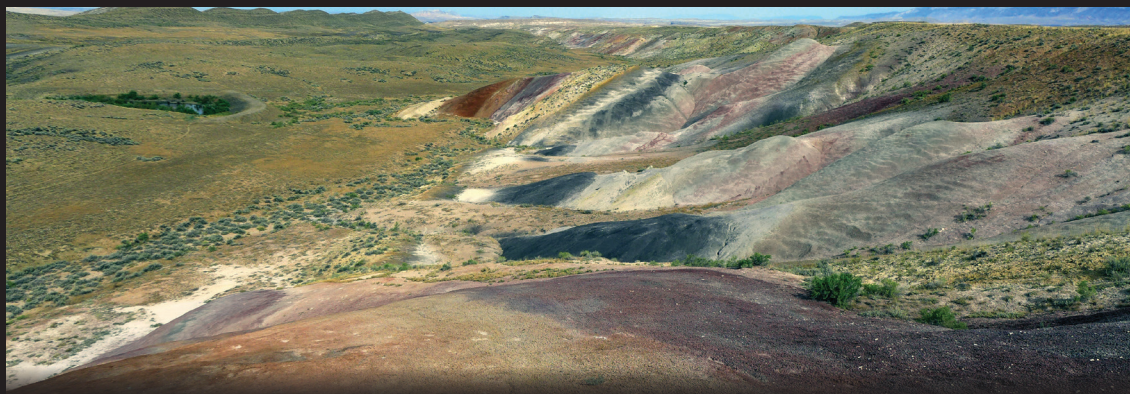


Critical Minerals in Wyoming

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Summary Report



Wyoming State Geological Survey
Erin A. Campbell, Director and State Geologist

Laramie, Wyoming
phone: 307-766-2286
email: wsgs-info@wyo.gov
website: www.wsgs.wyo.gov



Intrepreting the past,
providing for the future

On May 18, 2018, the U.S. Department of the Interior, Office of the Secretary, finalized a list of 35 mineral commodities deemed critical.

What is a critical mineral?

According to the Federal Register's legal definition, a critical mineral is a non-fuel mineral or mineral material essential to the economic and national security of the United States, the supply chain of which is vulnerable to disruption, and that serves an essential function in the manufacturing of a product, the absence of which would have significant consequences for our economy or our national security. Critical minerals are vital in order for a sector of the economy to function and have no viable substitutes.

More information is available at:

www.wsgs.wyo.gov/minerals/critical-minerals

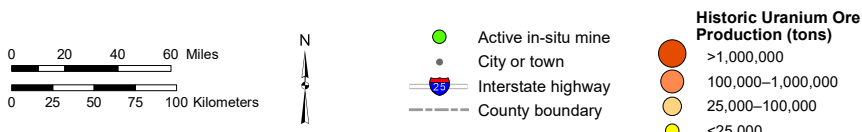
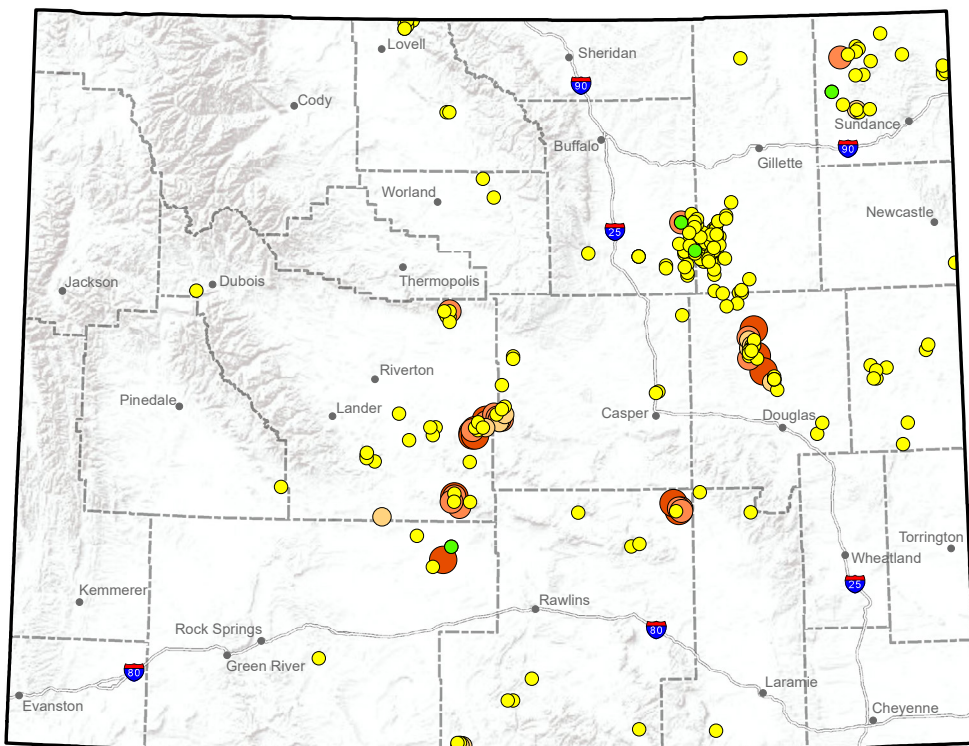
Critical minerals are important not only to the United States, but also to Wyoming's economy. In the past five years the Wyoming State Geological Survey (WSGS) has made a concerted effort to understand the geologic occurrence and recovery potential of some of these minerals in the state.

Wyoming's greatest critical mineral development potential is in uranium, helium, rare earth elements, and titanium. Uranium and helium have made, and continue to make, significant contributions to the state's economy. There is also potential in vanadium and the platinum group elements. Additional critical elements—produced as by-products associated with

commercial production of other minerals—have the potential to contribute to the state's economy and may in fact help facilitate the development of these other commercially viable resources.

Uranium

Wyoming has led the United States in uranium production for several decades and continues to do so despite depressed market conditions. There are currently four active uranium-mining operations in Wyoming, one each in Campbell, Crook, Johnson, and Sweetwater counties. The Lost Creek in-situ recovery mine, in Sweetwater County, currently is the largest con-



Uranium production and mine locations throughout Wyoming. The state has produced more than 238 million pounds of U_3O_8 , also known as yellowcake, since the early 1950s from over 200 mines. Current production is from in-situ operations in Campbell, Crook, Johnson, and Sweetwater counties.

tributor in Wyoming with approximately 1.9 million pounds of yellowcake (uranium concentrate) produced between August 2013 and September 2018. The largest contributor to Wyoming's production over the decades has been the Gas Hills uranium district in Fremont and Natrona counties, though there are no active mines in the district at this time.

Statewide, there are 11 operations in application and regulatory review, according to the U.S. Nuclear Regulatory Commission. On October 1, 2018, Wyoming assumed "Agreement State" status, meaning that the Wyoming Department of Environmental Quality will take primacy over the regulation of Source and By-product Material Licenses in the state, a role previously held by the Nuclear Regulatory Commission. Agreement State status will reduce the time required during the permitting process by eliminating duplicity by regulatory agencies.

Helium

The Shute Creek natural gas processing plant in eastern Lincoln County is one of two in the nation that produce Grade-A (99.997% pure) helium. Helium and other natural gases are gathered from deep wells drilled into the Madison Limestone in the LaBarge field in western Sublette County and shipped via pipeline to the Shute Creek facility. The LaBarge field is near the northern terminus of the Moxa Arch, a large anticline that contains much of western Wyoming's oil and gas and the highest concentration of helium in the state. The WSGS estimates 14.78 billion cubic feet of marginally economic and sub-economic helium resources exist beyond the known resources on the Moxa Arch, including those in the Greater Green River, Wind River, Powder River, and Bighorn basins and the western Wyoming thrust belt.

Rare Earth Elements

Rare earth elements (REE), a group of 17 metallic elements with similar chemical and physical properties, occur throughout Wyoming. The Bear Lodge REE deposit in Crook County is one of the largest in the country. The deposit hosts 10 identified REE and an estimated resource of nearly 1.1 billion pounds of rare earth oxides. REE enrichment occurs in a variety of geologic environments in



WSGS geologist uses a handheld X-ray fluorescence analyzer to check the chemistry of veins in an underground mine at South Pass City. This tool is helpful in determining the presence of critical and economic elements.

35 critical minerals

aluminum (bauxite)	graphite (natural)	rubidium
antimony	hafnium	scandium
arsenic	helium	strontium
barite	indium	tantalum
beryllium	lithium	tellurium
bismuth	magnesium	tin
cesium	manganese	titanium
chromium	niobium	tungsten
cobalt	platinum group metals	uranium
fluorspar	potash	vanadium
gallium	rare earth elements	zirconium
germanium	rhenium	

The list, published in the Federal Register, volume 83, number 97, pg. 23,295–23,296, is at <https://www.federalregister.gov/documents/2018/05/18/2018-10667/final-list-of-critical-minerals-2018>.

the state, including carbonatites, granites, various types of dikes, paleoplacers, phosphatic zones, and as secondary mineralization in fluid-altered sandstones.

Understanding Wyoming's Critical Mineral Resources

The WSGS is developing two online tools to aid the understanding and exploration of Wyoming's mineral resources. The Mines and Minerals Map of Wyoming, an interactive online map, enables users to browse, research, and download verified data for locations across the state. This map is currently available and updated frequently.

The second online tool, available in early 2019, incorporates more than 48,000 samples analyzed for up to 67 different elements into a predictive model. The model estimates known and potential areas of enrichment for each element across the state. It also highlights areas of unsampled and unlikely potential. These powerful tools will be useful in guiding future critical and economic mineral studies throughout Wyoming.

Selected WSGS critical minerals publications (available as free downloads at www.wsgs.wyo.gov/minerals/critical-minerals):

- Mineral Resources of Wyoming, Bulletin 50
- Uranium: Geology and Applications, Public Information Circular No. 46
- Rare Earth Elements in Wyoming, Report of Investigations No. 65
- A Comprehensive Report on Rare Earth Elements in Wyoming, Report of Investigations No. 71
- Iron Resources in Wyoming, Report of Investigations No. 67
- Phosphate Rock in Wyoming, Report of Investigations No. 68
- Lithium Resources in Wyoming, Report of Investigations No. 69
- Zeolite Resources in Wyoming, Report of Investigations No. 72
- Online Mines and Minerals Map of Wyoming

Caption for cover photo: Variegated layers of the Cloverly-Morrison formations in Big Horn County, Wyoming, contain calcium-phosphate concretions significantly elevated in REE concentrations.