Critical Minerals in the Context of Global Mineral Resources

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Why Are Minerals Important?

Technology is growing more complex...

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~30 elements

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~75 elements
China used more cement in the last three years than the U.S. used in the entire 20th century.

U.S.
in 100 years
4.5 gigatons
[1901-2000]

China
in 3 years
6.6 gigatons
[2011-2013]

Sources: USGS, Cement Statistics 1900-2012; USGS, Mineral Industry of China 1990-2013
~4X more population than 100 years ago
~6X more per capita consumption than 100 years ago
~26X more production than 100 years ago
Main Points:

◆ As world population and standards of living increase, new resources are needed

◆ Recycling, even if 100% efficient, cannot supply entire need

◆ More efficient or innovative manufacturing and technology can help, but cannot supply entire need

◆ Complete life cycle analysis needs to include upstream (exploration, discovery, and production) as well as downstream (manufacturing, recycling, disposal) parts of the cycle
World Trade

Although the US is a major producer and exporter of many commodities such as molybdenum and beryllium, it relies on world trade for most mineral resources and is >90% reliant on imports for 24 commodities, including REE.

Source: USGS Mineral Commodity Summaries (2016)
MAJOR IMPORT SOURCES OF NONFUEL MINERAL COMMODITIES FOR WHICH THE UNITED STATES WAS GREATER THAN 50% NET IMPORT RELIANT IN 2015

EXPLANATION
Number of commodities, 2015
- 0
- 1 to 3
- 4 to 6
- 7 to 12
- 13 to 18
- 19 to 24

Source: U.S. Geological Survey
A critical mineral as defined in a 2008 National Academy of Sciences report is one that is both essential in use and subject to the risk of supply restriction.

Mineral Commodity Summaries 2016

The Principal Rare Earth Elements Deposits of the United States—A Summary of Domestic Deposits and a Global Perspective

USGS Scientific Investigations Report 2010–5220
Critical Minerals Summary

1) World reserves are adequate, but production is limited and/or dominated by a few sources – e.g., China; supply disruption is possible.

2) Several bills concerning critical minerals currently pending in Congress

3) Future Federal policy guided by the work of several ongoing White House (OSTP) studies:
   a) Critical Materials - Criteria & prioritization
   b) Critical Materials information – sources, gaps, needs
   c) Critical Materials - Long term R&D strategy & needs
   d) Materials Genome Initiative

4) Data & Research cooperation with EU, EC, and Tri-Lateral Commission

5) New and ongoing research
   USGS – Genesis and resources of REE deposits, e.g., Mountain Pass, Bokan Mtn, etc.
   USGS – Annual Mineral Commodity Summaries & Minerals Yearbook
   DOE – Critical Materials Institute (CMI) – discussed by Rod Eggert