Center for Critical Minerals Strategy
A Project of Commanding Heights

Critical Minerals Potential and Projects: Illinois

This document provides background on critical minerals potential and projects in Illinois. Pursuant to Section 7002 of the Energy Act of 2020, the U.S. Department of Interior designated 50 minerals as "critical minerals," [1] which includes many of the key minerals used in electric vehicle (EV) batteries and green technologies, such as lithium, cobalt, manganese, nickel, graphite, and rare earth elements (REE). Copper is not considered a critical mineral, but because of its intensive use in EV batteries, copper resources were considered when preparing this summary.[2]

Critical Minerals Potential

Illinois may have potential in rare earth elements (REEs), but these resources are still being explored. These resources are thought to be concentrated in two areas, Hicks Dome and the Illinois Coal Basin.

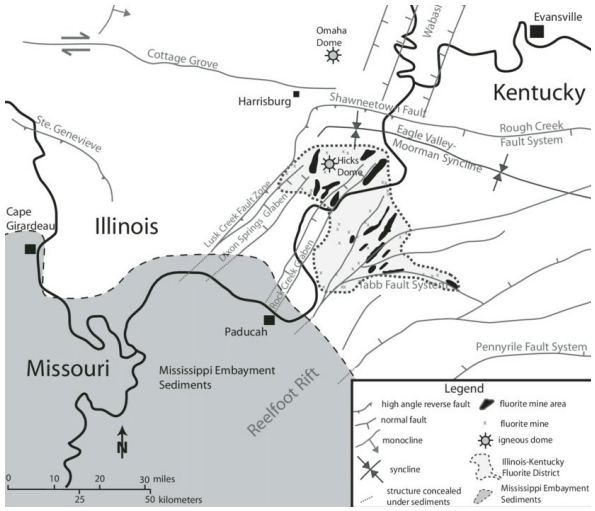
Hicks Dome

Hicks Dome is a mountain in Hardin County in southeastern Illinois near the border with Kentucky (see Map 1). Geologically, it is located in the Illinois-Kentucky Fluorspar District.[3] The Illinois-Kentucky Fluorspar District is the second-largest deposit of fluorspar, a critical mineral used to manufacture aluminum and steel, in the United States.[4] Historically, this area was mined for fluorspar from the early 1840s to the early 1990s, with the last fluorspar mine closing in 1996.[5]

REEs also occur in Hicks Dome, which contains reserves of 61,700 metric tons.[6] As of September 2022, American Lithium Minerals has acquired mineral rights around Hicks Dome, totaling 1358 gross acres, and planned to begin exploration in spring 2023.[7] The SAFE team was unable to find a more recent update.

[1] US Department of Interior, "2022 Final List of Critical Minerals," 2022, https://d9-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/s3fs-public/media/files/2022%20Final%20List%20of%20Critical%20Minerals%20Federal%20Register%20Notice_2222022-F.pdf.
[2] The Department of Energy has designated copper as a "critical material" for energy.
[3] Wilson, K.R., August 2019, "Rare Earth Elements at Hicks Dome, Southern Illinois, Their Mode of Mineralization and Relationship with Igneous Intrusions," Thesis, Southern Illinois University, https://www.proquest.com/dissertations-theses/rare-earth-elements-at-hicks-dome-southern/docview/2307147009/se-2.
[4] Schulz, K.J., DeYoung, J.H., Jr., Seal, R.R., II, and Bradley, D.C., eds., 2017, Critical mineral resources of the United States—Economic and environmental geology and prospects for future supply: U.S. Geological Survey Professional Paper 1802, 797 p., http://doi.org/10.3133/pp1802.
[5] Denny, F.B., Goldstein, A., Devera, J.A., Williams, D.A., Lasemi, Z., Nelson, 2008, "The Illinois-Kentucky Fluorite District, Hicks Dome, and Garden of the Gods in southeastern Illinois and northwestern Kentucky," The Geological Society of America, http://dx.doi.org/10.1130/2008.fld012(02).
[6] Bellora, J.D., Burger, M.H., Van Gosen, B.S., Long, K.R., Carroll, T.R., Schmeda, Germán, and Giles, S.A., 2019, Rare Earth Element Occurrences in the United States (ver. 4.0, June 2019): U.S. Geological Survey data release, https://doi.org/10.5066/F7FN15D1.
[7] American Lithium Minerals, Sept. 21, 2022, "Rare earths: An essential part of the green energy revolution," Innovation News Network, https://www.innovationnewsnetwork.com/rare-earths-an-essential-part-of-the-green-energy-revolution/25593/.

Map 1: Map of Hicks Dome and the Illinois Kentucky Fluorite District



Source: Denny, F.B., Goldstein, A., Devera, J.A., Williams, D.A., Lasemi, Z., Nelson, W.J. via The Geological Society of America.

Illinois Basin

The Illinois Basin underlies 70% of Illinois and parts of Indiana and Kentucky (see Map 2). The Illinois Basin hosts multiple energy resources, including oil, gas, and coal.[8] Coal is the most significant resource historically: coal mining has taken place in 76 out of the 102 counties in Illinois, with a total of over 7,400 coal mines having opened since the beginning of commercial mining in the 1870s.[9] Today, Illinois is one of the five largest coal-producing states, producing 35,614 thousand short tons or 6.3% of total U.S. coal production in 2021.[10]

Map 2. Map of the Illinois Basin

Source: Whittaker, S., Elrick, S., and Berg, R. via Illinois State Geological Survey

[8] Denny, F.B., Goldstein, A., Devera, J.A., Williams, D.A., Lasemi, Z., and Nelson, W.J., April 4, 2022, "The Illinois Basin: the geologic gift that keeps giving," Illinois State Geological Survey, https://blogs.illinois.edu/view/8931/1168229593#image-2.
[9] Borrow, A., Oct. 4, 2021, "Built on coal," University of Illinois, https://storied.illinois.edu/built-on-coal/#!
[10] U.S. Energy Information Administration, Nov. 8, 2022, "Which states produce the most coal?," https://www.eia.gov/tools/faqs/faq.php?id=69&t=2.

Coal and coal by-products, such as coal ash and coal waste piles, are considered potential sources of REEs, especially heavy REEs.[11] The economic viability of mining for REEs depends on the concentration of the REEs in the source material and the concentration of higher-value REEs.[12] The concentration of REEs in coal and coal by-products tends to be lower than in traditional commercial deposits. However, coal and coal by-products may include higher concentrations of heavy REEs. Since heavy REEs are relatively rarer than light REEs, and therefore more expensive, this may help the competitiveness of REE extraction from coal and coal by-products.[13] Extraction of REEs from coal ash and coal waste piles has the additional benefit of reuse and environmental remediation.[14]

The U.S. Department of Energy National Energy Technology Laboratory and the University of Kentucky found concentrations of greater than 300 ppm in coal samples from the Illinois Coal Basin.[15] Other studies of Illinois Coal Basin fly ash found average concentrations of 337 ppm.[16]

Major Mining Projects

As of October 2023, there are no major mining projects for REEs in Illinois. One project, the Will Scarlett Rare Earths Recovery Project, is in the exploration/pilot phase. **There are two major ongoing research initiatives related to REEs and other critical minerals potential in the state, the Illinois Basin Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Project and the Earth Mapping Resources Initiative (Earth-MRI).**

Will Scarlett Rare Earths Recovery Project

The Will Scarlett Rare Earths Recovery Project is located outside of Marion, Illinois on a closed coal mine site in the Illinois Coal Basin. In October 2019, Avalon Advanced Materials, an Australian company, and Coal Strategy Advisors, a U.S. company, signed an agreement to develop the project.[17] The goal of the project is to use "innovative new extraction technology" to recover REEs from waste at the mine site, which would also help with environmental remediation.[18] In February 2020, Avalon announced plans to construct a small-scale pilot facility by May/June 2020, however, the SAFE team could not find confirmation that this was successful.[19]

Illinois Basin Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Project

The Illinois Basin Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Project of the University of Illinois/Illinois State Geological Survey and funded by the U.S. Department of Energy through the National Energy Technology Laboratory. Other partners include Southern Illinois University, University of Kentucky, Oak Ridge National Lab, SynTerra, Indiana Geological and Water Survey, Kentucky Geological

[11] U.S. Department of Energy, 2017, "Report on Rare Earth Elements from Coal and Coal Byproducts,"https://www.energy.gov/fecm/articles/rare-earth-elements-report-congress.
[12] Das, S., Gaustad, G., Sekar, A., and Williams, E., 2018, "Techno-economic Analysis of Supercritical Extraction of Rare Earth Elements from Coal Ash," Journal of Cleaner Production, https://doi.org/10.1016/j.jclepro.2018.03.252.
[13] U.S. Department of Energy, "Report on Rare Earth Elements from Coal and Coal Byproducts."
[14] Das, S., Gaustad, G., Sekar, A., and Williams, E., "Techno-economic Analysis."
[15] U.S. Department of Energy, Nov. 29, 2017, "High Concentrations of Rare Earth Elements Found in American Coal Basins," https://www.energy.gov/articles/high-concentrations-rare-earth-elements-found-american-coal-basins.
[16] Das, S., Gaustad, G., Sekar, A., and Williams, E., "Techno-economic Analysis."
[17] Avalon Advanced Materials, Oct. 23, 2019, "Avalon signs binding letter of intent to earn interest in the Will Scarlett rare earths recovery project, Illinois, USA," https://avalonadvancedmaterials.com/news_media/news_releases/index.php?content_id=886
[18] Avalon Advanced Materials, April 13, 2020, "Avalon provides corporate update and outlines plans for summer work programs," https://avalonadvancedmaterials.com/news_media/news_releases/index.php?content_id=897
[19] Ibid.

Survey, Iowa Geological Survey, and Tennessee Geological Survey.[20] The goal of the project is to "evaluate the domestic occurrence of strategic elements in coal, coal-based resources, and waste streams from coal use in the region of the Illinois Basin."[21] The project includes a basin-wide assessment of REEs and critical minerals in coal and coal by-products; regional infrastructure, industries, and businesses; and innovative technologies for extraction. The project also includes the development of Technology Innovation Centers.[22]

Earth Mapping Resources Initiative (Earth MRI)

The Earth Mapping Resources Initiative (Earth MRI), a USGS program, was established in 2019 and expanded under the Bipartisan Infrastructure Law.[23] The goal of the program is to enhance geologic information and to identify regions with undiscovered critical minerals potential.[24] Under the Bipartisan Infrastructure Law, USGS has partnered with state geological surveys, including the Illinois Geological Survey, to support and expand data collection. In 2020, the USGS announced $106,978 in funding for critical minerals projects in Illinois that would allow the Illinois Geological Survey to participate in two geochemistry reconnaissance surveys in the Illinois Coal Basin – one focusing on lithium and REE potential in underclay deposits and one focusing on REE potential in phosphate rocks.[25] The USGS will also do a geophysical survey of southern Illinois and neighboring regions in other states, focusing on REEs, barium, beryllium, cobalt, fluorine, germanium, niobium, and titanium.[26] The results of these surveys for Illinois have not been publicly released.

[20] Freiburg, J.T., October 25-27, 20233, "The Illinois Basin Carbon Ore, Rare Earth, and Critical Minerals Initiative," U.S. Department of Energy National Energy Technology Laboratory, https://netl.doe.gov/sites/default/files/2022-11/ILBasin_CORE-CM_DOE_2022_redact.pdf
[21] "Illinois Basin Carbon Ore, Rare Earth, and Critical Minerals Initiative," Sept. 18, 2023, National Energy Technology Laboratory, https://netl.doe.gov/node/11905.
[22] Ibid.
[23] U.S. Geological Survey, Jan. 20, 2023, "Agency Information Collection Activities; Earth Mapping Resources Initiative (Earth MRI) Competitive Cooperative Agreement Program with State Geological Surveys," https://www.federalregister.gov/documents/2023/01/20/2023-01020/agency-information-collection-activities-earth-mapping-resources-initiative-earth-mri-competitive.
[24] U.S. Geological Survey, n.d., "Earth Mapping Resources Initiative (Earth MRI)," https://www.usgs.gov/special-topics/earth-mri.
[25] Communications and Publishing, Sept. 29, 2020, "Earth MRI Funds Critical Minerals Projects in Illinois," U.S. Geological Survey, https://www.usgs.gov/news/state-news-release/earth-mri-funds-critical-minerals-projects-illinois.
[26] Ibid.