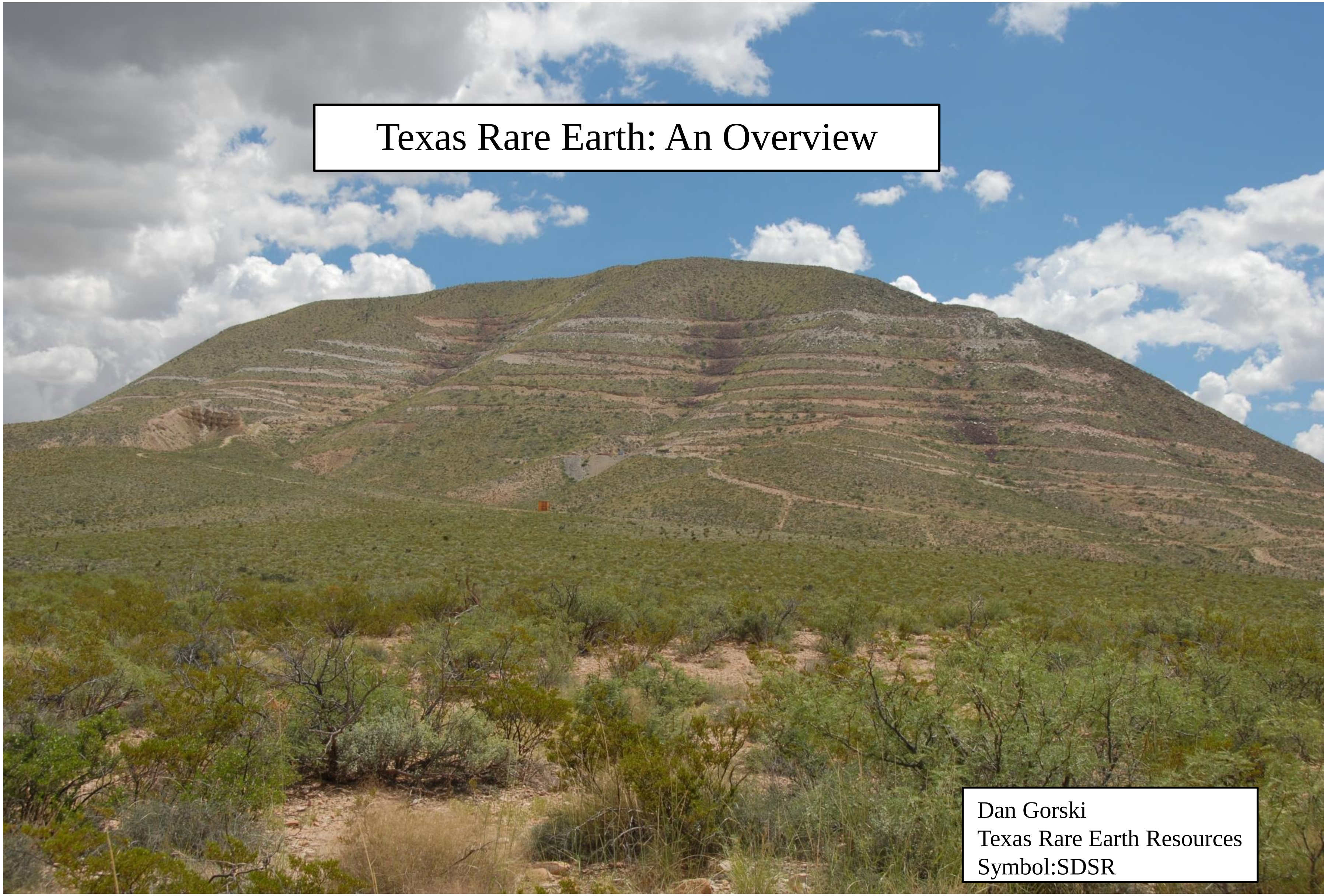

Texas Rare Earth: An Overview

Dan Gorski
Texas Rare Earth Resources
Symbol:SDSR

Background

China now mines, processes, and manufacturers the final products for approximately 97% of the rare earth metals while controlling a significant patent estate that encompasses much of the technology.

These products are vital for all technology, defense, energy, consumer electronics and much more.

China now is restricting export of these elements and products while demand is expected to double over the next five years.

It is imperative that the West in general and the United States in particular develop internal sources of these metals.

Rare Earth Basics

The rare earth metals or REE’s, shown with blue highlight, were discovered and isolated by researchers during the 19th and early 20th centuries. They are a group of 14 elements that are so similar in atomic and molecular properties that they are called the “lanthanide series” and are crowded into one square in the Periodic table.

Periodic Table of the Elements

H Hydrogen																
Li Lithium	**Be** Beryllium											**B** Boron	**C** Carbon	**N** Nitrogen	**O** Oxygen	**F** Fluorine
Na Sodium	**Mg** Magnesium											**Al** Aluminum	**Si** Silicon	**P** Phosphrous	**S** Sulfur	**Cl** Chlorine
K Potassium	**Ca** Calcium	**Sc** Scandium	**Ti** Titanium	**V** Vanadium	**Cr** Chromium	**Mn** Manganese	**Fe** Iron	**Co** Cobalt	**Ni** Nickel	**Cu** Copper	**Zn** Zinc	**Ga** Gallium	**Ge** Germanium	**As** Arsenic	**Se** Selenium	**Br** Bromine
Rb Rubidium	**Sr** Strontium	**Y** Yttrium	**Zr** Zirconium	**Nb** Niobium	**Mo** Molybdenu	**Tc** Technetium	**Ru** Ruthenium	**Rh** Rhodium	**Pd** Palladium	**Ag** Silver	**Cd** Cadmium	**In** Indium	**Sn** Tin	**Sb** Antimony	**Te** Tellurium	**I** Iodine
Cs Cesium	**Ba** Barium	**La** Lanthanum	**Hf** Hafnium	**Ta** Tantalum	**W** Tungsten	**Re** Rhenium	**Os** Osmium	**Ir** Irridium	**Pt** Platinum	**Au** Gold	**Hg** Mercury	**Tl** Thallium	**Pb** Lead	**Bi** Bismuth	**Po** Polonium	**At** Astatine
Fr Francium	**Ra** Radium	**Ac** Actinium														
Lanthanide Series		**Ce** Cerium	**Pr** Praseodymium	**Nd** Neodymium	**Sm** Samarium	**Eu** Europium	**Gd** Gadolinium	**Tb** Terbium	**Dy** Dysprosium	**Ho** Holmium	**Er** Erbium	**Tm** Thulium	**Yb** Ytterbium	**Lu** Lutetium		
Actinide Series		**Th** Thorium	**Pa** Proactinium	**U** Uranium												

They are almost always found together in nature although in varying proportions. Because the element Yttrium shares many chemical characteristics and usually occurs with the REE’s it is by convention grouped with them. These elements although called “rare” are in reality quite common in nature but are seldom found in concentrations high enough to be called “ore.”

Development History

In the beginning the REE's were regarded as chemical and physical curiosities, but during the course of the 20th century it was discovered that they had unique chemical properties that were useful in a wide range of industrial and chemical applications.

Originally their main uses were in phosphors in cathode ray tubes (early color TV), in various specialty alloys and as catalysts in various chemical processes. As technology advanced in the late 20th century, the uses for REE's exponentially increased. They have found their way into all manner of consumer electronic devices. Both LED's and LCD's require them. Hybrid vehicles are now one of the top consumers of REE both in their batteries and in their electric drives. One small Prius uses some 30 to 40 kg's of rare earth oxides. The present largest user of REE is the latest generation of wind turbines. One permanent magnet, 2.5 megawatt wind turbine uses about one half metric ton of REE magnets.

The Technology Cat's Out of the Bag

Because of their import to the energy sector, the elements that make up the high strength magnets are the most sought after as they make it possible to obtain great power from relatively small electric motors and generators.

Currently the market is primarily focused of the so called "green energy" applications with wind turbines and small hybrid vehicles as the driving force for growth. However, high power permanent magnet motors and generators are more efficient regardless of the propulsion system.

Diesel powered vehicles and equipment play a vital role in almost all stages of the economy. The world will beat a path to any technology that can materially cut diesel costs. Large mine haul trucks already are "hybrid". Thus, the end members of the existing transportation system, small eco-cars on one end and 400 ton mine trucks on the other use this technology. It will spread both ways. The potential of this market is not tied to the politics of the day and its size dwarfs the "green" uses.

There is good reason the market for these metals has been grossly underestimated. Once the technology cat is out of the bag there is no stopping it.

Geology and Deposit Types

REE's are widely distributed in rocks, but they are found in economic concentrations in only a few of them. All REE deposits are the result of magmatic the magmatic evolution of igneous rocks or in some cases the weathering of these rocks. The REE's are elements that are termed "incompatible" by geologists which means that they are not incorporated into any of the minerals that make up igneous rocks, *i.e.* feldspar and quartz. They tend to be concentrated in the last parts of a magma to solidify.

They can be fairly effectively subdivided into 5 basic types.

- Carbonatites
- Peralkaline Igneous Rocks
- Pegmatites and Hydrothermal Deposits
- Magmatic Iron Deposits
- Chinese Clay Deposits.

Geology and deposit types continued…

The type of deposit being developed is important to the economic evaluation of any project

- Carbonatites

  Carbonatites comprise some of the largest and highest grade REE deposits. Examples are Mountain Pass and Mt. Weld. They are all dominant in the light REE's (LREE) although some are fairly high in the magnet elements Praseodynium, Neodymium and Smarium.

- Peralkaline Igneous Rocks

  These rocks are the principal source of the heavy REE's (HREE). They tend to he lower grade than carbonatites but they tend to be large. The peralkaline rocks are also favorable in that they commonly contain many other rare elements that can be produced as co-products.

- Pegmatites and Hydrothermal Deposits

  These deposits tend to be small but high grade. They can occur in any igneous rock but are best developed in Peralkaline rocks.

- Magmatic Iron Deposits

  Very large, but usually low grade. They produce REE's as a co-product of iron. Their HREE content is highly variable.

- Chinese Clay Deposits.

  The principal source of HREE in the world. The ore is in a soil formed by the weathering of peralkaline igneous rocks in a warm humid climate.

Other Rare Metals

Besides the REE’s, there are other rare metals that have similar geochemistry in that they are also “incompatible” elements and are concentrated in nature by the same magmatic processes,

Periodic Table of the Elements Showing the "Rare Metals" as used in an Economic Sense

H Hydrogen																	**He** Helium
Li Lithium	**Be** Beryllium											**B** Boron	**C** Carbon	**N** Nitrogen	**O** Oxygen	**F** Fluorine	**Ne** Neon
Na Sodium	**Mg** Magnesium											**Al** Aluminum	**Si** Silicon	**P** Phosphrous	**S** Sulfur	**Cl** Chlorine	**Ar** Argon
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Rare Earth Metals

Others

Mine Economics

There are 4 factors that influence the economic viability of a REE deposit. They are almost of equal importance. They are in their order of importance:

- Tons and Grade

- HREE to LREE ratio or more realistically the proportions of the individual REE's

- Mineralogy

- Location and Geopolitics

In addition to these 4 critical factors, the presence of other rare metals in the ore that can be processed as a co-product can be important to the economics of a mine.

The role of tons and grade are self evident. The other 3, however, should be given a little more attention.

Light Rare Earth Versus Heavy

Atomic weight increases from left to right along the periodic sale. Rare earth metals were originally grouped into three classes, light, medium and heavy. Yttrium, although a lighter element and not technically a rare earth, has chemical and physical properties that have caused it to be grouped with the heavies.

Rare Earth Classification

	Light or 'Ceric'				Medium			Heavy or 'Yttric'						
Yttrium **Y**	Lanthanum **La**	Cerium **Ce**	Praseodym-ium **Pr**	Neodymium **Nd**	Samarium **Sm**	Europium **Eu**	Gadolinium **Gd**	Terbium **Tb**	Dysprosium **Dy**	Holmium **Ho**	Erbium **Er**	Thulium **Tm**	Ytterbium **Yb**	Lutetium **Lu**

Light or 'Ceric'				Medium			Heavy or 'Yttric'							
Lanthanum **La**	Cerium **Ce**	Praseodym-ium **Pr**	Neodymium **Nd**	Samarium **Sm**	Europium **Eu**	Gadolinium **Gd**	Terbium **Tb**	Dysprosium **Dy**	Holmium **Ho**	Erbium **Er**	Thulium **Tm**	Ytterbium **Yb**	Lutetium **Lu**	Yttrium **Y**

It now has become convention to divide them into heavy and light and drop the medium class. The dividing line between them is placed to the left of Europium, Gadolinium or Terbium, depending on the outlook of the author.

HREE to LREE Ratio

A lot is made of the HREE ratio by the various companies developing REE deposits. This chart divides the lights and the heavies at Terbium.

The green-yellow-gray classification was taken from an article published 2 Nov 2010 by Gareth Hatch. This article (http://www.techmetalsresearch.com/2010/11/review-of-a-proposed-new-method-for-evaluating-rare-earth-deposits/) sets up what is called the outlook coefficient based on the economic potential for each of the individual elements. This type of index or one similar will probably become more accepted than the widely used but somewhat ambiguous light vs. heavy.

REE's with Highest Growth Potential

Light							Heavy							
Lanthanum La	Cerium Ce	Praseodynium Pr	Neodymium Nd	Samarium Sm	Europium Eu	Gadolinium Gd	Terbium Tb	Dysprosium Dy	Holmium Ho	Erbium Er	Thulium Tm	Ytterbium Yb	Lutetium Lu	Yttrium Y

Critical REE's, magnet metals plus yttrium	(green)
Increased use limited to general economic growth	(yellow)
Potential oversupply	(gray)

Here the high potential metals Neodymium and Europium are technically light and the technically heavy Holmium, Thulium, Ytterbium and Lutetium are in potential oversupply.

Beauty is in the eye of the beholder.

Mineralogy

REE’s are found in a variety of minerals. The type of mineral that hosts the REE is the third most important factor effecting the potential of a deposit. All REE minerals have to be processed chemically in order to separate the 15 different elements into individual oxides. This chemical processing is the primary cost factor in a REE operation. The ease or difficulty of processing the primary mineral is the key in the processing chain.

- Minerals that respond to conventional concentration methods, floatation, gravity, magnetic etc. are desirable.

- Minerals that can be easily dissolved in relatively common reagents are desirable.

- Elements such as thorium and uranium chemically incorporated into the primary mineral are very undesirable because they are difficult to separate from the process solution. Thorium in particular is bad because it is radioactive and has no market, thus it must be disposed of after it is isolated.

Location and Geopolitics

Aside from the political risk that affects the economics of any mine, permitting, taxes, political stability, etc. the importance of location and access are probably more than average for a REE operation. The lower the unit value of the primary concentrate the closer the first stage chemical processing plant must be to the mine. The chemical processing plant is both reagent and energy intensive and requires a high level of skills to operate it.

- Mines close to a developed transportation, energy and skilled labor infrastructure will have a cost advantage.

- Mines in temperate climates will have a cost advantage over ones in the arctic.

Mining and Processing Economics

CAPEX

REE Mines have exorbitantly high capital costs. Avalon states that their mine-plant complex is going to cost approximately $900 million based on their current feasibility study. Lynas is reported to have already spent $400 million and probably will spend that much more. Molycorp raised $350 million which will be applied to an existing mine-plant complex at Mountain Pass. Both Molycorp and Lynas plan to sell a final separated product. Avalon, at present, will sell a mixed REE oxide to a final refiner. The principal CAPEX item is the chemical processing plant.

Costs

Costs are also high for these mixed rare metal mines. Lynas reports that 50% of their costs will be reagents and another 30% energy. This suggests that the principal costs are in the chemical processing of the floatation concentrate. Avalon cites a life of mine cost of $266/mt for ton of ore milled. Avalon’s process involves the chemical break down of the mineral zircon which is known to be refractory and probably accounts for these high costs.

Chinese Production

In 2010 the Chinese will produce approximately 110,000 metric tons of all REE oxides. The rest of the world produced, recycled or used from stockpiles another 15,000 tons.

Production from their three principal mine complexes are:

Baotou	55,000mt
Sichuan	10,000mt
Ionic Clay Region	45,000mt

Baotou is a large iron mining complex and produces almost no HREE. Because the REE is a by-product of the iron mine, REE production is closely tied to the iron output and they will not be able to greatly increase it.

Sichuan is a district based on several carbonatites and hydrothermal veins associated with them. REE is light dominant.

South China Ionic Clays are the principal source of the heavy REE's. The REE's have been concentrated in soil formed from the weathering of a peralkaline intrusive rock. Much of the mining in this district is done by individuals and is very inefficient. China is now trying to organize and control this mining. There is reportedly some 10 to 15 years of this resource left at current mining levels.

New Production

There are two mines that will be in production sometime next year.

Lynas, Mt. Weld	22,000
Molycorp, Mountain Pass	20,000

Both these deposits are carbonatites, therefore are dominated by the LREE's. They have to balance their ability to produce the magnet metals against the risk of overproducing the La and Ce and ruining those markets.

Other deposits that are in an advanced stage of development are:

Avalon, Thor Lake	10,000 increasing to 20,000

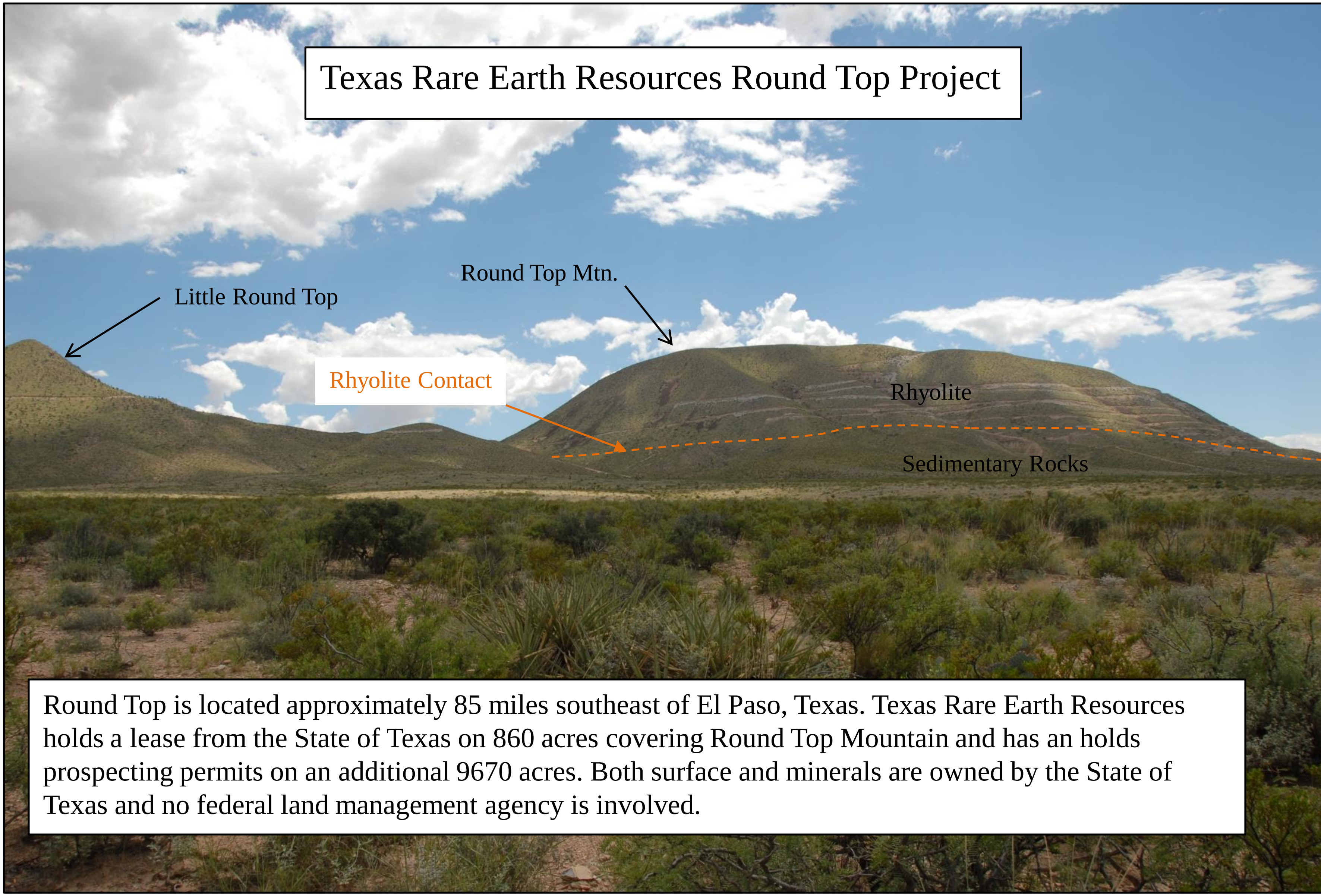
Avalon's Thor Lake deposit is hosted in a peralkaline igneous rock and is reported to contain 21% HREE. They do not publish the detailed mineralogy but it is thought that most of their HREE is tied up in the mineral zircon. They may still have a lot of work to do on their processing. Their website (http://avalonraremetals.com/) is an excellent source of information on rare metals in general and their deposit in particular.

Quest Rare Metals, Strange Lake

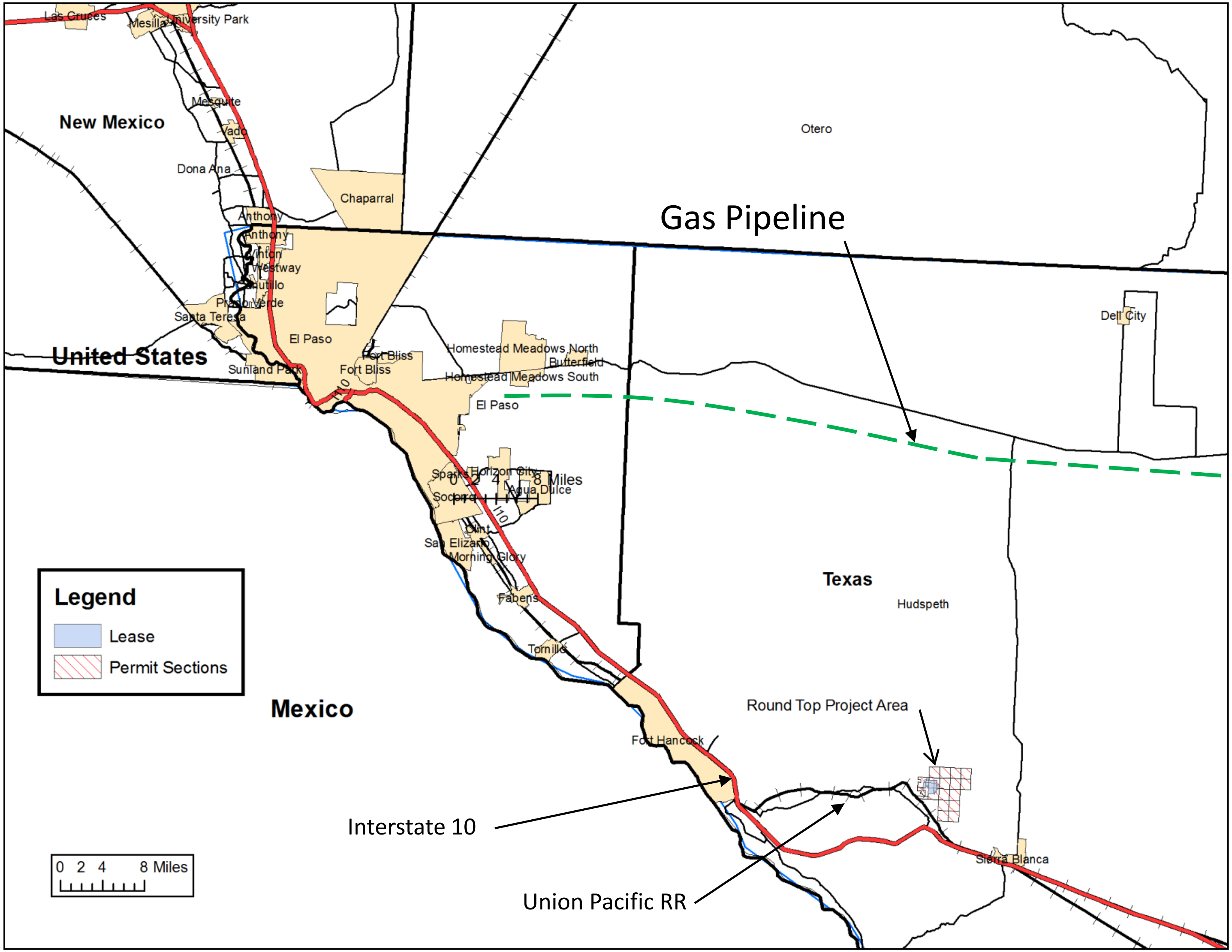
This project is still in the drilling stage but is one of the best ones in development. It is hosted in peralkaline rocks and they report an HREE content of 43 to 51%. However, they have not published the mineralogy of this deposit.

There are others whose data can be found on their respective websites.

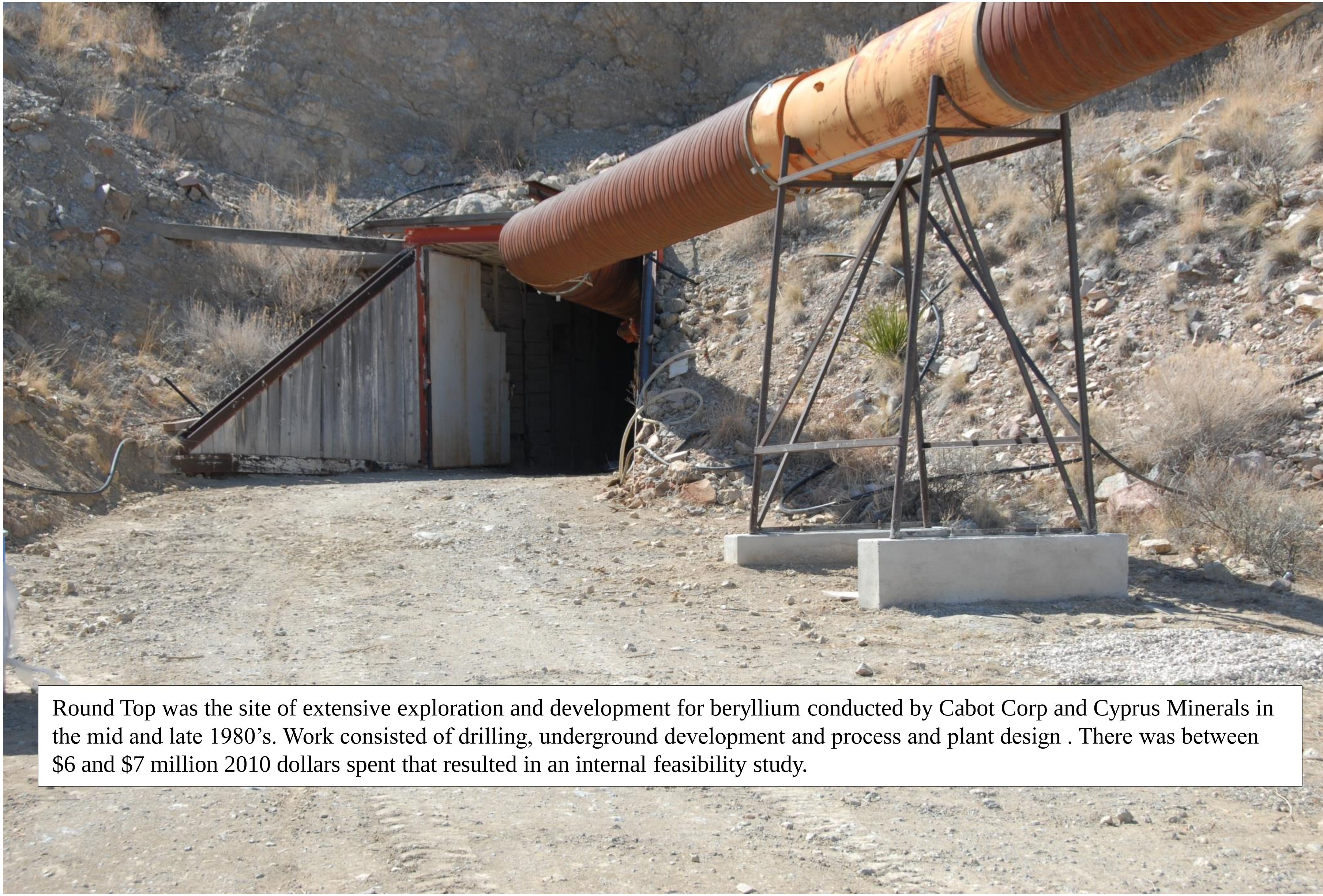
Texas Rare Earth Resources Round Top Project



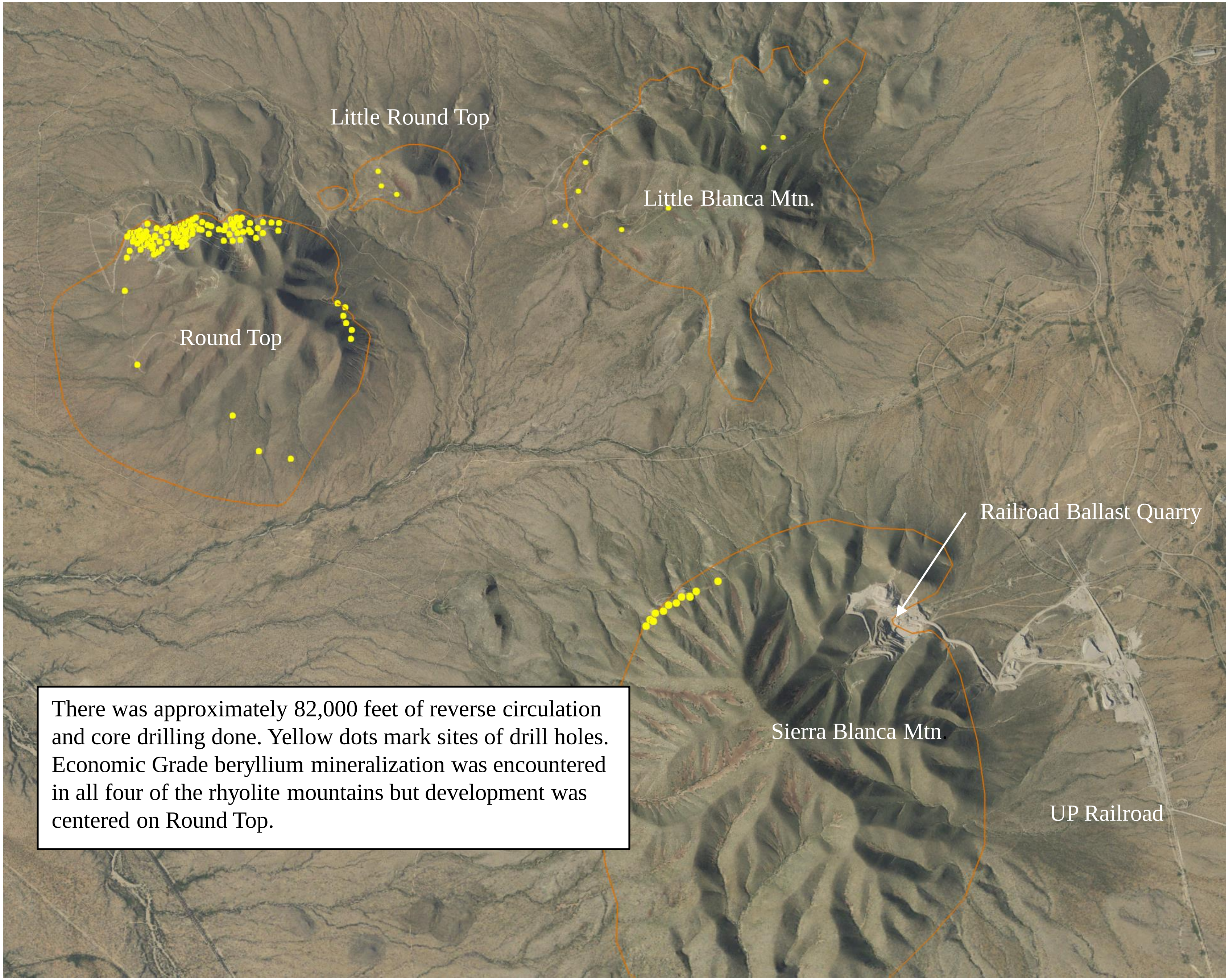
Round Top is located approximately 85 miles southeast of El Paso, Texas. Texas Rare Earth Resources holds a lease from the State of Texas on 860 acres covering Round Top Mountain and has an holds prospecting permits on an additional 9670 acres. Both surface and minerals are owned by the State of Texas and no federal land management agency is involved.



Location of the Round Top Project



Round Top was the site of extensive exploration and development for beryllium conducted by Cabot Corp and Cyprus Minerals in the mid and late 1980’s. Work consisted of drilling, underground development and process and plant design . There was between $6 and $7 million 2010 dollars spent that resulted in an internal feasibility study.


Little Round Top
Little Blanca Mtn.
Round Top
Railroad Ballast Quarry
Sierra Blanca Mtn.
UP Railroad
There was approximately 82,000 feet of reverse circulation and core drilling done. Yellow dots mark sites of drill holes. Economic Grade beryllium mineralization was encountered in all four of the rhyolite mountains but development was centered on Round Top.

Although the project was successful and resulted in a positive feasibility study, the project was not continued and was abandoned in the early 1990’s. Because neither uranium nor rare earth was of any economic interest at the time, neither were analyzed for during the course of the project by either of the companies.

Rare Earth Elements

It had long been known by geologists working for the Texas Bureau of Economic Geology (BEG), that the rhyolite laccoliths at Sierra Blanca contained a variety of rare earth (REE's) and other rare elements such as tantalum, niobium, thorium and lithium. During the course of the Cabot-Cyprus project and working with the project geologists, the BEG made a study of the REE and other rare element potential of the Round Top rhyolite. They analyzed a series of samples from outcrop and drill cuttings and studied the mineralogy of the rock. Their research was included in Geological Society of America Special Paper 246 in 1990.

The economically important conclusions of the BEG research was:

- *The rhyolites are so enriched in a number of trace elements that they should be considered large-tonnage, low grade resources of several rare metals, including yttrium, heavy rare earths, niobium, tantalum, lithium and thorium.*

- *Many of the economically interesting trace elements occur as discrete minerals*.

- *The resource is vast. The Round Top laccolith contains at least 1.6 billion metric tons of rhyolite.*

Results of the BEG Research

The research conducted by the Texas Bureau of Economic Geology was based on 15 samples collected from drill holes and drill road cuts on the surface. Chemical analyses and detailed mineral identification were done during the course of this work. Their important conclusions are:

There was an average of .69 kg per ton REE in the rhyolite.

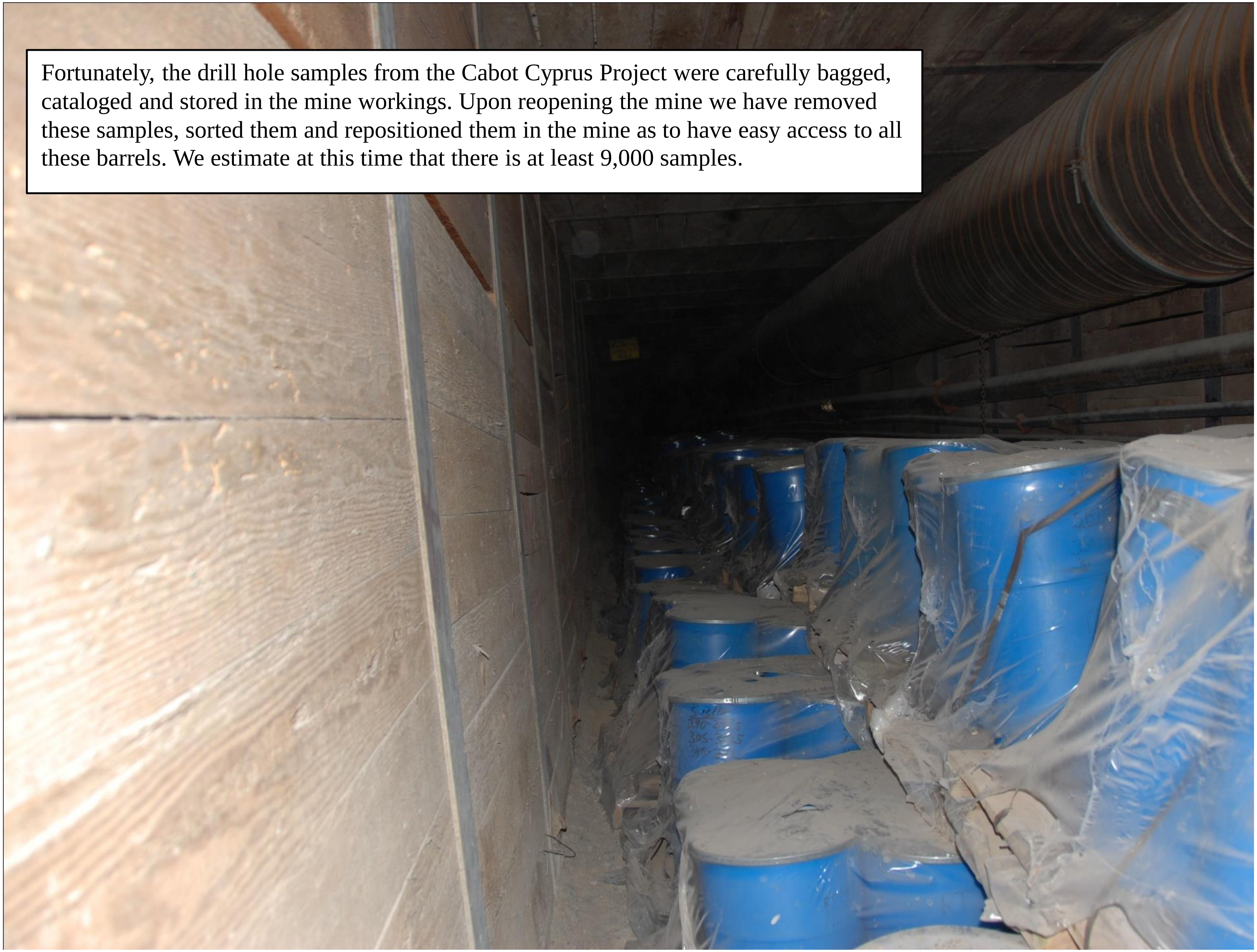
REE elements are contained principally in the minerals yttrofluorite and yttrocerite. Both these minerals are fluorides and are susceptible to conventional floatation and can be chemically broken down with relative ease.

The niobium and tantalum are hosted by the mineral columbite.

Thorium is confined to the mineral thorite.

The ratio of heavy REE oxide to light is .67%

Fortunately, the drill hole samples from the Cabot Cyprus Project were carefully bagged, cataloged and stored in the mine workings. Upon reopening the mine we have removed these samples, sorted them and repositioned them in the mine as to have easy access to all these barrels. We estimate at this time that there is at least 9,000 samples.



Drill Samples Stored in the Decline

Texas Rare Earth Project

Work to date has consisted of re-logging the Cabot-Cyprus drill hole samples and analyzing for rare metals and uranium. Analyses for some 200 have been reported back. The first objective was to confirm the conclusions of the BEG research. Preliminary conclusions are:

- Based on 113 analyses average REE oxide content of the entire thickness of the overlying rhyolite is .6 kilos per ton. There is an approximately equal amount of combined niobium and tantalum.

- The ratio of heavy REE oxide to light is 71%. Even more significantly, the content of the critical REE's is 60%.

We believe that our results confirm the conclusions regarding metal content of the rhyolite of the Bureau of Economic Geology.

In addition to the rhyolite potential we are seeing encouraging uranium mineralization.

- The face in one of the mine headings contains 1.09% uranium at the rhyolite contact.

- 10% of the drill holes logged to date contain >.1% uranium intercepts at the rhyolite contact.

Future Work

We plan to continue logging and analyzing the archived samples. Analysis of the rhyolite and defining the distribution of the uranium at the contact are the main objectives. Work will begin to confirm the mineralogy of the rare minerals by detailed laboratory examination of representative rhyolite samples. All analytical procedures will comprehensively reviewed and re-checked.

When the mineralogy has been established, bench scale work will begin to design a process for concentration.

Aside from developing the large low grade potential of the Round Top and Little Round Top rhyolites, geologic evidence now being developed points to higher grade targets lower in the system.

More drilling will doubtless be done later but we are fortunate in having the samples of 82,000 feet of drilling done by the former project.

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Economic Potential

We believe that the *in place* value per metric ton of REE and other rare elements in the rhyolite is sufficient to warrant examining the possibility of developing a large scale open-pit mining operation if a process can be developed to concentrate the rare earth minerals. It is difficult to arrive at a price for these elements but we estimate the *in situ* value to be somewhere between $45 to $80 per ton depending on the product produced. These values are on the high side for open pit mining nowadays, many copper and gold operations process ore in the $25 per ton range. We believe the extremely favorable ratio of REE's, the simple mineralogy seen so far and the enormous size of this rhyolite body will compensate for the low grade.

Using the average values see so far and the estimated tonnage of 1.6 billion, the Round top rhyolite could contain 960,000 tons of combined rare earth oxides, 60% of which are the designated critical elements.