Thirty-Eighth Annual

GEOSCIENCE DAY

PROGRAM AND ABSTRACTS

INDIANA UNIVERSITY OF PENNSYLVANIA
GEOSCIENCE DEPARTMENT

April 27, 2012
Room 134 Weyandt Hall

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GEOSCIENCE DAY SCHEDULE

8:20 –8:30 **Opening Remarks**
Dr. Steven A. Hovan

Session I – Oceanography, Geology and Climate

8:30 – 8:45 **Michael A. Russo**

BIOGENIC SILICA DIGESTION METHODS: ASSESSING THE IMPACT ON THE EOLIAN DUST RECORD

8:45 – 9:00 **Caz M. Bejger**

UTILITY OF CONODONTS FOR REFINING THE AGE OF THE UPPER STONEHENGE TRANSGRESSION AND BASAL NITTANY REGRESSION IN THE CENTRAL APPALACHIANS

9:00 – 9:15 **Michael S. Deemer**

THERMAL ALTERATION OF JOHNSTON SITE LITHIC MATERIALS

9:15 – 9:30 **Stephen G. Norair**

STREAM DISCHARGE TRENDS AND PATTERNS WITHIN THE GREAT LAKES REGION

9:30 – 9:45 **Renee M. Heldman**

COMPARING LAKE AND SOIL GEOCHEMISTRY TO UNDERSTAND LIMITATIONS ON BIOLOGY IN THE MCMURDO DRY VALLEYS, ANTARCTICA

9:45 – 10:00 **Refreshment Break**
Poster Viewing

Session II – Environment and Energy

10:00 – 10:15 **Tyson R. Milbrand**

PRELIMINARY STREAM SITE CHARACTERIZATION FOR QUAKER RUN, SCRA SITE 19

10:15 – 10:30 **Joshua D. Putt**

EFFECTS OF A NATURAL WETLAND ON ABANDONED MINE DRAINAGE ON THE NORTH FORK OF THE TWOLICK CREEK WATERSHED: COMMODORE, PENNSYLVANIA

10:30 – 10:45 **Heather E. McGinnis**

ANALYSIS OF ABANDONED MINE DRAINAGE (AMD) IMPACTS ON BEAR RUN, INDIANA COUNTY, PA DURING TIMES OF ABNORMALLY HIGH PRECIPITATION IN 2011

10:45 – 11:00 **Jason P. Wolfe**

SURFACE WATER QUALITY OF BEAVER RUN RESERVOIR DUE TO MARCELLUS GAS-SHALE DRILLING

11:00 – 11:15 **Patrick R. Boyle**

BASIN-WIDE SYNTHESIS OF THERMAL MATURATION INDICES OF THE PALEOZOIC APPALACHIAN BASIN

11:15 - **Guest Presentation: Alumni Lecture**
Steven J. Smith
Geodetic Earth Scientist
National Geospatial-Intelligence Agency (NGA)

CHRONOLOGIC MULTISENSOR ASSESSMENT FOR MOUNT CLEVELAND, ALASKA FROM 2000TO 2004 FOCUSING ON THE 2001 ERUPTION

BIOGENIC SILICA DIGESTION METHODS: ASSESSING THE IMPACT ON THE EOLIAN DUST RECORD

RUSSO, Michael A.

The study of eolian dust in deep sea sediment provides important information about ancient climates and the intensity of past atmospheric circulation. The main goals of this project are to assess the effectiveness of several different procedures commonly used to dissolve biogenic silica in oceanic sediments and to study the impacts these procedures have on the grain size and total mass of extracted mineral components. In the deep ocean far away from the influence continental mineral inputs by rivers and streams, the sediments are comprised of a variable mixture of biologically precipitated components (mainly organic carbon, calcium carbonate and hydrated silica), authigenic minerals (sea salts and iron/manganese oxides and hydroxides), and eolian minerals transported by the wind. To study the eolian component, all of the unwanted components must be dissolved so that only the dust remains. This is generally accomplished using a series of chemical rinses, however when sediment samples contain a large portion of biogenic silica, it can be difficult to completely remove. Biogenic silica can be dissolved using a variety of different procedures that employ a hot rinse in a strongly basic solution. We developed a matrix to test several different chemical concentrations and digestion times to see how well each works. After each extraction procedure a grain size analysis is performed on the extracted sample residue. The results will contribute to the research of paleoclimatic records by developing more effective techniques to extract the dust without removing some portion of it. This study will be particularly useful when trying to resolve eolian signals in parts of the ocean containing high biogenic silica (generally areas of biological productivity near quatorial and high latitude upwelling zones). Also, this information will help identify what impacts these procedures have on interpreting atmospheric wind strength when using eolian grain size data as a proxy.

UTILITY OF CONODONTS FOR REFINING THE AGE OF THE UPPER STONEHENGE TRANSGRESSION AND BASAL NITTANY REGRESSION IN THE CENTRAL APPALACHIANS

BEJGER, Caz M.

Conodonts (phosphatic, tooth-like microfossils) recovered from the upper part of the Lower Ordovician Stonehenge Formation and base of the overlying Nittany Dolomite include species characteristic of the *Rossodus manitouensis* Zone, which allows correlation with age-equivalent formations in areas outside of the Appalachians. The first goal was to determine how high into the Nittany Dolomite species of the *R. manitouensis* Zone persist, and thereby establish more precisely the location of the base of the overlying "Low Diversity Interval" (LDI). This will more tightly constrain the location of the base of the Stairsian Stage, which is known to lie just below the base of the LDI in other regions. A second goal was to scrutinize the lithologies at the Stonehenge-Nittany contact to resolve whether this boundary does record a regression (fall in sea level), or whether the basal strata of the Nittany Formation are simply upper Stonehenge facies that have been dolomitized. The third goal was to search for a number of conodont species that appear from recent work to be restricted to certain portions of the thick *R. manitouensis* Zone. Recovery of such species from the vicinity of the base or top of the upper member of the Stonehenge (referred to informally as the Logan Branch member) would provide welcome refinement to the ages of those boundaries. The base of the Logan Branch unquestionably represents a significant transgression (rise in sea level), and the top of the member perhaps records the subsequent regression.

COMPARING LAKE AND SOIL GEOCHEMISTRY TO UNDERSTAND LIMITATIONS ON BIOLOGY IN THE MCMURDO DRY VALLEYS, ANTARCTICA

HELDMAN, Renee M.

Taylor Valley, a glacially carved, ice-free region of the McMurdo Dry Valleys in Antarctica, contains highly varying saline soils. These fine-grained soils were deposited during repeated glacial periods during the Pleistocene. Taylor Valley is home to three major ice covered lakes, Lake Bonney, Lake Hoare, and Lake Fryxell, which experience an average annual temperature of -18°C and receive less than 10 cm of annual precipitation. Scottnema lindsayae, a species of nematode, is the dominant predator within the limited biodiversity of this extreme environment. This nematode is able to survive through anhydrobiosis, freeze drying itself until more suitable soil conditions (soil moisture) are sustained. The highly variable saline soils exert a first order control on the nematode populations. In attempts to understand the source of this geochemical variability, we compared the soil geochemistries of Taylor Valley to the geochemistries of the three major lakes. Climatic changes have resulted in historic fluctuations in lake levels saturating Taylor Valley soils with lake water to elevations possibly as high as ~300 meters. Warmer past climates would have resulted in increased glacial melting, reduced lake ice cover, and wind-driven mixing of the now geochemically stratified lakes. We hypothesize that finer-grained soils will retain lake water to eventual lake recession and also retain geochemical ratios of the lake waters. To test this hypothesis, I have taken a 10 year average of the lake geochemistries (from LTER site) for each of the three lakes, and weighted the highly stratified geochemical parameters for each of the depth intervals. I then determined the molarities for each of anion and cation, assuming that the lakes were able to mix in their entirety. Comparing the lake ratios of different geochemical parameters to ratios of geochemical soil data collected by Poage et al., we saw little to no correlation between the geochemistry of the soils and the lakes in Taylor Valley. This suggests that some other factors must be taken into account to understand the variability in Taylor Valley soil chemistry and ultimately how landscape and climate change might play a role in the environmental limitations and biological productivity of the McMurdo Dry Valley.

PRELIMINARY STREAM SITE CHARACTERIZATION FOR QUAKER RUN, SCRA SITE 19

MILBRAND, Tyson R.

Abandoned mine contamination affects many of the tributary streams in the Shamokin Creek watershed, significantly degrading the water quality and fishing potential of the area. Quaker Run, located near Kulpmont, Pa, is a tributary of Shamokin Creek positioned in east-central Pennsylvania. Quaker Run receives much of its water from now defunct coal mines and is impacted by Abandoned Mine Drainage (AMD). The waters from both Quaker Run and Shamokin Creek flow into the Susquehanna River, which was named America's most endangered river in 2005. This project involves conducting a preliminary stream site characterization for Quaker Run (site 19), with the assistance of the Shamokin Creek Restoration Alliance (SCRA), to assess the effects of Abandoned Mine Drainage to the site and the flux of pollutants the stream contributes to the Shamokin Creek. Initially, flow rates and water samples were taken from fall and winter months. These samples were then analyzed using the Inductively Coupled Plasma – Optical Emissions Spectrometer (ICP-OES) to determine levels of Fe, Al, and Mn (ppm) present in the water. The data was then related to past data collected by the SCRA to determine if Quaker Run has been degraded further. This research will help in determining if Site 19 is sufficiently impaired to require remediation. The data may also be used to provide baseline information to assist in the design and implementation of a suitable remediation system for site 19.

EFFECTS OF A NATURAL WETLAND ON ABANDONED MINE DRAINAGE ON THE NORTH FORK OF THE TWOLICK CREEK WATERSHED: COMMODORE, PENNSYLVANIA

PUTT, Joshua D.

I am conducting my research on the effects of abandoned mine drainage on the North Fork of Twolick Creek. In the region of my research, near Commodore, Pennsylvania, mines were prolific in the early 1900s and some mines still continue today. All of these mines from the past have caused major pollution problems in the area.

I am testing a small tributary that runs into the North Fork. The tributary comes out of an old mine shaft and then runs through a natural wetland before entering the stream. I have been sampling this tributary for pH, flow, and dissolved metal content to see if the wetland is affecting the amount of pollution entering the stream. Flow and pH measurements were made in the field at 5 sampling sites; elemental analysis was then run in the ICP laboratory at IUP to determine dissolved metal content in the water samples.

From the data collected we found that no remediation was needed. Our original hypothesis of the natural wetland doing the remediation on its own was not applicable to this site because the mine discharge entering the swamp needed no remediation to begin with. According to our tests, the water flowing into the wetland was nearly clean enough to reach EPA drinking water standards. Future sampling could be done to determine whether this site has become stable, or if this was a result of unusually high rainfall during our sampling season.

ANALYSIS OF ABANDONED MINE DRAINAGE (AMD) IMPACTS ON BEAR RUN, INDIANA COUNTY, PA DURING TIMES OF ABNORMALLY HIGH PRECIPITATION IN 2011

MCGINNIS, Heather E.

Bear Run, a headwater stream of the Susquehanna River, is severely impacted by abandoned mine drainage (AMD) from both surface and subsurface coal mining. Large-scale water quality improvement efforts have been ongoing since 2008 in an attempt to reduce the acidity and dissolved metal concentrations within the stream. Construction of these remediation systems is being completed in phases, with the most recent phase going online in the late summer of 2010. This project examines the stream's ability to neutralize pH, dissolved metals as well as other contaminants from a multiple site passive remediation system during a period of record precipitation and above normal average temperatures. Monthly water sampling of four selected locations (outflows and stream channel) were conducted to better understand the system's ability to handle changes in pH, acidity and dissolved metal concentrations during 2011. After the construction of earlier remediation phases (both constructed wetlands and limestone pits), in-stream total iron concentrations dropped 50% (Clark, SRBC). We believe the impact of abnormally high precipitation hinders the residence time as the water passes through the ponds of the passive remediation system. It appears, the passive remediation systems on Bear Run perform well under normal conditions; periods of abnormally high precipitation may permit AMD contaminated water to pass through the remediation sites at increased rates of flow, preventing the systems from properly neutralizing the increased volume of water. Our preliminary findings indicate increased precipitation days prior to sampling show a stable pH with fluctuating dissolved metal levels, potentially due to increased sub-surface water levels from previous months ground water recharge.

SURFACE WATER QUALITY OF BEAVER RUN RESERVOIR DUE TO MARCELLUS GAS-SHALE DRILLING

WOLFE, Jason P.

Our study monitored the impact of active Marcellus gas-shale drilling around and under the Beaver Run Reservoir in Westmoreland County PA, which supplies over 130,000 residences with drinking water. Water samples were taken within the reservoir and the surrounding watershed over the past year. Samples were tested for pH, Conductivity, TDS in PPM, temperature and metals such as manganese, magnesium, iron and calcium. Minor fluctuations in water chemistry have been detected but no samples showed conclusive evidence of contamination from gas-shale drilling.

BASIN-WIDE SYNTHESIS OF THERMAL MATURATION INDICES OF THE PALEOZOIC APPALACHIAN BASIN

BOYLE, Patrick R.

In order for organic rich rocks to generate hydrocarbons, they must become thermally mature by being buried in the subsurface of the earth for a sufficient amount of time. A basin-wide study was done on thermal maturation indices obtained from Rock-Eval pyrolysis and vitrinite reflectance measurements ($\%R_o$) of Middle and Upper Devonian samples from the Appalachian foreland. The indices were obtained from a large thermal maturity database compiled by the USGS that contains measurements from 767 subsurface samples collected from wells across the basin. A regional van Krevelen-type cross plot of the pyrolysis hydrogen index (HI) versus oxygen index (OI) shows a predominantly Type I (oil-prone) kerogen maturation path for several Devonian black shales while also revealing the expected pattern of maturation with distance from the Allegheny Front. A regional log-linear plot of $\%R_o$ versus depth shows that most samples fall along a normal linear trend. Preliminary analysis suggests that over mature outliers (i.e. higher than normal $\%R_o$ at a given depth) are associated with major unconformities. Results of this study provide insight towards a new regional perspective on thermal maturation indices within the Appalachian foreland.

CHRONOLOGIC MULTISENSOR ASSESSMENT FOR MOUNT CLEVELAND, ALASKA FROM 2000 TO 2004 FOCUSING ON THE 2001 ERUPTION

SMITH, Steven J.

The hazard posed by Mount Cleveland in Alaska's central Aleutian Islands is the interaction between erupted ash and aircraft. The understanding of these potential hazards can be applied to other threatening volcanoes in the Aleutian Islands. Remote sensing satellites have been useful for constraining the chronological events of the 2001 eruption activity. Thermal infrared data is analyzed for maximum estimated thermal flux of 15.3 GW and maximum effusion rates of 4.6 m^3/s during the February 19, 2001 eruption. These thermal estimates are compared to known field observations of the deposits to better classify the eruption sequence and activity. This sequence on the western flank of volcaniclastic debris-lahar-lava is similar to the stratigraphy of past deposits nearby. Post-eruption analysis of satellite and field observation data provide a useful view into the erosion of a 1.2 x 10^6 m^3 volcaniclastic debris flow fan deposit from the eruption along with continued morphologic changes of the volcano. Areal analysis of the fan deposit in radar imagery from March 31, 2001 until December 21, 2003 indicates an average decreasing trend of 20 m^2/day. This unique chance to determine the erosion rate of this deposit may be applied to similar eruption deposits at other island volcanoes.

Notes:

Acknowledgement

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