to the elevator, Sandra Flechsig for coordinating the logistics of our visitors and many other things, Bonnie Hoffman for managing our webpage and computers, Mary Cochran for taking care of our Geophysics computing facilities, Denise Mayberry for overseeing and coordinating all things related to the Center for Computational Geophysics, and of course, Yolanda Jara and Dora Pedraza for looking after the well-being of our department.
IRESS

The Industry Rice Earth Science Symposia (IRESS, which we previously referred to as RESIS) aim to facilitate communication and cooperation between the energy industry (including our many alumni in the industry) and the Department of Earth Science and other cognate disciplines at Rice University. The proposed symposia will occur once per year and will become a permanent recurring venue for industry and Rice scientists (and some scientists from other academic institutions) to share ideas, opportunities, and problems to be solved.

The first symposium is scheduled for January 22 and 23, 2014 on the Rice campus with an anticipated 250 participants. The theme of the first symposium is *Frontier Basins: Contemporary Problems, Research, and Policies* and will include half-day sessions on Imaging and Sedimentary Basin Modeling, Geomechanics and Fluid Flow, and Arctic Basins and Climate Change. Speakers will come from Rice, from other universities, and from industry. A poster session will showcase work by Rice graduate students and postdoctoral scholars.

A reception and dinner are scheduled in the evening of January 22 and will include a thematic talk following dinner. The second afternoon of the symposium will feature a big-picture talk on Energy Outlook and will conclude with a discussion of the outlook for the next symposium. Our long-term plan is to fund the costs of the symposia from three sources: (1) A registration fee for individuals, (2) contributions from companies, and (3) income from an endowment established from contributions from alumni. A generous alumni contribution, and—to a lesser extent—a departmental contribution, will defray some of the costs of the first symposium.

Rice Alumni are playing a major role in helping shape the symposia agenda and in securing support for this initiative. Ed Biegert, Ph.D. ’74 and Cathleen Trechter ’77 contributed the first gift to seed fund an endowment and to provide support for the first symposia. Several other alumni are engaging with IRESS through securing corporate sponsorships, inviting colleagues to attend the symposia, and making personal philanthropic gifts to the endowment. Please contact Alison Frost at 713.348.4268 or afrost@rice.edu if you would like to learn more about how you can help.
We are always interested in hearing updates from all our alumni. Please feel free to drop by any time and to come to any of our events. If you want to drop us a note and let us know about any exciting things in your life, please send an email to dugan@rice.edu. You can also follow department activities through Facebook (www.facebook.com/RiceEarthScience).

Support the Department of Earth Science at Rice University

You can help support the department by contributing to one of several funds:

___ Unrestricted gift to Earth Science: We use this for our most pressing needs.

___ IRESS (Industry Rice Earth Science Symposia): Facilitates communication between the Department, our Alumni, and Industry—See the prior page of this Newsletter for more information.

___ Devlin-Schnable Fund: Defrays the cost for our undergraduate students going to field camp.

___ Bally Fellowship fund: Supports promising graduate students and honors Bert Bally.

___ Vail Fellowship fund: Supports promising graduate students and honors Pete Vail.

Dept. Earth Science, MS-126
Rice University
6100 Main St.
Houston, TX 77005

Or go to the following URL: giving.rice.edu
Be sure to include the name of the fund in the “special instructions”.