Eocene Mosquito’s Last Supper — A Mineral Sciences/Paleobiology Collaboration

If you haven’t heard the news yet, there is a buzz circulating in the scientific community about a recent discovery that took place in the Smithsonian’s Departments of Paleobiology and Mineral Sciences. The uproar is about a small fossilized female mosquito found in Middle Eocene (46 million years ago) shale from northwestern Montana. What is so intriguing about this particular mosquito is that it died and was preserved after having a recent meal. Dale Greenwalt, a retired biochemist who collects and analyzes insect fossils from Montana for the Smithsonian Institution, made the initial discovery. Mr. Greenwalt wondered if the abdomen of the fossilized mosquito was engorged by blood. Eliciting the help of staff geologists Yulia Goreva, and Tim Rose and post-doc fellow Sandra Siljeström of the Department of Mineral Sciences, the group sought to answer this “Jurassic Park-like” mystery. Utilizing DMS’ ToF-SIMS (time-of-flight secondary ion mass spectrometer) and SEM (scanning electron microscope) the group was able to detect high levels of iron and evidence of heme-derived porphyrins, a blood protein, in the mosquito’s abdomen. From this evidence, Greenwalt and his team concluded that the Eocene mosquito did indeed have blood as its last meal.

News of the discovery spreaded quickly and was picked up by several media outlets, including the Washington Post, Associated Press and the National Geographic. Stories about the discovery are currently being prepared by journalists from several foreign countries. The results of this study are published in the Proceedings of the National Academy of Sciences, volume 110, pages 18496-18500. Those with a subscription to this journal can get access to the paper online at http://www.pnas.org/content/early/2013/10/08/1310885110.full.pdf+html. An audio piece on the fossil was done by NPR and can be heard at http://www.npr.org/2013/10/14/232048774/trapped-in-a-fossil-remnants-of-a-46-million-year-old-meal.
Kudos

- Long time member of DMS and noted meteoriticist Roy Clarke was honored by the Meteoritical Society on October 27, 1013 as its 2014 Service Award recipient. The celebration which was held in Washington, DC, was attended by many of Roy’s colleagues and members of the Department of Mineral Sciences. Congratulations Roy!

Left: Ed Scott (former president of the Meteoritical Society) presenting the 2014 Service Award to Roy Clarke. Right: Roy giving his acceptance speech. Photos by Yulia Goreva.

Awards & Grants

- Glenn MacPherson was awarded a grant for $59,000 from the Grand Challenges program (Unlocking the Mysteries of the Universe theme) to purchase a newest-generation X-ray energy-dispersive analyzer for the Department of Mineral Sciences’ scanning electron microscope. This new detector will increase the efficiency for X-ray area mapping by a factor of nearly 10x. The electronics for the analysis system have already arrived, and the detector itself is expected to be delivered in November.

- Cara Santelli received 2 grants this past fall. NSF, Environmental Engineering Program - Collaborative Research Grant: “Optimization of metal attenuation in biologically-active remediation systems”. This award ($177,807) is a collaboration with Colleen Hansel (WHOI) to identify the most effective microbial species and nutrient conditions (e.g., organic carbon and nitrogen composition) stimulating optimal Mn oxide formation and subsequent metal attainment in acid mine drainage treatment systems.

  DOE, EMSL/JGI Grant: “Genome-enabled Investigations of the Role of Secreted Proteins and Reactive Metabolites in Carbon Degradation by Pure and Mixed Ascomycete Fungal Communities”. Cara is a co-PI with Colleen Hansel (lead PI) to identify the pathways for carbon degradation in a diverse group of ascomycete fungi, with particular attention to the role of secreted proteins and small molecules. With this proposal, the full genomes of at least 6 different species of fungi (organisms previously identified by Santelli and Hansel because they contribute to the biogeochemical cycling of carbon and the remediation of metal polluted environments) will be sequenced. The award gives Cara free sequencing and access to highly technical scientific equipment and staff.
New Faces in DMS

Carla Rosenfeld recently finished her Ph.D. in Soil Science and Biogeochemistry at the Pennsylvania State University studying plant-soil interactions and their influence on heavy metals in soils. As a postdoctoral fellow at the Smithsonian, Carla will study the role of mycorrhizal fungi, which form symbiotic associations with a wide variety of plants, in pollutant mobility and bioavailability. To do this, Carla will collaborate with Cara Santelli and Melissa McCormick (SERC) studying microbially mediated metal transformations in selenium-contaminated acid mine drainage soils.

Alexandré (Lexy) Fowler is a new contractor in the Department of Mineral Sciences, and is collaborating with Cara Santelli on geomicrobiology research. Lexy is currently working on both fungal genome studies, and researching the relationships between fungal metabolisms and serpentine mineral weathering. She began working as a volunteer in Cara’s lab before receiving funding for contract work through Cara’s grants. Lexy has a BA in Geological and Environmental Sciences from Hartwick College and an MS in Geological Sciences with a focus in Geomicrobiology from the University of Connecticut. She recently published a paper on Bahamian stromatolites, and has previously studied both modern and fossil coral reefs on San Salvador Island, Bahamas. Lexy also works as a freelance writer of scientific education materials and curricula. She thoroughly enjoys working in the Mineral Science Department, and hopes to one day become a permanent employee at NMNH.

Denver Gem & Mineral Show New Acquisitions

Two samples of volcanic bombs (lava fragments that are ejected from a volcano during eruption) were recently acquired and added to the Petrology Collection. The bombs were collected from Mt. Shadwell, Western Victoria, Australia and shows the common aerodynamic spindle-shape that often develops as the lava travels through the air. These samples are the first purchase for the rock collection in the last 25 years.

The Division of Meteorites recently acquired a nearly whole stone and two fragments of the Chelyabinsk LL5 chondrite meteorite, which fell on February 15, 2013. The hundreds of kilograms of material that reached the earth’s surface resulted from a Near-Earth asteroid that entered our atmosphere with an estimated speed of 18.6 km/s (over 41,000 mph or 66,960 km/h), almost 60 times the speed of sound. With an estimated initial mass of about 10,000 tons, and measuring between 17 and 20 meters in size, it is the largest known natural object to have entered Earth's atmosphere since the 1908 Tunguska event that destroyed a wide forested area of Siberia. Due to its enormous velocity and shallow atmospheric entry angle, the object exploded in an air burst over Chelyabinsk Oblast, at a height of about 23.3 km (14.5 miles, 76,000 feet). The explosion generated a bright flash, producing many small fragmentary meteorites and a powerful shock wave. The total kinetic energy before atmospheric impact was equivalent to approximately 440 kilotons of TNT, 20–30 times more energy than was released from the atomic bomb detonated at Hiroshima. The predicted close approach of a second asteroid, the roughly 30-metre 2012 DA14 occurred about 16 hours later; detailed analysis of the two objects later determined that they were unrelated to each other.
The International Association of Volcanology and Chemistry of the Earth’s Interior (IAVCEI) General Assembly is held every few years in a city located on a volcanically active area. This year, over 1000 volcanologists, geophysicists, and geochemists from 43 countries convened in Kagoshima, Japan. IAVCEI meetings focus on efforts to mitigate volcanic disasters, and encompass volcano monitoring, eruption forecasting, and research in volcanology and related disciplines. Many presentations this year focused on the real-time acquisition of volcano monitoring data, as well as the use and improvement of databases and tools to handle such large data sets.

Several members of the Department of Mineral Sciences attended the IAVCEI meeting, including GVP personnel Benjamin Andrews and Brendan McCormick, DCO Postdoctoral Fellows Marion Le Voyer and Christoph Popp, grad student Stephanie Grocke, and visiting scientist Georg Zellmer, who all presented their most recent research. One important focus of this conference was the development of new databases in volcanology. Benjamin Andrews chaired a session on “databases in volcanology”, where he presented the new eruption database from Smithsonian’s GVP, entitled “Volcanoes of the World 4.0”. In this same session, Brendan McCormick also introduced his work on “A new global database of volcanic gas emissions”.

The exciting scientific program was complemented with a number of uniquely Japanese social events, including tea degustation, calligraphy lessons, and the chance to try a kimono and/or a samurai costume. During the mid-conference field trip, attendees were lucky enough to witness Sakurajima volcano erupt (pictured on the right), complete with a magnificent ash plume, ballistic rocks, and flank shaking.

Explosive volcanic eruptions: analysis of the LaMEVE database.


Meetings & Abstracts (cont.)


DMS curator Glenn MacPherson gave an invited Keynote Address at the 2013 Goldschmidt Conference in Florence, Italy, during August. Over 4000 geoscientists from all over the world attended the conference, which is a record for this annual meeting.


Meetings & Abstracts (cont.)

76th Annual Meeting of the Meteoritical Society

Edmonton, Canada
July 29 – August 2, 2013

**Bullock, E.S., Corrigan, C.M., McCoy, T.J. & Hill, K.** (2013) Unraveling the metamorphic, impact and cooling history of EH3 Chondrites.


In the Media

- DMS volcanologist Ben Andrews was recently featured in a Smithsonian web article. The short article highlights the work being conducted at Ben’s experimental volcanology lab at the Smithsonian’s Museum Support Center where he attempts to simulate volcanic eruptions. You can read the article at [http://www.mnh.si.edu/explore/Stunning-Science/an-erupting-volcano-in-a-wooden-box.html](http://www.mnh.si.edu/explore/Stunning-Science/an-erupting-volcano-in-a-wooden-box.html) and get a glimpse of Ben’s experiment in action.
Selected Publications


