

# Front & Center!

Quarterly Science Newsletter

Frontline Geoscience within the Geology, Energy & Minerals (GEM) Science Center

## Center Director Note...

Welcome to the third issue of our USGS Geology, Energy & Minerals Science Center (GEMSC) quarterly newsletter. Since the last newsletter, GEMSC staff have released 12 publications, 4 data releases, and presented across many venues including, but not limited to, Goldschmidt, European Geosciences Union (EGU), and Geoscience, Policy and Society (GPS) 2021. We onboarded 4 new employees this quarter and plan to advertise 4+ open positions that we hope you will check out (see text for more information)!

The end of our Fiscal Year is in September, our mission-critical science goals. Despite the year now, we have been able to maintain our core expand and enhance our portfolio. Energy and interest and we continue to explore both topics in commodity lifecycles (production, consumption,



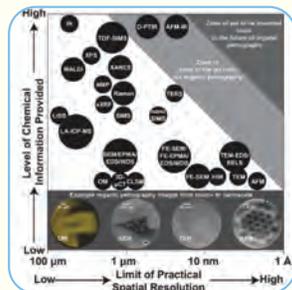
so our scientists are actively working to meet challenges of maximum telework for over a science objectives and look for opportunities to critical minerals continue to be topics of national depth, as well as assess the environmental impacts of disposal).

We appreciate the opportunity to share our science with you. To explore more on what we do, please visit our [USGS GEMSC website](#). If you know anyone who may be interested in receiving this newsletter, or if you would like to adjust your subscription status, please refer to the [online subscription form](#). As always, please reach out to me directly with any comments, questions, or ideas for collaboration you may have.

~ Tina Roberts-Ashby, PhD, Center Director of the GEMSC

## Science Spotlight...

### A Review of Spatially Resolved Techniques and Applications of Organic Petrography in Shale Petroleum Systems



GEMSC research scientist Paul Hackley, with support from Aaron Jubb (GEMSC), Ryan McAleer (FBSC), Brett Valentine (GEMSC), and Justin Birdwell (CERSC), published an article in the International Journal of Coal Geology that highlights spatially resolved techniques available for research in the field of organic petrography. With over 450 references, this review article serves as an overview of a wide variety of analytical techniques and their applications and limitations in shale petroleum systems, and as a comprehensive road map for readers to pursue in-depth investigations of specific techniques. The paper covers both traditional (e.g., fluorescence imaging and vibrational spectroscopy) and forthcoming techniques (e.g., tip-enhanced spectroscopy and photoelectron imaging) that can be used to measure dispersed organic matter in situ. Please contact Paul at [phackley@usgs.gov](mailto:phackley@usgs.gov) for a copy of the publication. View the full article [HERE](#).

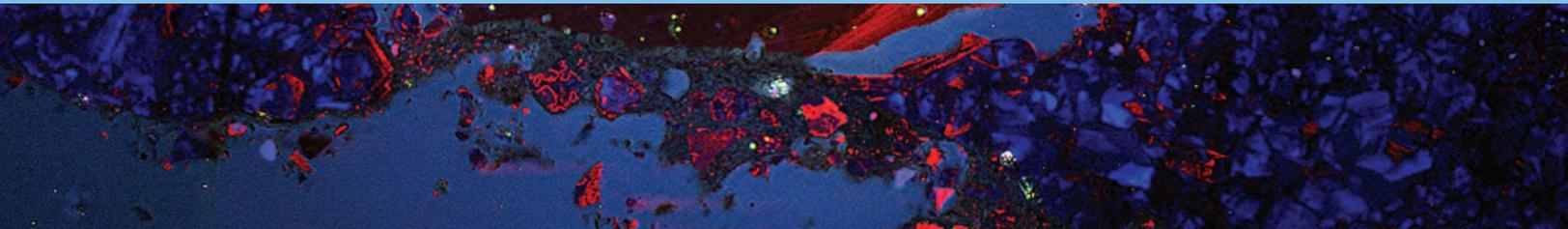
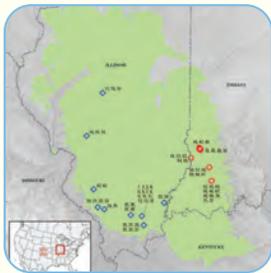


Photo: Scanning electron microscopy cathodoluminescence image showing differences in germanium concentrations in hemimorphite and sphalerite grains within a sample collected from mine tailings. Taken 2020, courtesy of Ryan McAleer and Nadine Piatak, USGS.

## Science Spotlight (Continued)...

### Trace Element Partitioning During Coal Preparation: Insights from U.S. Illinois Basin Coals



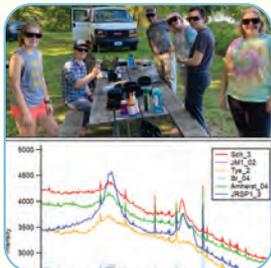
GEMSC scientists Allan Kolker and Clint Scott, along with collaborators from the USGS, Southern Illinois University, and the Indiana Geological and Water Survey, recently published a paper in the *International Journal of Coal Geology* that investigates coal quality in active mining operations in the Illinois Basin and the fate of trace elements during coal preparation. The study used the ratio of sulfur forms (Organic S/Pyritic S) to determine the overall coal cleaning efficiency at active mines in the Illinois Basin, and collected elemental data to assess partitioning during the processing stages. The concentrations of lithophile (e.g., Li, Al, rare earth) and chalcophile (e.g., As, Hg) elements decreased during the coal cleaning process and were concentrated in the coal waste fraction. These findings present a possible opportunity for recovering critical elements from coal waste, but also a potential hazard, due to enrichment in harmful elements such as Hg, As, and Pb. View the full article [HERE](#).

### Subsurface Carbon and Energy Storage Resource Assessments

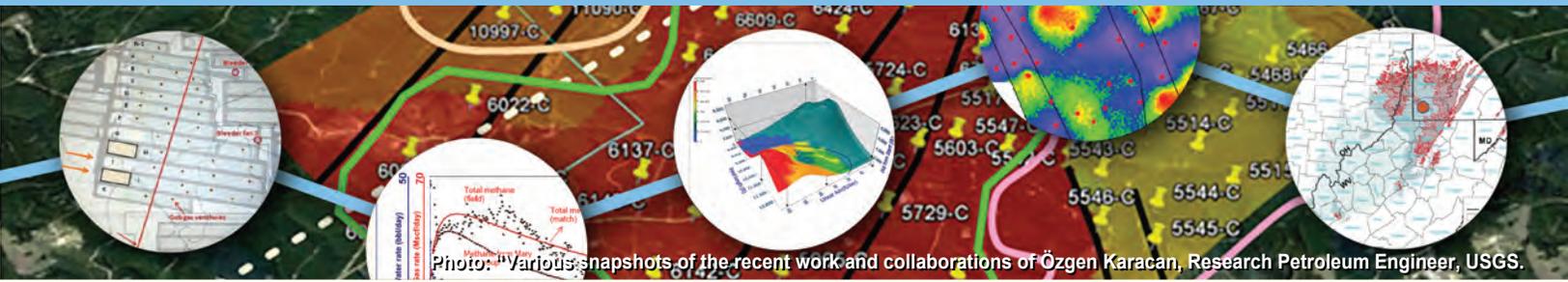


GEMSC research scientist Peter Warwick presented results of the 2013 USGS national geologic CO<sub>2</sub> storage assessment at the Geoscience, Policy, and Society (GPS) conference in June 2021. The virtual GPS conference brought together experts from around the world and focused on the crucial role of the subsurface and its resources with emphasis on renewable energy, sustainable use of resources, and low-climate impact. Peter's presentation highlighted the USGS's work on subsurface pore-space assessments in the United States and the application of these datasets to evaluate the potential of CO<sub>2</sub> enhanced oil recovery and subsurface CO<sub>2</sub> storage. Please contact Peter at [pwarwick@usgs.gov](mailto:pwarwick@usgs.gov) for more information or click [HERE](#) to visit the conference website.

### Portable Raman Analysis of Graphite: Testing a Field-Based Tool to Generate Geothermometry Data



GEMSC scientists Rebecca Stokes and Aaron Jubb, in collaboration with a team of undergraduate researchers led by Chuck Bailey from the College of William & Mary, tested the use of a portable Raman spectroscopy probe with the goal of generating geothermometry data from graphite-bearing rocks in the field. Field work was performed in early June in Central Virginia, covering the border between the Piedmont and Blue Ridge terranes. Preliminary results demonstrate the utility of the portable probe for generating spectroscopic data of high enough quality for coarse geothermometry estimates. Results from this study will be presented by one of the undergraduate team members at the upcoming GSA conference in Portland. Please contact Rebecca at [mstokes@usgs.gov](mailto:mstokes@usgs.gov) for more information about the project or equipment.



## Scientist Profile ~ Özgen Karacan...

I am a Research Petroleum Engineer. Although I was trained as a traditional petroleum reservoir engineer, the organizations that I worked and interacted with, editorship roles that I have held, and the projects I have been involved in gave me a broader perspective about topics related to, and in some cases completely unrelated to, petroleum engineering and equipped me with different skills. During my PhD studies, I was fortunate to participate in the establishment of the Petroleum Research Laboratory in Turkey. The laboratory was a public-private partnership with a mission to serve the industry and academia in funded projects. In its early years, I worked there as a lead researcher for R&D. I remember reading many thick user and maintenance guides for newly purchased instruments, such as AAS, TGA/DSC, ICP-MS, GC-MS, X-ray computed tomography (CT), and investigating instrument applications and theory from the literature as well as the standards needed for our diverse research projects.

After I graduated with my PhD, I came to the Pennsylvania State University (Penn State) as a post-doctoral fellow. I was responsible for conducting shaped-charge perforation experiments under in situ conditions imaged by X-ray CT to quantify permeability damage around perforations. During my post-doctoral tenure, we had an NSF grant to establish an X-ray tomography laboratory to support research both at Penn State and externally. I had the opportunity of being involved, again, in the establishment of the Center for Quantitative Imaging (CQI) under the Energy Institute. I became the first staff researcher of the CQI and was responsible for conducting research, mentoring graduate students in their thesis studies, using the facility and operating the scanners, and performing computational image processing for other research projects at Penn State, which led to many interesting discussions with fellow researchers. My most notable work at the CQI was a set of CT experiments using a dual-energy scan concept, where I was able to separate the differential swelling of different microlithotypes under in situ stress and mass storage when CO<sub>2</sub> was injected in coal beds. As a pioneering experiment on a popular topic at the time, this research drew much attention. John

Larsen, a great friend of mine who was editor of the Energy and Fuels journal at the time, helped interpret results of the experiment that I could not explain. John has since helped my career in many ways with his personal support.

My next career stop was with the NIOSH Pittsburgh Mining Research Division, where I worked for 14 years as a senior research scientist. My main research focus was on methane control in underground coal mines. I realized early on there was huge potential for the application of petroleum engineering methods to mining problems. By creating the synergy between these two disciplines, we had very productive years with my team and generated products that were received very favorably. Through these works, I was awarded the Alice Hamilton Science Award twice. For one project where I had plenty of spatial data, I decided to learn and apply geostatistics and wrote a paper on this work. During the same time, GEMSC's Ricardo Olea submitted a paper to the International Journal of Coal Geology for which I had been serving as the editor since 2009. When I received his paper, I sent my draft to Ricardo and asked whether he could read it and would like to collaborate for it. He read the paper and, to my great surprise, he travelled to Pittsburgh to refine my geostatistics knowledge with important hints, which was also the start of our friendship and fruitful collaboration for many years. I am indebted to Ricardo for both.

In 2017, I joined the USGS. So far, I have contributed to different tasks of the Utilization of Carbon and other Energy Gases Project as well as other projects. After working 14 years as an established scientist at NIOSH, the change was challenging at the beginning. However, after the transition period, I realized that my varied background was well suited to the USGS's broad mission. More importantly, each day I have constantly been impressed by the caliber of everyone, personally and scientifically, working in our Science Center, of which I am proud to be a part. I look forward to contributing more as best as I can.



Photo: Özgen Karacan, Research Petroleum Engineer, USGS GEMSC.



Photo: A team of undergraduate students led by Professor Chuck Bailey (College of William & Mary) and GEMSC scientist, Aaron Jubb, walking to an outcrop of graphitic phyllite in Central Virginia to test the use of a portable Raman probe in the field. Taken June 2021, courtesy of Rebecca Stokes, USGS.

### Employee Corner ~ Mary Croke...



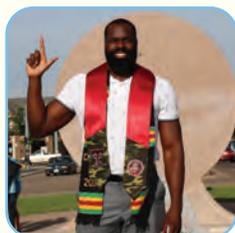
Mary Croke joined the GEMSC as an intern through the [USGS Pathways Internship Program](#). In 2018, she began working at the USGS as an intern through Northern Virginia Community College. Mary is currently pursuing a B.S. in Geology from George Mason University. She will work on data releases and data management projects within the GEMSC.

### Employee Corner ~ João Meyers...



João Meyers received a B.S. in Petroleum and Natural Gas Engineering from Unimonte, in Brazil, an M.S. in Geosciences from Shippensburg University, and is currently pursuing a Ph.D. in Environmental Science and Public Policy at George Mason University. He joined the GEMSC in May 2020 as a student contractor and started a [USGS Pathways Intern](#) position in May 2021. His areas of research include underground hydrogen storage, subsurface geology, and geochemical modeling. In his free time, João enjoys hiking, rollerblading, and outdoor activities in general.

### Employee Corner ~ Nick Small...



Nicholas “Nick” Small is a data scientist who joined the GEMSC’s Geoinformatics Team led by Bob Matthias in July 2021. He has a B.A. in Information Technology and an M.S. in Data Science from Texas Tech University. Nick specializes in migrating legacy applications to Amazon Web Services (AWS) cloud environment, developing Machine Learning and Artificial Intelligence algorithms, and designing predictive models to statistically analyze data.

### Employee Corner ~ Jessi Wilder...



Jessi Wilder joins the GEMSC as an intern through the [NAGT/USGS Cooperative Summer Fellowship Program](#). She received a B.S. in Earth Sciences at the University of Oregon in June and will start an M.S. in Geology at the University of Iceland in the Fall of 2021, with a focus on modeling structural and geomorphic evolution for use in hazard management. Jessi is working on a project entitled Depos-it models for critical resource assessment with the help of her GEMSC mentor, Graham Lederer.



Photo: Tri-basin Divide area, western Wyoming with a view to the Grand Teton Mtns. Taken in 2016 during CO<sub>2</sub> gas well sampling work, courtesy of Matt Merrill, USGS.

## Center Achievements & Recognition...

### Dave Houseknecht Receives AAPG Wallace E. Pratt Memorial Award



Congratulations to Dave Houseknecht of the GEMSC, who received the AAPG Wallace E. Pratt Memorial Award for “Petroleum systems framework of significant new oil discoveries in a giant Cretaceous (Aptian–Cenomanian) clinothem in Arctic Alaska.” The Wallace E. Pratt Memorial Award honors the author(s) of the best AAPG Bulletin article published each calendar year. We are proud of Dave and appreciate the many years of high-level science and mentoring he has provided to the USGS and to the public.

### GEMSC Team Members Embody Dedication, Passion, and Service

Many Federal workers demonstrate noteworthy dedication to public service. The GEMSC recognizes these team members who are marking significant length of service milestones for their unwavering devotion to serving the American people:

- **Mike Trippi**, 20 years, *April 2020*
- **Bernard Hubbard**, 20 years, *May 2021*
- **Allan Kolker**, 25 years, *November 2020*
- **Peter Schweitzer**, 30 years, *September 2021*
- **Leslie Ruppert**, 40 years, *August 2020*
- **Daniel Hayba**, 40 years, *November 2020*
- **Carla Kertis Brezinski**, 40 years, *April 2021*
- **Nora Foley**, 40 years, *July 2021*
- **Jane Hammarstrom**, 50 years, *February 2021*

## Join Our Team! ~ Job Opportunities...

The GEMSC frequently has opportunities for bringing in new staff. We anticipate advertising for a few positions in the next several weeks. Our anticipated needs are:

- **Research Chemist/Geologist** - GS 12/13
- **Program Analyst** - GS 11/12
- **Pathways Geologist** - GS 09/11
- **Biologist** – Recent Grads - GS 05/07

Monitor [USAJobs](#) for these upcoming vacancy announcements.

We also expect several upcoming Mendenhall post-doctoral positions, which will be listed [HERE](#).

Photo: Black Dragon Canyon area, San Rafael Swell, Utah. Taken in 2016 during natural CO<sub>2</sub> spring sampling work, courtesy of Matt Merrill, USGS.

## Quarter 3 Publications and Data Releases by GEMSC Authors...

### Publications (USGS and Outside)

An Integrated Geochemical, Spectroscopic, and Petrographic Approach to Examining the Producibility of Hydrocarbons from Liquids-rich Unconventional Formations:  
<https://doi.org/10.1016/j.fuel.2021.120357>

A Reactive Transport Model of Arsenic Cycling in a Petroleum-contaminated Aquifer:  
<https://doi.org/10.3390/w13111485>

A Review of Sand Detachment in Modern Deep Marine Environments: Analogues for Upslope Stratigraphic Traps:  
<https://doi.org/10.1016/j.marpetgeo.2021.105184>

A Review of Spatially Resolved Techniques and Applications of Organic Petrography in Shale Petroleum Systems:  
<https://doi.org/10.1016/j.coal.2021.103745>

Comment on "Correlation of the Stratigraphic Cover of the Pilbara and Kaapvaal Cratons Recording the Lead up to Paleoproterozoic Icehouse and the GOE" by Andrey Bekker, Bryan Krapež, and Juha A. Karhu, 2020, Earth Science Reviews, <https://doi.org/10.1016/j.earscirev.2020.103389>;  
<https://doi.org/10.1016/j.earscirev.2021.103594>

Insights on Geochemical, Isotopic, and Volumetric Compositions of Produced Water from Hydraulically Fractured Williston Basin Oil Wells:  
<https://doi.org/10.1021/acs.est.0c06789>

Insights on the Characteristics and Sources of Gas from an Underground Coal Mine using Compositional Data Analysis:  
<https://doi.org/10.1016/j.coal.2021.103767>

Organo-Facies and Mineral Effects on Sorption Capacity of Low Maturity Permian Barakar Shales from Auranga Basin, Jharkhand, India:  
<https://doi.org/10.1021/acs.energyfuels.0c04310>

Relating  $T_{max}$  and Hydrogen Index to Vitrinite and Solid Bitumen Reflectance in Hydrous Pyrolysis Residues: Comparisons to Natural Thermal Indices:  
<https://doi.org/10.1016/j.coal.2021.103768>

Single-well Production History Matching and Geostatistical Modeling as Proxy to Multi-well Reservoir Simulation for Evaluating Dynamic Reservoir Properties of Coal Seams:  
<https://doi.org/10.1016/j.coal.2021.103766>

Trace Element Partitioning During Coal Preparation: Insights from U.S. Illinois Basin Coals:  
<https://doi.org/10.1016/j.coal.2021.103781>

"Working on Microbes in Everything": An Interview with Denise Akob on the Natural Microbiome and Sustainability:  
<https://doi.org/10.1038/s42003-021-02300-0>

### USGS Data Releases

Dataset of Helium Concentrations in United States Wells:  
<https://doi.org/10.5066/P92QL79J>

GIS, Supplemental Data Table, and References for Focus Areas of Potential Domestic Resources of 13 Critical Minerals in the United States and Puerto Rico—Antimony, Barite, Beryllium, Chromium, Fluorspar, Hafnium, Helium, Magnesium, Manganese, Potash, Uranium, Vanadium, and Zirconium:  
<https://doi.org/10.5066/P9WA7JZY>

Injection of Deuterium and Yeast Extract at USGS Birney Field Site, Powder River Basin, Montana, USA, 2016-2020:  
<https://doi.org/10.5066/P9OPHTYH>

Input Files and Code for: Machine Learning can Accurately Assign Geologic Basin to Produced Water Samples Using Major Geochemical Parameters:  
<https://doi.org/10.5066/P95G2SZC>