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INTERFACES

Biological Iron Cycling Beneath the Luquillo Forest, Puerto Rico

by Dr. Maryann Bruns & Morgan Minyard, Dept of Crop and Soil Sciences

Weathering of bedrock to form soil is an important process that increases mineral surface area and facilitates nutrient and energy cycling. Most previous research on bedrock weathering has emphasized physicochemical alterations, rather than biological processes. Quartz diorite bedrock underlying the Luquillo Forest in eastern Puerto Rico has provided particularly interesting material for weathering studies, because it has one of the highest documented weathering rates of granite in the world (White *et al.*, 1998). Former BRIE Graduate Fellow Heather Buss, now a NRC Postdoctoral Fellow at USGS in Menlo Park, CA, published evidence that biological iron oxidation was coupled to bedrock weathering three meters below the soil surface of the Luquillo Forest (Buss *et al.*, 2005). There, at the base of the soil profile directly above the quartz diorite corestones, direct counts by standard epifluorescence microscopy revealed that total microorganisms, including iron-oxidizing bacteria, increased in abundance relative to numbers found throughout the overlying mineral matrix. Higher cell densities directly above the corestones were correlated with increases in moisture content and HCl-extractable Fe(II) and Fe(III).

In the Luquillo Forest, most of the soil profile above such “microbial hot zones” consists of saprolite, an isovolumetric yet porous matrix of altered rock that has been weathered in place. US DOE funding supports ongoing research on Luquillo saprolite by CECG Faculty Sue Brantley in Geosciences and Mary Ann Bruns in Crop and Soil Sciences. Morgan Minyard, BRIE Graduate Fellow in Soil Science, recently used the confocal laser scanning microscope (CLSM) in the Huck Institute’s Cell Imaging/Flow Cytometry Facility to demonstrate bacterial distribution in material from the saprolite-bedrock interface zone.

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Dr. Cindy Werner - After Penn State

After graduation from the University of Missouri-Columbia (Geological Sciences Department), Dr. Werner completed a NAGT summer internship at the USGS in Lawrence, KS. She then spent two years at Los Alamos National Laboratory where she worked on environmental and volcanic geochemistry. From there she headed to Penn State University to get a Masters and Ph.D. degree working on CO_2 emissions in Yellowstone and Solfatara, Italy. She completed her Ph.D. in 2002 and started working as a volcanic fluid geochemist at GNS Science in Taupo, New Zealand. Her position involved measuring CO_2 emissions from volcanic and geothermal areas as part of a volcanic hazards monitoring effort in the Taupo Volcanic Zone on the North Island of New Zealand. She is currently a Research Geologist at the USGS, Cascade Volcano Observatory.

Dr. Werner’s research includes investigation of temporal variability of CO_2, SO_2, and H_2S emissions from volcanic and geothermal regions and how that relates to seismicity and deformation; field based study of the spatial correlation between heat and mass flux using thermal IR and diffuse gas techniques; testing of micrometeorological, remote, airborne techniques in monitoring of volatiles and heat; and identification of sources of gases using gas chemistry and isotopes.

In her work as a geosciences graduate student at Penn State, Dr. Werner estimated that the Mud Volcano area of Yellowstone National Park emits about 106,000 tons of carbon dioxide each year, and further research indicated that the entire Yellowstone system emits as much as 16 million tons of carbon dioxide per year. That’s equivalent to the output of about 3-4 medium-sized power plants that burn fossil fuels. “We believe,” concluded Werner, “that geothermal systems are significant contributors to global estimates

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Featured CECG Committee Member

Dr. Carmen Enid Martinez
Assistant Professor of Environmental Soil Chemistry

My educational background began in Chemistry (B.S., University of Puerto Rico – Rio Piedras Campus), but my interests later shifted to Environmental Chemistry (M.S., Rutgers University) and finally to Soil Chemistry (Ph.D., Rutgers University; Post-doc, Cornell University). Here at The Pennsylvania State University (July 2002 to present), I have developed four distinct research projects, all of which relate to the chemical and biogeochemical cycling of trace and major elements in soils.

In the first project we have taken an innovative approach to establish the link between the chemical forms of elements - particularly zinc, cadmium, and sulfur - and the microbial populations present in peat (organic) soils. While studying the solid phase speciation of zinc and cadmium in deep peats, we identified biogenic zinc sulfide (ZnS) spherules embedded within the organic matrix and found that Cd forms a co-precipitate with them ($Zn_{1-x}Cd_xS$). This is a very significant finding because metal co-precipitates, as predicted by thermodynamic principles, can limit the solubility of toxic or essential metals enough to prevent excessive biological availability in soils. In organic surface soils we found that Zn binds to nitrogen- and sulfur-containing functional groups of soil organic matter in addition to binding to the more abundant oxygen-containing functional groups.

Our second project uses soil solids (organic matter, Fe oxide, montmorillonite), as well as systems that mimic organo-mineral complexes, to study the kinetics of the partition of copper among these soil constituents. Our results show that organic matter, both dissolved organic matter (DOM) and solid phase organic matter (SOM), determines the solubility and speciation of Cu, and that Fe oxides do not compete effectively for the retention of Cu in mixed systems. The formation of Cu-DOM complexes seems to restrict the amount of Cu retained by the solid phases, thus increasing the concentration of Cu available for uptake by plants and the potential mobility of Cu in soil environments.

Our third research effort strives to understand pedogenic and transport processes in soils. Based on the fact that Al, Fe, and Si oxides exist as metastable mixtures in soil solutions and coat soil particles, we synthesize nano-sized colloidal particles of Al-substituted Fe oxides and measure the effect that

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A Local Environmental Observatory: The Shale Hills Catchment

The Shale Hills Catchment is a 7.9-ha forested watershed located in central Pennsylvania. It is characteristic of low-lying shale hills of the Ridge and Valley Physiographic Province of the eastern United States that extends from central New York to northern Alabama. This V-shaped catchment, up to 25-48% slope of concave, convex, or linear type, contains four basic landforms: 1) south-facing slope with deciduous forest and underbrush, 2) north-facing slope with deciduous forest and thicker underbrush, 3) valley floor or floodplain of a first-order headwater stream, with evergreen trees along the western side and deciduous forest on the eastern side, and 4) topographic depressional areas (swales) with deciduous forest cover and deeper soils. Depth to bedrock (>200-m thick Rose Hill shale) ranges from <0.25 m on the ridge tops and upper side slopes to >2 m in the valley bottom and swales. The soils of the catchment were formed from shale colluvium or residuum, with many channery shale fragments throughout most of the soil profiles. A total of five soil series (the Weikert, Berks, Rushtown, Blairton, and Ernest series) have been identified, mapped, and fully characterized.

As early as the 1960s, the Penn State Forest Hydrology group started investigations in this catchment (Leavesley, 1967; Lynch, 1976). A comprehensive hydrologic experiment was conducted to determine the physical mechanisms of streamflow generation at the upland forested catchment and to evaluate the effects of antecedent soil moisture on stormflow volume and timing. A spray irrigation network was installed to apply a controllable amount of rainfall over all or part of the watershed. The hydrologic and soil moisture data were collected using a network of piezometers, neutron access tubes, rain gauges, and four weirs. The robust dataset collected during that time period is still yielding valuable information.

In the mid-1990s, hydrologic engineers began studying the area for the purpose of validating a dynamical model for hillslopes and small catchments (Duffy, 1996). One product of this effort was to make this dataset available to the hydrologic community as a testbed for dynamic catchment response.

Since 2003, there have been renewed research activities from the Penn State Hydropedology team, with the intent to make the Shale Hills a long-term Hydropedologic Observatory (Lin, 2006; Lin et al., 2006). The goal is to use such a field laboratory for investigating fundamental processes of landscape water fluxes at multiple scales, and to characterize spatio-temporal patterns of surface and subsurface water flow mechanisms, soil moisture distributions, and their relations to landscape features and the hydrologic cycle. Detailed maps of soils, elevation, landforms, depth to bedrock, and vegetation have been completed, along with a number of

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ground-penetrating radar and electromagnetic induction surveys for mapping subsurface featuresand understanding soil variability. A total of 115 multi-depth TDR (Time Domain Reflectometry) access tubes have been installed, along with nested tensiometers, pieziometers, thermocouples, and shallow observation wells at selected locations. Real time monitoring of stream discharge at the catchment outlet and precipitation at more than ten locations thoughout the catchment have been established. A conceptual model of hillslope hydrology has been developed that portrays typical soil moisture profiles along the hillslope and identifies four main flow pathways downslope (i.e., subsurface macropore flow, subsurface lateral flow at A-B horizon interface, return flow at footslope and toeslope, and flow at the soil-bedrock interface). Further testing of this conceptual model would lead to enhanced understanding and modeling of preferential flow dynamics at the small watershed scale, particularly in relation to the role of soil distribution and lateral flow.

In 2004, a National Science Foundation supported Real-time Hydrologic Monitoring Network (RTH_Net) project was initiated to investigate the multi-scale, multi-process dynamics of the terrestrial water and energy balance. Shale Hills is being developed as a “super-site” within RTH_Net where detailed eddy covariance flux analysis will be combined with soil and groundwater measurement arrays, flow gauging, and micrometeorological stations. RTH_Net will extend the current sensor systems within Shale Hills to resolve the roles of soil moisture and groundwater within the water cycle through the use of Evaporation-Transpiration-Recharge (E-T-R) sensor arrays to fully capture the essential space-time scales of terrestrial hydrology. The RTH_Net field facility will promote research into how currently available real-time sensor systems can be used to directly measure the natural coupling between atmosphere, land surface, and subsurface processes at multiple scales of interest. RTH_Net will help identify how thresholds, feedbacks, and nonlinearities in atmosphere-soil-stream-groundwater systems serve to amplify low-frequency modes in runoff.

In 2005, the Center for Environmental Kinetics Analysis (CEKA) at Penn State selected Shale Hills as its focused field site to begin investigations of weathering rates and redox reactions. The established hydrologic database will greatly facilitate CEKA’s efforts to apply data developed through modeling and laboratory investigations to the field. CEKA is an Environmental Molecular Sciences Institute based at Penn State with members at three National Laboratories (Sandia, Lawrence-Berkeley, and Pacific Northwest). CEKA is a joint research and education initiative of the National Science Foundation, the U.S. Department of Energy (DOE), and Penn State University. CEKA brings together chemists, geochemists, biochemists, soil scientists, materials scientists and engineers to measure and synthesize kinetic data for environmental systems and to model the temporal evolution of such systems. The Center’s initiative emphasizes the problem of scaling in terrestrial environmental kinetics, with especial emphasis on the mineral-water interface with and without cells and biofilms. In a highly collaborative research effort, CEKA focuses on the following question: What approaches and insights can be developed to extrapolate rates of environmentally important reactions across a variety of scales?

Currently, researchers are hoping to make the Shale Hills a coupled test site for Hydrologic Observatory and Critical Zone Exploration. A proposal entitled ‘Hydropedology-Hydrogeophysics-Biogeochemistry Connections’ has been developed and the funding is being sought.

For more information, please contact Henry Lin at henrylin@psu.edu about hydropedology, Patrick Reed at preed@engr.psu.edu or Chris Duffy at cxd11@psu.edu about RTH_Net, and Susan Brantley at brantley@eesi.psu.edu about CEKA.

References cited:

- Duffy, C. J. 1996. A Two-state Integral-balance Model for Soil Moisture and Groundwater Dynamics in Complex Terrain, Water Resour. Res. 32:2421-2434 and Soil Moisture in Relation to Streamflow on Two Shale Hills Watersheds. Master of Science Thesis. The Pennsylvania State University, University Park, PA.
- Leavesley, G.H. 1967. Effects of Aspect, Slope, and Soil Moisture in Relation to Streamflow on two Shale Hills Watershed Master of Science Thesis. The Pennsylvania State University, University Park. PA.
- Lin, H.S. 2006. Temporal Stability of Soil Moisture Spatial Pattern and Subsurface Preferential Flow Pathways in the Shale Hills Catchment. Vadose Zone Journal 5:317-340.
- Lin, H.S., W. Kogelmann, C. Walker, and M.A. Bruns. 2006. Soil Moisture Patterns in a Forested Catchment: A Hydropedological Perspective. Geoderma 131:345-368.
- Lynch, J. 1976. Effects of Antecedent Soil Moisture on Storm Hydrographs. Ph.D. Thesis. The Pennsylvania State University, University Park. PA.

The NATIVE

by Dr. Anne Thompson and Dr. Brett Taubman

The NATIVE (Nittany Atmospheric Trailer and Integrated Validation Experiment) mobile atmospheric chemistry research facility was designed by Dr. Anne Thompson and Dr. Brett Taubman in the Department of Meteorology for satellite validation, air quality monitoring, investigations of pollution transport and deposition, and for use as an educational outreach tool. The facility houses a suite of in-situ trace gas instruments for measuring ozone, carbon monoxide, sulfur dioxide, and oxides of nitrogen; active and passive remote sensing instruments for atmospheric profile and column measurements of ozone and aerosols; and several meteorological probes. Data collected during field experiments is transferred in near real time from anywhere in the country using a satellite broadband communication system.

NATIVE has played an integral role in several international, multi-institutional field campaigns. In March, 2006, the facility was transported to Houston, TX for INTEX-B/MILAGRO (INtercontinental chemical Transport EXperiment/Megacity Initiative: Local And Global Research Observations) phase I, a NASA and NSF funded experiment aimed at measuring Mexico City air pollution transported into the U.S. NATIVE then headed up to Richland, WA for April and May, 2006, as part of INTEX-B/MILAGRO phase II, this time measuring Asian air pollution transported into the U.S. In the summer of 2006, the facility was stationed in Beltsville, MD at the Howard University Atmospheric Research Site for WAVES 2006 (Water Vapor Validation Experiment – Satellite/Sondes), a NASA based experiment with the goal of acquiring a statistically robust set of summertime measurements of atmospheric water vapor, aerosols, and trace gases for assessing instrument accuracy and verifying satellite retrievals.

When not traveling the country, NATIVE makes continuous measurements in University Park on the northeast end of campus behind the Procurement Services Building. This summer, NATIVE may be headed back down to Beltsville or even to Panama for more field experiments. Either way, it should be another busy year for the Meteorology Department's mobile atmospheric chemistry facility. For a more detailed description of the research facility and its activities, the instruments onboard, and plots of daily measurements, visit the NATIVE website at http://www.meteo.psu.edu/~btaubman/Webpage/native.html.

Another Successful Penn State Grad

Dr. Kideok Kwon

After my productive graduate career in terms of both research and family at Penn State, I moved to Berkeley CA for a postdoctoral position at the Lawrence Berkeley National Laboratory. Now, I see more Bears than Lions, so I often miss the Happy Valley. Besides Nittany Lion football games, one thing that I really enjoyed at Penn State was participation in the CECG Environmental Chemistry Student Symposium (ECSS). The CECG ECSS provided rich opportunities for interaction with many students and faculty who had diverse academic backgrounds. The interactions with people from multiple disciplines encouraged me to look at environmental issues from different disciplinary viewpoints to understand the issues in more comprehensive ways. Such experience actually has helped me enjoy working on my current research with people from diverse disciplines at Berkeley. My current research investigates structures of hexagonal layer-type Mn-oxides (e.g., birnessite) produced by microbes in Professor Gary Sposito's research group. The biogenic birnessites have attracted special attention due to their various roles in the fates of metals and organic matter in the environment. However, structural characterization of the biogenic birnessites has been limited not only because of their poor crystallinity and the small size of the particles but also because of structural sensitivities to types and contents of Mn vacancies, Mn oxidation states, and interlayer cations. Therefore, I have been utilizing plane-wave first-principle methods to deconvolute the complex effects of vacancies and interlayer cations on structures (and hence reactivities of Mn-oxides) by collaborating with experimental microbiology and spectroscopy groups.

Environmental Chemistry in a Liberal Arts Context - by Loren Byrne (Mary Ann Bruns grad student)

Greetings from Wooster! After graduating from the Penn State Ecology Program last August, I moved to Wooster, Ohio to begin a one year position as Visiting Assistant Professor of Biology at the College of Wooster. During the fall semester I taught two courses: introductory ecology and a non-majors course in environmental science. Both provided me with opportunities to integrate environmental chemistry topics into a liberal arts curriculum.

Because the introductory ecology course had a laboratory session, I was also able to integrate into this course some of the research methods I used while completing CECG-funded research for my Ph.D. I designed two laboratory experiences in which the students gathered and analyzed their own data. The first project was an examination of soils and earthworms in forest, lawn, and bark mulch habitats. During this experience, students gained hands-on experience digging in soils to collect earthworms and observing relationships between the habitat types and soil chemical and physical properties. For most of my students, this experience provided them with their first introduction to basic principles of soil science, something they seemed to enjoy despite a few shrieks spurred by energetically wriggling worms.

Another environmental chemistry-related laboratory project I developed for this course was a litter decomposition study. I had the students create their own litterbags from mesh screen and fill them with oak and pokeberry leaves. Groups of litterbags of each leaf type were placed in the same forest, lawn, and bark mulch areas used in the soils and earthworm study. Students were responsible for collecting litterbags once each week for six weeks and calculating their percent mass lost (*i.e.*, a measure of decomposition rate). This project fostered discussion of variables that influence decomposition and carbon cycling, especially differences in the carbon-to-nitrogen ratios of the oak and pokeberry leaves. I found that the students particularly enjoyed this laboratory experience because they "owned" it, having been engaged in the entire project from its inception to completion. I learned the value of this pedagogical technique while serving as a TA for my dissertation advisor Mary Ann Bruns' soil ecology course in which students can design their own semester-long research projects.

Although the non-majors environmental science course did not have a laboratory session, I integrated research into it by discussing results of my Ph.D. research during lectures about the ecological effects of urbanization and lawn management. In addition, environmental chemistry played a prominent role in this course because I used carbon and nitrogen as focal points for discussing a variety of topics including evolution, acid rain, agriculture, and, of course, global climate change. Although I am not a big advocate of watching films during class time, I showed "An Inconvenient Truth" at the end of the semester because most students had not seen it and because it provides an excellent overview of many environmental issues as they relate to global climate change. My students responded favorably to the film's content, even though some voiced a dislike of Al Gore for political reasons. Politics aside however, I found that the film synthesized many of the topics that I had covered throughout the semester and therefore helped communicate to students why understanding environmental chemistry is important to humanity. In my view, this is certainly one of the key messages that all students should hear as part of a well-rounded liberal arts education.

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The CLSM image (Figure 1 below) shows saprolite grains demonstrating consistent physical association between bacterial cells (bright green) and amorphous secondary minerals (large dark masses) but not with quartz particles (refractile body in the center). Other images of Luquillo saprolite are being processed by Chuck Anderson of the Center for Environmental Kinetics Analysis (CEKA) for stereo 3-D projection on the CEKA GeoWall (see Fall 2005 issue of Interfaces).

Morgan Minyard and BRIE Fellow Jennifer Williams will travel to Puerto Rico in January to collect additional samples for more intensive characterization of bacterial distribution as well as tests for genes associated with bacterial iron oxidation.

References
White, A. *et. al.,* 1998. Geochim Cosmochim Acta 62:209-226.
Buss, H.L. *et. al.*, 2005. Geobiology 3:247-260.

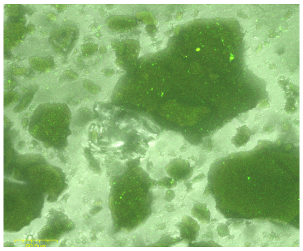

Figure 1. CLSM image of bacteria in Luquillo saprolite.

Introducing CECG's Newest Committee Member -

Jay Regan is an Assistant Professor of Civil and Environmental Engineering. He joined Penn State in 2002 after completing his Ph.D. at the University of Wisconsin-Madison, where he studied the persistence and speciation of ammonia-oxidizing bacteria (AOB) in chloraminated drinking water distribution systems. Jay's research focuses on microbial processes in environmental engineering applications, with an emphasis on merging molecular microbial ecology with engineering analyses. Upon arriving at Penn State, he expanded on his work with AOB by developing a quantitative molecular assay for these bacteria and applying this technique to monitor several chloraminating utilities in the U.S., correlating AOB abundance with changes in water chemistry and following their response to nitrification control strategies. His group is currently studying AOB diversity and abundance in several nitrifying wastewater treatment plants and looking for relationships between the AOB community and system performance. Another area of research in Jay's group is energy recovery from biomass and biomass-derived wastes, focusing on microbial communities and isolates that catalyze fermentative biological hydrogen production, electricity production in microbial fuel cells (MFCs), and methanogenesis in anaerobic digesters and natural environments. The hydrogen work has entailed comparing the cellulolytic and hydrogen-producing capabilities of various clostridia species. With MFC systems, Jay's group investigates the influence of the anode biofilm community composition on MFC performance, and recently they coupled cellulolytic microbes with exoelectrogenic bacteria in MFCs to recover electricity from cellulosic materials. For the anaerobic digestion of municipal and agricultural solids, they are testing the capacity of natural methanogenic consortia to persist at low pH conditions induced by high organic loads, which cause digester failures with the consortia typically enriched in these systems. Jay is also a member of Penn State's Hydrogen Energy Center, the Biomass Energy Center, and the College of Engineering Environmental Institute, and has served on the Biogeochemistry Research Initiative for Education executive board since 2003.

Dr. Regan has taken Dr. William Burgos' position on the Center for Environmental Chemistry and Geochemistry Executive Committee as the representative for the Department of Civil and Environmental Engineering.

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different amounts of Al substitution and time might have on solid phase transformations and colloidal deposition in soils. The presence and transport of mixed metal oxides in soils may affect the mobility of solutes, including nutrients applied in fertilizers and toxic elements. This work also includes field investigations; we placed several substrates within the soil horizons of a spodosol, here in Pennsylvania, and will monitor the formation of surface coatings in-situ.

In our fourth project we investigate the suitability of a highly charged laboratory-synthesized clay mineral, Na-4-mica, for the remediation of copper (Cu) contaminated soils from Chile. The addition of Na-4-mica to Cu-contaminated soils resulted in decreased solubility and phytoavailability of Cu in a variety of soils. This synthetic clay has promise for the remediation of small metal-contaminated sites, such as Brownfield sites. The clay may be applied to the soil surface to entrap the metal contaminant(s), drastically reducing the amount of metals entering waterways or being absorbed by plants, thus allowing for the re-vegetation of affected areas.

In sum, the research conducted in my laboratory includes studies of the solid- and solution-phase speciation of trace and major elements (both nutrients and contaminants) and their biogeochemical cycles and focuses on a mechanistic understanding of these processes. We approach soil-chemical questions by combining traditional solution chemistry approaches with microscopic and spectroscopic methods and anchor our interpretations on thermodynamic and kinetic principles.

Dr. Martinez has served on the CECG Executive Board since 2003. Members of the Soil and Environmental Chemistry Laboratory: Dr. Carmen Enid Martínez (PI, Assistant Professor), Dr. Soh-joung Yoon (Post-doctoral Associate), Carolina Yáñez (Ph. D. student, graduated December 2006), Nadia Martínez-Villegas (Ph.D. student), Ekaterina Bazilevskaya (Ph.D. student) and Jason Stuckey (M.S. student).

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of carbon dioxide" (The New York Times, December 26, 1997). Cindy was a past BRIE (Biogeochemical Research Initiative for Education) affiliate and she was involved with the CECG during her time at Penn State. In 1999 she was one of five who received first prizes at the 2nd Annual CECG Environmental Chemical Student Symposium for their poster presentations.

The 10th Annual Environmental Chemistry Student Symposium April 13-14, 2007

The CECG student-run Environmental Chemistry symposium was held April 13 - 14, 2007 and the CECG was pleased to host keynote speaker David Dzombak from Carnegie Mellon University. Dr. Dzombak is Professor of Civil and Environmental Engineering and serves the environmental community as Associate Editor of *Environmental Science & Technology*.

The Environmental Chemistry Student Symposium (ECSS) is a student organized and run symposium designed to foster interactions between undergraduate and graduate scientists and engineers engaged in environmental research. Students from multiple disciplines gather to present their research to the environmental community from Penn State and regional educational institutions. This symposium is sponsored by the Center for Environmental Chemistry and Geochemistry and is open to the public. Posters and oral presentations are presented by both graduate and undergraduate students and cash prizes are awarded. The 2007 ECSS was held in the Chemistry Research Building on the University Park campus of Penn State. The student organizers of the ECSS this year were: Michael Davis, Co-Chair; Nadia Martinez-Villegas, Co-Chair; and Katya Bazilevskaya, Tim Fischer, Barbara Fricks, Kevin Mueller, Aaron Regberg, Caleb Strepka, Jason Stuckey, Hui Tan, Andy Wall, and Yi Zuo.

Our guest speaker, Dr. Dzombak, received his Ph.D. in Civil-Environmental Engineering from the Massachusetts Institute of Technology in 1986. He also holds an M.S. in Civil-Environmental Engineering (1981) and a B.S. in Civil Engineering from Carnegie Mellon University (1980). In addition, he received a B.A. in Mathematics from Saint Vincent College in Latrobe, PA (1980). He is a registered Professional Engineer in Pennsylvania and a Diplomat of the American Academy of Environmental Engineers.

Dave's research and professional interests include: aquatic chemistry, especially interactions of chemicals with mineral surfaces in water; fate and transport of chemicals in surface and subsurface waters; water and wastewater treatment; soil treatment; hazardous waste site remediation; abandoned mine drainage remediation; river and watershed restoration; and public communication of environmental science. He has published numerous articles in leading environmental engineering and science journals; book chapters; articles for the popular press; and two books (Surface Complexation Modeling: Hydrous Ferric Oxide, Wiley-Interscience, 1990; and Cyanide in Water and Soil, CRC/Taylor&Francis, 2006). He also has a wide range of consulting experience.

CECG
Center for Environmental Chemistry and Geochemistry

10th Annual Environmental Chemistry Student Symposium
April 13-14, 2007

A student-run symposium fostering interdisciplinary interactions and collaborations between researchers at Penn State and local universities

Keynote Speaker:
David Dzombak
Professor of Civil and Environmental Engineering
Carnegie Mellon University

Posters and oral presentations open to both graduate and undergraduate students

Cash prizes for top student presentations

CECG Briefs

On Thursday, January 25, 2007, the annual CECG Wine and Cheese Event took place at the Nittany Lion Inn. The guest speaker was Dr. Michael Kuperberg from the Office of Biological and Environmental Sciences, U.S. Department of Energy. His talk was entitled “Interfaces - microbes, minerals, science and policy”. Due to the inclement weather, the attendance was smaller than usual but the event went smoothly and the talk was enjoyed by the attendees. Mike’s talk was an excellent introduction for young faculty and grad students submitting proposals to DOE for support. Jim Kubicki presented a slide show at the Wine and Cheese Event which mentioned the goals of CECG and highlighted successful CECG activities during the past year. This slideshow can be viewed at the CECG Website: http://www.essc.psu.edu/CECG/

Contributions to the CECG Newsletter made by: Debra Lambert, Maryann Bruns, Kideok Kwon, Brett Taubman, Henry Lin, Loren Bryne, Anne Thompson, Karl Mueller, Enid Martinez, John Regan, Jim Kubicki, and Cynthia Werner

CECG
Center for
Environmental
Chemistry and
Geochemistry

The Center for Environmental Chemistry and Geochemistry
Debra Lambert, Newsletter Editor
Earth and Environmental Systems Institute
Karl Mueller, CECG Director
Eberly College of Science
104 Chemistry Building
Penn State University
University Park, PA 16802
ADDRESS SERVICE REQUESTED