Sarah Hall (AAAS Science & Technology Policy Fellow), (Un)Well stories: Private well water quality in coastal Maine.

Abstract: Negative health outcomes are known to be associated with the chronic low-dose exposure arsenic, radon, and uranium, which are commonly found in groundwater throughout New England. The shared geologic history of ancient oceans, magmatism, orogeny, and glaciation has resulted in similar fractured bedrock and surficial deposit aquifers that many rural private well owners rely on. About half of Maine residents rely on private wells for their drinking water. While state agency websites make available statistical information about potential contaminants and provide guidance about water testing and treatment, residents remain exposed to contaminants via their drinking water. The "All About Arsenic" project, hosted by the MDI Biological Laboratory in Bar Harbor, ME, enables collaboration between students, teachers, and scientists to expand water testing, education, and communication about water quality. Since 2015, the project has generated new curricular materials, multidisciplinary research, and the collection of >3000 water samples by secondary school students. College of the Atlantic students and faculty expanded this effort by offering additional testing to look for spatial and temporal patterns in groundwater quality and found that some contaminant abundances vary throughout the year, in some cases to levels exceeding state and EPA limits. These results suggest that the current well water guidelines in Maine are not sufficient to ensure the health of residents in rural communities. Further, this study highlights the unique "well stories" associated with each private well resulting from the many different physical (e.g. well type, bedrock, landscape position, season) and social (e.g. use, maintenance, treatment/filtration) characteristics contributing to the water chemistry; these unique well stories are not well represented in the guidance materials available to well owners. Coupled with existing barriers to testing and mitigation, private well owners are left vulnerable to being exposed to harmful contaminants.

Bio: Sarah Hall is currently an AAAS Science & Technology Policy Fellow working in the Natural Hazards Mission Area of the USGS. After majoring in Geology at Hamilton College, she worked at an environmental consulting firm and served as an AmeriCorps Team Member in Atlanta, Georgia. She completed her PhD in Earth Science at the University of California, Santa Cruz with a focus in geomorphology and geochronology. Studying neotectonics in the Andean forearc and the glacial history of the Peruvian Andes, she considered questions on the climate and tectonic evolution of the Andean Orogen. Since 2012, Sarah has been a geoscience professor at College of the Atlantic in Bar Harbor, ME, teaching undergraduate students and conducting community-based drinking water quality research and watershed projects within and around Acadia National Park. For the last decade she has been an active member of the Geological Society of Maine and looks forward to engaging with the Geological Society of Washington community.

Bonnie McDevitt (USGS), Radium mineral associations within abandoned mine drainage relevant to the future of critical mineral extraction.

Abstract: While coal mine drainage (CMD) poses a regional water-quality issue across Appalachia, these fluids also tend to have elevated concentrations of rare earth elements (REEs) and other critical minerals (elements), such as cobalt (Co) and nickel (Ni). These elements have been documented to co-precipitate with Fe, Mn, and Al oxyhydroxides within CMD treatment systems. In some cases, REE concentrations in solid phases are upwards of 2,500 mg/kg. Radium (Ra), a known carcinogen, has also been documented to sorb to Fe- and Mn- rich river sediments in a stream impacted by both upstream CMD and treated oil

and gas wastewater in Pennsylvania. Despite potentially serious human and environmental impacts from Ra contamination, a baseline assessment of Ra in CMD and associated solids has never been conducted. Such a study is necessary in conjunction with evaluating the potential for extracting REEs from CMD treatment facilities. To test the hypothesis that Ra may accumulate with REE and other critical elements in CMD solids, we collected water and sediment samples from 4 bituminous and 9 anthracite CMD sites in Pennsylvania, representing gradients of pH, metals, and SO_4 concentrations. Our data suggest Ra concentrations were relatively low in CMD water and corresponding solid samples (<0.5 Bq/L and upwards of 850 Bq/kg, respectively) and positively correlated with increasing Mn content in solids (R^2 = 0.90). Sequential leaching of solids, largely composed of amorphous Fe, Al, and Mn oxyhydroxide and silicate minerals, indicate that Ra is largely retained in recalcitrant minerals less susceptible to dissolution. REEs are also largely retained in the solids throughout the leaching process. While retention of Ra throughout sequential leaching has environmental and human health benefits related to reduced mobility, associations with REEs in solids may lead to concentration of Ra in effluents or solids if REE extraction and subsequent solids manipulation is economically viable. These results provide an understanding of overall Ra activities and fate and transport behavior in CMD-impacted environs and are discussed with perspective toward guiding targeted REE and critical mineral extraction activities.

Bio: Bonnie McDevitt is a Research Physical Scientist at the U.S. Geological Survey where she conducts research on energy-related wastewaters and assesses potential environmental impacts of wastewater management. Most recently, Bonnie is co-leading a Bipartisan Infrastructure Law research effort to quantify watershed scale environmental impacts from coal mining in Appalachia. Bonnie completed a Mendenhall post-doctoral fellowship from 2020 to 2023 studying radium treatment in oil and gas produced water. She obtained her B.S. from the University of Delaware in 2012 and her PhD in Environmental Engineering from Penn State University in 2020. Bonnie worked for 3 years in the domestic drinking water and municipal wastewater treatment field prior to returning for a PhD.

Rebecca Stokes (USGS)**,** The role of graphite in a changing energy landscape: a geological perspective

Abstract: Natural crystalline graphite is an industrial mineral of high criticality for the U.S. economy, driven by its use as the primary anode material in Li-ion batteries— a technology crucial for the energy transition away from fossil fuels. In response to graphite's criticality, the U.S. Geological Survey is currently exploring research topics regarding the geologic occurrence of graphite deposits and the associated physicochemical properties. Crystalline graphite can form in a range of geologic environments, from high-temperature metamorphic terranes to moderate-temperature hydrothermal vein systems. Thus, despite its simple chemistry and easily conceptualized sheet-structure, natural graphite can have a wide range of physical and chemical characteristics, all of which may have deleterious or beneficial effects on battery anode performance. This presentation will review the importance of graphite in advanced technology applications and highlight several related research topics including the surprising range of trace element chemistry and trace mineral textures in crystalline graphite.

Bio: Rebecca Stokes is a research scientist at the USGS where she conducts research in the broad field of energy materials characterization. Rebecca's current research projects include graphite characterization for battery applications and the catalytic role of clays in natural hydrocarbon production. Rebecca Stokes received her B.S. in Geology from Texas A&M University in 2006, and a M.S. (2008) and Ph.D. (2012) from Indiana University focused on metamorphic petrology. Rebecca was a Postdoctoral

Associate at MIT from where she helped developed an alternative potash fertilizer using K-feldspar. Rebecca worked in the mineralogy group at Chevron from 2013-2019 and joined the USGS in 2020. Rebecca is an active member in the Clay Minerals society and serves as Chair of the Source Clays Committee.