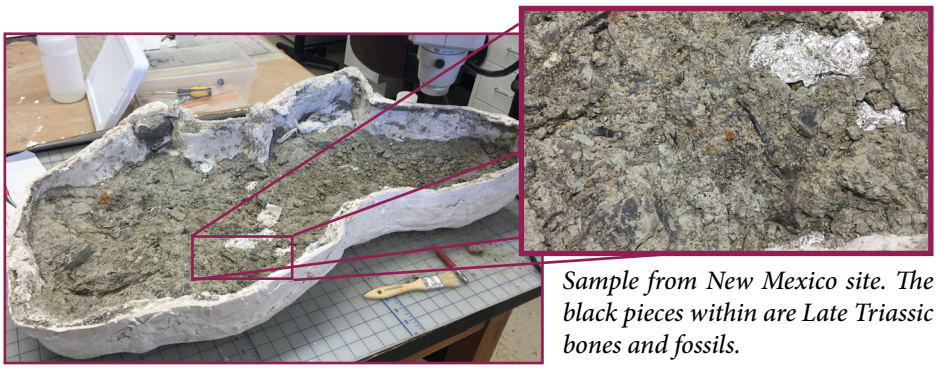
Department of geosciences at Virginia Tech

February Newsletter

Geosciences February Highlight

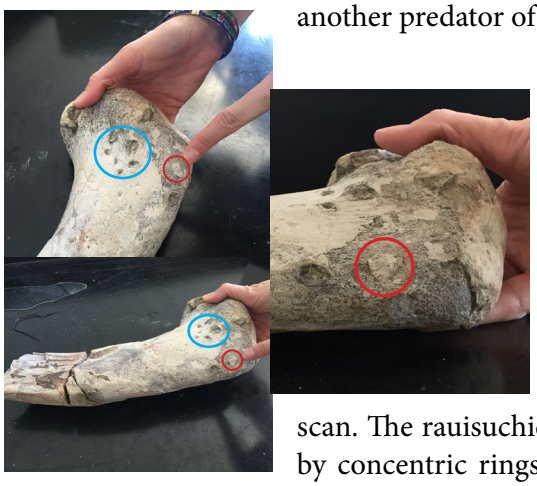


Sample from New Mexico site. The black pieces within are Late Triassic bones and fossils.

250 Million Years of the Crocodile Family Tree

Jump back in time along the branches of the crocodile family tree, and one discovers crocodile ancestors that galloped on land, others that had horns, and still others that were plant-eaters with short pug-like snouts. Jump even further back, into the Late Triassic, and phytosaurs -- which share a common ancestor with crocodiles and birds -- pop up. Phytosaurs may have looked superficially like crocodiles, but they could grow up to 20-25 feet in length, with mouths full of huge carnivorous teeth. There's even evidence they date back to the Early Triassic, which means a 30-million-year gap in their evolutionary record to account for. It's not hard to see why Michelle Stocker is fascinated by this ancient and venerable reptilian family tree.

Some of Stocker's more well known research involves discoveries she's made with Sterling Nesbitt at fossil sites located near Ghost Ranch in New Mexico, including an entire phytosaur tooth that nearly pierces through the bone of a rauisuchid, another predator of that time period.



Rauisuchids were land-dwelling, carnivorous creatures that weren't thought to interact much with the crocodile-esque phytosaurs. This thigh bone proved otherwise. The phytosaur tooth (circled in red) lodged so far into the bone it nearly pierced through, as the researchers discovered via CT scan. The rauisuchid survived that attack, as evidenced by concentric rings around the tooth where the bone healed. However, other holes in the bone (circled in blue), made by a later phytosaur attack, indicate the animal was not so lucky the second time.

Continued on page 3...

What's Inside

Geoscience Students in the News

From The Roanoke Times:

"Virginia Tech student Thomas Wood looks through a microscope while using an airscribe tool, described as a tiny jack hammer, to remove particles of rock from a fossilized dinosaur specimen from New Mexico Tuesday."

Geosciences in the News

From USGS Press Release: Graduate student, Brady Ziegler, is a member of the research team studying arsenic levels in an aquifer contaminated with crude oil near Bemidji, Minnesota. In 1979, a pipeline ruptured there, spilling oil onto the ground and near a wetland. USGS teams have monitored the site for over 30 years, tracking the oil plume as it migrated through the ground water.

The team Ziegler works with was recently brought on board to determine if arsenic levels increased near the plume. Microbial processes at oil spills increasingly convert Fe III to Fe II, causing Fe II to dissolve into groundwater. Naturally occurring arsenic in aquifers typically attaches to solid Fe III, but reduction of Fe III to Fe II reduces attachement sites for arsenic. As levels of Fe solid III decrease, levels of dissolved arsenic in the water increase.

The research Ziegler helped with, and which is described in this USGS press release, provides information about how arsenic levels in the water have changed. It also provides evidence that the dissolved arsenic has not drifted beyond the petroleum hydrocarbons of the oil plume. Ziegler is a student of Madeline Schreiber, seen in the USGS photo to the left.

From VT News: The Italian Society of Mineralogy and Petrology recently awarded honorary fellowships to Nancy Ross, professor and head of the Department of Geosciences, and Robert 'Bob' Bodnar, University Distinguished Professor and C.C. Garvin Professor of Geochemistry.

"'To have two members of the same department chosen for this honor is really quite extraordinary," said Lay Nam Chang, Dean of the College of Science.'

From VT News: A first-year geosciences student, Anna Montgomery, was part of a five-person team that designed an award-winning NASA project to address radiation exposure in space flight.

"Team ARES memebers and current Virginia Tech students Christopher Dobyns and Anna Montgomery, fourth and fifth from left, worked with NASA and Lockheed Martin to study space flight radiation exposure."

Sterling Nesbitt made a couple appearances in Virginia Tech news for his research with the paleontology department. Both he and Michelle Stocker were recognized in the Virginia Tech 2014 Year In Review for their work on the phytosaur tooth, mentioned in this newsletter's feature story. He was also recognized by VT News in January for one of his most recent papers, in which he gave the name, Nundasuchus, to a previously unknown, ancient reptilian animal he discovered in 2007.

Above: Nesbitt in the Paleontology Lab (2014)

Right: Nesbitt at the Tanzanian site of his discovery (2007). Photo by Dr. Roger Smith, Iziko Museum, South Africa.

Paleontology continued...

Then there's Stocker's favorite fossil: it's the skull of a very young phytosaur, also from the New Mexico site. Fossils of young animals are important because they help paleontologists understand how a species grew and developed. Among the features that confirm this is a juvenile phytosaur's skull, rather than that of a small animal, are the disproportionally large eye sockets and the needle-like tooth cavities. Similar proportions are seen in baby alligators today. Stocker will use CT scans of the small skull to develop a better understanding of the brain cavity and neural pathways for young phytosaurs.

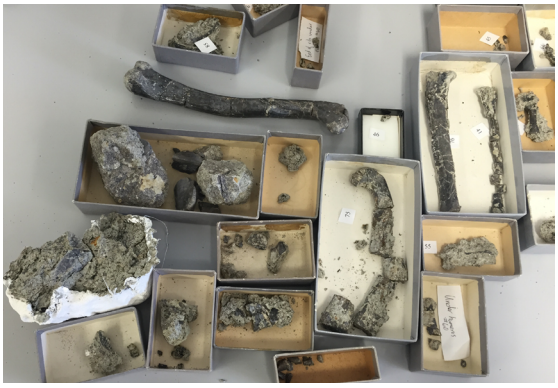
Stocker's work also extends into Texas, Wyoming and even Tanzania. In Texas and Wyoming, Stocker's research jumps ahead a couple hundred million years to the Eocene, where she's researching a previously undiscovered species of legless lizards known as amphisbaenians. Her work at these sites will help researchers develop a better understanding of how ancient climate changes affected this species and their relations. Meanwhile, in Tanzania, Stocker is working with a team that's recently uncovered the bones of another previously unknown animal within the crocodile family tree.

Right: Stocker doing Eocene fieldwork in Wyoming.

Left: Stocker putting a bone back together in Tanzania

Stocker has been at Virginia Tech for barely more than a year, but already her infectious love of paleontology has spread. She's contributed to the growing media attention the paleontology department has garnered lately (highlighted in other sections of this newsletter), and she helps run the paleontology labs, working closely with students and volunteers to clean and prepare fossils.

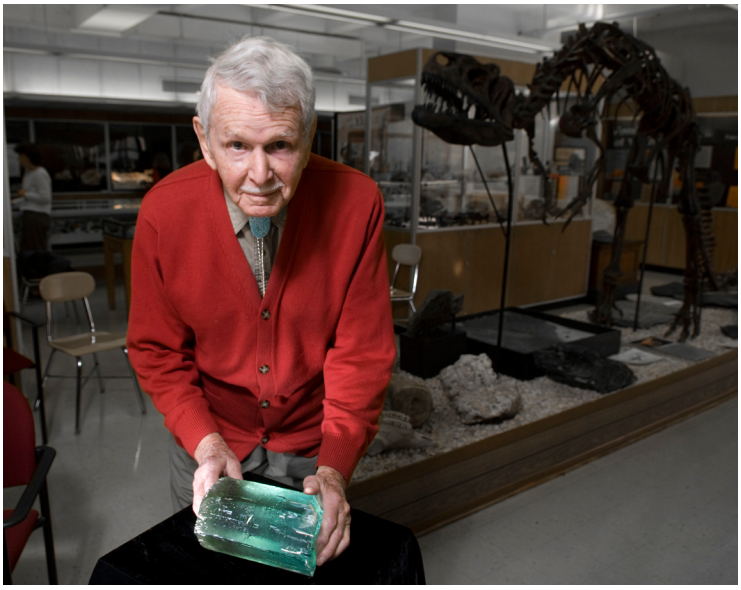
Get Involved!



The VT paleontology lab needs volunteers. Samples collected in a wrap made of burlap and plaster (seen on the front page) are brought back to the Virginia Tech paleontology labs, where students and volunteers work dilligently to remove dirt and debris from each piece of bone. Once fragments are cleaned, the task of reassembling them begins, which is akin to a puzzle on steroids.

It can take 10 times longer to clean and reassemble bones than it takes to find them in the field, and that task simply can't be completed by the researchers alone. However, because of the nature of the work, they're looking for people who can dedicate at least 5-10 hours per week, and preferably someone who's good with their hands and is detail oriented. If you know anyone who might want to get involved working with fossils, please have them get in touch with any of the researchers involved in the paleontology lab.

In Memory of Dr. Arthur Kirk



On January 26, 2015, Dr. Arthur Abbitt Kirk, 99, passed away at his home in Portsmouth, Virginia, with his family by his side. As an orthopedic surgeon, philanthropist, and a man of many talents he left his mark on the Portsmouth, Norfolk and Suffolk, Virginia communities in many ways. Never a man to seek recognition for himself, he served quietly as a husband, father, Army officer, surgeon, community volunteer. He gave his medical talents and financial support to many causes and individuals both close to home and far away—volunteering in 1968 and on three other occasions for medical field work with Care-Medico in such far flung places as Afghanistan and Indonesia.

Dr. Kirk graduated from Chuckatuck High School in 1933 and attended Virginia Polytechnic Institute, graduating in 1937, with a B.S. in Biology. He graduated from the Medical College of Virginia in 1941, and completed an internship at Walter Reed Army Hospital in Washington, D.C. where he specialized in orthopedics. A veteran of World War II, he served as a Major in the Army and commanded a unit that provided medical support for the 82nd Airborne and assisted newly freed prisoners at the Ludwigslust Concentration Camp in Germany in 1945. He and his unit helped to save hundreds, and perhaps even thousands of starving and ill prisoners. This experience was humbling to him, and helped to influence him toward a lifelong quest of service to his community, which turned out to be a world-wide community as he made many trips abroad to train doctors in underdeveloped countries in his specialty, orthopedic surgery. He was a nationally and internationally renowned surgeon and invented numerous procedures for orthopedic repairs, especially to the hands.

Some of this remarkable generosity of Arthur Kirk was directed toward Virginia Tech, which he loved. He made major monetary donations to the university and to the College of Science. Since a major avocation of his, both during his working life and after he retired (at age 79!), was gem cutting, Dr. Kirk prepared many gemstones, large and small, from rough stones he acquired from many places, but mostly from Brazil. His grand-daughter noted at his memorial service that he always seemed to have one or more sizeable cut stones in his pocket, or in his luggage while traveling, which he could pull out and dazzle people with. His relationship with the Museum of Geosciences dates back to the mid-1970s (40 years) when the museum was in its infancy. He donated a considerable number of his own cut gems to the Museum of Geociences (and one is even in the Smithsonian). Foremost among those at Virginia Tech is the well known Hokie Topaz, a large cut blue topaz which has been on display in the museum's gem case for many years. In recent years he also became interested in donating large natural crystals and stones. In 2007 the museum acquired a large gem-quality aquamarine from the Province of Minas Gerais, Brazil, through his efforts and funding. In 2013 he donated a cluster of large, deeply colored emerald crystals on quartz-mica matrix, also from Brazil, and prepared from its rough state by Dr. Kirk himself. Between these donations, he also provided funds for us to acquire a secure and very well lighted case in which to properly display many of the items he had donated. This case debuted in the Fall of 2014.

We who knew Dr. Arthur Kirk personally are grateful for the privilege of having been acquainted with such a gracious and remarkable man, and everyone in the Department of Geosciences should be thankful for the mineralogical legacy he has left for all of us at Virginia Tech.

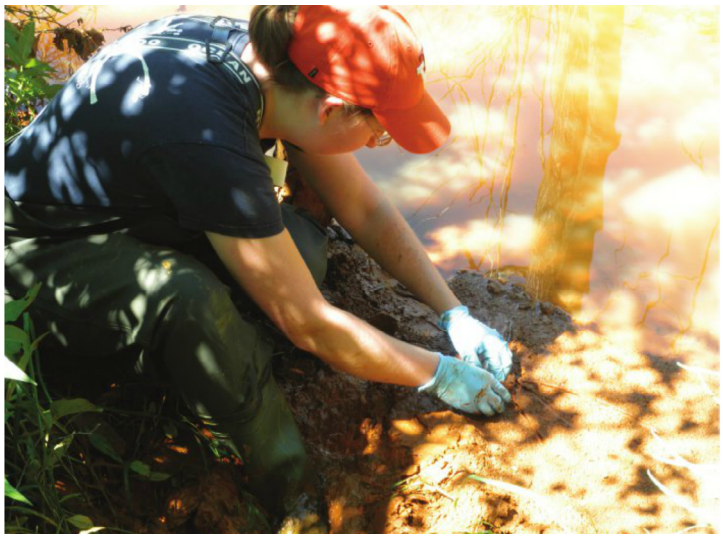
Alumni Stories...

Hello from the UK! It's been some time since I sent an update. In 2011 Valerie and I moved to Anchorage AK for a year and a half on contract to acquire a node survey across the Cook Inlet. What an adventure that was. After returning to Houston for a short time, I got a new position as a Sr. Processing Geophysicist at TGS in Bedford UK. We jumped at the oppertunity and moved ourselves and our 2 dogs to the UK. I'm even used to driving on the left side of the road now. We're enjoying the people, travelling, and the immense history that europe has to offer.

Robert Nejako

Recent Alumnus Highlighted in New VT Magazine

Recently-graduated PhD student Carol Johnson was highlighted in the new VT College of Science student research magazine "Breakthrough," published in May 2014. Her article, "The big role of small particles in uranium mine drainage pollution," gives an overview of her research in Germany at a former East German uranium mine, examining iron cycling and metal transport at the nanoscale.



Published research from this project:
Johnson, C. A., Freyer, G., Fabisch, M., Caraballo, M. A., Küsel, K., & Hochella Jr., M. F. (2014). Observations and assessment of iron oxide and green rust nanoparticles in metal-polluted mine drainage within a steep redox gradient.Environmental Chemistry, 11, 377–391.

Johnson earned another accolade for her paper this month, when it became ranked number one as the Most Read *Environmental Chemistry* paper for the past 12 months.

Johnson is currently a postdoc at Duke University in the Deptartment of Civil and Environmental Engineering. Her main research project focuses on how to measure not just the concentration of metals in polluted systems, but how to predict how much of those metals will be "available" for transformation by organisms, a.k.a. "bioavailability." Mercury is a very toxic element - particularly when transformed to methylmercury by bacteria - because it can be more easily taken up into fish tissues and ultimately humans. Currently there is no accurate, easy, and inexpensive method of measuring the methylation potential of mercury in the environment on a large-scale, predictive basis. Carol's efforts will hopefully improve the way researchers assess and remediate contaminated sites.

Geosciences Publications

Chen, A.-L., W. E. G. Müller, X.-G. Hou, and S. Xiao, 2015. New articulated protospongiid sponges from the early Cambrian Chengjiang biota. Palaeoworld, doi:10.1016/j.palwor.2014.11.006.

Dr. Martin Chapman, Director of the Virginia Tech Seismological Observatory, was co-editor of a special volume of the Geological Society of America dedicated to the 2011 Virginia Earthquake that has just been published.

> The magnitude ~5.8 Mineral, Virginia, earthquake of 2011 was the largest to occur in the Appalachian region in more than 100 years. It was felt over much of the eastern United States and southeastern Canada, caused significant damage from central Virginia to the National Capital Region, and was responsible for the automatic safe shutdown of a nuclear power station. It invigorated interest in earthquake processes, hazards, and preparedness along the Eastern Seaboard, and responses of the science and engineering communities to this rare event serve as models for responding to future events. The earthquake provided important new seismologic, engineering, geologic, hydrologic, and geophysical data that contribute to the understanding of earthquakes in eastern North America and to better assessment and mitigation of seismic hazards. This volume published by the Geological Society of America contains a collection of 23 chapters that makes these results available for geoscientists, engineers, and decision makers interested in understanding earthquakes and seismic hazards in eastern North America and other intraplate settings.

Horton, J.W., Jr., Chapman, M.C., and Green, R.A., eds., 2015, The 2011 Mineral, Virginia, Earthquake, and Its Significance for Seismic Hazards in Eastern North America: Geological Society of America Special Paper 509, 431 p
http://specialpapers.gsapubs.org/content/509

Statistical analysis of soil geochemical data to identify pathfinders associated with mineral deposits: An example from the Coles Hill uranium deposit, Virginia, USA
Denise M. Levitan, Carl E. Zipper, Patricia Donovan, Madeline E. Schreiber, Robert R. Seal II, Mark A. Engle, John A. Chermak, Robert J. Bodnar, Daniel K. Johnson, Joseph G. Aylor Jr.
Journal of Geochemical Exploration, In Press, Corrected Proof, Available online 26 December 2014, Original Research Article

Geosciences Conferences & Talks

Dr. Michelle Stocker attended the Society for Integrative and Comparative Biology meeting in West Palm Beach, Florida, at the beginning of January. Her title was "Iterative evolution of archosauromorph body plans through the Mesozoic: Cranial convergence on pachycephalosaurids by a new Triassic archosauriform."

Dr. Shuhai Xiao presented the department colloquium at the Department of Geological Sciences at Indiana University on January 25, 2015.

Awards & Grants

Kyle Ashley was awarded the highly competitive 2015 Outstanding Doctoral Student in the Virginia Tech College of Science. Ashley is an ICTAS fellow who is supervised by Rick Law and Bob Tracy. He has also worked closely with Bob Bodnar, Mark Caddick and Besim Dragovic.

Qing Tang, a graduate student in Dr. Shuhai Xiao's research group, was one of two students to win a graduate research award from the American Association of Stratigraphic Palynologists - The Palynological Society (AASP-TPS). The following write-up about Qing comes directly from the AASP-TPS 2014 newsletter.

> I started my BSc in Geology at Northwest University, China in 2006. And I soon found my interest in geology, because I really enjoyed all the geological field courses. We could go outdoor, touching various mountains and waters throughout the country, looking for ancient rocks and fabulous fossils. Upon graduation, I had to make a difficult decision to decline a job offer from an oil company. Instead, I chose to study for my Master's Degree in paleontology and stratigraphy at Nanjing Institute of Geology and Paleontology, University of Chinese Academy of Sciences, because I enjoyed in discovering the history of our planet.
>
> During my time in Nanjing from 2010 to 2013, I had the opportunity to work with several wonderful professors who sparkled my interest in palynological research. My co-advisors, Dr. Xunlai Yuan and Dr. Shuhai Xiao, taught me how to pick a project and how to design a research plan. Within a year into my Master's program, I began to work on a research project on early Neoproterozoic acritarchs in the North China Block. The project aimed at characterizing the eukaryote biodiversity prior to the Cryogenian glaciations in order to better understand biological evolution through global ice ages and to test the biostratigraphic significance of acritarchs. We designed and tested new maceration techniques to extract fragile acritarchs from fine-grained siliciclastic rocks, and recovered abundant well-preserved organic-walled species, one of which is a potential early Neoproterozoic index fossil. The data, published in a research article in Precambrian Research in 20134, adds to the growing diversity of early Neoproterozoic fossils and strengthens the basis for improved biostratigraphic correlation of early Neoproterozoic strata.
>
> For my Ph. D. program which started in 2014, I will continue study Neoproterozoic acritarchs under the supervision of Prof. Shuhai Xiao at Virginia Tech. My research project is focused on acritarch biostratigraphy and paleobiology. I will apply a modified low-manipulation extraction technique to isolate acritarchs from shales, and will examine these acritarchs using a combined light and electric microscopic analysis. Integrating paleobiological, sedimentological, and geochemical
> data collected from strata deposited before and after Cryogenian glaciations, I hope to develop a better understanding of eukaryote survivorship through some of the most severe
> ice ages in Earth history.

An NSF grant was recently awarded to Bob Bodnar (PI), Esther Schwarzenbach (Co-PI) and Hector Lamadrid (student). The title of the award is *In-situ monitoring of reaction progress during serpentinization of oceanic lithosphere using synthetic fluid inclusions.*

Christopher Griffin, a paleontology masters student, recently received a research grant from The Jurassic Foundation for his proposal entitled *Ontogeny and Individual Variation in the Late Triassic Theropod Coelophysis bauri.*