2015 Environmental Chemistry Symposium
University of Alaska Fairbanks

24 April 2015 (UAF SpringFest) – 9:00 AM to 4:30 PM

University of Alaska Museum of the North, 907 Yukon Drive, Fairbanks, AK 99775
The meeting and lunch / reception will take place in the Museum's Auditorium.

Organizers:

William R. Simpson, Sarah Hayes, Jennifer Guerard

Sponsors:

Department of Chemistry and Biochemistry, UAF
College of Natural Sciences and Mathematics, UAF
Geophysical Institute, UAF

Special Thanks to:

Meghan Murphy (CNSM Public Information Officer), Jessica Armstrong (CNSM Graduate coordinator), Laurie Long (Chemistry and Biochemistry Administrative Assistant), Janet Thompson (UA Museum of the North).

Schedule

Time	Presenter	Title
9:00	William Simpson	Welcome to Symposium and Logistics
9:10	Tom Green	Department of Chemistry and Biochemistry Chair's welcome
9:15		Session 1 – Moderator: Thomas Trainor
9:15	Amanda Barker	Attenuation of lead and antimony in shooting range soils by iron amendments using simulated rainwater and soil columns
9:30	Nicole Knight	Assessment of tellurium in semi-arid mine tailings at Delamar, Nevada: Implications for human and ecosystem health
9:45	Canrong Qiu	Structural study of surface complexation of Pb(II) and Sb(V) on the hematite (1-102) surface
10:00		Coffee Break
10:15		Session 2 – Moderator: William Simpson
10:15	Theresa Vertigan	Effects of Low-Level Methylmercury Exposure on Adipose Cells
10:30	Kristian Nattinger	Analysis of Fairbanks Airshed Fine Particulate Matter (PM2.5) Speciation Data: Background, Methods, and Significance
10:45	Jamie McKee	Synthesis and characterization of polymer-supported cyclodextrin nanoscaffolds for use in future environmental studies
11:00		Coffee Break
11:15		Session 3 – Moderator: Ana M. Aguilar-Islas
11:15	Justine Burd	Investigating the Relationship between Bromine Monoxide Seasonal Behavior and Meteorology
11:30	Megan Roberts	Spatial and temporal variability of the suspended particulate Fe over the Gulf of Alaska shelf
11:45	Sean Egan	Development and implementation of an ash aggregation scheme for the Weather Research Forecasting with Chemistry (WRF-Chem) model
12:00		Lunch -- Italian themed buffet Chicken Parmigana and Baked Ziti
13:00		Session 4 – Moderator Jennifer Guerard
13:00	Jennifer Chambers	Using FTIR to analyze aerosols produced through the combustion of different fuel types
13:15	Dallon Knight	Bioaccessibility of metal(loid)s from mine wastes in the Western United States and Alaskan road dust
13:27	Kyle Milke	Transport mechanisms of metal-bearing historic mine tailings in a semi-arid environment
13:39	Riley Witte	Evaluating Potential for Recovery of Te as a Byproduct of Au Extraction At the Golden Sunlight Mine (Whitehall, MT)
13:51	Various	Oral session wrap up
14:00	------	Enjoy the Museum while the room is reset for Reception / Posters
15:00	Posters / Reception	Bring your poster to the museum on Thursday afternoon for Museum staff to hang at the meeting.
16:30	Symposium End	See you next year!

Attenuation of lead and antimony in shooting range soils by iron amendments using simulated rainwater and soil columns

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Lead (Pb) and antimony (Sb) contamination pose a major environmental threat to training land sustainability for areas used by the U.S. Department of Defense (DoD). This is a result of firing excercises that use soil berms as backstops. Fragments of bullets are susceptible to weathering processes in soil environments, leading to the release of metal(loid) species into solution. Pb and Sb are contaminants of interest because they primarily constitute small arms rounds [1]. Pb and Sb are both toxic, and Sb is also a suspected carcinogen [2]. Understanding Pb and Sb speciation and mobility is essential for identifying the potential toxicity of a range soil and for remediating a given site.

As a result, stabilization of metal contaminants is of interest, particularly, what types of substrates have potential to promote the retention of Pb and Sb from migrating off-site. Treating soils with both cationic (Pb) and oxyanionic (Sb) components can be difficult due to enhanced mobility of Sb at circumneutral/high pHs and enhanced mobility of Pb at low pHs [3,4]. Traditional treatments, such as phosphate or carbonate would not be approprite, however, iron (Fe) has been shown to be a potentially effective sorbent [5].

In this study, we added Fe(II) chloride and nanoscale zero-valent iron (NZVI), in a dispersion, to four types of shooting range berm soils in laboratory soil columns in order to study the effects Fe has on metal attentuation. The columns were flushed with simulated rainwater and monitored using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) and synchrotron-based X-ray Absorption Spectroscopy (XAS). We found significant attentuation of Sb by Fe in certain systems, whereas Pb became more mobilized.

[1] Filella, M. et al. (2002) *Earth Science reviews* **57**, 125. [2] Gebel, T. (1997) *Chemico-biological interactions* **107**, 131. [3] Okkenhaug, G. et al., (2011) *Environmental Pollution* **159**, 2427. [4] Reddy, K.J. et al., (1995) *Plant and Soil* **171**, 53. [5] Okkenhaug, G. et al., (2013) *Environ. Sci. Technol.* **47**, 6431.

Assessment of tellurium in semi-arid mine tailings at Delamar, Nevada: Implications for human and ecosystem health

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Tellurium (Te) is a rare metalloid (average crustal abundance ~ 3 μg kg^{-1}) increasingly used by the alternative energy industry to create highly efficient solar panels that contribute to global energy solutions. Although Te can be enriched in Au-Ag deposits, it is not recovered. Instead, significant amounts of Te are deposited in mine wastes exposed to the environment. Tellurium in the form of Te(IV) has been shown to be more toxic than Te(VI) and better-studied environmental villains, Se(IV) and As(III). Due to chemical behavior similar to Se, Te has the potential to have deleterious impacts on the environment, but there is very little data that exists on environmental Te behavior. The weathering of Te-bearing mine tailings under surficial conditions can transform Te to more mobile and bioaccessible forms and have implications for human and environmental health.

The goal of this research is to determine whether Te-rich historic mine tailings pose a health risk to surrounding ecosystems and communities. The historic Delamar mining district, located in semi-arid Lincoln County, NV, was mined for Au and Ag from 1891 to 1938, and produced at least 450,000 tons of mine tailings containing elevated concentrations of Te (up to 455 mg kg^{-1}). Two distinct tailings piles were sampled as a function of depth. Extensive sulfide weathering, determined using X-ray absorption spectroscopy (XAS), suggests the tailings are mostly oxidized. Although certain thermodynamic datasets predict the more toxic Te(IV) as the dominant species under surficial conditions, bulk fits modeling Te speciation in the tailings via XAS point to the predominance of Te(VI), the less toxic form of Te.

Strong semi-arid winds, supported by HYSPLIT modeling, and rainfall events can greatly impact metal(loid) transport at Delamar. Tellurium and other toxic metal(loid)s (e.g. Cu, Pb, Bi, and As) are enriched in surficial tailings, likely present as bioaccessible efflorescent salts, and may be susceptible to dispersion. Roughly 50% of particles by weight have diameters below the wind transportable threshold of 37 μm. Preliminary elemental compositions of soils seemingly influenced by wind and surface water erosion from the tailings support the transport of Te-containing tailings. Physiologically-based extraction tests for surficial tailings are being performed to evaluate Te bioaccessibility. Tellurium is predicted to form strong complexes with iron (oxy)hydroxides, which is a likely sink for environmental Te. Indeed, electron microscopy indicates the enrichment of Te in small particles associated with Fe. Additionally, Te affinity to ferrihydrite is being examined to investigate environmental Te sequestration. Taken together, these results lend insight into the potential health and environmental impacts of Te.

Structural study of surface complexation of Pb(II) and Sb(V) on the hematite (1-102) surface

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Environmental fate and transport of heavy metal or metalloid contaminants are largely determined by the interfacial processes occurring at mineral-water interfaces, such as adsorption/desorption, precipitation/dissolution, and electron transfer. In the environment, the minerals are ubiquitous, usually of high specific surface area, and often contain numerous reactive surface sites, which exhibit high affinity for different aqueous ions. Depending on the solution chemistry, the aqueous ions could either chemically bond to surface sites via surface complexation reactions or form precipitation as surface coating on mineral surfaces. In addition, the electron transfer could be triggered at the mineral interface as well when the sorbate or the substrate contains redox sensitive elements.

A fundamental understanding of interfacial processes relies on structural information on a molecular scale, which is usually difficult to be obtained. In this talk, molecular scale structural studies of surface complexation of Pb(II) and Sb(V) on a hematite (1-102) surface will be present to elucidate the relationship between the surface reactivity and substrate surface structure as well as the sorbate type. Depending on the sample preparation, two stable and chemically different surface terminations (called half layer and full layer terminations, respectively) could be produced at the hematite (1-102) substrate surface. Crystal truncation rod X-ray diffraction technique (CTR) was utilized to probe the interfacial structure of hematite (1-102) surface, which is reacted with Pb(II) or Sb(V) under *in situ* reaction condition. CTR modeling results indicated that hematite (1-102) surface with both surface terminations show affinity for Pb(II) via a bidentate edge-sharing binding configuration. It should be noted that the half layer termination surface contains two reactive bidentate edge-sharing sites, while only one reactive bidentate edge-sharing site was found on the full layer termination surface. The inertness of one of the bidentate sites on the full layer termination surface was found to be related to the local site geometry, which has a O-Fe-O bond angle too large to form a stable Pb(II) surface complex. On the other hand, Sb(V) adsorption was only found on the half layer termination under tridentate mode with a combination of corner-sharing and edge-sharing binding configurations. The adsorption of Sb(V) on the full layer termination was unfavorable, which is attributed to the fact that the adsorption of Sb(V) will significantly over-saturate the valence of triply coordinated oxygen groups in the full layer termination structure. The molecular structural models of surface complexation reactions presented here could serve as a basis to better model the thermodynamic behaviors of metal sorption on mineral surfaces in a more complicated system.

Effects of Low-Level Methylmercury Exposure on Adipose Cells

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Mercury-containing compounds are environmental pollutants that have become increasingly consequential in the Arctic regions of North America due to processes of climate change increasing their release and availability at northern latitudes. Currently, the form of mercury known to be most detrimental to human health is methylmercury, CH_3Hg^+, which is found in the environment primarily accumulated in the tissues of predatory fish, including those consumed by Alaska Natives through subsistence farming. Much is known about the neurotoxicity of methylmercury after exposure to high concentrations, but little is known about toxicity to other tissues and cell types, particularly at long-term exposure to lower concentrations as would occur through fish consumption. This study aims to investigate the potential effects of methylmercury exposure on adipocytes, the main cellular components of adipose (fat) tissue, and explore possible consequences of exposure on metabolic disorders such as obesity and diabetes.

Effects of methylmercury exposure on isolated adipocytes in culture were assessed using assays for cytotoxicity and an ELISA assay for vascular endothelial growth factor (VEGF), a signaling molecule shown to be important for maintaining metabolic status in adipose tissue. Results showed a significant increase in toxicity with methylmercury concentration in cells exposed to methylmercury during differentiation. Results also indicate that VEGF secretion may be elevated in adipocytes exposed to methylmercury after the process of differentiating into mature, fat-storing cells. These results provide a basis for further exploration into metabolic consequences of methylmercury exposure.

Analysis of Fairbanks Airshed Fine Particulate Matter (PM2.5) Speciation Data: Background, Methods, and Significance

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Fairbanks, AK experiences extreme pollution episodes that result in violations of the fine particulate matter (PM2.5) National Ambient Air Quality Standards (NAAQS). High emissions of particulates during cold periods from home heating, transportation and other sources are exacerbated by concurrent temperature inversions. Particulate speciation data (the measured composition of the PM2.5 particulate matter) has been collected by the EPA. This primary data will be analyzed for trends and compared with known changes in local emissions. Comparisons will be chosen specifically to answer the following three questions: Is there a difference in the overall composition of particulates found in North Pole and Fairbanks? Are there any temporal trends in particulate composition? Is there a correlation between the SO_4^{2-} concentration and the age of the air mass? Is there a similar correlation with transition metal concentration? Hypotheses will be based on the results of prior data driven studies and interpretive modeling studies.

Synthesis and characterization of polymer-supported cyclodextrin nanoscaffolds for use in future environmental studies

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Cyclodextrins are well-studied cyclic glucose macrocycles that possess chemically distinct hydroxyls. We synthetically modified native cyclomaltoheptaose to produce a new amphiphilic cyclodextrin, heptakis (6-O-sulfobutyl-2, 3-dibenzyl) cyclomaltoheptaose. This amphiphile has been shown to form micelles at concentrations near 100 μM and promote the synthesis of nearly monodisperse and colloidally stable polystyrene nanoparticles using emulsion polymerization. We believe these amphiphilic cyclodextrins are non-covalently embedded into polystyrene nanoparticle via the benzyl groups while the particle itself is electrostatically stabilized in solution by the sulfobutyl groups. These particles have been characterized by dynamic light scattering, zeta potential measurements, conductivity titration, and NMR. These highly stable model colloids can be the basis of other nanoparticles, stabilized by amphiphilic cyclodextrins, in which the primary hydroxyls are selectively modified with functional groups other than sulfonates. These polymer-supported cyclodextrin nanoparticles serve as scaffolds upon which functional groups that possess ion-exchange and chelation properties can be anchored and could be subsequently used for environmental investigation and remediation.

Investigating the Relationship between Bromine Monoxide Seasonal Behavior and Meteorology

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Halogens play powerful roles as oxidizers in the atmosphere, including removing atmospheric pollutants. In the Arctic, halogen abundance is higher in spring due to the presence of snow and sea ice. Future climate predications show a decrease in sea ice and snow cover, which could consequently cause a decrease in halogen abundance, leading to higher ozone levels and longer-lived atmospheric pollutants in the Arctic. To better understand how climate change may affect the halogen abundance and behavior, we need to better understand the role meteorology plays on the behavior of halogens. Observations of reactive bromine behavior in late spring have shown an abrupt drop in in concentration, with no recovery; however, a recurrence behavior is seen at some sites and years where reactive bromine concentration will recover for at least a day. Further analysis of these behaviors and how they relate to meteorology could give us indication on how halogens may respond to future climate changes.

Spatial and temporal variability of the suspended particulate Fe over the Gulf of Alaska shelf

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The Gulf of Alaska (GOA) is a region with contrasting ecosystems where the availability of the essential micronutrient iron (Fe) contributes to the observed productivity. The Fe study presented here is part of the North Pacific Research Board's Gulf of Alaska Ecosystem Research Project (GOAERP), which investigates the interconnections among various trophic levels in this region. Sampling was conducted over the GOA shelf during two field seasons (2011 and 2013). Chemical iron species differ in their biological availability. For example, dissolved Fe is much more readily available than particulate Fe; while particulate Fe can be separated into a labile fraction, which is potentially transferable to the dissolved phase on time scales relevant to phytoplankton blooms, and a refractory fraction considered biologically unavailable. Knowledge of both temporal and spatial variability of iron species over the GOA shelf is limited. To address this knowledge gap dissolved and suspended particulate iron were studied. This talk will focus on the particulate iron data from the 2013 field season. Seawater samples were filtered on board and the filters subsequently frozen at -20^{o}C until further processing at University of Alaska Fairbanks. Processing and analytical methods will be discussed. Results indicate the suspended particles over the broad Western GOA shelf displayed higher concentrations of Fe (~120 nM on average) compared to suspended particles over the narrower Eastern GOA shelf (~20 nM on average), with the exception of a station near the Copper River plume, where total suspended particulate Fe ranged from ~430 nM to ~860 nM. Throughout the study region the suspended particulate Fe was preferentially partitioned into the refractory fraction (84%). These observations together with the molar Fe:Al ratio (0.65) of the suspended particles reveals the particulate Fe load is dominated by glacial inputs.

Development and implementation of an ash aggregation scheme for the Weather Research Forecasting with Chemistry (WRF-Chem) model

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The Weather Research Forecasting with Chemistry (WRF-Chem) model aids in the prediction of volcanic ash and sulfur dioxide (SO_2). Model output from WRF-Chem is robust and capable of aiding multiple endeavors, such as aircraft hazard mitigation and the validation of new remote sensing retrieval products. While SO_2 modeling using WRF-Chem is well defined, volcanic ash modeling requires further development. Importantly, WRF-Chem does not include a volcanic ash aggregation scheme. Currently, we are developing an ash aggregation "module", written in a combination of C and Fortran, to rectify this issue. This module, in its current state, utilizes empirical and a priori information to model the coagulation of volcanic ash particles both in the distal and proximal plumes. Importantly, we focus on deriving a sticking efficiency term as well as the development of a collisional cross section derived from Brownian motion, differential sedimentation and vertical shear. In addition, we focus on the importance of water content and the roles it plays in all three of its phases during ash transport.

Using FTIR to analyze aerosols produced through the combustion of different fuel types

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Solid particles and liquid droplets suspended in the atmosphere, a.k.a. particulate matter, cause important environmental impacts, such as changing the scattering and absorption of light in the atmosphere and decreasing the earth's albedo, and human health concerns, such as increasing the risk of heart attack, asthma, and chronic obstructive pulmonary disease. The sources of particulate matter include sea spray, vehicle emissions, industrial processes, and biomass burning. These sources have unique chemical and spectral signatures that can be used to identify them and quantify their contributions to an ambient air sample. Fourier Transform Infrared Spectroscopy produces infrared spectra that can be used to separate the functional group compositions of primary organic aerosols from the combustion of the most common fuel types present in Alaska's boreal forest. This information will be used to quantify the impacts of particles from different fuels on the particle concentrations in and impacts of wildfire smoke.

Bioaccessibility of metal(loid)s from mine wastes in the Western United States and Alaskan road dust

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Recent studies have underscored concerns regarding health risks associated with wind transport of toxic metal(loid)s sourced from abandoned mine tailings. Use of mine wastes as road fill, as is a common practice in Fairbanks, Alaska, can further exacerbate metal(loid) translocation to populated areas and facilitate human exposure. Indeed, anthropogenic enrichment of toxic metal(loid)s (e.g., As, Cd, Cu, Pb, Zn, and Ni) along roadways has been reported in urban and rural areas. In order to pose a health risk, metal(oid)s from the tailings must enter the body, either by inhalation or ingestion, then solubilize under conditions present in the lung or GI tract. In this study, we report the total metal(loid) content in geomedia as well as the physiologically-soluble fraction from mine tailings from across the Western US and road dust from the Fairbanks area in Alaska.

Surficial (0-2 cm) samples were collected from mine tailings in the southwestern US and road dusts were collected using passive samplers and artificial disturbance in Fairbanks, AK. Samples were subjected to total elemental analysis and size fractioned by dry sieving to determine the fractions of particles that are small enough for ingestion, wind transport, and inhalation. Appropriately size fractionated samples were subjected to physiologically based extraction tests (PBETs) simulating interaction of geomedia with lung and stomach fluids prior to supernatant analysis by ICP-MS. These results lend insight into evaluating the health risk associated with wind transported metal(loid)s from mining activities.

Transport mechanisms of metal-bearing historic mine tailings in a semi-arid environment

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Release of metal(loid)s to the environment from mine tailings has degraded ecosystem vitality and community health in many semi-arid locations. Tellurium is a relatively understudied metalloid that can be more toxic than well known environmental villains, As and Se. Little is known about the behavior of Te in the surficial environment, but Te can be enriched in residual mine tailings from gold extraction (up to 455 mg kg^{-1} at study site). Under surficial conditions, Te in mine tailings undergoes oxidative weathering and is also susceptible to wind and water transport. The potential toxicity combined with mass transport of Te-bearing particles by wind or water raises concerns regarding nearby ecosystem, environmental, and human health.

The goal of this project is to assess the mass transport of Te and other toxic metal(loid)s by wind and water from the 450,000 tons of residual mine tailings in the historic, semi-arid Delamar mining district (Lincoln County, NV). Samples collected from 0-2 cm depth along 8 radiating transects (8 samples each) centered at the largest tailings pile were used to assess local wind transport. HYSPLIT modeling indicates that the predominant winds travel from southwest to northeast, but short-term anemometer data and elemental composition of samples, determined using WD-XRF, suggests wind transport at the site may be complicated by local topography. An additional 10 samples collected along a dry streambed downstream from the site were used to assess surface water transport of the tailings toward a playa used for off-road recreational driving. Elevated concentrations of toxic metal(loid)s in streambed samples indicate that there is mass transport of tailings via surface water. However, the anticipated logarithmic decay of elemental concentrations downstream is not observed. However, substantial concentrations of some metal(loid)s (up to 120 mg kg^{-1}) indicate offsite enrichment near roads. Together, these results represent an important first step toward understanding mine tailings mass transport and the potential resultant impacts of Te on the environment.

Evaluating Potential for Recovery of Te as a Byproduct of Au Extraction at the Golden Sunlight Mine (Whitehall, MT)

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Tellurium (Te) is an energy-critical element, found in limited supply in the earth's crust (average crustal abundance 3 $\mu g\ kg^{-1}$). The development of high efficiency CdTe-based thin-film photovoltaics has created unprecedented demand for Te, which is predicted to outstrip current global production. Although there are several high-grade Au-Ag telluride deposits in the western US, almost all Te is produced as a byproduct of copper extraction. Telluride minerals of Au, Ag, Bi, and Pb, the most common Te-bearing phases in Au-Ag and Cu ores, vary widely in their vulnerability to extraction methods. Despite metallurgical challenges, recovering Te from Au-Ag mining is one potential way to meet increasing demand for Te. This project examined the behavior of Te throughout the Au extraction process at the Golden Sunlight Mine (Whitehall, MT). Total elemental analysis of mill samples was performed either by wavelength dispersive X-ray fluorescence (WD-XRF) or using peroxide sinter dissolution prior to analysis by inductively coupled plasma-mass spectrometry (ICP-MS). Elemental concentrations up to 100s $mg\ kg^{-1}$ were observed, indicating that significant amounts of Te are present in the mill samples. Future recovery of Te relies on a detailed understanding of Te speciation and transformation throughout the extraction process. However, this study is an important first step in determining the feasibility of Te recovery from Au-Ag telluride deposits.

Poster Submission

Fate of Chemical Herders and Burn Residue in Arctic Waters Following In Situ Burns

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Oil spill contingency planning requires information that supports choice of response method: mechanical recovery, biodegradation, chemical dispersion, and/or in situ burning. Regarding possible spills in the Arctic, the value of in situ burning as a possible primary response option depends on ice cover and slick thickness, among other factors. Chemical agents, known as thickening agents or "herders" may enhance the opportunities and effectiveness for in situ burning in ice covered areas. With careful evaluation of the physical and chemical processes associated with herder application and subsequent burning, industry, government, Alaskan natives and other interested parties will be better able to assess the usefulness of this response option and judge the safety and effectiveness of herder use in the Arctic, as well as estimate its effects on the environment. This research utilizes a combination of bench and mesoscale tests to evaluate the fate of the chemical herders applied and the resultant burn residue.

Poster Submission

Hydrograph partitioning of a sub-arctic glacial watershed, Interior Alaska: A geochemical analysis

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Alaska's rivers are strongly influenced by snow and glacier melt, yet contribution to larger-scale watershed runoff is rarely quantified. Anticipated future changes of snow and glacier melt due to climate warming ultimately impacts the ability of managers and communities to plan and adapt to short- and long-term runoff variations. An understanding of the contributing sources of river discharge via geochemically-based hydrograph separation techniques can help refine runoff forecasts and projections.

Field measurements, laboratory and modeling analyses equip us to address two main objectives: a) *Quantify* contribution of glacier melt, snow melt and rainfall to lowland streamflow and b) *Assess* hydrologic pathways of glacier wastage within a watershed underlain by discontinuous permafrost. Water samples for geochemical analyses include end-of-winter snow pack cores, rain, surface water, glacier surface meltwater, glacier terminus runoff, winter baseflow and groundwater from the Jarvis Creek watershed (634 km^2), Interior Alaska since 2011. Water samples are analyzed for major ions, oxygen ($\delta^{18}O$) and deuterium (δD) stable isotopic ratios and suspended colloid characterization. Preliminary results show distinct chemical signatures of contributing sources and significant seasonal $\delta^{18}O$ variability in Jarvis Creek runoff. Ultimately, laboratory analyses of stable isotope and dissolved ion concentrations will inform our end-member volumetric mixing models and allow us to quantify the contributing sources to streamflow while gaining fundamental knowledge about the regional hydrologic system.

Poster Submission

Air Quality Impacts of Chemical Herder mediated In-Situ Burning for Arctic Oil Spills

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With increased vessel traffic through the Northwest Passage, carrying bulk fuels such as No. 2 fuel oils and Bunker C, as well as the increased interest for crude oil exploration and production in the Chukchi and Beaufort Seas, the potential for an oil spill incident in that area has increased significantly. If the spill was to occur in partial ice-covered waters, most of the response tactics normally utilized in either open water or completely ice-covered conditions become impractical. In such situations in-situ burning (ISB) in conjunction with herder application can prove to be an efficient response tool. However, there are concerns regarding air quality impacts when choosing in-situ burning as an oil spill response measure. The proposed research aims to conduct systematic assessment of the impacts on air quality during ISB in combination with chemical herders in ice-infested waters. The research would focus on measuring in-plume concentrations (via lab-scale tests), and local ground-level concentrations (via field-scale tests) of atmospheric particulate matter and various combustion gases (e.g. CO, CO_2, NOx, VOCs) during an ISB event.