# UNL Geophysics Team newsletter

# academic year of 2022-2023

GEOPHYSICS ROCKS!

## Graduation

**Md Ariful Islam** successfully defended his MS thesis "**Crustal Structures of Diebold Knoll and Adjacent Juan De Fuca Oceanic Crust from Integration of Seismic, Gravity and Magnetic Data**" in Summer 2023. Ariful's project was focused on an enigmatic oceanic feature on the Juan de Fuca oceanic plate – the Diebold Knoll, the isolated seamount that is located ~ 60 km seaward of the Cascadia accretionary prism. Ariful integrated marine geophysical data from the RR1718 cruise that Dr. Filina participated in in 2017. The gravity analysis suggests that the seamount is not completely isostatically compensated, while magnetic modeling revealed that the seamount was formed during a period of reverse magnetic polarity. Integrating these with the seismic reflection data, Ariful concluded that the seamount is relatively young (0.8 to 1.8 Myr old), and it was formed far away from the spreading center in the intraplate settings.

While being a student of the UNL Geophysics team, Ariful participated in a seismic **CHINOOK cruise** in southern Cascadia (August 2022) led by New Mexico Tech and Oregon State University. The results of this fieldwork are summarized in the recent publication.

In Fall 2022, Ariful received the **Outstanding Graduate Student Award** from the Department of Earth and Atmospheric Sciences (EAS). He has presented the results of his research at multiple professional meetings, such as the workshop on active continental margins in July 2022, the annual convention of the American Geophysical Union (AGU) in December 2022, annual meetings of the Nebraska Academy of Sciences (NAS) in 2022 and 2023, as well as during annual UNL Spring Research Fairs in 2022 and 2023. His talk at the last NAS meeting received one of the **best student awards** from the Nebraska Geological Society. Ariful has submitted an abstract for the upcoming AGU2023. The paper on his thesis is currently in preparation to be submitted to Geochemistry, Geophysics, Geosystems.

In Fall 2023, Ariful starts the Ph.D. program at the University of Indiana. **Congratulations, Ariful! We are extremely proud of you!**

## New Students of the UNL Geophysics Team

**Zachary Clowdus** joins our team as an MS graduate student starting Fall 2023 to work on the integrated geophysical analysis of Iceland. This research project is a part of the tectonic studies in the Northern Atlantic that our team started in 2023 with generous funding from the National Science Foundation. Recently, the oceanic affiliation of the crust beneath the Greenland – Iceland – Faroe Ridge is challenged by the scientific community with continental geochemical signatures observed in some Icelandic lava samples and even a new continent – Icelandia – being proposed by some authors. Zach's project will investigate the nature of the crust under Iceland by testing various geological scenarios via the integration of multiple geophysical data from public domains. He was awarded the Teaching Assistantship by the Department of Earth and Atmospheric Sciences. **Welcome to our team, Zach!**

**Katie Steinauer** starts her MS project in Fall 2023. Katie's research utilizes near-surface geophysics for hydrogeological applications in Nebraska. Kathie was awarded the Teaching Assistantship from the Department of Earth and Atmospheric Sciences. In addition, Katie's project received research funding from the Daugherty Water for Food Global Institute. Kathie will utilize microgravity and seismic refraction methods to study the water fluctuations in a local Nebraska aquifer. The research will take advantage of the instrumentation that is available in the UNL Geophysics Lab and will involve multiple repeated surveys utilizing our portable CG-5 gravimeter (we just got it back from maintenance by the manufacturer) and our 24 channels seismic spread that was purchased by EAS in 2022. Moreover, the project will utilize the two absolute gravity base stations on the UNL City Campus that were established by our team in 2022. The time-lapsed land gravity measurements and repeated seismic refraction surveys are intended to track the seasonal changes in water amount within an aquifer. **Looking forward to seeing your results, Katie!**

**Hermione Lofton** joined our team in May 2022 as an Undergraduate Research Assistant. Hermione worked full time the entire Summer of 2022 on the Northern Atlantic project. Her research was focused on developing a database of scientific drilling in the Northern Atlantic. This database will be used by multiple students to constrain integrated geophysical models in this region. Hermione summarized the results of three expeditions in the area, namely DSDP38 (Deep Sea Drilling Project), ODP 104(Ocan Drilling Program), and IODP 396 (International Ocean Discovery Program). Hermione presented her first poster during the UNL Summer Symposium in August 20233. The primary focus of Hermione's poster was summarizing the findings about the basement rocks and volcanic complexes that were sampled in the area. Hermione plans to continue her research during the Fall of 2023. Furthermore, Hermione has submitted an abstract to be presented at the upcoming annual AGU convention in December of 2023. This is quite ambitious for an undergraduate student, and we applaud Hermione for her braveness. **Good job, Hermione!**

**Allison Conzemius** started her research project in May 2023. Allison received the Undergraduate Creative Activities and Research Experience (UCARE) grant from UNL to investigate the tracks of the Yellowstone hotspot via joint analysis of geological and geophysical data. The award includes stipends for Summer 2023 and for the entire academic year of 2023-2024. For her summer research, Allison performed a literature review of the Yellowstone past calderas and found published hotspot tracks from different authors. To our surprise, there are some discrepancies among published interpretations that Allison is going to investigate further during the upcoming academic year. Allison also gathered gravity and magnetic data over central North America and overlayed the tracks from the literature to evaluate correlations and patterns in potential fields. Allison presented her up-to-date findings at the UNL Summer Research Symposium. For the upcoming academic year, Allison will further detrend and filter potential fields in order to highlight the anomalies associated with the hotspot track, as well as continue her literature review to integrate geochemical and age data for known Yellowstone calderas with lineaments in gravity and magnetics. **Nice to have you with us, Allison!**

## Continuing Students

**Morgan Madsen** joined our team in Spring of 2022 as an Undergraduate Research Assistant. Morgan has received the UCARE stipend multiple times (!), namely for Summer 2022, and for academic years of 2022-2023 and 2023-2024. Morgan studies the geological structures along the Cascadia Subduction Zone and their expression on various geophysical datasets. Morgan's initial interests were in the known landslide complexes in the margin, that apparently have some promising signals in potential fields. Morgan successfully presented multiple posters at UNL Research Fairs and gave talks during the annual meeting of the Nebraska Academy of Sciences in 2022 and 2023. Morgan will continue the project in the upcoming academic year with the focus shifted on the pronounced lineament in the southern Juan de Fuca plate that we currently interpret as a previously unmapped propagator wake. Morgan will evaluate this hypothesis via integration of different geophysical datasets and will present her findings at the upcoming AGU convention in San Franciso, CA in December of 2023.

For the summer 2023, Morgan was working on the Northern Atlantic project and developed a database of publicly available seismic data over the Norwegian margin. The results were presented at the UNL Summer Research Symposium. The project will be continued by another undergraduate student that we hope to hire in the Fall of 2023. **Well done, Morgan!**

**Jonathan Wear** started his MS project in August 2022 after receiving his BS in Geology from the UNL Department of Earth and Atmospheric Sciences in the Spring of 2022. Jonathan studies the crustal affiliation of the Voring Marginal High in the Norwegian Sea. For his project, Jonathan models the magnetic signatures of the seaward dipping reflector complexes that are known on the Norwegian margin from seismic data and were sampled by the IODP expedition 396. Jonathan presented his up-to-date findings at the NAS meeting in April 2023, as well as during UNL 2023 Research Fair and Summer Symposium. In addition, Jonathan has submitted an abstract to AGU2023 to present the results of his magnetic modeling. The project will also involve the analysis of seismic refraction data in collaboration with the University of Oslo. Jonathan's research project is partially sponsored by the U.S. Science Support Program as a post-IODP expedition award and by the National Science Foundation. **You are awesome, Jonathan!**

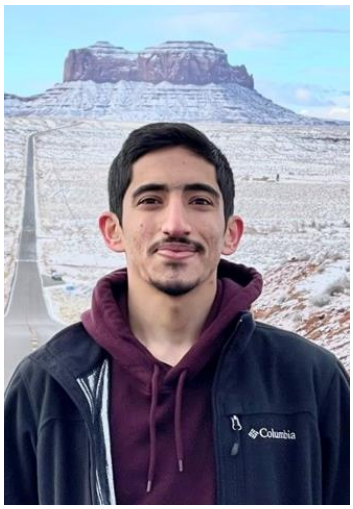
GEOPHYSICS ROCKS!

## Highlights from the UNL Geophysics Alumni

**Patrick Szopinski** (graduated in 2019 with BS in Geology) will be visiting EAS during the 2023 Geology Alumni event in September! Patric is currently employed as Laboratory Manager in SCI Engineering Inc. (St. Louis, MO), but plans to apply the graduate school at Missouri S&T starting Fall of 2024. Patrick is actively involved in the American Institute of Professional Geologists (AIPG) for the last five years. He wrote an article titled "The Optimal Path to Professional Licensure & Where I Went Wrong" for AIPG Bulletin. He also will attend the AIPG 60th Anniversary conference this year (in Covington, KY), where he will serve as a technical session chair and assist the early-career professional staff as part of their mentoring program. We will ensure that Patrick can share his professional experience with the current EAS students during his UNL visit in September. **Looking forward to seeing you again, Patrick!**

**Evan Parsons** (graduated in 2020 with BS in Geology) is now a **Geophysicist** in the U.S. Army Corps of Engineers in Omaha, NE. In the Spring of 2023, Evan visited my GEOL442/842 Environmental Geophysics class and gave an excellent talk about his professional experience. On a personal note, Evan got married last year! Our entire team congratulates Evan and his spouse. **We are SO happy for you!**

Two of our graduates, **Khawlh Al Farsi** and **Sulaiman Al Badi**, got fully funded scholarships for Master's programs from the Petroleum Development of Oman. Sulaiman has been studying Petroleum Geosciences at Sultan Qaboos University since last fall, while Khawla begins her study of **Exploration Geophysics** at the University of Aberdeen in Scotland this fall. Once they got their degrees, they will work for Petroleum Development Oman. **Congratulations! We are so proud of you! Best of luck in your studies!**



**Erik Jacobson** and **Sulaiman Al Badi** both utilized our drone-based magnetic surveying system. Erik has assembled that system to study the fault related to the Midcontinent rift in northeastern Nebraska, while Sulaiman used this system to locate the old well that was drilled almost five decades ago for petroleum exploration. Nowadays, there is a cornfield in that location, and there is no evidence of the well at the surface. As the well was cased with metal pipes, it is a source of the pronounced magnetic anomaly, which allows us to confidently locate it. The project revealed that the well is located ~ 35 m away from its database location. The two undergraduate theses will be combined in the paper to be submitted to The Leading Edge journal this Fall.

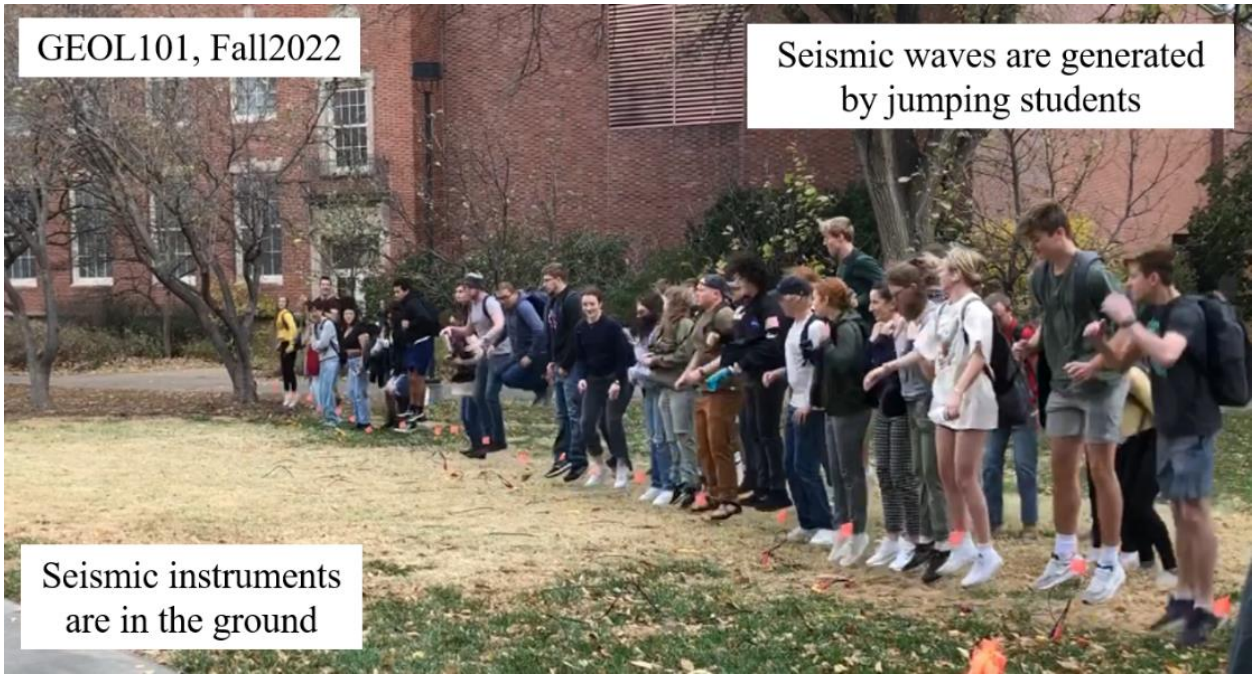
**Lucas Hartford** (our graduate from August 2018) has left Terracon where he was working as **Geophysicist** since his graduation. Lucas was involved in multiple different geophysical surveys ranging from the multi-electrode resistivity studies along the levees of the Missouri River, various seismic surveys (P-wave, MASW, and ReMi collection methods), and spontaneous potential – these are a few I was aware of. For the last few years, Lucas was the only geophysicist in Terracon's Colorado office establishing a geophysical program there. This summer, Lucas moved to Minneapolis and is currently looking for new opportunities. **Best of luck, Lucas!**

**Kris Guthrie** (graduated with MS last year) started an exciting new position as an Environmental Specialist at the Nebraska Department of Environment and Energy. Kris is happy in this new role and has even already advertised several job openings for our graduates. **Congratulations, Kris!**

Kris has submitted a paper based on the MS thesis to the Transactions of the Nebraska Academy of Sciences. The paper went through the first round of reviews and got positive comments. Kris is about to submit a revised version and we are fairly optimistic about the outcome.

## 2022 - 2023 UNL Geophysics highlights

In 2022, the Department of Earth and Atmospheric Sciences purchased a 24-channel seismic spread. This wonderful instrument is housed by the UNL Geophysics Lab and has been used in several classes for demonstration and for class projects. This equipment will be utilized for several surveys in the upcoming year to map the aquifers in Nebraska.

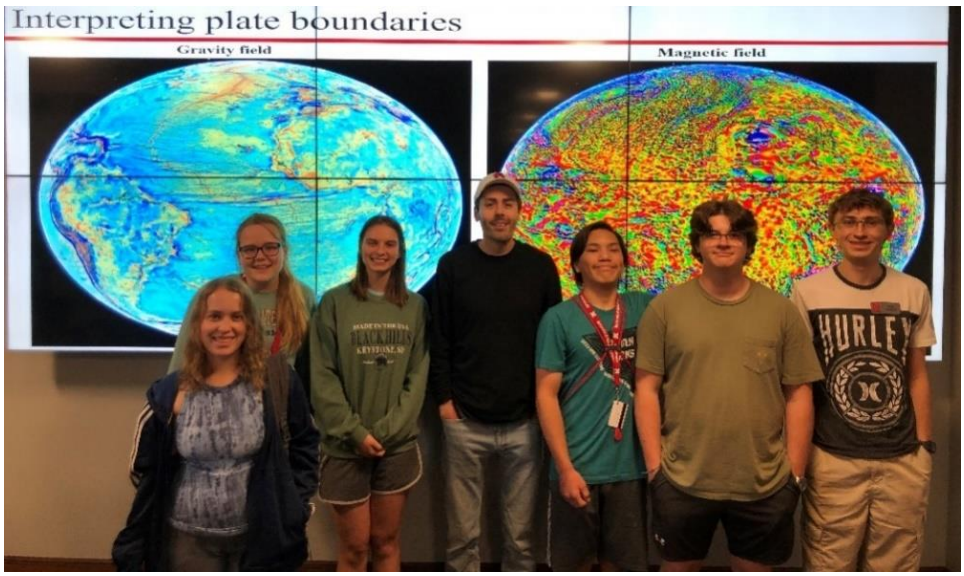



In 2023, Dr. Filina developed and offered for the first time a new class – Environmental Geophysics. This class provided students with hands-on experience with multiple geophysical instruments of the UNL Geophysics Lab. Students collected Ground Penetrating Radar data on the City Campus and in the park nearby, performed gravity surveys over the known subsurface voids, such as tunnels and the Robbers' cave here in Lincoln, and acquired a seismic refraction survey over the box culvert in the Antelope Creek Labyrinth Weir. Overall, this class was successful and will be offered again in 2025.

In November of 2022, Dr. Filina was invited to become a Faculty Fellow of the Daugherty Water for Food Global Institute. The overall mission of this organization is to conduct scientific research on food security with less pressure on scarce water resources and to share knowledge through education and communication. The near-surface geophysics surveying over the Nebraska aquifers that we start in the Fall of 2023 is partially sponsored by the Daugherty Water for Food Global Institute.

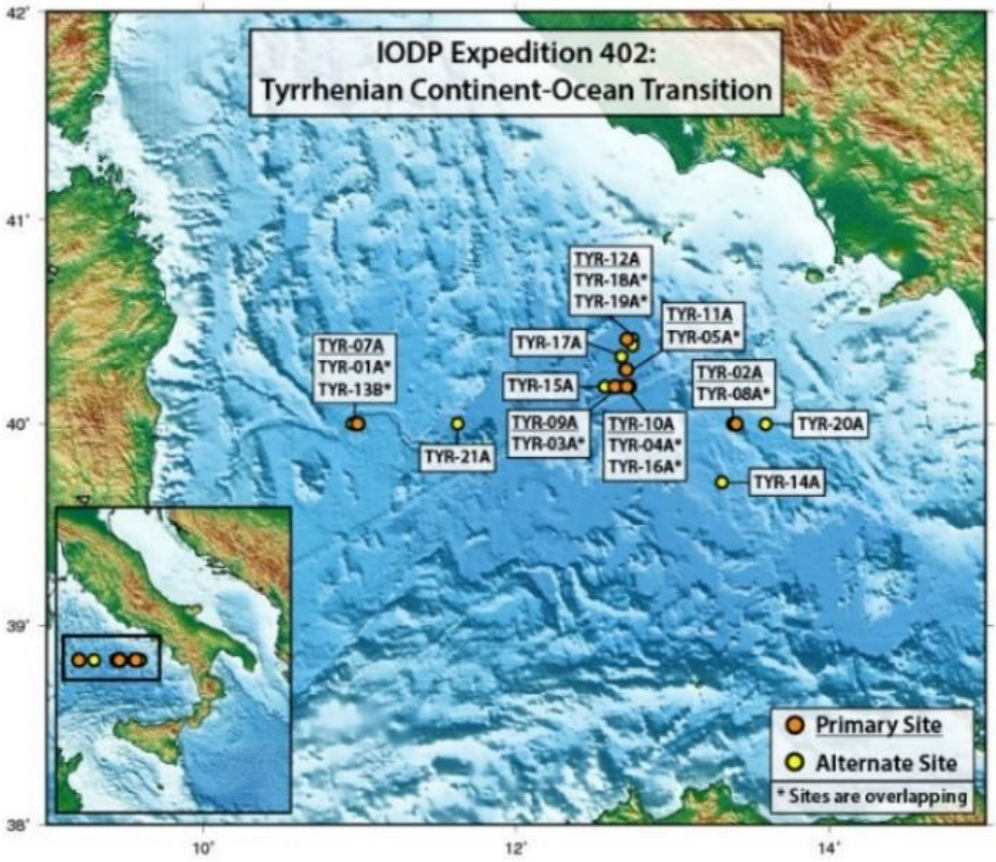
In March of 2023, Dr. Filina received a prestigious research grant from the National Science Foundation to study the tectonic history of the Northern Atlantic. If you missed it, there is a story in Nebraska Today about this project. As of August 2023, we have three students already working on this project, and we are looking for more. The project will take 5 years, and the ultimate goal is to perform a tectonic reconstruction of the entire region that agrees with all available geophysical data (seismic, gravity, magnetics) and geological observations (core data and dredging results).

In the Summer of 2023, Dr. Filina offered a week-long summer camp "Discover Physics of Earth" to high-school students. **Jonathan**, **Morgan**, and **Hermione** helped to teach this exciting course. The course was a big success, and it will be offered again. In 2024, this camp will include the cohort of underrepresented girls from Girls Inc. of Lincoln and Omaha as their stipends are covered by Dr. Filina's grant.



## Heads-up for the academic year of 2023 - 2024

- The Northern Atlantic project is our main focus. We currently have 2 graduate students (**Jonathan Wear** and **Zachary Clowdus**) and one undergraduate student (**Hermione Lofton**) working on it. We hope to hire at least one more undergraduate for the academic year of 2023-2024 and one more graduate student starting Fall 2024 to work on it.
- We continue our investigation of the Cascadia Subduction Zone (**Morgan Madsen**, UCARE). Two papers are currently in review (by **Asif Ashraf**, our graduate from 2021) and one is to be submitted by **Ariful Islam**.
- We continue our successful collaboration with the University of Hamburg on the origin and tectonic history of the Bathymetrists seamounts in the equatorial Atlantic. We are currently looking for a dedicated student for this project. **Dr. Huebscher** from the University of Hamburg will be visiting UNL in October 2023.
- We are starting an exciting new project focused on near-surface geophysics for hydrogeology in Nebraska (**Katie Steinauer**)
- Our team has submitted six (!) abstracts for the upcoming AGU 2023, so we will be busy this fall getting ready for this conference.
- Dr. Filina is accepted to participate in the IODP Expedition 402 (**Tyrrhenian Continent-Ocean Transition**). The expedition will last from February to April of 2024. We plan to collect samples of the exhumed mantle in the central Tyrrhenian Sea!



# Publications

Berndt, C., **IODP396 Science Party**, **2023**, Shallow-water hydrothermal venting linked to the Paleocene-Eocene Thermal Maximum, ***Nature Geosciences***, doi:10.1038/s41561-023-01246-8

**Filina, I.** and E. Beutel, Geological and geophysical constraints guiding new tectonic reconstruction of the Gulf of Mexico, in ***Tectonic Processes: a Global View*, Volume 1. *Extensional Tectonics*: *Continental Breakup to Formation of Oceanic Basins*,** editors I. Çemen, E. Catlos, published by Wiley-Blackley for AGU, **Invited book chapter**, **in press**, doi:10.1002/essoar.10511463.1

Planke, S., Berndt, C., Alvarez Zarikian, C.A., Agarwal, A., Andrews, G.D.M., Betlem, P., Bhattacharya, J., Brinkhuis, H., Chatterjee, S., Christopoulou, M., Clementi, V.J., Ferré, E.C., **Filina, I.Y.**, Frieling, J., Guo, P., Harper, D.T., Jones, M.T., Lambart, S., Longman, J., Millett, J.M., Mohn, G., Nakaoka, R., Scherer, R.P., Tegner, C., Varela, N., Wang, M., Xu, W., and Yager, S.L., **2023,** Mid-Norwegian margin magmatism and paleoclimate implications, , ***Proceedings of the International Ocean Discovery Program***, v. 396, doi:10.14379/iodp.proc.396.105.2023

Egorov, V., Dunlap, D.B., Amoyedo, S.O., **Filina, I.**, Gharib, J., Davogustto, O. and Nemeth, B., **2023**, Organizing a special section. ***Interpretation***, 11(1), pp.1-6, doi:10.1190/INT-2023-0112-FE.1

# Papers currently in review:

Longman, J., Clementi, V., Frieling, J., Jones, M. Chatterjee, S., Planke, S., Berndt, C., Alvarez Zarikian, C., Betlem, P., Brinkhuis, H., Christopoulou, M., Ferre, E., **Filina, I.**, Harper, D., Lambart, S., Millett, J., Mohn, J., Scherer, R., Varela, N., Xu, W., Yager, S., The impact of marine silicate diagenesis in the Norwegian Sea on Early Eocene climate, ***Earth and Planetary Science Letters***, manuscript EPSL-D-23-00873

**Ashraf, A**., **I. Filina**, Zones of weakness within the Juan de Fuca plate mapped from the integration of multiple geophysical data and their relation to observed seismicity, manuscript 2023GC010943, ***Geochemistry, Geophysics, Geosystems***, revisions submitted

**Ashraf, A.**, **I. Filina**, Crustal densities of propagator wakes of the Juan de Fuca plate from gravity modeling, ***Tectonophysics***, manuscript TECTO16479, in review

# Papers to be submitted:

**Guthrie, K.**, **I. Filina**, Two new absolute gravity base stations established in Lincoln, NE, ***Transactions of the Nebraska Academy of Sciences***, manuscript #1562, in revisions

**Islam, A.**, **I. Filina**, **A. Trehu**, Tectonic History of Diebold Knoll from Integration of Seismic, Gravity and Magnetic Data, ***Geochemistry, Geophysics, Geosystems***

# Presentations

## American Geophysical Union (2022)

**Filina, I., Fernandez, A.**, C. Huebscher, Spatial analysis of potential fields over Bathymetrists Seamounts to quantify magmatic underplating and map major faults, ***American Geophysical Union***, paper T32B-07

**Ashraf, A.**, **I. Filina**, Mapping seamounts of the Juan de Fuca plate and assessing their clustering from spatial analysis of potential fields, ***American Geophysical Union***, paper T32B-06

**Islam, A.**, **I. Filina**, Crustal architecture of the Diebold Knoll on Juan de Fuca plate from integrated geophysical analysis, ***American Geophysical Union***, paper T32B-04

**Fernandez, A.**, **I. Filina**, C. Huebscher, Integrated Geophysical Analysis Over Carter Seamount in the Central Atlantic Ocean, ***American Geophysical Union***, paper T32B-05

## Geological Society of America (2022)

**Ashraf, A., I. Filina,** Linking key tectonic features of Juan de Fuca plate to observed seismicity in Cascadia Subduction zone, ***Geological Society of America Abstracts with Programs***, v. 54, no. 5, doi: 10.1130/abs/2022AM-383908

## Nebraska Academy of Sciences (143rd annual meeting, 2023)

**Filina, I.,** Roots beneath intraplate seamounts – crustal flexure or magmatic underplating?

**A. Islam**, **I. Filina**, Tectonic history of the Diebold Knoll on Juna de Fuca plate from integrated geophysical analysis **(Best student paper award)**

**A. Fernández**, **I. Filina**, Integrated geophysical analysis of the northern Bathymetrists seamounts in the Atlantic Ocean

**M. Madsen**, **I. Filina**, Delineating submarine paleo-landslides off the coast of southern Oregon from various geophysical datasets

**J. Wear**, **I. Filina**, Using magnetic data to better understand the nature of anomalously thick crust in the northeast Atlantic Ocean

## UNL Summer Research Symposium (2023)

**H. Lofton**, **J. Wear**, **I. Filina**, Developing a Database of Scientific Drilling of the Northern Atlantic

**M. Madsen, J. Wear, I. Filina**, Summarizing Seismic Data Over the Norwegian Margin

**J. Wear, I. Filina,** Modeling the Magnetic Signatures of Seaward Dipping Reflectors on the Norwegian Margin

**A. Conzemius, I. Filina,** Developing a Set of Geophysical Maps to Track the Yellowstone Hotspot