Forty-Fourth Annual

Geoscience Day

April 27, 2018
HUB Monongahela Room

Indiana University of Pennsylvania
Geoscience Department

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Program and Abstracts

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PROGRAM SCHEDULE

- OPENING REMARKS BY DR. STEVE HOVAN -

SESSION 1: PALEONTOLOGY, GEOCHEMISTRY AND GEOPHYSICS

8:00 **Brennan Ferguson**
Relating *Fragilariopsis Kerguelensis* Fragments to Original Valve Dimensions

8:12 **Nicole Lees**
Determining the Paleogeographical Origin of the *Allosaurus Fragalis* from within the Cleveland Lloyd Dinosaur Quarry (Price, Utah) Using Biogenic Apatite δ18O Values

8:24 **Justin Petricko**
Elemental Composition Analysis of the Cleveland Lloyd Dinosaur Quarry Identifying Diagenetic & Bio-accumulate Sedimentation Processes Associated with Bone Deposition

8:36 **Austin Patch**
Paleoredox Analysis of Two Cores through the Marcellus Shale, Harrison and Wetzel Counties, West Virginia

8:48 **Ryan O'Donnell**
In-Situ Calcite Precipitation on Shales: Modeling Enhanced Tight Shale Re-Fracturing and Reservoir Simulation

9:00 **Nicole Kelley**
Resistivity Imaging of Preferential Flow Paths from a Passive Acid Mine Drainage Treatment System in the Huff Run Watershed, Ohio

9:12 **Nieko Santoro**
Examining Conductivity and Subsurface Heavy Metal Concentrations within Western Pennsylvania Through the use of Inductively Coupled Plasma Optical Emission Spectroscopy and Aerial Photography

9:24 **Aaron Seidel**
Investigation of Methane and Soil Carbon Dynamics using Near Surface Geophysical Methods at the Tanoma Educational Wetland Site, Tanoma, Pennsylvania

- COFFEE BREAK AND POSTER SESSION -

SESSION 2: HYDROLOGY AND ENVIRONMENTAL GEOLOGY

10:00 **Nick Payne**
Marsh Run Indiana Pa. Flash Flooding Events Worsened Due to Mitigation Lines from Municipal and Private Buildings/Parking Lots

NOTES

10:12 **Garrett Sharp**
Assessing the Impact of AMD Chemistry on Algal Communities

10:24 **Jillian Mathews**
Impacts of Urban Environments on Marsh Run

10:36 **Nick Bradley**
A Phase-1 Environmental Site Assessment of the Bryce Brothers Factory in Mt. Pleasant, Pennsylvania

10:48 **Courtney Sullivan**
Phase 1 Investigation of Indiana University of Pennsylvania Rain Garden

11:00 **Erin Johnson**
Factors Affecting Gas Flow Rate from Legacy Wells in Indiana, Pennsylvania

11:12 **Brock Kennedy**
Flow Rate Methodology with Respect to Legacy Wells in Indiana County

- LUNCH BREAK -

SESSION 3: ASTRONOMY, TECTONICS AND VOLCANOLOGY

12:30 **Kyler Yingling**
Galilean Orbital Resonance and Europa-Io-Storm Related Positions

12:42 **Drake Kutkat-Tonkin**
Lateral Ramps and Seismicity within the Valley and Ridge of the Central Appalachians

12:54 **Caleb McCombie**
Climate-Derived, Differentiated Uplift along Central Range within Hualien County, Taiwan

1:06 **Amy Clegg**
The Eastern Central Range of Taiwan: An Assessment of Metamorphic Foliations that Record Recent Exhumation

1:18 **Alex Patch**
Determining Crystallization Dynamics of Recycled Tephra through Reheating Experiments

SESSION 4: FEATURED ALUMNI PRESENTATION

1:30 **Samantha Ritzer '14**
Are All Shales Created Equal?: A Comparative, Multi-proxy Geochemical Study of Paleozoic and Mesozoic Black Shale Basins in North America

Relating *Fragilariopsis Kerguelensis* Fragments to Original Valve Dimensions

Brennan Ferguson

Morphological variability in marine diatoms recovered from sediment cores has become a valuable proxy for changes to temperature, sea-ice and nutrient conditions in the past. Of particular utility in the Southern Ocean is *Fragilariopsis kerguelensis*. Typically, a full valve is required for morphological measurements. However, especially during glacial periods, the majority of *Fragilariopsis kerguelensis* valves found sediment cores are fragmented reducing the usable sample size. As *F. kerguelensis* is the dominant species of diatom in the Southern Ocean and extensively used as a proxy record, including fragments as usable specimens would be helpful to many studies. As such, it is important to be able to reliably relate the geometry of fragments to the valves original length normalized width, which is related to various oceanographic conditions. This study compares various valve measurements to the width:length ratio in an attempt to identify a viable proxy from fragmentary valves.

The prevalence of ferruginous conditions among the analyzed sections suggests that this proxy is only valid for specific basins. Further, our data shows signals of changing redox conditions within a single basin depocenter, suggesting that a one-size-fits-all method of reservoir characterization and production may not be the most effective.

Ultimately, creating a more accurate depositional model that can be applied to a single basin or translated from one unit to another is a step towards improving the efficiency and decreasing the environmental footprint of natural gas extraction in the transition to cleaner energy.

Are All Shales Created Equal?: A Comparative, Multi-proxy Geochemical Study of Paleozoic and Mesozoic Black Shale Basins in North America

Samantha Ritzer

Much of the energy potential in North America is in the form of natural gas that is stored in unconventional shale reservoirs. At present, operators understand how to find, broadly analyze, and produce these hydrocarbon-rich horizons. Finer details about the initial geochemical conditions that give rise to these highly productive intervals remain poorly constrained over variable spatial and time scales.

Here we study a series of Paleozoic and Mesozoic basins in North America using an array of geochemical proxies including total organic carbon (TOC) and $\delta^{13}C_{org}$ analysis, iron speciation, and redox-sensitive trace metal abundances, coupled with sedimentology. Together, these proxies for organic matter preservation and provenance, basin restriction, and redox conditions (ie. anoxic, euxinic, or ferruginous) provide a robust, yet nuanced, depositional model for each target zone. Compilation and comparison of each depositional model to others in the series allows for discovery of subtle correlations, or lack thereof, that may have been overlooked as a factor in exploration or production.

Preliminary results from the Williston, Appalachian, Midland, Liard, Peace River, Fort Worth, and Gulf Coast basins suggest that all shales are not created equal. Redox conditions vary greatly from basin to basin, especially in the proportion of sulfidized reactive iron, i.e. whether the overlying water column was ferruginous or euxinic. The variability between basins is especially important with the use of certain proxies, such as molybdenum enrichment, which requires euxinia to correctly interpret basin restriction and paleohydrogeography.

Determining the Paleogeographical Origin of the *Allosaurus Fragalis* from within the Cleveland Lloyd Dinosaur Quarry (Price, Utah) Using Biogenic Apatite δ18O Values

Nicole Lees

The Cleveland-Lloyd Dinosaur Quarry is part of the Morrison formation of eastern Utah and is death assemblage dating to the late Jurassic. The CLDQ is a crucial site to understanding the dynamics within the Morrison formation. The quarry contains is the highest density of Jurassic bones discovered to date, with the highest allotment of bones belonging to *Allosaurus fragilis*. The quarry has an abnormally high ratio of predators to prey for a death assemblage. Unlike most predator traps, the CLDQ lacks a defined snaring mechanism, has a wide distribution of individual elements and has an imbalance between prey and predator, with a 3:1 ratio favoring prey. While multiple hypotheses have been put forward to explain the assemblage preserved at Cleveland-Lloyd, recent work suggests a component of both drought and flood processes created the deposit. We are analyzing the δ18O values obtained by processing the bioapatite from *Allosaurus* dentin, obtained from this location, to hypothesize their geographical origin. Since oxygen isotope values in vertebrate bone typically reflect the isotope values of the water they drink, similar values imply the *Allosaurus* are from a small geographic area, whereas disparate values would imply the *Allosaurus* were washed into the pond that the quarry represents from across a broad geographic area.

Elemental Composition Analysis of the Cleveland Lloyd Dinosaur Quarry Identifying Diagenetic & Bio-accumulate Sedimentation Processes Associated with Bone Deposition

Justin Petricko

The Cleveland Lloyd Dinosaur Quarry located approximately 30 miles south of Price, Utah has remained an unsolved paleontological mystery for nearly 100 years. The sedimentation process of the CLDQ can help in assisting to determine the depositional environment during the upper Tithonian of the Jurassic (148 m.a). This would be essential for reconstructing Paleoclimatology to define what processes could inhibit the deposition of nearly 12,000 fossilized Jurassic dinosaur remains. By measuring the concentration of elements in relation to deposited dinosaur bones we can begin to define whether the deposition of the bones trends towards a diagenetic sedimentation, or the process of elements transferring from the sediment into the bone itself. We can also observe if the sedimentology of the CLDQ can be derived from a bio-accumulation process, or the process of the elements present within the bone leaching out into the sediment influencing its composition. By using X-ray Fluorescence to determine the concentration of elements from sediment samples we can trace if elements transfer into, or away from the bone to define what processes are taking place, and what predominantly influences the sedimentology at the CLDQ. Understanding the relationship between deposited bone, and the sedimentology of the surrounding sediments we can begin to understand if the elements within the bones themselves influenced the sedimentology at the CLDQ, or the sedimentology at the quarry itself influenced the composition of the bones.

Determining Crystallization Dynamics of Recycled Tephra through Reheating Experiments

Alex Patch

Explosive basaltic volcanoes with low mass eruption rates often have insufficient energy to expel clasts beyond the vent rim, resulting in clasts falling back into the vent. Pyroclasts may be reheated, or even encapsulated in more juvenile melt and ejected again - i.e., recycled, producing microcrystalline-rich areas surrounded by microlite-poor matrix. Similar textures have been observed within tephra in volcanoes around the world, including the submarine volcano, NW Rota-1, Mariana arc. Interestingly, the matrix glass of microlite-rich areas of NW Rota-1 samples are highly enriched in chlorine (≤ 2 wt% Cl).

In this study, recycling textures were reproduced through reheating basaltic tephra in a 3.5% NaCl aqueous solution as an analog to submarine recycling, and compared to untreated 'dry' experiments. All experiments were run in a 1atm tube furnace over timescales of 5-60 minutes and temperatures 700° C-1100°C. SEM imaging and EDS element mapping were used to analyze the extent of reheating-induced crystallization and determine mineral phases produced.

Reheating-induced crystallization starts at ≥1000°C and extensive crystallization (no matrix glass remains) occurs at ≥1100°C and ≤ 5 minutes. Reheated samples saturated in NaCl solution show similar timescales for crystallization as untreated samples, but a greater extent of crystallization, including localized microcrystalline-rich areas (similar to inclusions found in NW Rota-1 tephra), a texture seemingly unique to NaCl influenced samples, suggesting interaction with NaCl influences crystallization. Chlorine concentrations do not appear to be elevated within the microcrystalline-rich areas, as found in NW Rota-1 microcrystalline inclusions.

The Eastern Central Range of Taiwan: An Assessment of Metamorphic Foliations that Record Recent Exhumation

Amy Clegg

Taiwan is the expression of ongoing arc-continent collision, taking place where the Luzon volcanic arc moves NW at a rate of approximately 80mm/yr., relative to the fixed passive margin of China. The collision is contributing to the exhumation of metamorphic basement rock in the eastern Central Range. The Luzon volcanic arc occurs on the western margin of the Philippine Sea plate and is colliding with the Chinese continental shelf which is part of the Eurasian plate. Dramatic orogeny associated with northeast to southwest extension is reconstructing the island. My work is aimed at documenting the geometry and kinematics of the youngest metamorphic foliations in the exhuming crystalline basement material. The metamorphic rocks of the eastern Central Range include low- to moderate-grade and phyllites, enveloping rare high-pressure/low-temperature blocks. The phyllitic metamorphic rocks are the focus of my efforts. This material has undergone multiple phases of recrystallization under differential stress conditions, yielding at minimum two foliations (S1 and S2). I focus on S3 because it is minimally overprinted by deformation indicating a possible transition from ductile to brittle to exposure in the eastern Central Range. Compositional banding within this basement material provides evidence of mechanisms that accompanied the exhumation process. While systematically interpreting orientation and geometry of the foliations, Taiwan's current tectonic activity will be better understood by clear classification of each fabric, including establishing its parent material, characterizing crystallization patterns, and classifying mechanisms at play during exhumation. Understanding Taiwan's ongoing collision can support future expectations on the continuous passage of the plates and provide more information on concern for potential earthquakes, landslides, and other natural disasters.

Paleoredox Analysis of Two Cores through the Marcellus Shale, Harrison and Wetzel Counties, West Virginia

Austin Patch

The Appalachian basin contains a number of organic-rich shale units that have been recognized as important for natural gas production. In particular, the Middle Devonian Marcellus Shale is one of the largest unconventional natural gas plays, accounting for 40% of shale gas in the U.S. The Marcellus shale has been heavily researched, but questions remain about the depositional environment and, in particular, the extent to which the basin was restricted.

A high-resolution geochemical study was completed on a total of 145 feet of core from two separate wells in Harrison and Wetzel counties, West Virginia. We use iron speciation, total organic carbon (TOC), δ13Corg, redox-sensitive trace elements, and major and minor elemental analyses to explore bottom-water redox conditions in the Marcellus shale. Preliminary data suggests that both Marcellus shale cores were deposited in predominantly anoxic and often euxinic conditions. Comparative results indicate that the depositional environments between the cores are markedly different.

It has been suggested that in addition to thermal maturity, spatial factors, including basin restriction, depositional environment and sedimentology play a key part in unconventional source rock and reservoir quality. The wells used in this study were spaced only 36 miles apart and such variable results were unexpected. Ultimately, we seek to further investigate how redox conditions in particular correlate with typical indicators used in natural gas exploration and production to increase the efficiency and accuracy with which basins and formations are evaluated.

In-Situ Calcite Precipitation on Shales: Modeling Enhanced Tight Shale Re-Fracturing and Reservoir Simulation

Ryan O'Donnell

Current low oil/natural gas prices have emphasized the necessity for enhanced production rates from tight shale reservoirs. Increasing production life and prolonging the production duration of the shale formations through carbon dioxide stimulation of wells previously targeted for hydraulic fracturing may increase productivity and the economics of the plays. Steep decline of production is a poorly understood factor of hydraulic fracturing due to a multiplicity of variables in shale mineralogy, geochemistry, and fracture characterization. However, re-fracturing with supercritical carbon dioxide (SCC02) may increase production rates on mature, depleted wells if modeling can account for reservoir conditions which may hinder the effects of the (SCC02) injection. For example, Marcellus shale is often ubiquitously mineralized by calcite druze cementation. The effects of calcite druze cement may dampen the production rates of (SCC02) due to calcite mineralization on free surface fractures, causing the mineralizing fill interface to swell as the calcite precipitates on adjacent fracture walls and expansion of the fracture, thus displacement occurs. However, accurate modeling of calcite precipitation has not been studied as a major influence on the dampening of production rates in either hydraulic fracturing or enhanced re-fracturing.

This study aims to answer the linkage between the observable effects of calcite druze cement growth on mineralized fill interfaces and the fracture behavior by using an in-situ apparatus to develop calcite-on-shale samples. The samples were subjected to the calcite growth apparatus to show the effects of short-term calcite precipitation in a hypothetical "legacy well" to model the effects on geochemistry and mineralogy of various shale samples. Experimental treatment of the samples simulates the conditions where calcitic precipitation may inadvertently fluctuate the production within the Marcellus and other shale plays, and may also serve as a simulated model for future studies of reservoir development in a laboratory settings.

Climate-Derived, Differentiated Uplift along Central Range within Hualien County, Taiwan

Caleb McCombie

Hualien County extends into the Central Range of Taiwan, which is the poorly understood, highly deformed, metamorphic core of the island. High precipitation expressly related to monsoonal cycles of south Asia, intensifies mass wasting across the Central Range. Phyllitic schist and slate dominate the bedrock of the mountainous region which exhibits exceptional topographic relief, thus increasing the rate of landslides and shedding of sediments. Much investigation has been performed in the region in the form of geodetic records of uplift, seismic measurements, and sediment outflow. Little attention has been specifically paid to mining data for evidence of climate-derived, differentiated uplift. This describes dynamic precipitation patterns along the Central Range and increased sediment flux out of local catchment basins. The phenomena would connect specific regions of accelerated uplift from decreased mass overhead, to the long-term precipitation records in Hualien County. Many tributaries flow perpendicular to the longitudinal valley and are regularly monitored by the Central Weather Bureau for stream flow, sediment output, and stream power. Geodetic stations placed by consortium of institutions provide a wide lens of average uplift rates at specific points throughout the county. Taking into consideration geologic/soil composition, watershed area, average hillslope incline percentage will clarify if the Central range has a dynamic rising action due to uneven rainfall distributions, or rather for extraneous reasons. Differentiated uplift due to climactic patterns could generate better understanding of the sensitivity ongoing orogenic events have towards surficial processes.

Lateral Ramps and Seismicity within the Valley and Ridge of the Central Appalachians

Drake Kutkat-Tonkin

Pohn and Coleman (1991) used seismic and geologic data to trace the source of seismic anomalies (concentrations of earthquakes) occurring within the Appalachian valley/ridge. Their research led them to find that a geologic structure known as a lateral ramp was the source. This type of ramp, also known as a transfer fault, is the face that is revealed from the off-set of blocks due to faulting and movement within the basement rock that is perpendicular to the strike of the Appalachian valley/ridge. Lateral ramps are unique compared to normal ramps, as the direction of the dip is perpendicular to the propagation of the crustal motion. Normal ramps, in contrast, are parallel to the propagation of the crustal motion. As the crust moves in a certain direction, parts of it move faster than others, this can cause a block-like effect causing a lateral ramp to form. Not much is known about why or how lateral ramps cause seismicity. The purpose of this research is to determine whether lateral ramps still concentrate a noticeable level of seismicity within the Appalachian valley/ridge or not.

Subsurface and basement geology data constrain the locations of the lateral ramps in question. The area of study is determined by the perimeter of the polygon formed by the found ramp locations viewed in satellite imagery. Seismic anomalies and earthquake data for this research are bounded by the source, magnitude, and geographic location of the anomaly. The ramps in question are within the Appalachian valley/ridge within eastern-central PA and northern MD. The correlated data and imagery are manipulated through ArcGIS to visualize the ramp locations along with the historical and present seismic anomalies. The noticeability of the seismic anomalies that may be produced by lateral ramps are determined and concentrated by the overall average magnitude within the study area correlated to the average of magnitudes produced by lateral ramps. The importance of this research is that many of these ramps are under towns and cities and understanding the possible seismic danger of these ramps could allow for further research as well as preparedness for earthquakes.

Resistivity Imaging of Preferential Flow Paths from a Passive Acid Mine Drainage Treatment System in the Huff Run Watershed, Ohio

Nicole Kelley

Huff Run Watershed in northeast Ohio is a small sub-watershed of the Ohio River Watershed, with a catchment area of 14.7 square miles along the length of Huff Run. Alternating beds of sandstone, siltstone and shale interstratified with coal, clay and limestone underlie the watershed, and engendered over a century of coal extraction in the area. This legacy of coal extraction greatly impacts the quality of local groundwater. Acid mine drainage (AMD) resulting from coal refuse piles, surface mine spoils, water-filled impoundments and abandoned mine workings creates an acidic solution of contaminants that percolates through permeable sedimentary rock units into local aquifers. High concentrations of iron, manganese, sulfates and dissolved solids have been found in groundwater samples, as well as increased levels of specific conductance and water hardness. For over thirty years, a consortium of governmental and non-governmental agencies has worked to passively treat AMD contamination across the watershed with reclamation and restoration projects at former extraction sites. Since AMD leachate includes heavy metal ions that influence soil conductivity, electrical resistivity imaging (ERI) can be used to track potential contaminant flow paths in the subsurface near these projects as a measure of their efficacy in containing contaminants. It is a rapid and minimally invasive method that can be inverted to determine a spatially continuous electrical resistivity distribution within the subsurface and potential flow paths. To constrain ERI data, inductively coupled plasma optical omission spectrometry (ICP-OES) is used to determine the bulk chemistry of water in the system as well as nearby Huff Run. Between those methods, and borehole correlations of bulk chemistry along the ERI profile, this study aims to provide insights into the ability of passively engineered AMD remediation systems in the Huff Run Watershed to isolate metals and prevent contaminants from leaching into the subsurface.

Examining Conductivity and Subsurface Heavy Metal Concentrations within Western Pennsylvania Through the use of Inductively Coupled Plasma Optical Emission Spectroscopy and Aerial Photography

Nieko Santoro

Acid mine drainage (AMD) emanating from three abandoned mines discharge an estimated 126 pounds of iron per day into the Tanoma remediation wetlands in Pennsylvania. The mine system contains approximately two billion gallons of AMD, and feeds the remediation wetlands 1500-2800 gallons of AMD per minute seasonally into the mitigation system. This high rate of discharge produces areas where high velocity flow scours the wetland bottom, moving precipitants and destroying vegetation roots.

Although the discharge into Tanoma is known to be damaging, other discharges to surface waters have shown metal concentrations several times higher, and are left untreated to enter reservoir systems. This draws attention to these remediation sites, the processes used to treat them, and the source of these pollutants. With most of the research that's been conducted in the AMD remediation field relating to remediation ponds within the Tanoma Remediation system and its iron concentrations, there is very little information about the effects of these large influxes of metals from the subsurface mine areas and the effects it has on biodiversity and methane production within an AMD remediation site. This research investigates the conductivity, presence and concentration of metals below the Tanoma treatment wetland and other subsurface water sources using inductively coupled plasma optical emission spectroscopy (ICP-OES). Furthermore, our ICP data is compared with surface metal concentrations, aerial photography, and methane levels within the Tanoma AMD site to identify relationships and the potential effect they have on the productivity and effectiveness of the remediation site through time.

Galilean Orbital Resonance and Europa-Io-Storm Related Positions

Kyler Yingling

Io and Europa are the closest Galilean moons of Jupiter. They are in a 1:2 orbital resonance. These moons have defined orbital phases of 0 when between Jupiter and Earth, orbital phase 180 when directly behind Jupiter, and orbital phase 90,-90 when between the 0 and 180 phases. When Io crosses over specific magnetic anomaly points of Jupiter (A, B, C) and Io is in its 0 orbital position, the result enhances the intensity of radio waves. These alignments are labeled respectively: Io-A, Io-B, and Io-C. The enhanced radio wave emissions produced arise from the conductive nature of the plasma torus expelled by Io's heavy volcanism. Is Europa's orbital position synchronizing with Io's position during Io-related phases? Two years of gathered data points from the NASA Radio Jove Telescope submissions provide data ranging from radio waves, time/date, to Io-Storm type. The "In-The-Sky" online program that uses modern geophysical data to map the positions of the Galilean Moons yields the location and orbital positioning of Europa compared to Io's position. By being able to control the variable of Io's orbital position during Io storms, we are able to identify our independent variable of Europa's orbital position to determine any linear or recurrent intervals for a Europa-Io Storm related orbital position trend.

Flow Rate Methodology with Respect to Legacy Wells in Indiana County

Brock Kennedy

Hundreds of thousands of legacy gas wells in may exist in Pennsylvania. Only a relatively small number (about 14,000) exist in the PA Department of Environmental Protection legacy well data base. These wells may pose significant environmental and safety risk because most of these wells were completed before the regulatory framework after of the PA Oil and Gas Act took effect. The first portion of my study is an attempt to validate the location/status of a selected subset of 28 wells in the regional Indiana County. I was able to locate 36 percent of them; out of the ten located wells five of them leaked a detectable amount of methane. I also attempted to compare methodology used to measure emissions from these wells using a multiple techniques. To measure the leak rate of each found well I used a two instruments, a quick change orifice and calibrated digital flow meters (Alicat). I am going to do a statistical analysis comparing the flow rate values to determine error between instruments with a primary focus on two wells in Indiana County found to be emitting methane. To ensure validity of my results I will compare my data to controlled lab standardizations.

Investigation of Methane and Soil Carbon Dynamics using Near Surface Geophysical Methods at the Tanoma Educational Wetland Site, Tanoma, Pennsylvania

Aaron Seidel

Studies to constrain methane budgets of Pennsylvania have sought to quantify the amount and rate of fugitive methane released during industrial natural gas development. However, contributions from other environmental systems such as artificial wetlands used to treat part of the 300 million gallons per day of acid mine drainage (AMD) are often understated or not considered. The artificial wetlands are sources of both biogenic and thermogenic methane and are used to treat AMD which would otherwise flow untreated into Pennsylvania surface waters. Our research utilizes a combination of indirect non-invasive geophysical methods (ground penetrating radar, GPR) and the complex refractive index petrophysical model, aerial imagery, and direct measurements (coring and gas traps) to estimate the contribution of biogenic methane from wetlands and legacy thermogenic methane from acid mine drainage from a closed and flooded coal mine at an artificial wetland designed to treat these polluted waters at Tanoma, Pennsylvania.

Our approach uses three-dimensional (3D) GPR surveys to define the thickness of the organic soils from the wetland surface to the regolith -bedrock interface to create a volume model of potential biogenic gas stores. Velocity data derived from the GPR is then used to calculate the dielectric permittivity of the organic soils and then modeled for gas content when considering the saturation, porosity and amount of soil present. Depth-profiles are extracted to confirm soil column interfaces and determine changes in soil carbon content with depth. Direct comparisons of gas content are made with gas traps placed across the wetlands that measure the spatial and temporal variability of gasseous methane released. In addition, methane dissolved in the waters from biogenic processes in the wetland and thermogenic processes underground are analyzed by a gas chromatograph to quantify those additions. In sum, these values can then be extrapolated to estimate carbon stocks in AMD areas such as those with similar water quality and vegetation types in the Appalachian region. This research demonstrates the ability of indirect geophysical methods and the CRIM petrophysical model to estimate methane gas fluxes and total carbon stocks within artificial wetlands. This will be of assistance to understand the environmental impact of methane released from naturally occurring sources and legacy coal mines, not only commercial extraction and distribution activities.

Marsh Run Indiana Pa. Flash Flooding Events Worsened Due to Mitigation Lines from Municipal and Private Buildings/ Parking Lots

Nick Payne

Marsh Run is one of few streams that runs through Indiana borough and White Township. A large portion of land surrounding Marsh Run is overlain by impermeable surfaces which do not allow water to be absorbed into the ground. Many of these surfaces have drains that transport storm or melt water directly to the stream which increases how fast the water makes it to the stream. Due to the increased velocity by the drains, the amount of water that is being discharged into the stream could rapidly increase water levels causing flooding. With so many drainage lines, water is rapidly being added to the stream, which the stream cannot handle. With the determined amount of discharge coming from the lines, we can find better ways to slow down storm and melt water from going into the stream. This will slow down the rate of which water reaches the stream, therefore lowing the flooding events. Many flood events throughout the year have caused thousands of dollars in damage to properties within close proximity to the stream. Floods have also cost the borough and tax payers thousands of dollars to clean up and fix damages caused by flooding. I hope to determine whether there is a high amount of storm water coming from these mitigation lines which is causing flooding. Preliminary data shows an average of 2.48 Gallons Per Minute for two-inch pipes. Four-inch pipes have an average of 9.48 Gallons Per Minute.

Factors Affecting Gas Flow Rate from Legacy Wells in Indiana, Pennsylvania

Erin Johnson

In Pennsylvania, estimates suggest that as many 400-700 thousand wells have been drilled in the past century and a half. Many of these older “legacy” wells were abandoned or orphaned prior to the development of the modern regulatory framework and thus have an unknown closure status and may pose environmental risks related to leaking gas or fluids. This study is aimed at trying to determine atmospheric and/or environmental variables that may cause fluctuations in gas emissions from leaking wells. Data was collected from a specific well in Indiana County, Pennsylvania that is leaking, variably. Discrete gas samples show that methane comprises more than 95% of the leaking gas and table isotope ratios are consistent with thermogenic sources. Regular intervals of emission flow rate data were also collected and compared to a variety of meteorological conditions. Short term (hourly to daily) flow rates are significantly affected by atmospheric pressure and slightly affected by the Moon’s gravitational pull on the Earth based on its position in each phase. Long term factors (monthly or yearly) may include precipitation and its impact on the water table or subsurface mine flooding. This study can help determine the causes of flow rate changes on one specific well which can then be used to help estimate regional emissions.

Phase 1 Investigation of Indiana University of Pennsylvania Rain Garden

Courtney Sullivan

My research project is a phase 1 investigation located on 1030 Wayne Ave, Indiana, PA. The site has been occupied by McCarthy Hall since 1966 and has been demolished this past year to make room for a rain garden. A rain garden is a planted depression or a hole that allows rainwater runoff from impervious urban areas such as roofs, driveways, parking lots, and compacted lawn areas to soak into the ground and contribute to flooding. My research project is to investigate any possible contamination left behind from McCarthy Hall or from industries that have occupied this site in the past. The average annual rainfall in Indiana, PA is 46.49 inches and storm water runoff has been an issue for IUP campus. This rain garden will help the community significantly as long it is planted in a safe location site. In order to identify any potential contamination, I consulted Sanborn Fire Insurance of Indiana, PA in 1910 and also looked at online EPA maps of known contamination sites in the area. I have found that a hazardous waste cleanup occurred on 1410 Wayne Avenue since 1985, covering 19 acres and last updated in 2016. In 1910 there was a Marble Works Tile Construction North of 7th street and Hetrick & Wilson Indiana Roller Mills North of 8th street. If any possibility of contamination is found in my research then a phase 2 investigation would be recommended to determine the extent of the problem for the site of the rain garden.

Assessing the Impact of AMD Chemistry on Algal Communities

Garrett Sharp

Acid mine drainage pollutes over 3000 miles of streams and ground water in Pennsylvania alone, and in response many solutions have been developed to counteract the effects of acidic mine drainage. It is estimated by USGS that restoring these watersheds would cost $5 billion-$15 billion in total. As economic conditions place limits on expenditures, cost effective means of remediation are of critical importance. It is a common practice to allow spoilage piles from many tributaries to enter stream systems unaltered; remediation then occurs further down the stream profile. Associated with algal biomass reduction, acid mine drainage may cause an overall decrease in nutrient retention and elemental energy flow. This drastically affects downstream ecosystems as they rely on the production of phosphorous and carbon from algal biofilms to maintain a certain standard of health. In this study two different tributary branches of Blacklick Creek were used to investigate biofilm retention.

Impacts of Urban Environments on Marsh Run

Jillian Mathews

In this study, we analyzed the amount of stormwater runoff from urban areas entering Marsh Run in Indiana, Pennsylvania. Four Solinst datalogger sensors were placed into the stream that continuously collected changes in water level from May 2017 through November 2017 at fifteen minute intervals. These sensors provided the rate at which water rose and fell throughout the duration of this study. We determined an approximate volume of water within the system itself by calculating the discharge. This was accomplished by using a flowmeter to measure the depth and velocity of various sections of the stream. These values were then added for a total discharge for the reach. The discharge and water levels were used to create rating curves which allow for a conversion from water depth to water discharge. While these rating curves showed a slight exponential function, due to the flashy nature of these streams there was not enough data at high water levels to utilize the discharge data for further analysis. In order to calculate the baseflow of the streams, we used the water levels to ensure the highest accuracy of our results. Preliminary results show that during peak storm events, stream base flow is approximately between 20-40%, meaning surface runoff is responsible for the remaining 60-80% of water entering the reaches. By determining the amount of stormwater from residential regions entering the river system, it is hoped that we can determine if that has impacted the flooding in the region. According to our preliminary results, stormwater is a main contributor to rising water levels during storm events.

A Phase-1 Environmental Site Assessment of the Bryce Brothers Factory in Mt. Pleasant, Pennsylvania

Nick Bradley

Mt. Pleasant is one of the oldest towns in Pennsylvania and has a rich history of various prosperous industries. During the transition from the 19th century to the 20th century, the Bryce Brothers Company maintained a glass factory that produced different types of glass. The original location of the site was discovered through historical Sanborn fire insurance maps provided by Penn State University. The site was a glass factory from the late 19th century until around 2002. The site in question is currently used as a Levin furniture warehouse on the original historical property. Early glass production commonly involved priming with heavy metals and mixing oil and water in the float glass method of making glass windows. Due to few government regulations the use of toxic chemicals such as lead in early glass production, it is possible that this original site could still hold some contaminants. The heavy metals and oils used during the early years of the glass factory could have contaminated the underlying soils or groundwater if they deposited near or on the site. The EPA provides online maps of known sites of contamination around the country. The town of Mt. Pleasant does have two known Superfund sites, but neither appears related to glass production. Visits to the site showed that the site did not appear to have any long-term contamination based solely off the vegetation surrounding the area. However, if any contaminants exist, this Phase-1 Environmental Site Assessment will locate the most likely areas of contamination to check in any Phase-2 investigations.