NATIONAL ACADEMIES Sciences Engineering Medicine

Board on Earth Sciences and Resources | Committee on Earth Resources

Brines as a Resource for Critical Minerals

Joint BESR/CER Spring Meeting

May 7, 2024

10:30 am ET In-person participants arrive for registration, welcome, and breakfast

WELCOME (Keck 100)

11:00 am ET **Welcome**
Isabel Montañez, BESR Chair
David Spears, CER Chair

OVERVIEW TALKS

*moderated by David Spears

11:10 am **Hydrogeological origin of brines (12 min + 5 min Q&A)**
Jennifer McIntosh, University of Arizona

11:27 am **Domestic Resources (12 min + 5 min Q&A)**
Scott Hynek, U.S. Geological Survey

DOMESTIC RESOURCES

*moderated by Michael Manga

11:45 am **Oil and gas/basinal brines (8 min)**
Madalyn Blondes, USGS

11:55 am **Geothermal brines (8 min)**
Pat Dobson, Lawrence Berkeley National Laboratory

12:05 pm **Shallow and Surface Lithium Brines (8 min)**
LeeAnn Munk, University of Alaska

12:15 pm **Panel Discussion**

12:45 pm **Break**

EXTRACTION, IMPACTS, AND ECONOMICS
*moderated by Isabel Montañez

1:30 pm **Overview of DLE and other technologies (10 min + 5 min Q&A)**
Tom Lograsso, Critical Minerals Institute

1:45 pm **Environmental impacts and hazards of brine utilization (10 min + 5 min Q&A)**
Sophie Parker, The Nature Conservancy

2:00 pm **Economics of brine resources (10 min + 5 min Q&A)**
Simon Jowitt, University of Nevada-Reno

2:15 pm **Break**

RESEARCH NEEDS AND OPPORTUNITIES
*moderated by Doug Hollett

2:30 pm **Research Needs Panel Discussion**

1. Jennifer McIntosh, University of Arizona
2. Scott Hynek, U.S. Geological Survey
3. Madalyn Blondes, U.S. Geological Survey
4. Pat Dobson, Lawrence Berkeley National Laboratory
5. LeeAnn Munk, University of Alaska
6. Tom Lograsso, CMI
7. Sophie Parker, Nature Conservancy
8. Simon Jowitt, University of Nevada-Reno

3:15 pm **Research Opportunities (8 min presentations each)**
Hichem Hadjeres, DOE-FECM
Alex Prisjatschew, DOE-GTO
Steve Mackwell, NSF

3:45 pm **Adjourn**

~~~~~~

4:00 pm **Gilbert White Lecture from BESR's Geographical and Geospatial Sciences Committee**
Kyle Whyte, University of Michigan
~~~~~~

SPEAKER BIOGRAPHIES

Madalyn Blondes is the co-Lead of the Oil & Gas Waters Project at the U.S. Geological Survey (USGS) and is also leading the USGS National Assessment of CO2 Storage Resources through CO2 Mineralization. The Oil and Gas Waters Project provides information on the volume, quality, commodities, impacts, and possible uses of water produced during generation and development of energy resources, particularly hydrocarbons, in order to address scientific and societal questions regarding the linkage between energy development and water resources. Madalyn obtained her B.A. from the Pomona College Geology Department in 2003 and her Ph.D. from the Yale University Department of Geology & Geophysics in 2008. She did postdoctoral research at the University of Maryland before joining the USGS in 2010.

Pat Dobson is an Earth Staff Scientist in the Energy Geosciences Division at Lawrence Berkeley National Laboratory. He joined Berkeley Lab in 2000 and has been involved in a variety of geologic and geochemical research projects related to geothermal systems and geologic high-level nuclear waste disposal. He was the lead of Berkeley Lab's Geothermal Systems Program from 2016 until his retirement from full-time employment at the Lab in 2023, but he is still active as a rehired retiree. Prior to joining Berkeley Lab, he worked as a geologist for Unocal Corporation in their research laboratory and geothermal division. He was a postdoctoral fellow at Caltech and UC Santa Barbara, and received his Ph.D in geology from Stanford University. He was the lead scientist for the recently completed collaborative study "Characterizing the Geothermal Lithium Resource at the Salton Sea".

Hichem Hadjeres is currently a program manager with U.S. Department of Energy Fossil Energy and Carbon Management.

Scott Hynek is a hydrologist with the Utah Water Science Center.

Simon Jowitt is the tenured Director of the Ralph J. Roberts Center for Research in Economic Geology and the Arthur Brant Chair of Exploration Geology at the University of Nevada, Reno. He was previously an associate professor of economic geology at the University of Nevada, Las Vegas and a research fellow and lecturer at Monash University. His research focuses on the use of geochemistry to unravel geological processes to understand mineralizing systems, petrology, mineral exploration, global tectonics, and the links between magmatism and metallogeny. He has also undertaken research on mineral economics, global metal resources, the security of supply of critical elements, the "economic" side of economic geology, the environmental impact of mining, and the potential uses of mining and other wastes for metal production and CO2 sequestration. He is currently the Vice-President for Student Affairs for the Society of Economic Geologists (SEG) and was awarded the SEG's Waldemar Lindgren Award in 2014. Jowitt received a B.Sc. (Hons) degree in geology from the University of Edinburgh, an M.Sc. in Mining Geology from the Camborne School of Mines, and a Ph.D. from the University of Leicester.

Thomas Lograsso is the Director of the Critical Materials Institute (CMI). He has been a member of its Leadership team since the inception of CMI, leading the Developing Substituting Focus area initially. Lograsso has been a materials scientist at the Ames National Laboratory since 1988. Lograsso's research specialty is solidification physics, and he has applied his

background to the synthesis and design of new novel materials in single crystalline forms. Tom is a co-inventor of a rare-earth free substitute (Galfenol) for the magnetostrictive alloy, Terfenol-D which contains the critical elements Tb and Dy. Lograsso received his B.S., M.S. and Ph.D. degrees in Metallurgical Engineering from Michigan Technological University.

Alexis McKittrick is currently a program manager in the U.S. Department of Energy (DOE) Geothermal Technologies Office. She serves on the SWE board of directors in her personal capacity. Prior to joining the DOE, Dr. McKittrick served as a senior researcher at the IDA Science and Technology Policy Institute in Washington, D.C., where she conducted nonpartisan research and analysis for the White House Office of Science and Technology Policy and various federal agencies. She also worked in the U.S. Environmental Protection Agency's Climate Change Division, focusing on greenhouse gas analysis and policy for the oil and gas, chemicals, and semiconductor sectors.

Jennifer McIntosh is a Professor and University Distinguished Scholar in the Department of Hydrology and Atmospheric Sciences at the University of Arizona (UA), and a Joint Faculty member in the UA Geosciences Department (2006-present). She also held an Adjunct Research Geologist position with the United States Geological Survey (2007-2017) and is currently an Adjunct Professor at the University of Saskatchewan. McIntosh is a fellow of the Geological Society of America and the Canadian Institute for Advanced Research (CIFAR) Earth 4D: Subsurface Science and Exploration Program. McIntosh received her PhD in Geology from the University of Michigan (2004) and was the Morton K. and Jane Blaustein Postdoctoral Fellow at Johns Hopkins University in Earth and Planetary Sciences (2004-2006). Her research focuses on solute and isotope chemistry of fresh to saline fluids to constrain sources, residence times, biogeochemical reactions, and flowpaths of waters, solutes (including lithium and other critical elements), and gases in the earth's shallow crust.

Lee Ann Munk is a Professor of Geochemistry and Geological Sciences at the University of Alaska and Director of the Alaska Critical Minerals Cooperative. Her research expertise is in environmental and exploration geochemistry and resource geology with an emphasis on solutions for the energy transition. She is focused on improving the understanding of the origin of continental lithium brines and emerging lithium deposits including low temperature "oil field" brines and volcanic-sedimentary lithium deposits. Her research team is also a global leader in the development of watershed-scale frameworks for sustainable approaches to lithium brine extraction. Their innovative work synthesizes remote sensing, hydrogeology, geochemistry, geophysics, and subsurface geologic datasets to advance scientific understanding of lithium deposits, exploration methods, and environmental issues relevant to stakeholders.

Sophie Parker is the Director of Science for Climate and Land Use in the California Chapter of The Nature Conservancy. She leads a team of scientists focused on generating the evidence, relationships, and communications necessary to design and implement cutting-edge strategies to further biodiversity conservation in this era of rapid environmental change. She holds a B.A. in Biological Sciences from Wellesley College, and a Ph.D. from the Department of Ecology, Evolution, and Marine Biology at the University of California, Santa Barbara. Prior to joining The Nature Conservancy in 2008, Parker was a postdoctoral scholar studying soil microbial

ecology in California grasslands. One of her long-term career goals is to better integrate the fields of soil science and ecosystem ecology into conservation practice.

Alexandra Prisjatschew is a general engineer with U.S. Department of Energy Geothermal Technology Office.