

Bulletin

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Testing ChatGPT's geological prowess

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This month's issue of [WIRED magazine](#) explores numerous aspects of the current buzz around Generative AI. It may be a gamechanger for productivity. It may be an enabler of academic dishonesty. It may be a harbinger of the end times. I decided to see what all the fuss was about.

ChatGPT is a free, online chatbot. Signing up for an account is a necessary first step, but relatively quick and painless. What follows is a transcript of my 'conversation' with the AI (version 3.5, which is the free version), trying to see how clever it was about geology.

My text is in blue, ChatGPT's response is in black, and then I've highlighted areas in yellow that I discuss briefly after each response, [in red and in brackets].

Callan: What sorts of metamorphic rocks would I expect to find if a granite intruded into a layered sequence of three sedimentary rocks: a quartz sandstone, a shale, and a limestone?

ChatGPT: When a granite intrusion occurs within a layered sequence of sedimentary rocks like quartz sandstone, shale, and limestone, the surrounding rocks can undergo **contact metamorphism** due to the heat and chemically active fluids from the intruding magma. The types of metamorphic rocks that may form in this scenario are influenced by the composition of the original sedimentary rocks and

the temperature and pressure conditions. Here's what you might expect to find:

1. **Hornfels:** Hornfels is a common type of contact metamorphic rock that can form in response to the heat from the granite intrusion. It is characterized by a fine-grained texture and typically lacks foliation. The specific mineral composition and appearance of the hornfels would vary based on the composition of the original sedimentary rocks:
 - **Quartz Sandstone:** The quartz sandstone would likely become a **quartz-rich hornfels** with a hard and glassy texture.
 - **Shale:** The shale may transform into a shale hornfels, which would have a harder, more compact texture than the original shale.
 - **Limestone:** The limestone can undergo metamorphism into a **calc-silicate hornfels** with the introduction of minerals like pyroxenes and garnet. It might lose its characteristic fossil content and develop a more crystalline appearance.
2. **Marble:** Depending on the degree of metamorphism and the presence of carbonates in the original limestone, parts of the limestone layer might also undergo regional metamorphism and transform into marble. Marble is a non-foliated metamorphic rock primarily composed of recrystallized calcite or dolomite.
3. **Contact Metamorphic Zone:** There may be a transitional zone around the granite intrusion where the sediments are partially altered but not completely metamorphosed into distinct

rock types. This zone could contain various minerals resulting from the interaction between the hot magma and the adjacent sedimentary rocks.

4. **Skarn Deposits:** In some cases, the interaction between the hot fluids from the granite and the limestone may lead to the formation of skarn deposits. Skarns are characterized by the presence of minerals like garnet, pyroxene, and vesuvianite.

The specific mineral assemblages and textures would depend on the temperature, pressure, and duration of the metamorphic event, as well as the chemical composition of the original rocks. The result can be a complex assemblage of metamorphic rocks and minerals within the contact aureole surrounding the granite intrusion.

[I think this is a pretty good answer to the question. (1) You'll note that I didn't say tell me how these three protoliths will react to 'contact' metamorphism, only that a granite intruded. The AI figured out that this meant contact metamorphism would occur, and cited the reasons why. (2) If my own students were answering this question, I'd expect them to suggest the limestone protolith would become "marble" rather than calc-silicate hornfels (and the quartz sandstone would become "quartzite"), but the AI's answer is a pretty good one, assuming some level of impurity in the protolith. And it brings marble up in the next numbered paragraph. (3) As for numbered paragraphs, as you'll see below, this seems to be a standard format for an answer to my prompts – an introduction, some numerical list of various aspects of the issue, and then a concluding paragraph. (4) Also, may I just point out how pleasant it is to read a response like this where all the words are spelled correctly, and the punctuation is present in all the appropriate places? 😊]

Callan: How should I interpret a pelitic schist with kyanite porphyroblasts?

ChatGPT: The presence of kyanite porphyroblasts in a pelitic schist is significant and can provide valuable information about the metamorphic history and conditions that the rock has experienced. Here's how you can interpret a pelitic schist with kyanite porphyroblasts:

1. **Metamorphic Grade:** Kyanite is a high-pressure, high-temperature mineral that typically forms at relatively high metamorphic grades. Therefore, the presence of kyanite porphyroblasts suggests that the pelitic schist has undergone high-grade metamorphism. This can help you estimate the temperature and pressure conditions that the rock has been subjected to during its metamorphic history.
2. **Mineral Assemblage:** In addition to kyanite, pelitic schists often contain other minerals such as mica (biotite and muscovite), garnet, staurolite, and quartz. The specific mineral assemblage can provide further insights into the metamorphic conditions and the composition of the original sedimentary rock. The presence of these minerals can also be used to estimate the metamorphic grade.
3. **P-T Path:** Kyanite is a polymorph with andalusite and sillimanite, meaning it can transform into these minerals at different pressure-temperature conditions. Studying the coexistence of kyanite with other minerals in the schist can help geologists reconstruct the pressure-temperature (P-T) path that the rock followed during metamorphism. This information can reveal the burial and subsequent uplift history of the rocks.
4. **Tectonic Setting:** The presence of kyanite in a pelitic schist can be indicative of specific tectonic settings, such as subduction zones or continental collision zones. These are environments where high-pressure, high-temperature conditions are commonly found.
5. **Geological History:** The occurrence of kyanite porphyroblasts provides clues about the geological history of the region. It suggests that the rocks underwent significant tectonic and metamorphic events in the past, which may include subduction, mountain-building, or other geologic processes.
6. **Age Dating:** If possible, radiometric dating of the kyanite or associated minerals can help determine the timing of metamorphism. This can provide constraints on when the high-grade metamorphic event occurred in the geological history of the region.

In summary, the presence of kyanite porphyroblasts in a pelitic schist is a strong indicator of high-grade

metamorphism and can yield valuable information about the rock's history, the pressure-temperature conditions it experienced, and the tectonic settings in which it formed. It is an essential tool for geologists to unravel the complex geological processes that have shaped the Earth's crust.

[This is a very good answer, in my opinion. It “knows” that kyanite only forms under high P + high T conditions, and that is likely induced by orogeny. I’m impressed. I do note the consistent formatting of the intro sentence, which is mealy-mouthed and information-free, but I can get over that. The numerical list of relevant considerations is robust and correct. Okay – now I decide to up the ante with an “impossible” geologic scenario.]

Callan: Let's say I have an outcrop of shale that contains trilobite fossils, and that shale is cross-cut by a rhyolite dike containing zircons. The zircons are fed into an ICPMS and it's discovered that they include impurities of uranium and lead, specifically ^{235}U and ^{207}Pb , in a ratio of 1:1. How should I interpret this outcrop?

ChatGPT: The interpretation of the outcrop containing shale with trilobite fossils and a cross-cutting rhyolite dike with zircons showing a 1:1 ratio of ^{235}U to ^{207}Pb impurities is quite interesting and can provide valuable geological information. This scenario suggests several important points:

1. **Fossil Dating:** Trilobite fossils found within the shale provide evidence for the age of the sedimentary rock. Trilobites are extinct marine arthropods, and their fossils have well-established ranges in Earth's history. By identifying the trilobite species and consulting fossil records, you can estimate the approximate age of the shale, which may help constrain the geological time frame when these sediments were deposited.
2. **Cross-Cutting Relationship:** The presence of a cross-cutting rhyolite dike within the shale indicates that the dike is younger than the shale. Dikes are igneous intrusions that cut across existing rock layers, which suggests that the shale was already in place before the rhyolite dike intruded. This information helps in understanding the sequence of geological events in the area.

3. **Zircon Dating:** The zircons within the rhyolite dike contain uranium (^{235}U) and lead (^{207}Pb) impurities in a 1:1 ratio. This ratio indicates that these zircons have undergone radioactive decay, with ^{235}U decaying into ^{207}Pb . This decay process can be used for radiometric dating.
4. **Radiometric Dating:** By measuring the ratio of parent (^{235}U) to daughter (^{207}Pb) isotopes in the zircons and knowing the half-life of ^{235}U , you can determine the age of the rhyolite dike. The 1:1 ratio suggests that half of the ^{235}U has decayed to ^{207}Pb , which implies that the zircons have reached their isotopic equilibrium. Using radiometric dating techniques, you can calculate the age of the dike's formation.
5. **Tectonic History:** The presence of the rhyolite dike and its age can provide insights into the tectonic history of the region. It may indicate a period of volcanic activity or magma intrusion in the area during a specific geological time.
6. **Geological Context:** The age of the dike can be compared to the age of the trilobite-bearing shale to understand the broader geological context. If the ages match, it suggests that the dike formation and sediment deposition occurred around the same time. If the dike is significantly younger, it may represent a separate geological event.

In summary, the combination of trilobite fossils in the shale and radiometric dating of the zircons in the cross-cutting rhyolite dike provides a valuable framework for understanding the geological history of the outcrop. It helps establish the relative timing of events, provides age constraints, and contributes to the broader understanding of the geological processes that shaped the area.

[There is a lot to unpack here. First off, the responses are mostly (but not entirely) correct. However, almost always they don't go far enough. Or at least, they don't go as far as a professional geologist would. (1) For instance, it notes the ranges of trilobites, but doesn't note the “take-home message,” which is that the shale must be Paleozoic. It could also constrain numerically the bracketing of ages that these trilobites imply – 541 Ma to ~252 Ma. (2) I really like the way the AI describes the relative dating of the dike and the shale. It expresses the idea generally, and then specifically and

particularly applies it to the circumstance I've suggested. (3) The isotopic dating is key, and so I was pleased to see the AI correctly interpret the 1:1 ratio of parent to daughter isotope as evidence that half the parent isotope has decayed, with therefore a presumption of 0% daughter in the zircon at the time the decay system began. (4) But then it says something nonsensical, which is "that the zircons have reached their isotopic equilibrium," which is literally and specifically not true, but further this is not even something that people say. There is no isotopic 'equilibrium' with parent and daughter in numerical balance. So this is a big red flag that the AI doesn't really know what it's talking about. (5) The circumstance described at the end, where hypothetically a rhyolite and a Paleozoic marine shale formed in the same place at the same time is geologically implausible. Such a coincidence of disparate processes should never occur. Again the implication is: this AI doesn't know what's plausible in terms of physical processes on our planet.

... Anyhow, to force the AI to reckon with the isotopic data I had provided, I pointed out what it had missed.]

Callan: But how old is the dike?

ChatGPT: To determine the age of the rhyolite dike accurately, you would need to perform radiometric dating on the zircon crystals within the dike. The 1:1 ratio of ^{235}U to ^{207}Pb impurities in the zircons suggests that these zircons have reached isotopic equilibrium, meaning they have undergone radioactive decay.

Here's how you can calculate the age of the dike using radiometric dating:

1. **Collect Samples:** First, you would need to collect samples of zircon crystals from within the rhyolite dike. The samples should be carefully prepared for analysis.
2. **Radiometric Analysis:** Perform radiometric analysis using techniques like uranium-lead (U-Pb) dating. This involves measuring the isotopic ratios of ^{235}U and ^{207}Pb in the zircon crystals.
3. **Calculate Age:** Using the isotopic ratios and the known half-life of ^{235}U , you can calculate the age of the zircon crystals and, by extension, the age of the rhyolite dike.

The half-life of ^{235}U is approximately 703.8 million years.

The age calculation would involve determining how many half-lives have elapsed to reach the observed 1:1 ratio of ^{235}U to ^{207}Pb . The formula for this calculation is:

Age (in years) = $(\ln[(N(\text{Pb})/N(\text{U})) + 1] / \lambda)$ where:

- $N(\text{Pb})$ is the number of ^{207}Pb atoms.
- $N(\text{U})$ is the number of ^{235}U atoms.
- λ is the decay constant, equal to $\ln(2)$ divided by the half-life of ^{235}U .

4. **Interpret Age:** The calculated age of the rhyolite dike will provide a numerical estimate of when the dike formed. This age can then be used to understand the geological history of the region, including when the dike intruded relative to the deposition of the shale containing trilobite fossils.

It's important to note that the accuracy of the age determination depends on the quality of the sample and the precision of the analytical techniques used in the radiometric dating process. Additionally, multiple zircon samples may be analyzed to ensure the reliability of the age estimate. Without the specific data from radiometric dating analysis, it's not possible to provide an exact age for the rhyolite dike. The age would need to be determined through laboratory analysis of the zircon crystals.

[(1) Again with the "isotopic equilibrium" thing. So weird. (2) Great point that 1 zircon dated isn't as good as multiple zircons dated. (3) It says I didn't give it any data. But I did. I didn't specify numbers of atoms, but I did say that the amount of parent equaled the amount of daughter, and thus (in my mind) one half-life had elapsed.]

Callan: I did give you specific data - the ^{235}U and ^{207}Pb are in a 1:1 ratio. That is, there's exactly as much ^{207}Pb as there is ^{235}U .

ChatGPT: I apologize for the oversight in my previous responses. If you have a 1:1 ratio of ^{235}U to ^{207}Pb in the zircon crystals within the rhyolite dike, it indicates that all the ^{235}U has decayed to ^{207}Pb . In other words, the zircon crystals have

reached isotopic equilibrium, and the age of the dike is equal to the half-life of ^{235}U .

The half-life of ^{235}U is approximately 703.8 million years. Therefore, the age of the rhyolite dike, based on the 1:1 ratio of ^{235}U to ^{207}Pb , would be approximately 703.8 million years.

So, the rhyolite dike is estimated to be around 703.8 million years old based on the information provided.

[(1) Big error when the AI says “it indicates that all the ^{235}U has decayed to ^{207}Pb ,” as a 1:1 ratio indicates that half of the parent has decayed into daughter. (2) Again with this foreign concept of isotopic equilibrium!!, which means nothing to me, but despite that, (3) the correct conclusion emerges, which is the date I set up – one half-life’s worth. But then (4) it repeats the answer three times in slightly different phrasing.]

Callan: Good, but how can that be squared with the age of the shale, based on the trilobite fossils?

ChatGPT: The age of the rhyolite dike, estimated to be around 703.8 million years based on the 1:1 ratio of ^{235}U to ^{207}Pb in the zircon crystals, is significantly older than the age of the shale containing trilobite fossils. This presents a geological puzzle that needs to be resolved. There are a few possible explanations for this discrepancy:

1. **Intrusion of Older Material:** It's possible that the rhyolite dike represents an older geological event, and it intruded into younger shale layers. This can occur in cases of geological complexity where older rocks are exposed or uplifted later in Earth's history.
2. **Reversed Dating:** There could be a methodological issue with either the radiometric dating of the zircons or the interpretation of the age of the shale based on trilobite fossils. It's essential to ensure that the dating methods and interpretations are accurate.
3. **Tectonic or Geological Events:** Geological processes such as faulting, folding, or tectonic movements can lead to the juxtaposition of rocks of different ages. In such cases, it's possible that the shale containing trilobite fossils was folded or faulted into contact with the older rhyolite dike.

4. **Remobilization:** In some cases, younger volcanic activity or hydrothermal processes can remobilize older zircon crystals and incorporate them into younger rocks. This could potentially explain the presence of older zircon crystals within a younger dike.

To resolve this discrepancy and better understand the geological history of the area, further geological and stratigraphic investigations, as well as additional radiometric dating of relevant rock units, may be necessary. Careful fieldwork, analysis of structural relationships, and a thorough reevaluation of dating methods and interpretations are essential steps in reconciling the ages of the dike and the shale with trilobite fossils.

[(1) It still hasn't said explicitly that the shale has to be Paleozoic, but it does reach the correct conclusion that I've set up a scenario with a host rock that is younger than the igneous dike that intrudes it. (2) It recognizes that this is a “discrepancy,” a “puzzle.” Good! (3) Its first proposal is nonsensical, but the AI arm-waves its lame ‘explanation’ away by invoking “geological complexity. Nope. (4) The explanation in point 2 is valid, but calling it “Reversed Dating” is weird, and not something a human geologist would do. (5) I think it's clever to invoke a fault, perhaps parallel to the margin of the dike. (6) Remobilization of zircons is very clever, and I think actually a great way to resolve this. The AI probably doesn't understand what remobilization means, but it explains the relationship between the mineral and the rock in a very compelling way.]

Callan: I like the xenocryst hypothesis. [Note that I'm throwing in some new vocabulary here – hitherto not employed and not defined.] That's a good way to resolve this. How would I test it?

ChatGPT: The xenocryst hypothesis, suggesting that the zircon crystals within the rhyolite dike are older and derived from a different source (xenocrysts), is a plausible explanation for the presence of older zircon crystals within a younger rock. To test this hypothesis, you can employ several geological and analytical techniques:

1. **Petrographic Examination:** Conduct detailed petrographic studies of the zircon crystals and the surrounding rhyolite. Look for evidence of xenocrystic zircon inclusion within the dike.

Xenocrysts may have different textures, compositions, or zoning patterns compared to the host rock's indigenous minerals.

2. **Mineral Inclusions:** Examine the zircon crystals for inclusions of other minerals or foreign material that may provide clues to their origin. Inclusions within the zircon crystals can suggest they were transported from elsewhere.
3. **Geochemical Analysis:** Analyze the chemical composition of both the zircon crystals and the host rhyolite. Look for differences in major and trace element compositions that may suggest distinct sources. Xenocrysts often exhibit different trace element signatures compared to the minerals formed in situ.
4. **Isotope Analysis:** Perform isotope analysis on the zircon crystals. Look for isotopic signatures (e.g., isotopic ratios of U/Pb, Lu/Hf, or O) that may indicate the zircons have a different isotopic history than the host rock. Isotopic data can reveal the age and source of the xenocrysts.
5. **Field Relationships:** Examine the field relationships between the rhyolite dike and the surrounding rocks, including the shale containing trilobite fossils. Carefully map the contact relationships, fault zones, and any evidence of intrusion-related deformation. Understanding the geological context is crucial.
6. **Cross-Cutting Relationships:** Determine if there are any features that provide evidence of the dike intruding into the shale, such as chilled margins or cross-cutting relationships. This can help establish the relative timing of events.
7. **Age Dating:** If possible, perform radiometric dating on both the zircon crystals and the rhyolite dike to confirm their ages. If the zircons yield significantly older ages than the dike, it supports the xenocryst hypothesis.
8. **Source Characterization:** If xenocrysts are identified, attempt to characterize their probable source(s). This may involve comparing the xenocryst compositions and ages to known geological units or regions in the vicinity.

By combining these approaches, you can build a comprehensive understanding of the origin and

history of the zircon crystals within the rhyolite dike. If the evidence consistently supports the xenocryst hypothesis, it would suggest that the zircon crystals were indeed transported from an older source into the dike, providing valuable insights into the geological history of the area.

[Dang, as soon as I drop “xenocryst” into the conversation, ChatGPT immediately figures out what I mean, and shows me so by defining it! Many of the proposed tests are quite clever and would I think be valid ways of testing whether the zircons were inherited or crystallized from the rhyolite’s magma. I think this is a win for ChatGPT. Now I’m going to switch things up as far as the zircon’s age.]

Callan: Let's go back to the zircons, and let me change the data. Instead of a 1:1 ratio, let's say we find a 1:3 ratio of parent to daughter instead. How old is the rhyolite now?



Zircon
Mindat.org

ChatGPT: If you find a 1:3 ratio of parent (^{235}U) to daughter (^{207}Pb) isotopes in the zircons within the rhyolite dike, it indicates that the zircons have not reached isotopic equilibrium. In this case, the zircons are still in the process of radioactive decay, with some of the ^{235}U having decayed into ^{207}Pb . To calculate the age of the rhyolite dike based on this data, you can use the concept of the radioactive decay equation. The ratio of parent to daughter isotopes (1:3) represents the initial condition when the zircons formed. Here's how you can calculate the age:

1. **Determine the Decay Constant (λ):** The decay constant (λ) for ^{235}U is known and is approximately 9.85×10^{-10} per year.
2. **Calculate the Age:** Use the radioactive decay equation for the age (t) of the sample:

$$\text{Age } (t) = (1/\lambda) * \ln[(N(\text{Pb})/N(\text{U})) + 1]$$

Where:

- $N(\text{Pb})$ is the number of ^{207}Pb atoms.
- $N(\text{U})$ is the number of ^{235}U atoms.
- λ is the decay constant.

In this case, you have a 1:3 ratio, which means that 25% (1/4) of the ^{235}U has decayed into ^{207}Pb .

$$\text{Age (t)} = (1/\lambda) * \ln[(1/4) + 1]$$

3. **Calculate the Age:** Plug in the values to calculate the age:

$$\text{Age (t)} = (1/9.85 \times 10^{(-10)} \text{ per year}) * \ln[(1/4) + 1]$$

$$\text{Age (t)} \approx 866.46 \text{ million years}$$

So, if you find a 1:3 ratio of parent (^{235}U) to daughter (^{207}Pb) isotopes in the zircons within the rhyolite dike, it suggests that the rhyolite dike is approximately **866.46 million years old** based on the radioactive decay of ^{235}U to ^{207}Pb .

[(1) My new prompt has set up a rhyolite twice as old as the dike in the first scenario, but now ChatGPT thinks that this is evidence of *less* radioactive decay having elapsed ("still in the process of radioactive decay"). (2) This isn't a one-off; it comes back a few lines later with the incorrect quantification that only 25% of the parent isotope has decayed. (3) But then the answer that pops out is *older* than the misinterpreted setup should imply – The AI says the dike is now *older* than 1 half-life, not younger. What the heck? This does not make sense. But I felt like I needed to intervene with the first thing the AI got wrong, and deal with the calculation later.]

Callan: You misunderstand. It's 75% of the ^{235}U that has decayed. Only 25% is left.

ChatGPT: I apologize for the misunderstanding. If you find a 1:3 ratio of parent (^{235}U) to daughter (^{207}Pb) isotopes in the zircons, indicating that 75% of the ^{235}U has decayed, you can calculate the age of the rhyolite dike as follows:

1. **Determine the Decay Constant (λ):** The decay constant (λ) for ^{235}U is approximately $9.85 \times 10^{(-10)}$ per year.
2. **Calculate the Age:** Use the radioactive decay equation for the age (t) of the sample:

$$\text{Age (t)} = (1/\lambda) * \ln[(N(\text{Pb})/N(\text{U})) + 1]$$

In this case, you have 25% (1/4) of the original ^{235}U remaining, which means that 75% (3/4) has decayed into ^{207}Pb .

$$\text{Age (t)} = (1/\lambda) * \ln[(3/4) + 1]$$

3. **Calculate the Age:** Plug in the values to calculate the age:

$$\text{Age (t)} = (1/9.85 \times 10^{(-10)} \text{ per year}) * \ln[(3/4) + 1]$$

$$\text{Age (t)} \approx 1.936 \text{ billion years}$$

So, if you find a 1:3 ratio of parent (^{235}U) to daughter (^{207}Pb) isotopes in the zircons within the rhyolite dike, it suggests that the rhyolite dike is approximately 1.936 billion years old based on the radioactive decay of ^{235}U to ^{207}Pb .

[Better, but this isn't correct. The right answer would be 2 half-lives have passed, each worth 703.8 million years, and so the age would be 1407.6 million years. Whole-integer numbers of half lives are easier to calculate. I checked my math at this online radiometric dating calculator <https://www.calculator.net/half-life-calculator.html> and confirmed I had the right answer, meaning that ChatGPT got it wrong. Okay, time to move on...]

Callan: Can you make me a picture of the outcrop?

ChatGPT: I'm **sorry** for any confusion, but I'm a text-based AI model, and I'm unable to create or display images or pictures, including geological outcrop illustrations or diagrams. However, I can provide you with a textual description of how you might depict the outcrop:

1. **Shale Layer:** Draw a horizontal layer representing the shale containing trilobite fossils. You can add some trilobite illustrations or symbols within this layer to represent the fossils.
2. **Rhyolite Dike:** Draw a vertical or diagonal intrusion cutting across the shale layer. Label this as the rhyolite dike. You can use a different color or pattern to distinguish it from the shale.
3. **Zircon Crystals:** Within the rhyolite dike, you can add small circles or dots to represent the zircon crystals. Label them to indicate their 1:3 ratio of parent (^{235}U) to daughter (^{207}Pb) isotopes.
4. **Arrows and Labels:** Use arrows and labels to indicate the cross-cutting relationship of the dike relative to the shale layer. This will help convey the geological context.
5. **Geological Features:** If there are any other notable geological features, such as faults, folds, or bedding layers, you can include them in the illustration and label them accordingly.

Remember to include a legend or key to explain the symbols, colors, and labels used in your illustration. This will help viewers understand the geological features and relationships depicted in the outcrop.

[I note this is the second time that ChatGPT has apologized to me. It's a very polite and respectful AI, and it makes me feel like I was a bit curt when I told it "You misunderstand." What are the proper levels of respect in interacting with such a tool, such an 'entity'? I'm not sure I yet know. As for the drawing suggestions, this is all good advice. I think I could follow this to make a decent rendition of the imagined outcrop, but then again, I did start off with that image in my head when I made the original prompt. It occurred to me that there are also image-generation AIs out there too. Maybe I can make one of them render a "photo" of my imagined outcrop. I used one called Canva, and fed into it the following prompt...]

Callan: A photo of an outcrop of shale that contains trilobite fossils, and that shale is cross-cut by a rhyolite dike containing zircons. A rock hammer serves as a sense of scale.

The word "dike" got flagged as inappropriate, so I had to rephrase:

Callan: A photo of an outcrop of shale that contains trilobite fossils, and that shale is cross-cut by a **tabular rhyolite intrusion** containing zircons. A rock hammer serves as a sense of scale.



[This is what I got. I think it looks fairly realistic, but doesn't show anything like what I was imagining. There were actually four images generated by the AI, but this was the only one that showed something that could plausibly be a rhyolite dike (the far edge, lighter in color than the bulk of the boulder). All four images generated had this austere "Martian" feel to them. I decided to try again, pushing for a realistic cross-cutting dike...]

Callan: A photo of an outcrop of shale that contains trilobite fossils, and that shale is cross-cut by a **stripe** of rhyolite containing zircons. A rock hammer serves as a sense of scale.

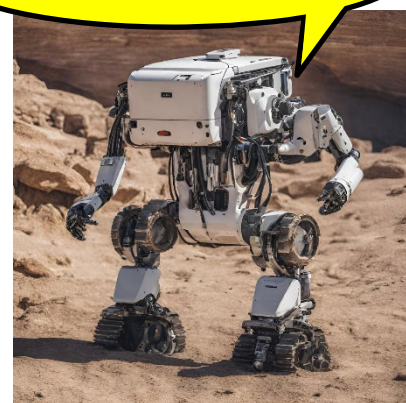


[Ugh. Even worse! (and still no rock hammer)]

In a way, it's a relief... My job is secure for a few more months!

This was an interesting exercise in exploring the power and the limits of generative AI. I'd be curious to hear from other NAGT members about their experiences with this new tool. Maybe in the next issue of the *Bulletin*?

Thanks for reading, human.



(also generated by Canva AI)



A Call For Participation: Stories of Scientific Ocean Drilling

by **Laura Guertin**
Penn State Brandywine

Do you have a story related to scientific ocean drilling? Consider adding your voice to our StoryCorps community! Community participation is needed for a strong community archive.

If you have participated in scientific ocean drilling in any role (on board or on shore), we would like to hear from you! Myself and two former Onboard Outreach Officers that have sailed on *JOIDES Resolution* are using the StoryCorps platform to generate an audio collection of stories that goes beyond the scientific results obtained from deep sea cores.

We encourage you to explore the existing collection **Tales from the Deep: Stories of Scientific Ocean Drilling** and think about a topic you would like to record a conversation about. It is OK to have your story be a topic that is already in the collection (this will provide richer material from which to develop classroom material). Recorded conversations have been around photography, which books to bring on board, lost luggage, working with scientists from



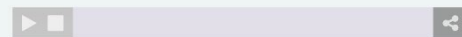
across the globe, being a graduate student at sea, and more.

Why build this audio collection? As scientists, we need to be proactive in sharing our stories of the scientific process as well as the scientific results. We want to show our “human” side as a scientist, shatter stereotypes, and engage the broadest audiences. Although *JOIDES Resolution* will no longer be sailing past 2024, the stories of scientific ocean drilling must be preserved and continue moving forward.



"I get there [Narita Airport], and my luggage doesn't come out until the very end... my luggage was shredded... except the coffee"

Recorded April 25, 2023 • Archived April 25, 2023 • 25:07 minutes



ID: APP3825825



To explore the StoryCorps Archive for **Tales from the Deep**, visit: <https://bit.ly/SciODstorycorps>. If you are interested in participating in this project, please contact Laura Guertin (guertin@psu.edu). Note that recordings posted to the StoryCorps website are publicly available and archived at the American Folklife Center at the Library of Congress.



STEM Outreach Programs for Schoolteachers at Princeton University

by **Laurel Goodell and Danielle M. Schmitt**
Princeton University

For many years, Princeton University has participated in outreach activities that engage the local community in science. One particularly effective program is QUEST (Questioning Underlies Effective Science Teaching), run by Princeton's Program in Teacher Preparation (Teacher Prep) (<https://teacherprep.princeton.edu/> under the leadership of Assistant Director of STEM Dr. Jessica Monaghan.

QUEST offers week-long summer workshops that bring local schoolteachers to campus to enhance their understanding, enthusiasm and confidence in math and science by engaging in activities as adult learners. Some workshops also include off-campus activities. While Princeton scientists provide content (often the "broader impacts" for research grants), two other components are critical to the success of the program. First, Teacher Prep plays a critical role in reaching out to Princeton scientists and facilitating development of QUEST curricula, advertising the program, recruiting teachers, finding support that allows teachers in low-income districts to attend, and providing logistical support. Secondly, a "Lead Teacher" in each workshop – a previous QUEST participant – serves as a facilitator and leads "Teacher Talk" sessions that focus on classroom applications and pedagogical techniques such as Next Generation Science Standards (NGSS).

QUEST offers several workshops per year. This article describes two recent geosciences workshops.

Buried Secrets: The Geological Significance, Formation and History of Iron Ore Deposits in the New Jersey Highlands was a 2023 QUEST unit led



QUEST teachers examine a flooded iron mine entrance near Ogdensburg, NJ where Thomas Edison's "New Jersey and Pennsylvania Concentrating Company" operated from 1891-1900. The orientation of the ore, and the mine, generally follow the trend of the metamorphic foliation. At its peak, the workings employed almost 500 workers, but was a financial failure. Thomas Edison did have a few other successful ventures, of course!

by Professor Blair Schoene, Geosciences Lab Manager Laurel Goodell, Geoscience Research Specialist Isabel Koran and Lead Teacher Martha Friend (Princeton Regional School District), with funding provided by one of Schoene's NSF research grants.

In the 18th and 19th centuries, over a hundred mines in Precambrian rocks of the Highlands made New Jersey a major U.S. iron producer. This activity drove local economies, spurred settlement of the region, and helped fuel the industrial revolution. Buried Secrets engaged participants in exploring fundamental questions related to the formation and age of this iron ore.

First, teachers learned about New Jersey geology, rocks and minerals, and plate tectonics. This included a presentation by Dr. Pierre Lacombe of the USGS (retired) on historical aspects of the mining. The centerpiece of the week, however, was an all-day field trip to the Highlands. Teachers hiked past flooded mine entrances and the remnants of Thomas Edison's mining complex near Sparta, NJ, that once employed hundreds of workers in a completely deforested landscape. The group then completed transects across the now reforested bedrock, searching for outcrops, mapping rock types and measuring metamorphic foliation.



Professor Laure Resplandy (left) and QUEST participant using carbon dioxide probes to investigate photosynthetic rates under different conditions.

The last two days were back on campus, where participants merged their field measurements to discover they had mapped a bedrock structure that could be interpreted as a several kilometer-scale fold. Next, teachers examined textures in ore samples and experimented with igneous intrusion models, which indicated an igneous origin for the ore bodies that must post-date metamorphism. Finally, teachers learned about absolute dating, toured Professor Schoene's high-precision Thermal Ionization Mass Spectrometry laboratory and evaluated data that confirmed the post-metamorphic timing of ore emplacement.

As a result of their Buried Secrets experiences, participants made significant gains in understanding the geology of New Jersey and the processes that occur at plate boundaries. They also benefitted from exposure to the interdisciplinary toolkit of fieldwork, experiments, modeling, and lab analyses that geoscientists use to address scientific questions; perspectives that they will be bringing back to their own classrooms.



QUEST teachers visualizing and measuring the orientation of foliation in aneisses of the New Jersey Highlands.

Climate Change: Exploring Solutions to a Complex Problem was a QUEST workshop developed by Geosciences' Professor Laure Resplandy, Lab Manager Danielle Schmitt, graduate student Abigale Wyatt, Teacher Prep's Dr. Jessica Monaghan and Princeton Middle School's Dr. Steve Carson. Its goals were 1) to increase teachers' understanding of the components of climate and climate modeling, the predictions and impacts of climate change, and the role of human activities in the climate system and 2) to explore cutting-edge technologies that can mitigate the effects of a changing climate. Funding and support were provided by Princeton's High Meadows Environmental Institute, the Cooperative Institute for Modeling the Earth System, and the Department of Geosciences.

2022 participants explored patterns in atmospheric CO₂ concentrations (including the role of terrestrial vegetation and marine phytoplankton), investigated the effect of albedo on temperature, learned about climate models and supercomputing, and toured Princeton's High Performance Computing Research Center (which houses a powerful super-computer used to run climate models). The participants also used a climate simulator to investigate the effects of different CO₂ concentrations and analyzed how projected temperature changes could impact not only ecosystems, but also sea level at regional and global scales.

In 2023, the workshop was expanded to allow teachers to design their own experiments using high albedo paint and collect their own data, to model how changes in roof albedo can offset global warming. Two activities using climate projections from the IPCC (Intergovernmental Panel on Climate Change) Sixth Assessment Report were also incorporated. They first explored Physical Science Basis (Working Group I) data on temporal and spatial patterns of projected temperature, precipitation, soil moisture, and how these variables are related. Participants then considered how projections of changes in the frequency and intensity of extreme heat events might affect these variables.

In the second activity, teachers examined illustrative pathways from the Mitigation of Climate Change

IPCC Report (Working Group III) that are projected to stay below 2°C warming and incorporate different combinations of fossil fuel sources, renewable energy sources, and various carbon dioxide removal technologies. The outcomes of these pathways were compared to those based on current policy and to those that take moderate action to curb the current trajectory of greenhouse gas emissions. Teachers also evaluated the feasibility of each pathway in staying below a 2°C warming target.

An important aspect of QUEST is that it does not end with the last day of the summer workshop. To facilitate implementation of activities beyond QUEST, teachers leave with resources and materials to use in their own classrooms. Many teachers are repeat participants, and some become Lead Teachers themselves. And over the years, QUEST has impacted thousands of elementary, middle and high school students as they perform their own QUEST-type investigations guided by QUEST-trained teachers.



QUEST teachers visiting Princeton's High Performance Computing Research Center housing Tiger, a powerful supercomputer used to run climate models. (Right) Curt Hillegas, head of Research Computing for Princeton's Office of Information Technology, provides a peek into one of Tiger's racks that contains many processors.



Spring 2024 Eastern Section Meeting in Berkeley Springs, West Virginia

by Steve Lindberg
U-Pitt Johnstown

Here is your early bird notice for the spring 2024 eastern section meeting to be held at the (already reserved) historic Country Inn at Berkeley Springs, West Virginia on May 2-3-4, 2024. It is still early and I am deciding on the schedule for the weekend; but the tentative events will be:

Another “flat rate” registration fee as we had in place for the 2023 Ithaca, New York meeting. A Thursday afternoon early arrival field trip to the C&O Canal followed by the Thursday evening social get-together, a presentation along with a “swap and share” your teaching materials. Friday morning presentations, poster session, lunch, and an afternoon field trip to look at the geology (and opportunity to collect specimens) at the U.S. Silica Quarry in Berkeley Springs. Friday evening Geo-Auction ! Saturday field trip to the geological site “Round Top Hill” along the C&O Canal. Saturday evening eastern section dinner and awards. Registration and all details will be in the next issue of the eastern section Bulletin. Hope you can make to the 2024 meeting!





Fall 2023 “Outcrops”

by **Steve Lindberg**
U-Pitt Johnstown

On a recent geology field trip to examine the local Upper Carboniferous, Pennsylvanian period stratigraphic section; Pitt-Johnstown Energy and Earth Resources students had to determine where in the stratigraphic section they were located. Using the descriptions of rock units within the section, and a hint provided by their dropper bottles filled with 10% HCl, they were able to arrive at the conclusion that the coal exposed on this hillside was the Upper Kittanning C' seam.

Here on the Appalachian Plateau of western Pennsylvania the Upper Kittanning Coal was, and in some locations still extensively mined in both deep and open-pit mines . The Upper Kittanning coal lies above the key marker bed, the Johnstown Limestone. The Johnstown Limestone will produce a noticeable effervescence with the hydrochloric acid. Since this field assignment has already been turned in, it is now safe to publish the answer!



Eastern Section and New York Outstanding Earth Science Teachers

NAGT Eastern Section is pleased to recognize two earth science teachers, one for the Section and one for the State of New York.

Eastern Section

David Amidon has been teaching middle school science for over 20 years in Central NY, also serving as a coach and advisor for many of the programs in his district. He strives to engage his students by focusing on place-based and experiential learning strategies. His students have compared indigenous and modern food webs, created action plans to limit single use plastic, helped coordinate an environmental-themed concert with the local symphony orchestra, and accurately predicted the annual ozone minimum.

David's professional highlights include National Board Certification, selection to the New York State Master Teacher Program, an invitation to serve as a global ambassador for the Educators @ Space Academy program, and is a recipient of NY's Empire State Excellence in Teaching Award from the Governor's Office. David is also a National Geographic Certified Educator, a NASA/JPL Solar System Ambassador, and he sailed on board the NOAA ship Reuben Lasker as a NOAA Teacher at Sea. He is a Certified American Meteorological Society (AMS) Teacher and was invited to present at the 2023 AMS Annual Meeting last winter in Denver.

As a Teacher Ambassador for the National Center for Science Education (NCSE), he has helped craft many lessons and activities teaching climate change. He was part of the NCSE cohort that presented these storylines to the American

Association for the Advancement of Science (AAAS), and will be a featured speaker at the Science Teacher Association of New York State (STANYS) annual conference.

In addition to the OESTA, David has also received national teacher of the year awards from the American Geosciences Institute and the National Middle Level Science Teachers Association, the Excellence in Science Teaching Award from STANYS, and is a two-time recipient of the Presidential Innovation Award for Environmental Educators from the White House Council on Environmental Quality and the U.S. Environmental Protection Agency.

New York State

Joseph C. Perry earned his BS in Elementary Education with a concentration in Earth Sciences from SUNY Fredonia and MS in Administrative Education from SUNY Brockport. Mr. Perry started teaching Regents Earth and Space Sciences at Palmyra Macedon High School in 1998, and started teaching dual credit courses (Intro to Astronomy, Intro to Geology and Science of Natural Disasters) in 2008. He also maintains the Palmyra Macedon Central School District's Weatherbug Weather Station, and frequently holds star viewing events with the district's 11-inch Celestron telescope. Outside the classroom, Mr. Perry is advisor to the MasterMinds club, Model UN, is the Wayne Finger Lakes earth and space science mentor teacher. Mr. Perry has been a union executive officer for more than 20 years, is a past president of Palmyra-Macedon Faculty Association and currently is the president of the Wayne County Educators Federation. Since 2004 he has worked at NYSED as an educational specialist for test development. Mr. Perry is an avid traveler for school and science. He has been lead or co chaperone for school trips to; Niagara Falls, Albany, Boston, New York, Philadelphia, Chicago, Washington DC, Grand Canyon, the United Kingdom and Greece. He has been selected to attend Honeywell Educators at Space Academy in 2018, CERN's International Teacher's Weeks in 2022 and CGLL's Shipboard Science in 2023. Mr. Perry has been honored to receive the awards of; Special Recognition by Palmyra-Macedon's BOE in 2008, The Edward G Roy Jr. Award for Excellence in K-8 Earth Science Teaching - National Finalist by AGI in 2019.



FROM THE ARCHIVES

by **Steve Lindberg**

U-Pitt Johnstown

For this issue of the *From The Archives* we feature a lab exercise of unknown origin, date, and

authorship. This was found in an archives folder containing a variety of notes, writings, membership lists, receipts, and other documents labeled “assorted stuff from the 80’s”. If you can find the geologic maps for these locations, then here is your introductory lab ready to use. I have reproduced it here exactly as found, with no revisions, additions, or other editing. Enjoy !



Observational Earth Science - Geologic Map exercise

Williamsville, VA

1. What structure is Big Valley (NW area of map)? Does it appear we can always count on topography to reflect structure?

Geologic Map of PA

2. What is the structure just NE of Altoona (near SW corner of map)?
3. What is the structure SE of Huntingdon (lower center of map)?
4. From the outcrop pattern, how do the rocks lie in the NW part of the map?
5. This map covers what two physiographic provinces that are also found in Maryland?

Allegheny County, MD

6. a) What is the compass direction of the strike of most of the formations on this map? In what direction do the mountain ridges trend in this area?
b) What type structures cover the county?
c) How many major anticlines, and how many synclines are there?

Geologic Map of MD

7. a) The map shows what type of geologic structures dominate MD west of Hagerstown?
b) How many major anticlines cross the northern border of MD from Hagerstown to the western edge of the state?
8. Rocks of which geologic eras, and what types (igneous, sedimentary, or metamorphic), predominate in each of the 5 physiographic provinces?
9. How many Precambrian gneiss (nice?) domes are found around Baltimore?
10. Which way do the coastal plain rocks dip? What does the pattern on the map in Charles and Calvert Counties (south of Annapolis) tell you about the amount of dip?
11. a) Use the topographic maps to find the Bear Pond Mountains (just west of Hagerstown), and Warrior, Collier, & Irons Mountains (just east of Cumberland). Then look on the geologic map and identify the general structure of these mountains.
b) Give the name of the formation and the rock type that makes the latter 3 mountains? Why should this make mountains?
12. a) What is the overall structure of the Blue Ridge?
b) By looking at the shape and location of the ridges of the Blue Ridge (from the topo map), the shape and location of the rock units (from the geologic map), and reading the rock descriptions of the rocks of the province, what named formation and rock type would you say is primarily responsible for the ridges?

Wavelets and White Horses: the Beaufort Scale Explained

by Beth Doyle

Northern Virginia Community College
Outreach officer, *JOIDES Resolution Expedition 400*

On a recent ship-to-shore broadcast, one of the JOIDES Expedition 400's ice navigators was asked about the challenges posed by rough seas. He mentioned "white horses," a nautical term for what landlubbers commonly call white caps. Sailors in polar seas care about them because they can conceal smaller icebergs, also known as "growlers." White horses are also associated with the Beaufort scale, an essential guideline for the visual estimate of wind speed.

What's the Beaufort Scale?

Officially, it's called the Beaufort Wind Force Scale, but there's usually no need to be so formal. It's a way to measure and describe wind speed and its effects on the ocean. It helps sailors, meteorologists and adventurers understand and communicate the conditions they're dealing with.

The JOIDES Ice navigator, Victor Gronmyr, explained that the Beaufort Scale "was a way to categorize something that everyone had a different opinion about."

Who is Beaufort, and why does he get a scale named after him?

Ahh, Admiral Sir Francis Beaufort! A remarkable cipher of a man, he was born in Ireland in 1774 and joined the British Royal Navy as a teenage midshipman. At the time, sailors made regular weather observations, but they lacked a standard



Sir Francis Beaufort 1774-1857
(Stephen Pearce, Royal Museums Greenwich)

scale. As noted on Wikipedia, a "stiff breeze" to one, might be another's "soft breeze." As an officer, Beaufort standardized the scale, which has since evolved and included contributions from others.

The scale was used informally by sailors since Beaufort developed it in 1805. The Beaufort Scale was adopted officially and first used on Charles Darwin's famed scientific expedition on the HMS *Beagle*.

How does this scale work, anyway?

It's all about observations! You look at the sea's surface and how it behaves. Beaufort's Scale ranges from 0 to 12, with 0 being calm and 12 a full-blown hurricane. The National Oceanic and Atmospheric Administration's website details the many different personalities that waves can express. The description for "Beaufort 3" nearly reads like a haiku:

"Large wavelets.

Crests begin to break.

Foam of glassy appearance.

Perhaps scattered white horses."

At Beaufort 8, you'd be holding onto your hat with gale-force winds, high waves, foam, and "spindrift," or spray everywhere.

What if you don't have a fancy wind speed measuring device?

Beaufort's Scale is super user-friendly. You can estimate the wind speed just by observing how the wind affects the water and nature around you. A windsock at the bow of a ship can give you a sense of how strong the wind is.



This wind sock shows "Force 3," or "Beaufort 3"
(Beth Doyle & IODP)

The simple genius of the scale means that it's employed today by sailors, fishermen, meteorologists, kite surfers, and anyone who spends time near the water.

Do the JR navigators rely on the Beaufort Scale?

Expedition 400 Captain Harm Nienhuis says that he uses the scale, "all of the time," to talk about the wind, though he notes that he would, for instance, say "Force 5" instead of "Beaufort 5."

Force 5 means moderate waves and many white horses, though it can sound more alarming to some.

"When I hear 'Force 5' I think that sounds horrible," Operation's Superintendent, Bill Rhinehart said. "I'm from Texas so the first thing I

think is 'category five,' as in hurricane."

Hurricane force winds are indeed covered by the Beaufort Scale, as it tops out, at 12.



White caps, also called "white horses"
(Heike Zimmerman & IODP)

Can Expedition 400 expect higher Beaufort numbers?

Fortunately, for most of our time in Baffin Bay, the JR has languished in Beaufort 3 seas. Our transit back to Reykjavik takes us around the southern tip of Greenland and north towards Iceland where the water, Captain Nienhuis says matter-of-factly, "could be more energetic."

Meaning, the white horses could be out of the corral and galloping free.



Beth Doyle and Michelle Pratt are currently serving as outreach officers on JOIDES Resolution's 400th expedition off the northwest coast of Greenland.

Award nominations

by **Christopher Roemmele**
West Chester University

Greetings to all educators of geology and earth science. I am Christopher Roemmele, your Awards Chair for NAGTES. I teach at West Chester University in West Chester, Pennsylvania, and taught high school/middle school earth science for 15 years in New Jersey. I know how hard we all work as teachers and getting a proverbial pat on the back and thank you is nicely motivating. Perhaps you work with or know someone whom you feel deserves this recognition. In that case, I strongly urge you to nominate this person for one of our Eastern Section awards, or one of the National NAGT awards. The Eastern Section meeting is a wonderful time to heap praise upon those individuals who have excelled in the work and promoted geoscience education.

Information about all our Eastern Section awards can be found on our section website. Please note the deadline is being/has been changed to February 1! So start thinking and get those forms filled out now! Completed nomination forms should be sent to me at croemmele@wcupa.edu. However, you must place your nomination via the online forms found on the National NAGT web site at <http://nagt.org/nagt/programs/oest.html>

Here is a list of our awards. Perhaps there is one with your (or a colleague's) name on it!



OUTSTANDING EARTH SCIENCE TEACHER

The OEST Awards program was adopted by NAGT in 1971. Its purpose to honor pre-college teachers of earth science, their excellence and commitment to teaching and teaching earth science

DIGMAN AWARD FOR EXCELLENCE IN GEOSCIENCE EDUCATION

The Digman Award is designed to recognize an individual who works to bring geoscience to the general public. We look for individuals who are not teachers, but work in a capacity that educates the general public in areas of the geosciences. Museum directors, curators and assistants, state survey employees, mine and quarry public relations people would all qualify for this award. The nomination information for this award is also on our section website.

JAMES O'CONNOR MEMORIAL FIELD CAMP SCHOLARSHIP

The James O'Connor scholarship is given to a college geology or earth science major who is attending a geologic field camp course (typically over the summer) as part of their college degree program. The \$500 scholarship assists the student in covering the expenses of their field camp.

Nominate a student currently enrolled in your geology program. Nomination information appears on the section website.

DISTINGUISHED SERVICE AWARD FOR THE EASTERN SECTION

The Distinguished Service Award is given to a member of the Eastern Section (still actively teaching or retired) who has, over the years, contributed to the growth and activities of the Eastern Section. This person should have a history of continued service to the Eastern Section. Nomination information appears on our website.

JOHN MOSS AWARD FOR OUTSTANDING COLLEGE TEACHING

The John Moss award is reserved for instructors and professors who, at the college level, model and promote outstanding teaching in the geosciences. Nomination information appears on section website.





Nominations for NAGT Teacher Education Division (TED) Earth Science Teacher Leader Award

by **Christopher Roemmele**
West Chester University

NAGT's Teacher Education Division (TED) has developed ten criteria to encourage and support K-12 educators to move from the role of teacher to that of teacher leader. This competitive annual award honors teachers who satisfy at least seven of the ten leadership criteria and recognizes them as Earth Science Teacher Leaders. Each qualified nominee will receive a certificate of recognition but only one nominee per year will earn the award. This nomination form supports a two-step process:

First, the candidate is nominated by a colleague, administrator, or other person with knowledge of the candidate's qualifications using the form below. Self-nominations are allowed.

Second, the Earth Science Teacher Leader Award Committee will review entries and may request more supporting information from the nominee during the scoring period.

Selection of the awardee is made in the late spring-early summer. Acknowledgement of awardee(s) will be made in the autumn of each award year by the selection committee and TED's Executive Committee.

This year, the National Association of Geoscience Teachers (NAGT) Teacher Education Division (TED) is pleased to recognize Wichita Falls, Texas teacher **Bryce Henderson** as an exemplary K-12 Earth Sciences teacher leader and as the inaugural recipient of the TED's Earth Science Teacher Leader Award. Bryce has distinguished himself as an outstanding Earth Sciences educator through service to the professional community, distinction in the classroom, and dedication to the advancement of geosciences pedagogy.

Bryce has spent his career using his passion for teaching to help others discover a love of learning. As a leader at Wichita Falls ISD, he works to empower others to make an impact on the world beyond the classroom. While his focus is on teaching, he also specializes in curriculum development and works closely with the OnRamps program at the University of Texas at Austin to serve over 41,000 Geoscience students in 195 districts across the state. Bryce is committed to improving the art of teaching and focuses his action research efforts on closing STEM achievement gaps while increasing representation in the field of geoscience.

The [National Association of Geoscience Teachers](#) works to raise the quality of and emphasis on teaching geosciences at all levels. We count among our members K-12 teachers and college/university faculty as well as educators working with the public through outlets such as museums and science centers. NAGT seeks to: foster improvement in Earth sciences education at all levels of formal and informal instruction, emphasize the cultural significance of Earth sciences, and disseminate knowledge to the public. NAGT's [Teacher Education Division](#) provides practical guidance to Earth sciences teachers and their educators. More information regarding the Earth Science Teacher Leader Award is available on the website. Nominations are due by March 31, 2024.



“Friends of Mineralogy” Pennsylvania Chapter Symposium, Johnstown, Pennsylvania

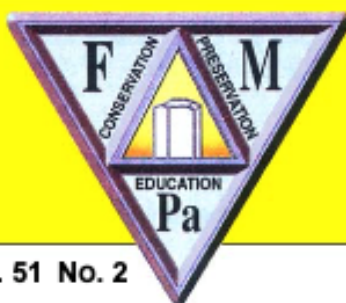
"Friends Of Mineralogy" Fall 2023 Symposium! On November 10-12, 2023 the Pennsylvania chapter of the Friends Of Mineralogy will be having their 2023 meeting and symposium here in Johnstown at the University Of Pittsburgh At Johnstown campus. It will be held in the campus conference center, registration is only \$15 for non-members and it includes entrance to the symposium speakers, free rock/mineral/fossil give-away of the extra geology samples from our geology dept. (Friday and Saturday evening), plus a Sunday field trip to collect minerals and fossils at the New Paris Limestone Quarry located about 30 minutes from campus. You must be a registered attendee to take advantage of the geology dept. rock give-away (we have hundreds of pounds of extra rocks, minerals, and fossils to give away) and registered for the Sunday field trip. Some of our eastern section members might have been to this quarry on a previous spring meeting trip I hosted. Lots of fossils, calcite and the chance to find some nice purple fluorite. There will be several mineral dealers set up at the symposium along with our geology club. Here are most of the details plus the registration form. The FOM website has more information under the "what's new" menu. E-mail me if you have any additional questions. Hope to see you here for the symposium! <https://rasloto.com/FM/whats-new/>

Steve Lindberg

Pitt-Johnstown

Energy and Earth Resources Dept.

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FRIENDS OF MINERALOGY Pennsylvania Chapter NEWSLETTER



VOL. 51 No. 2

SEPTEMBER 2023

Plan NOW to Attend:

**SYMPOSIUM on
Pennsylvania Mineralogy
& Geology, and
First Annual SHOW
at University of Pittsburgh-Johnstown**

Meet & Greet Friday Nov. 10
Friday evening at the Sleep Inn. Show off
your most significant find of the summer.

Mineral, Gem & Fossil SHOW
Sat. Nov. 11 FREE ADMISSION
8:30 a.m. - 6:00 p.m., Conference Center,
University of Pittsburgh - Johnstown.
40 tables of dealers with fascinating merchandise

SYMPOSIUM Sat. Nov. 11
FM-PA members \$10, non-members \$15, students free
8:00 a.m. - 5:00 p.m., Conference Center, University of
Pittsburgh - Johnstown. In person or Online. Six
presentations (see page 2), Annual Meeting of the
membership & elections, silent auction, giveaway table.

Field Trip Sun. Nov. 12 Departs 9:30 a.m.
Open only to Symposium registrants who attend Friday
afternoon safety briefing in person or online. Safety
equipment will be required on the trip.
JOIN US! -



Conference Center at the Living-Learning Center, University of Pittsburgh - Johnstown.

S. Lindberg photo

The Symposium will have informative talks by knowledgeable speakers on minerals, geology and mining in Pennsylvania and beyond (see page 2). This is a hybrid meeting with attendance both in person and via Zoom. Doors open for check-in at 8:00 a.m., with the presentation scheduled to conclude at 5:00 p.m. All interested mineral collectors are invited to register and attend.

As usual, the Symposium will include a silent auction, give-away table, and plenty of opportunities for visiting with fellow enthusiasts. To keep costs down, we are not providing refreshments this year.

REGISTRATION is open now by mail or internet.
The registration form is available on the web site
<https://rasloto.com/FM/whats-new/>

On site registration on Saturday November 11 is possible, but it is by paper form only, cash or check only. Registration for FM-PA members is \$10, non-members \$15, college and younger students free (parents must provide supervision of minors.)

LODGING: Blocks of hotel rooms are being held at three establishments; see page 2. Note the October 10 or 20 reservation deadlines.

LUNCH: There are several possibilities for lunch: Order a box lunch to be delivered to the building (\$16, order must be received by Nov. 4, see registration form); walk to brunch buffet at the campus dining hall, \$16 payable on site, no reservation needed; and several restaurants are within short driving distance.

continued on page 2



Welcome! This is the main entrance lobby where all attendees will enter, registration and information tables will be here, large area for exhibit tables. *S. Lindberg photo*

SYMPOSIUM continued from page 1

PROFESSIONAL GEOLOGISTS: Five Professional Development Hour credits available for full lecture attendance.

WEB SITE: <https://rasloto.com/FM/whats-new/> has updates, details, and the registration form.

CONTACT: e-mail: <bstephens@stephensenv.com>

SYMPOSIUM PRESENTATIONS

scheduled for Saturday include:

William Kochanov, PG

Gypsum Occurrence in the Lower Pennsylvanian Vanport Limestone, Lawrence County, Pennsylvania

Dr. Andrew A. Sicree

Minerals from Centre County: From the bottom of the quarry to the top of the Sky

Dr. Robert J. Altamura

A Model for the Cause of Iridescence in Plagioclase Feldspar and the effect of Superimposed Polysynthetic Twinning

Chris Howard, Aleya Shreckengost, and Dr. Ryan Kerrigan

The Geochemistry and Petrology of the Bald Hill Bentonites in Southwestern Pennsylvania

Aleya Shreckengost

Examining Mineral Fluid Inclusions to Assess the Economic Potential of Allegheny Hydrothermal Systems

William Stephens, PG and Stephen R. Lindberg
Minerals and Geological Investigations at the New Paris Quarry, Pennsylvania



Mineral Show - picture this room filled with 40 tables of mineral, gem & fossil vendors! S. Lindberg photo

LODGING

Blocks of rooms have been reserved for November 10, 11 and 12 at three hotels for attendees of the 2023 Symposium. They are being held on a first come, first served basis. **Note the October 10 or 20 reservation deadlines.**

Comfort Inn Of Johnstown

<https://www.choicehotels.com/pennsylvania/johnstown/comfort-inn-hotels/pa113>

Address : 455 Theatre Dr, Johnstown, PA 15904

Phone : (814) 266-3678

Within 1 mile of campus

15 rooms reserved under "FOM" \$130 + tax per night

Must reserve by October 20

Holiday Inn Express of Johnstown

<https://www.ihg.com/holidayinnexpress/hotels/us/en/johnstown/jstjt/hoteldetail>

Address: 1440 Scalp Ave, Johnstown, PA 15904

Phone: (814) 266-8789

About 1.5 miles from campus

15 rooms reserved under "FOM", 2 queen beds at

\$124.99 plus tax

Must reserve by October 10

Sleep Inn of Johnstown

<https://www.choicehotels.com/pennsylvania/johnstown/sleep-inn-hotels/pa030?mc=llgoxxpx>

Address: 453 Theatre Dr, Johnstown, PA 15904

Phone: (814) 262-9292

Within 1 mile of campus

15 rooms reserved under "FOM"

\$85 per night, 2 double beds.

Must reserve by October 10



Symposium - picture this room filled with fellow collectors, and fascinating presentations on Pennsylvania minerals on the screen! S. Lindberg photo



Friends of Mineralogy Pennsylvania Chapter
2023 Fall Symposium at University of Pittsburgh,
Johnstown Campus
Saturday November 11 and Sunday November 12, 2023

***** PROFESSIONAL DEVELOPMENT HOURS (PDH) AVAILABE
FOR PROFESSIONAL GEOLOGISTS *****

**Field Trip: Sunday, November 12 -- New Paris Lime and Stone Co. Quarry
OPEN TO SYMPOSIUM REGISTRANTS ONLY**

NAME _____

Email _____

Address _____

City _____ State _____ ZIP _____ Phone _____

I plan to attend via ZOOM _____ YES

I plan to attend the field trip _____ YES

FMPA Chapter Member _____ X \$10

Student _____ FREE

Non Member _____ X \$15

2024 Dues Payment _____ (Senior 62 and older \$15, students \$15, regular \$20, family \$25)

OR chose a box lunch delivered to the building for \$16 including a sandwich, fruit salad.

side salad, desert bar, and water.

NOTE: Box lunch orders MUST be received by November 4.

Turkey breast and provolone cheese _____ X \$16

Ham and Swiss cheese _____ X \$16

Roast beef and cheddar cheese _____ X \$16

Grilled veggie wrap _____ X \$16

Tuna salad _____ X \$16

Grilled Mediterranean chicken sandwich _____ X \$16

Online convenience fee (if using PayPal) \$2.00

TOTAL \$ _____

Please pay via PayPal to rasloto@aol.com and email this form to rasloto@aol.com

or mail this form with a check made out to Friends of Mineralogy to:

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