RARE EARTH ELEMENTS (REE) IN NEW MEXICO—SUMMARY

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INTRODUCTION

Rare earth elements (REE) are increasingly becoming more important in our technological society and are used in many of our electronic devices. REE include the 15 lanthanide elements (atomic number 57-71), yttrium (Y, atomic number 39), and scandium (Sc; Table 1) and are commonly divided into two chemical groups, the light REE (La through Eu) and the heavy REE (Gd through Lu and Y). REE are lithophile elements (or elements enriched in the crust) that have similar physical and chemical properties (Table 1), and, therefore, occur together in nature. The name REE is misleading; the content of the REE in the earth's crust ranges from 60 ppm for Ce to ~0.5 ppm for Tb and Lu, which is greater than the crustal abundance of silver (Ag). Four REE (Y, La, Ce, and Nd) have larger crustal abundances than lead (Pb). However, REE are not always concentrated in easily mined economic deposits and only a few deposits in the world account for current production. Thorium (Th), uranium (U), niobium (Nb) and other elements typically are found with REE; most deposits are radioactive because of their Th and U content.

The U.S. once produced enough REE for U.S. consumption, but since 1999 more than 90% of the REE required by U.S. industry have been imported from China. However, the projected increase in demand for REE in China, India, United States, and other countries could result in increased exploration and ultimate production from future deposits in the U.S. and elsewhere. Furthermore, specific REE are becoming more economically important. Recently, the Chinese government announced that it is examining the economic feasibility of continuing to export REE from their deposits. REE deposits have been reported from New Mexico (Fig. 1; Table 2), but were not considered important exploration targets because the demand in past years has been met by other deposits in the world. However, with the projected increase in demand and potential lack of available production form the Chinese deposits, these areas in New Mexico should be re-examined for their REE potential. For the purposes of this report, a REE occurrence is defined as 1) production of REE minerals, 2) whole-rock chemical analysis of approximately 1000 ppm total REE, 500 ppm Y, or 100 ppm Sc, or 3) REE minerals found in sufficient quantities to be considered a mineral resource. Production of REE from New Mexico deposits is in Table 3. An open-file report on REE in New Mexico is in progress.

TABLE 1. Rare earth elements (REE) * Promethium does not occur naturally.

Rare Earth Element	Symbol	Oxide	Conversion factor (% element x conversion factor - % oxide)	Atomic Number	Abundance in the upper crust (ppm)
Scandium	Sc	Sc_2O_3		21	14
Yttrium	Y	Y_2O_3	1.269	39	21
Lanthanum	La	La_2O_3	1.173	57	31
Cerium	Ce	Ce_2O_3	1.171	58	63
Praseodymium	Pr	Pr_2O_3	1.17	59	7.1
Neodymium	Nd	Nd_2O_3	1.166	60	27
Promethium	Pm	*	*	61	*
Samarium	Sm	Sm_2O_3	1.16	62	4.7
Europium	Eu	Eu_2O_3	1.158	63	1.0
Gadolinium	Gd	Gd_2O_3	1.153	64	4.0
Terbium	Tb	Tb_2O_3	1.151	65	0.7
Dysprosium	Dy	Dy_2O_3	1.148	66	3.9
Holmium	Ho	Ho_2O_3	1.146	67	0.83
Erbium	Er	Er_2O_3	1.143	68	2.3
Thulium	Tm	Tm_2O_3	1.142	69	0.30
Ytterbium	Yb	Yb_2O_3	1.139	70	2.2
Lutetium	Lu	Lu_2O_3	1.137	71	0.31
Thorium	Th	ThO_2	1.138		
Zirconium	Zr	ZrO_2	1.351		
Niobium	Nb	Nb_2O_5	1.431		

TABLE 2. This is a list of mining districts and selected mines containing REE in New Mexico, including districts with REE in NURE stream sediments. District (DIS) or Mines (NM) Identification Number is from the New Mexico Mines Database. Supporting data while be in the final open-file report.

District or Mines Identification number	District (Selected Aliases)	Year Of Discovery	Other Selected Commodities Present	Age of REE Deposits	Type Of REE Deposit
Bernalillo County					
NMBE0007	Monte Largo	1960s	REE, U, Th, Nb	Cambrian-Ordovician	carbonatite
NMBE0005	Herrera Ranch	1950s	REE, U, Th, Ti	Cretaceous	Beach placer sandstone
DIS004	Tijeras Canyon	1880	F, U, Th, REE	Proterozoic	pegmatite
Cibola County					
DIS017	Zuni Mtns (Copper Hill, Coopperton, Montezuma, New Cornwall)	Late 1800s	U, REE	Proterozoic	Precambrian veins/ replacements, REE-Th-U veins in alkaline rocks
Colfax County					
DIS020	Laughlin Peak (Chico Hills)	1950s	REE, U, Th, Nb, Be	32.3-22 Ma	GPM (REE-U-Th veisn), carbonatite
NMCO0004	Cimarron	1950s	U, Th, REE, Ti	Cretaceous	Beach placer sandstone
Grant County					
DIS044	Black Hawk (Bullard Peak)	1881	U, REE	Proterozoic	pegmatite
DIS045	Bound Ranch (Langford Hills, Separ)	?	F, U, REE	Proterozoic	polymetallic vein
DIS046	Burro Mtns (Tyrone)	1871 (earlier mining by Spanish and Indians)	F, U, Be, REE	Proterozoic	Pegmatite, REE-Th-U veins in alkaline rocks
DIS058	Gold Hill (Camp Bobcat)	1884	F, Be, REE, U, Th	Proterozoic	Pegmatite, REE-Th-U veins in alkaline rocks
DIS067	Telegraph (Red Rock, Anderson, Ash Creek, Wild Horse Mesa, Clarks Peak)	1881	F, U, Th, REE	Cambrian-Ordovician	Precambrian vein/ replacement, disseminated Y-Zr deposits in alkaline rocks
DIS068	White Signal (Cow Spring)	1880	F, Ra, Th, Nb, Ta, Be, REE	Proterozoic, Cambrian-Ordovician	polymetallic vein, REE-Th-U veins in alkaline rocks, pegmatites
Hidalgo County					
DIS080	San Simon (Granite Gap)	1897	Be, F, U, REE	33.2 Ma	Pegmatite, fluorite veins
Lincoln County					
DIS091	Capitan Mtns	1911	Fe, U, Th, REE	34.0 Ma (K/Ar,	GPM (REE-U-Th veins)
DIS092	Gallinas (Red Cloud)	1885	Cu, F, Fe, REE, U, Th	30.7 Ma	GPM (REE-U-Th veins)
Luna County					
DIS106	Florida Mtns	1876	F, Fe, REE	Cambrian-Ordovician	epithermal fluorite, disseminated Y-Zr deposits in alkaline rocks
McKinley County					
DIS117 (NMMK0072)	Gallup (Torriva anticline)	1950s	U, Th, REE, Ti, Nb, Zr	Cretaceous	beach placer
NMMK0108	Miguel Creek	1950s	U, Th, Ti, Fe,	Cretaceous	Beach placer sandstone

District or Mines Identification number	District (Selected Aliases)	Year Of Discovery	Other Selected Commodities Present	Age of REE Deposits	Type Of REE Deposit
	Dome		Zr, REE		
NMMK0261	Standing Rock	1950s	U, Th, Ti, REE, Zr, Fe	Cretaceous	Beach placer sandstone
NMMK0060	Farr Ranch	1950s	U, Th, REE, Ti	Cretaceous	Beach placer sandstone
Otero County					
DIS128	Cornudas Mtns (Wind Mtn)	1950s	Be, Au, U, REE	36.3 Ma	GPM (REE-U-Th veins, disseminated Y-Zr deposits in alkaline rocks)
DIS255	Hueco Mtns	1950s	REE	34.5-34.7 Ma	GPM (disseminated Y-Zr deposits in alkaline rocks)
DIS130	Pajarito	1900s	REE, Y, Zr, F	1230-1140 Ma	Disseminated Y-Zr deposits in alkaline rocks
DIS132	Three Rivers (Apache No. 1, White Mtn)	1911	REE	~45.3 Ma	volcanic-epithermal vein, REE anomalies in ground water
Rio Arriba County					
DIS139	Bromide No. 2	1881	REE, Th, U, F	1750 Ma	REE-Th-U veins
DIS145	Hopewell (Headstone)	1880	REE	~1467 Ma, Recent	Precambrian veins/replacement
DIS147	Ojo Caliente No. 1	1900s	Bi, Nb, REE	Proterozoic	pegmatite
DIS148	Petaca	1870	mica, Nb, Ta, Be, REE, U, Th, F	Proterozoic	pegmatite
NMRA0001-NMRA0003	Stinking Lake		U, Th, Ti, REE	Cretaceous	Beach placer sandstone
Sandoval					
NMSA0028	B.P.Hovey Ranch	1950s	U, Th, Ti, REE	Cretaaceous	Beach placer sandstone
NMSA0049	Herrera Ranch	1950s	U, Th, Ti, REE	Cretaceous	Beach placer sandstone
San Juan County					
NMSJ0088	Sanastee	1950s	U, Ti, REE, Th, Y, Zr, Fe	Cretaceous	Beach placer sandstone
DIS154	Farmington (Hogback)	1950s	U, REE, Ti, Th, Fe, Nb, Zr	Cretaceous	Beach placer sandstone
DIS159	Toadlena area	1950s	U, Ti, REE, Th, Zr, Nb	Cretaceous	Beach placer sandstone
San Miguel County					
DIS162	Elk Mtn	1936	Mica, Ta, REE, U, Nb	Proterozoic	pegmatite, disseminated Y-Zr deposits in alkaline rocks
DIS161	El Porvenior	1916	Th, U, F, Ta, Nb, mica, REE	Proterozoic	Precambrian veins/ replacements, pegmatite
DIS164	Rociada	1900	Li, mica, REE, Ta, U, Be	<1720 Ma	Precambrian veins/ replacements, pegmatite
DIS166	Tecolote (Villanueva, Mineral Hill, Rio de la Vaca)	1879	Be, Ta, Nb, mica, U, V, REE	Proterozoic	Precambrian veins/ replacements, pegmatite
Santa Fe County					
DIS185	Nambe (Aspen Ranch)	1900s	Nb, mica, Be, Cu, REE	Proterozoic	pegmatites
Sierra County					
DIS190	Caballo Mtns (Palomas Gap, Red Hills)	1881	F, U, Th, Ba, REE, Ti, Nb	Cambrian-Ordovician	REE-Th-U veins in alkaline rocks
DIS203	Salinas Peak (Good Fortune	1655	F, REE in stream	Tertiary	RGR

District or Mines Identification number	District (Selected Aliases)	Year Of Discovery	Other Selected Commodities Present	Age of REE Deposits	Type Of REE Deposit
	Creek, Bearden Canyon, Bear Den)		sediments		
Socorro County					
DIS210	Chupadera Mtns (Coyote Hill)	1950s	U, Th, Nb, Ti, F, REE	Cambrian-Ordovician	carbonatite, REE-Th-U veins in alkaline rocks
DIS219	Lemitar Mtns	1880	F, Zn, U, Th, Nb, Ti, REE	449 Ma	carbonatite, REE-Th-U veins in alkaline rocks
DIS230	Ojo Caliente No. 2	1900	Be, U, REE	Tertiary	volcanic-epithermal vein, rhyolite-hosted beryllium
Taos County					
DIS232	La Cueva (Costilla Creek)	1974	U, Th, Nb, Be, mica, REE	Proterozoic	Precambrian vein/ replacement, pegmatite, REE-Th-U veins
DIS236	Picuris (Copper Hill, Harding)	1902	Nb, Ta, Be, Li, mica, U, Be, REE	Proterozoic	Precambrian vein/ replacement, pegmatite
Torrance County					
DIS256	Lobo Hill	1980s	REE, U, Th, Nb, Y	518 Ma	carbonatite, REE-Th-U veins in alkaline rocks
DIS245	Pedernal Hills	?	U, Th, REE, Fe	Multiple, Precambrian are 1660-1650 Ma, REE are 469 Ma	Precambrian vein/ replacement, VMS, REE-Th-U veins in alkaline rocks

Elements

Be—beryllium	REE—rare-earth elements	Th—thorium
Ti—titanium	F—fluorine	U—uranium
Y—yttrium	Fe—iron	Nb—niobium
Ta—tantalum	Li—lithium	

TABLE 3. REE production from New Mexico deposits.

District Number	Name	Production
DIS092	Gallinas Mountains	146,000 lbs of bastnaesite concentrate
DIS148	Petaca district	112 lbs of samarskite, few hundred lbs of monazite, 12,000 lbs of Ta-Nb-REE ore
DIS162	Elk Mountain-Spring Mountain	500 lbs of Ta-U-REE concentrate
DIS164	Rociada	Several thousand tons of REE-Ta ore
DIS166	Tecolote	$10,000 worth of beryl, tantalite-columbite and monazite
DIS058	Gold Hill	Unknown production in 1950s

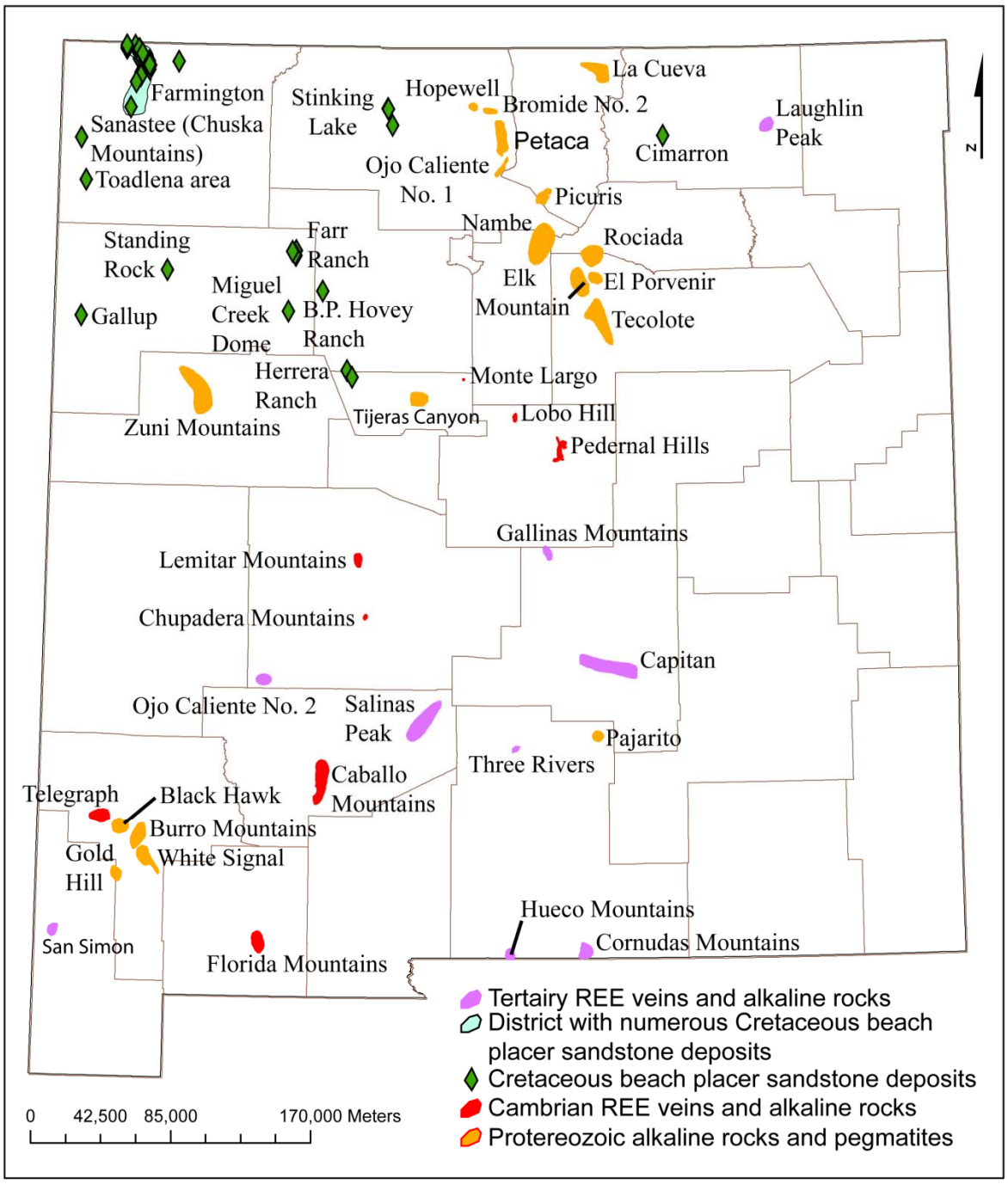

FIGURE 1. REE deposits in New Mexico.