

Alaska's Critical Minerals

Supporting Alaska's decision makers with critical minerals and rare earth elements information

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Critical minerals are non-fuel minerals essential to the economic and national security of the United States, the supply of which is vulnerable to disruption. The absence of these critical minerals would have significant consequences for our economy and national security.

Critical Minerals and Rare Earth Elements

The importance of rare earth elements (REE) cannot be overstated. According to the Department of Energy (DOE), since 1988, China has been the dominant supplier of REE and critical minerals (REE/CM) for global markets.

With hundreds of uses in clean energy, oil refining, electronics, batteries (particularly for electric vehicles), lighting, and defense technologies, rare earths are critical to the stability and growth of modern society.

Critical Minerals and Rare Earth Elements continued

The U.S. is presently heavily reliant on imports to supply REE and associated compounds for the products that require them such as permanent magnets, motors, and turbines. As such, a secure, reliable, and sustainable domestic supply of these strategic resources is essential to the continued well-being of our Nation's energy and electronics industries. It is an important contributor to our national security. Alaska, with our abundant resources, can help!

DOE's Carbon Ore, Rare Earth and Critical Minerals (CORE-CM) Initiative for U.S. Basins has been designed to address the upstream and midstream critical minerals supply chain and the downstream manufacturing of high-value, nonfuel, carbon-based products, to accelerate the realization of full potential for carbon ores and critical minerals within U.S. mineral-rich basins.

On behalf of DOE's Office of Fossil Energy and Carbon Management, the National Energy Technology Laboratory (NETL) competitively awarded funds to 13 CORE-CM centers throughout the United States to establish teams from private industry, universities, and state and federal government to develop and implement strategies that will enable specific U.S. basins to realize their full economic potential for producing REE/CM and high-value, nonfuel, carbon-based products.

Led by UAF's Institute of Northern Engineering and the Alaska Division of Geologic and Geophysical Surveys, the Alaska CORE-CM program is a public-private endeavor intended to spur economic growth in Alaska while meeting the nation's need for critical minerals and rare earth elements. The Alaska CORE-CM program spans across the three major academic units of the University of Alaska system, includes several companies, and seeks to establish Alaska as a leader in the REE/CM industry.

In the first Alaska's Critical Minerals newsletter, we described the scope of the Alaska CORE-CM program. In this newsletter we will be discussing: (1) an approach for preparing a Strategic Plan addressing each element of the value chain; (2) the scientists and researchers across the UA system who are making things happen, and (3) what has been done so far to position Alaska to be a strategic supplier of REE/CM for the nation.

UAF is preparing to compete for additional funds from DOE/NETL's CORE-CM program. If successful, DOE will provide additional funds supporting implementation of an Alaska-specific Technology Innovation Center that addresses the technical needs associated with developing Alaska's REE/CM industry.

The Alaska CORE-CM Approach

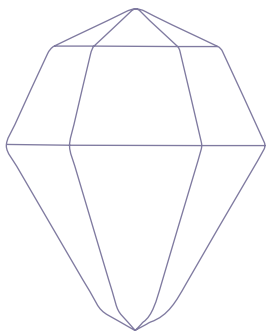
The first phase of the CORE-CM program is to plan. The Alaska CORE-CM team is reaching out to many of Alaska's operating mines, as well as placer miners, to better understand their needs in order to enable them to better pursue REE/CM. One avenue is the Stakeholder Meeting, September 13-14, 2023, at UAF. The overarching questions that will be addressed during this meeting are:

- What makes the most sense for Alaska and our unique environment?
- How can our universities identify, and address, miner's needs for research and testing?

Answers to these questions will form the basis for two strategic planning documents. The first is the Alaska CORE-CM plan that will become part of the continuation application to DOE. If successful, this will be the avenue that provides

the initial funding for the Alaska Technology Innovation Center (TIC). It will be dedicated to serving industry by providing research results that can lead to Alaska becoming the nation's dominant REE/CM producer. The second strategic planning document will include many of the same elements as the first, but will also include recommendations more appropriately addressed to the State policy makers and regulators.

A key requirement for preparing actionable plans that reflect the needs of the industry is engaging knowledgeable people. In addition to reaching out to industry, the Alaska CORE-CM program has assembled a large team of mining engineers, chemists, other scientists, educators, researchers, state agencies, and more. We will have additional information on these team members in this and later Alaska's Critical Minerals newsletters.



A key requirement for preparing plans that reflect the needs of the industry is engaging knowledgeable people. We have assembled a large team of mining engineers, chemists, other scientists, educators, researchers, state agencies, and more.



Brent Sheets

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Brent Sheets is the principal investigator for the CORE-CM project. Wise utilization and development of Alaska's abundant natural resources is Brent's passion.

Since 2016 he serves as the director of University of Alaska Fairbanks' (UAF) Petroleum Development Laboratory where he engages industry, state and federal agencies, and university researchers to serve the oil and coal industry's research needs, and now minerals. The Petroleum Development Lab has projects concerning enhancing Alaska's oil production; CO2 capture, utilization and sequestration; and developing a combined heat and power plant on a former refinery site; and the CORE-CM project which has a talented, and ever-growing, team of professionals.

Prior to working for the university, Sheets spent more than 20 years working in various management and leadership positions for the US Department of Energy. Sheets has been with the University of Alaska Fairbanks since 2011.



Billy Connor

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Billy Connor, PE, is the acting director of INE and the director of UAF's Arctic Infrastructure Development Center since 2005. He is retired from the

Alaska Department of Transportation and Public Facilities where he served as the Statewide Research Manager for six years.

Since joining UAF, Connor has managed three university transportation centers, remained active in the Transportation Research Board (TRB) where he was recognized as a featured speaker at TRB's Dialog With Leaders Lecture and continues to be active in his work to improve the performance of low volume roads.

For the last five years, Connor has been a key member of the National Science Foundation "Navigating the New Arctic project Landscape Evolution and Adapting to Change in Ice-rich Permafrost Systems."



David Barnes

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Dr. Barnes, PE, is a research professor at University of Alaska Fairbanks specializing in assessing and mitigating environmental impacts. He also

holds a research and teaching position at Montana State University (MSU) in Bozeman, Montana.

Prior to moving to MSU, Barnes was at UAF for 24 years as an associate dean of research, professor of civil and environmental engineering, INE director, and interim director of the Water and Environmental Research Center (WERC). He was the first principal investigator on the funding provided by the State of Alaska to address critical minerals in the state.

For the CORE-CM program Barnes work focuses on environmental impacts of critical mineral production in Alaska and mitigating these impacts. Specifically he is focusing on 1) the treatment and management of the waste streams produced by extracting CM/REE from tailings and other byproducts of mining and 2) the environmental impacts of processing tailings.

Barnes received his B.S. and M.S. in civil engineering from New Mexico State University and his Ph.D. from Colorado State University.



Brandon Briggs

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Dr. Briggs is a professor of geomicrobiology in the Department of Biological Sciences at the University of Alaska Anchorage. He has been at the

university since 2015 and is working in the areas of mineral extractions and separations and leading the development of the Technology Innovations Center.

Briggs attended Idaho State University for his bachelor's and master's degree, and Oregon State University for his Ph.D.



Subhabrata Dev

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Dr. Dev is a research assistant professor and works in the Water and Environmental Research Center at UAF where he has been a professor for the past five years.

Dev's research interests include critical minerals recovery, acid mine drainage treatment, mining wastes remediation, and water quality. For CORE-CM, Dev is working on developing critical minerals strategies from mining waste streams.

Dev received his Ph.D. from the Indian Institute of Technology Kharagpur, India.



Rajive Ganguli

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Dr. Ganguli, PE, was on the mining engineering faculty at UAF for almost 20 years and served as the chair of the Mining and Geological Engineering department, and

director of the Mineral Industry Laboratory. He has led or worked on projects involving rare earth mineral processing, bacterial remediation of mine tailings, coal combustion, mine sampling, machine learning and workforce development.

Now an associate dean at the University of Utah, Ganguli's research interests include machine learning and the various grand challenges of mining. For Core-CM, Ganguli is leading the waste stream task and has interacted with the mining industry and acquired tailings samples that are being used to generate key data.

Ganguli holds three degrees in mining engineering, including a Ph.D. in mining engineering from the University of Kentucky. He is a Registered Professional Engineer (Mining) in Alaska.



Tathagata Ghosh

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Dr. Ghosh is an associate professor, chair of the Department of Mining and Mineral Engineering, and director of the Mineral Industry Research Lab (MIRL) at

UAF where he has taught and conducted research for the past 10 years. His areas of expertise lie in mineral processing, innovative separations and extraction technologies of REEs, and tailings management. He is collaborating on the development of the Technology Innovation Center.

Ghosh's research interests include advanced beneficiation technologies, REE separation methods, computational fluid dynamics applications in mineral processing, numerical modeling, dry separation, advanced physical processing, comminution, population balance modeling, process simulation and control, coal preparation, fine particle processing, gravity separation techniques, flotation, and agglomeration.

For CORE-CM, he is working on advanced REE separations circuits and flowsheet design; development of the Technology Innovation Center, and methods of REE extraction from Alaskan Mine Tailings.



Menghua (Marty) Liu

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Dr. Liu is an associate professor of analytical chemistry and the director of the Advanced Instrumentation Laboratory at the UAF Geophysical Institute. He

has been a researcher for eight years. His research interests are critical minerals, high temperature partitioning of siderophile elements and highly siderophile elements and application to magmatic sulfide deposits. The partitioning experiment results and control factors can be applied to REE and other critical minerals' exploration, extraction and waste management.

For CORE-CM, Liu is working on mineralogy and mineral characterization, and will conduct partitioning experiments on REE and related elements to provide/constrain utilized conditions and methods for the exploration and extraction of critical minerals.

Liu graduated from the University of Western Ontario.

Bob Loeffler

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Bob Loeffler is a research professor of public policy at the University of Alaska Anchorage where he specializes in land and resource issues, the mineral industry and Alaska's economy. He has been with the UAA Institute of Social and Economic Research since 2010. Most of his teaching involves economic, fiscal, and social issues surrounding Alaska's resource base and the Alaska economy and much of his research involves the mining industry.

Loeffler holds B.S. and M.S. degrees from Stanford and a Master of City and Regional Planning from Harvard.



Lee Ann Munk

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Dr. Munk is the lead scientist of the Alaska Critical Minerals Hydrogeochemistry Lab at the University of Alaska Anchorage. She is a geoscientist

and geochemist with over 25 years of experience leading research on critical minerals and related trace elements in ore deposits and the environment. Her broader research is centered on the origin and hydrogeochemistry of lithium deposits and other energy transition CM such as REEs and copper. She is currently a professor in the Department of Geological Sciences at UAA.



Eric Peterson

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As a researcher with more than 40 years' experience, Dr. Peterson is providing expertise in the areas of strategic and critical minerals and separations

science to the CORE-CM team. He has spent the past 30 years at Idaho National Laboratory, at DOE headquarters in the Office of Energy Efficiency and Renewable Energy, and at the National Science Foundation. For the CORE-CM project, is working in the areas of strategic and critical materials and separations science and technology.

Peterson acquired his Ph.D. in chemistry from Montana State University.

The Alaska CORE-CM Approach continued

The Alaska CORE-CM team meets weekly, and various subgroups have been formed to address different aspects of the value chain. These include resource assessment, waste stream reuse, separations and processing technology, and soon will include refining and manufacturing. By meeting regularly, we have identified areas for collaboration across academic units and with industry, including technology providers and vendors.

The University is making strategic investments in equipment and personnel based on these collaborations. Much of what has been accomplished so far will be discussed during the September stakeholder meeting. The Alaska CORE-CM team will be seeking input to confirm its investments, to date, have been wise investments and to ensure we follow the most beneficial path going forward.

What makes the most sense for Alaska and our unique environment?

Alaska has vast strategic and critical mineral deposits, but infrastructure is lacking. Unlike most other jurisdictions, a new development in Alaska generally has additional costs of building roads, putting in bridges, providing power for heat and mine operations, building remote work camps and, often, transporting workers when a mine is remotely located. In the lower 48, tying a proposed mine to existing infrastructure is usually an option...in Alaska, not so much. So, lack of infrastructure must not be overlooked, and it is not an area overlooked by the CORE-CM program.

How can our universities identify and address miner's needs for research and testing?

The primary objective of the September Stakeholder meeting is to learn what the mining industry needs to develop the REE/CM resources.

The University of Alaska has received \$7.8 million from the state for REE/CM research and development. The university has been building capacity by acquiring new lab equipment, refurbishing laboratory space, and hiring additional researchers to expand our in-state knowledge-base and research and testing capabilities.

The September Stakeholder meeting is an opportunity to share what the University of Alaska has accomplished and to seek feedback regarding the university's next steps for helping to establish an REE/CM industry in Alaska.

A few examples for how the University of Alaska is investing its resources include:

- Purchased an Inductively Coupled Plasma Mass Spectrometry (ICP-MS). This device can be used to assess the concentration of specific elements within a mineral sample.
- Purchased a Laser Induced Breakdown Spectrometer (LIBS) system to provide real-time lithium analysis.
- Refurbished an X-ray spectrometer and hired a mineralogist.
- Hired an additional faculty member who is an expert in hyperspectral data processing, analysis and data interpretation.
- Acquired airborne hyperspectral data from several regions across Alaska.
- Purchased a modern underground mining truck to replace a 1980s model that did not have current technology. The mining truck will be used to train new mine workers.
- Developing a novel and sustainable biotechnological method for extracting and concentrating rare earth elements from a variety of Alaskan feedstocks.
- Developed new exploration techniques using artificial intelligence for copper-cobalt exploration in Alaska.



Sean Regan

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Dr. Regan has a broad background in geochronology, with most emphasis given to U-Th-Pb systematics of a wide array of chronometers (monazite, zircon,

rutile, apatite, and columbite) and has helped oversee the new Noble Gas Mass Spectrometer at the Geophysical Institute. His background is broadly in igneous and metamorphic petrology, ductile structure, and critical minerals systems.

Regan has a B.Sc. from St. Lawrence University, and an M. Sc. and Ph.D. from the University of Massachusetts Amherst, where he worked extensively on petrochronology of high-grade gneiss terranes.

After briefly working as a research geologist at the U.S. Geological Survey where he focused on rare earth element systems, Regan became an assistant professor at UAF and joined the UAF Geophysical Institute in 2020. His current research covers a broad range of topics including structural evolution of the Denali fault, magma transport and emplacement, and multi-phase geochronology of critical mineral systems.



Martin Stuefer

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Dr. Stuefer is a research professor at the UAF Geophysical Institute, the director of the Alaska Climate Research Center, the director of the

Hyperspectral Imaging Laboratory (HyLab), and the State Climatologist. He conducts research within the Geophysical Institute on the University of Alaska Fairbanks campus.

In support of Alaska's interest in critical minerals and rare earth elements, Stuefer is acquiring data across the Alaska Range and in Interior Alaska from the Canadian border to the Lost River historical tin mine on the Seward Peninsula.



Patrick Tomco

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Dr. Tomco is an associate professor of chemistry and has been with the University of Alaska since 2011 when he held a postdoctoral research scientist position. In 2017, he was named the director of the Applied Science Engineering and Technology Laboratory.

Tomco acquired his Ph.D. in agricultural and environmental chemistry from the University of California, Davis. His research interests include: nutrient cycling, contaminant fate and transport, LC/MS/MS instrumental analysis, biodegradation, stable isotope methodology, terrestrial-aquatic interactions, and microbial ecology.

The Alaska CORE-CM Approach continued

Going Forward

A strong multidisciplinary scientific team has come together to understand and build upon previous efforts for developing Alaska's vast CORE-CM resources.

The Alaska CORE-CM team will promote development of REE-CM extraction wherever it makes economic sense. And for areas where it is not quite economical, it will organize research to address lowering the entry cost of production. We will also be providing workforce training. With this comprehensive vision in mind, the highly diverse (academics, industry, state agencies, and national labs) and subject matter experts on our Alaska team (geologists, chemists, biologists, mining engineers, etc.) seeks industry guidance so that, working through public-private partnerships, we can jointly address our unique Alaskan needs.

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Alaska CORE-CM Stakeholder Input Meeting

September 13–14, 2023

8:30 a.m.

Wood Center | University of Alaska Fairbanks
1731 S. Chandalar Drive, Fairbanks, Alaska

We need *your help* to identify how the University of Alaska can support critical mineral development in our state.

