EARTH SCIENCE
RICE UNIVERSITY

Department of Earth Science Newsletter
December 2014

Photo of Claudia Sayao-Valladares (visiting scientist from Rio de Janeiro State University, Brasil), Michael Farner (PhD student), Hehe Jiang (PhD student), Xun Yu (visiting student from Nanjing University, China), and Cin-Ty Lee. The group (including Julia Morgan, who is taking the photo) is examining mylonites and pseudotachylites in the Santa Rosa shear zone in southern California. The purpose of this work is to better constrain the timing of deformation and how the nature of deformation evolves during the exhumation of the batholith. Student Jiang has been developing in situ U-Pb geochronology of titanite and sphene. She hopes to explore the complex interplays between magmatism, crustal thickening, uplift and erosion in continent forming events, with implications for long term climate.

Letter from the Chair

Dear Alumni and Friends of the Department,

I am pleased to invite you to read our December 2014 Newsletter. It has been an excellent year for the Department of Earth Science and I am eager to share our news with you.

Our first Industry Rice Earth Science Symposium (IRESS) was a big success. We had over 175 participants from industry and academia over the two-day (January 22 and 23, 2014) event. The participants, including many of you, were enthusiastic about the talks and the great interactions between Rice faculty and students, Rice alumni, and our many other friends in industry. I thank everyone responsible for making our first symposium a success, including the many alumni who helped make it happen. IRESS will be an annual recurring event, with IRESS 2015 scheduled for March 11 and 12, 2015. Please save the date (or, better yet, register online now at iress.rice.edu). The interactions planned for the symposium will strengthen the department's relations to industry and to our many alumni in industry.

Our faculty continues to be highly recognized for its research achievements. In last year's newsletter I mentioned many of the key honors bestowed on our faculty members since 2000. Since that Newsletter Professor Julia Morgan received the Silver Award for Science Leadership and Service from the American Geophysical Union (AGU) and Professor Jeff Nittrouer received the Luna Leopold Award, the early career award given out by the Earth Surface Processes section of the AGU. Last summer, in commemoration of its fortieth anniversary, Geophysical Research Letters recognized the forty most important papers (as selected by its editors) to have been published in the journal since its inception, and I was honored to have two of my publications selected. Last week Professor Raj Dasgupta received a Macelwane Medal from the AGU, which is the top early career award given out by the AGU.

We look forward to hearing from you or, better yet, seeing you soon!

Sincerely,

Richard G. Gordon
Chair, Department of Earth Science

Department News

In 2014, the Department of Earth Science maintained its tradition of excellence in transformative research, and our faculty continued to be highly recognized for its research achievements. As mentioned in the Chair's letter, faculty members Julia Morgan, Jeff Nittrouer, and Rajdeep Dasgupta respectively received the Paul Silver Award, Luna B. Leopold Award, and the James B. Macelwane Medal from the American Geophysical Union (AGU). Moreover, Alan Levander and Fenglin Niu made new discoveries on recycling of continental lithosphere and intraplate volcanism, which were published in Nature and Nature Geoscience.

The department continues to be involved with Rice's Energy and Environment Initiative (EEI). Alan Levander is a member of the Advisory Board, and the department has three active projects with EEI.

We will be welcoming our newest faculty member to the Department in January of 2015. Laurence Yeung, currently an NSF Earth Science Postdoctoral Fellow at UCLA, will be joining Rice and adding expertise in stable isotopes in the environment. You can learn more about Laurence online at (http://www2.ess.ucla.edu/~lyeung/) or stop by and meet him in January.

Two new staff members have joined us. We hired Clinton Heider to oversee the Linux needs of the department and be the geophysics computer administrator. We also hired Susi Haveman as the assistant to the chair. Both Clinton and Susi have stepped right into the swing of the department, helping make things move smoothly.

This past fall, we welcomed 29 new graduate students consisting of 10 new Ph.D. students, 5 thesis masters students, and 14 Professional Master's students. We look forward to watching them move forward in their training and research.

Our undergraduates have made big strides in the past year. First, they have developed their own society—Rice Undergraduate Geosciences Society (RUGS)—aimed at enriching the experience for Earth Science undergrads. In addition the department started an Honors Thesis for undergraduates. Both of these endeavors are upping the game for our undergrads.

As we strive to keep expanding our interactions with our alumni, we have had a few alumni-directed events this year. Bert Bally continues to lead Bert Bally's Map Tales, the latest of which emphasized the geology of Mexico. We also hosted another Taste of Rice lecture during Homecoming weekend where John Anderson, Cin-Ty Lee, and Carrie Masiello shared their research programs to a packed room of alumni and students. The event ended with a great reception on the Geology Labs patio.

The department welcomed two new Wiess visiting professors, Drs. Onno Oncken and Yusuke Yokoyama. Dr. Oncken is the Director of the Department Geodynamics and Geomaterials of GFZ, the German Research Centre for Geosciences. Onno's office is located in room 326. Dr. Yusuke Yokoyama is a Professor at the Atmosphere and Ocean Research Institute, University of Tokyo, and Yusuke's office is located in room 226; email yokoyama@aori.u-tokyo.ac.jp.

Research Highlights

Subduction-induced upwelling feeds the Changbaishan and other back-arc intraplate volcanism

The Changbaishan volcanic complex located on the border between China and North Korea, approximately 1,300 km away from the Japan Trench subduction zone, is difficult to be explained with the current paradigm of plate tectonics. Seismologist Fenglin Niu and an international team deployed a total of 127 portable broadband seismographs across an area of 1200 by 800 km in northeast China. The team identified a continuous slow velocity anomaly in the mantle beneath Changbaishan, extending from the surface to the uppermost lower mantle through a gap in the subducted Pacific Plate from their high-resolution seismic images. The anomaly was interpreted to represent hot and buoyant sub-lithospheric mantle, which has been dragged down by the sinking Pacific Plate and is now escaping through a gap in the subducting slab. This subduction-induced upwelling process produces decompression melting that feeds the Changbaishan volcanoes, and may also explain back-arc volcanism observed at other subduction zones. The study is published in *Nature Geoscience* on May 18, 2014 (vol. 7, 470–475, doi:10.1038/ngeo2166).

Subducting oceanic plates are thinning adjacent continents.

Whereas subduction recycling of oceanic lithosphere is one of the central themes of plate tectonics, the recycling of continental lithosphere appears to be far more complicated and less understood. Delamination and convective downwelling are two widely recognized processes invoked to explain the removal of lithospheric mantle under or adjacent to orogenic belts. An international team of scientists, led by Alan Levander, discovered another mechanism for thinning of continental lithosphere adjacent to subduction. The study was published in the last month's issue of *Nature* (13 November 2014, vol. 515, 253–256, doi:10.1038/nature13878).

The team found that the continental margins of plates on either side of the Atlantic Ocean are thinner than expected. They attributed the thinning to the removal of the viscous bottom layers of the continental shelves by adjacent subducting oceanic plates. The process drives surface tectonics and pre-conditions the margins for further deformation by creating topography along the lithosphere–asthenosphere boundary. This can lead to development of secondary downwellings under the continental interior, probably under both South America and the Gibraltar arc, and to delamination of the entire lithospheric mantle, as around the Gibraltar arc.

The study used portable seismographs belonging to the NSF-funded IRIS/PASSCAL facility that were deployed for several years with instruments from Spain's IberArray and Venezuela's National Seismograph Network. From that data, geophysicists determined the topography of the LAB using techniques roughly similar to medical CAT scans and ultrasound images.

Earth Science at Rice University

Ongoing Departmental Activities

IRESS 2014: Rice University's Department of Earth Science hosted its first annual Industry-Rice Earth Science Symposia (IRESS) on January 22 and 23, 2014, with great success. Organized by a committee of dedicated Rice Earth Science alumni and faculty, IRESS 2014 focused on "Frontier Basins: Contemporary Problems and Research" and hosted three technical sessions that highlighted

the current technologies in the oil and gas industry and future advancements and areas of research. Speakers presented technical papers on the imaging geologic processes from the grain-to-seismic scales, quantitative stratigraphic modeling, geomechanics at field and regional scales and modeling of these processes, and the knowledge and the challenges of geologic exploration in the high Arctic. The symposium brought together over 150 attendees from 28 energy companies, 7 universities, and 3 government-related organizations. Participants exchanged knowledge through a program of lectures, panel discussions, and networking sessions. The event also gave Earth Science students the opportunity to present their research with industry experts and corporate recruiters in a poster competition.

The 2014 symposia culminated with a keynote dinner lecture featuring Jostein Mykletun, Consul General of Norway, titled "The Arctic: Opening of a New Ocean - Implications for the energy, shipping, and offshore sectors." Dr. Mykletun emphasized the importance of collaboration between industry and academia as offshore drilling techniques continue to evolve in changing climates. With the impressive feedback from attendees, IRESS 2014 proved to be a synergizing tool for Rice University and the energy industry. The Department of Earth Science will continue to host public lectures throughout the year to continue the momentum into IRESS 2015 (March 11–12, 2015).

Thursday Departmental Seminars: This past year we have had talks on a variety of topics including 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 Earth and planetary Science. First, meet with the speaker over coffee and cookies at 3:30p.m. in the Library on the 2nd floor. The seminar is held in room 100 from 4:00-5:00 p.m., 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.

Selected Faculty Awards in the past year

- **Julia Morgan** is the winner of the 2013 Paul G. Silver Award for Outstanding Scientific Service. This award is given jointly by the Seismology, Geodesy, and Tectonophysics sections of the American Geophysical Union to a member who has excelled in mentoring of junior colleagues, leadership of community research initiatives, or other forms of unselfish collaboration in research.
- **Jeff Nittrouer** is the recipient of the American Geophysical Union (AGU) 2013 Luna B. Leopold Award, given by the Earth and Planetary Surface Processes Group (EPSP). The award is given to a young scientist for making a significant and outstanding contribution that advances the field of Earth and planetary surface processes. **Jeff** also delivered the Robert P. Sharp Lecture at the fall 2013 AGU meeting. This is the capstone lecture for the EPSP Focus Group. In addition, **Jeff** was also acknowledged by AGU for his Excellence in Refereeing for articles submitted to Water Resources Research.
- **Rajdeep Dasgupta.** The American Geophysical Union has honored Rice geologist Rajdeep Dasgupta with the James B. Macelwane Medal, awarded this year to five scientists for significant contributions to the geophysical sciences by an outstanding early career scientist. Dasgupta's lab studies geographic evolution, with a focus on reactive processes in Earth's mantle that take place over millions of years. He was recognized at the organization's 2014 fall meeting in San Francisco.

Geounion Activities

Geounion, the departmental student and post-doc organization, stands to promote community events and has continued its traditions in this past academic year. While the primary focus of students and post-docs is to make strides in research, academic, and individual career goals, Geounion provides opportunities for the department to foster a sense of community. This year, Geounion has helped arrange many of the departmental traditions that have been in place for some time, including the always comical Enlightenment banquet and the ever popular Crawfish Boil. This summer, Geounion helped promote student Clint Miller's 'Summer Shenaniganza' events, which has brought students and faculty together to engage in informal chalk talks on campus. Looking forward, Geounion will help continue these traditions and will proceed in serving the community within our department.

Graduate Awards and Announcements

- Emily Chin received the 2014 "The Leroy Caleb Gibbon Award"
- Pranabendu Moitra and Chinh Nguyen shared the 2014 "The Torkild Rieber Award in Geology"
- Lily Seidman and Anna Ruth Halberstadt shared the 2014 "The Sam and Helen Worden Fellowship".
- Jeniffer Masy and Lin Zheng shared the 2014 "The Sam P. Worden Award in Geophysics".
- Michael Farner received the 2014 "Outstanding Graduate Student Teaching Award".
- Rebecca Minzoni received the 2014 "Douglas & Martha Lou Broussard Fellowship".
- Lacey Pyle received the 2014 "Outstanding Department Service Award".
- Shuo Ding received the 2014 "Houston Geological Society Outstanding Student Award".

Undergraduate Awards and Announcements

- Larisa LeMere received the 2014 "The Eugen Merten Memorial Prize in Geology and Geophysics".
- Sarah Gerenday and Victoria Yuan shared the 2014 "The Torkild Rieber Award in Geology"
- Li Ann Chia received the 2014 "Outstanding Undergraduate Student Award".
- Rachel Marzen received the 2014 "Houston Geological Society Undergraduate Scholarship".

Recent graduates

PhD

- Emily Chin (2014) – now a post doc at Brown
- Inna Kurganskaya (2014) – now post doc working for Andreas Lüttge at Rice Earth Science
- Jeniffer Masy (2014) – now at BP
- Jacob Siegel (2014) – now at BP
- Jie Zhang (2014) – now at BP
- Lin Zheng (2014) – now at CGG

MS

- Ayca Agar-Cetin (2014) – now at Turkish Petroleum Corporation
- Han Chi (2014) – now at CGG
- Tao Huang (2014) – now at Sinopec office in Oklahoma
- Xin Zhao (2014) – now at Berger Geosciences LLC

Professional Masters of Subsurface Geoscience

- Avery Arendale (2014) – now at Roxanne Oil
- Dilan Derici (2014) – now at Turkish Petroleum Corporation
- Mi Jiao (2014) – now at ExxonMobil
- Curtis Johnson (2014) – now at Apache Corp
- Xia Li (2014) – now at PDS Corp
- Song Lu (2014) – now at Halliburton Landmark
- Seun Olawole (2014) – now at Halliburton Landmark
- Hamid Shahid (2014) – now at Schlumberger
- Heather Stilwell (2014) – now at Ellington Geo
- Selin Temel (2014) – now at Turkish Petroleum Corporation

BS

- Li Ann Chia (2014) – now teaching in Malaysia
- Max Daniller-Varghese (2014) – now working on Ph.D. at UT Austin
- Nicholas George-Jones (2014) – now working for Power Plan until he goes to med school
- Caleb McBride (2014) – now working with the Navigators in Lima, Peru for two years.
- Sergio Ruiz (2014) – now enjoying post-Rice life
- Charles 'Ray' Throckmorton (2014) – now coaching girls' volleyball at St. John's School while preparing for graduate school
- Yang 'Nana' Xu (2014) – now working on MS in geology at Pennsylvania State University
- Diming Yu (2014) – now working on MS in geophysics at MIT
- Victoria Yuan (2014) – now working on Ph.D. at UC Santa Clara.

Alumni News and Announcements

In connection with IRESS 2014, which is featured elsewhere in this newsletter, several alumni-only events were held. Beginning in September 2013 a seminar featuring four faculty members was held. Andre Droxler, Jeff Nittrouer, Alan Levander, and Fenglin Niu gave summaries of their current research. A lively discussion followed on the Geology Patio helped with beer, wine and lots of goodies courtesy of Katrina Coterill. Later Bert Bally had two sessions on Maps, the first a general outline of the history of maps and the second about mapping the Artic, a feature in one of the IRESS 2014 sessions. Ken Adbulah (Ph.D. 1995) hosted the after party. In Spring 2014 alumni were invited to two industry related seminars. The seminar of Robert Feinstein (Ph.D. 1979) of Schlumberger was A Brief Look at Seismic Responses of Deepwater Reservoirs: Salt Basins, Basins without Salt and Sub-Basalt Imaging. The talk of Adjunct Professor Mitch Harris, recently retired from Chevron, was Great Bahama Bank: Mapping Water-Depth Variation and Depositional Facies on a "Flat-Topped" Isolated Carbonated Platform. This fall, Adjunct Professor Rusty Riese, retired BP, spoke on Climate Change: Facts and Fictions. In December, Bert Bally hosted two map sessions on Mexico.

Over eighty alums and their spouses joined current faculty and students at a private reception during AAPG week in April, which was here in Houston. Old friends were able to catch up on what each had been doing and meet alums from other eras and soon-to-be alums. This was a great opportunity for our students to network with professional geologists. Plan to come to our next get together.

Be sure to follow what is happening in the Department by logging onto our Facebook page (www.facebook.com/RiceEarthScience). Send your news about job changes, new spouses, new children (or grandchildren), and any other very interesting information you would like to share to

Martha Lou Broussard (mlbrou@rice.edu). Stop by the Department if you are near and, if you have not had a chance to see the remodeled building, ask for a tour.

Faculty Spotlights

Associate Professor - Carrie Masiello

Carrie Masiello and PhD student Lacey Pyle have just begun a new project working in Silas Little Experimental Forest (SLEF) in New Jersey to study the effects of forest fire frequency on the amount and chemical composition of carbon stored in the forest's soils. Soils contain a large reservoir of carbon: there is more than twice as much carbon in soils as in the atmosphere. But this soil carbon reservoir is "active," meaning that it can grow larger or smaller. Decomposition can decrease carbon in the reservoir and inputs of plant litter and charcoal can increase soil carbon. Increasing the size of the reservoir also decreases the atmospheric CO2 pool and increases forest soil fertility. Paradoxically, one of the most important components of a stable soil carbon reservoir is charcoal, which is produced when forests burn. Pyle hypothesizes that there's a sweet spot in fire frequency, where fires happen often enough to make plenty of charcoal for soil, but slowly enough that the forest has time to regenerate. US Forest Service land managers have been conducting well documented experimental burns at SLEF since the 1920s, varying the frequency of burns from annually to every 50 years. Pyle will use solid-state nuclear magnetic resonance imaging to examine the chemical composition of the soil charcoal at SLEF. By analyzing the soil charcoal from a range of forest fire frequencies, Pyle and Masiello hope to find that ecosystem's sweet spot for fire.

ESCI PhD student Lacey Pyle at her field site in Silas Little Experimental Forest, New Jersey; faculty advisor associate professor Carrie Masiello.

Carey Croneis Professor - Alan Levander

My research group is finishing research on the NSF Continental Dynamics BOLIVAR[1] project, an investigation of the lithosphere and upper mantle in the southern Caribbean and Venezuela that we began a decade ago. The list of BOLIVAR alumni is rather long, but a few things worth noting are the recent hires of BOLIVAR post-doc Beatrice Magnani as an Associate Professor by Southern Methodist University, and Maximiliano Bezada as an Assistant Professor by the University of Minnesota. (Max was a deployer during the BOLIVAR active source experiment and subsequently completed a PhD at Rice). Fenglin Niu and I hope to continue studies in South America with a field program in the Merida Andes and northern Colombia to look at flat slab subduction.

We are in an advanced state of analysis of the NSF Continental Dynamics PICASSO[2] project seismic data, a multi-national and multi-disciplinary investigation of the tectonics of the Gibraltar Arc, Alboran Sea and Atlas Mountains in the western Mediterranean. Seismic images show large-scale mantle lithosphere delamination under the Rif and Betic mountains. Recent papers in G[3] were authored by Rice post-doc Imma Palomeras, graduate student Sally Thurner, and Rice visiting scientist Puy Ayarza of the University of Salamanca. Another has been submitted by Rice visiting student Alba Gil of the University of Barcelona.

Rice post-doc Eric Kiser and I are now focused on the NSF GeoPRISMS-EarthScope iMUSH [3] Project, an investigation of Mount St. Helens. The Rice component of the project is an active source experiment utilizing 3500 seismographs to record 24 shots around MSH designed to seismically image the crustal magma system. A passive array of 70 broadband stations operated by the University of Washington will image the upper mantle and lowermost crust.

Brandon Dugan, Fenglin Niu and I have begun shale gas resource research for the Rice Energy and Environment Initiative (EEI). The shale gas resources investigations span lab measurements of rock properties, microseismicity monitoring, and seismic imaging.

[1] BOLIVAR: Broadband Onshore-offshore Lithospheric Investigation of Venezuela and the Antilles arc Region: Rice (lead), Indiana, UT, Scripps, Georgia

[2] PICASSO: Program to Investigate Convective Alboran Sea System Overturn; Rice (lead), USC, Oregon, WHOI

[3] iMUSH: Imaging Magma Under St Helens: University of Washinton (lead), Rice, Oregon State, Cornell, University of Texas El Paso, ETH-Zurich.

Student and Post-Doc Spotlights

Postdoctoral Researcher - Eric Kiser

As a seismologist, Eric Kiser studies the rupture properties of large earthquakes and the structure of the crust and upper mantle using seismic waves generated by natural earthquakes and man-made explosions. After graduating from the University of Illinois with a degree in geology, Eric started his research career as a graduate student at Harvard University. There he worked with his advisor, Miaki Ishii, using seismic array data to study some the largest and most interesting earthquakes ever recorded by modern instruments, such as the destructive 2011 Tohoku, Japan earthquake. Some of these ruptures lasted several minutes, traveled hundreds of kilometers, and took very circuitous paths while releasing stress that had been building for hundreds of years. Animations of their results for many of the massive events that have taken place over the last decade can be found at http://www.seismology.harvard.edu/research/backproj.html. In addition to being visually impressive, these results can be used to quickly assess hazards such as where ground shaking from an earthquake is likely to be strongest and the tsunami potential of the event.

The growing number of seismic arrays around the world is creating great opportunities to investigate the details of large and small earthquakes. These details may help us answer fundamental and societally relevant questions related to earthquake sources. For example, it has long been debated whether it is possible to determine the location of the next large earthquake along a subduction zone given the rupture details of a recent large event. The source imaging capabilities of the newly developed seismic arrays have already provided significant insights into this problem, and as new processing techniques are developed, these large data sets may make it possible to pinpoint regions with increased seismic hazard potential in near real time. Though Eric has moved away from this research for the time being, earthquake source seismology will be a major focus of his work in the future.

Eric's interest in the assessment and mitigation of natural hazards led him to Rice to work with Alan Levander on the iMUSH (imaging magma under St. Helens) active-source seismic experiment at Mount St. Helens, Washington. This project, which took place in July and August 2014, used underground explosions to generate seismic waves that will be recorded at temporarily installed seismic instruments within a 18,000 km^2 area centered on the volcano. While deploying instruments over such a large area where an eruption recently occurred is logistically challenging, this project should produce one of the best data sets ever recorded of a magmatic system. With this data, Eric hopes to image the locations and connectivity of magma bodies from the upper crust down to the Moho at about 35 km depth. This information, combined with results from other institutions that will be using passive-source seismic, magnetotelluric, and petrologic data, should provide insights into how the magmatic architecture controlled recent volcanic activity in this region, and what hazard potential currently exists at Mount St. Helens.

Graduate Student - Sally Thurner

The western Mediterranean is not just a great place to vacation—it also happens to be one of the most geologically and tectonically fascinating places on Earth. If you want to find out why, then you should talk to PhD candidate, Sally Thurner. Sally came to Rice in 2009 after completing an undergraduate degree in Geosciences at the University of Arizona. She is a global seismologist who enjoys all things Earth Science and has a passion for unraveling the Earth's tectonic history. Global seismologists use signals recorded from earthquakes around the world to determine the internal structure of the Earth. Their methods can tell us about structures as shallow as the Earth's crust to as deep as the Earth's core.

In particular, Sally's research has been focused on understanding the tectonic history of the western Mediterranean between Southern Spain and Northern Africa. This region represents a major tectonic boundary between the Eurasian plate and the African plate. There was once (about 30 million years ago!) a subducting oceanic plate between these two continental plates. Sally's research provides information about this major continent-continent collision and the fate of the oceanic slab that has was caught in between. It turns out that the once subducting oceanic slab is still attached to the base of the continent beneath Spain and Africa. Moreover, as the slab continues to fall deeper into the mantle, it is simultaneously removing pieces of the continental lithosphere, a phenomenon known to geoscientists as delamination. Thus, Sally's work has captured the final stages of a "dying" subduction zone and she hopes her work can be used as an analog for other subduction zones around the world.

Sally research is not confined to the Mediterranean. She has also been researching the deep crustal structure in the central U.S. Her research will change the way you think about the Great Plains. Although North and South Dakota may appear flat and boring from the surface, Sally will tell you that the subsurface structure is quite exciting. Using both seismic and gravity data, Sally's research shows evidence of deformation from the Trans-Hudson Orogeny, a major mountain building event that occurred over 1.8 billion years ago!

Sally's research in the Western Mediterranean has already been published in "Geochemistry, Geophysics, Geosystems"; there you can read the complete story of the fated oceanic slab. Also, remember to stay tuned to hear more about the preserved Precambrian structures in the Great Plains. But do not let her obsession with the Earth's mechanics fool you; Sally also sees the beauty the Earth has to offer. Check out her webpage http://www.owlnet.rice.edu/~smt4/index.html/Welcome.html to see pictures of some of the beautiful places she has been able to travel to as a geoscientist.

Graduate Student - Pankaj Khanna

Carbonate reefs are often referred to as "sea-level dip sticks" because most sea-level records, in particular during last deglaciation, are built on the need for coralgal reefs to vertically grow fast enough to keep up with sea-level rise in order to remain within the zone where light penetrates the

upper ocean; if the reef growth rates are not sufficient, the reefs leave the photic zone, give up, and cease to live. Reef morphologies evolve as a direct response to their struggles to keep up with high rates of sea level rise. My Ph. D. research focuses on quantifying these reef morphologies using state of the art imaging methods such as high resolution multi-beam bathymetry mapping of upper most Pleistocene (20-11 kyr old) coralgal reefs along the South Texas Shelf edge offshore Corpus Christi or drone-based photogrammetry for Upper Cambrian (500 myr) microbial reefs in Mason County (Central Texas).

My amazing journey in geology started from Himalayas foothills and brought me in August 2012 to the Earth Science Department at Rice University. The Himalayas always intrigued me since my childhood and, as far as I can remember, I wanted to learn about rocks, reason why I decided to enroll at University of Delhi (India) first in a Bachelor honor and then in a Master program in Geology. During my Master research, I developed immense interests in studying carbonates and hence decided to apply for Ph. D. graduate programs in the US to focus my Ph. D. research on reefs, and, lucky me, I landed at Rice, working with Prof. André Droxler.

Less than a month after my arrival at Rice, I started my PhD research in participating at a scientific cruise in September 2012 onboard R/V Falkor funded by the Schmidt Ocean Institute during which we collected very high resolution multibeam sonar data over 11 drowned carbonate banks on the south Texas shelf edge. We observed amazing morphological features, frozen in time, such as spurs and grooves, terraces, as well as small atoll morphology. These features are very important in understanding the evolution of these banks and also provide an excellent record on how ice sheets have melted!

My second and parallel research project used drones/quadcopters to collect very high resolution aerial imagery, after elaborate processing, to create 3D texturized point cloud models of a series of unique, spectacular, and surprising unstudied outcrops of Upper Cambrian microbial bioherms in private, but recently accessible, ranches in Mason county, central Texas. The goal of this project is to understand the spatial organization, overall architecture, and detailed morphologies of these bioherms, which are not only exposed on the cliffs on 2D but also on river floors in 3D. This research project is mainly funded by a consortium of oil companies, with the main objective to learn more about microbial reefs, an effort linked to the recently discovered pre-salt microbial reservoirs offshore Brazil.

Ultimately, in a comparative approach, my research will establish and contrast the various similarities and differences between transgressive coralgal and microbial reefs that grew 500 million years apart! Both reefs represent low-latitude, shelf edge, mixed siliciclastic carbonate system; their overall morphologies and organization are thought to be mostly the products of sea-level fluctuations. Obviously the organisms building those reefs were very different in the Uppermost Pleistocene and Upper Cambrian. Amplitude of sea-level fluctuations are also known to be much higher in the Pleistocene icehouse than in the Upper Cambrian greenhouse worlds but the fundamental process of sudden switch from siliciclastics to carbonates apparently applies to both, and the detailed morphologies of the reefs resulted in their struggle to keep up with the rates of sea level rise.

Initial results of my research have so far been published in various conference proceedings which include talks at GSA South Central-2013 and AAPG ACE-2014 as well poster presentations at AGU 2013 and AAPG-ACE 2014. I also participated at the IRESS 2014 poster student session in

which my poster was selected as the second best. I have recently completed a summer internship at Chevron, working with the Aerial imagery data set we collected in Mason, unraveling the mystery of the Upper Cambrian microbial reef morphologies.

Undergraduate Student – Victoria Yuan

Victoria Yuan is recently graduated senior whom originally entered Rice with interests in chemistry and social sciences. However after encountering quantum mechanics in her freshman honors chemistry class, she quickly decided that theoretical chemistry did not appeal to her. After taking Earth Systems and Cycles co-taught by John Anderson and Jerry Dickens and TA'd by Becky Minzoni, she realized the interdisciplinary and integrative nature of Earth Science was the perfect place to turn her interests to.

Victoria's first research experience began with a summer internship in an environmental analysis lab at the National Kaohsiung Marine University. This internship was her initial exposure to what a graduate school lab looked like and also taught her technical aspects of research. She returned to Rice and began working with Ph.D. candidate Becky Minzoni on Antarctic sediment cores as an undergraduate research assistant. This experience really taught her how the scientific process worked from formulating questions, to deciding research locations, and best proxies to use to address these questions.

During the summer before her senior year, Victoria participated in an NSF-REU at the Graduate School of Oceanography with Rebecca Robinson serving as her advisor. Her project involved creating a ~3 Ma record of denitrification from ODP Site 1242 and correlating changes in the denitrification signal with the development and intensity of oxygen minimum zones locally, regionally, and globally. She later presented her poster at the AGU Fall Meeting 2013 and at IRESS 2014.

To continue the experience of an independent research project, Victoria started a senior project at Rice under the guidance of John Anderson studying the sediment record of Maxwell Bay for any evidence of grain size capturing glacial erosion efficiency.

Victoria has also worked to serve the community is some way at Rice and in the larger Houston area. Being a first generation college student, Victoria has been active in mentoring other first generation college students and doing presentations at local high schools to answer questions of what the college experience can be like.

Another manifestation of this commitment is her participation as External Vice President in Rice Undergraduate Geoscience Society (RUGS). A group of Earth Science undergraduates decided to form RUGS to better serve the growing undergraduate population and to address concerns and desires in a more cohesive and formal manner.

With the efforts of Victoria and the other officers, RUGS held it inaugural event, a graduate school panel, on Friday March 14, 2014. The event was a great success with freshmen to senior

undergraduates attending and with a wide range of panelists from different backgrounds from both MS and PhD programs and faculty member Raj Dasgupta.

Victoria is now pursuing a PhD in paleoceanography/paleoclimatology at University of California, Santa Cruz. She will be co-advised by Christina Ravelo and Adina Paytan. Her research will involve studying how the Pacific warm pool has behaved in the past and variations in the El Niño-Southern Oscillation phenomenon. She hopes to continue to be engaged with undergraduates and other first generation scientists.

Alumni Spotlight

Alexander Ray Simms, Ph.D. 2006, Associate Professor, University of California – Santa Barbara

Alex's research revolves around using coastal systems to reconstruct past records of sea-level, climate, and tectonic changes. After working for many years along the Texas coast, Alex's current research has expanded to include the coastlines of Antarctica and California. He has recently developed two new methods for reconstructing past sea levels. The first uses Holocene microbial mats (similar to stromatolites) located within the intertidal zone of the upper reaches of semi-arid and arid estuaries. His research group recently showed that microbial mats from Baffin Bay, located in southern Texas, are able to faithfully reconstruct past sea levels to +/-30 cm for the past 5,000 years. Another method was developed for the coastlines of Antarctica. Using optically stimulated luminescence (OSL; a technique that basically dates the last exposure to sunlight), Alex and colleagues are obtaining ages of raised beaches based on dating the underside of cobbles. The premise is that the last time the cobbles were exposed to sunlight (e.g. resetting the OSL "clock") is when they were actively being turned over in the surf zone near sea level. The raised beaches are recording the post-glacial rebound of the continent due to the ice that has melted since the last "ice age".

Since moving to more "hospitable" climates, Alex has turned his attention to using coastal deposits to understand the tectonic events of the California coast and the general characteristics of marine deposits along active margins. This includes examining how tsunamis affect coastlines and using the sedimentary record of local coastal marshes to reconstruct the history of tsunami inundation of the southern California Coast. He is also involved in a project that is investigating the characteristics of unique sea floor fans in 30-70 m of water along the northern Santa Barbara Channel.
Even with new research in Antarctica and California, Alex continues to enjoy looking at his old thesis area. He recently completed a project with his former PhD advisor – John Anderson – determining the long-term (100,000 year) subsidence for the Texas coast. He also continues to investigate the intrinsic controls on how bayhead deltas along passive margins such as the Texas coast respond to sea-level rise and fall.

IRESS 2015

Industry-Rice Earth Science Symposia

The 2015 Industry-Rice Earth Science Symposium (IRESS 2105) theme is *New Geological Targets, Technologies, and Challenges: Our Continuing Dialog with Industry*. The symposium will be March 11-12, 2015 in the Grand Hall of the Rice Memorial Center.

Building on the success of IRESS 2014, we are hosting a symposium with technical talks by Rice faculty and industry experts, an energy vision session, two poster sessions, and a dinner speaker (http://iress.rice.edu/schedule_2015.html). Technical talks will cover topics including new plays in Mexico, Colombia, and Venezuela, seismic imaging and interpretation, shale properties, microbial reefs, and carbon isotopes in methane-rich sequences. In addition, Andre Droxler will lead a post-IRESS field trip (March 13-15, 2015) to visit Upper Cambrian Microbial Carbonates in Mason County (Central Texas).

We anticipate a symposium with engaging talks, lively discussion, and collaborative education, so please visit the website (iress.rice.edu) and register to attend IRESS 2015. Also share the IRESS information with your colleagues; the event is open to all.

Alumni continue to play a major role in helping shape the symposia agenda and in securing support for this initiative. Thanks to the efforts our alumni our corporate sponsorship for IRESS 2015 has surpassed that for IRESS 2014. In addition, personal philanthropic gifts have helped increase the endowment. Please contact Nellen Hawkins at 713-348-5824 or nellen.hawkins@rice.edu 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).

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

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____ 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.

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Or go to the following URL: giving.rice.edu
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Special thanks to our staff!

The department staff continues to help maintain smooth and efficient operations in the department. For all of their efforts and assistance, we thank Martha Lou Broussard, Sandra Flechsig, Susi Haveman, Clinton Heider, Bonnie Hoffman, Yolanda Jara, Pat Jordan, Mary Ann Lebar, Denise Mayberry, Dora Pedraza, Roger Romero, Soookie Sanchez, and Lee Willson.

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