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NEWSLETTER OF
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SESE Source

THIS ISSUE

EVENTS

Outreach event: Akimel A-Al Middle School
Nov. 30

Astronomy Open House
Dec. 3

SESE Holiday Party
Dec. 8

SESE Reception at AGU
Dec. 14

Geoscience exhibit displays 'Trail of Time'

By Nicole Staab Cassis

Spectacular in its depth and breadth of beauty and unequaled in inspirational power, the Grand Canyon is a natural masterpiece. Acting upon the canyon's potential for public geoscience education, scientists coordinated the construction of the world's largest geoscience interpretative exhibit: the Trail of Time. This interpretative walking timeline trail focuses on the Grand Canyon's vistas and rocks and aims to guide visitors toward a better understanding of time.

After 15 years of work and all the accompanying trials and tribulations of putting together a major partnership most people would be happy with simply snipping a ribbon to signal the project's completion. The official opening of the Trail of Time, however, went far beyond a basic dedication ceremony; project organizers brought together an impressive gathering of high-profile geoscientists, informal geoscience education researchers and science interpreters for a three-day symposium. Speakers discussed at length how people understand complex topics such as geologic time from several angles, including the academic side, education side and psychology side.

"We decided that not only is it a celebration of a great exhibit but this opening might be a chance to bring together people from all over with different expertise to talk about how we effectively communicate geosciences to the public," explains Karl Karlstrom of the University of New Mexico (UNM).

Karlstrom, along with Laura Crossey also of the UNM, and Steve Semken of ASU worked as the three principal investigators. Michael Williams of University of Massachusetts was a close collaborator; UNM graduate student Ryan Crow was an integral member of the team, and Judy Bryan, chief of interpretation at Grand Canyon National Park, was the primary collaborator between the team and the National Park Service.

continued on page 2

continued from page 1

It took 6 million years to carve the world-renowned steep-sided chasm, but the canyon is actually considered a very young feature geologically. What is often overlooked by the millions of visitors each year is the fact that the rocks exposed in it are about 2 billion years old. The age of the canyon pales in comparison to the age of the rocks within it.

But in our instantaneous society where we expect immediate email responses and depend on fast-food meals, how do you make 'millions of years' have any meaning? To us, 1 million seems unimaginably long. Time is easily comprehended when it is measured in increments of years. While this unit is adequate when looking back on recent human records, it is insufficient for discussing geologic time, which spans 4.6 billion years. Conceptualizing and comprehending time when it spans anything more than a few centuries is a challenge for many people.

A grasp of the magnitude of geologic time is the foundational knowledge needed to construct an understanding of many aspects of our planet and the universe, yet it is something that most people rarely engage with or are even taught.

"Our hope is that Trail of Time visitors will walk away with a better understanding of how human time scales relate to geologic time scales," explains Semken, associate professor in SESE. "Geologic time is one of the most significant ideas that science has ever come up with. It accurately accounts for humanity's place in the universe and it also shows us how profound and how old and how vast the universe is in terms of time. It's something that you have to learn in order to really understand other key scientific concepts, such as biological evolution."

National parks are premiere locations in the world in terms of informal science education and they are sometimes the only place where people go to learn science, especially earth science. These parks play an enormous role in educating broad cross sections of the public about earth science, the principles of earth science, and earth science processes.

Canyon's magnificence and its recognition as one of the most famous geological landscapes in the world sets it apart from other natural features, but its extensive exposure of geological time is also unique. Karlstrom, Crossey and Michael Williams of the University of Massachusetts, all Grand Canyon geological researchers for decades, first envisioned turning a Grand Canyon hiking trail into a walking timeline that would represent the magnitude of geologic time. Semken joined the team years later to help realize the potential of the project for how people learn about geologic time.

The layout of the trail was based upon simple math. Since the oldest rocks at the Grand Canyon are 1.8 billion years old (1,800 million years), this means 1,800 meters of trail (almost 2 km) is needed to represent the history of the Grand Canyon. At every meter of its length, the trail is marked with inset bronze disks, each meter symbolizing 1 million years of Earth's history.

Imagine that one long stride represents a million years, and you have to take 2,000 of those strides just to get to the age of the oldest rock in the Grand Canyon, which is less than half the age of the Earth. By walking this timeline trail, visitors get a physical as well as intellectual sense of how long geologic time is.

Funded by the NSF Informal Science Education Program, this was the first time that any National Park Service site has participated in a project of this type. Many other types of exhibits and curricula have been created to address geologic time, but there is nothing comparable in scale or scope to the Trail of Time, according to Semken.

For Rebecca Frus, a SESE graduate student focusing on earth science educational research, the Trail of Time is now officially part of Grand Canyon National Park, but that doesn't mean the project is complete.

"Most people here would agree that it's not done. Some people still have to work on the trail, and other people like me are still finishing research," explains Frus, who is writing her thesis under Semken's supervision on how visitors understand the relationship between the horizontal timeline and the vertical strata represented in the walls of the canyon. "It's nice to say it's now officially part of the park but it doesn't feel done."

Nearly 50 park service employees from across the country attended, with several expressing interest in exporting the Trail of Time idea to other national parks and incorporating the concept into the local landscape.

"The hope is that this workshop will lead to new ideas which we can give to the park," says Karlstrom. "This group of experts has recommendations and they are: geosciences education is needed, we need to do it better, and here are some specific ways to do it. The Trail of Time is one example, but many other good ideas are emerging already from the workshop."

Work also remains to be done on the web-based virtual Trail of Time, which will be a resource available to those who cannot visit Grand Canyon in person, and will also enhance the learning experience for those who do hike the Trail.

Eye-Tracking Technology

By Delia Miranda and Nicole Staab Cassis

Geology is among the most visual of the sciences, with photographs being one of the main ways that geologists conceptualize and communicate geologic information. Learning college-level geology usually requires students to combine visual information with written text, and in many introductory geology classes textbooks are the primary source of content information. SESE graduate students Melanie Busch and Joshua Coyan, under the advisement of Professor Steve Reynolds, are conducting geoscience education research to better understand the role of text, figures, and visualizations in student learning using an innovative tool that tracks eye movement.

Reynolds, who specializes on the structure, tectonics, and regional geology of the Southwest, is also one of the country's top researchers in geoscience education and geocognition. He was the first geologist with his own eye-tracking laboratory, which provides a way to explore and document where students focus their gaze and how they integrate information from the text and pictures while they are learning. He and his students use the tool to investigate how undergraduate students interact with and learn from geologic photographs and other visual aids such as diagrams, illustrations, and 3D animations.

"The resulting data can be processed to determine where, how long, and how many times a participant looks at a specific location," explains Busch. In most cases, a person is thinking about whatever it is that he/she is looking at. Thanks to data provided by the eye-tracking technology, Busch and Coyan can infer something about students' cognitive processes.

The researchers have students sit in front of the eye tracker, which is housed in a box below the computer monitor. One camera records eye movements while another tracks head movement. The head camera enables the eye tracker to collect accurate eye fixation data even if a student has moved his or her head.

Busch and Coyan strive to answer three main questions: 1) How do students interact with textbooks and how can we better design and use textbooks to promote student learning; 2) Are objects that show scale in photographs distracting or do they help draw the student into an image, and how do they affect student learning from photographs; and 3) Is there a difference in how a student interacts with a 2D versus a 3D image.

Geology is taught using images that usually include an object for scale. One interesting observation the team made was that scale objects can be distracting and prevent students from focusing on the geologic content in the image.

"When students look at a geologically rich photograph that contains a human for scale, the human can be a major distraction and in some cases we have found that students will look at the human scale as much as 70 to 80% of the time they are allowed to look at the image," says Coyan. "This can have adverse effects on learning."

They also found that even when the geology featured in a photograph extends to the edges of an image, novice geology students primarily only look at the center of the image.

Based on these types of observations, the team is able to make recommendations on how best to use photographs when teaching. A better understanding of how students learn can eventually lead to the development of improved teaching materials and methods. Busch's specific area of research is observing how students integrate text and figures while learning geology, and Coyan is exploring how students look at and learn geology from photographs of geologic features.

"I'm learning how people take in information when first learning geology and how to most effectively present new information to learners," says Busch. "Regardless of my career path – teaching, presenting research results, etc. – this research will help me to be a better communicator."

Eye tracking has been used in several capacities, from advertising and product design, to psychology studies and now in the field of geoscience education. Coyan and Busch are already seeing a trend in textbook development in which authors are striving to create books that are consistent with the cognitive processes of the learner. A fitting example is Reynolds' recently published Exploring Geology, an innovative and successful college textbook designed from cognitive and educational research.

Reynolds reports, "Through this research, we have the potential to totally change the textbook paradigm and how we teach introductory classes. Our research shows that tight integration of text and distraction-free figures is critical in student learning – students who keep referring to figures while they read the text learn more than students who do not. We need to redesign our teaching and curriculum to promote this integration. If we can determine how to do this, and document the learning gains, we can change the world of undergraduate education."

The Island of Java: Explorations in Mud and Magma

By Matthew C. Button

While the world turns to examine the human effect on global warming, some scientists like Associate Professor Amanda Clarke and SESE graduate student Jean-François Smekens are looking at the way the earth is cooling itself. But what is truly interesting is that volcanoes, with all their connotations of fire and destruction, may be playing subtle roles in cooling the climate. Smekens is focusing on volcanism, and has for the past few years been interested in volcanic emissions specifically in persistently active exploding volcanoes.

"These volcanoes are making small explosions, but on a regular basis, so they are really small explosions that happen every hour or so, and they can be active for decades like that," Smekens says.

These smaller volcanoes are constantly releasing a gas known as sulfur dioxide (SO_2) during these regular and miniature explosions. SO_2 transforms into sulfate aerosols when put into the atmosphere and these particles have radiative properties which tend to reflect sunlight away from the atmosphere rather than absorbing and heating it. In this manner SO_2 gases can contribute to global cooling, however, not all volcanoes produce SO_2, or produce it in vast amounts.

The fact that volcano emissions cool the earth is not a new concept; historical evidence has shown a correlation between massive eruptions and colder winters. Even as far back as 1816 during the "Year without a Summer" when Indonesia's Mount Tambora released a massive ash cloud and SO_2 gases which caused frosts to last into July in areas far from the eruption such as New England and Northern Europe. However Smekens and Clarke are not interested in these massive single and short eruptions, such as the more contemporary example of Mount St. Helens. These giant explosions do release SO_2 into the air because of their sheer vastness, but Smekens believes that the thousands of smaller volcanoes whose smaller releases are constant may also play a role in climate change.

"We want to look at whether the contribution of these smaller volcanoes is negligible by quantifying their output of SO_2," says Smekens.

Previous techniques for measuring SO_2 output involved looking at satellite images however often times the gaseous plumes of tiny volcanoes cannot be accurately perceived, let alone quantified. Many of these smaller volcanoes exist in Alaska and the Russian Kamchatka Peninsula.

Measuring the amount of gas being released from a burning hot ash plume atop an active and dangerous volcano is not so easy a task. Smekens employs a special ultraviolet (UV) camera which measures sunlight passing through the gas plume. If SO_2 is present in the plume it will absorb part of the UV light and the camera will notice this difference in UV concentration against the background of the sky. The camera creates a 2d concentration map of the plume every five seconds, making thousands of images that when strung together and analyzed through a specially designed program can measure the amount of SO_2 output. Because of this observations can only occur during the day when ultraviolet light is provided by the sun.

Smekens and other scientists in his group have used this technique to measure the output of Santiaguito, a volcano in Guatemala. Of course the technique is not flawless; the ash output of the plumes can block the UV being picked up by the camera. This problem affects satellite assessment of these plumes as well, and most of these volcanoes are so small the plumes cannot be perceived from space. The accuracy of the findings can be checked by examining the UV light penetration of the gas cloud on several wavelengths, or by using Differential Optical Absorption Spectroscopy (DOAS) to find the concentration at specific points of the gas plume. The advantage to their newer method is the special 2d measuring it allows, rather than simple single point analysis of the past.

"One of the things we've put into the proposal is a point source method that works simulta-

continued on page 5

continued from page 4

neously with our UV camera. One of these methods is DOAS, which is better calibrated for measuring the amount of gas at a certain point. So we can validate the special images created by the UV method, by checking them against the spectrometer's findings," Clarke explains.

Virtually no data about these smaller volcanoes exists so Smekens and his collaborators have been looking at several of these similar types of volcanoes. Santiaguito, a Guatemalan volcano, active since 1922, has average eruption intervals around a half hour and continuously injects SO2 into the atmosphere. Smekens hopes to use this UV camera technique to examine these volcanoes for long periods of time.

"For this one [the initial Santiaguito, Guatemala trip] I worked on a thousand images, but the hard part was writing the program, and that's done. These thousand images were only for two hours of observation. We hope to go into Indonesia and observe a bunch of volcanoes for eight hours a day for three weeks," Smekens says.

This goal is to assess the long-term behavior of these numerous smaller volcanoes in regions of Indonesia where they are prevalent. Quantifying the exact amount of gases released by minor volcanoes can offer clues to how they act as natural balancers against Man's affect on global climate.

Un-Muddling Mud Volcanoes

By Matthew C. Button

Just twenty miles north of Smekens' SO_2 measuring site, Clarke has another project brewing in the web of volcanoes across Indonesia. Last summer she and a team of geologists and specialists in hydrological systems, including the project's main collaborator Hilairy Hartnett, were able to travel to the small island of Java to examine mud volcanoes.

At first glance Java seems to be a tropical paradise, but a closer look beneath the surface reveals the island is a result of massive collision of the Indonesian and Pacific tectonic plates. As the Indonesian plate is thrust up forming mountain ranges of south Java, to the north the pacific plate is pushed down and warped, bent under the mega-tons of pressure between floating crust. In this crinkled area, what geologists call a "subduction zone" where plates overlap and form a basin, sediment from the surrounding line of volcanoes builds up atop natural deposits of oil and gas to form high pressure mud pockets – and mud volcanoes. These are similar to surrounding magmatic volcanoes except instead of fiery molten rock oozing from beneath the earth thick mud does.

Mud volcanoes appear all over the world from the small ones in California's Salton Sea to those in Azerbaijan and India. Indonesia is unique in its concentration of mud volcanoes.

In 2006 an exploration drilling exercise in Java led to bizarre activities around a fissure line in the small town of Porong, Sidoarjo. Increases in activity in the surrounding volcanoes, drilling and a minor earthquake recorded just a week before might have been causes of the massive mud volcano explosion, leaking out enough mud to bury multiple warehouses. The activity at these mud volcanoes can fluctuate from bubbling or oozing out slowly to fountains of mud similar to magmatic volcanoes (without the magma).

"Because it's a mud volcano it's not really a volcano – it's not my expertise ... but many of the techniques you would use to monitor behavior and changes in the volcanism are applicable," explains Clarke.

Some scientists see the mud volcanoes as part of a larger cycle connected with magmatic neighbors, flushing the sediment and water still hot from magmatic activity to the surface elsewhere.

"We want to monitor these volcanoes in order to determine if the amount of mud and gas coming out is changing, so we can assess the future evolution, and find out how they're output of mud will change," Clarke says.

Mysteries about connections between surrounding magmatic hydrothermal systems and perpendicular fault lines and earthquakes are the fundamental topics these experiments have the potential to shed light on.

Coral fossils within the mud can give hints of the depth and age of the sediment. The Java Basin was at one time under the ocean, and these fossils are evidence of the oceanic sediment deep beneath. But the rate at which the volcanoes spew mud is important for the safety of local communities. Though most of the effects of the volcanoes are minimal – seeping into homes and buildings and ruining farm fields – they have in rare cases been known to kill. Communities are actually directing the mud flows from the mainland to the sea via canal in an effort to salvage properties in the area of the eruption.

Although still in the proposal stage, Clarke plans to make another visit in 2011 to examine those natural messes that have baffled locals for centuries.

Dust in the Air and the Climate Scare

By Matthew C. Button

CalNex 2010, a massive multi-million dollar project, aims to understand air quality, climate change, and their connection in California and the eastern Pacific coastal region. It is funded by the California Air Resources Board, the National Oceanic and Atmospheric Administration, and the National Science Foundation. SESE Regents' Professor Peter Buseck is a participant in this project, with the specific goal of determining the nature, composition and other properties of aerosol particles in Los Angeles, Calif. air and their interactions with sunlight and subsequent effects on climate change.

Aerosol is a term that many people correlate to the fruity hairspray that cosmetologists use to hold those frazzling curls, but from a scientific standpoint aerosol refers to a suspension of fine particles or liquid droplets in a gas. These suspensions can exist in the air as smoke, smog, pollen, or oceanic haze, and they can come from cars, factories, sea spray and innumerable other sources. Aerosol in the atmosphere also forms from gases such as sulfur dioxide and abundant organic compounds, and volcanoes also produce vast amounts of aerosol.

"Much research has been done on the effects of gases on climate change, but detailed consideration of aerosols has lagged behind, although that situation is changing rapidly," Buseck says.

Buseck and his team have been part of previous initiatives, such as a similar analysis of Mexico City's air quality. However, most previous studies have focused on aerosols as ensembles or averages, whereas Buseck sees that magnification of individual aerosol particles can reveal significant details that may be overlooked in the convenience of averaging.

Buseck also explains that there are common misconceptions about airborne particles. Most people might assume these bits of matter floating about in the breathable air are spherical and relatively pure materials. However, close examination under a Transmission Electron Microscope (TEM) reveals that generally this is not the case. Although liquid droplets are indeed spherical in the air, most solid particles have irregular shapes, a fact that is important when considering the way they interact with sunlight and thus influence warming or cooling the atmosphere and, eventually, climate.

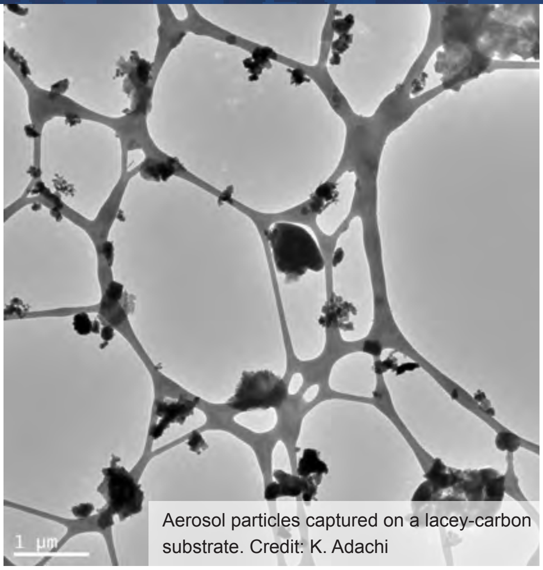
These TEM images often end up looking like cocoons of particles, bound up together in webs of lacy carbon and speckled with different particles. These speckles can be identified by their their signature structures, shapes, and compositions, and the web-like structure is the part of the filter that Buseck and his colleagues use to gather particles.

To examine the air and the miniscule particles it contains, air was drawn into filtered canisters to collect particles for further examination by Kouji Adachi, postdoctoral research associate in Buseck's group.

"Each canister has three chambers, which have smaller and smaller entrances for particles, so we can look at three sets of different sized particles," Adachi explains.

Postdoctoral research associate Kouji Adachi tending an aerosol sampler on the roof of a building at CalTech during the CalNex campaign.

These specialized canisters, as well as sampler instruments from many other government and university groups from around the globe, were placed on the roof of a building at the California Institute of Technology (CalTech), 10 miles northeast of downtown LA. Samples were then collected at different intervals throughout the day. The samples were returned to ASU and examined with the TEM, revealing the composition, 3D shapes, structures, ingrowths, and aggregations of the tiny aerosol particles.



Aerosol particles captured on a lacey-carbon substrate. Credit: K. Adachi

Specifically, Buseck and Adachi are observing and measuring the different parts of the individual aerosol particles. This can mean looking at the particle as a whole or examining a single part, such as organic matter, soot, metals, sulfates, sea salt, or carbonates.

The parts of the particles are what most intrigue Buseck because what's inside a particle can affect whether it scatters or absorbs sunlight. Knowing that myriads of particles exist within our skies, their presence and their reflective and other optical properties can determine whether sunlight will reflect back into space or penetrate the skies and contribute to global warming. Of course the particles can have other effects. For example, aerosols within coal mines have long been known as causes of black lung disease, and smog often affects the visibility of our skies, but the primary focus of Buseck's research is on the aerosol's implications in the realm of climate change.

"Gases affect global changes, whereas aerosols can have their greatest effect on local and regional scales," Buseck says. Particles especially affect the climate around mega-cities such as LA where polluting aerosols are heavily concentrated.

Buseck and Adachi are in the preliminary stages of interpreting the data they've collected from CalNex. An intriguing effect they've noticed is the difference between samples taken at night versus during the day. Understanding why this day-night difference occurs could be essential to understanding when and what types of air pollution are produced.

ALUMNI PROFILE

Steve Kadel

Glendale Community College Professor

By Matthew C. Button

In 1990, Steve Kadel was a soon-to-be graduate of the University of Virginia (UVa) and ASU was his school of choice for graduate studies — not simply because of the weather and the exceptional ranking as a geology program, but because the school offered opportunities to travel and as the saying goes: "see the most rocks…and be the best geologist."

"You know [ASU] is a big school, but once you're in a graduate program it's more like a community and the size issue is much more peripheral," explains Kadel.

Despite differences between the close-knit traditional theme of UVa and the urban enormity of ASU, Kadel did his graduate work from 1990-1995 as a geology major under ASU's geology department, which is now part of SESE. Kadel has since worked both in the field and the classroom participating in a broad spectrum of projects from educational outreach to data analysis for NASA's Galileo Mission.

Kadel describes Ron Greeley's Planetary Geology Group (PPG) as having the most influence during his ASU experience. Through PPG Kadel helped with the brute data analysis of the Magellan and Galilieo mission. Kadel's focus was on volcanism, and during his time at SESE many of his projects reflected that choice of focus. He was also allowed to analyze lava tubes in Hawaii and Mount St. Helens. PPG was the first and only research group actually given permission by the park service to drill into the floor of these tubes and examine the thermal erosion beneath. Thanks to PPG he was able to take several field trips, which were his favorite part of his experiences at ASU, including a 17-day tour of geologic features of the Pacific Northwest, and a seven-weekend mapping project of the Goldfield Mountains.

"The main thing I love is all the field experiences there, and I get a feeling, without getting heavily involved, that that's getting harder to do, to take as many field trips," explains Kadel. "I mean in Arizona you can do everything and California is next door – it's a volcano paradise and a tectonic paradise, fossil stuff up north into Utah – it's just a great location."

After leaving ASU in 1995, Kadel worked for an environmental consulting firm doing practical field services from soil logging, to report writing, document searches and teaching part time at community colleges. After two years, during occupational fluctuations of the nineties in the shrinking environmental sector, Kadel's company collapsed and he returned to ASU as a research specialist for a year. During this time he worked on the Jupiter aspect of the NASA Galileo mission doing remote sensing, and also educational outreach projects. After a year back at ASU, Kadel was hired full time to work for area community colleges. From this point on, Kadel changed his focus from research to education.

"It's interesting because I still like the field experience, if anyone wants me to tag along with a geological eye and help out I'm always excited to do that, but mainly I find that although I can do the research and it's interesting to me I like the satisfaction of having the students in front of me and seeing the progress they're making and feeling that I'm making a direct impact," Kadel says.

Kadel is currently working as a tenured full-time instructor at Glendale Community College. He has also aided publishing companies produce introductory geology textbooks, and has recently finished animations for a textbook that aids student comprehension. He sees the community college system as a great system for learning, with small flexible classes and new students whom he can take on his own field studies. He has created several trips for his students such as an annual field course called "Fire and Ice" a 6-10 day trip that goes from death valley up through Owen's Valley in eastern California looking at volcanic features, and then progressing to Yosemite to look at a glacial features. This field tour was featured in a documentary by Maricopa Public Television, available for viewing at the bottom of the page **here**.

Kadel advises current geology majors to take advantage of all possible in-the-field opportunities while they have the supplemental funding of a massive university. Just two months ago he accompanied a colleague to Brazil to examine basalt impact craters. The most memorable trip he has taken was one to Iceland where he was able to observe a plethora of volcanic activity. Be it for official research, to teach, or for personal intrigue Kadel sees field trips as essential for any success in the area of geology.

"The great thing about it is that I can create these trips, as long as we do the background work, and we can run it every few years and people with little or no knowledge of geology can find a true passion for it," says Kadel.

News and Views Fall Roundup

We would like to take this opportunity to recognize the following students and faculty for their recent accomplishments and hard work.

Ariel Anbar, Prof. — Invited to discuss his recent work on unlocking the secrets of oxygenation of the Earth's ocean and atmosphere on the local NPR affiliate KJZZ.

Arjun Heimsath, Assoc. Prof. and SESE Graduate Students
Put together material and helped present it to a group on the "Friends of the Pleistocene" trip in the Henry Mountains of Utah.

Bryan MacFarlane — Recipient of a Courtright Scholarship awarded by the Arizona Geological Society. MacFarlane is currently pursuing his M.S. in Geological Sciences.

Everett Shock, Prof. —
The name *Thermogladius shockii* is proposed for a new organism found in Yellowstone National Park, in honor of Everett Shock who pioneered the investigation into Yellowstone hot springs with coupled culturing, phylogenetic, geochemical, and thermodynamic approaches.

GeoClub — Donated $865 to the Ravi DeFillipo Geology Field Camp Scholarship Fund.

James Rhoads, Assoc. Prof. — Named a faculty exmplar by the university for his talent and hard work. Rhoads' work represents the ideals of the New American University.

Richard Fisher — Joined the SESE team in August to help with design and planning for the new exhibit/outreach space in ISTB4.

Rose Petrini — Filling our long-vacant SESE front desk position. She will be covering the 9 a.m. - 1 p.m. shift. Please be sure to welcome her to SESE and introduce yourself, if you haven't already.

Space Grant Students — A special thanks to the Space Grant interns (and support staff) who volunteered several hours this semester at outreach events.

Tom Sharp, Prof. and ESE Day Volunteers —
Congratulations and thank you to all those who helped make Earth and Space Exploration Day such a huge success this year! The winner of the petrified bowl raffle, donated by GeoClub, was Kenia Jimenez. Runner-up prizes went to Shirley Weng and Zame Arrandale.

Vithal Tilvi — Recipient of the Rodger Doxsey Award from the American Astronomical Society for his dissertation abstract. Tilvi is currently pursuing his Ph.D. in Astrophysics.

Photo Focus — Kip Hodges examines the framework of what will be the first floor of ISTB-IV during a site visit in October.