RARE EARTHS[1]

(Data in metric tons of rare-earth oxide (REO) content, unless otherwise noted)

Domestic Production and Use: Rare earths were mined by one company in 2000. Bastnasite, a rare-earth fluocarbonate mineral, was mined as a primary product by a firm in Mountain Pass, CA. The United States was a leading producer and processor of rare earths and continued to be a major exporter and consumer of rare-earth products. Domestic ore production was valued at an estimated $14 million. Refined rare-earth products were produced primarily by three companies with operations in Phoenix, AZ; Freeport, TX; and Chattanooga, TN. The estimated value of refined rare earths consumed in the United States was more than $700 million. The approximate distribution in 1999 by end use was as follows: automotive catalytic converters, 60%; glass polishing and ceramics, 11%; permanent magnets, 8%; petroleum refining catalysts, 7%; metallurgical additives and alloys, 6%; rare-earth phosphors for lighting, televisions, computer monitors, radar, and X-ray intensifying film, 2%; and miscellaneous, 6%.

Salient Statistics—United States:	1996	1997	1998	1999	2000[e]
Production:					
Bastnasite concentrates	[2]20,400	[e]10,000	[e]5,000	[e]5,000	5,000
Imports:[3] Thorium ore (monazite)	56	11	—	—	—
Rare-earth metals, alloys	429	529	953	1,780	2,370
Cerium compounds	3,180	1,810	4,940	3,990	4,300
Mixed REO's	879	974	2,530	5,980	2,290
Rare-earth chlorides	1,070	1,450	1,680	1,530	1,030
Rare-earth oxides, compounds	10,300	7,070	3,720	7,760	11,800
Ferrocerium, alloys	107	121	117	120	128
Exports:[3] Rare-earth metals, alloys	250	991	724	1,600	1,830
Cerium compounds	6,100	5,890	4,640	3,960	3,870
Other rare-earth compounds	2,210	1,660	1,630	1,690	1,590
Ferrocerium, alloys	4,410	3,830	2,450	2,360	1,830
Consumption, apparent[4]	W	19,400	11,500	11,500	17,900
Price, dollars per kilogram, yearend:					
Bastnasite concentrate, REO basis	2.87	2.87	2.87	2.87	2.87
Monazite concentrate, REO basis	0.48	0.73	0.73	0.73	0.73
Mischmetal, metal basis, metric ton quantity[5]	7-11	8-12	6-8	5-7	5-7
Stocks, producer and processor, yearend	W	W	W	W	W
Employment, mine and mill, number	NA	327	183	102	100
Net import reliance[4] as a percent of apparent consumption	18	E	56	70	72

Recycling: Small quantities, mostly permanent magnet scrap.

Import Sources (1996-99): Monazite: Australia, 67%; France, 33%; Rare-earth metals, compounds, etc.: China, 71%; France, 23%; Japan, 3%; United Kingdom, 1%; and other, 2%.

Tariff: Item	Number	Normal Trade Relations 12/31/00
Thorium ores and concentrates (monazite)	2612.20.0000	Free.
Rare-earth metals, whether or not intermixed or interalloyed	2805.30.0000	5.0% ad val.
Cerium compounds	2846.10.0000	5.5% ad val.
Mixtures of REO's except cerium oxide	2846.90.2010	Free.
Mixtures of rare-earth chlorides, except cerium chloride	2846.90.2050	Free.
Rare-earth compounds, individual REO's (excludes cerium compounds)	2846.90.8000	3.7% ad val.
Ferrocerium and other pyrophoric alloys	3606.90.3000	5.9% ad val.

Depletion Allowance: Monazite, 22% on thorium content and 14% on rare-earth content (Domestic), 14% (Foreign); bastnasite and xenotime, 14% (Domestic and foreign).

Government Stockpile: None.

Prepared by **James B. Hedrick [(703) 648-7725, jhedrick@usgs.gov, fax: (703) 648-7722]**

RARE EARTHS

Events, Trends, and Issues: Domestic demand for rare earths in 2000 was higher than that of 1999. U.S. imports of rare earths remained at high levels in most trade categories as a result of the temporary closure of the rare-earth separation plant at Mountain Pass, CA. The plant is expected to resume separation operations. The mine continued to produce bastnasite concentrates and cerium concentrates. The trend is for continued increased use of the rare earths in many applications, especially automotive catalytic converters, permanent magnets, and rechargeable batteries.

Researchers at the U.S. Department of Energy's Ames Laboratory developed a new group of rare-earth-containing alloys that boost the cooling performance of cryocoolers.[6] The erbium-based alloys can absorb 25% to 175% more heat than the lead regenerators presently used in many cryocoolers. Cryocoolers are refrigeration devices that cool scientific equipment, magnetic resonance imaging scanners, medical fertility and anthropomorphic storage systems, and defense equipment components.

The *4th International Conference on f-elements* was held in Madrid, Spain, during September 17-21, 2000. The *4th International Conference on Rare Earth Development and Applications* is scheduled for June 15-20, 2001, in Beijing, China. The conference, *Rare Earths—2001* is planned for September 22-26, 2001, in Sao Paolo, Brazil.

World Mine Production, Reserves, and Reserve Base:

	Mine production[e]		Reserves[7]	Reserve base[7]
	1999	2000		
United States	5,000	5,000	13,000,000	14,000,000
Australia	—	—	5,200,000	5,800,000
Brazil	1,400	1,400	280,000	310,000
Canada	—	—	940,000	1,000,000
China[8]	70,000	70,000	43,000,000	48,000,000
India	2,700	2,700	1,100,000	1,300,000
Malaysia	350	250	30,000	35,000
South Africa	—	—	390,000	400,000
Sri Lanka	120	120	12,000	13,000
Former Soviet Union[9]	2,000	2,000	19,000,000	21,000,000
Other countries	—	—	21,000,000	21,000,000
World total (rounded)	82,000	81,000	100,000,000	110,000,000

World Resources: Rare earths are relatively abundant in the Earth's crust, but discovered minable concentrations are less common than for most other ores. U.S. and world resources are contained primarily in bastnasite and monazite. Bastnasite deposits in China and the United States constitute the largest percentage of the world's rare-earth economic resources, while monazite deposits in Australia, Brazil, China, India, Malaysia, South Africa, Sri Lanka, Thailand, and the United States constitute the second largest segment. Xenotime, rare-earth-bearing (ion adsorption) clays, loparite, phosphorites, apatite, eudialyte, secondary monazite, cheralite, and spent uranium solutions make up most of the remaining resources. Undiscovered resources are thought to be very large relative to expected demand.

Substitutes: Substitutes are available for many applications, but generally are less effective.

[e]Estimated. E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1]Data includes lanthanides and yttrium, but excludes most scandium. See also Scandium and Yttrium.

[2]As reported by Molycorp, Inc. employee.

[3]REO equivalent or contents of various materials were estimated. Data from U.S. Census Bureau.

[4]Monazite concentrate production was not included in the calculation of apparent domestic consumption and net import reliance. Net import reliance defined as imports - exports + adjustments for Government and industry stock changes.

[5]Price range from Elements - Rare Earths, Specialty Metals and Applied Technology, Trade Tech, Denver, CO.

[6]U.S. Department of Energy, Ames Laboratory, 2000, Versatile set of alloys could enhance performance of cryocoolers, Ames, IA, Ames Laboratory, News Release, August 21, 2 p.

[7]See Appendix C for definitions.

[8]Number reported in China Rare Earth Information, Baotou, Inner Mongolia, China, v. 6, no. 2, p. 1.

[9]As constituted before December 1991.