

March 19, 2012

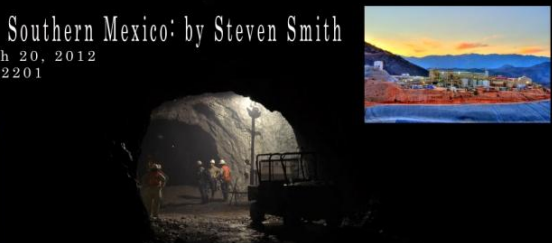
Upcoming MEETINGS

Tuesday, March 20

- Gold Trip Presentation, Steve Smith, CIVL 2201 (11:30)

Gold Mining in Southern Mexico: by Steven Smith

Tuesday, March 20, 2012
11:30am Civil 2201



Nested in a caldera of an ancient volcano in the state of Oaxca Mexico, one will find the Gold Resource Corporation's most recent mining site.

Recently part of the Gold Display committee visited the El Aguila gold mine in Southern Mexico. Come and hear some of what we learned about the gold mining process. This will be a short photo presentation on the professional and personal experiences of the trip.

- EAS Gold Mine Committee, CIVL 2201 (Noon)

Wednesday, March 21

- Undergrad Committee, CIVL 2201 (9:00 am)

Monday, March 26

- EAS Faculty Meeting, CIVL 3201 (11:30-1:20)

RECENT EAS PRESENTATIONS

Sun, Wen-Yih, 2012: "A modified atmospheric nonhydrostatic model on low aspect ratio grids" at National Center University, Taiwan, March 13.

Sun, Wen-Yih, 2012: "Regional Model Simulation of Ozone and its Climatic Impact" at National Center University, Taiwan, March 13.

Sun, Wen-Yih, 2012: "Numerical Simulation of Asian Dust Storm", Academia Sinica, Taiwan, March 16.

EAS PUBLISHED ARTICLES in Eos

13 March, 2012 - **Shepson, P.B.**, et al, "Changing Polar Environments: Interdisciplinary Challenges," Eos, Transactions, American Geophysical Union, Vol. 93, No. 11, pp. 117-124. (See attached article)

NESTA EVENTS

Tickets now available for all NESTA ticketed events at:

<https://www.nestanet.org/cms/content/store/event>

- Wednesday, March 28 - **From Glacial Till to Minerals that Thrill!** - NESTA's full day Field trip, leaving about 8 am and returning about 5 pm. We will be spending some time at various areas of the Hanson Aggregates Midwest, Inc.'s Harding Street Quarry. This quarry is a sand and gravel pit. We will be observing the operations and looking at layers of dolomite, black shale, and Devonian / Silurian limestone. Dr. Nelson R. Shaffer from the Indiana Geological Survey will be guiding the trip and explaining the various layers. This will be a collecting trip so bring your collecting bags. We will provide lunch, hard hats and safety glasses. Tickets are available for \$35 in advance or \$40 on-site.
- Thursday, March 29 - **Sampling Midwest Geology** - NESTA's 1/2 day Field trip, leaving about 1 pm and returning about 5 pm. A printed field guide will be provided. This trip will be to the IMI (Irving Materials, Inc.) Pendleton Quarry. This site is well known for their amber colored calcite as well as their twin calcite crystals. Time permitting we will make a couple of other quick stops including Mounds archeological site built by the prehistoric Adena culture indigenous peoples of eastern North America. Dr. Nelson R. Shaffer from the Indiana Geological Survey will be guiding the trip and giving us a peak into Indiana's past. Tickets are available for \$30 in advance or \$35 on-site.

INDIANA ASSOCIATION OF ENVIRONMENTAL PROFESSIONALS 2012 SCHOLARSHIP PROGRAM

The INAEP has opened the registration for applicants to this year's scholarship program. The INAEP donates to deserving students of Indiana programs who aspire to be the leaders of tomorrow in the environmental realm. This is for graduate and undergraduate students who will be in a degree program in 2012-13. There will be two awards of \$1,000. For more information, go to:

<http://www.inaep.com/files/66311329759968INAEP2012ScholarshipApp.pdf>

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

The National Research Council of the National Academies sponsors a number of awards for graduate, postdoctoral and senior researchers at [participating federal laboratories and affiliated institutions](#). These awards include generous stipends ranging from \$42,000 - \$75,000 per year for recent Ph.D. recipients, and higher for additional experience. [Graduate](#) entry level stipends begin at \$30,000. These awards provide the opportunity for recipients to do independent research in some of the best-equipped and staffed laboratories in the U.S. Research opportunities are open to U.S. citizens, permanent residents, and for some of the laboratories, foreign nationals.

Detailed program information, including online applications, instructions on [how to apply](#) and a [list of participating laboratories](#), is available on the NRC Research Associateship Programs www.nationalacademies.org/rap.

Questions should be directed to the NRC at 202-334-2760 (phone) or rap@nas.edu.

There are four annual review cycles:

Review Cycle: **May**; Opens March 1; Closes May 1

Review Cycle: **August**; Opens June 1; Closes August 1

Review Cycle: **November**; Opens September 1; Closes November 1

Review Cycle: **February**; Opens December 1; Closes February 1

Applicants should contact prospective Adviser(s) at the lab(s) prior to the application deadline to discuss their research interests and funding opportunities.

REMINDER – 3-DAY GRANT DEVELOPMENT WORKSHOP – IU

A reminder for you to join the Three Day Grant Development Workshop at IU, Bloomington, IN, March 21-23. Learn from Professional Grant Writers how to write and secure grant proposals from various funding agencies. Attendee list is being finalized. If interested, please visit: <http://www.granttrainingcenter.com/> or contact us at 1-866-704-7268 to **register/reserve** seating. Additional discounts are available for groups that would like to participate in this interactive workshop. Contact person is Matt Devine.

A NOTE FROM OUR ACADEMIC COUNSELOR Fulbright Program Information Sessions

The US Student Fulbright Program is the largest U.S. international exchange program offering opportunities for students, scholars, and professionals to undertake an academic year of international graduate study, advanced research, and teaching in elementary and secondary schools in over 140 countries.

US Student Fulbright Program Info Session Thursday, March 22 - STEW 318 - 6-7 pm

This info session will provide an overview of the U.S. Student Fulbright Program and offer suggestions for preparing a competitive application. All students are welcome, but especially those undergraduates who will graduate in December 2012, May or August 2013 or current graduate students.

US Student Fulbright Program Info Session Tuesday, April 3 - STEW 320 - 6-7 pm

This info session will provide an overview of the U.S. Student Fulbright Program and offer suggestions for preparing a competitive application. All students are welcome, but especially those undergraduates who will graduate in December 2012, May or August 2013 or current graduate students.

US Student Fulbright Program Essay Workshop Wednesday, April 18 - STEW 320 - 6-7 pm

This session will provide information about writing the personal statement and statement of grant purpose for Fulbright full grants and English Teaching Assistantship grants. **RSVPs encouraged, but not required.** crjosney@purdue.edu (Christy Gosney).

Events:

Thursday, **March 22** in BRNG Rm. 2290 at 6:30 p.m. African American Studies Film Festival. "Tyler Perry vs. Spike Lee. What do the Films of Tyler Perry and Spike Lee say about Black Communities?" Refreshments will be served.

Friday, **March 30** and Saturday, **March 31**.

Purdue Pugwash 2012 Conference on Biotechnology: The Risks and Rewards of Rewriting Life. The conference will last from 6:00 pm to 8:15 pm on Friday and 9:30 am to 5:30 pm on Saturday. An optional conference social will occur Friday at 8:15. Dinner on Friday and breakfast and lunch on Saturday will be provided, and attendees will receive a t-shirt with registration. To help cover some of the costs of the event, there is a registration fee of \$20. Registration and additional information is online at

www.purdue.edu/pugwash/

MARCH BIRTHDAYS!!!

9th – Ki-Hong Min
11th – Elizabeth McNie
17th – Greg Michalski
21st – Larry Braile
24th – Megan Sapp Nelson
26th – Joseph Francisco
27th – Dongbin Xiu



IMPORTANT NOTICE ABOUT THIS NEWSLETTER

This newsletter is used as the primary information source for current and upcoming events, announcements, awards, grant opportunities, and other happenings in our department and around campus. Active links to additional information will be provided as needed. Individual email announcements will no longer be sent unless the content is time-sensitive. We will continue to include our publications, presentations and other recent news items as well. Those using paper copies of the newsletter should go to our newsletter archive on the EAS website at www.purdue.edu/eas/ and **Click on News** to access active links as needed. Material for inclusion in the newsletter should be submitted to Wanitta Thompson (thompson@purdue.edu) by **Friday noon** of each week for inclusion in the Monday issue. **If it is in the newsletter, we assume you know about it and no other reminders are needed.**

For answers to common technology questions and the latest updates from the EAS Technology Support staff, please visit http://www.purdue.edu/eas/info_tech/index.php.

Also, as an additional resource for information about departmental events, seminars, deadlines, etc., see our departmental calendar at <http://calendar.science.purdue.edu/eas/seminars>.



Changing Polar Environments: Interdisciplinary Challenges

PAGES 117–118

In the past few decades, there has been enormous growth in scientific studies of physical, chemical, and biological interactions among reservoirs in polar regions. This has come, in part, as a result of a few significant discoveries: There is dramatic halogen chemistry that occurs on and above the sea ice in the springtime that destroys lower tropospheric ozone and mercury [Simpson *et al.*, 2007; Steffen *et al.*, 2008], the sunlit snowpack is very photochemically active [Grannas *et al.*, 2007], biology as a source of organic compounds plays a pivotal role in these processes, and these processes are occurring in the context of rapidly changing polar regions under climate feedbacks that are as of yet not fully understood [Serreze and Barry, 2011].

Stimulated by the opportunities of the International Polar Year (IPY, 2007–2009), a number of large-scale field studies in both polar environments have been undertaken, aimed at the study of the complex biotic and abiotic processes occurring in all phases (see Figure 1). Sea ice plays a critical role in polar environments: It is a highly reflective surface that interacts with radiation; it provides a habitat for mammals and micro-organisms alike, thus playing a key role in polar trophic processes and elemental cycles; and it creates a saline environment for chemical processes that facilitate release of halogenated gases that contribute to the atmosphere's ability to photochemically cleanse itself in an otherwise low-radiation environment. Ocean-air and sea ice-air interfaces also produce aerosol particles that provide cloud condensation nuclei.

Sea ice is undergoing rapid change in the Arctic, transitioning from a perennial or multiyear ice pack to a thinner, seasonal first-year ice pack, thereby transforming the Arctic into a more Antarctic-like system. Most climate models project an ice-free summer Arctic by the end of the century, with some

projections indicating considerably sooner. Such changes in critical interfaces will likely have large effects across the system, from habitat loss to dramatic changes in heat and water vapor fluxes and changes in atmospheric chemistry. Arctic changes will teleconnect throughout the globe via induced changes in ocean circulation and concomitant modification of weather systems. The loss of sea ice is likely to alter human behavior on a large scale, including adaptive behavior of subsistence hunters across the Arctic and utilization of new trade routes opening across the Canadian archipelago.

To help humans adapt, improve Arctic climate and weather predictions, and better understand the impacts of a seasonally ice-free Arctic on ecosystems and humans, it is essential that scientists understand

interactions among components of the entire ocean-climate-cryosphere-human system and potential feedbacks at their most fundamental levels. In particular, the complexities of polar systems must be properly captured in Earth system models. Although the Antarctic may serve as a model for some aspects of the future Arctic system, its contrasting response to climate change emphasizes that many key processes exhibit differing challenges at both poles. One approach to tackling research questions involving climate change in polar regions is to examine topics for focused study as a thematically organized set. This set, discussed below, parallels some of the major scientific and public interest advances of the IPY.

Sea Ice Processes

Sea ice is both a reservoir and a substrate for biogeochemical compounds. Physical forces interact with chemical and biological processes within the ice in complex ways,

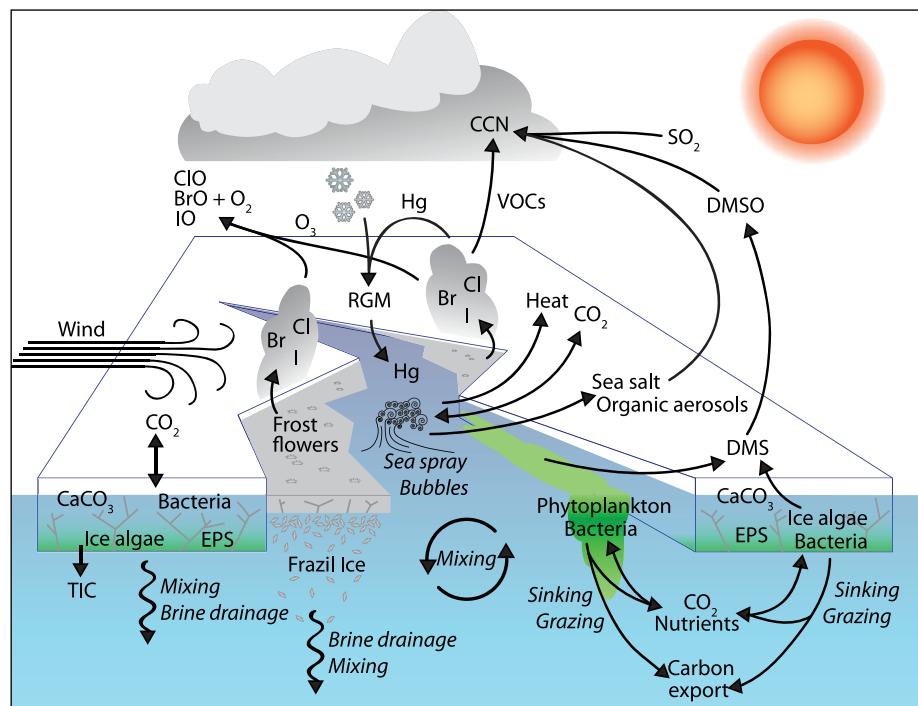


Fig. 1. Schematic of some ocean-atmosphere-sea ice-snowpack interactions among the chemical, physical, and biological processes in polar regions. These include but are not limited to feedbacks involving such chemical species as volatile organic compounds (VOCs), cloud condensation nuclei (CCN), total inorganic carbon (TIC), dimethyl sulfoxide (DMSO), reactive gaseous mercury (RGM), dimethyl sulfide (DMS), exopolymeric substances (EPS), and other molecular exchanges, as shown.

thereby enforcing limits to the production and consumption of biogenic gases (e.g., oxygen, carbon dioxide, and dimethyl sulfide) throughout the seasonal cycle [Loose *et al.*, 2011]. Gas transport through sea ice pore spaces is temperature dependent and typically minor when the ice is cold, but it increases in warm springtime ice. Subfreezing temperatures inside sea ice can promote calcium carbonate precipitation, driving the carbonate system away from seawater equilibrium, thereby altering the net transport of inorganic carbon between the atmosphere and the deep ocean. However, the magnitude depends on physical rates and pathways that are poorly constrained.

Direct exchange at the air-sea interface also occurs through cracks, leads (long, thin breaks in the ice caused by the combined action of wind and water currents), polynyas (areas of open water surrounded by sea ice), and open water. Sea ice reduces the surface area available for air-sea fluxes, but turbulent ice-ocean and ice-air interfacial stresses, buoyant convection, and wind waves potentially increase gas, aerosol, moisture, and heat transfer above what would be expected over a continuous, quiescent ice cover. Estimates of biogenic material exchanges in the polar ocean and their impact on larger scales will require a good knowledge of constraints on these processes.

The Polar Microbial Loop

Scientific understanding of the flow of energy and material within marine ecosystems and the role of microbes in elemental cycles lags in polar regions. Despite its inherent environmental extremes, sea ice provides a habitat for cryoadapted algae and bacteria, which may catalyze physical changes in the surrounding cryosphere. Exopolymers, proteins, and polysaccharides, produced by microbes as a defense against freezing, alter the microstructure of sea ice and the production of organic aerosols that could act as cloud condensation nuclei. Dense pigment layers not only affect ice albedo but also influence ice structure and stability via solar energy absorption.

In concert with their direct impact on the polar carbon cycle, microbes produce other climatically active species, including dimethyl sulfide and halocarbons, which are precursors of aerosols and reactive oxidizing compounds (e.g., bromine and chlorine atoms). Currently, significant gaps remain in understanding these biologically mediated processes due to the limited number of polar studies fully integrating rate measurements of biological, chemical, and physical processes with good temporal and spatial coverage.

Primary Aerosols

Sea salt aerosol, an important primary aerosol in polar regions, is generated from breaking waves or wind blowing over ice, snow, and frost flowers on the sea ice. Large changes in sea salt aerosol inputs, energy exchange

above leads and polynyas, and fluxes of biological and biologically derived material become more likely as the timing and extent of open water are altered. Evidence is clear that organic components from biological activities contribute a substantial fraction of the atmospheric aerosol [e.g., Orellana *et al.*, 2011]. These bio-organic compounds can influence important chemical and physical properties of aerosols, such as their solubility, surface tension, morphology, growth, and oxidation. These physical properties control aerosols' climatic and health effects.

Consequently, understanding the significance of biological particles and associated biogenic volatile compounds (e.g., dimethyl sulfide) for atmospheric processes and air-ice-snow interfaces is of great importance. Key issues to address involve characterizing bio-organic matter and understanding its transformation processes, including its effects on cloud nucleation and climate.

Reactive Halogens in Polar Regions

Many Arctic and Antarctic coastal stations record springtime events of depletion of ground-level ozone and mercury related to halogens released through a complex interplay between gas phase and condensed phase chemistry and meteorology in the lower troposphere. Global Ozone Monitoring Experiment satellite observations of atmospheric backscattered ultraviolet radiation have identified large clouds of bromine oxide (BrO) in springtime over sea ice in both hemispheres. BrO affects the tropospheric oxidizing capacity and is part of a natural biogeochemical cycle leading to the widespread and persistent removal of ground-level ozone and atmospheric mercury, converting the latter into nonvolatile products that reach the surface via either dry or wet deposition. However, exact halogen sources (open water, sea ice, snow, frost flowers, or aerosols) and the mechanisms for halogen release remain a source of controversy.

There is new evidence for extremely active iodine oxide and chlorine chemistry in polar regions, yet their distributions, sources, and magnitudes are also uncertain. Changing sea ice extent and character may significantly affect absolute and relative concentrations of all these reactive halogens; active research and observations via surface measurements from atmospheric platforms and satellites will help to resolve such uncertainties.

Anthropogenic Impacts

As Arctic seasonal sea ice retreats, anthropogenic pressures from sources inside and outside the Arctic will increase. Expanded infrastructure, coupled with increased ship traffic and resource development, will change the chemical nature and concentration of trace gases and particulates in the Arctic boundary layer and will increase pollutant loading to ground and ocean

waters. Local effects (e.g., from ship traffic) could include increased sulfur emissions, which will provide cloud-forming particles that alter albedo and precipitation, while increased black carbon emissions will decrease local albedo. Increases in other transportation-related pollutants and long-range transport of Eurasian emissions will alter oxidative chemistry (e.g., via increased inputs of nitrogen oxides).

Anthropogenic impacts on the Arctic will occur on a wide range of scales—from community to regional to pan-Arctic. Human and material infrastructure will be required to mitigate anthropogenic effects and feedbacks at all these levels. Thus, solid scientific understanding of the relationships between anthropogenic pollutants and the physical, chemical, and biological state of the polar environments is necessary to inform decision makers in the development of sound and effective public policy regarding management of polar environments.

Upscaling

A major challenge in understanding and predicting physical, chemical, and biological exchanges among ocean, atmosphere, sea ice, and snow, within the context of a changing ice and climate regime in the polar regions, is in bridging gaps between scale size and scientific issues. Some measurements are done in laboratories at the microscale level, while others are made from satellites. While their key goals are to measure and model small-scale processes driven by or linked to interactions with sea ice, scientists also aim to understand the significance and applicability of these processes on the 1- to 100-kilometer (or larger) scales of satellite observations and Earth system models.

However, a single-model grid cell or satellite footprint often contains a wide range of ice types and states, and the scales of interest depend on the processes studied. Quantifying the system-wide effects of new ice formation or ice deformation requires considering different temporal or spatial scales for biology, chemistry, or physics. Hence, large-scale models currently designed to represent physical air-ice-ocean interactions will require creative approaches to adequately represent such small-scale processes. Tackling these challenges requires connecting effectively across disciplines, developing models in parallel on all scales, and considering scaling and heterogeneity issues when designing field process studies to interpret and evaluate satellite observations.

Effective Organization of Polar Interdisciplinary Research

Perhaps the most important lesson from recent sea ice studies is that physical, chemical, and biological processes interact in distinctive and complex ways and should not be studied independently of one another. Rapidly changing polar environments

challenge the scientific community to develop robust and reliable models applicable on both small and system-wide scales for the poles and the entire Earth. A better understanding of how chemical and biological species exchange among all ocean, air, snow, and ice reservoirs is needed to anticipate and understand the effects of sea ice loss in polar environments. With this information, researchers can better prepare community planners and public policy makers for what may lie ahead.

In addition, an effective organizational structure will help the scientific community articulate research priorities and identify optimized and cost-effective approaches during the current period of funding challenges. For example, because individual countries, including the United States, manage few icebreakers and other polar research platforms, an organized research community can play a role in brokering priorities and organizing coordinated field campaigns in both polar regions. Several initiatives have been undertaken to get organized. The International Geosphere-Biosphere Programme's Surface Ocean-Lower Atmosphere Study (SOLAS) has formulated sea ice biogeochemistry as one of its new foci, and the IPY's Ocean-Atmosphere-Sea Ice-Snowpack project (OASIS) [Shepson *et al.*, 2003] has recently decided to continue with a second phase aimed at more effective coordination and approaches that seek to interconnect the

necessary disciplines, e.g., meteorology; climate science; atmospheric chemistry; polar ocean biology; and sea ice physics, chemistry, and biology. The SOLAS and OASIS communities will work together through the new Scientific Committee on Oceanic Research working group of the International Council for Science, known as the Biogeochemical Exchange Processes at the Sea-Ice Interfaces, which was formed in late 2011.

Acknowledgments

This article was developed from discussions at a recent OASIS workshop held in Telluride, Colo. See the updated OASIS Web site (www.oasishome.net) for more information, workshop presentations, and reports on future activities as they are generated.

References

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Author Information

Paul B. Shepson, Purdue University, West Lafayette, Indiana; E-mail: pshepson@purdue.edu; Parisa A. Ariya, McGill University, Montreal, Quebec, Canada; Clara J. Deal, University of Alaska Fairbanks; D. James Donaldson, University of Toronto, Toronto, Ontario, Canada; Thomas A. Douglas, U.S. Army Cold Regions Research and Engineering Laboratory, Fairbanks, Alaska; Brice Loose, University of Rhode Island, Narragansett; Ted Maksym, Woods Hole Oceanographic Institution, Woods Hole, Mass.; Patricia A. Matrai, Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, Maine; Lynn M. Russell, Scripps Institution of Oceanography, La Jolla, Calif.; Benjamin Saenz, University of California, Santa Cruz; Jacqueline Stefels, University of Groningen, Groningen, Netherlands; and Nadja Steiner, Fisheries and Oceans Canada, Victoria, British Columbia, Canada