ST.038
Critical Mineral Potential of the United States: Why do we care? What and Where?

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The U.S. is 100% import reliant for graphite, niobium, and rare earth elements (REEs), and more than 50% reliant for cobalt, tin, tungsten, and other commodities that are increasingly in demand for emerging technologies. Interest in identifying domestic sources of critical minerals in the United States led to mandates from the government for the USGS to develop criteria for defining criticality, establish a list of critical mineral commodities, and partner with State Geological Surveys and others to acquire new framework geologic data (mapping, geophysics, lidar) for evaluating the potential for new and as-yet-undiscovered critical mineral resources. To guide selection of areas for new data collection, the Earth MRI (Mapping Resources Initiative) was established to outline focus areas that could contain critical mineral resources based on existing geologic data. The first phase of Earth MRI identified focus areas for REEs; the second phase considered focus areas for aluminum (bauxite, alunite), cobalt, graphite, lithium, niobium-tantalum, platinum-group elements (PGEs), tin, titanium, and tungsten. These commodities occur in various deposit types that form in diverse mineral systems; these systems operate in specific geotectonic settings to form a variety of genetically related ore deposits. Mineral systems are much larger than ore deposits and have features that are more likely to be detected by new framework geologic data. Identification of one part of a large mineral system raises the possibility that related ore deposit types may be present nearby or under cover. Focus areas are therefore defined to encompass mineral systems that are known, or inferred, to contain critical mineral-bearing ore deposits.

The mineral systems most likely to host future U.S. REE resources are magmatic REE systems (carbonatites, alkaline igneous rocks), placers and paleoplacers (monazite in heavy mineral sands), marine chemocline systems (REE-rich phosphorites), and deposit types associated with iron oxide-apatite and iron oxide copper-gold systems (Fig. 1). Focus areas for mid-Paleozoic phosphates that could host REEs were selected from formations identified on state-scale geologic maps. Generalized outlines of known mining districts or mineral belts, distributions of occurrences, and geochemical or geophysical anomalies are the basis for some focus areas. Mafic magmatic systems that host PGEs and cobalt, for example, are partly exposed in the mid-continent rift area of the central U.S. where new geophysical data are crucial for evaluating potential buried resources. Some focus areas contain known mineral deposits or occurrences of critical mineral commodities that are actively mined or may have produced in the past. Other focus areas are geologically permissive for the occurrence of critical minerals because the focus area has evidence of the presence of particular mineral systems. Priorities for selecting specific focus areas for new work consider the land status relative to exploration and development potential, the data needs for defining target areas, and the likelihood that new discoveries could reduce import reliance. National and regional maps represent a first step in selecting areas for new data acquisition to evaluate the critical mineral potential of the United States.

Fig. 1. Focus areas for REE-bearing mineral systems in the United States.