Alaska Geologic Society Technical Conference 2024
UAF Geoscience Student Colloquium 2024

Time	Speaker	Affiliation	Talk Title	Virtual or IRL?
8:30 – 9:00	Opening Remarks, Pathfinders awardees, student scholarship winners, sponsor recognition			
9:00 – 10:00	Claudia Cannatelli	UAA		IRL
10-10:30	Sarah Fowell	UAF		IRL
10:30 – 11:00	Coffee break			
11:00 – 11:30	Jamshid Moshrefzadeh	UAF	“Like Clockwork: Diffusion Chronometry Aids in Eruption Forecasting at Redoubt Volcano, Alaska”	IRL
11:30 – 12:00	Florian Hoffmann	UAF		IRL
12:00 – 12:30	Jason Westlee Craig			VIRTUAL
12:30 – 1:30	Lunch break			
1:30 – 2:30	Barrett Salisbury	DGGS	"Removing the Guesswork from Tsunami Evacuations: New Insights into the Tectonic Tsunami of 1964"	IRL
2:30 – 3:00	Abigail Nastan	DGGS		IRL
3:00-3:30	Natalia Ruppert	AEC		IRL
3:30 – 5:00	Poster Session			

Location: University of Alaska Fairbanks Troth Yeddha’ campus, Reichardt building
Time: Saturday, April 6th, 2024 from 8 am – 5 pm.
Lunch will be provided only to those who are registered.

Presentation Abstracts

Like Clockwork: Diffusion Chronometry Aids in Eruption Forecasting at Redoubt Volcano, Alaska

Jamshid Moshrefzadeh, Jessica Larsen, Pavel Izbekov

We are investigating the rates of magmatic processes using diffusion chronometry on products of the 2009 eruption of Redoubt Volcano, Alaska. To aid in eruption forecasting efforts at this hazardous volcano, we conduct a synthesis of interdisciplinary monitoring data together with diffusion chronometry on pyroxenes to develop a spatio-temporal model of the magmatic system, focusing on products of the most recent 2009 eruption. Our diffusion modeling results indicate that the replenishment of mafic magma at Redoubt occurs on the timescales of years to decades before eruption, with crystals erupted in 2009 recording evidence of perturbations in the magma system preceding both 2009 and the 1989 eruption onset. By synthesizing our diffusion timescales with results of interdisciplinary monitoring data, we perform petrologic monitoring to date events such as the ascent of mafic magma from depth and subsequent magma injection occurring in the shallow (2–5 km) system. Shared changes observable across seismicity, radiative power, deformation, gas emissions, surface ice melt, and petrology all indicate that Redoubt experiences protracted replenishment of low-silica andesite during inter-eruptive periods, with notably drastic increases in activity occurring 3–4 months before eruption onset. Our results will help inform new forecasting tools that may aid the Alaska Volcano Observatory by providing the template of activity expected to occur within the few months immediately preceding future eruption onset.

The UAF Geochron Lab: 40Ar/39Ar dating capabilities, first results, and future directions
Florian Hofmann

This talk will introduce the capabilities of the new state-of-the-art mass spectrometer for 40Ar/39Ar dating which was recently installed at the UAF Geochron Lab. Current research at the Geochron Lab focuses on microCT pre-screening of samples to improve the accuracy and precision of 40Ar/39Ar ages, dating very young (<10 ka) volcanic rocks, and studying the long-term displacement history of faults. The talk will also give an overview of possible applications of the 40Ar/39Ar method and opportunities for collaboration.

Checking on recent Alaska earthquakes and swarms
Natalia Ruppert

When Alaska has less than 50,000 earthquakes in a given year, we consider it quiet. 2023 was a quiet year for Alaska, with the Alaska Earthquake Center reporting 45,546 seismic events in Alaska and neighboring regions. This is ~1,500 less than in 2022, and about 8,900 less than the record-breaking 2018. The largest earthquake was a magnitude 7.2 event that occurred on July 16 in the Alaska Peninsula region. It was a late aftershock of the 2020 M7.8 Simeonof Earthquake. Aftershocks continued, albeit at a slower rate, within the 2018 M7.1 Anchorage, 2018 M6.4 Kaktovik, 2018 M7.9 Offshore Kodiak, 2020 M7.8 Simeonof, and 2021 M8.2 Chignik aftershock sequences. The Purcell Mountains earthquake swarm and the Wright Glacier cluster northeast of Juneau also continued to be active. In my presentation I will review some of these sequences in more detail.

The role of fluids in the Earth's crust: implications for Alaska's volcanism and hydrothermal activity

Claudia Cannatelli

Water supply and budget are essential aspects of a subduction system as they affect the productivity of arc magmas, the cycling of volatiles in the mantle, and the rheology of the mantle beneath subduction zones. Volatiles (H2O, CO2, S, F, Cl, Br, Li) play an important role in the evolution of magmatic processes and the physics of volcanic eruptions. However, volatiles are also necessary for the development of magmatic-derived hydrothermal systems. In this talk, I will present some recent findings on immiscible volatile phases exsolving from melts and their role in crystallization and heat and mass transfer to geothermal systems.

Utilizing multispectral imagery and SAR to assess flood impacts in remote Alaskan communities to improve flood mitigation strategies

Harper Baldwin, Chris Maio, Matthew Balazs, Simon Szwieback, Franz Meyer, Richard Buzard

There is a dearth of geoscientific data to inform mitigation strategies in remote and historically underfunded Alaskan coastal communities. These communities face increasing coastal hazards, such as erosion and flooding, as a result of projected climate changes. Currently, flood modeling in many communities is based on simplistic bathtub models that do not take hydrologic flow patterns into account. Improving these models is necessary to create sufficient mitigation strategies, but up-to-date bathymetric and real-time oceanographic data necessary to create storm surge models is unavailable. Remote sensing methods could fill this data gap by directly delineating the spatial extent of flooding during events. This research assesses (1) the feasibility of utilizing Maxar multispectral imagery to delineate historic maximum flood height based on the spectral characteristics of inundated vegetation in Goodnews Bay, AK, and (2) the accuracy of floodlines delineated from Synthetic Aperture Radar amplitude imagery acquired during a storm event in Pilot Point, AK. Both methods are compared for their differing strengths, and results obtained from analysis of Synthetic Aperture Radar imagery are particularly accurate. This research is a novel application of remote sensing techniques in communities that are uniquely hazarded by flooding and gives credence to the potential use of this technology to improve mitigation strategies and preparedness in remote communities on the west coast of Alaska.

The Alaska Volcano Observatory as a Resource for Geologic Work in Alaska: Recent Updates and Future Improvements

Abbey Nastan, Cheryl Cameron, Scott Crass, Dain Harmon

The Alaska Volcano Observatory (AVO) is responsible for monitoring and studying Alaska's volcanoes: issuing alerts when activity is observed or predicted; creating informational products about hazards; and conducting new scientific studies on Alaska volcanoes to better understand their eruptive characteristics. Since AVO's formation in 1988, the organization has amassed a large amount of volcanological data, publications, and analyses, which is stored in AVO's Geologic Database of Information on Volcanoes in Alaska (GeoDIVA). This forms the backend of AVO's website, which serves much of GeoDIVA's data to the public. Recently, AVO made a substantial upgrade to the website, including accessibility improvements and new features and search functions. This presentation will provide an overview of important resources for geologic work related to volcanoes in Alaska, such as eruption chronologies and a large body of publicly available media, as well as current and future work on additional resources such as stratigraphic layer data and geochronology.

Removing the Guesswork from Tsunami Evacuations: New Insights into the Tectonic Tsunami of 1964

Barrett Salisbury, Elena Suleimani, Dmitry Nicolsky

This talk will give an overview of recent National Tsunami Hazard Mitigation Program (NTHMP) activities in Alaska including advances in subduction zone science that necessitated updates to Alaska's existing tsunami inundation maps, new insights into the tectonic tsunami of the 1964 Great Alaska Earthquake, implications for hazards in areas previously assumed to be immune to tsunami impacts, and resources for living or recreating in tsunami-prone areas.

Timing of Mesozoic exhumation of the metamorphic core of the southern Brooks Range: New constraints from low temperature thermochronology

Jason Craig, Elizabeth Miller, Jaime Toro

The tectonic process responsible for the Mesozoic exhumation of the metamorphic core of the Brooks Range (BR) remains unresolved and has been a point of controversy for over three decades. Previous workers have proposed that the uplift of blueschist to greenschist facies rocks is related to Jura-Cretaceous Brookian contraction and thrusting (Till and Snee, 1995; Till, 2016), while others have countered that exhumation mainly occurred during a post-contractional mid-Cretaceous thermal and extensional event (Miller and Hudson, 1991). To evaluate these two endmember tectonic models, this study integrates new zircon (U-Th)/He data with existing data from prior studies (Bigot-Buschendorf, 2015) to delineate thermal histories from distinct structural domains across the orogen. Northerly samples derived from unmetamorphosed to low-greenschist facies rocks of the Endicott Mountains Allochthon, Doonerak Fenster, and the northern Central Belt yield Paleocene and Eocene-Oligocene cooling ages, which are related to renewed contractional deformation in the Cenozoic (O'Sullivan et al., 1997a, 1997b). In comparison, southerly samples from middle-upper greenschist facies rocks from the normal fault-bound Schist and Phyllite belts are characterized by mid-late Cretaceous cooling ages (~105-75 Ma). Shared thermal histories across the Schist Belt-Phyllite Belt contact, which is a normal fault that omits structural and metamorphic section, indicate that cooling occurred syn to post-slip on normal faults. The youngest metamorphic fabric (Sd) also cuts across the normal fault system. New (U-Th)/He data provide a minimum age for both normal faulting and the youngest fabric (Sd). The timing of the observed mid-late Cretaceous cooling event is contemporaneous with exhumation and greenschist-amphibolite facies metamorphism documented in the Arrigetch-Igikpak thermal high of the central BR (Toro et al., 2002; Vogl et al., 2002), regional magmatism that is syn-extensional (Akinin et al., 2020), formation of the Yukon-Koyukuk successor basin (Patton et al., 1994, 2009; O'Brien et al., 2018), and opening of the Amerasia Basin (Miller et al., 2017). Collectively, results support models for the Mesozoic exhumation of the metamorphic core of the BR driven by heating and extensional doming of mid-lower crustal rocks.

The Bering Land Bridge: Great Grazing or Buggy Bogs?

Sarah J. Fowell[1], Beth Caissie[2], Jenna Hill[2], David Scholl[2], Matthew Wooller[1], Nancy Bigelow[1], Chris Maio[1], Sambit Ghosh[1], Josh Barna[1], Sara Datson[1], Ryan Oeste[1], Sarah Andreanoff[1], Jim Costigan[1], Wil Kleiner[1], and Xochitl Munoz[1]

1. University of Alaska Fairbanks
2. United States Geological Survey

To reconstruct the vegetation and climate of the Bering Land Bridge during and after the last glacial maximum, we collected a suite of cores from the Bering Sea shelf in August 2023. In total, we retrieved 425 m of core from 36 sites south of the Bering Strait, including multicores, vibracores, gravity cores, and jumbo piston cores. To obtain sediment deposited in lakes and bogs on the emergent land bridge, we used the R/V Sikuliaq's subbottom profiler to identify basins beneath relatively flat-lying marine sediment and targeted those sites. In water depths less than ~80 m, small basins a few hundred meters across were common between buried channels. Cores from these sites contain laminated sediment beneath 2-5 m of massive marine mud. Macrofossils extracted from these laminated units include abundant moss fragments, chironomid head capsules, and *Daphnia* egg cases, indicative of freshwater ecosystems. Preliminary stable carbon and nitrogen data from a site northeast of St. Matthew Island indicates a transition from marine to freshwater conditions between 450 and 500 cm depth in the 755 cm core. Terrestrial plant material extracted from six cores has been submitted for radiocarbon dating; results are pending. We tentatively conclude that portions of the Bering Land Bridge looked very different from the arid steppe-tundra that covered Siberia and Alaska during the last glacial stage. Rivers meandered across low-lying flats and ponds, bogs, or oxbow lakes dotted the floodplain, restricting steppe vegetation and grazing animals to better-drained slopes and uplands.

Poster Abstracts

Isotopic, geochemical and petrographic analysis of the Otuk Formation, Northern Alaska

Robin M Carbaugh, Michael T Whalen

The Triassic-Jurassic (T-J) boundary is associated with one of the big five mass extinction events and is characterized by global negative δ13C excursions, indicating a major disruption in the carbon cycle. The Triassic extinction event was caused by Central Atlantic Magmatic Province (CAMP) volcanism, the cause of the breakup of Pangea. Abundant greenhouse gas emissions, including CO2 and CH4, affected multiple environmental factors. Global warming, ocean acidification, deoxygenation, mass mortality, and lithological change are documented across the boundary. These environmental fluctuations are also observed due to human-induced global climate change, making understanding the end-Triassic extinction significant. Northern Alaska during the Late Triassic has evidence of being deposited in an upwelling zone, influencing redox conditions on the seafloor. I hypothesize that isotopic, geochemical and petrographic analyses into Northern Alaska's Late Triassic Otuk Formation will give a better understanding of the depositional environments in which it formed. Our research has documented the Triassic-Jurassic boundary using carbon and nitrogen isotopes in the rock record, where previously it was not well recorded in Alaska. Research into the Otuk Formation also identified the petroleum potential of these organic-rich rocks, finding high petroleum potential. Oxygenation fluctuations, influenced from upwelling and mass extinction, were identified through fossil identification, and pyrite framboid imagery. It was found that there was a lithological change from oxic bivalve-rich facies to dark, low-oxygen, organic-rich shales across the T-J boundary, indicating significant environmental change.

Laboratory experiments on gas-driven volcanic tremor and long period seismicity

Kyungmin Kim, Laura Spina, Jacopo Taddeucci, Francesco Pennacchia, Chiara Cornelio, Elena Spagnuolo, Társilo Girona

Volcanic tremors and long-period (LP) events are seismic signals thought to be related to magmatic/hydrothermal fluid processes. Theoretical studies have proposed a mechanism suggesting that the buildup of gas beneath permeable cap in shallow volcanic conduits induces spontaneous pressure oscillations, giving rise to volcanic tremor and LP events (Girona et al., 2019, https://doi.org/10.1029/2019JB017482). Here we explore experimentally this hypothesis by varying gas flux, geometry, porosity and permeability of the cap of analogue volcanic conduits. Our experimental setup consists of a vertically arranged cylindrical pipe with a 4 cm internal diameter. The pipe configuration included from the base to the top: a water-filled section, an air pocket, a permeable cap, and an upper pipe section open to the atmosphere. Compressed air was injected into the water at the base using gas flow- meters, while pressure oscillation in the air pocket beneath the permeable cap, pipe vibration (acceleration), and pressure signals at the top of the pipe were monitored by two pressure sensors, an accelerometer and a microphone. Preliminary results reveal that pressure oscillations within the 2-150 Hz frequency range manifest in the air pocket beneath the permeable cap, likely related to resonance due to gas accumulation. Hence, increasing the thickness of the gas pocket beneath the permeable cap shifts the peak frequency toward slightly higher values, from approximately 15 Hz to around 20 Hz. Our study aims to serves as a reference for volcanic signals in natural setting by laboratory experiment.

A new look at the mammalian fauna of the Prince Creek Formation, North Slope, AK

Xochitl Muñoz, Jaelyn J. Eberle, Lauren N. Wilson, John P. Wilson, Gregory M. Erickson, Patrick S. Druckenmiller

The Prince Creek Formation (PCF) on the North Slope, AK is the most important site for Mesozoic Arctic vertebrate fossils worldwide, as it preserves a rich array of dinosaurs, birds, fish and mammals. Mammals of the PCF are very poorly studied and on the basis of their tiny tooth fossils, four species have been known to occur: a metatherian (a stem marsupial), a small eutherian (a stem placental mammal) and two multituberculates (an extinct, rodent-like group). Most Mesozoic mammals are named exclusively on teeth, as they are very diagnostic and complete skeletons are incredibly rare. However, these teeth do not show the full picture of mammalian diversity in the PCF. Newly discovered specimens, including toothless jaws and postcranial material, reveals a much greater mammalian diversity. Through a comparative morphological analysis of jaws, we determined that there are at least six different morphotypes present in the PCF, none of which are multituberculates. In addition, we have postcranial material from a cat-sized mammal, which is extremely large for the Mesozoic and represents yet another previously unknown species. Collectively, these fossils bring the number of mammals in the PCF up to at least nine morphologically distinct taxa, five of which are not attributable to the known mammals. These findings more than double the mammalian diversity of the PCF, and provide important information for studies of the latitudinal diversity gradients in the Late Cretaceous ecosystems.

Disentangling the drivers of flow variability on Greenland outlet glaciers
Amy Jenson, Martin Truffer, Jason Amundson, Lizz Ultee

Understanding the processes that govern the flow variability of Greenland's tidewater glaciers is paramount for accurate projections of mass loss. Observations of some outlet glaciers suggest seasonal variations in runoff is the primary control on velocity changes, while for others, changes in terminus position and surface elevation is dominant. A single glacier can also demonstrate different seasonal velocity patterns from one year to the next and over longer timescales the predominant driver of ice flow variability may change. We aim to disentangle the drivers of glacier types and the processes that dictate the evolution from one type to another. We use the numerical ice flow model Elmer/Ice with the built-in GlaDS subglacial hydrology model in an effort to reproduce the different kinds of outlet glacier behavior. By forcing seasonal variations in runoff and terminus position for different synthetic glacier geometries, we observe the response in velocity and the sensitivity to bed topography. We explore whether geometry alone can explain the different kinds of observed behaviors and potentially even a switch in ice flux behavior as a glacier retreats into a different dynamic state.

Reconstructing a 1980's DEM of the Greenland ice sheet

Annegret Pohle, Andy Aschwanden, Douglas Brinkerhoff

Reproducing the past evolution of the Greenland ice sheet is a critical step towards credible predictions of its future mass loss. However, the time span over which such hindcasts can be performed is limited, among other things, by the availability of observations that can serve as initial conditions, in particular digital elevation models (DEMs). Currently, the earliest high-resolution DEM that is suitable as an initial condition for ice sheet modeling is the GrIMP DEM [Howat et al., 2014] with a nominal date of 2007. Given the large time scales over which the ice sheet evolves, a hindcasting time span of around 15 years is likely insufficient to validate that the models capture the relevant dynamical processes of the ice sheet. In analogy to the climate system, we would thus still be modeling the ice sheet 'weather'. To address this issue, we reconstruct a DEM of the Greenland ice sheet for the 1980s by combining coastal observations from 1978-1987 [Korsgaard et al., 2016] with outputs of the Parallel Ice Sheet Model (PISM). First, we produce an ensemble of model runs that start from the GrIMP DEM and evolve into a wide range of geometries that represent plausible states of the ice sheet in 1980. Using these model generated geometries, we then extract the spatial characteristics of ice sheet elevation with the Singular Value Decomposition (SVD), which allows us to fit a set of coefficients to the observations on the coast with simple linear regression. The resulting DEM is thus both compatible with ice flow physics and has information about observations along the coast, which is also the area where most of the elevation change took place over the last decades. To our knowledge, this is the first estimate of a DEM for the entire Greenland ice sheet prior to 2000, and the first step towards extending the hindcasting period for the Greenland ice sheet from 15 years to 40 years.

Tectonic implications of sheared belemnites from Limestone Gap, Eastern Talkeetna Mountains, Alaska: an unlikely collaboration between structural geology and paleontology

Jochen Mezger, René Hoffmann, Henning Bergermann

Belemnites are extinct Mesozoic cephalopods characterized by a finger-shaped internal skeleton, known as rostrum (plural: rostra), a common fossil in Jurassic-Cretaceous marine sediments. Composed of brittle calcite, rostra break in centimetre-sized fragments when subjected to deformation. Bent and sheared, but still cohesive rostra are very rare. Lower Cretaceous calcareous mudstones of the eastern Talkeetna Mountains contain a bounty of sheared and bent rostra of the species Cylindroteuthis. Microstructural analyses reveal rostra are held together by veins of calcite fibres. The thin and mechanically weak mudstone that contains the belemnite fossils is sandwiched between stronger limestone and sandstone, suggesting that deformation of the belemnite rostra result from tectonic activity along a nearby thrust fault. In order to distinguish biogenic calcite produced by the animal from the abiogenic calcite that cemented the deformed fossils, the rostra were examined under fluorescence light and cathodoluminescence microscope. Biogenic calcite phases are characterized by radial fibrous calcite crystals with concentric growth lines. Growth lines fluoresce green-yellow and the rostra minerals show no luminescence in the cathodoluminescence analysis. Fibrous vein calcite on the other hand is lacking fluorescence and growth rings and shows a strong red-orange luminescence in the cathodoluminescence, characteristic of Mn-rich abiogenic calcite phases. Similarly, electron microprobe reveals increased manganese and iron content in the fracture calcite, corroborating an abiogenic origin. In contrast, the biogenic calcite is enriched in magnesium and strontium compared to the abiogenic calcite. The most plausible explanation of shearing and bending of belemnite rostra is compressive stress during thrust faulting.

Geologic sources of nitrogen in Interior Alaska
Yesim Goyette

Nitrate concentration in streams and groundwaters of Interior Alaska exceed those of other high-latitude regions. Concentration in some groundwaters of Fairbanks surpass EPA nitrate drinking water standards by 4-12x, posing health risks linked to methemoglobinemia and risk for some cancers. Due to Fairbanks' low population and subarctic climate typical sources of nitrogen are not applicable. Big cities with higher densities of fossil fuel combustion and people are subject to nitrogen via atmospheric deposition and sewage. Sewage is also unlikely as these groundwater nitrate levels in Fairbanks haven't changed since the 1950s; therefore unaffected by population flux. Absent from Fairbanks as well is large-scale agricultural activity, known to leech nitrogen through fertilizer run-off in places such as the Mississippi river delta. Lastly, the low temperatures exhibited for most of the year suppress biological nitrogen fixation. Without these other sources present I propose that rock is a possible source of stream nitrogen not yet empirically examined in Alaska. To do so I will analyze a dataset of (δ15N) and bulk N from 87 rock samples collected from catchments throughout Interior Alaska. This project aims to describe spatial patterns both vertically and horizontally in rock N, use stable isotopes to assess sources of rock derived N, as well as evaluate correlation of rock-derived N with nitrate concentration in streams and groundwaters.

Developing techniques to date young volcanics in Alaska
Ada Causey, Cori Patchkofsky

Determining the timing of past eruptions is a crucial aspect of studying volcanic activity. This project aims to develop techniques to date past eruptions using 40Ar/39Ar dating of the Camile and Lost Jim flows in Alaska via the use of a mass spectrometer.

Exploring Heat and Gas Emissions at Mount Edgecumbe

Claire Puleio, T. Girona, T. Lopez, V. Wasser, C. Cardellini, L. Clor, D. Benavente

Mount Edgecumbe, a volcano on Kruzof Island near Sitka, Alaska, began inflating and showed increased seismicity in April 2018. An exploration of thermal and gas emissions was conducted at the volcano to better understand the subsurface processes occurring, aid in monitoring efforts, and assist in eruption forecasting. Here we use satellite data to analyze low-temperature thermal anomalies over ~20 years at Kruzof Island, which have been shown to increase prior to eruptions. While the thermal data does not indicate an obvious increase in low-temperature thermal anomalies across the volcano and island, it was used to identify potential degassing locations on the island were we later collected diffuse CO2 measurements and samples. We also collected direct gas samples of bubbling areas on the island, measured gas emissions at a potential degassing area, and conducted a gas-flight around the volcanic edifice. Preliminary results indicate that there are no measurable volcanic gas emissions at Mount Edgecumbe. These preliminary results provide further insight into the subsurface processes at Mount Edgecumbe and establish background gas emission levels at the volcano that can be used to compare with future observations of unrest.

Improved temporal constraints on the formation of the Alaska orocline inferred from forearc basin geometry and fault cross-cutting relations

Robert J. Gillis, Jeffrey M. Trop, Erin E. Donaghy, Christian C. Ragnacci

Curved tectonic features and vintage reconnaissance paleomagnetic data imply that western Alaska rotated counterclockwise 30°–50° between 68 and 44 Ma. The accretionary prism and the Border Ranges fault system (BRFS) that bounds it are the best examples of tightly bent tectonic elements, yet coastwise westward transport of the prism from 600 to as much as 3200 km between ~70 and 50 Ma implies that most translation was complete prior to bending. The late Paleocene–early Eocene forearc basin is commonly thought to follow the curvature of the BRFS northeastward through the Matanuska Valley toward the oroclinal hinge and is therefore also bent. Moreover, the Bruin Bay and Castle Mountain fault systems (BBFS, CMFS) together are largely believed to define a curved boundary between forearc and arc domains. Although the CMFS has been recognized to offset pre–Cenozoic arc–forearc systems by as much as 130 km, new geologic mapping, structural, and stratigraphic studies suggest the late Paleocene–early Eocene forearc basin follows a parallel, linear trajectory to earlier arcs through the Talkeetna Mountains and that the CMFS offsets the entire, unbent Jurassic–Paleogene arc–forearc complex right laterally. Forearc basin geometry and cross cutting relations thus refine the timing of rotation between 52 and 38 Ma or later, bracketed by deposition of the youngest rotated forearc basin strata in the Talkeetna Mountains and the youngest CMFS strike-slip basin sediments.

Resource progression and the Dark Sky conversation in the process
Steven Carhart

Alaska Geoscience resource progressions often end up part of the Dark Sky problem
The wonderful work of geosciences within Alaska companies and Universities supports many valuable resource progressions. These resource developments include Mining and Oil and Gas facilities. Also includes buildings and campuses that house the geoscientist. We need to be involved in a better implementation of our resources development stages. Alaska has many locations that have a high Bortle* (good to bad) number. Includes Oil and Gas facilities, Mining, and other industrial sites, City, State, Office buildings, Homes we live in, and many University campuses. Without realizing we are part of the problem. The transition to a carbon neutral can start with us. Dark Sky and it's connection with geology and resource progression can start here.

Sedimentation and Crustal Anatomy of the Extinct Mid Oceanic Ride, Canada Basin
Wisnu S. Priyanto, Bernard J. Coakley

The Canada basin was formed during 66˚ counterclockwise rotation of Arctic Alaska during the Mesozoic. The history of the Canada Basin is not well known, but the existence of an extinct mid-oceanic ridge in basin may offer some constraint. This study aims to discover the sedimentation and crustal structure of this extinct mid-oceanic ridge. This study combined multichannel seismic reflection (MCS) data collected from RV SIkuliaq in 2021 with previously acquired data to generate a basement map of the Canada Basin. On each MCS line, the basement was picked on a high amplitude reflector that underlies the stratified sediments of the basin. These picks were depth converted. A grid was fitted to the estimated depths using minimum curvature to smooth the interpolation. The result shows sedimentation is thins from east to west and thickens from north to south. We recognize the buried bathymetry as an extinct mid-oceanic ridge based on our basement map. We conclude that the sedimentation has changed direction several times during the evolution and the mid-oceanic ridge is unsegmented based on our seismic profiles parallel to the spreading ridge. As for future work, we are establishing the new model using ocean bottom seismometer data to understand the Canada Basin feature on the lithosphere scale.

Investigating the Magmatic Plumbing System of Pavlof Volcano, Alaska over Time with Olivine-Hosted Melt Inclusions

Valerie Wasser, Lopez, T.M., Larsen, J.F., Izbekov, P.E., Loewen, M., Waythomas, C., Newcombe, M., Iacovnio, K.

Pavlof Volcano, Alaska is frequently active and often erupts with little precursory signals. A better understanding of the Pavlof magma system and determining if and where magma stalls or accumulates could potentially help the Alaska Volcano Observatory interpret any of the limited monitoring signals. Here we present olivine-hosted melt inclusion analyses from tephra samples of two prehistoric and the 2016 Pavlof eruptions to assess the melt volatile concentrations (H2O, CO2, S). Melt inclusion H2O and CO2 concentrations are analyzed by Fourier-transform infrared spectroscopy. In addition, melt inclusions containing a shrinkage bubble are either homogenized with a Linkam heating stage or the bubble is accounted for through thermodynamic modeling. 50 melt inclusions from the pre-historic eruptions analyzed so far show a wide range in H2O concentrations from <0.5 wt% to >5 wt%, and CO2 concentrations are typically below the lower limit of detection (~30 ppm) but reach values as high as 900 ppm. Pressures calculated based on these volatile concentrations and the MagmaSat model range from 2,500 bar (~8 km) to <100 bar (<0.5 km). Preliminary results suggest that melt inclusions follow closed-system degassing paths. We also find that water diffusion likely happened at several depths implying that magma stalled several times during the ascent. Analyses of the 2016 eruption as well as electron microprobe analyses investigating major element composition and sulfur content in these melt inclusions as well as host forsterite contents will hopefully give further insights into the Pavlof magma system.

EXPERIMENTAL INVESTIGATION OF CRYSTALLIZATION TEXTURES: INTERPRETING THE JUWA PASS RHYOLITES AND THE SALIÑA MATIJS BASALTIC TRACHYANDESITES, FROM BONAIRE, LEEWARD ANTILLES

Ozzy Schneider, Michael Wolf

Bonaire, an island within the dissected Cretaceous arc in the Leeward Antilles, has a complex geological history (Wright & Wyld, 2011). Bonaire has a starkly different magmatic history than that of its current sister islands, Aruba and Curacao. Bonaire has more silicic/intermediate compositions within its bedrock whereas the other islands' basements are mainly mafic. This study compares textures of igneous rocks found at Juwa Pass and Saliña Matijs, Washington Slagbaai National Park, northwestern Bonaire, to those formed in experiments in order to recreate the emplacement, cooling and crystallization environments of rhyolite and basaltic trachyandesite. Experiments ranged in time from 11 to 1,346 hours, with cooling rates ranging from 0°C/hr to 2.24°C/hr. The samples created were analyzed by SEM (SE & BSE imagery) to study crystal growth patterns, and then compared with natural textures seen in thin sections. Samples were then compared to one another, finding which cooling rate best matched each sample. Bonaire's Washikemba Group has no distinction on historical geologic maps (Westermann & Zonneveld, 1956) between the basaltic trachyandesite intrusions and rhyolite hypabyssal or surface flows, and my study aimed to find a similarity between the two through microtextural analysis. While surface flows tend to show more aphanitic textures than those of intrusions, the rhyolite has an aphanitic matrix composed of a felty, microlite textures, and the basaltic trachyandesites from Bonaire have an aphanitic matrix as well, however it consists of more phenocrysts throughout the matrix. Both the rhyolite and the basaltic trachyandesite have allotriomorphic matrixes, indicating a similarity in cooling rates, despite chemical differences and emplacement geometries. The rocks have more similarities to experimental samples with slower cooling rates, and the basaltic trachyandesite sample would need more time in cooling rate experiments to better mimic textures found in the natural rocks.

Understanding the Landscape Change Through Organic Content of a Lake Core Over Time

Cedar J.N. Hanger, Nancy Bigelow

The history of lakes can give insight to how the land might have looked to humans thousands of years ago. An interdisciplinary group of researchers collected lake cores from Dennison Lake, ~10 km south of Chicken, Alaska to assess whether the lake was contemporaneous with late Pleistocene (~13,600 yr BP) archaeological remains recovered from a bluff overlooking the lake. The sediment cores extend back to ~10,700 yr BP, although the lake was present only after ~4200 yr BP. Prior to lake formation, the sediments indicate a low-energy stream flowed in the basin. Loss on ignition, (LOI), throughout the record indicates periods of high (~80%) and low (<10%) organic content. High LOI is found with reworked organic matter in the stream deposits ~10,500-9000 yr BP and when the lake was most productive after ~2000 yr BP. LOI fluctuates wildly ~10,500-9000 yr BP indicating extensive landscape instability and sediment mobilization. The timing suggests this could be related to warming and permafrost melt associated with the Holocene Thermal Maximum when summer temperatures are thought to be warmer than modern. While the lake was not present during the earliest archaeological occupations, younger remains date to the late Holocene, suggesting that the presence of a nearby water source may have drawn people to the bluffs overlooking the lake. Finally, recent lake level lowering due to beaver dam failure suggests the possibility that initial lake formation could have been the result of dam-building, although no ancient dams have been identified.