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 1999. 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 $32 million. Refined rare-earth products were produced primarily by two companies; one with operations in Phoenix, AZ, and Freeport, TX; and another with a plant in Chattanooga, TN. The estimated value of refined rare earths consumed in the United States was more than $600 million. The approximate distribution in 1998 by end use was as follows: automotive catalytic converters, 35%; petroleum refining catalysts, 10%; glass polishing and ceramics, 31%; permanent magnets, 5%; metallurgical additives and alloys, 14%; phosphors, 3%; and miscellaneous, 2%.

Salient Statistics—United States:	1995	1996	1997	1998	1999[e]
Production: Bastnasite concentrates	[2]22,200	[2]20,400	[e]10,000	[e]5,000	5,000
Imports:[3] Thorium ore (monazite)	22	56	11	—	—
Rare-earth metals, alloys	905	429	529	953	1,270
Cerium compounds	2,740	3,180	1,810	4,940	4,080
Mixed REO's	678	879	974	2,530	8,430
Rare-earth chlorides	1,250	1,070	1,450	1,680	1,760
Rare-earth oxides, compounds	6,500	10,300	7,070	3,720	5,600
Ferrocerium, alloys	78	107	121	117	122
Exports:[3] Rare-earth metals, alloys	444	250	991	724	1,010
Cerium compounds	5,120	6,100	5,890	4,640	4,240
Other rare-earth compounds	1,550	2,210	1,660	1,630	1,560
Ferrocerium, alloys	3,470	4,410	3,830	2,450	1,900
Consumption, apparent[4]	W	W	19,400	11,500	17,700
Price, dollars per kilogram, yearend:					
Bastnasite concentrate, REO basis	2.87	2.87	2.87	2.87	2.87
Monazite concentrate, REO basis	0.44	0.48	0.73	0.73	0.73
Mischmetal, metal basis, metric ton quantity[5]	8-11	7-11	8-12	6-8	5-7
Stocks, producer and processor, yearend	W	W	W	W	W
Employment, mine and mill, number	NA	NA	327	183	100
Net import reliance[4] as a percent of apparent consumption	6	18	E	56	72

Recycling: Small quantities, mostly permanent magnet scrap.

Import Sources (1995-98): Monazite: Australia, 75%; and France, 25%; Rare-earth metals, compounds, etc.: China, 75%; France, 19%; Japan, 3%; United Kingdom, 1%; and other, 2%.

Tariff: Item	Number	Normal Trade Relations 12/31/99
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: Percentage method, monazite, 23% on thorium content and 15% on rare-earth content (Domestic), 15% (Foreign); bastnasite and xenotime, 15% (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 1999 was higher than that of 1998. U.S. imports of rare earths increased in most trade categories, however, domestic mine production remained lower than historical levels because of a blocked wastewater pipe at the mine at Mountain Pass, CA. Significant delays in governmental approvals to repair or install a new pipe have resulted in consideration of alternative processes and evaporative systems. Domestic rare-earth exports were lower in most trade categories, primarily the result of continued depressed markets in southeast Asia. The overall trend is for increased use of rare earths in automotive catalytic converters, permanent magnets, and rechargeable batteries.

The U.S. Department of Energy provided $750,000 in funding to researchers at its Ames Laboratory and Astronautics Corp. of America to build a prototype rotary magnetic-refrigeration unit. The magnetic-refrigeration unit is based on a rare-earth alloy of gadolinium, silicon, and germanium.[6]

The *22nd Rare-Earth Research Conference* was held in Argonne, IL, from July 11-15, 1999. The conference *Rare-Earth-Doped Materials and Devices IV* is scheduled for January 22-28, 2000, in San Jose, CA. The *4th International Conference on f-elements* is planned for September 17-21, 2000, in Madrid, Spain.

World Mine Production, Reserves, and Reserve Base:

	Mine production[e]		Reserves[7]	Reserve base[7]
	1998	1999		
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]	65,000	65,000	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)	76,600	76,500	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 in Unocal Corp. annual reports and as estimated by the USGS commodity specialist.

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

[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, 1999, Work begins on prototype magnetic-refrigeration unit: Ames, IA, Ames Laboratory news release, May 25, 1 p.

[7]See Appendix C for definitions.

[8]Number reported in China Rare Earth Information, Baotou, Inner Mongolia, China.

[9]As constituted before December 1991.