**Speciation and Reactivity of Uranium and Organic Matter in Abandoned Mine Wastes from Laguna, New Mexico**

**Carmen A. Velasco**[1], Sumant Avasarala[1], Abdul-Mehdi Ali[1], Kateryna Artyushkova[1], Christopher Osburn[2], José M. Cerrato[1]

1. Department of Civil Engineering- The University of New Mexico
2. Department of Earth and Planetary Sciences- The University of New Mexico
3. Department of Chemical and Nuclear Engineering - The University of New Mexico
4. Marine, Earth, and Atmospheric Sciences- North Carolina State University

We applied spectroscopy, microscopy, and water chemistry techniques to investigate the speciation and reactivity of organic matter on uranium (U) binding from abandoned U mine waste from the Jackpile Mine in Laguna Pueblo, New Mexico. Preliminary studies using fixed angle X-ray fluorescence (XRF) analysis show 3.14% carbon (C). Results from microprobe mapping suggest that uranium particles are surrounded by carbon inclusions. We hypothesize that the presence of carbon in the mine waste influences the uranium binding and therefore its release to the environment. Loss on ignition (LOI) analysis showed that 12.98±0.25% mass was lost. The change on mass after the LOI might be due to the loss of organic content of the samples. Analyses with X-ray photoelectron spectroscopy (XPS) show changes on the carbon binding after the LOI experiments and the oxidation of U (IV) to U(VI). The mean concentration of acid extractable for mine waste was 0.54±0.1% U before LOI and 0.64±0.01% U after LOI. Basic Extractions of the Particulate Organic Matter (BEPOM) and Excitation Emission Matrix (EMM) show the presence of humic and fulvic-like groups in the mine waste. Findings from this study are relevant to identify how the binding of U and C in mine wastes can influence U mobilization in order to inform risk assessment and reduction strategies.

**Keywords:** uranium, organic matter, mining legacy

**Post-Explosion Tracer Gas Study in Fractured Granite**

**Sofia Avendano**, Melinda Horne, Celeste Herrera, Mark Person, Eugene Gorman, Anastasia Stroujkova, and Jesus D. Gomez-Velez, New Mexico Tech

Radioactive noble gas detection at suspected underground nuclear test sites is the only proven way to confirm that a nuclear test has occurred. However, the migration of gas effluent through fracture networks is still poorly understood. A pilot field study of the gas migration through rock damaged by explosions was conducted in a rock quarry in New Hampshire in the summer of 2017. Tracer gas ($SF_6$), used as a proxy for the noble gas, was released into a cavity created by an explosion (63 kg of TNT at a depth of 13 m) during the summer of 2016. The upper 5 m of borehole were grouted with stainless steel tubing sealed in the concrete and the gas was pumped through the tubing. Before the gas release, we conducted a series of geophysical and hydrologic tests: a pump test, slug tests, a tracer test, and TEM and ERT surveys. Pressure and electrical conductivity transducers were placed in the surrounding boreholes to monitor the pressure changes and tracer arrival during the pumping. The results of the pump test show that the rock is well connected and has high permeability. We observed gas breakthrough immediately after the release. During the first minute after injection, a pressure wave was observed in two boreholes suggestive of inertial effects and hydraulic fracturing after gas release. The concentrations observed at each monitoring site are consistent with the pump testing. The results of this study will be used in our upcoming experiments and to test detailed mathematical models.

**Assessing somatic growth of Rio Grande river cooter (*Pseudemys gorzugi*) in the Black River drainage, New Mexico**

**Thanchira Suriyamongkol,** Eastern New Mexico University

Growth rate and body size are important life history traits that can influence reproductive success and other life history traits in turtles. Rio Grande river cooter (*Pseudemys gorzugi*) is one of the least studied North American freshwater turtle species. Currently, the species is under review by the USFWS for potential federal listing. However, the data on demographic parameters and natural history traits that would aid in the decision-making process is insufficient. The objective of this study is to estimate growth rates of *Pseudemys gorzugi* of different age classes caught within the Black River drainage from 2016 to 2017. We used carapace length of the initial captures from 2016 and recaptures from 2017 to calculate the individual growth rates. We used ANOVA to compare the growth rates among size classes. In 2017, we recaptured 13 juveniles, 8 females, and 11 males. Straight line carapace length of initial captures ranged from 44 to 114 mm for juveniles, 124 to 172 mm for males, and 203 to 265 mm for females. Mean growth rate was 13.91±6.15 mm/year for juveniles, 4.27±4.56 mm/year for males, and 1.13±2.30 mm/year for females. Growth rates among sexes were not significantly different ($p = 0.09$); however, growth rates among age classes showed a significant difference ($p < 0.01$). In conclusion, growth rates tend to decrease as the size of turtles increases.

**Keywords:** *Pseudemys gorzugi*, turtles, growth rates

**Invasive Bullfrogs may not be that bad after all: Paine effect and the invasion paradox**
**Nicasio Gonzalez**, Calvin Vialpando, Jesús Rivas, New Mexico Highlands University

Invasive species exert an unprecedented pressure on the trophic dynamics of an ecosystem. The American bullfrog (*Rana catesbeiana*) is well documented as an ecological threat, and is recognized as one of the most widespread and detrimental invasive species in the world. Because of their broad trophic niche they exert top-down pressure on the lower trophic levels. In northeastern New Mexico, at the Rio Mora National Wildlife Refuge, we are studying the effects that the presence of invasive bullfrogs may have on the small riparian fauna in the region. This experimental study involves the comparison a 2.4 Km stretch of river in which bullfrogs have been managed (experimental site), with a 2.4 Km stretch of river where bullfrog populations have been left intact (control site). We studied the populations of small cryptic vertebrates that use artificial cover-board objects by regularly sampling transects in each site.
We compared biodiversity indices among both sites. Our preliminary data shows that diversity where bullfrogs are present is higher (Inverse Simpson = 2.159, Shannon weaver = 1.094, Pielou's J =.562, E-evenness = .427) than in the area without Bullfrogs (Inverse Simpson = 1.618, Shannon weaver = .827, Pielou's J = .359, E-evenness = .229). Contrary to our expectations, the presence of bullfrogs does not seem to detrimentally affect diversity. Rather, Paine effect may be contributing to the higher diversity of components of the lower trophic levels where the generalist predator is present.
**Keywords**: *Rana catesbeiana* , Invasion ecology, Paine effect, Management of invasion

**Subsurface Characterization of Thermal Springs in Cascade Range and Olympic Mountains, Washington using Multiple Mineral Equilibria Geothermometry**

**Jon K. Golla,** University of New Mexico

Alongside local (Cascades vs Olympics) lithologic (igneous rocks vs marine turbidites) and tectonic (complex fault clusters vs spaced subvertical thrusts) comparisons, estimated subsurface temperatures and mineral-fluid equilibria conditions are used to diagnose the geothermal flow paths of five Cascade Range (Carson, Bonneville, Ohanapecosh, Baker, and Carson) and two Olympic Mountains (Olympic Complex and Sol Duc) thermal spring sites. This work continues analysis of thermal spring chemistry data collected in the summer of 2016. All speciation calculations were done through SOLVEQ.

Most estimated temperatures for Cascade waters (53-153 $^{O}$C) are hotter than Olympic waters (53- 103 $^{O}$C). These estimates generally fall within the ranges projected by some select conventional geothermometers (Cristobalite, Chalcedony, Quartz, Na/K, and Na-K-Ca). The average difference between reservoir and discharge temperatures is greater in the Cascade springs ($\bar{x}$ difference: 53 $^{O}$C vs 27 $^{O}$C). Furthermore, the Cascade waters show more evidence of chemical evolution since ascent, as Carson (groundwater dilution=24%), Bonneville ($CO_2$ degassing=23%), and Ohanapecosh ($CO_2$ degassing=2%) were corrected for disequilibria. Conversely, all five Olympic springs are apparently still in equilibrium with their last reservoir.

The geothermal fluids feeding the Cascade springs may be undertaking an indirect path to the surface, as reflected by a greater temperature difference between surface and reservoir and evidence of disequilibria and a structurally complex setting. On the other hand, the fully equilibrated Olympic waters appear to have been cooled to a lesser extent during upflow and cycled through thrust-imbricated turbidites, so there may be a more direct connection between the reservoir and the springs.

**Hydrothermal Liquefaction of Algae Grown on Dairy Wastewaters**

Meshack Audu, New Mexico State University

According to researchers the recent incidence of hurricane Harvey and Irma were linked to the contribution of climatic change. One of the biggest contributors to climate change is the release of greenhouse gases (especially from the combustion of fossil fuels) so the need for advance alternative energy (e.g bio fuels) cannot be over emphasized. Algae just like plants help to reduce the carbon contents in the atmosphere through photosynthesis, treat wastewater to acceptable limits and can also converted into useful energy dense biofuels. Hydrothermal liquefaction (HTL) is a thermochemical process of converting algae biomass into various bio fuels. The HTL process involves the use of subcritical water (270-350°C and 8-18 MPa) both as a solvent and a reagent to convert the organic biomass constituents into energy-rich bio fuels.

This study presents two strains of algae to analyze the influence of growth conditions on the biofuel yields. The *Filamentous algae* was grown in a fresh dairy water pond while the other strain we nicknamed *Dr Myint's sample* was grown in a brackish dairy water pond. According to the United States Geological survey (USGS) 71% of the earth is covered with water and the oceans holds about 96.5% of earths water (which is basically brine water), Since biofuels will be one of the future's alternative energy source, the need to grow algae faster and with cheaper resources to meet the market demand cannot be over emphasized.

**Elemental Composition and Reactivity of Metals in Wood Ash**

**Asifur Rahman**, Eliane El Hayek, Johanna M. Blake, Rebecca J. Bixby, Abdul-Mehdi Ali, Michael N. Spilde, Cyrena Ridgeway, Kateryna Artyushkova and José M. Cerrato, University of New Mexico

We investigated the elemental composition along with dissolution and adsorption of metals in wood ash under laboratory-controlled conditions using aqueous chemistry, microscopy and spectroscopy to better understand metal availability after wildfire events. Ash samples were prepared from three different tree species (Quaking Aspen, Ponderosa Pine and Blue Spruce) collected from Valles Caldera, New Mexico. Acid extractable elemental cation analysis suggested that wood ash burnt at both $350^0$C and $550^0$C have significantly higher ($p < 0.05$) metal concentrations from oven dried wood at $60^0$C. Pine ash samples at $350^0$C and $550^0$C were associated with high concentrations of metals such as Mg, K, Ni, Cu, Si, Cr and Fe. $350^0$C Pine ash released the highest Dissolved Organic Carbon content (11.32$\pm$0.28 mg carbon/L) in the batch experiments. Further experiments and characterization were conducted on the Pine ash samples. We observed dissolution of Cr, Ni, Fe, Cu and Zn in solution reacting Pine ash with deionized water. In the batch adsorption experiments with Cu(II) and Cr(VI), rapid decrease in Cu(II) concentration in solution was observed, suggesting possible adsorption and/or precipitation of Cu(II) onto $350^0$C pine ash. Limited decrease of Cr(VI) in solution was observed suggesting repulsion of negatively charged $350^0$C pine ash surface and the anionic species of Cr (e.g., $HCrO4^-$ and $CrO4^{2-}$). XPS survey scan detected presence of Cu on the reacted ash, indicating that Cu is associated with the ash “near surface” region. These results help to better understand how dissolution and adsorption processes can affect the fate of metals in water post fire.

**Biochemical characterization of *Nannochloropsis salina* under nitrogen limiting and reduced temperature conditions**

**Stephanie Willette,** Saba Gill, Barry Dungan, F. Omar Holguin
Plant & Environmental Sciences, New Mexico State University

The marine microalga *Nannochloropsis salina* CCMP1776 was cultivated under nitrogen limiting and reduced temperature conditions to induce alterations in the biochemical composition of fatty acids and lipid classes. Nitrogen limitation increases carbon allocation to either neutral lipid or starch granule formation in other microalgal species, while reduced temperature induces polyunsaturated fatty acid (PUFA) productivity to increase membrane fluidity. Both reduced nitrogen and temperature were used for combined treatment regimes in *N. salina* to determine how PUFAs are assembled into and remodeled between lipid classes. Intact lipids were characterized by ultra-performance liquid chromatography coupled with mass spectrometry (UPLC-MS) to identify lipids classes. Several lipid classes were detected, including two monoacylated lipid products: monoacylglycerol tri-methyl homoserine (MGTS) and monogalactosyl monoacylglycerol (MGMG).

The detection of monoacylated lipid products suggests that these groups participate in lipid remodeling pathways, and the composition of lipid species within MGTS and MGMG indicates which acyl chains are preferentially retained during lipid remodeling. Similarly, polar metabolites were extracted and characterized by gas chromatography coupled with time-of-flight MS (GC-TOF-MS). Metabolic profiles were uploaded for pathway enrichment analysis in VANTED V2.6.3., and statistical differences were observed for several primary metabolites. Free amino acids, polyamine, and citrate cycle metabolite levels were altered under nitrogen limitation and reduced temperature compared to nitrogen limitation alone, which indicates that metabolic distinction occurs between treatment conditions. This suggests differential regulation of secondary metabolism under nitrogen limitation and reduced temperature vs. nitrogen limitation alone.

**Team Externship at Santa Fe Community College to Gain Experience in Algae Culture and Harvesting**

**Huilin Wang**, Tianbai Tang, Meshack A. Audu, Duplex Tchinda, Brian Treftz Department of Chemical & Materials Engineering, New Mexico State University Department of Civil Engineering, New Mexico State University

At the end of June, we travelled to Santa Fe Community College (SFCC) for two- weeks NM EPSCoR externship program. The externship began from 6/26/2017 to 6/30/2017 as first week, and the second week began from 7/3/2017 to 7/7/2017. The travel members include Huilin Wang, Tianbai Tang, Meshack A. Audu, who are graduate students from Department of Chemical & Materials Engineering, Duplex Tchinda, who is a graduate student from Department of Civil Engineering, and Brian Treftz, who is an undergraduate student at NMSU.

During the externship at Santa Fe, we learned a lot about algae farm, cultivation, and some knowledge involved. First, we learned about aquaponics, which is a mutualism system that fish and plant benefits from the activity of each other. Next, we learned about two systems for cultivating the algae: enclosed system –photo bioreactor and open system—open raceway pond. Both systems have their merits and limitations. We also did cell counts and created a calibration curve that relates concentration versus population of the cells so that one can predict the population of cells at any given day once you know the concentration. We were also exposed to different harvesting methods that include a continuous flow centrifugation system and an ultrafiltration system; these systems also recycle the water back into the algae pond. Finally, the staffs showed us the how to make food-grade algae.

Keywords: Hydrothermal Liquefaction, yield, high heating value, brackish, Batch reactor, Algae

**Investigation of patterned and non-patterned poly(2,6-dimethyl 1,4-phenylene) oxide based anion exchange membranes for enhanced desalination and power generation in a microbial desalination cell**

**Francisco Lopez Moruno**[a,b], Juan E. Rubio[c], *Carlo Santoro[b] , Plamen Atanassov[b], José M. Cerrato[a], Christopher G. Arges[c]

AEM – Anion exchange membrane MDC – Microbial desalination cell

Quaternary ammonium poly(2,6-dimethyl 1,4-phenylene oxide) (QAPPO) anion exchange membranes (AEMs) with topographically patterned surfaces were assessed in a microbial desalination cell (MDC) system. The MDC results with these QAPPO AEMs were benchmarked against a commercially available AEM. The MDC with the non- patterned QAPPO AEM (Q1) displayed the best desalination rate (a reduction of salinity by 53±2.7 %) and power generation (189±5 mW $m^{-2}$) when compared against the commercially available AEM and the patterned AEMs. The enhanced performance with the Q1 AEM was attributed to its higher ionic conductivity and smaller thickness leading to a reduced area specific resistance. It is important to note that Real Pacific Ocean seawater and activated sludge were used into the desalination chamber and anode chamber respectively for the MDC – which mimicked realistic conditions. Although the non-patterned QAPPO AEM displayed better performance over the patterned QAPPO AEMs, it was observed that the anodic overpotential was smaller when the MDCs featured QAPPO AEMs with larger lateral feature sizes. The results from this study have important implications for the continuous improvements necessary for developing cheaper and better performing membranes in order to optimize the MDC.

**Alterations in metabolite pool and lipid content in *Galdieria sulphuraria* under mixotrophic growth**

Khadijeh Mozaffari, Ujala Sehar, Barry Dungan, F. Omar Holguin
Plant and Environmental Sciences, New Mexico State University, NM

The *Galdieria sulphuraria* (unicellular red microalgae) is capable of growth under extreme environments such as hot habitats with low acidity. Moreover, *G. sulphuraria* potentially might be used in the biofuel production, wastewater remediation and high-value products. It can grow autotrophicall, mixotrophically, and heterotrophically on a variety of carbon sources. In the current research, the content and compositions of neutral and polar lipids, fatty acids and metabolites are determined under different carbohydrate supplementation. The outcome of such research is beneficial for understanding the carbon metabolism of this alga under varying carbon sources and to evaluate cellulosic hydrolysates as a source of low-cost carbon for mixotrophic cultivation.

*Keywords*: Red alga, mixotrophy, biomass yield, metabolite pools

**Groundwater controls on water chemistry in the Jemez river**

**C McGibbon**, L Crossey, K Karlstrom, T Grulke
University of New Mexico

The Jemez River is a snowmelt-dominated system serving as outlet for water discharging from the Valles Caldera, with a smaller but significant contribution from springs. The groundwater inputs contain a geothermal component, which leads to degradation of water quality. This increases downstream and multiple natural tracers highlight the extent of the fluid mixing, as far as 40 miles to the south. Climate models predict less snow pack, causing a decrease in river discharge, a relative increase in spring contributions, and degradation in water quality. This degradation will affect local habitats and stake holders. Salinity/conductivity and [As] increase downstream from the headwaters in the Valles Caldera to the boarder of the study area at San Ysidro. Peak concentrations occur at Soda Dam and at San Ysidro. Major ion chemistry indicate that spring water a Soda Dam is a mixture of geothermal water from the Valles Caldera and local meteoric water. Geochemical mixing models indicate water-rock interaction with basement granites, and several tracers indicate dissolution of carbonates and evaporates in the distal regions is adding Sr with a non-radiogenic $^{87}Sr/^{86}Sr$ value. Combining $^{87}Sr/^{86}Sr$ with conservative tracers can help to establish mixing volumes of spring and river water.
These vary with river discharge: during low flow conditions, at 17 cubic feet per second (cfs), the relative component of spring contribution at Soda Dam is 5% of total river discharge. This work highlights evolution of groundwater along the flow path from the Valles Caldera to as well as potential alterations to river water chemistry/degradation.

**Evaluation of biomass productivity and nutrient removal by *Scenedesmus Obliquus* in Municipal Waste Water for biofuel production**

**Kaavya Polisetti,** New Mexico State University

The goal of this study was to determine the biomass productivity and nutrient removal by the algae *Scenedesmus Obliquus* in Municipal wastewater for biofuel production. Domestic wastewater treatment techniques that are in current use were developed decades ago for the specific purpose of meeting discharge standards to protect public health and preserving receiving water quality. Their energy needs and indirect impacts on the environment are now considered unsustainable and cost prohibitive. Microalgae can be used to reduce organic carbon and nutrient in urban wastewaters at the same time yields energy-rich biomass for biofuel production. *S.obliquus* is a freshwater microalga that is a potential candidate for biodiesel production. The microalgae *Scenedesmus Obliquus* was cultivated in different wastewater media conditions and compared to the standard BG-11 media. The biomass productivity of the algae in wastewater was higher than that of the standard media. The NH4 and P nutrient removal rates were also observed.

**Algal indicators of acidic inputs and intermittent flow in streams in the Valles Caldera National Preserve**

**April Fox**, Water Resources Program, University of New Mexico, Albuquerque, New Mexico 87131; Dr. Rebecca Bixby, Department of Biology and Museum of Southwestern Biology, University of New Mexico, Albuquerque, New Mexico 87131

In freshwater ecosystems, there are many variables that can influence the distribution of biological communities including flow, pH, nutrients, and heavy metals. These habitats are a result of dynamic environments where physical and biological attributes vary in time and space. Diatoms and other algae often live within narrow environmental conditions, making them important ecological indicators of aquatic ecosystems. Algae respond to these environmental factors with changes in biomass and changes in species assemblages. For example, high conductivities and lower pH, caused by geothermal inputs, can dramatically influence water quality and biological communities in aquatic systems. Low pH, in combination with intermittent flow, may influence algal diversity in streams.

The relationship between pH and flow in the Sulphur Creek watershed in the Valles Caldera National Preserve, New Mexico may be a contributing factor to the diversity of algal assemblages found in upstream reaches compared to communities found in geothermally influenced waters downstream. Seven sites within the Sulphur Creek watershed were sampled between May 2016-September 2016 for diatom composition, stable isotopes, major ions, and flow. Water quality and isotopologues indicate three distinct types of waters within the watershed and that geothermally influenced waters are causing episodic acidification of downstream Redondo Creek. A shift in diatom community structure is observed between upstream and downstream reaches of the watershed with acidophilic diatoms dominating waters with pH<4. Utilizing algal assemblage diversity as indicators of water quality in geothermal- influenced waters may assist in the ongoing reclassification of the Sulphur Creek watershed.

***Key Words: algae, water quality, geothermal, intermittent flow***

**Geochemical characterization of Bouse carbonates; towards an understanding of Bouse diagenesis**

**Ferguson, C**.[1], Crossey, L.[1], Karlstrom, K.[1], Spilde, M.[2]
[1]Department of Earth and Planetary Sciences, [2]Institute of Meteoritics

This paper examines the Bouse Formation carbonates using stable isotope, Sr and SEM/microprobe data, and possible paleontological features to evaluate the extent to which carbonates retain their primary composition. These data could help determine marine versus non-marine depositional environment of the Bouse Formation, the record of first arrival of the Colorado River to the Gulf of California. The major goals are to decipher the diagenetic history of the Bouse and determine the nature of the tubular features found in some of the facies. Textural evidence from cut slabs and thin sections show mottled carbonate textures indicating multiple carbonate generations. Microprobe data have revealed amorphous silica intergrown with the carbonate; the silica replaces forams and other fossils and likely represents an important silica diagenetic event. Our present working hypothesis is that Bouse carbonates have undergone both silica and carbonate diagenetic events that have modified primary compositions such that interpreting and understanding the original environment relies on finding un-/ least-altered portions of the samples and then applying suitable microscale analyses.
Tubular features resemble worm tubes and/or casts of vegetation; they have lengths up to several cm, sub-mm-scale inner diameters, and cm-scale outer diameter. One of the possibilities for these features is that they were formed by serpulids, a genus of tube worms. Comparison with published paleontological studies of serpulids is underway. There is one known fresh water serpulid, 5 known brackish/geothermal species, and more than 350 marine species. Thus, identification of serpulid species in the Bouse may have important depositional environment implications.

**Tomographic and morphometric analysis of shallow sediments: Pamplona Zone, Gulf of Alaska**

**Wesley Clary,** Lindsay Worthington, Louis Scuderi, Hugh Daigle, University of New Mexico, John Swartz, University of Texas

Convergence and shallow subduction of the Yakutat microplate beneath North America has shaped the Pamplona zone fold and thrust belt in the northeastern Alaska subduction zone. Here, convergent tectonics and glaciomarine sedimentary processes have created patterns of deformation and deposition recorded by a shallow sedimentary sequence with varying fluid pressure, compaction, and fault activity. If the record of ice sheet advance is preserved on the seafloor and in the underlying sediments then bathymetric evidence of glaciomarine processes should overlap with evidence of overpressure, such as low velocity zones in the shallow sediments.

In this study, we present a velocity model through the Bering trough as well as regional drainage shape characteristics. We use streamer tomography on a seismic survey from the St. Elias Erosion and Tectonics Project (STEEP) to determine a velocity model. We further inform our interpretation using physical properties relationships developed with data from core samples (IODP Expedition 341) taken near the seismic line. To document drainage morphology, we use smooth sheet bathymetry to identify a drainage network and query profile shapes at well distributed locations; where profile shape is determined by fit with a power function. Initial results suggest overlap between u-shaped drainage profiles towards the SE end of the Bering trough and low-velocity shallow sediments NE of the shelf break. In part, because this overlap occurs within the mapped extent of the last glacial maximum, we find our tomography results consistent with buildup of overpressure due to glacially driven loading of highly saturated sediments.

**Keywords:**
Bathymetry, tomography, overpressure, glaciomarine

**CUSTOM SETUP FOR HIGH-QUALITY ORGANIC SEMICONDUCTOR CRYSTAL GROWTH**

**Evgenii Oskolkov**, Georgii Bogdanov, Sergei Rigin, Gil Gallegos
Departments of Chemistry and Computer Science, New Mexico Highlands University, Las Vegas, NM 87701

Organic electronic and optoelectronics recently are drawing significant attention due to ease of manufacturing, light weight, transparency, flexibility and other properties which is difficult to achieve using inorganic electronic materials. In recent years much attention was attracted by materials built of two and more components, for instance, donor and acceptor molecules. For such materials, strong correlation between their internal structure and properties usually exists. Main interests of our group are focused on creation of two-component organic or organic-inorganic materials with potential application as semiconductors and light emitting diodes. Variation of crystal structure of the same material (polymorphism or variation of stoichiometry) can be achieved by different crystallization conditions. At present solution crystallization is mainly used for such purpose. Gas-phase crystal growth also has been used due to its ability to produce highly pure crystalline materials from μm to cm-sized samples [1,2]. In this project, we are assembling a custom setup for gas-phase crystal growth. High-end three-zone tube furnace and precise controller will be coupled to achieve maximum quality and uniformity of organic crystals and organic thin films being synthesized, while turbomolecular pump will help to achieve high-vacuum environment to maintain high purity of produced structures. This setup would be a powerful tool in organic crystal growth, particularly for organic semiconductor crystals.

Authors are grateful to NM EPSCoR program (NSF IIA-1301346) for funding the acquisition of instrumentation.
*Keywords:* vapor growth; organic crystal; tube furnace; organic semiconductors

References:

[1] R.A. Laudise, Ch. Kloc, P.G. Simpkins, T. Siegrist, Physical vapor growth of organic semiconductors, Journal of Crystal Growth 187 (1998) 449-454

[2] D. Vermeulen, L.Y. Zhu, K.P. Goetz, P. Hu, H. Jiang, Charge transport properties of Perylene- TCNQ crystals: The Effect of stoichiometry, Journal of Physical Chemistry C 118 (2014) 24688- 24696

GRADUATE STUDENT POSTER #41

**Assessment of Episodic Hydrothermal Activity in the Rincon Geothermal System**

**Melinda Horne[1]**, Matt Folsom[1], Jeff Pepin[1], James Witcher[2], Mark Person[1], Shari Kelley[3]
[1]Hydrology Program, New Mexico Tech, Socorro, NM; [2]James Witcher and Associates, Las Cruces, NM; [3]New Mexico Bureau of Geology & Mineral Resources

The Rio Grande Rift is characterized by high crustal heat flow and fractured basement bedrock, giving rise to a number of low temperature (< 100 $^{O}$C) geothermal systems near Las Cruces, NM. One such is the fault-controlled Rincon system north of Las Cruces. This area has shallow (~310m) temperatures up to 96 $^{O}$C, and opal mineralization adjacent to the fault that dates between 2.15-1.95 Ma. The opal deposits form discrete layers deposited in Camp Rice fluvial sediment, and laterally shift to calcite away from the fault. These deposits, in combination with overturned temperature profiles from the geothermal exploration borehole SHL-1, suggest hydrothermal activity along the Rincon Fault is episodic in nature. We hypothesize that progressive opal precipitation diminishes fluid flow up the fault until a micro-seismic event reinitiates hydrothermal activity.

We have developed a transient hydrothermal model of the Rincon Fault in order to conduct a sensitivity analysis that focuses on temporal variations in Rincon fault zone permeability through time. Nearby seismic events magnitude 3 or greater are being analyzed to find a source that may have caused the most recent onset of Rincon geothermal activity. Formation resistivities will be measured along the Rincon Fault using TDEM surface geophysical surveys to explore the extent of the geothermal system. Early model results indicate that the temperature overturns observed in well SHL-1 began decades ago following a century-scale period of quiescence.

**New Mexico "continental smokers": Geothermal potential of spring vents that show mantle degassing and high $CO_2$ content**

**Anderson, J.,** Crossey, L.C., Karlstrom, K.E., Person, M., Kelley S., Darrah, T. Whyte, C., McGibbon, C., Smith, Blomgren, V., Witcher J., Hrncir, J., Holt, B., Golla, J., and Walk C.

Carbonic springs and wells in New Mexico exhibit evidence for mantle-to-groundwater connections. In addition to high $CO_2$ partial pressure, these vents (termed "continental smokers") have high $^3He/^4He$ ratios, major faults nearby, travertine deposits, and low mantle velocity regions below the surface. These attributes indicate crustal permeability capable of transporting fluids and heat from deep within the Earth to near-surface groundwater systems. They typically occur within tectonically extended regions of the Earth's crust with high heat flow. The term "continental smokers" arises from their similarities to oceanic smokers at mid- ocean ridges. Robust correlations exist between high $^3He/^4He$ values and regions of relatively low mantle seismic wave velocity. No strong correlation exists between helium isotope ratios and crustal thickness suggesting that regional mantle volatile sources are more essential than crustal conduit systems. Low seismic velocities in the mantle indicate partial melt, a logical source of deeply derived helium ($^3He$) and $CO_2$-bearing volatiles. Springs and wells with the highest helium isotope ratios in the NM area ($^3He/^4He$ in non-airlike groundwater) are located above the Valles Caldera (3.86 to 6.16 RA), Rico area of SW Colorado (4.75-5.88 RA), SE corner of AZ near the NM boarder (up to 4.23 RA), Bravo Dome (up to 3.78 RA), and Socorro magma body (NM Tech wells = 1.41 to 1.91 RA). This study also applies multiple geochemical tracer analyses to evaluate fluid mixing end members, fluid pathways, and the geothermometry of deeper fluids leading to a synthesis of geothermal resources in the New Mexico region.

**Modeling the Energy/Water Nexus in New Mexico**

**J. Mamkhezri**, E. Kalhor, K. Zemlick, J. Joshi, K. Walter, N. Lu, J. Thacher, J.M. Chermak

A major objective of this research is to develop a model that explores the nexus between human activity, energy, water, and the environment in New Mexico (NM). We develop a System Dynamics (SD) model that incorporates the social and natural world associated with alternative energy futures. Our goal is to compare and contrast energy futures and their tradeoffs, and to find possible policy scenarios for sustainable management of energy in NM. There are six interconnected modules designed to deliver this goal : (1) Oil and natural gas production, where drilling activity and production of oil and natural gas are modeled; (2) Hydraulic fracking and produced water disposal, in which the costs of re-using co-produced water for fracking is compared with that of fresh water resources; (3) Natural gas consumption by sector, where the demand of commercial, residential, industrial and electric sectors for natural gas are modeled; (4) Electricity generation by competing sources, where generation of electricity from fossil fuel and renewable energy sources as well as related economic implications are put in perspective, (5) Implications of energy lifecycle on health, which collects pollution outcomes of all the aforementioned modules and connects it with the number of ER visits; and (6) energy preferences survey, which captures consumers' preferences on energy sources among NM residents. Our SD model investigates all these energy-related issues at county level, between 2004 and 2054, on a monthly basis.

**Keywords:** Energy-water nexus, System Dynamics, Hydraulic Fracking, Electricity Generation, Drilling Activity, Energy Consumption, Health, Preferences

**Carotenoid and lipid synthesis remodeling events of a Chlorococcum sp. under carbon limitation**

**Sa'Rae Montoya,** New Mexico State University

This research is an extension of previous work that was carried out to collect data analyzing the biochemical composition, carotenoid synthesis, and lipid synthesis/remodeling events in a Chlorococcum sp. under stressed conditions. It is known that photooxidative stress causes this microalga to turn carotenogenic resulting in highly pigmented biomass. The aim of this study was to further examine the relationships that occur due to photooxidative stress. To gain a better understanding of the interactions occurring as a result of unfavorable conditions this research analyzed biomass cultivated under carbon limitation along with previously outlined conditions. These cultures were grown under constant 24-hour light, at 25°C, with no agitation under nitrogen deprived and non-deprived conditions. In addition, both culture treatments were not given additional $CO_2$ supplementation differing from the original treatments. Metabolite, lipid and carotenoid profile determinations were carried out and compared to the results observed by the previous study.

**Shallow reflectors in the southern Albuquerque basin from the Sevilleta Array**
**Tori Finlay**, University of New Mexico

The Sevilleta Array was a dense seismic array deployed for 12 days in February, 2015 by collaborators from the University of New Mexico, New Mexico Tech, and Colorado State University. Approximately 800 vertical component, 10-Hz geophones were deployed across the Sevilleta National wildlife refuge in northern Socorro County, New Mexico. The array was designed to investigate the northern half of the Socorro magma body, an actively inflating mid-crustal sill. However, the data has provided an opportunity to examine shallow reflectors in the southern portion of the Albuquerque basin in addition to the magma body. Teleseismic virtual source reflection profiling (TVR) utilizes the free surface reflection of a teleseismic P-wave as a "ghost" source in dense arrays. During the deployment, the Sevilleta Array recorded 62 teleseismic events greater than M5. Applying TVR to the data collected by the Sevilleta Array, we present 2-D profiles created from the four events with the highest signal to noise ratio. Shallow reflectors of interest dominate profiles taken from the northwestern-most quadrant of the array (near the Sierra Ladron uplift) and western edge of the Rio Grande rift. These reflectors may represent normal faulting from the region's past and present tectonic activity.

**Keywords:** Socorro Magma Body, Seismology, Rio Grande Rift

**Fermentation of Wastewater-Grown Algae Through Saccharomyces Cervisiae for Potential Bioethanol Production**

David Arellano, Eastern New Mexico University

Utilizing a wastewater resource, cattle waste liquid, to effectively cultivate algal biomass is an extensively explored third-generation biofuel technique; the produced biomass could then be processed for fermentation to produce bioethanol. This bioremediation/cultivation pathway shows potential for a post third-generation bioethanol fuel source. Through experimentation and research this study aims to prove the viability and potential of this post third-generation bioethanol fuel source. Algal biomass is obtained from the Algal Turf Scrubber (ATS) system at Eastern New Mexico University in Portales, NM. The ATS operates with an indigenous algal community, composed of many different species and varieties including single cell and diatoms through to large filamentous species. Biomass is thoroughly lysed by using a combination of sonication and heat as proven by literature. The process sonicates the mixture, easily and quickly rupturing the cells, when followed by steam heating and pressure complete cell destruction can be attained. The resulting slurry is actively saccharified using mild acid and heat during the lysing process to hydrolyze available carbohydrates. Saccharification under these conditions renders the available complex carbohydrates into readily fermentable monosaccharides. *Saccharomyces cerevisiae* fermentation under controlled conditions has shown extensive removal of the same monosaccharides made available by lysing and then hydrolysis of algal biomass. Current inconclusive evidence suggests fermentation has occurred, however further analysis is required to determine total amount. Analysis of products of lysing and saccharification process, and of ultimate fermentation products will be done on a GC-MS.

**Keywords:** Saccharomyces cerevisiae, Bioethanol, Algal Biofuels

**Synthesis of Nanocrystalline Heterostructures with Dual Emission**

**Tom Nakotte,** New Mexico State University

Recently, synthesis of PbSe/CdSe (core/shell) quantum dots, which display emission in both the visible and IR have been reported [1], opening up the system to potential applications as flourophores for labeling and imaging. This goes along with the already realized benefits of enhanced carrier multiplication and suppressed Auger recombination, which make PbSe/CdSe quantum dots suitable for solar applications. Here, we present synthesis and characterization of PbSe/CdSe/CdS nanocrystalline heterostructures, which display enhanced IR emission as well as emission in the visible region. Visible emission is observed when the nanocrystals are excited with an infrared source, indicating that up- conversion may be occurring. Up-conversion is a process, in which a low energy photon interaction with the PbSe core causes higher-energy excitations within the CdSe/CdS shell [2]. These excitations can then be collected in the form of photocurrent or converted into higher-energy photons for capture by a photovoltaic cell. The IR photoluminescence spectra from the PbSe cores indicate greatly increased exciton lifetimes compared to core-only and core/shell samples, which can be attributed to the reduction of the electron−hole overlap resulting from the delocalization of the electron wave functions into the outer CdS shell [3]. The PbSe cores were synthesized using a traditional hot injection method, followed by a cation exchange from Pb to Cd to form PbSe/CdSe (core/shell) quantum dots, onto which a CdS outer-layer was grown using a modified approach of the SILAR method [4]. The nanocrystals were characterized using absorption, photoluminescence, and lifetime measurements as well as HRTEM.

[1] Lin, Q.; Makarov, N. S.; Koh, W.-k.; Velizhanin, K. A.; Cirloganu, C. M.; Luo, H.; Klimov, V. I.; Pietryga, J. M., *ACS Nano* **2015,** *9* (1), 539-547.

[2] Makarov, N.S.; Lin, Q.; Pietryga, J.M.; Robel, I.; Klimov, V. I., *ACS Nano* **2016** *10* (12), 10829-10841

[3] Lee, D. C.; Robel, I.; Pietryga, J. M.; Klimov, V. I., *J. Amer. Chem. Soc.* **2010,** *132* (29), 9960-9962.

[4] Li, J. J.; Wang, Y. A.; Guo, W.; Keay, J. C.; Mishima, T. D.; Johnson, M. B.; Peng, X. *J. Am. Chem. Soc.* **2003**, *125*, 12567-12575.

**Integration of Product Design and Cellular Manufacturing through an Axiomatic Approach**

[1]**Alejandro Najera-Acosta**, Delia J. Valles-Rosales and [2]Blanca R. Venegas-Mata
[1]Department of Industrial Engineering, NMSU, [2]Universidad Autónoma de Ciudad Juárez (UACJ), México

In today's industrial practice there is a wide range of customer needs affecting designers in many decisions on product design to find the most suitable alternatives. The activities involved in the integral development of a product, need as a preliminary stage a clear definition of the type of product to be designed. The literature related to a rational methodology that addresses product design and manufacturing issues is limited. The design of a product determines 80% of manufacturing cost, and different ways to manufacture it can be considered.
It is proposed a product design framework that integrates Axiomatic Design (AD) and Cellular Manufacturing (CM) to creates associativit between the product and its manufacturing processes. In this case of study, the AD final product has two different components fabricated and transported in a manufacturing cell. The AD is based on the existence of 4 domains, which are zig-zagged for an optimal design. It uses matrix methods to systematically analyze the transformation of customer attributes into functional requirements, design parameters, and process variables. Summarizing, the proposed framework is a logical and systematic axiomatic approach for the product design in cellular manufacturing systems, which makes it easily portable into practice, providing the guidelines for the decomposition of the design problem and independent mappings between problems and solutions. The suggested methodology provides feasible solutions that best meets the design and manufacturing objectives. It establishes scientific basis to design and to improve design activities by providing the designer with a theoretical foundation based on logical and rational thought processes and tools.

**Keywords:** product design, axiomatic design, cellular manufacturing, design methodology, penholder.