

31st Annual Geosciences Student Research Symposium



Welcome to the Geosciences Student Research Symposium (GSRS), a conference produced and organized by graduate students of the Department of Geosciences at Virginia Tech. The main objective of the symposium is to help students gain experience in developing communication skills, event preparation, leadership, mentorship, and team building. GSRS provides a platform for students to communicate their research across the full range of our department's disciplines. This promotes student growth as scientists and strengthens our department. GSRS offers a unique opportunity for students to prepare for future large-scale conference talks and presentations by gaining practice presenting their research to a broader audience of scientists on campus.



Through scientific talks, poster sessions, and discussions during breakfasts, lunches, and the department's favorite banquet, we can all learn and grow together. As always, GSRS will feature an exciting series of talks and posters presented by VT Geoscience graduate and undergraduate students.



Constructive feedback on student presentations from faculty, students, and visiting guests is highly encouraged. We will have live oral and poster presentations in Conference Room 310 in Kelly Hall on Thursday and Friday. We will also have light snacks and refreshments in the USLB Building, followed by our banquet and awards ceremony on Friday evening, also in the USLB Building.

2026 GSRS Code of Conduct

All participants and audience members in the 2026 Geoscience Student Research Symposium will be expected to...

SHOW RESPECT

- Participants and audience members should be respectful to students running the event and to each other
- If you must enter/exit the conference room while a presentation is in progress, do so quietly and respectfully
- Show consideration and listen with an open and receptive mindset
- Avoid saying or doing anything that may be perceived as harassment or bullying
- Limit talking during presentations, whisper if necessary
- Keep phones on silent during presentations

BE INCLUSIVE

- Show that you welcome a diversity of individuals, identities, and abilities
- Demonstrate an appreciation of differing perspectives
- Refrain from making exclusionary comments or engaging in behaviors based on any identity-based factors
- Be mindful of personal and professional biases

BE PROFESSIONAL

- Maintain professional conduct during all GSRS events
- Respect others' wishes regarding having their presentation filmed or photographed
- Keep questions brief, respectful, and relevant to the topic

In addition to this Code of Conduct, the VT [Undergraduate](#) and [Graduate](#) Honor Codes and [Principles of Community](#) also apply. We will follow all university policies for reporting misconduct, see the **Graduate Student Handbook** and [Reporting Flow Charts](#) for explicit policies and resources.

This document was ratified by the full body of GSRS committees on **February 10, 2025**

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UpGoer5: David Go (chair)

Judiciary: David Go (chair)

Moderators: Delaney Kirr (chair)

Senior Advisors: Denise Burgett and Esther Oyedele

Special thanks to:

Faculty Advisor: Dr. Benjamin Gill

Workshop Leaders: Dr. Julia Cisneros, Anya Gupta, and Tabitha Nowak

Student volunteers throughout the GSRS event

Presentation Format and Logistics

Oral presentations: Graduate and undergraduate students will be presenting 12-minute talks followed by 3 minutes for questions.

Poster Presentations: Undergraduate students will be presenting posters on Thursday between 11:30 am–1:15 pm and on Friday between 12:00 pm–1:45 pm. Students will present their posters and field questions during these timeframes.

Up-Goer Five: The ‘Up-Goer Five’ Challenge is a presentation format where scientists communicate their research using only the 1,000 most commonly used words in the English language; a talk format geared towards science communication to a broad audience. Our Up Goer Five challenge, scheduled from 11:30 am–12:00 pm on Friday, April 4 in Derring Hall, room 4069, will feature 5-minute graduate student presentations in the Up-Goer 5 format. This format lets students practice science communication skills accessible to a broad audience and are notorious for their humorous aspects.

GS(art)S: GS(art)S is a science communication exhibition during GSRS that uses art to share geoscience interests. Student artwork including photography, painting, sculpture, fiber arts, and more will be displayed in the upstairs lobby of Kelly Hall.

4th Annual GS(art)S

“Art and science are often seen as two very different disciplines. One studies the natural world through observing, testing, and experimenting against theories. The other is an interpretation of what one sees around them to create something. But the two can work together, and when they do, it can create something rather different and unique.”

~Jan Freedman

Geologist for the Royal Commission for AlUla

The history of art and geoscience is deeply intertwined, particularly through the influence of landscapes and geological formations on artists. Many artists throughout history have depicted the natural world, often incorporating detailed observations of geological features such as rock formations, erosion patterns, and even fossils, capturing Earth's history in their work. Today, geoscience students at Virginia Tech leverage the intersection of art and science to communicate their research.

GSRS 2026 is excited to continue GS(art)S, a geoscience-themed art exhibition featuring handmade pieces by graduate and undergraduate students, on display both days of the symposium.



2024 GS(art)S Gallery Wall

2026 GSRS Schedule

THURSDAY, MARCH 19

Location: Kelly Hall, Room 310

8:30 **Breakfast**

8:50 **Opening remarks, Jim Spotila**

Talk Session 1

Highlighting the Hydrosphere: Advances in Aquatic Earth Systems

9:00 Bronte Heerdink Past Ocean Circulation in Baffin Bay During the Pliocene Greenland Ice Sheet Evolution

9:15 Daniel Alvarez Quantifying the Spatial Variability of Dune Morphology and Bedload Fluxes within Sand-Bedded River Bends

9:30 Delaney Kirr Investigating Microbially Mediated Manganese Removal and Mobilization Mechanisms during Managed Aquifer Recharge

9:45 Yohtaro Kobayashi Improving Modelling of River Surface Light Availability by Integrating Additional Spatiotemporal Drivers

10:00 **Coffee Break**

Talk Session 2

Reconstructing Ancient Life and Ecology: Evolutionary and Environmental Change Across Geologic Timescales

10:15 Helen Burch No Reptile Left Behind: Incorporating Microvertebrates into Community Structure Analysis for a Diverse Upper Triassic Assemblage from Northeastern Arizona

10:30 Orin Lole Durbin Constraining the Ediacaran-Cambrian Boundary in South China Using Microfossils

10:45 Amy Hagen What Happens When Tropical Coral Reefs Get Cold? New Insight from Fossil Hawaiian Coral Nitrogen Isotopes

11:00 Ian Justice Quantifying Benthic Ecological Response to Hyperthermal Events: An Analysis of the Triassic-Jurassic Transition in Nevada

11:15 Peter Rhynard Sinuses and Species: New Insight into the Cranial Anatomy of Allosaurus and the Role of Paranasal Sinuses in Species Diagnosis

11:30 **Lunch and Poster Session 1**

Maddie Bendetti The Development of Reproducible Lab Experiments to Establish the Ground-Truth of Seismic Wave Velocities in Earth's Critical Zone

Cora Jones	Comparing Morphology of Refurbished and Natural Coastal Dunes
Paige Georgeou	Hyperspectral Imaging as a Tool for Rapid Polymer Identification
Jackson Rider	Characterizing Temporal Trends in Microplastic Concentration over Time in Lake Sediments at Mountain Lake, Virginia
Julia Gadsby	The Carbon and Sulfur Isotope Records of Ordovician Stairsian Extinction from Western Maryland Reveal Global Change to Marine Oxygenation
Matthew Centofanti	Recharge Sources to Karst Springs in Hanging Rock Valley, Virginia
Trevor MacDuffee	Late Ordovician Brachiopod Morphology and Diversity Trends Under Shallowing Conditions
Olivia Evilsizer	Fighting Phytos

Talk Session 3

The Crossroads of Sedimentology and Seismology: Seismic Signals, and Subduction Zones, and Continental Margins

1:15	Tabitha Nowak	Reconstructing Spatial and Temporal Megathrust Rupture History Using Stratigraphy and Microfossils at Sitkinak Island, AK
1:30	Gabrielle Troia	Estimating Vertical Land Motions (VLM) and Investigating VLM Drivers in West Point, Virginia
1:45	Rahi Abrar	Seismic Swarm Migration Tracks Stress-Dependent Diffusivity in Enhanced Geothermal Systems
2:00	Valerie Ayubu Meshili	Towards an Integration of Geodetic Data to Investigate Transient Deformation at Ol Doinyo Lengai Volcano, Tanzania
2:15	Faizan Sabir	Reconstructing Greenland Ice Sheet Response to Past Climate Change Using Physical Sedimentology from Melville Bugt Trough Mouth Fan
2:45	Coffee Break	

Talk Session 4

The Rise and Fall of Life: Evolution and Extinction in the Fossil Record

3:00	Danielle Fitzgerald	Redescription of the Abroreomorph Paracharnia: The First Named Ediacara-Type Macrofossil from China
3:15	Brynden Perkins	Dinosaurs on the Brain: The Braincase of Asilisaurus Kongwe Fills Incomplete Record in Early Dinosaur Evolution
3:30	Mark Nohomovich	The Anatomical Evolution of the Urostyle, A Novel Structure Formed from Caudal Vertebrae in Anurans (Frogs)

3:45	Sydney Stanard	Investigating the Timing of Biotic Recovery Following the End-Permian Mass Extinction in the Eastern Panthalassa Ocean
Talk Session 5 <i>From Active Margins to the Core–Mantle Boundary: New Insights into Earth’s Subsurface Dynamics</i>		
4:00	Jessica Zak	Refining Tsunami Inundation Extent from the 1700 Cascadia Earthquake in Alsea Bay, Oregon, Using Diatom Assemblages and Grain Size Analysis
4:15	Ziyu Deng	Constraining Seismic Heterogeneities in the Core-Mantle Boundary Region Using S and ScS Travel Times
4:30	Alina Valop	On the Viscosity of the Lower Mantle
4:45	Benjamin Avellaneda	Toward a Unified Geodetic Framework for Plate and Microplate Kinematics of the African Continent

FRIDAY, MARCH 20

Location: Kelly Hall, Room 310

8:30 Breakfast

Talk Session 6

Atmosphere to Aquifers: Investigating Environmental Processes Across All-the-Spheres

9:00	Maryam Karami	From Africa to the Canary Islands: Chemical and Mineralogical Characterization of Saharan Dust Within and Above the Atmospheric Boundary Layer
9:15	Steve Yoon	Framework for Monitoring Global Impact of Dams on River Surface Temperature
9:30	Lily Maddox	A Framework for Mapping Reservoir Heterogeneity from Surface Deformation
9:45	Desire Piphus	Investigating Arsenic Mobilization from Potomac Aquifer Sediment Using Laboratory Experiments

10:00 Coffee Break

Talk Session 7

Revealing Hidden Histories: New Approaches to Fossils and the Geological Record

10:15	Maranda Stricklin	Comparative Identification of Novel Bone Lesions within Cervical Vertebrae (VMNH 129952) in <i>Deinosuchus</i> and Implications of Pathophysiology
10:30	Ana Oliveira	A New Method for the Extraction of Three-Dimensional Calcareous Microfossils from a Carbonate Matrix: Using the Ediacaran Fossil <i>Cloudina</i> as an Example
10:45	Isaac Pugh	New Bones in an Old Drawer: Reexamining the Holotype of a Late Triassic Reptile

11:00	Simba Srivastava	Combining Perspectives on Archosaur Growth Reveals Hidden Diversity of Crocodylian Relatives in the Latest Triassic Period (~205 MYA)
11:15	Kameron Finch	Assessing the Feasibility of Sedimentary eDNA as a Proxy for Refining Historic Tsunami Inundation at Salmon River Estuary, Oregon, USA
Upgoer V Talks		
11:30	Anya Gupta, Esther Oyedele	
12:00 Lunch		
1:00	Poster Session 2	
	Keely Edwards	Evaluating Ferrous Iron Dynamics and Microbial Interactions during Managed Aquifer Recharge
	Finbar Belt	Delineating Karst Springsheds from Basin GIS Analysis: Case Study of the Hanging Rock Valley, Virginia Tech
	Tanween Syed	Using Coprolite to Create a Body-Size Estimation Model for Triassic Reptiles
	Jasmine Floyd	An Analysis of the 2024 Vertical Land Motion (VLM) Positioning Surveys of the Chesapeake Bay
	Saye Woodard	First Upper Triassic Caecilian (Lissamphibia: Gymnophiona) from the Tecovas Formation of Texas Reveals that Ceacilians were Widespread in Western USA
	Denyce Jasicki-Velin	Can Insect Carbon Stable Isotopes In Temperate, C3 Dominated Environments Identify Long-Term Vegetation Changes?
	Maxwell Gillespie	Time-Lapse Seismic Refraction Survey of a Stream Valley in Blacksburg, Virginia
	Cecil Lavezzo	Identification and Extraction of Sulfide Minerals in a Costal Plain Aquifer during Managed Aquifer Recharge
	Sarah Naimy	Hydrogeochemical Survey of the Lower Arroyo Seco
	Bradley Roos	Conducting Reproducible Science for the Analysis of GNSS Data that Monitors an Active Volcano
	Sofia Kryder	Enamel-Less Teeth? Identifying the Microstructures, Shape, and Possible Causes of Enamel-Less Reptile Teeth from a Late Triassic Microvertebrate Assemblage
Talk Session 8		
<i>“Linking Particles, Processes, and Aquatic Systems”</i>		
2:00	Hunter Cornwell	Evaluation of Common Shape Factor Function via Natural and Synthetic Particle Shape Geometries
2:15	Nivedita Priyadarshini Kamaraj	Multispectral Retrieval of Chlorophyll-a in Chesapeake Bay
2:30	Break	

2:45	Alicia Bateman	Investigating Shallow Groundwater Discharge and Chemistry from Fractured Sedimentary Rocks into a Drinking Water Reservoir in the Central Appalachians
3:00	Hana Thurman	“Seiche” It Ain’t So: the SWOT Satellite Captures a Striking Lake Phenomenon
3:15	Coffee Break	
Talk Session 9		
<i>From Water to Watts: Research Across Natural and Engineered Systems</i>		
3:30	Morgan Lundberg	Tracking Iron Nanomineral Changes to Improve Water Quality Management in Freshwater Reservoirs
3:45	Sushrita Dutta	From Satellite Observations to Society: Quantifying Global Water Storage Systems with GRACE
4:00	David Go	River Surface Area in the Mississippi Basin Across Flow Conditions
4:15	Eleni Ziu	Improving Battery Manufacturing Through Better Precursor Design
4:30	Olasunkanmi Olorunsaye	Predicting Groundwater-Driven Land Subsidence in the Chesapeake Bay Region of the Virginia Coastal Plain
4:45	Closing Remarks, Jim Spotila	
<i>Friday Evening Location: Undergraduate Science Laboratory Building</i>		
5:00	Social with Light Snacks	
5:30	Banquet and Prize Ceremony	

Poster and Oral Abstracts

PAST OCEAN CIRCULATION IN BAFFIN BAY DURING THE PLIOCENE GREENLAND ICE SHEET EVOLUTION

Heerdink, Bronte, Dept. of Geosciences, Virginia Tech, Blacksburg, VA 24061

The Arctic is one of the most climate-sensitive regions on Earth, where increasing atmospheric carbon dioxide (CO₂) concentration amplifies warming and accelerates ice loss. Baffin Bay, a sea located between Canada and Greenland, is a converging point for the West Greenland Current, which transports heat into the area associated with the Greenland Ice Sheet (GrIS). Although modern climate change is linked to anthropogenic activities, the Pliocene serves as the ideal analogue due to the similar atmospheric CO₂ levels, reduced ice sheet extents, and a comparable configuration of the continents. However, the variability and strength of the Paleo-West Greenland Current remains imprecise due to preexisting data primarily being limited to sediment cores from the eastern Baffin Bay and locally captured seismic datasets.

By analyzing contourite deposits via their associated physical property and integrating grain-size distributions from International Ocean Discovery Program (IODP) Sites U1606B and U1608A, this study will reconstruct paleocurrent dynamics in eastern Baffin Bay and evaluate the relationship of oceanic forcings to GrIS inception and development. By examining the sedimentary characteristics and thicknesses of the contourite deposits, we can predict how the paleo-West Greenland Current has contributed to the development of the GrIS.

These samples will be prepared for the Malvern Mastersizer 3000 by removing the organic materials via a 30% hydrogen peroxide bath for six weeks and three centrifuged rinses. Preliminary results show that the median grain size ranges from a medium silt (21.9 μm) to very fine sand (79.44 μm). Once the grain size data is collected for up to 240 samples, the distribution will be analyzed to determine the strength of the current. This study will improve our understanding of the influence of ocean currents on Arctic heating, evaluate how the GrIS reacted to increased heat in the Pliocene and assess the implications for present-day climate change, and provide new constraints for Pliocene climate models.

QUANTIFYING THE SPATIAL VARIABILITY OF DUNE MORPHOLOGY AND BEDLOAD FLUXES WITHIN SAND BEDDED RIVERBENDS

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In sand-bedded rivers, dunes are the predominant bedform and contribute to hydraulic roughness, sediment transport, and topographic variability along the riverbed. As they adjust to changing discharge magnitudes, dunes reflect local hydraulic and sedimentary conditions while modulating near-bed velocities. Furthermore, their migration rates provide a physical basis for estimating bedload transport rates due to their sediment compositions. Thus, quantifying their geometries and migration rates provides insight into the spatial and temporal processes governing riverbed evolution. Within broader channel dynamics, dunes respond to sediment transport conditions as erosion and deposition redistribute sediment and modify river planform geometry. Sediment eroded from channel banks is transported along the riverbed, increasing variability in bed elevation and flow depth that generates hydraulic heterogeneity and velocity gradients across the channel. Over time, outer bank erosion and inner bank deposition promote the development of river bends and increase channel curvature, concentrating flow toward deeper regions along the outer bank. This redistribution of flow drives lateral channel migration across the floodplain, producing hydraulic conditions within river bends that differ from those in straight river reaches. However, current studies oversimplify the influence of hydraulic heterogeneity on river bathymetry by combining straight and bend reaches within the same analyses. This study aims to quantify the spatial variability of dune morphology and bedload fluxes within riverbends to contextualize these processes with our understanding of meandering mechanisms. Using repeat multibeam echosounder surveys of the Sheepnose Bend, Missouri River, MO, we quantify heights, wavelengths, and leeside angles for each dune by deploying the Bedform Analysis Method for Bathymetric Information. For our spatial analysis, we separate the riverbend into multiple subsections using channel banks and centerlines, allowing us to quantify average dune metrics per section and observe their cross-sectional and streamwise variabilities. By combining our results with calculated bedload transport rates, we compare spatial trends in dune morphology and sediment fluxes to link dune shapes and sizes to topographic evolution along the riverbed. This information offers insight into the long-term evolution of the channel, thus improving our understanding of the links between riverbed processes and meandering mechanisms.

INVESTIGATING MICROBIALLY MEDIATED MANGANESE REMOVAL AND MOBILIZATION MECHANISMS DURING MANAGED AQUIFER RECHARGE

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Managed aquifer recharge (MAR) can benefit communities by increasing groundwater yields, preventing land subsidence, and reducing saltwater intrusion in coastal areas. However, introducing water with a different chemical composition than an aquifer's native groundwater may result in unintentional releases of naturally occurring contaminants into groundwater, including manganese (Mn). The Hampton Roads Sanitation District in Virginia implemented a MAR initiative in 2018 called the Sustainable Water Initiative for Tomorrow (SWIFT) to address the overuse of groundwater in the Potomac Aquifer and reduce the nutrient load to the Chesapeake Bay. The SWIFT project involves the injection of oxygenated, highly treated wastewater into the sub-oxic to anoxic Potomac Aquifer. My overarching hypothesis is that this change in oxygen conditions has the potential to stimulate biogeochemical transformations of Mn, which occurs naturally within the Potomac Aquifer.

To test my hypothesis, I conducted microbial enrichment experiments using Potomac Aquifer sediments, Potomac Aquifer groundwater, and SWIFT recharge water. During these experiments, I explored the capacity of the native microbial community within the Potomac Aquifer to reduce and oxidize Mn under different oxygen conditions. In the aerobic experiment, I supplemented microcosms with both Mn (II) and oxygen. In the anaerobic experiment, I supplemented the microcosms with synthetic δ -MnO₂ and maintained oxygen-free conditions. These microcosms were incubated for 21 days and sampled throughout the incubation period for dissolved Mn (II). Additionally, samples were taken for 16S DNA sequencing to profile the microbial community present in each microcosm. Sediments from the microcosms were analyzed with X-ray photoelectron spectroscopy, energy dispersive spectroscopy, and scanning electron microscopy to characterize the mineralogical changes that occurred during incubation. Anaerobic experiment results suggest that microbially mediated Mn reduction occurs in the Potomac Aquifer in the absence of oxygen. Aerobic experiment results suggest that Mn is removed from the water of the Potomac Aquifer by adsorption or oxidation in the presence of oxygen. These experiments provide insight into Mn removal and mobilization mechanisms acting in a large-scale MAR operation and will inform operational conditions to minimize the release of naturally occurring contaminants during the SWIFT and other MAR efforts worldwide.

IMPROVING MODELLING OF RIVER SURFACE LIGHT AVAILABILITY BY INTEGRATING ADDITIONAL SPATIOTEMPORAL DRIVERS

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The light regime at the surface of river waters is driven by the relative angle of the sun, atmospheric conditions, local and regional topographical features, characteristics of riparian vegetation, and both the orientation and the hydraulic geometry of a river. The duration of river surface light exposure throughout the year controls the amount of solar energy available to a river which affects the water temperature and the river metabolism. Understanding the spatiotemporal distribution of the river surface light regime is important for improving estimates of potential energy for river metabolism. Collecting in-situ measurements of light availability involve installing and maintaining sensors that measure light levels in terms of lux or photosynthetic active radiation (PAR). Since installation and maintenance of sensors is both time consuming and costly, we apply light availability models to estimate the light regime of a river. Prior river surface light availability models estimate the percentage of shading cast upon the river surface by surrounding riparian vegetation. StreamLight, a recent river surface light availability model, integrates a canopy radiative transfer model into a vegetative shading model to estimate the available PAR at the surface of river waters. While StreamLight has been used in various applications for multiple publications, our previous work which applied StreamLight across the contiguous United States has identified oversights within the model which we believe are important to resolve for further modelling.

Here we present a new river surface light availability model which builds upon StreamLight by improving the partitioning of diffuse and direct radiation both above and below the riparian canopy. We also improved the attenuation of radiation through the canopy by differentiating between deciduous or coniferous riparian canopy. Furthermore, we integrate additional driver models such as shading by large topographic features, presence of ice and snow on the water surface, and dynamic river surface length and depth estimates. Preliminary results of the new model show improvements in the validation when compared to a validation performed in our previous work. These improvements show that the new model further captures the spatiotemporal distribution of river surface light availability and thus can be applied at a scale larger than national level.

NO REPTILE LEFT BEHIND: INCORPORATING MICROVERTEBRATES INTO COMMUNITY STRUCTURE ANALYSIS FOR A DIVERSE UPPER TRIASSIC ASSEMBLAGE FROM NORTHEASTERN ARIZONA

BURCH, Helen, Dept. of Geosciences, Virginia Tech, Blacksburg, VA 24061

The Late Triassic represents a pivotal interval in terrestrial history, marked by pronounced climatic fluctuations, faunal transitions, and major evolutionary innovations. The Chinle Formation of the southwestern United States preserves an exceptional stratigraphic and paleoecological record of the taxonomic and ecological transformations that preceded the end-Triassic extinction. For the first time, we document the Green Layer Locality, an incredibly diverse assemblage deposited in a fluvial environment dated just after the Adamanian-Revueltian biotic turnover event (~216 Ma) in the Jim Camp Wash beds of the Sonsela Member (mid-Norian). Exceptional preservation of both macro- and microvertebrates at this locality make it a key assemblage for interpreting faunal composition, ecological interactions, and community turnover yet to be explored in the Late Triassic. The macrofauna at the site includes large-bodied vertebrates typical of Late Triassic faunas, primarily phytosaurs, aetosaurs, temnospondyls, and archosauromorphs. The microfauna reveals far greater taxonomic diversity in bone fragments and isolated teeth attributable to both large and small-bodied taxa, including fish, sharks, frogs, and small, lizard-like reptiles, including numerous undescribed species. We applied ecological trait modeling by integrating phylogenetic bracketing, anatomical comparisons, and new methods linking tooth crown height to body mass. These approaches allowed us to assign functional traits (diet, body mass, and motility) to each species and categorize them into guilds of animals with equivalent roles in their community. We applied interpretations of guild interactions to construct trophic networks for all community members and excluding small-bodied taxa only known from teeth. Our analysis reveals an unexpectedly diverse and complex multi-tiered trophic network in which the majority of dietary diversity exists among the smallest body mass groups, importantly indicating that incorporating microvertebrates allows us to build more realistic and complete trophic networks. This study represents the first application of these methods to a terrestrial Late Triassic locality, and we aim to extend this approach across a broader temporal range in the southwestern United States to investigate long-term patterns of ecological change. By adapting approaches developed for modern and invertebrate systems to fossil vertebrate communities, we establish a powerful framework for reconstructing ancient ecosystems and comparing community structure across deep time.

CONSTRAINING THE EDIACARAN–CAMBRIAN BOUNDARY IN SOUTH CHINA USING MICROFOSSILS

LOLE DURBIN, Orin, Dept. of Geosciences, Virginia Tech, Blacksburg, VA 24061

The Ediacaran–Cambrian boundary is arguably the most critical transition in Earth history and is currently defined by the Fortune Head (Newfoundland, Canada) GSSP at a point once regarded as the first appearance of the branching trace fossil *Treptichnus pedum*. However, *T. pedum* has subsequently been found below the GSSP, and its distribution is largely restricted to sandstone facies where crucial chemostratigraphic correlation tools are difficult to apply. Investigations of microfossils in latest Ediacaran and basal Cambrian strata of South China suggest that these microfossils can provide an alternative biostratigraphic marker for the Ediacaran–Cambrian boundary in this area. Cambrian acanthomorphic acritarchs are widely distributed in chert-phosphorite layers intercalated with carbonates and shales, thus allowing their biostratigraphic occurrences to be calibrated with small shelly fossil biozones and carbon isotope data. Here, the earliest Cambrian *Asteridium-Heliosphaeridium-Comasphaeridium* (AHC) assemblage zone is identified at numerous localities in chert-phosphorite layers in the basal Cambrian Yanjiahe, Liuchapo, and Niutitang formations, representing diverse depositional environments. The late Ediacaran fossils, *Horodyskia minor* and *Nenoxites jiumenensis* (HmNj) are identified in the lower Liuchapo Formation, but do not overlap with Cambrian acritarchs. The acritarch assemblage zone is in close stratigraphic proximity with basal Cambrian small shelly fossils and a negative $\delta^{13}\text{C}$ excursion (BACE) known to occur at the Ediacaran–Cambrian boundary. Thus, in South China, the first occurrences of AHC assemblage microfossils and last occurrences of the HmPj fossil assemblage can be used to constrain the boundary to a 0.5 m resolution.

WHAT HAPPENS WHEN TROPICAL CORAL REEFS GET COLD? NEW INSIGHTS FROM FOSSIL HAWAIIAN CORAL NITROGEN ISOTOPES

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Tropical coral reefs are critical hotspots of marine biodiversity, but their health is threatened by the escalating effects of anthropogenic climate change. Studying fossil coral reefs that experienced dramatic temperature and oceanographic changes can allow us to better understand how modern reef systems are likely to respond to future environmental change. In this study, we used geochemical proxies to analyze short- and long-term nutrient dynamics in coral reefs surrounding the island of Hawai'i that grew between 130,000 and 225,000 years ago during the Penultimate Glacial Maximum. Despite the large sea level and temperature shifts associated with glaciation, corals consistently exhibit the same average nitrogen isotope composition ($\delta^{15}\text{N}$). This suggests that on long timescales, reef nitrogen cycle processes remained stable and coral health was not negatively impacted by glacial conditions. However, short-term variability does occur within individual corals and between sample sites, which may indicate that localized processes were transiently affecting the nitrogen cycle. Our findings highlight the resiliency of tropical coral reef ecosystems and their ability to adapt when faced with adverse environmental conditions, at least during cold intervals.

QUANTIFYING BENTHIC ECOLOGICAL RESPONSE TO HYPERTHERMAL EVENTS: AN ANALYSIS OF THE TRIASSIC-JURASSIC TRANSITION IN NEVADA

Justice, Ian, Dept. of Geosciences, Virginia Tech, Blacksburg, VA 24061

The end-Triassic mass extinction saw a sharp decline in shallow marine biodiversity corresponding with a volcanically induced hyperthermal event. The subsequent Early Jurassic ecological recovery, which included the return of coral reef ecosystems, is not well-documented. I plan to conduct a thorough sampling of Early Jurassic marine invertebrate fossils from the New York Canyon area of Nevada to study the recovery of taxonomic and functional diversity. By analyzing local facies and environmental proxies, my interpretation will be constrained by careful consideration of taphonomic and sequence stratigraphic factors. I also intend to use ecophysiological data in tandem with an existing earth system model to investigate why the ecological impact of this hyperthermal event was so much more severe than the otherwise similar Paleocene-Eocene Thermal Maximum. These results will shed light on an understudied portion of evolutionary history that could have critical implications for the long-term impact of contemporary climate change.

SINUSES AND SPECIES: NEW INSIGHTS INTO THE CRANIAL ANATOMY OF *ALLOSAURUS* AND THE ROLE OF PARANASAL SINUSES IN SPECIES DIAGNOSIS

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Allosaurus (Dinosauria: Theropoda) is among the most well-studied of theropods, and indeed, all dinosaurs. Abundant fossil material has supplied data for studies of growth, reproduction, life history, ecology, and phylogenetic relationships over the past 150 years, yielding a remarkable understanding of its biology. As such, the genus is effectively a “model theropod”, where understanding of its biology can be applied to lesser-evidenced extinct taxa, making the use of its biology vital even beyond the genus. Recently, the North American allosaurs were reduced to two species, *Allosaurus fragilis* and *Allosaurus jimmadseni*, diagnosed by differences in the atlas-axis complex and a handful of cranial traits. However, most specimens have not been identified to a species, and fewer retain the cranial traits used to diagnose species. Systematic differences in the internal bone anatomy of different species would permit better species diagnoses when currently recognized diagnostic traits are unavailable. To test if paranasal sinus anatomy could be used to differentiate species in the same genus, several *Allosaurus* skulls were CT-scanned, including both complete skulls and isolated elements from both North American species. Segmented bones were used to explore paranasal sinus anatomy and test the use of internal anatomy in species diagnosis. Here, we report variation in the morphology and extent of paranasal sinuses among specimens assigned to different *Allosaurus* species. Notably, the nasal sinuses vary in their extent (proportional volume), and lacrimal sinuses vary in their method of structural support. In addition, we report novel nuances of several *A. jimmadseni* skull bones, including the jugals, maxillae, and occipital bones. This project presents full-skull segmentation of the *A. jimmadseni* specimen MOR 693, including all bones, paranasal sinuses, and the braincase endocast. The full skull model will provide improved access to fossil material of this well-studied “model theropod” when fossils are not physically available.

THE DEVELOPMENT OF REPRODUCIBLE LAB EXPERIMENTS TO ESTABLISH THE GROUND-TRUTH OF SEISMIC WAVE VELOCITIES IN EARTH'S CRITICAL ZONE

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This study aims to understand the effects of tree roots and overlying stress on measured seismic velocities in the soil beneath trees. Previous field studies have measured high-velocity zones beneath trees, but no reproducible laboratory experiments have been conducted to confirm their findings. To address the knowledge gap, benchtop experiments were conducted to measure p-wave velocities in compacted soil and wood. Compacted soil exhibited p-wave velocities of 200-400 m/s, while wood produced velocities ranging from 2200-7300 m/s due to the strong anisotropic behavior of grain orientation. Reproducible methods for conducting experiments were established concerning soil mixture preparation, compaction methodology, and the acquisition of p-wave seismic velocity measurements. The in-lab experiments aim to replicate field observations through synthetic and real tomography models concerning multiple subsurface situations. In-lab experiments include multiple layers of soil compaction under approximately 1 metric ton of stress. Experiments vary based on the presence or absence of buried wood and the overlying compressive stress, while soil mixture and moisture remain constant throughout. The results aim to deepen the understanding of root-soil interactions, their influence on soil shear strength, and the resulting seismic wave behavior beneath trees to confirm or refine observations made in the field beneath real trees. Future work is encouraged to explore the effects of moisture content, root geometries, and refined tomographic models to close remaining knowledge gaps. By combining laboratory and synthetic studies, this research establishes reproducible methods to simulate and quantify the impact of roots and overlying stress on soil structure, contributing to a broader understanding of the critical zone and tree-soil mechanical interactions.

COMPARING MORPHOLOGY OF REFURBISHED AND NATURAL COASTAL DUNES

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Coastal frontal dunes are the first line of defense against storm surges, thus constituting a billion dollar industry of coastal resilience [1]. As storm surges increase in severity and frequency frontal dunes face increased erosion. Coastal conservation methods have been studied to determine efficacy. Yet the effects of these methods on dune morphology are understudied. In this study, I evaluated dune morphology of two beaches, one natural and one refurbished, along North Carolina's coast. The two beaches included in this research are Fort Fisher, an east-facing, unpopulated beach with no significant refurbishment projects; and Oak Island a south-facing beach town with a large refurbishment history. The morphology of the dunes on both beaches were first evaluated by DEM's from North Carolina's Spatial Download. We defined a research area of 1.4 km x 35 m on each beach. High spatial resolution DEMs were created over smaller regions in both study areas using a KAARTA Stencil 2 handheld Lidar unit. The Fort Fisher dunes reach a maximum height of 4.9 m, and the crestline of the dune extends across the entire research area (1.4 km long). Oak Island dunes reached a height of 3.9 m and have distinct human-made breaks ~24.3 m. These breaks work as access paths to the beach, originally designed to prevent erosion; we show these paths facilitate sediment loss. Grain size and beach face measurements via Lidar survey suggest Fort Fisher's dunes have thick vegetation on the stoss and lee sides and are composed of well-sorted fine-medium quartz sand. Oak Island dunes are dominantly composed of fine-medium-sorted quartz sand but are capped by a 2-8 cm thick crust of shells, roots, and other miscellaneous sediments. That has attributed to erosion through morphological decay caused by cannoning processes. We quantify the amount of sediment loss that occurs across dunes through seasonal LIDAR scans and wind data. We conclude the morphological differences observed can be attributed to the extensive dredge and dump operations and revegetation efforts on Oak Island. At Oak Island, we hypothesize that sediment from previous restorations does not function well with young rooting sea grass, leaving frontal dunes susceptible to high rates of erosion. These findings offer insight towards future management strategies to protect communities that depend on coastal resiliency.

HYPERSPECTRAL IMAGING AS A TOOL FOR RAPID POLYMER IDENTIFICATION

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Plastic pollution is widespread in Earth's water, soils, and atmosphere, with growing concern in micron-sized particles that are more mobile and readily ingested. Assessing health risks requires accurately identifying the types of plastic to which people are exposed. Current methods, such as infrared and fluorescence microscopy, are chemically specific but limited by low throughput. Hyperspectral imaging (HSI) offers a faster, high-throughput alternative by capturing spatially resolved spectral signatures. Already used in the recycling industry to sort macroplastics, we are adapting this approach to identify and classify micron-scale particles from environmental samples. This research will develop a database of plastic spectral signatures under varying conditions (e.g. virgin polymers and degraded litter) that can be used to quickly identify and quantify plastic particles, including in mixed media such as sediments. HSI images will be acquired across the 400-1700 nm wavelength range using a dual-camera, lab-based HSI system. Each camera is fitted with a macro lens, enabling imaging at special resolutions below 100 micrometers. The resulting database will be validated using a set of "unknown" particles to assess classification accuracy and detection sensitivity. Beyond microplastics, HSI has broad applications across environmental and resource sciences. In mining and environmental science, it is used to map the mineralogy of hard rock cores and sediments in both laboratory and drone-based systems, enabling rapid identification of iron oxides, rare earth elements, clays, silicates, and other mineral phases. It is also increasingly applied in food inspection to detect contaminants while assessing quality attributes such as fat and protein content in meat and ripeness or bruising in produce. Its non-invasive, non-destructive nature further makes it well suited for archeological exploration and studying artifacts. Together, these applications demonstrate the versatility of HSI across materials, environments, and spatial scales.

CHARACTERIZING TEMPORAL TRENDS IN MICROPLASTIC CONCENTRATION OVER TIME IN LAKE SEDIMENTS AT MOUNTAIN LAKE, VIRGINIA

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Plastic production began in the early 20th century, with a rapid increase in production in the mid-1900's following World War II. This increase in production has, in turn, led to an increase in microplastic particles (<5mm) being deposited in the sedimentary record. Freshwater systems, such as lakes, serve as a natural depositional environment for microplastics as they gradually accumulate sediment over time. Here, we collected multiple 50-cm deep sediment cores from the lakebed of Mountain Lake in Pembroke, VA, to quantify changes in microplastic concentrations and composition over time. Additionally, we looked to identify potential patterns in microplastic concentrations and grain size. ²¹⁰Pb and ¹³⁷Cs analysis provided a chronology of the sediment sequences, showing that ~6 cm depth corresponds to ~1900. Microplastic particles were extracted in 1 cm intervals, isolated, counted, and classified based on morphology and color. Following classification, a subset of plastic particles was selected and underwent polymer characterization using a uRaman Spectrometer. Preliminary results revealed that as grain size decreases, microplastic concentration seems to increase. Microplastic concentrations demonstrate a gradual increase over time, with observed concentrations ranging from 32 particles/g to 438.7 particles/g dry weight. Future research will look to identify trends in polymer composition and investigate potential mechanisms for plastic infiltration in lake environments.

THE CARBON AND SULFUR ISOTOPE RECORDS OF ORDOVICIAN STAIRSIAN EXTINCTION FROM WESTERN MARYLAND REVEAL GLOBAL CHANGES TO MARINE OXYGENATION

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The Early Paleozoic saw two major biodiversification events that were important turning points in evolution of marine ecosystems. The Cambrian Explosion (545 to 525 Ma) was the first major diversification of skeletonized animals that was followed by Great Ordovician Biodiversification Event (GOBE; 471 to 458 Ma) that saw a tripling of marine biodiversity. However, between these evolutionary events was a 40-million-year plateau in marine diversity that appears to be caused by several rapid extinction events, those drivers are still largely unknown. Deoxygenation in the oceans has been posed as one of the drivers of these extinction events. Here we investigate the final extinction event of this interval, the Ordovician Stairsian extinction (~484 million years ago). To reconstruct the environmental conditions across this event, we have generated the carbon and sulfur isotope record. Studies from sedimentary successions found in present day Nevada and Utah that represent deposition on the northern margin of the paleocontinent of Laurentia show positive excursions in both carbonate carbon ($\delta^{13}\text{C}_{\text{carb}}$) and carbonate associated sulfate sulfur ($\delta^{34}\text{S}_{\text{CAS}}$) isotopes. The excursions have been interpreted as representing global changes in the carbon and sulfur cycles caused by transient increases in the burial of organic carbon and pyrite sulfur under expanded ocean anoxia.

These positive carbon and sulfur isotope excursions associated with the Stairsian extinction have only been identified in a handful of successions that were deposited in the Panthalassic Ocean. To assess whether these are indicative of a global change in carbon and sulfur cycles, we are investigating whether they are preserved in other paleo-ocean basins. Here we will present $\delta^{13}\text{C}_{\text{carb}}$ and $\delta^{34}\text{S}_{\text{CAS}}$ data from a succession located in the Chesapeake and Ohio Canal Historical Park in western Maryland. This represents deposition on the southern margin of Laurentia in the Iapetus Ocean. The $\delta^{13}\text{C}_{\text{carb}}$ record shows a +4‰ positive excursion in parallel with a +15‰ positive excursion in the $\delta^{34}\text{S}_{\text{CAS}}$ record. These excursions are consistent with results found in the Western US and therefore support the hypothesis of global changes to the carbon and sulfur cycles. Using both records together, we have interpreted these changes as representing global marine anoxia to offer insight into the conditions that drove this extinction event that preceded the GOBE.

RECHARGE SOURCES TO KARST SPRINGS IN HANGING ROCK VALLEY, VIRGINIA

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In karst settings, aquifer characterization and recharge delineation can inform land managers in decision-making regarding the protection of water resources, including spring water supplies that sustain fish hatcheries. The Hanging Rock Valley (Virginia) is underlain by Ordovician carbonates surrounded by shaly mountain slopes capped with Silurian sandstone. Karst features such as springs, swallets, caves, and sinkholes are present in the valley, especially near siliciclastic contacts. Virginia's primary supplier of fingerling brook trout, the Paint Bank Fish Hatchery relies on water from three karst springs in the valley. The objective of this study is to evaluate connections between the springs and different sources of recharge, including precipitation, sinking streams, and internal drainage, with the goal of protecting the karst springs' water quality.

To meet this objective, a team from the Virginia Department of Conservation and Recreation and Virginia Tech conducted four dye tracing experiments between Fall 2024 and Winter 2025. Results show hydrologic links between sinking streams and caves in the valley to the three springs, indicating that each spring has its own distinct recharge source. To further investigate connections between recharge sources and the springs, temperature and specific conductance sensors were installed in November 2024 and March 2025, respectively. These sensors are collecting 60-minute interval data at the three springs. During precipitation events, there is a strong correlation between precipitation patterns and shifts in spring water temperature and specific conductance, suggesting that precipitation creates surface runoff that enters sinking streams (allogenic recharge) that discharge at the springs. In contrast, during base flow conditions, consistent temperatures and specific conductance in the springs suggest that the system is influenced by slow internal (autogenic) recharge. Combined, these patterns suggest that the springs are sourced from both fast-moving and slower flowing waters. Further work using continuous dye-tracing methods and analyzing additional sensor data will help further define sources and types of recharge to the springs.

LATE ORDOVICIAN BRACHIOPOD MORPHOLOGY AND DIVERSITY TRENDS UNDER SHALLOWING CONDITIONS

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Brachiopods have innumerable uses within the field of stratigraphy; however, little is known about how paleoenvironments influence brachiopod morphologies. While some research done in the latter part of the 20th century assessed brachiopod diversity trends at various water depths, a thorough understanding of the true extent of morphological change these diversity trends represent is lacking. Many previous studies also lack certain morphological character data critical to understanding those important data trends. This study aims to identify meaningful variation among brachiopods communities preset at different water depths. This assessment includes a broad variety of characters with preference to quantitative over qualitative data. The material used for this study is gathered from the Maysville, Kentucky area and the rock units are all a part of the Cincinnati Arch sequence. Using lithostratigraphy outlined in previous literature, brachiopods from multiple high standing facies at varying water depths have been collected and analyzed using 3d modeling software and image analysis. This quantitative data is to be tabulated and evaluated using correspondence analysis and significance testing with emphasis on confidence intervals to determine water depths effect on profile and structural elements. So far, we expect to see a trend towards larger more robust genera as water depth decreases. However, an increased prevalence of immature forms and smaller species has been noted in near-shore environments. Understanding the effect of water depth on brachiopods not only has applications in stratigraphy as an environmental proxy but can also define important differences among genera and species. Determining what variations in character are due to habitat can help add weight to certain differences among brachiopods groups, and aid to delineate between various species and genera in a more meaningful way.

FIGHTING PHYTOS

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Finding behavior through deep time may appear impossible, but inferences for extinct animals can be made from living animals and how certain features relate to their behavior (i.e. tooth shape and diet, morphology and movement, and certain placements of features that would be evolutionarily advantageous to certain hunting habits). For example, modern-day crocodylians have features that aid in behaviors associated with a semi-aquatic carnivorous ecology like conical teeth for capturing fish, shorter limbs for reducing drag while swimming, and eyes and nostrils situated on the top of the skull for ambush hunting. Direct evidence of behavior can also be understood from skeletal pathologies or injuries. Bite marks are one example of this, where teeth of one individual may scrape or puncture a bone of another individual, either during some kind of within-species instance or a predator-prey interaction. Biting is common among crocodylians today for both interactions. On food items, crocodylian teeth can leave identifiable marks that tell us how they were made. Through antagonistic interactions, crocodylians may have severe injuries like limb or tail loss or loss of a portion of the jaws. By observing these animal interactions and their evidence, certain patterns appear that could also show up in the fossil record. Phytosaurs are an extinct group of archosaurs from the Triassic that have a morphology similar to that of modern crocodylians. By comparing the similar body plans, we can also look for evidence of similar behaviors related to those body features. Bite marks on phytosaurs have been found in parts of the body also exhibited in crocodylians that are victims of intraspecific aggression. We describe a new phytosaur skull that shows a clear pathology with the tip of the lower jaw missing, inferred to show skeletal stress similar to that face-biting aggression. The anterior most portion of the dentary which would include the first approximately 18 teeth, number of teeth is missing, and where the bone begins posterior to that it preserves a spongy external morphology similar to that of healed bone. By studying pathologies in phytosaurs, we can test whether their behaviors were also convergent with those of modern-day crocodylians, and whether extinct species healed in similar ways. Comprehending behavior across deep time provides a view of how prehistoric animals interacted with their environments and other animals.

ENAMEL-LESS TEETH? IDENTIFYING THE MICROSTRUCTURES, SHAPE, AND POSSIBLE CAUSES OF ENAMEL-LESS REPTILE TEETH FROM A LATE TRIASSIC MICROVERTEBRATE ASSEMBLAGE

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Microvertebrate fossil sites are accumulations of disarticulated scales, bones, and teeth that are present throughout the fossil record. The fossils are found in various states of preservation, from partial skeletons to fragmentary teeth and bones. Another unique mode of preservation, often overlooked, alters the microstructures of teeth. This form of preservation is characterized by the absence of the majority, if not all, of the enamel (outer component), whereas the dentine (inner component) remains intact. The cause of decalcification may result from the biotic processes in the crocodylian gut and/or abiotic weathering. To investigate the structures and possible formation of 'enamel-less' teeth, we sampled a Late Triassic microvertebrate site near Petrified Forest National Park in Arizona. Examining the tissues of 'enamel-less' teeth, 11 teeth of various shapes were embedded in epoxy and cut into histological sections. Next, five teeth with clear enamel representing various tooth shapes were also embedded and sectioned for direct comparison. The teeth were sectioned along the transverse or coronal plane and mounted onto plexiglass microscope slides. In addition to comparative histology of the dental microstructures of the two types of teeth, acid etching was performed with a weak hydrochloric acid solution to examine the crystalline structure of the tooth tissues. Three enamel-less teeth and two comparative teeth were then embedded in epoxy and sectioned. After mounting the sections onto slides, they were polished with 1200-grit paper. Next, the teeth were etched with 1 mol L⁻¹ HCl for approximately 20 seconds to expose the enamel crystalline structures. After 20 seconds, the sections were rinsed with DI water to stop the etching and placed in an ultrasonic water bath for 30 seconds to remove any remaining debris. Using SEM the enamel-less teeth were examined and compared with the other teeth. Using these methods, my goals are to determine the tissues preserved in these 'enamel-less teeth', describe the external surfaces of the 'enamel-less teeth' and compare the 'enamel-less teeth' to pristine teeth from the same locality. With this information, I will evaluate the various abiotic and biotic processes that may have caused 'enamel-less teeth' to have been preserved. The results will help understand whether the preservation and condition of bones and teeth are related to abiotic or biotic processes and what those conditions can tell us about the potential diet and behavior of Late Triassic carnivores and the taphonomic processes that occurred prior to, during, or after deposition.

RECONSTRUCTING SPATIAL AND TEMPORAL MEGATHRUST RUPTURE HISTORY USING STRATIGRAPHY AND MICROFOSSILS AT SITKINAK ISLAND, AK

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Rupture variability and multi-section earthquakes along the Alaska-Aleutian subduction zone (AASZ) complicate seismic hazard assessments for vulnerable Alaskan coastal communities. We address a critical gap in the millennial-scale megathrust earthquake record in the region west of Kodiak Island, where the historical record spans ~200 years and the paleoseismic archive is fragmentary. Sitkinak Island, located at the western extent of the 1964 Mw 9.2 rupture zone, is well-positioned to study the variability of slip in this region. Previous work identified five episodes of sudden late-Holocene vertical coseismic deformation marked by laterally extensive peat-mud (subsidence) and mud-peat (uplift) contacts, but questions remain about the site-wide continuity of paleoseismic evidence and the amount of land-level change recorded. A multi-core analysis and quantitative approach across diverse depositional settings is needed to corroborate this unique mixed uplift and subsidence record.

Here, we compare stratigraphic and microfossil data from paired sites in different geomorphic environments on Sitkinak Island. In an east-west transect of seven cores, we identified and dated four sharp stratigraphic contacts that indicate two subsidence events (1964 CE and 484-653 cal yrs BP) and two uplift events (475-529 and 731-900 cal yrs BP). Across earthquake contacts we analyzed fossil diatoms, key indicators of salinity changes, and applied a transfer function to statistically relate diatom assemblages to elevations within the tidal frame. Preliminary paleoelevation reconstructions across sharp contacts indicate subsidence of 0.89 ± 0.29 m at 1964 CE, uplift of 0.43 ± 0.28 m at 475-529 cal yrs BP, subsidence of 0.34 ± 0.28 m at 484-653 cal yrs BP, and uplift of 0.54 ± 0.27 m at 731-900 cal yrs BP. We find the timing and direction of coseismic land-level change is consistent between two distinctive geomorphic environments in south Sitkinak Lagoon, strengthening our confidence in a mixed uplift and subsidence signal at the site.

Ongoing analysis of an additional sediment core will further constrain 1964 CE land-level change estimates. Our quantitative estimates of paleoearthquake rupture behavior will be integrated into rupture models to define slip variability in this region, improving hazard assessments in Alaska.

ESTIMATING VERTICAL LAND MOTIONS (VLM) AND INVESTIGATING VLM DRIVERS IN WEST POINT, VIRGINIA

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Vertical land motions (VLM) have been observed in the Chesapeake Bay region using various surveying methods for decades. Multiple processes such as glacial isostatic adjustment, aquifer compaction, and sediment compaction have been suggested as potential drivers of VLM in the region. Although a recent, robust VLM solution exists for the region, rates of VLM vary spatially and may be influenced by local processes. The West Point Land Motion Observatory maintained by the U.S. Geological Survey is equipped with an extensometer, continuous Global Navigation Satellite System (GNSS) station, and a corner reflector for Interferometric Synthetic Aperture Radar (InSAR) observations, making it an ideal location to investigate the roles of potential VLM drivers. In addition to the aforementioned datasets, this ongoing study leverages groundwater level data, campaign GNSS observations, and near-surface geophysical data from West Point, Virginia to estimate the local rate of VLM and investigate the roles of potential short-term drivers. GNSS campaign data collected from 2019 to 2025 at four sites in the West Point area are being processed with GAMIT/GLOBK to obtain millimeter-precision velocity estimates. InSAR observations from Sentinel-1 are being obtained and processed using Alaska Satellite Facility's On Demand Processing service and HyP3 to obtain a vertical velocity estimate using MintPy. Additionally, groundwater level data from all five aquifers underlying West Point are being used to examine trends in the extensometer time series. Results of this study will improve our understanding of regional VLM, its drivers, and aid planning and policy decisions associated with coastal resiliency to relative sea-level rise.

SEISMIC SWARM MIGRATION TRACKS STRESS-DEPENDENT DIFFUSIVITY IN ENHANCED GEOTHERMAL SYSTEMS

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Earthquake swarms are widely interpreted as manifestations of transient fluid transport and pressure diffusion within faults and fractured reservoirs. Their space-time migration patterns have been used to infer hydraulic properties of the medium on which they propagate. In the laboratory, stress dependent diffusivity is pervasive both in intact and fractured granitic rocks. Little evidence of stress dependent diffusivity has been shown in the field. During multi-stage stimulation of the enhanced geothermal system (EGS) at Otaniemi, Finland, analysis of published earthquake catalogs shows that migrating microseismicity systematically exhibits higher apparent diffusivities toward shallower depth and reduced apparent diffusivities toward increasing depth. We leverage seismicity migration as a quantitative signal to constrain depth-dependent diffusivity using a computationally efficient framework. Fluid injection perturbs pore pressure within the surrounding rock mass, modifying the effective stress state and potentially triggering earthquakes along critically stressed preexisting zones of weakness when a critical threshold pressure (CTP) is reached. First, we construct a three-dimensional homogenous reservoir model with a log-normally distributed CTP field. To calibrate the CTP field, we model fluid pressure evolution by solving the diffusion equation with constant injection rate, homogeneous diffusivity, and no-flow Dirichlet boundary conditions. 95th percentile space-time migration envelopes of synthetic seismicity migration fronts are compared to the square-root of time theoretical migration and we choose the best fit for the following simulations. Then, we introduce an exponential depth-dependent diffusivity model defined by reference diffusivity D_0 and decay constant A , assuming that depth encodes lithostatic stress. We run forward simulations incorporating the full multi-stage injection history in the Otaniemi EGS to evaluate the performance of (D_0, A) parameter pairs at matching observed apparent diffusivities towards shallow and deeper depths compared to the injection depth. The best (D_0, A) pair and its probability distribution are inferred using a Markov Chain Monte Carlo (MCMC) approach. By studying seismic swarm spatio-temporal migration in a stress-dependent diffusivity model, our methodology offers a transferable and efficient approach for subsurface characterization, enabling improved assessment of its permeability architecture.

TOWARDS AN INTEGRATION OF GEODETIC DATA TO INVESTIGATE TRANSIENT DEFORMATION AT OL DOINYO LENGAI VOLCANO, TANZANIA

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Understanding transient ground deformation driven by magmatic activity requires separating short-lived volcanic signals from long-term tectonic and other non-volcanic processes. At active volcanoes such as Ol Doinyo Lengai, located in the Natron Rift segment of the East African Rift System, this separation is critical for interpreting magma transport and assessing volcanic hazards. In this work, we seek to integrate 2.5 years (June 2023 – December 2025) of continuous Global Navigation Satellite System (GNSS) data from the TZVOLCANO Global Navigation Satellite System (GNSS) network with the corresponding 2.5 years of Sentinel-1 Interferometric Synthetic Aperture Radar (InSAR) data to characterize the spatial and temporal evolution of transient deformation over that timeframe. Sentinel-1 data (ascending) are obtained through Hybrid Pluggable Processing Pipeline (HyP3) from Alaska Satellite Facility and analyzed using the Miami InSAR Time-series Software in Python (MintPy) to derive Line-of-Sight displacement time-series and deformation maps. GNSS data are processed with GAMIT/GLOBK to obtain high-precision station position time-series. We find vertical rates from GNSS relative to a local reference frame (OLO5) range from -1.98 mm/yr to 4.5 mm/yr and LOS velocities in a similar reference from InSAR at the GNSS locations ranging from -7.9 mm/yr to 6.7 mm/yr. We then explore using the Robust Network Imaging algorithm to interpolate vertical GNSS-derived velocities for use when combining with InSAR LOS velocities. The next step is to jointly combine the horizontal GNSS velocities, RNI interpolated vertical velocities, and InSAR LOS observations to create a new, consistent vertical velocity solution for the region and assess deformation. Finally, the Targeted Projection Operator will be employed to assess GNSS time-series spanning June 2023 – December 2025 for transient motions, such as inflation episodes. Detecting and characterizing inflation episodes is particularly important because they may represent precursors to eruptive activity.

RECONSTRUCTING GREENLAND ICE SHEET RESPONSE TO PAST CLIMATE CHANGE USING PHYSICAL SEDIMENTOLOGY FROM MELVILLE BUGT TROUGH MOUTH FAN

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The Greenland Ice Sheet (GrIS) is experiencing intense ice melting at present, leading to sea-level rise amid recent climate change. By targeting sediment deposits at continental slope, our goal is to investigate whether the GrIS underwent substantial deglaciation on one or more occasions during the Pleistocene. We will link physical sedimentology processes with ice sheet advance and retreat using turbidites layer dataset, ice-rafted debris (IRD) count coupled with grain size measurements. This study will reveal the history of sediments in Melville Bugt during glacial-interglacial intervals and their implications for GrIS in the region.

We have counted ~20,000 sand layers interpreted as turbidites from both sites U1603 & U1604 using >800 core images from IODP Expedition 400 in NW-Greenland. To further characterize these sand layers, we conducted grain-size analysis on >150 representative sediment samples from both sites, ranging from fine silt to coarse sand. The stratigraphic distribution of turbidite sand layers in both sites suggest periods of high frequency of turbidite sedimentation alternating with periods of no sand deposition on the slope. In addition to that, we plan to conduct outsized clast counting using x-ray scan images from the recovered cores, which will provide information about the occurrence of IRD during ice sheet retreat to identify major interglacial episodes.

REDESCRIPTION OF THE ARBOREOMORPH *PARACHARNIA*: THE FIRST NAMED EDIACARA-TYPE MACROFOSSIL FROM CHINA

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Paracharnia dengyingensis (Ding and Chen, 1981) Sun, 1986, a unipolar frond with a wide stalk and an elongate, parallel, bifoliate leaf-like petalodium, was discovered in 1978 in the bituminous limestone of the Shibantan Member (~551–543 Ma), Dengying Formation, in the Yangtze Gorges area of South China. It is the first named Ediacara-type macrofossil from China. Since its initial description in 1981 and subsequent re-examination in 1986, extensive advancements have been made in the taxonomy and classification of Ediacaran frondose fossils. We reanalyzed *Paracharnia dengyingensis* in light of these advancements. Based on the angle between the primary branches and stalk, as well as the angle between the primary branches and secondary branches, *Paracharnia dengyingensis* is inferred to demonstrate an *Arborea*-type branching pattern. Its elongate petalodium distinguishes *Paracharnia dengyingensis* from other species in South China that have an *Arborea*-type branching pattern, but is comparable to the rangeomorph *Trepassia* Narbonne et al., 2009 and the arboreomorph *Akrophyllas* Grimes et al., 2024. A phylogenetic analysis using an updated character matrix places *Paracharnia* Sun, 1986 within the Arboreomorpha. This suggests that the petalodium shape of *Paracharnia* is a convergent feature seen across different groups of Ediacaran fronds. The redescription and reanalysis of *Paracharnia* ensure this taxon can be accurately incorporated into the global dataset of Ediacaran fronds and contribute to ongoing discussion on the evolution of the Ediacara biota.

DINOSAURS ON THE BRAIN: THE BRAINCASE OF *ASILISAURUS KONGWE* FILLS INCOMPLETE RECORD IN EARLY DINOSAUR EVOLUTION

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There are many gaps in the fossil record that often make it difficult to sort out the paleoecology, paleobiology, and relationships of both extant and fossil groups. For example, the order and manner of evolution of the earliest dinosaurs is a subject of continued debate. One obscure group of herbivorous Triassic reptiles, the silesaurids, are close to the origin of the dinosaurs and are an important aspect of this debate. In the traditional view, silesaurids are the closest relatives of the dinosaurs (as dinosauriforms), but some recent analyses have suggested they may instead be among the earliest members of the herbivorous ornithischian dinosaurs. These competing hypotheses have different impacts on the paleobiology of the earliest dinosaurs (e.g., the ancestral condition of dinosaur locomotion, feeding habits, variation, etc.) as well as the timing of their evolution. Although new specimens and species of silesaurids have been discovered at a rapid pace in recent years, there are some portions of their anatomy that are still not well sampled due to the incomplete nature of the fossil record. One of these is the portion of the skull that houses the brain, the braincase. Until now, only one definite silesaurid has had its braincase described in detail, the namesake species, *Silesaurus opolensis*. This makes for a sizable gap in important anatomical data that can further inform our understanding of their relationships. Here, I describe the braincase of the silesaurid *Asilisaurus kongwe* from the Middle Triassic Manda Beds of Tanzania, an exemplary species known from excellent skeletal material from multiple individuals. Among our sample of *Asilisaurus* material is a complete braincase, a partial braincase from the holotype site, and dozens of isolated bones. I use computed tomography (CT) data and digital segmentation software to create a 3D reconstruction of the braincase and compare it with that of *Silesaurus* and the earliest dinosaurs. The braincase contains several fine anatomical similarities to *Silesaurus*, which are distinctly different from those seen in the earliest dinosaurs. Furthermore, some details of their anatomy show variation between individuals, similar to what has been reported in other silesaurids and other early dinosaurs. My results further highlight the previously enigmatic braincase anatomy of dinosaurs and their earliest kin and present further evidence for the traditional view that silesaurids were relatives of the dinosaurs, rather than members of the group themselves.

THE ANATOMICAL EVOLUTION OF THE UROSTYLE, A NOVEL STRUCTURE FORMED FROM CAUDAL VERTEBRAE IN ANURANS (FROGS)

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Novelty as a biological concept describes the emergence of traits that also provide a new function, which allows organisms to occupy different niches. The use of developmental data in combination with the fossil record can clarify the timing and order of appearance of aspects of these structures. The urostyle is a novel structure found only in anurans (living frogs and their extinct close relatives) whose shape varies among groups of frogs based on phylogenetic relationships or locomotion. Developmental observations confirm that the urostyle is a result of the fusion between the caudal vertebrae and an ossified hypochord, a temporary structure in non-amniotes that lies ventral to the notochord. Living anurans are the only animals that maintain a hypochord that undergoes ossification. Recent developmental data show that the ossification of the hypochord helps facilitate tail loss in froglets by reshaping the dorsal aorta. My study addresses when the urostyle evolve and how did the urostyle diversify in its morphology? We describe the oldest 3D-preserved urostyle from the Upper Triassic Dockum Group using μ CT, synchrotron, and osteohistological data to understand timing and acquisition of morphological features that can help predict locomotion style in this extinct frog. The Dockum urostyle is wider anteriorly and slowly tapers posteriorly, forming a conical structure. This urostyle preserves a dorsal ridge that extends partway down the shaft. On the ventral surface, a groove extends the entire length. Anteriorly, a biconvex cotyle is present for articulation with the sacral vertebra. This combination of features may imply a type of locomotion and phylogenetic relationship for this frog. A biconvex cotyle is seen in species that can hop and burrow, this is corroborated by other Late Triassic frog fossils that support the hypothesis that frogs were able to hop by the Late Triassic. Most early branching anurans have a smooth urostyle on the dorsal surface. CT data reveal that the neural canal extends almost the entire length of the urostyle. Osteohistological and CT scan data show repeated areas of lower density between centra, suggesting that the vertebrae are not fully fused into a single structure. This indicates either skeletal immaturity in this Late Triassic individual or an adult morphology that is 'transitional' at this point in anuran evolution. By understanding the evolutionary history of the urostyle, we are gaining insight into the evolution, locomotion, development, and diversification of an important living group.

INVESTIGATING THE TIMING OF BIOTIC RECOVERY FOLLOWING THE END-PERMIAN MASS EXTINCTION IN THE EASTERN PANTHALASSA OCEAN

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Understanding mass extinctions means understanding the history of life on Earth; macroevolution is so tied to mass extinctions that we cannot separate the two. The End-Permian Mass Extinction (EPME) was the largest mass extinction of the Phanerozoic, with an estimated 81% of marine species and 70% of terrestrial vertebrate species going extinct. Despite the ruination the EPME wrought on Earth's ecosystems, it also ushered in the rise of the modern marine faunal regime. This recovery, however, was not simple, and it continues to baffle researchers today.

Among those who study mass extinctions, it is commonly believed that recovery from the EPME was protracted, taking 5-9 million years for the abundance and diversity of Earth's biota to return to pre-extinction levels. Despite this assumption, researchers continue to find fossil localities that preserve "unexpected" (Brayard et al., 2017) complex and diverse ecosystems from the Lower Triassic, dating back as early as 2 million years after the EPME. I hypothesize that this discrepancy is due to an incomplete understanding of the stratigraphic record, especially in the Southwestern US where most of the research investigating the Early Triassic in the US has been done.

During the Early Triassic, the Southwestern US was the continental margin of the eastern Panthalassa Ocean on the western edge of Pangea. The rocks deposited during this period are largely carbonates containing homogenous fossil assemblages, leading researchers to conclude that these were areas with low diversity still suffering from the effects of the EPME.

However, where a biotic community exists along the continental shelf has significant effects on the diversity and abundance of fauna living there. In the past, researchers have not placed much importance on the specific facies represented in these Early Triassic deposits, which has resulted in a limited view of this paleoenvironment, muddying our understanding of recovery timing.

I aim to constrain the timing of biotic recovery following the EPME by examining these deposits within the full context of depositional facies and their effect on the fossils they contain. I intend to develop a stratigraphic correlation and regional facies model along a transect spanning Utah, Nevada, and California, placing the known fossiliferous localities of interest within a unified facies framework and synthesizing the previous research from this area within this new context. By creating this comprehensive analysis, I hope to elucidate the true timing of biotic recovery following the EPME.

REFINING TSUNAMI INUNDATION EXTENT FROM THE 1700 CASCADIA EARTHQUAKE IN ALSEA BAY, OREGON USING DIATOM ASSEMBLAGES AND GRAIN SIZE ANALYSIS

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Although the CSZ has not experienced an earthquake in modern history it has experienced several large ($>M_w$ 8.5) earthquakes throughout the Holocene with the last event occurring in 1700 C.E. These events are well documented in salt marshes along the Pacific Northwest coast, where the stratigraphic record reveals layers of sand and mud from past rupture and tsunami events. However, the magnitude of these past earthquake events and inundation extent of the subsequent tsunamis are still poorly constrained at multiple estuaries, such as Alsea Bay, OR. Through laboratory analysis of the diatom assemblages and grain sizes within these sediments we can further constrain the 1700 CE tsunami extent beyond the presence of tsunamigenic sand sheets. Sand alone is not a reliable indicator of tsunami inundation due to post-depositional processes, erosion, and incomplete preservation, which may underestimate the true inland extent. Incorporating microfossil proxies such as diatoms allows for more precise delineation of inundation boundaries and improved reconstruction of tsunami impact zones. Previous work at Alsea Bay has identified tsunami deposits and subsidence (Nelson et al., 2008) but the full extent of the tsunami impact zone has not been systematically mapped. Mapping these smaller estuaries to find tsunamigenic sand sheets and shifts in diatom assemblages is crucial for refining the tsunami inundation estimates and improving rupture models. Fieldwork conducted in October 2025 involved collecting sediment cores and mapping the distribution of tsunamigenic sand in Alsea Bay and Lint Slough. Sand deposits were identified and tracked across the bay with an average thickness of 5.75 cm and down Lint Slough with an average thickness of 3 cm, representing the first systematic mapping of tsunami deposits within Lint Slough. Because tsunami inundation models for this region produce varying scenarios, new field-based data are the first step for better constraining model outputs. Future work will aim to perform more detailed sedimentological and diatom analysis on collected sediment cores. These analyses will aid in refining the tsunami inundation extent of the 1700 CE earthquake at Alsea Bay, improve regional correlation of CSZ events, and contribute to hazard assessments for the central Oregon coast.

CONSTRAINING SEISMIC HETEROGENEITIES IN THE CORE–MANTLE BOUNDARY REGION USING S AND SCS TRAVELTIMES

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The core–mantle boundary (CMB) region is a major boundary layer where chemical and thermal exchange occurs between the liquid iron core and the silicate mantle. In this study, we investigate the seismic velocity structure in the CMB region by analyzing the travel times of S waves that propagate through the mantle and ScS waves that are reflected from the core-mantle boundary. The ray paths of the S and ScS waves are very similar in the bulk mantle, and their differential travel times can be used to isolate signals from the CMB regions. We process broadband seismograms recorded at the Global Seismographic Network (GSN) for earthquakes with magnitudes greater than 5.7 from 2020 to 2025. This dataset includes deep earthquakes with focal depths greater than 400 km as well as shallow events with depths less than 20 km. We measure the travel times of S, SS, ScS and ScSScS waves at a period of 25-second seconds. The measurements are made in the frequency domain based on spectral division. We compare the observed travel times with predictions calculated from a 3D tomographic model S40RTS. Our preliminary results show that the global tomographic model explains S, SS, ScS and ScSScS measurements well, indicating that model S40RTS is adequate for the bulk mantle. However, the ScS-S and ScSScS-SS differential travel times, which are most sensitive to the lowermost mantle, are about twice as large as model predictions. These discrepancies suggest that heterogeneities in the lowermost mantle are much stronger than previously suggested. We plan to expand the dataset to improve ray-path coverage and use the differential travel time dataset to better constrain the amplitude and spatial distribution of CMB heterogeneities.

TOWARD A UNIFIED GEODETIC FRAMEWORK FOR PLATE AND MICROPLATE KINEMATICS OF THE AFRICAN CONTINENT

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Quantifying plate tectonic motion is crucial for characterizing regions of continental deformation and building a reliable geodetic framework for future regional kinematic studies. The African continent, which includes the East African Rift System, provides a natural setting to examine plate and microplate kinematics across a broad region of active extension. Current kinematic models describe large scale plate motions but often differ in how they separate rigid plate behavior from distributed deformation in rift zones. This work aims to develop a consistent Global Navigation Satellite System (GNSS) velocity solution and a unified block kinematic model of Africa in a Nubia-fixed reference frame. First, three published GNSS velocity solutions in the International Terrestrial Reference Frame 2014 (ITRF2014) are compiled and transformed into a common Nubia-fixed frame. Second, two previous kinematic models with different microplate configurations are reproduced within uncertainties using the software TDEFNODE to ensure this study builds upon previous work. Finally, the combined GNSS velocity solution is inverted to assess plate and microplate partitioning across the African continent to develop a new comprehensive kinematic model of Africa using TDEFNODE. The final model will provide a continent-scale geodetic framework that can be used to refine future kinematic studies.

ON THE VISCOSITY OF THE LOWER MANTLE

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CMB topography and geoid are shaped by the interaction of mantle density structure and viscosity structure across the mantle. In this study, we use sensitivity kernels to explore how lower mantle seismic velocity structure, specifically Large Low Shear Velocity Provinces (LLSVPs), affect the long-wavelength CMB topography. Building on whole-mantle models from Hager & Clayton (1989), we construct a series of five-layer models where we vary the bottom layer viscosities and layer thickness. We find that small changes in the viscosity or thickness of the lowermost mantle can either increase or suppress the amplitude of the CMB topography, especially at the longest wavelengths (i.e., degrees 2 and 3). At these wavelengths one must consider the density of the transition zone and entire lower mantle. At shorter wavelengths (i.e., above degree 4), only the region within 500 km of the CMB affects CMB topography. The viscosity in the region just above the core, can produce strong positive or negative correlations between LLSVPs and CMB topography. Positive correlations indicate that this region is nearly the same viscosity as the lower mantle, negative correlations indicate that this region is much weaker (i.e., lower viscosity) than the lower mantle. Models that show no correlation between CMB topography and LLSVPs could be reconciled with intermediate viscosities. This has broader implications: a weak layer at the base of the mantle may decouple mantle flow from CMB topography. A basal weak zone may naturally arise from post-perovskite, a mineral expected to form at these depths in ULVZs and predicted to have low viscosity. Our findings highlight how subtle changes in lower mantle structure can dramatically alter coupling between the core and the mantle, with potential implications for the magnetic field and changes in rotation.

FROM AFRICA TO THE CANARY ISLANDS: CHEMICAL AND MINERALOGICAL CHARACTERIZATION OF SAHARAN DUST WITHIN AND ABOVE THE ATMOSPHERIC BOUNDARY LAYER

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Atmospheric dust plays a critical role in Earth's radiation balance, and its radiative behavior is strongly controlled by mineralogical composition. This composition is dynamic, evolving over time in response to shifts in source regions, emission intensity, atmospheric mixing, and transport pathways. Although mineral dust is represented in many climate models, substantial uncertainties remain in how its properties and impacts are characterized. These uncertainties largely arise from limited field observations and the coarse spatial and temporal resolution of existing global mineralogical datasets, which constrain our ability to accurately represent dust variability and its evolving radiative impacts. In this study, we investigate the mineral composition of aerosol dust collected at two elevations in Tenerife, Canary Islands, a region frequently influenced by Saharan dust. From April 2023 to April 2024, weekly samples were collected using high-volume filtration at La Laguna and Izaña, located at 600 and 2300 m above sea level respectively, spanning both boundary layer and free troposphere conditions. Each dust sample was analyzed for mineral composition using powder X-ray diffraction (XRD) performed on both a laboratory-based instrument and a synchrotron source to improve resolution for low-concentration phases. Elemental composition was further characterized using X-ray fluorescence (XRF) and scanning electron microscopy with energy-dispersive spectroscopy (SEM-EDS). Powder XRD analysis indicates clear shifts in mineral composition and relative abundance, with high-altitude samples from Izaña enriched in silicates and clays, whereas low-altitude samples from La Laguna were dominated by salts and carbonates. To complement these mineralogical analysis, back-trajectory analyses were conducted using NOAA's Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model, combined with parent soil mineralogy assessments using data from NASA's Earth Surface Mineral Dust Source Investigation (EMIT) mission. Back-trajectory analyses reveal that the low-altitude site (La Laguna) is affected by both urban pollution and Saharan dust, whereas the mineral composition of the high-altitude site (Izaña) is mostly influenced by long-range transported dust, resulting in a more stable mineralogical profile over time. This research aims to trace the mineralogical evolution of dust throughout its atmospheric journey, ultimately advancing our understanding of its impacts on climate and environmental systems.

FRAMEWORK FOR MONITORING GLOBAL IMPACT OF DAMS ON RIVER SURFACE TEMPERATURE

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Dams can warm or cool downstream river temperature with important implications for river thermal regime and aquatic ecosystem dynamics. While the literature has examined the thermal impacts of river obstructions at local to continental scales, a global assessment has yet to be done. This is in part because in situ data are spatially sparse, while modeling approaches depend on hard-to-measure temperature driving variables and require extensive calibration. Here, we use Landsat 8 and 9 Thermal Infrared Sensor satellite data to monitor water temperatures along regulated rivers at regional scale, serving as a proof of concept to upscale for global application. The dataset will improve our understanding of changing river temperature regime in an era of global dam development, and will characterize reservoir-river dynamics governing temperature, methane emissions, and ice processes.

A FRAMEWORK FOR MAPPING RESERVOIR HETEROGENEITY FROM SURFACE DEFORMATION

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Large scale Carbon Capture and Storage (CCS) requires injecting significant volumes of fluid into deep aquifers. For this, understanding how reservoir properties vary spatially is critical for safety and efficiency, but constraining them at the project scale is challenging. Conventional approaches for understanding reservoir properties are either too invasive and spatially limited or computationally expensive to be useful at a local scale over a large area.

Surface deformation measured via InSAR provides a non invasive look into the subsurface, but translating deformation patterns into reservoir properties has been difficult. This project aims to address this by developing an efficient workflow to invert observed surface deformation for probability maps of reservoir properties. For efficiency, we use a Vertical Flow Equilibrium model for pressure diffusion paired with a semi analytical Green's function approach for surface deformation, allowing for thousands of scenarios to be simulated and assembled into a catalogue of synthetic data.

The synthetic catalogue of deformation data will be representative of elongated reservoir geometries typical of CCS targets. We will generate random fields for permeability, porosity, and compressibility using geostatistical and stochastic methods to create realistic heterogeneity and correlation lengths. The catalogue will be used to train a machine learning model to invert observed deformation histories for spatial distributions of permeability, porosity, and compressibility in a large subsurface reservoir. Providing a non invasive characterization tool for CCS project selection and monitoring.

INVESTIGATING ARSENIC MOBILIZATION FROM POTOMAC AQUIFER SEDIMENT USING LABORATORY EXPERIMENTS

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In 2018, the Hampton Roads Sanitation District launched the Sustainable Water Initiative for Tomorrow (SWIFT) program, a managed aquifer recharge (MAR) operation involving the injection of highly treated wastewater effluent into the Potomac Aquifer in southeastern Virginia. The SWIFT program aims to maximize groundwater yields of the Potomac Aquifer and prevent land subsidence and saline intrusion along the Virginia coast. However, a risk associated with MAR includes the mobilization of naturally occurring trace elements, such as arsenic (As), into groundwater, due to differences in geochemistry between injected water and ambient groundwater. Previous monitoring near the pilot SWIFT recharge well detected elevated dissolved As in groundwater, coinciding with changes in operational conditions, including well disinfection and recharge start-up after extended shutdowns.

A pilot batch experiment was conducted to investigate the influence of water geochemistry on the release of arsenic from sediment into solution. In the experiment, two treatments were used: (1) DI water to mimic the oxic SWIFT water during recharging conditions, and (2) DI water with a free chlorine concentration of 4 mg/L to mimic the SWIFT water with a chlorine residual during MAR well disinfection. Arsenic mobilization was observed for both treatments, with higher mobilization in the chlorine treatment. Results suggest that SWIFT water may trigger oxidation mechanisms that could release arsenic from sulfide minerals.

To further test this mechanism, sulfide minerals were extracted from Potomac Aquifer sediment using heavy-liquid density separation. An oxidation experiment using DI water and DI water (4 mg/L chlorine) was conducted on the separated pyrite. A scanning electron microscope (SEM) coupled with energy dispersive spectroscopy (EDS) was used to visualize and quantify changes in pyrite structure and composition, confirming that pyrite oxidation occurs. Solution chemistry was analyzed for As release from sulfide minerals.

COMPARATIVE IDENTIFICATION OF NOVEL BONE LESIONS WITHIN CERVICAL VERTEBRAE (VMNH 129952) IN *DEINOSUCHUS* AND IMPLICATIONS OF PATHOPHYSIOLOGY

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The giant crocodyliform *Deinosuchus* is widely known from Campanian Upper Cretaceous deposits across North America. Despite abundant material, specimens with evidence of pathology remain rare. Here, we report a previously undescribed cervical vertebra (VMNH 129952) from the Tar Heel Formation that exhibits two regions of bilateral, irregular bony lesions consistent with a potentially chronic infection. The vertebra is referred to *Deinosuchus* based on its relatively large size and the abundance of remains within the Tar Heel Formation as well as in stratigraphically equivalent Appalachian localities. This specimen thereby constitutes the first documented case of disease-associated bone proliferation in this genus.

Gross morphological examination revealed asymmetrical, porous bony proliferations positioned bilaterally along the ventrolateral surfaces of the cervical centrum, lateral to the ventral keel and near the neurocentral junction. The affected surface texture has a pock-marked appearance, which indicates periosteal proliferation and cortical remodeling. There is also localized degradation of the ventrolateral margin of the anterior surface of the centrum, suggesting progressive remodeling associated with the pathological process. These features are most consistent with chronic osteomyelitis, though differential diagnoses may include neoplasia or metabolic bone disease. The external morphology of the lesion lacks the typical presentation of metabolic conditions. Furthermore, neoplasia in extant crocodylians is infrequently observed and usually benign. Likely etiology involved either localized trauma with secondary infection or systemic infection with vertebral involvement. This hypothesis is supported by partially healed punctures in other vertebrae from the same collection. Computed tomographic (CT) imaging and anatomical investigation provided a framework for refining the differential diagnosis and yielded insight into the origin and development of these lesions.

Vertebral osteomyelitis is infrequently reported in extant crocodylian taxa and almost unknown in fossil crocodyliforms. The bilateral distribution and presence of the lesions in this specimen offer rare insight into the pathophysiological response of large crocodylomorphs and pathology within *Deinosuchus*. This case expands the sparse record of pathologies in the vertebral skeleton of a fossil crocodyliform and highlights the utility of paleopathology in reconstructing ancient disease processes.

A NEW METHOD FOR THE EXTRACTION OF THREE-DIMENSIONAL CALCAREOUS MICROFOSSILS FROM A CARBONATE MATRIX: USING THE EDIACARAN FOSSIL *CLOUDINA* AS AN EXAMPLE

Ana Carolina Valadares Maciel de OLIVEIRA, University of Brasília & Virginia Tech

This study presents a new method to extract calcareous microfossils of *Cloudina* Germs, 1972 from a carbonate matrix. These microfossils occur in a limestone matrix of the Ediacaran Nama Group in southern Namibia. The extraction method consisted of a series of physical and chemical procedures aiming at separating skeletons from the rock matrix. The samples were submitted to two chemical treatments using the novel Solution Drip System (DS) and the traditional Immersion System (IS). Different concentrations of acetic acid (1.8% and 4%) were used in both systems in order to evaluate the effectiveness of different acid concentrations in disaggregating the studied samples. Digestion in both DS and IS modalities took place simultaneously in order to observe the reactions and evaluate the effectiveness of the disaggregation process. Although both systems yielded microfossils, the drip system with a 4% acetic acid solution was proven to be more effective, recovering three-dimensional specimens, including internal molds and external surface of the skeletons. These specimens allow for the observation of important morphological features, such as the funnel-in-funnel construction, lamellar structure of funnel walls, and annular striations on outer funnel walls, which were not previously accessible through thin section observations. In conclusion, the integration of thin section observations and morphological characterization of chemically extracted three-dimensional skeletons can provide key morphological information about *Cloudina*, which has been variously interpreted as an annelid or an cnidarian animal, and has shed key insights into the origin and early evolution of animal biomineralization in the Ediacaran Period. The new method developed in this study can be applied to the extraction of many other Ediacaran-Cambrian calcareous microfossils embedded in carbonate rocks, unlocking their morphological information and evolutionary significance.

Advisors: Dermeval Aparecido Do Carmo (University of Brasília) & Shuhai Xiao (Virginia Tech)

NEW BONES IN AN OLD DRAWER: REEXAMINING THE HOLOTYPE OF A LATE TRIASSIC REPTILE

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The fossil record is dominated by partial skeletons and broken bones, posing numerous challenges to reconstructing extinct animals. In many cases even a single articulated skeleton can alter how we interpret both individual species and larger groups. As new discoveries are made, previously discovered specimens can become easier to interpret. One case where this is particularly true is drepanosauromorphs, a group of enigmatic reptiles from the Triassic. Groundbreaking discoveries over the past decade encourage reexamination of previous drepanosauromorph specimens. This is what I have done with *Dolabrosaurus aquatilis*, a drepanosauromorph from the Upper Triassic of northern New Mexico, USA. *Dolabrosaurus* has been in several publications in the over 30 years since its description, becoming a key anatomical reference and important data point in phylogenetic analyses. Not all material was originally described due to unique and confusing bones. Referencing newer discoveries made it possible for me to identify the undescribed portions of the *Dolabrosaurus* holotype. Previously unidentified bones include an enlarged second metacarpal, forelimb bones, and a partial articulated femur and tibia. The enlarged metacarpal and forelimb bones are similar to specimens from the similarly aged Hayden Quarry in New Mexico. These identifications suggest that *Dolabrosaurus* possessed a robust modified forelimb present in other drepanosauromorphs like *Drepanosaurus*. Using this information, I suggest that the previously described hand is from the left forelimb and renumber the digits to accommodate an enlarged clawed second digit. The right hindlimb with much of the foot was originally preserved as a two-sided natural mold that was filled with colored epoxy and set in clear resin. The natural mold has since been lost, and the two-part cast has been confused for both hindlimbs by some authors. Clarifying the method of preparation has allowed me to identify a separate limb impression as the left hindlimb. Much of the tail has also been reconstructed with epoxy, but appears to be made from natural molds. Preliminary CT data shows additional bones hidden in some of the blocks, including an additional femur, ribs, and wrist bones. From the reorganized and newly recognized bones, the *Dolabrosaurus* holotype represents portions of every non-skull skeletal region either as bone or impressions. This reinterprets *Dolabrosaurus* as a drepanosauromorph with robust forelimbs as opposed to previous more slender-limbed reconstructions. Based on recent analyses, this indicates previously unsuspected hook-and-pull digging adaptations, possibly for burrowing into trees like some living mammals such as silky anteaters.

COMBINING PERSPECTIVES ON ARCHOSAUR GROWTH REVEALS HIDDEN DIVERSITY OF CROCODYLIAN RELATIVES IN THE LATEST TRIASSIC PERIOD (~205 MYA)

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Crocodyles are extremely unique from other vertebrates in their slow metabolism and growth, armored carapace, immense bite strength, and semiaquatic habit with a squat posture. The fossil record indicates that the first three traits arose in agile pursuit predators forming an evolutionary grade named 'Sphenosuchia.' However, the 'sphenosuchian' record is sporadic, with most species diagnosed from one specimen, singletons within their respective localities or even entire rock units. This lack of spatiotemporal overlap prevents a close comparison of variation in both morphology and size; when the two sources of variation are studied in isolation, it can preclude needed insight into how the characteristics of crocodyles varied within and between species. Here we use an integrated approach on three 'sphenosuchian' specimens of different sizes from a single locality, assessing both morphological variation and gross size in relation to each other to evaluate whether the size array indicates a growth series. We describe skull and neck elements of two newly identified 'sphenosuchians' (CM 87670 and CMNH 51104) from the latest Norian/Rhaetian-aged (~209-5 mya) *Coelophysis* Quarry from Ghost Ranch, New Mexico, USA, which is a rare example of an assemblage capturing a 'snapshot' of a single coeval vertebrate community. We compare them to the only crocodylomorph skull formally described from the *Coelophysis* Quarry (CM 29894, referred to *Hesperosuchus agilis*). CM 87670 is slightly smaller than the referred '*Hesperosuchus*,' but we see no substantial anatomical difference between the two and assign them to one species. The skull of CMNH 51104 is only half the length of the '*Hesperosuchus*' specimen, but bone fusion in the skull roof and robust microstructure of the armor plates suggest against it being an immature individual of the same species as the '*Hesperosuchus*' specimen. Additionally, the morphology of the skull roof and teeth are consistent with more anatomically derived 'sphenosuchians.' Combining different ageing methods indicates persistence and coexistence, rather than replacement and turnover, among non-crocodyliform crocodylomorph lineages in the low latitudes up to the latest days of the Triassic Period.

ASSESSING THE FEASIBILITY OF SEDIMENTARY eDNA AS A PROXY FOR REFINING HISTORIC TSUNAMI INUNDATION AT SALMON RIVER ESTUARY, OREGON, USA.

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Great (>Mw 8.5) subduction zone earthquakes are capable of producing some of the most devastating natural hazards in the world. The Cascadia subduction zone (CSZ) has experienced several great earthquakes throughout the Holocene, with the most recent event occurring in 1700 C.E. These previous rupture events are well documented within the stratigraphic record found in multiple estuaries along the west coast. However, despite this extensive record, the magnitude of these rupture events and the inland extent of the subsequent tsunamis are not well constrained. Currently, studies that focus on reconstructing historic inundation extents rely on tracking marine sand deposits inland. However, this is understood to be an underestimate, with studies showing that sand falls out of suspension before the tsunami wave stops its progression inland. Understanding the true inland extent of these historic events is essential for accurate earthquake modeling, especially in regions like the CSZ which have not experienced a rupture since the development of modern instrumentation. To better characterize the inland extent of the previous 1700 C.E tsunami we developed a new proxy, environmental DNA (eDNA), which has been shown to distinguish tsunami derived sediment from non-tsunami sediment in coastal overwashes. However, this proxy has not been previously attempted to map prehistoric tsunamis inland extent. Here, we analyzed sediment cores from the Salmon river estuary transecting inland from the coast to test if eDNA can be used to map historic tsunamis further inland than the current sand derived limit. Sediment cores were sub-sampled in 1-cm intervals, spanning from the pre-earthquake lithology through the coseismic and tsunami events into the post-event lithology. eDNA was then extracted from these samples using Quigen soil kit, before being sequenced on a MinIon Mk1B Nanopore sequencer to a read depth of >7,500 per sample. Preliminary results demonstrate that tsunami intervals appear to have distinct microbial assemblages when compared to the pre and post earthquake environments. They also demonstrate the eDNA can be used effectively to track prehistoric tsunamis inland as this trend was observed in each core along the analyzed transect, extending the previous inundation extent of the 1700 C.E tsunami at Salmon river. Future work aims to see if this signal can be traced further inland, and if these findings are supported by geochemical proxies.

EVALUATING FERROUS IRON DYNAMICS AND MICROBIAL INTERACTIONS DURING MANAGED AQUIFER RECHARGE

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Managed aquifer recharge (MAR) is increasingly used as a strategy to enhance groundwater supplies, prevent land subsidence, and reduce environmental impacts such as nutrient loading to surface waters. In southeastern Virginia, the Hampton Roads Sanitation District (HSRD) developed the Sustainable Water Initiative for Tomorrow (SWIFT) to help address over-withdrawal from the Potomac Aquifer and decrease nutrient discharge to the Chesapeake Bay. Since 2018, SWIFT has utilized MAR to recharge the aquifer by injecting highly treated, oxygenated wastewater into the Potomac Aquifer system. Since the chemistry and redox state of the recharge water differ from those of native groundwater, this process may disturb the existing geochemical conditions. Iron, a naturally occurring and redox-sensitive element in the Potomac Aquifer, is particularly susceptible to these changes, as shifts in oxidation–reduction conditions can alter the balance between dissolved ferrous iron (Fe (II)) and solid-phase ferric minerals, ultimately influencing groundwater chemistry and metal mobility. The SWIFT project in the Potomac Aquifer System provides a unique opportunity in a controlled setting to evaluate how these redox disturbances influence iron cycling.

My overall hypothesis is that the introduction of oxygenated recharge into an anoxic aquifer stimulates a measurable increase in dissolved Fe (II) concentrations through coupled microbial processes and sediment–water interactions. To test this hypothesis, I conducted two sequential microcosm experiments using Potomac Aquifer groundwater, SWIFT recharge water, and aquifer sediments collected from the SWIFT research site. In the first experiment, groundwater-only microcosms were established to characterize baseline Fe (II) behavior under controlled aerobic and anaerobic conditions. The second experiment followed the same experimental setup but instead utilized SWIFT recharge water. Both setups consisted of 3 separate microcosm conditions containing media with bioavailable carbon sources, water, and azide to serve as an abiotic control. Microcosms were incubated over a 21-day period and sampled throughout the incubation period to quantify dissolved Fe (II) concentrations using the ferrozine colorimetric method. Preliminary results from the groundwater experiment demonstrate clear redox-dependent differences in Fe (II) concentrations, with greater accumulation under aerobic conditions. Ongoing microcosm experiments will further reinforce the relative importance of microbial and abiotic oxidation and reduction, as well as adsorption processes. Collectively, this work provides insight into iron cycling during MAR and supports the prediction of geochemical responses during SWIFT and similar recharge operations that may face challenges with trace metal mobilization.

DELINEATING KARST SPRINGSHEDS FROM BASIN GIS ANALYSIS: CASE STUDY OF THE HANGING ROCK VALLEY, VIRGINIA TECH

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Karst watersheds are challenging to delineate because groundwater flow within subsurface conduits and other karst features does not necessarily follow surface topography. Because of this complexity, karst watersheds are often not well-delineated by use of traditional topographic methods, requiring alternative methods, such as dye tracing and GIS-based watershed delineation methods.

Our study site, located in the Hanging Rock Valley, is home to the Paint Bank Fish Hatchery which gets its water supply from three karst springs. The bedrock underlying the valley is made up of Ordovician limestones and dolostones which are overlain by shales and capped by ridge-forming Silurian siliciclastic units. Water draining from the overlying shale and siliciclastic units supplies the karst system with recharge via losing streams, sinkholes, and swallets.

Our objective is to delineate the recharge areas of each springshed to better delineate the sources of water supplying the springs. To achieve this, a team from the Virginia Department of Conservation and Recreation and Virginia Tech conducted dye tracer experiments from fall 2024 to winter 2025. The results of those experiments suggest connections between: Spring 1 to Humphries Cave, Spring 2 to Shires Cave and a swallet, and Spring 3 to a sinkhole at the southern end of the valley. These data provide context needed to analyze topographic drainages of the sinking streams within the valley. The delineation will be performed using a GIS basin analysis geoprocessing tool. The boundaries delineated using this tool will be compared to the delineations suggested by dye tracing. Results of this study will inform the fish hatchery managers about the recharge areas for springs that source their water supply.

USING COPROLITES TO CREATE A BODY-SIZE ESTIMATION MODEL FOR TRIASSIC REPTILES

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The body size of an animal is critical to understanding its ecological niche as it is linked to diet, metabolism, reproduction, both within the animal's species as well as in a broader ecosystem. Estimating body-size is especially significant for extinct species, as their ecology cannot be directly observed, only inferred. To estimate body size, I am creating a new method utilizing coprolites (fossil feces) as a basis to extrapolate body size. We chose coprolites as the basis of this model as they are plentiful within the fossil record and yield data on the diets of animals through CT scans and thin section analysis, which can aid in ecological reconstruction. To estimate body size for extinct vertebrates, I am creating a database using living reptiles, measuring both their mass and various measurements of their excreted feces. During the course of this research project, I will collect data from ~500 living reptiles, including crocodylians, squamates, and testudines from zoos in collaboration with zookeepers. My data will include the animal's mass, total length, snout-vent length, as well as their feces mass and maximum diameter. From there, I will create a regression model relating feces size to body size to further understand the relation between coprolite diameter and body mass. Then, I will measure coprolites from a Triassic-aged vertebrate community and estimate their distribution of body sizes using the linear model. This new methodology will lead to a greater understanding of the ecology of an animal in its ecosystem as its body size can inform what its niche and metabolic rate, as well as creating an association between prey remains found in coprolites and the body size of the potential predator.

AN ANALYSIS OF THE 2024 VERTICAL LAND MOTION (VLM) POSITIONING SURVEYS OF THE CHESAPEAKE BAY

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The Chesapeake Bay (CB) is experiencing relative sea-level rise at impactful levels, in part because of land subsidence. The causes of land subsidence in this region are from several processes such as post-glacial rebound and groundwater extraction. Studies have observed vertical land motions (VLM) in the area using many approaches with contradicting results. This work is part of a larger study that has the goals of (1) collect campaign-style Global Positioning System (GPS) data annually over a five-year period to contribute to a new baseline of VLM for the CB area and (2) clarify the geologic and anthropogenic drivers of VLM. My contribution to this larger project is to evaluate daily positioning data collected in 2024 as part of the broader annual campaigns. All daily positioning data files were quality checked using the open-source program teqc for multipath, number of hours of data collected, number of data collected. This analysis demonstrates the quality of the data collected and allows for other scientists to use the archived open-access data.

FIRST UPPER TRIASSIC CAECILIAN (LISSAMPHIBIA: GYMNOPHIONA) FROM THE TECOVAS FORMATION OF TEXAS REVEALS THAT CAECILIANS WERE WIDESPREAD IN WESTERN USA

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Today, there are two groups within Lissamphibia (living amphibians): Batrachia (salamanders and frogs) and Gymnophiona (caecilians). Of these three groups, Caecilians have the poorest fossil record, with only approximately eleven occurrences over ~230 million years. A large chronologic and geographic gap exists between their hypothesized origins in the Late Paleozoic and their next known occurrence in the Late Triassic. This gap is most likely because of their small body size, burrowing lifestyle, and the lack of identification of fragmentary bones. We are describing a new specimen found in the Upper Triassic Dockum Group of Texas, a region where caecilian fossils had yet to be reported. The two mm long right lower jaw fragment was recovered during microvertebrate screenwashing. This jaw has two rows of pedicellate tooth attachment bases, a key diagnostic feature of caecilians. To enhance our understanding of the morphology of this specimen, we used μ CT scanning, which revealed some of the same anatomical features present in *Funcusvermis gilmorei*, the only other Triassic caecilian fossil, from the Chinle Formation of Arizona. These two specimens differ in size, but the size difference is well within the range of variability for *F. gilmorei*. No other morphological data currently supports differentiation between the two specimens. However, extant species show that geographic isolation is a common driver of speciation. More specimens and data are needed to confidently place this specimen within *F. gilmorei*. The presence of a caecilian in the Late Triassic of Texas enlarges the paleobiogeography of extinct caecilians and is a convincing indicator to search for caecilian fossils. We predict additional caecilian fossils will be recovered from Upper Triassic Adamanian deposits in New Mexico, Utah and Colorado. We also hypothesize that when using microvertebrate collection techniques, caecilian fossils can be found in other equatorial regions from the Triassic, consistent with their extant tropical distribution.

CAN INSECT CARBON STABLE ISOTOPES IN TEMPERATE, C₃ DOMINATED ENVIRONMENTS IDENTIFY LONG-TERM VEGETATION CHANGES?

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Insects from arid and tropical Australia have been shown to be reliable recorders of local vegetation change when analyzed via stable carbon isotope ($\delta^{13}\text{C}$) values because they consume plants or other insects that consume the plants. Because plants using different photosynthetic pathways – C₃ or C₄ – have strikingly different $\delta^{13}\text{C}$ values (averaging -27 ‰ vs. -12 ‰, respectively), the plant type can be identified and tracked up the food chain. However, it is not yet known whether insects from a temperate, largely C₃ environment will be sufficiently sensitive recorders of relatively small amounts of C₄ vegetation on the landscape. To assess whether stable isotope values in insects from temperate southwest Virginia reflect the proportion of C₄ plants (warm-season grasses) on the landscape, we measured the isotopic values of insects collected using aquatic and terrestrial traps from a variety of vegetation types at three separate field sites between May and October 2024. Vegetation types targeted included C₃ dominated landscapes, such as forests or croplands with wheat and soy, or C₄ dominated, including corn fields and native and non-native grasses. We hypothesized that insect $\delta^{13}\text{C}$ values would reflect the relative abundance of C₄ plants in the landscape. Preliminary results show compositional differences between riparian and terrestrial traps, with riparian traps dominated by Diptera families while terrestrial traps had a greater abundance of Trichoptera and Coleoptera. Forthcoming carbon isotope results will allow us to determine whether there are detectable differences in resource use by arthropods collected from riparian and terrestrial traps in predominantly C₃ or C₄ environments. Ultimately, we will use the results of this study to interpret carbon isotope values measured in insectivorous bat guano accumulations and estimate the proportion of native grassland habitats (C₄) on Virginia's pre-European Valley and Ridge landscapes.

TIME-LAPSE SEISMIC REFRACTION SURVEY OF A STREAM VALLEY IN BLACKSBURG, VIRGINIA

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The critical zone (CZ), “Earth’s outer skin,” extends from above the unweathered bedrock to the treetops, where air, water, soil, and life interact (Brantley S. et al., 2007). After precipitation events, water infiltrates the CZ, following preferential pathways determined by subsurface structure. Previous hydrologic research has used electrical resistivity tomography (ERT) in conjunction with tracer tests and various methods to map these pathways along with water saturation changes in the subsurface (Parsekian, A. D et. al., 2015). This project aims to examine if seismic velocities are effective in measuring the movement of CZ water in any detail. Time-lapse seismic surveys have been primarily conducted to monitor large-scale changes in hydrocarbon reservoir fluid properties, but few time-lapse seismic surveys have been conducted at smaller scales to analyze fine details of CZ water movement.

We plan to fill this knowledge gap using time-lapse seismic refraction data that was collected daily over a period of 26 days in a stream valley in McDonald Hollow, Blacksburg, VA. The stream was hydrologically monitored with a soil moisture sensor, three stream flow sensors, one stream gauge sensor, and precipitation and temperature data. Two 50-meter seismic lines were collected: One line ran perpendicular to the stream (Line 101), while the other line ran along the valley, parallel with the stream (Line 201). Each line contained 0.25 m node spacing and 1 - 2 m shot spacing. P-wave velocity tomograms have been generated for data recorded on day 2 for both Line 101 and Line 201. In locations that are not near the stream, these models display a gradient of P-wave velocities ranging from 100 to 2000 m/s within the upper five meters, overlying a 2000 m/s zone below five meters. This was interpreted as unweathered bedrock overlain by roughly four meters of a weathering zone, overlain by roughly one meter of colluvium on the surface. Next to the stream, these models display a moderately high velocity (1000 m/s) at the surface that continues over 5 meters depth. This was interpreted as all hydrologically weathered bedrock. Next, we will generate P-wave velocity tomograms for data that was collected on days following a precipitation event. We expect to see higher P-wave velocities in areas with higher potential for saturation.

IDENTIFICATION AND EXTRACTION OF SULFIDE MINERALS IN A COASTAL PLAIN AQUIFER DURING MANAGED AQUIFER RECHARGE

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Managed aquifer recharge (MAR) involves the introduction of secondary water into groundwater systems to restore aquifer storage, mitigate land subsidence caused by groundwater extraction, and increase water supply sustainability. However, MAR operations can alter subsurface geochemical conditions and potentially mobilize naturally occurring arsenic (As). The Sustainable Water Initiative for Tomorrow (SWIFT) project in the Hampton Roads region of southeastern Virginia is recharging the Potomac Aquifer to enhance the sustainability of the aquifer as a drinking water source and help mitigate saltwater intrusion. Previous studies have shown that MAR operations in this region influence groundwater As concentrations. Because the stability of As-hosting minerals is strongly redox-dependent, shifts in aquifer redox conditions during recharge may control As mobilization.

This study investigates pyrite in the Potomac Aquifer through grain size analyses and pyrite mineral extractions. Identifying areas of high sulfide minerals in the aquifer can help identify areas where As is distributed in quantiles below scanning electron microscopy (SEM) detection limits. Because As concentrations in the solid phase were below SEM detection limits, chemical oxidation experiments were conducted on the separated pyrite fractions and dissolved As concentrations were measured to assess As release. A combination of analytical techniques, including laser diffraction, X-ray diffraction (XRD), and scanning electron microscopy (SEM), along with physical separation methods such as heavy liquid density separation and sieve analysis, were used to identify and isolate pyrite from bulk sediment samples. The results provide insight into the mineralogical controls on As mobilization during MAR in the Potomac Aquifer.

HYDROGEOCHEMICAL SURVEY OF THE LOWER ARROYO SECO

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The Arroyo Seco is a major tributary of the highly engineered Los Angeles River. The stream derives its water from the San Gabriel Aquifer with its lower portion flowing through intensely urbanized areas of Los Angeles, California. Primary input flows consist of nonpoint source dry weather urban runoff and baseflow groundwater seepage through cracks, drains, and weep holes in the channel's concrete lining. Despite its proximity to dense metropolitan areas, no systematic study of trace elements, nutrients, and major inorganic parameters or constituents has been conducted in the Arroyo Seco. This lack of baseline data hinders future ecological and public health risk assessments.

This study investigates changes in water chemistry along a 5.4-mile stretch of the lower Arroyo Seco between 134 Bridge and Avenue 43. This channel segment overlies crystalline bedrock and marine sedimentary units, including the marine sandstones, siltstones, and fluvial deposits of the Topanga Formation and the underlying selenium-enriched white shales of the Monterey Formation. 59 stations were sampled during dry-season conditions to collect groundwater and surface water flow samples from channel cracks, springs, drains, and weep holes in accordance with EPA protocols. Field conductivity measurements were converted to Total Dissolved Solids (TDS), and laboratory analyses included ammonia, nitrate, orthophosphate, sulfate, and off-site selenium testing.

Surface water TDS increased downstream in areas where higher TDS groundwater inputs clustered, suggesting groundwater control of channel salinity. Nitrate concentrations generally exceeded the 0.38 mg/L ambient level, with surface water values rising and falling with groundwater, suggesting subsurface inflows as the primary driver rather than surface runoff. Selenium concentrations increased downstream, with several groundwater samples exceeding the 5 µg/L EPA aquatic life standard. This hydrochemical signature seen in the data is reflective of the geologic units underlying the lower Arroyo Seco as measured selenium values increased beyond the Topanga-Monterey Formation boundary line.

This reconnaissance effort identified and mapped groundwater inflow sources and established the first hydrochemical baseline for the lower Arroyo Seco, providing the groundwork for future isotopic and hydrochemical tracer studies in this urban stream valley.

CONDUCTING REPRODUCIBLE SCIENCE FOR THE ANALYSIS OF GNSS DATA THAT MONITORS AN ACTIVE VOLCANO

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The Targeted Projection Operator (TPO) is a method that analyzes Global Navigation Satellite System (GNSS) time-series data, which can be used to detect transient deformation signals occurring at a volcano; such signals may be a precursor for volcanic activity. Ol Doinyo Lengai, an active volcano in the East African Rift, has been continuously monitored by several GNSS stations since 2016. Prior efforts to analyze the GNSS data with TPO indicated a period of prolonged quiescence, until an episode of rapid uplift was detected from March 2022 - December 2022 (Daud et al., 2024). This work extends the time-series analysis through December 2024 by evaluating how the surface motion has evolved since the uplift event. The GNSS time-series data were analyzed with `tsview`, a MATLAB application, to detrend and compute horizontal and vertical components of millimeter-precision velocities at each station. TPO uses the Chi-Square distribution to highlight time periods with deviations from expected amplitude trends. From January 2023 - June 2024, the stations followed a long-term subsidence pattern with vertical velocity rates in an IGB14 reference frame ranging from -5.5 to -9 mm/yr and 1-sigma uncertainties ranging from ~0.5-1 mm/yr. Test values, which are an indicator of significance, generally remained below thresholds of 1 sigma, indicating a lack of anomalous deformation signals or quickly changing conditions. Both findings suggest that gradual surface depressurization began after the rapid uplift period. Further research is needed to understand anomalies occurring in the GNSS data from July 2024 - December 2024.

Abstract Mineral Dust and Gas Turbine Engine Interactions

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Aircraft turbine gas engines experience CMAS melt formation during operation, which reduces engine efficiency, and shortens component lifespans. Weathering of rotor and stator blades calls into question the composition of erosive dust particles found within the engine after takeoff, flight, and landing. Real-world conditions are simulated in engine models using lab synthesized quartz dust to analyze erosive results. These results show a mixture of synthesized quartz dust, and unidentified material suspected to be some type of metal. Spectroscopic analysis of these metal particles is needed to understand their composition and origin, and whether or not they originate from metal blade erosion during high-temperature engine operations, or some other mineralogical occurrence. Preliminary quantitative observations of particles through microscopic image analysis show leading edge and pressure side stator blades have the highest quantities of unidentified particles throughout each successive stage of the turbine engine. The next step is spectroscopic analysis for particle composition determination. Pinpointing the origin of the unidentified particles will determine improvements necessary to increase gas turbine engine productivity for commercial and military use.

EVALUATION OF COMMON SHAPE FACTOR FUNCTION VIA NATURAL AND SYNTHETIC PARTICLE GEOMETRIES

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Parameterizing the shape of particulates is a commonly applied technique in various scientific disciplines due to the effect minute differences in shape can have on larger systems, such as drag, earthquake liquefaction, and drug absorption. This is most often achieved with a select “shape factor” (SF) equation, where axis lengths or relative particle volumes are used to compute a representative geometric value. However, there are many formulations of SF equations, some of which are commonly implemented despite the existence of potentially better suited factors. Moreover, of the myriad of formulae available, those utilizing three principal axis measurements (with or without particle surface area and volume) represent a factor class uniquely suited for decreasing computational burden. Subsequently, I will present an analysis of commonly cited shape factors collected based on their implementation of principal axis measurements, focusing on whether a given shape factor displays the ability to separate dissimilar particles (and, likewise, group particles together of the same or similar geometry). These shape factor evaluations were conducted via qualitative analyses of separate regions of particle shape distributions (as calculated via each individual SF equation), ensuring that no particles of the same (or similar) shape exist in differing regions of their respective distributions. These analyses resulted in two primary observations: one, Aschenbrenner’s shape factor (ASF), Oblate-prolate index (OPI), and particle shape parameter (PSP), and a newly proposed modified shape factor (MSF), function as ideal shape factors; and two, that a tailored combination of these factors is likely to yield a complete description of particle shapes.

TRACKING IRON NANOMINERAL CHANGES TO IMPROVE WATER QUALITY MANAGEMENT IN FRESHWATER RESERVOIRS

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Freshwater drinking reservoirs are vital to public water supply, with approximately 74% of U.S. freshwater derived from surface sources. These systems often experience seasonal anoxia driven by thermal stratification, promoting the reductive dissolution of iron (Fe) minerals and the subsequent release of associated contaminants. Iron, a redox-active metal, not only imparts aesthetic and taste issues in drinking water but also facilitates the mobilization of toxic elements such as arsenic and lead. Two freshwater reservoirs near Roanoke, Virginia, Falling Creek Reservoir (FCR) and Beaverdam Reservoir (BVR) serve as test sites due to their comparable hydrologic and geologic settings. To prevent anoxia, FCR uses a hypolimnetic oxygenation (HOx) system that delivers oxygen to deep waters, oxidizing dissolved Fe and causing it to precipitate as ferrihydrite (Fhy) and settle back into the sediments. Ferrihydrite (Fhy), a poorly crystalline Fe(III) oxyhydroxide, is metastable and can transform into lepidocrocite and eventually into more stable goethite in the presence of Fe(II). Characterizing the iron mineralogy within these reservoirs is therefore critical for understanding redox-driven mineral transformations and their influence on water quality. Confirming the presence and extent of these transformation pathways provides key insight into biogeochemical cycling in drinking water reservoirs. High-resolution transmission electron microscopy (HRTEM) was used to image and identify Fe minerals at the atomic scale. HRTEM allows precise measurement of d-spacings, the unique structural fingerprints used to identify minerals. Preliminary results indicate the presence of abundant ferrihydrite and goethite, minor lepidocrocite, and trace magnetite. Ongoing work focuses on quantifying uncertainty in d-spacing measurements, which is particularly complex for nanocrystalline samples containing multiple, coexisting mineral phases.

FROM SATELLITE OBSERVATIONS TO SOCIETY: QUANTIFYING GLOBAL WATER STORAGE EXTREMES WITH GRACE

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The increasing frequency and intensity of hydrological extremes in a warming climate are elevating risks to ecosystems, infrastructure, and water security worldwide. These trends underscore the need to quantify water-storage variability and characterize the magnitude and frequency of terrestrial water storage (TWS) extremes at the global scale. Variations in TWS derived from the Gravity Recovery and Climate Experiment and its follow-on satellite mission (GRACE/FO) provide an unprecedented basis for monitoring large-scale water availability. However, the statistical behavior of extreme low-storage (drought-type) and high-storage (flood-type) events, and their spatial co-occurrence, remains insufficiently quantified.

Here, we analyze 23 years (2002–2025) of GRACE/FO TWS observations using a Peaks-Over-Threshold (POT) extreme-value framework with region-specific exceedance thresholds. Exceedances are modeled using extreme-value analysis to estimate return levels and exceedance probabilities for both deficit (low-tail) and surplus (high-tail) storage anomalies, enabling consistent comparison of drought- and flood-type extremes across diverse hydroclimatic regions.

Preliminary results reveal distinct spatial patterns in the return values of TWS extremes. Three dominant regimes emerge: (i) drought-dominated regions characterized by frequent deficit extremes, (ii) flood-dominated regions where surplus extremes prevail, and (iii) dual-extreme hotspots where both high and low storage anomalies occur with substantial magnitude. Co-occurring high- and low-storage extremes are most pronounced in the Amazon basin, with 10-year return levels of approximately +100 cm for excess storage and -80 cm for deficit storage (water-equivalent depth), and in the polar regions, where strong cryospheric mass variability yields 10-year return levels of about +200 cm (excess) and -90 cm (deficit). In contrast, the Tibetan Plateau and northern Africa display relatively low extreme variability, while flood-type storage extremes dominate South Asia, with \sim +100 cm 10-year return levels. The largest return values occur in Greenland and coastal Antarctica, reflecting pronounced ice-mass variability and cryospheric control on TWS.

Overall, this study provides a global statistical framework for quantifying terrestrial water storage extremes. Future work will focus on population-dense regions to demonstrate the value of GRACE-based observations for advancing multi-hazard water-risk assessment under ongoing climate change.

RIVER SURFACE AREA IN THE MISSISSIPPI BASIN ACROSS FLOW CONDITIONS

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Rivers are hotspots of biogeochemical exchange and important components of the global carbon cycle. The surface area of rivers is a key parameter used to calculate greenhouse gas exchange between rivers and the atmosphere. Accurate estimates of river and stream surface area (RSSA) are thus necessary for atmospheric carbon accounting. Previous work has applied remote sensing and hydrologic scaling theory to make static estimates of RSSA, while other studies have applied hydraulic geometry and modeled discharge to quantify the climatology of global RSSA. To date, no study has used remote sensing to quantify the variability of RSSA with streamflow.

Because most rivers are too narrow to be observed by remote sensing, estimates of RSSA from remote sensing are made by quantifying the statistical distribution of evenly spaced width measurements on wide rivers and extrapolating these distributions to the headwater scale. From river widths measured in the field and satellite imagery, we find that within an interval of drainage area and discharge percentile, widths are best described by a log-normal distribution, with a location parameter increasing with discharge percentile and drainage area. We estimate network length at the headwater scale across flow conditions using published estimates of network length elasticity. We combine these length-scaling and width-scaling frameworks together to estimate RSSA and the statistical distribution of river sizes for the Mississippi River Basin across flow conditions and find that with increasing flow, RSSA increases primarily by network extension at the headwater scale.

IMPROVING BATTERY MANUFACTURING THROUGH BETTER PRECURSOR DESIGN

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Lithium-ion batteries dominate the global battery market. Lithiated nickel-rich nickel-manganese-cobalt (NMC) oxides are among the most widely used cathode materials due to their high energy density and long cycle life. The synthesis of the NMC hydroxide precursor plays a critical role in determining final cathode performance, as precursor composition and structure directly influence functionality. NMC cathodes are typically produced in two steps: (1) precursor synthesis and (2) thermal treatment to convert the precursor into the layered oxide cathode. Most prior studies focus on synthesizing ordered beta-phase nickel hydroxide ($\text{Ni}(\text{OH})_2$) in batch reactors because of its thermodynamic stability. However, pH fluctuations and particle inconsistencies batch systems can lead to variable precursor properties, ultimately affecting cathode performance. In contrast, we will investigate poorly crystalline alpha-phase $\text{Ni}(\text{OH})_2$ synthesized using a mixed flow reactor (MFR). The MFR provides a stable, scalable, and well-controlled reaction environment, enabling improved control over precursor phase, crystallinity, and morphology. Additionally, alpha-phase $\text{Ni}(\text{OH})_2$ may facilitate more favorable dopant incorporation (Mn and Co) due to its structural disorder and interlayer species. Our first objective will be to determine the growth pathway of pure alpha-phase $\text{Ni}(\text{OH})_2$ and evaluate how solution chemistry and reactor dynamics, specifically supersaturation, residence time, pH, and mixing, govern phase selection, crystallinity, morphology, and structural disorder. In and ex-situ characterization using x-ray scattering and absorption methods will track structural evolution during synthesis and subsequent aging. Ultimately, this work aims to establish mechanistic and structure–property relationships that link precursor synthesis conditions and growth pathways to the performance and manufacturability of nickel-rich NMC cathodes.

PREDICTING GROUNDWATER-DRIVEN LAND SUBSIDENCE IN THE CHESAPEAKE BAY REGION OF THE VIRGINIA COASTAL PLAIN

OLORUNSAYE, Olasunkanmi, Dept. of Geosciences, Virginia Tech, Blacksburg, VA 24061

The Chesapeake Bay region of Virginia experiences one of the highest rates of Relative Sea Level Rise (RSLR) along the U.S Mid-Atlantic coast. This is exacerbated by the compounded effects of vertical land motion (VLM), with land subsidence posing significant threat to coastal ecosystems, infrastructures, and water resources. Satellite geodetic observations from Sentinel-1 Interferometric Synthetic Aperture Radar (InSAR) reveal spatially heterogeneous subsidence patterns across the Virginia Coastal Plain (VACP), however, the mechanisms responsible for these varying subsidence patterns still need to be quantified. Existing studies of VLM in the VACP have linked observed land subsidence to various drivers using GNSS dataset. While this provides sufficient temporal dataset, the spatial coverage remains poor, thereby limiting the understanding of regional land subsidence in the VACP. This study aims to investigate how much observed VLM is driven by groundwater extraction, aquifer-system compaction, relative to other background regional processes such as glacial isostatic adjustment (GIA) and sediment compaction. We address this gap by integrating high resolution multi-temporal InSAR time series with continuous GNSS measurements for validation, and long-term groundwater-level records across the VACP. Statistical and machine learning methods, including Copula Analysis and Random Forest Models will be used to disentangle the drivers of land subsidence and quantify the nature of relationships between groundwater and surface deformation. These observations will further be incorporated into a fluid mechanical model to constrain elastic and inelastic compaction at depth. Results are expected to provide a quantitative structure for attributing VLM to subsurface processes and improve predictive capabilities under future groundwater-use and flooding scenarios.

**GS(art)S
Artist
Statements**

Anya Gupta

Pangong Tso, 2024

Photography

Situated at over 14,000 ft above sea level, Pangong Tso is a striking endorheic lake that stretches from Ladakh, India into western Tibet, spanning a total length of 134 km. It sits in a valley of the upper drainage basin of the Indus River at the east end of the Karakoram Range, in one of the most dramatic landscapes on earth. Standing on its shoreline, surrounded by peaks rising beyond 20,000 feet, watching yaks graze along the water's edge, and seeing China across the expanse, the scale is surreal. At this same elevation in the continental United States, we would be nearing the summit of Mount Whitney - yet here, it is warm, grassy, and level.



Anya Gupta

Appalachian Sunset, 2026

Watercolor, gouache, and ink

I have been lucky to have spent the last 7 years on the east coast - exploring the North Carolina Piedmont during my undergrad, and now reveling in the beauty of the Blacksburg Appalachians. This painting was inspired by an epic sunset during the February winter freeze; it shows the sun setting over the rolling valley-and-ridge, with rhododendrons, the bellwether of spring, blooming in the foreground. While I love California's rugged mountain ranges, with their jagged peaks and glacially carved valleys,



I've developed a newfound appreciation for the quieter, more nuanced and heavily-foliaged beauty of these mountains.

David Bunin

Earth's Curvature, 2025

Photograph

Flying back home to Blacksburg from Indianapolis on board the Hokie Bird, a business jet owned and operated by Virginia Tech, VT students and faculty were treated to a beautiful view of the western foothills of the Appalachians from high above the clouds. After a day of meetings and presentations about the impacts of geological materials to the operations of aircraft engines, this view was a welcome sight to reflect on the implications of this work. Using a wide-angle lens at cruise altitude, the slight curve of the horizon is visible past the Hokie Bird's wing tip.



Helen Burch

Homologous Oasis, 2025

Gauche on canvas

This work is inspired by the Seascape series of modernist Hyman Bloom, who studied cadavers in anatomy labs to create provoking works of art depicting the life-death transition. This piece was created during my time in Michelle Stocker's morphology of the vertebrates and references real specimens dissected at Virginia Tech. It celebrates the artistic and informational utility of skeletal remains after death. The work is meant to highlight bones which are shared across taxa (homologous structures) that share evolutionary origins, and features taxa from sharks to coyotes.



Claudia Cave

Recovering the Satellites, 2026

Magazine

Titled after a beloved Counting Crows album and song, "Recovering the Satellites" encapsulates the high of studying abroad, the enormous gratification and deep nostalgia I collected, and now trying to come back down.



Jack Beckstead

Archaeopteryx Skeleton, 2026

Cross stitch on canvas

The archaeopteryx is a genus of bird-like dinosaur from the late Jurassic period. The discovery of the archaeopteryx in 1861 served to show the transition between dinosaurs and modern day birds as they have many traits of both. For over a century, the archaeopteryx was thought to be the oldest avian fossil, and while older avians have been found in the 21st century, they are still a crucial transition fossil.



D. Sarah Stamps

GNSS Set-Up in Saint Andre de Kamouraska, Canada, 2025

Photography



Angelina Stephens

Painted Folds, 2026

Photograph

This photograph was taken during my study abroad in Fall 2025 in Lavertezzo, Switzerland. The starkly contrasting colors of the folds which have been polished by the rain give these structures an almost painted look over the landscape. The folded rocks appear to stretch endlessly in front of this perspective, folding back and forth away and back towards the viewer. I found this scene fascinating because of how beautifully complex, yet so visibly clear, the geology here is.



Natalie Hermosillo

The Land Meets the Sea, 2026

Photograph

This photograph was taken at Point Lobos, California, along a stretch of coastline shaped by tectonic uplift and marine erosion. Some of the oldest rocks exposed here date back to the Cretaceous period, when dinosaurs dominated the planet. This is one of my favorite places to explore on the California coast. The deep blue Pacific contrasts with the resistant, dark rock outcrops that have withstood persistent wave energy. Together, the ocean and rock highlight both the beauty and the geologic history of the California coast.



Prescott Vayda

Cambrian Explosion, 2026

Paper, cardboard, acrylic paint

Origami renditions of iconic fossils from the early Cambrian representing the diversification of animals. *Anomalocaris* (yellow), a stem arthropod, used its jointed appendages to acquire prey. *Halkieria* (orange) could be a stem mollusk, or it might be more closely related to annelids and brachiopods. *Olenoides* (green), common trilobite from this time, probably ate worms. *Opabinia* (purple), another stem arthropod, had five eyes and a grasping appendage for a mouth. *Pikaia* (beige) is a stem chordate, our closest relative in this assemblage. *Wiwaxia* (red) is an armored stem mollusk. Origami designs are not my own.

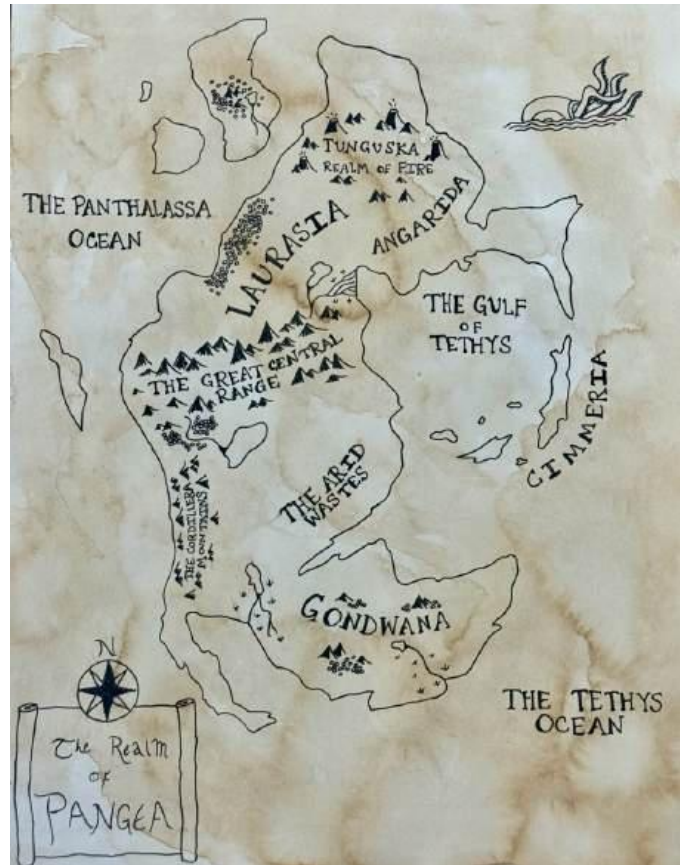


Sydney Stanard

The Realm of Pangea, 2026

Pen on paper

A map of the supercontinent Pangea as it would have existed in the early Triassic, 252 MA, drawn in a style inspired by JRR Tolkien's maps in his books *The Lord of the Rings*. Of note is "Tunguska, Realm of Fire," representing the Siberian Traps, a large igneous province that intruded into the carbonate Tunguska Basin in modern-day northern Russia. Like Tolkien's Mordor, the Siberian Traps were an area of continuous large-scale volcanism. The massive amount of carbon released by the Siberian Traps is believed to have led to net global warming, triggering the largest mass extinction of the Phanerozoic.



Amy Hagen

Towering Figures, 2025

Photography

While doing fieldwork in Namibia, one might spot any number of iconic African animals. Seeing a giraffe in the wild was a bucket list item for me and we eagerly pulled over on the side of the road so I could take this picture. But I was equally excited to capture one of the large termite mounds that kept protruding out of the landscape. During our 8-hour drive across northern Namibia, I observed the different shapes of these mounds and especially appreciated how they varied in color from bright red to white, reflecting the soil color.



Johann Organ

Banded Iron Formations, 2026

Oil Pastels

The artwork I created is of Banded Iron Formations (BIFs). The artwork is an abstract piece with lots of toned down tones and hues to show the age of these formations. The piece is also illustrated using pastels showing how even these ancient formations can be weathered away. I was also inspired to make a piece of BIFs due to there being a large amount of paleo focused art and wanting to focus on something that is not often illustrated in the art world.



Danielle Fitzgerald

Where Earth Meets Sky, 2025

Photography

This work captures Dr. Shuhai Xiao hiking toward a Precambrian section in the Bakh Gol region of the Khuvsgul Basin, northern Mongolia. The figure, small against the vast terrain, emphasizes both the physical and intellectual journey required to access deep time. Field geology is an act of persistence — moving across remote landscapes in search of exposures that record Earth's earliest histories.

The Precambrian strata of the Khuvsgul Basin preserve evidence of ancient environments and early life, reminding us that the most profound chapters of our planet's story are often written in quiet, weathered rock faces far from view. The ascent through mist suggests both uncertainty and discovery: the cloud obscures the destination, yet it also symbolizes the unknown past that scientific inquiry seeks to illuminate.



Esther Oyedele

Balanced in Fracture, 2026

Digital Photograph

This photograph captures Split Rock at Grandfather Mountain in North Carolina, formed through millions of years of weathering as freezing water expanded within small cracks, gradually forcing the rock apart. The massive boulder appears divided yet remains standing. It is a visible reminder that pressure does not always lead to collapse. Instead, fracture can become part of stability. As someone interested in how sustained forces reshape Earth systems over time, I was drawn to this formation as a natural expression of slow change. Split Rock reflects how landscapes respond to stress through adjustment rather than failure, revealing the quiet balance that can exist even within visible breaks.



Maranda Stricklin

Not Forgotten, 2026

Digital

This piece reflects the beauty of evolution. Life never truly disappears, it only changes over time. A cardinal standing on a Utahraptor skull symbolizes continuity across deep time. The work celebrates evolution not as loss, but as persistence, and how paleontology allows us to see



Maryam Karami

Carried by Wind, 2026

SEM Images

This work features three scanning electron microscope (SEM) images of ancient diatoms found within atmospheric dust particles collected at Izaña, Tenerife (2,300 m above sea level), Canary Islands. The samples were analyzed at the Nanoscale Characterization and Fabrication Lab (NCFL) using a JEOL IT-500HR field-emission SEM. The original grayscale images were enhanced with false color to better visualize particle morphology and texture, and subtle graphic elements were added to the first two images to enhance their artistic expression. This work bridges geoscience and art, revealing the hidden beauty and complexity of mineral dust at the nanoscale.

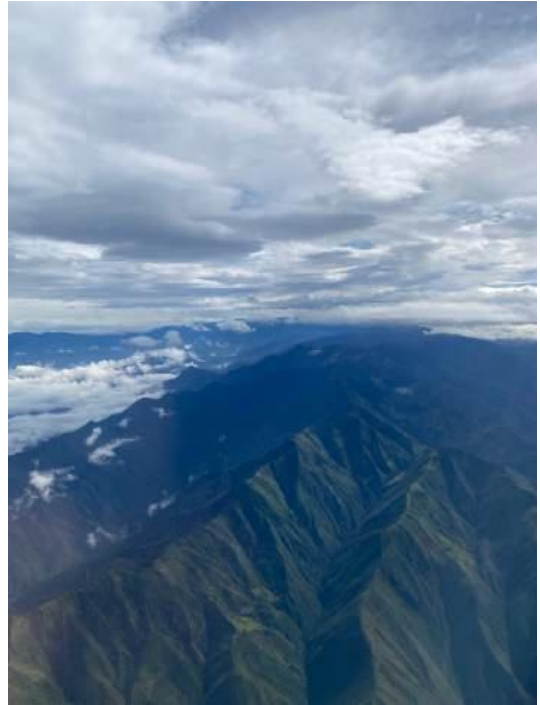


Morgan Lundberg

From the Window Seat, 2024

Photograph

Blinking my eyes open after hours spent darting across the Galápagos Islands, I pressed my forehead to the airplane window just in time to see the Andes rising through the clouds, welcoming me back to mainland Ecuador. A week earlier, I had made my way through Quito, a city perched more than 9,000 feet above sea level, where driving through clouds felt ordinary. Yet after all I'd experienced, the wildlife, the culture, the thin mountain air, nothing matched the quiet awe of watching those ancient peaks pierce the sky, where earth and heavens met as one.



Tanween Syed

The Scythe Lizard, 2026

Oven-bake clay, acrylic paint, flocking powder, fake plants.

Therizinosaurus cheloniformis was a high browsing theropod that roamed modern-day Mongolia during the late Cretaceous. I find *Therizinosaurus* to be one of the most fascinating dinosaurs we have knowledge of due to how unique it is from other theropods. *Therizinosaurus* has a wealth of derived characteristics such as its high browsing lifestyle, large forelimbs, and giant claws, the true use of which we still don't fully understand. This sculpture was made



to an interpretation of what a *therizinosaurus* could have possibly looked like while living.

Sylvia Reese
Shishaldin Volcano Copy,
2026

Medium (Graphite and Charcoal on Paper)

Sometimes I wonder what it would be like to stand at a precipice and look out at a magnificent view. This combined with my urge to explore the volcanism of far off places allowed me to complete this work. I hope you enjoy my copy of a photo by Matt Loewan in 2025. (LAT 54.798470, LON - 163.59472753) Thank you and I hope you enjoy this piece.



Esther Oyedele

Carried Under Pressure, 2026

Acrylic on canvas

This piece reflects how sustained, often invisible pressure reshapes systems over time. In this painting, I express the silhouette of Christ carrying the cross layered within a human profile to symbolize burdens carried both outwardly and internally. The textured strokes surrounding the head evoke strain and weight, while the kneeling figure represents adaptation under stress. In my research, I study how human demands place long-term pressure on groundwater systems, gradually altering landscapes in ways that are not always immediately visible. Creating this work allowed me to reflect on how both natural systems and people respond to persistent stress through slow change, endurance, and transformation.



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