

IMPLICATIONS OF COMPETITION FOR RARE EARTH ELEMENTS (REE) IN AFRICA

BY

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USAWC STRATEGY RESEARCH PROJECT

**IMPLICATIONS OF COMPETITION FOR RARE EARTH ELEMENTS (REE) IN
AFRICA**

by

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ABSTRACT

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According to the Congressional Research Service, China possesses over ninety-seven percent of the industrial production capacity for rare earth elements (REEs), thus creating a global monopoly. Most of the global REE supply-chain is located within China's national territory, or under its influence through the purchase of mineral rights from other parts of the world, such as Africa. In 2010, China constrained the exports of REEs into the world market. It is feared that China will further limit exports of REEs as a tool to shape foreign policy, but the real reason may be to meet its own increasing needs. REEs are critical to production of many commonly used items like cell phones, computers, and military weapons technology. Production of REEs takes a significant amount of time to develop, usually in terms of decades. The only developed U.S. source of REEs is located at Mountain Pass, California and has been out of production since 2002, but is due to reopen in mid-2012. Should the U.S. remain dependent upon China for the majority of its REE supply, or do alternatives exist elsewhere like Africa.

IMPLICATIONS OF COMPETITION FOR RARE EARTH ELEMENTS (REE) IN AFRICA

A state may possess a valuable natural resource... to which it enjoys a *monopoly* or market control... Moderation in the exercise of privilege is the key to retaining it...

—Charles Freeman¹
Arts of Power: Statecraft and Diplomacy

The Chinese currently possess market dominance over global production and processing of rare earth elements (REEs). In September 2010, China constrained REE exports into the world market in retaliation over an altercation with Japan.² It is feared that China will further limit REE exports as a tool to shape foreign policy, but the real reason may be to meet its own needs. For several decades, China and other countries have made numerous overtures to secure mineral rights from several African nations for themselves. In light of these statements, should the United States engage African countries in trade negotiations to access alternative sources of supply?

The term REE can easily be a misnomer. REEs are generally found in great abundance upon the earth's surface; however, they are not usually found in sufficient quantities to justify the cost of extracting them directly from the ground or from other ore deposits.³ Therefore, U.S. policy makers must ascertain if REEs exist in sufficient quantities on the African continent to warrant further global competition before engaging in diplomatic efforts regarding REE procurement.

This paper will touch upon several areas. It will provide some historical examples of competition for natural resources and a brief history of REEs. Next, it will identify past policies that limited domestic mineral procurement and show what is being done to correct that unfortunate circumstance. The current demand for REEs will be identified along with alternative sources of supply. Competition for REEs from Africa

will be addressed in three sections: one focused on Chinese influence, a second on other interested parties, and a third on African challenges. Lastly, some conclusions and recommendations will be presented.

Background

There are many historical examples of competition for natural resources. Two examples will illustrate this point. Sodium chloride, also known as salt, is a naturally occurring mineral compound essential to sustain life. Salt was used for centuries as a means to preserve food for extended periods of time, like salt pork or salt codfish for example. Salt was considered a valuable trading commodity throughout history. Controlling local salt supplies created monopolies that effected its distribution and cost. In the year 780 A.D., Chancellor Yang Yan of the Tang Dynasty taxed many common household commodities, one of these being salt. Private sale and distribution were outlawed and salt agents were appointed by the state to collect taxes and ensure its strict control.⁴ Perhaps this incident from ancient Chinese folklore can offer insights into China's mineral quest for REEs today.

During the Second World War (WWII), the German's were aware of the strategic importance to control natural resources. As Germany was simultaneously engaged in fighting Russia, France, and Great Britain; he allowed his Italian ally to exercise control over most of southeastern Europe. At this time, Romania had vast oil supplies and Hungary and Yugoslavia produced twenty-three percent of the world's bauxite, a mineral critical to the production of aluminum used in the manufacture of military airframes. Southeastern Europe became critically important to the German's once the British severed their access to natural resources from South America and Asia.⁵ This could be one reason why the German's began their North African campaign. They

wanted to reach the Saudi Arabian oilfields to keep their military juggernaut from grinding to a halt. Knowing natural resources would always be in short supply during the war, Hitler demanded his country develop stockpiles and create synthetic substitutes for natural commodities like oil and rubber.⁶

To place the current demand for REEs in context, their discovery and application to industry is a fairly recent phenomenon as compared to other precious metals such as gold or copper, which has been known and valued for millennia. The history of REEs is broken down into four time periods. The first period begins sometime in the late 1800s in what was referred to as the *Monazite-placer era*, which lasted until 1964. The period between 1965 till 1984 was known as *Mountain Pass era*. This makes reference to the only American rare earth element mine located in the Mojave Desert at Mountain Pass, California. The *Transitional era* lasted from 1985 to 1991 as global dominance in global REE production transitioned from the U.S. to China. The current period, which began in 1991, is referred to as the *Chinese era* of REE production.⁷ Moreover, unless alternate sources of supply for REE are found soon in marketable quantities elsewhere, many countries are likely to become victims of this newest Chinese monopoly for some time to come.

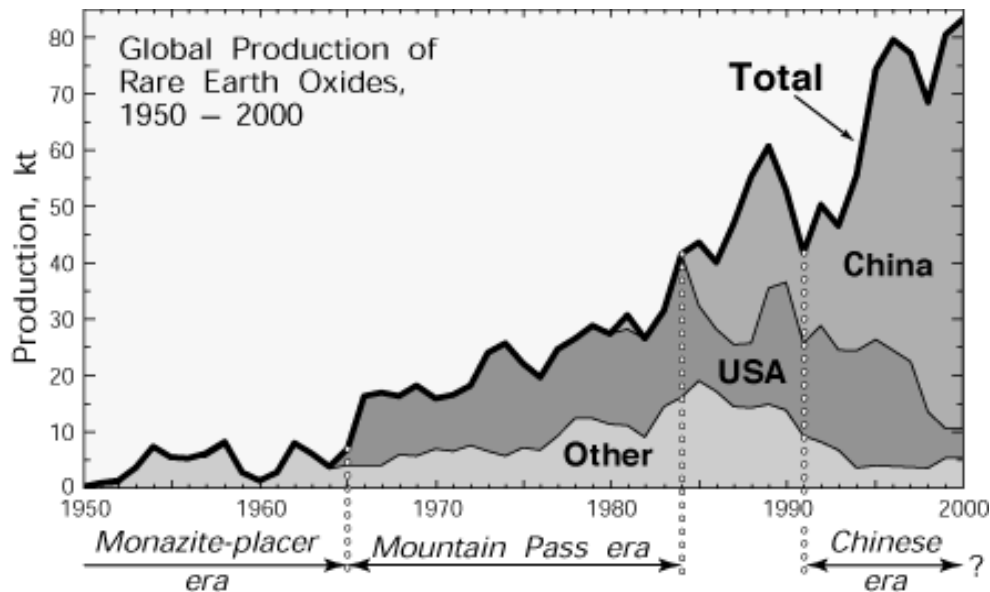


Figure 1: Global Rare Earth Production Eras⁸

Sovereign states have always sought to control the natural resources found within their borders. The Treaty of Westphalia signed in 1648, formally acknowledged the state as the legitimate entity to bargain with on all matters within a given territory, at least in Europe. However, the affect of European colonization transplanted these concepts around the world, and they are still prevalent in Africa since many of these countries were former European colonies. Many social upheavals (religious or otherwise) have occurred over the last few decades changing the normative political constructs in the world, thus adding to the rise of none-state actors as major players on the international scene. Furthermore, with increased global competition for natural resources, the tenuous balance between formal and informal players who both exert control over access to REEs must now be taken into account. The challenge of competing with trans-national actors is of grave concern to the United States and is especially acute in a continent with such political and economic complexities and social nuances as there are in Africa.⁹

China currently holds a monopoly on the global supply and production of REEs. It has been estimated by the Congressional Research Service (CRS) that China possesses up to ninety-seven percent of the international production capacity for quality REEs.¹⁰ With such a monopoly under China's direct control, the United States has some reason for anxiety. The U.S. must act prudently when engaging China on other political fronts and be wary of China's aggressive foreign policy of fostering strong relations with the developing world. China already has huge economic investments to improve the infrastructure of various African countries while attempting to secure minerals rights for REE access from several countries, such as: Burundi, Malawi, South Africa, and Tanzania.¹¹

Some may ask why the Chinese are more successful than the United States when it comes to establishing long-term business relationships with countries in Africa. Well, the secret may lie within their approach. On 2 May 2009, a paper was presented to the International Communication Association which focused on the similarities and differences of corporate social responsibility (CSR) between the United States and China. This paper revealed four findings based on data from some two hundred corporate websites found on either the U.S. Fortune 500 list or the top Fortune 50 list of Chinese companies.¹² The fourth finding in this study is the most telling and states that China leads the U.S. when it comes to focusing on the value of friendships in their business relationships.¹³ Perhaps, this explains why the Chinese pragmatic-business approach has more appeal in Africa than the U.S. value-based approach.

With the current Chinese embargo constraining the flow of REEs into the world marketplace, many countries are beginning to grasp the importance of REEs to both

their national and the global economy.¹⁴ REEs make possible numerous commercial products that many people now take for granted like: cell phones, color television, and laptop computers, just to name a few.¹⁵ In some cases, the global constraint of REEs may threaten American vital interests and be worth going to war to possess. Especially those REEs that play a key role in the U.S. defense industry, like Samarium Cobalt or Neodymium Iron Boron used in the development of permanent magnets necessary to produce modern jet fighter engines, missile guidance systems, smart bombs, and laser range finders.¹⁶ Australia, Canada, India, and Iran, as well as North and South Korea have all been aggressively competing with China for access to REEs in Africa.

Both Koreas fully recognize the importance of REEs to their high-technology industries and realize the major role they play in their nuclear programs as well. To emphasize North Korea's national concern over the issue, Kim Jong Il visited the Hamhung Semiconductor Materials Factory on June 30, 2009. He impressed upon the factory's management the need for modernizing their facility and the importance of obtaining domestic access to REEs for use in computer manufacturing.¹⁷ South Korea is no less concerned about this issue than the North. It realizes it must broaden its REE supply-base beyond China and is now beginning to look elsewhere for other sources of supply. The chief executive of the Korea Resource Corporation (KRC) recently announced that South Korea is exploring options to obtain REEs from Central Asia, Mongolia, Vietnam, and even as far away as Africa.¹⁸

Policy and Legislation

The Korean War raised concerns about the United States' ability to access raw materials to sustain a viable defense posture and ensure a robust economy. Failure to anticipate the events leading up to WWII a decade earlier, made the U.S. government

resolute not to return to an isolationist view of the world as it had done in the 1930s. The United States was now forced to seek new mineral sources vital to the war effort and proper functioning of its Armed Forces. So, in January 1951, President Truman established the President's Materials Policy Commission (PMPC) to study the need for obtaining long-term access to raw materials and to make recommendations regarding how to obtain access to large quantities of natural resources, when required.¹⁹

William S. Paley, the president of the Columbia Broadcasting System was asked to be chairman for the PMPC. The commission released its final report in June 1952. It was aptly named the Paley Report and made some startling assertions. "... [T]he Paley Commission specifically rejected national self-sufficiency ...and advocated instead that the United States pursue the policy of lowest-cost materials acquisition from whatever source."²⁰ The reasoning for this decision is unknown, but domestic mineral deposits may have been viewed as a sort of strategic reserve. This recommendation was the precursor to globalization, a concept that would become internationally pervasive several decades in the future. The Paley Commission advocated all democratic nations consolidate their mineral assets in order to withstand the perceived Communist threat, anything less would equate to a self-imposed blockade.²¹

It became very clear upon the release of the Paley Report that America was consuming natural resources at an alarming rate. Statistical analysis obtained by the PMPC covering the period from 1900 to 1950 revealed some shocking data. For example, the PMCP's report entitled *Resources for Freedom* showed that consumption rates for coal rose by two hundred and fifty percent during this period, while natural gas

usage expanded twenty-six times, and crude oil consumption increased by nearly thirty fold of the rates found in 1900.²²

Congress passed the Defense Production Act (DPA) of 1950 to ensure stockpiles of minerals would be ready during a national emergency. This legislation required cooperation between commercial and government entities to guarantee that personnel, facilities, and resources were available when needed to ensure national security.²³ Soon thereafter, the Revenue Act of 1951 was passed. It provided a liberal tax credit system that allowed U.S. companies greater flexibility to operate outside of the country and encouraged foreign investments.²⁴ The DPA was updated on 30 September 2009 and can be found as Public Law 111-67 in U.S. Code, Title 50, and subsection 2061.²⁵

The Paley Report offered three important recommendations for the future. First, create stockpiles of critical natural resources for use in case of emergency. Second, keep production facilities in mothballs to be brought back on line when needed. And third, begin research towards developing synthetic substitutes for all critical natural resources in the event that they ever become fully depleted.²⁶ These recommendations seem eerily familiar to those made by the Nazi government in the 1940's.²⁷

Moving forward to 2009, Florizelle Liser the Assistant U.S. Trade Representative (USTR) for Africa made some interesting observations during testimony to the House Committee for Energy and Commerce. She sees great opportunities to export many commodities off the continent, but "...poor infrastructure conditions, weak governance, poorly developed institutions,"²⁸ limit the ability of African businesses to compete in the global environment. Ms. Liser suggested engaging the African Growth and Opportunity Act (AGOA) to strengthen investments and build greater capacity in Africa. In 2008, Ms.

Liser cites African imports as tripling since 2001; however, she concedes that the global recession has reduced AGOA's full effectiveness. Ms. Liser stresses the need to foster economic growth through various African institutions such as: the African Union (AU), the Common Market for Eastern and Southern Africa (COMESA), East African Community (EAC), Economic Community of West African States (ECOWAS), the Southern African Customs Union (SACU) and the West African Economic and Monetary Union (WAEMU). AGOA and Trade Capacity Building (TCB) are considered the two driving forces for a vibrant U.S. - Africa trade policy. Ms. Liser believes economic diversification, infrastructure improvements, and greater AGOA utilization are necessary to further expand U.S. - Africa trade.²⁹

Recently in 2010, there were several pieces of legislation introduced by Congress specifically related to the procurement, processing, and stockpiling of REEs. The National Defense Authorization Act (NDAA) for Fiscal Year 2011 Report, which accompanied senate bill (S. 3454), has a passage specifically on rare earth alternatives. The narrative requests a sixty-one point nine (\$61.9) million dollar budget increase to explore other sources of supply, thus weaning us from dependence upon China. For example, permanent magnets are used in the production of aircraft engines and many other advanced technologies. The bill talks about securing a domestic-supply chain for the REEs needed to produce such magnets, and requires the development of substitute materials as well.³⁰ Unfortunately, this bill died in committee and did not become law.³¹

The Senate's second legislative proposal regarding REEs was the Rare Earth Supply Technology and Resources Transformation (RESTART) Act of 2010. It accompanied senate bill (S. 3521) that established a rare earth policy task force (TF)

required to report annually to Congress on any policy that discourages REE development or procurement. This TF includes representation from the Secretaries of several governmental departments such as: Agriculture, Commerce, Defense, Interior, and State. Also, the Secretary of the Interior may request the advice and participation of other elements of the government like the White House Council on Environmental Quality (CEQ) and the Office of Management and Budget (OMB) to clarify the quality and accuracy of their final reports. The focus of these annual reports is on supply chain vulnerabilities, stockpile reporting, and exploration of legal authorities to ensure future access to REEs.³² Senate hearings on bill (S. 3521) were last held 30 September, 2010. With the change in congressional makeup as of the results of the November 2010 congressional elections, both S. 3454 and 3521 must be reintroduced during the 112th Congress for further consideration if they are to become law.³³

On 29 March 2010, the House Subcommittee on Trade introduced (H.R. 4866), the Rare Earth Supply-Chain Technology and Resources Transformation Act of 2010. The intent of this legislation is to re-establish a domestic REE production capability to make the United States again competitive in the world market. The act establishes an interagency working group (IWG) led by the White House Office of Science and Technology Policy (OSTP) and the USTR appoints members of other governmental departments to the IWG such as: Commerce, Defense, Energy, Interior, and State. This IWG must ensure a robust supply chain for future industrial and defense projects. The USTR should work with the World Trade Organization (WTO) to secure fair trade practices for the procurement and sale of REEs and guarantee markets remain open for these very important commodities, both now and long into the future. The Department

of Energy (DOE) would issue guidance regarding how to procure REEs for the domestic commercial markets, and the Department of Defense (DOD) would issue guidance focused on developing a strong defense supply chain by stockpiling REEs under the direct management of the Defense Logistics Agency (DLA). The USTR must further engage the WTO to procure loan guarantees for the development of an REE supply chain. The USTR is required to report regularly to congress on types of REEs obtained and from where they were purchased.³⁴ This bill was referred to the House subcommittee on Readiness on 8 April 2010. H.R. 4866 must also be reintroduced in 2011 based on the November 2010 congressional elections, as mentioned above.³⁵

The 2010 National Security Strategy (NSS) offers further insights to the importance of maintaining access to REEs. The NSS identifies the growing global demand for natural resources and suggests countries combine such limited assets in order to maintain international order. The NSS also talks about strengthening international norms by engaging institutions like the Group of Twenty (G-20), the Organization for Economic Cooperation and Development (OECD), and the United Nations (UN) in order to, “institutionalize transparent practices in ...international banking and tax policy, and private sector engagement around natural resources.”³⁶

Demand

According to the CRS, the world’s annual demand for REEs is currently estimated at 134,000 tons. The international production rate for REEs, centered mostly out of China, is projected to be 124,000 tons. Therefore, we currently see a shortfall of 10,000 tons per year, provided there are no significant increases in the near-term global demand. But, the CRS is already predicting global demand to reach 180,000 tons by 2012 and possibly 200,000 tons by 2014. China’s REE production is not expected to

reach much beyond 160,000 tons by 2014, so it is incumbent upon the U.S. and other global consumers of REEs to seek alternative sources as soon as possible.³⁷

Supply

There are seventeen elements on the periodic table that are considered to be REEs. Fifteen of these elements are found in the chemical group called lanthanides. They are listed as follows with full name and chemical abbreviation: lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), and lutetium (Lu). The other two elements are scandium (Sc) and yttrium (Y), which are similar in chemical properties, but are not part of the lanthanide family.³⁸

La 57	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71	Y 39
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Lanthanides

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	An	Lr														

Figure 2: REEs as positioned on the Periodic Table of Elements³⁹

REEs are often obtained as a byproduct from the mining of other ores such as: gold (Au), iron (Fe), copper (Cu), uranium (U), and phosphates (PO_4).⁴⁰ Since phosphates are normally found as a compound and not found in pure elemental form, they warrant some further clarification. Generally, phosphorus (P) bonds with four parts oxygen (O) to create a phosphate. Phosphates are essential to the cell structure of all plants and animals. Plants gain phosphates from either the soil or from synthetic fertilizers, whereas, animals gain phosphates from the foods they eat.⁴¹ It is important to understand that REEs are not usually found in pure elemental form, but often as byproducts of another process.

REEs can be divided into two basic categories. The first four REEs in the lanthanide family are referred to as Light REEs (LREEs) and include: lanthanum, cerium, praseodymium, and neodymium, which are often found in heavy concentrations ranging from eighty to ninety percent of an overall find.⁴² Mountain Pass, CA has been known to produce mostly LREEs. Mountain Pass expects to become fully operational around mid-2012 now that it has secured new environmental permits from the government. The mine closed in 2002 due to an increase in Chinese REE production that lowered market prices and because of various environmental restrictions.⁴³

Heavy REEs (HREEs) are considered those elements with atomic numbers ranging from sixty-two to seventy-one, with the only exception being Yttrium.⁴⁴ In September 2010, the Globe Metals and Mining Company of Australia reported the discovery of the HREE dysprosium at their Mount Muambe site in Mozambique not far from the city of Tete.⁴⁵ Dysprosium is used in developing lasers, high intensity lighting, and control rods for nuclear reactors. This site was previously mined for the LREEs:

cerium, lanthanum, and neodymium in the late 1990s. However, when fluorite deposits were re-analyzed in 2009 specifically looking for HREEs the discovery was made. This deposit is considered high quality ore yielding samples measuring up to one-hundred sixty-eight part per million (ppm).⁴⁶

Four REEs were found in basaltic lava flows of Botswana, Zimbabwe, and the northern part of South Africa. Those elements are: strontium, neodymium, hafnium, and lead.⁴⁷ Of those four elements, only neodymium is an REE, but strontium and hafnium are considered isotopes with compositions similar to the seventeen REEs. It appears hopeful that other REEs may be discovered in these areas at some point in the future. The South Africa platinum mines located in the Merensky Reef of the Bushveld Complex have shown trace element patterns in magma flows for some REEs. However, further exploratory mining is required to determine the exact type of the REE deposits in that area.⁴⁸ Of these three countries, Zimbabwe seems to have the most contentious relations with the United States at present. Since 1986, the U.S. has condemned Zimbabwe for a series of negative behaviors to include: hostile rhetoric, rule of law, and human rights violations. In 2002, Zimbabwe's presidential elections came under scrutiny by the international community for poorly executing electoral laws and failure to stop pre-election violence. To date, relations still remain tense and will prohibit any REE procurement under AGOA until these issues are resolved.⁴⁹

Gold mining operations in Sierra Leone has discovered some REEs as the result of recent excavations. Black sand concentrates have revealed commercially exploitable levels of the following REEs: La, Ce, Nd, Dy, Lu and Sc. Neodymium is used in the

development of many green technologies like permanent magnets to run wind turbines. And, lanthanum is used in the development of hybrid car batteries.⁵⁰

The Montero Mining Company owns the Wigu Hills REE deposit in Tanzania. Wigu Hills is located several hundred kilometers west of port city of Dar es Salaam. The site has REEs found in simple carbon deposits containing no radioactive materials, which should make extraction less expensive and reduces many safety concerns.⁵¹ Tanzania does not currently have the ability to process REEs. But, South Africa does have that capability and may be able to help Tanzania process the find.

The South Africans discovered REE deposits at their Steenkampskraal mine similar in composition to those from Tanzania. In February 2002, the Rare Earth Extraction Company (Rareco) made requests of the South African Department of Minerals and Energy to re-open the old Steenkampskraal mine which lies just north of the town of Van Rynsdorp. This mine has not been operational since 1963. As part of the agreement to re-open the mine, Rareco was granted indemnity from past environmental damage and has pledged to ensure their new venture will meet or exceed all international standards. Rareco has already obtained a five-year contract with a European firm to obtain two-thirds of the mine's future yield.⁵²

January 2009, Rareco announced a contract with the Canadian company Great Western Mineral Group (GWMG) for exclusive rights to all of the REEs coming out of the Steenkampskraal mine. In August, Rareco confirmed signing a ten-year agreement with GWMG and in September GWMG announced a twenty percent purchase of Rareco stock. According to data provided by Rareco, the mine produces fifteen of the seventeen REEs in the following order of descending percentage yield: Ce - 46.55%, La

– 21.63%, Nd – 16.66%, Pr – 5.0%, Y – 5.0%, Sm – 2.5%, Gd – 1.55%, Dy 66 - 0.67%, Er – 0.08%, Tm – 0.07%, Yb – 0.07% , Ho – 0.05%, and Lu – 0.01%.⁵³

Malawi has recently experienced rapid economic growth as a result expanding mining ventures, particularly in the area of increased REE production. Global Metals has reported favorable results from preliminary REE samples taken in 2010. If these sights are proven commercially viable, Global Metals predicts a large increase in foreign investments. As of August 2010, the construction of Chipata-Machinji rail line between Malawi and Zambia is complete providing both countries with access to the port of Nacala in Mozambique, thus increasing the potential for marketing this new find.⁵⁴

Development of a REE supply chain development can take a very long time. Sources can vary as to the exact timeline, but it is safe to say this is a multi-year process potentially ranging from five up to fifty years.⁵⁵ Developing an REE mine requires several steps from the mine's inception until full scale production occurs. Figure 3 displays the process used at Mountain Pass, California.

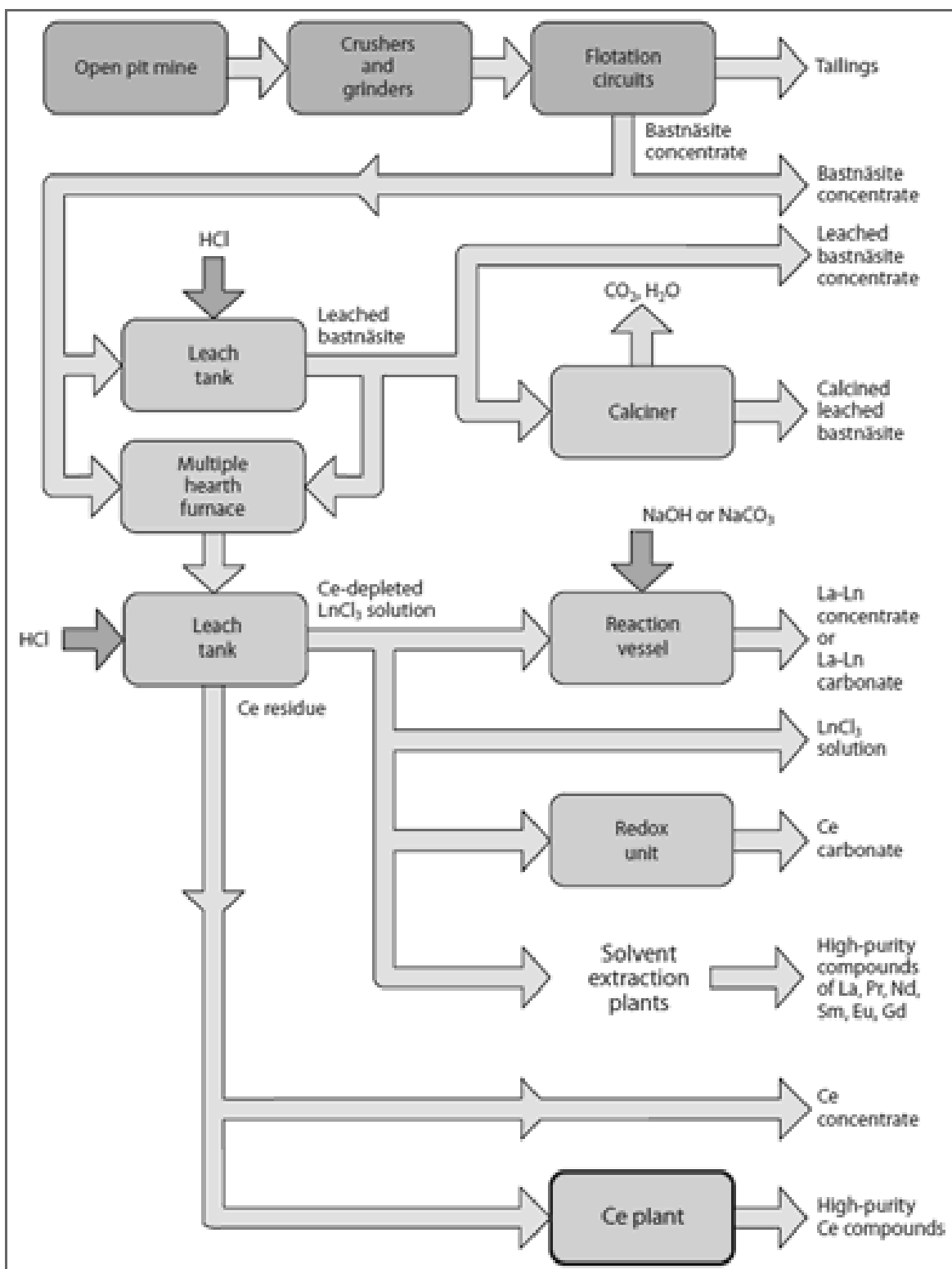


Figure 3: Diagram of REE ore processing at Mountain Pass, CA⁵⁶

First, a substantial REE deposit must be obtained. There are two methodologies for finding REEs. *Greenfield exploration* seeks REE deposits in sufficient quantities to ensure a mine's economic viability. The alternative method is called *Brownfield exploration*, which involves returning to past sites and continuing further exploratory drilling.⁵⁷ As mentioned earlier, REEs are fairly abundant within the earth's crust, but are not usually found in sufficient quantities to make extraction feasible. Therefore, the primary factor that drives *Greenfield exploration* is a significant rise in the market price. Now that China decided to increase their own REE stockpiles constraining the global REE supply-chain, thus raising the market price and making *Greenfield exploration* necessary and more affordable.

The second major step in developing an REE mine is called *proving the deposit*. This phase involves drilling core samples and sufficient quantities to make extraction profitable. This step requires studies of economic feasibility, environmental impact, metallurgical processing, as well as making applications for mining permits with various government agencies. Most mines derive their financial backing from other mining operations, corporations, banks, or other external investors.⁵⁸ It may be possible to derive capital for the development of African REE mines from the International Monetary Fund (IMF) or the World Trade Organization (WTO), but only if the above mentioned criteria is met and if the host nation can guarantee internal security to sustain the long-term viability of the operation.

The third part of developing an REE mining operation involves building the mine and a processing plant once all studies are complete and the permits have been obtained. The *ramp-up process* is considered the most difficult part of establishing REE

production. It may be a relatively flawless venture or it can be fraught with enormous difficulties. This is the phase where most mines fail. This *ramp-up process* has been as short as three months like Niobec, Canada in 1976, or longer than three years as was the case in Araxá, Brazil in the 1960s.⁵⁹

The final phase of developing an REE mine involves planning for future *reclamation and closure*. In the past mines were just abandoned upon terminating production, now consideration is given to restoring the land to its previous condition, where possible. This involves removing the facilities, equipment, and if feasible the tailings and waste products as well.⁶⁰

On 17 November 2010, the U.S. Geological Survey posted a news release on the internet citing the results of a nationwide survey that discovered fourteen states with the potential for mining REEs. Those states are Alaska, California, Colorado, Florida, Georgia, Idaho, Illinois, Missouri, Nebraska, New Mexico, New York, North Carolina, South Carolina, and Wyoming. The southeastern states generally contain large phosphate deposits that have the potential to bear yttrium and lanthanum. The other states have potential placer deposits found in the sediments of various river valleys. None of these new deposits have yet been proven to meet the standard annual consumption rates, but the initial reports look favorable.⁶¹ The chart below shows the locations of new U.S. REE deposits and either their proven or probable yields.

Deposit		Tonnage (metric tons)	Grade (percent TREO)	Contained TREO (metric tons)	Source
Reserves—Proven and probable					
Mountain Pass,	California	13,588,000	8.24	1,120,000	Molycorp, Inc. (2010).
Resources—Inferred					
Bear Lodge,	Wyoming	10,678,000	3.60	384,000	Noble and others (2009).
Resources—Unclassified					
Bald Mountain,	Wyoming	18,000,000	0.08	14,400	Osterwald and others (1966).
Bokan Mountain,	Alaska	34,100,000	0.48	164,000	Keyser and Kennedy (2007).
Diamond Creek,	Idaho	5,800,000	1.22	70,800	Staatz and others (1979).
Elk Creek,	Nebraska	39,400,000			Molycorp, Inc. (1986).
Gallinas Mtns.,	New Mexico	46,000	2.95	1,400	Jackson and Christiansen (1993).
Hall Mountain,	Idaho	100,000	0.05	50	Staatz and others (1979).
Hick's Dome,	Illinois	14,700,000	0.42	62,000	Jackson and Christiansen (1993).
Iron Hill,	Colorado	2,424,000,000	0.40	9,696,000	Staatz and others (1979).
Lemhi Pass,	Idaho	500,000	0.33	1,650	Staatz and others (1979).
Mineville,	New York	9,000,000	0.9	80,000	McKeown and Klemic (1956).
Music Valley,	California	50,000	8.6	4,300	Jackson and Christiansen (1993).
Pajarito,	New Mexico	2,400,000	0.18	4,000	Jackson and Christiansen (1993).
Pea Ridge,	Missouri	600,000	12	72,000	Grauch and others (2010).
Scrub Oaks,	New Jersey	10,000,000	0.38	38,000	Klemic and other (1959).
Wet Mountains,	Colorado	13,957,000	0.42	59,000	Jackson and Christiansen (1993).

Figure 4: Known and Potential REE deposits in the United States.⁶²

Next, the same November 2010 report provides us with two more tables showing REE deposits outside of the United States, of particular interest are those REE deposits found in Africa. Now we can compare and contrast what is available from Africa verses what we could obtain within the continental United States.

Deposit		Tonnage (metric tons)	Grade (percent TREO)	Contained TREO (metric tons)	Source
Measured-in-pit resources					
Brockman,	Australia	4,290,000	0.2	8,600	Chalmers (1990).
Mount Weld,	Australia	2,100,000	15.5	326,000	Lynas Corporation (2010).
Thor Lake (Lake Zone),	Canada	12,010,000	1.70	204,000	Paul and Stubens (2009).
Steenkampskraal,	South Africa	249,500	11.80	29,500	Great Western Minerals Group Ltd. (2009).
Measured, indicated, inferred resources					
Brockman,	Australia	50,000,000	0.23	115,000	Chalmers (1990).
Cummins Range,	Australia	4,170,000	1.72	72,000	Navigator Resources Ltd. (2009).
Dubbo,	Australia	73,200,000	0.89	651,500	Alkane Resources (2010).
Mount Weld,	Australia	15,020,000	8.60	1,292,000	Lynas Corporation (2010).
Narraburra,	Australia	55,000,000	0.03	16,500	Capital Mining Ltd. (2009).
Nolans Bore,	Australia	30,300,000	2.80	849,000	Arafura Resources Ltd. (2010).
Hoidas Lake,	Canada	2,847,000	2.00	57,000	Dunn (2009).
Strange Lake,	Canada	137,639,000	0.97	1,335,000	Daigle and Maunula (2010).
Thor Lake (Lake Zone),	Canada	175,930,000	1.43	2,516,000	Paul and Stubens (2009).
Thor Lake (North T),	Canada	1,136,000	0.71	8,000	Palmer and Broad (2007).
Zeus (Kipawa),	Canada	2,270,000	0.11	2,500	Knox and others (2009).
Kvanefjeld,	Greenland	457,000,000	1.07	4,890,000	Greenland Minerals and Energy Ltd. (2009).
Kangankunde Hill,	Malawi	2,500,000	4.24	107,000	Lynas Corporation Ltd. (2007).
Unclassified resources					
John Galt,	Australia	382,000	7.96	30,400	Northern Uranium Ltd. (2010).
Olympic Dam,	Australia	>2,000,000,000	0.50	>10,000,000	Oreskes and Einaudi (1990).
Yangibana,	Australia	3,500,000	1.70	59,500	Jackson and Christiansen (1993).
Araxá,	Brazil	450,000,000	1.80	8,100,000	Filho and others (2005).
Catalão I,	Brazil	10,000,000	0.90	90,000	Hirano and others (1990).
Pitinga,	Brazil	164,000,000	0.15	246,000	Bastos Neto and Pereira (2009).
Poços de Caldas,	Brazil			115,000	Wedow (1967).
Seis Lagos,	Brazil	2,900,000,000	1.50	43,500,000	De Sousa (1996).
Tapira,	Brazil	5,200,000	10.5	546,000	Hirano and others (1990).
Kasagwe,	Burundi	67,000	1.50	1,000	Jackson and Christiansen (1993).

Figure 5. Known and Potential REEs deposits outside the United States.⁶³

Deposit		Tonnage (metric tons)	Grade (percent TREO)	Contained TREO (metric tons)	Source
Oka,	Canada	210,000,000	0.127	267,000	Orris and Grauch (2002).
Mrima Hill,	Kenya	6,000,000	16.2	972,000	Pell (1996).
Ak-Tyuz,	Kyrgyzstan	15,000,000	1.00	150,000	Malyukova and others (2005).
Karajilga,	Kyrgyzstan	957,000	0.70	6,700	Bogdetsky and others (2001).
Kutessai II,	Kyrgyzstan	20,228,000	0.22-0.3	<60,000	Stans Energy Corp. (2010).
Sarysai,	Kyrgyzstan	7,000,000	0.20	14,000	Bogdetsky and others (2001).
Pilanesberg,	South Africa	13,500,000	0.70	94,500	Lurie (1986).
Zandkopsdrift,	South Africa	31,500,000	3.60	1,130,000	Frontier Minerals (2009).
Kizilcaören,	Turkey	4,695,000	2.78	130,500	Morteani and Satir (1989).
Dong Pao,	Vietnam	500,000,000	1.40	7,000,000	Kušnir (2000).
Mau Xe North,	Vietnam	557,000,000	1.40	7,800,000	Kušnir (2000).

Figure 6: Known and Potential REEs deposits outside the United States (Continued)⁶⁴

One very important point to keep in mind with all of the data presented in figures five through seven, most of these new REE finds have not yet been proven and are at various stages in the production cycle. The Iron Hill, Colorado site appears to have the greatest possibilities to meet our future domestic needs, but it could take years to develop and reach full production. The two largest African finds exist in Malawi and South Africa, but they already have numerous customers soliciting those commodities. For the short-term, waiting for increased production from the U.S. Mountain Pass site seems to be the best option, but it will not be fully operational until mid-2012. So, as long as the Chinese continue to constrain the world REE market, it looks like engagement of DLA managed stockpiles in conjunction with the thirteen million metric tons of rare earth from Mountain Pass, CA is the best short-term solution.

Despite the great potential for accessing REE deposits from Africa, Figure 7 indicates the limited supply-chain for such prospects. The chart obtained from the Mineral Commodity Summaries 2010 clearly shows no individual African countries listed as past global producers of REEs. The chart also depicts the countries who are the major annual producers of REEs and shows who possesses the largest stockpiles ready for global market sale.

World Mine Production and Reserves: Reserves data for Australia, China, and India were updated based on data from the respective countries.

	Mine production^e		Reserves^g
	<u>2008</u>	<u>2009</u>	
United States	—	—	13,000,000
Australia	—	—	5,400,000
Brazil	650	650	48,000
China	120,000	120,000	36,000,000
Commonwealth of Independent States	NA	NA	19,000,000
India	2,700	2,700	3,100,000
Malaysia	380	380	30,000
Other countries	<u>NA</u>	<u>NA</u>	<u>22,000,000</u>
World total (rounded)	124,000	124,000	99,000,000

Figure 7: Global REE Mining Production and Reserves⁶⁵

Furthermore, review of the U.S. Geological Survey's 2008 Mineral Yearbook provides an excellent graphic representation of where the United States obtains its major imports of REEs. As it is clearly evident from Figure 8 below, no African countries were depicted as providing any major source of REE imports to the U.S. in 2008 either. With no solid supply-chain already established from Africa, and taking into account the time to ramp up REE mining to full capacity, the short-term prospects are bleak for obtaining large quantities of REEs from Africa in the immediate future.

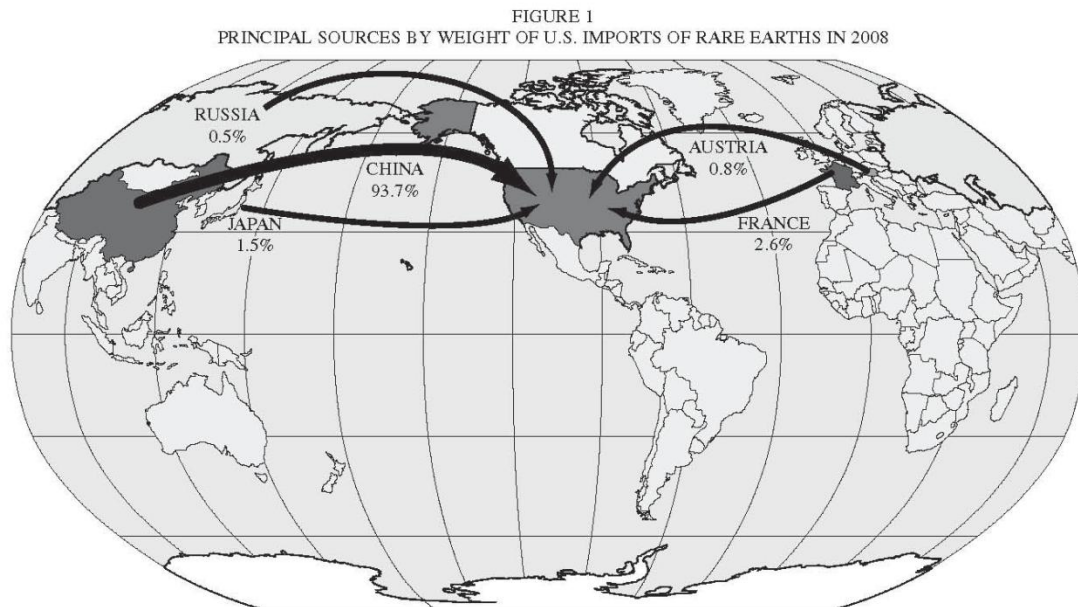


Figure 8: Graphic depiction of the major REE importers to the U.S. in 2008⁶⁶

Impact of Chinese Competition

In November 2006, the Chinese hosted the Forum on Chinese and African Cooperation (FOCAC) in Beijing. Forty-eight African delegations endorsed the idea of expanding Chinese involvement on the African continent to improve the infrastructure of African nations and elevate the status of Africa on the world scene. China's foreign

policy towards Africa centers on gaining access to energy resources and access to limited commodities, such as REEs. The Chinese sought African allegiances by supporting United Nations (UN) peacekeeping operations on the continent and by cancelling huge sums of African debt (in U.S. Dollars: one point forty-two (\$1.42) Billion in 2006 and one Billion dollars in 2007).⁶⁷

China has often referred to itself as the champion of the developing world. They joined the World Trade Organization (WTO) in 2001 to further expand their already growing economy. One of the conditions for joining the WTO was to treat China as a non-market economy (NME) until the year 2015. The Chinese bill their immense financial growth as a challenge and not a threat to the world economy. Although they play the NME card well, the Chinese have negotiated bilateral agreements with several countries to be acknowledged as a market economy. To date, the European Union (EU) and the U.S. have not granted them any such request. Professor Pang Zhongying from Nankai University believes China is attempting to become a major global power by hiding behind the guise of economic openness.⁶⁸ Chinese investment in Africa provides us with evidence of this assertion. The Chinese sponsor massive improvements to rail and port infrastructures in various African countries as short-term payment for long-term access to African mineral deposits.

China can relate to Africa's fear of neo-colonialism by the United States and other western nations. China likes to remind Africans that it too "...emerged from former colonial encroachment, internal chaos and economic destitution to achieve spectacular economic growth and infrastructure development." This message "...has a powerful resonance in Africa."⁶⁹ Although China is improving African infrastructure, they

are taking a purely business-like approach. They do not impose their values upon the Africans, and have been known to turn a blind eye to inner turmoil and corruption within the countries that they are trying to assist. The Chinese tend not to invest in local labor to retrieve lucrative mineral assets; this caused some strife in Zambia in 2006 when the presidential candidate accused them of unfair labor practices.⁷⁰

China grasps the importance of keeping open sea lines of communication (SLOCs) throughout the world to ensure the free flow of commerce. China is expanding its blue-water naval capability and is seeking global ports of call to berth its ever increasing fleet.⁷¹ In December 2008, the Chinese Navy deployed its naval assets to the Gulf of Aden off the coast of Somalia to be part of the world's anti-piracy efforts there.⁷² This action, accompanied with China's desire to develop aircraft carrier and short range ballistic missile capabilities, raises concerns as to Chinese intentions. Many analysts still feel these efforts are primarily focused on Taiwan, but others see it in a larger context. Some believe the Chinese want to patrol the area known as the *second island chain* which includes Japan, to Guam, and out to the Marshall Islands.⁷³ Figure 9 shows the location of the second island chain and the potential range of several Chinese ballistic missiles.

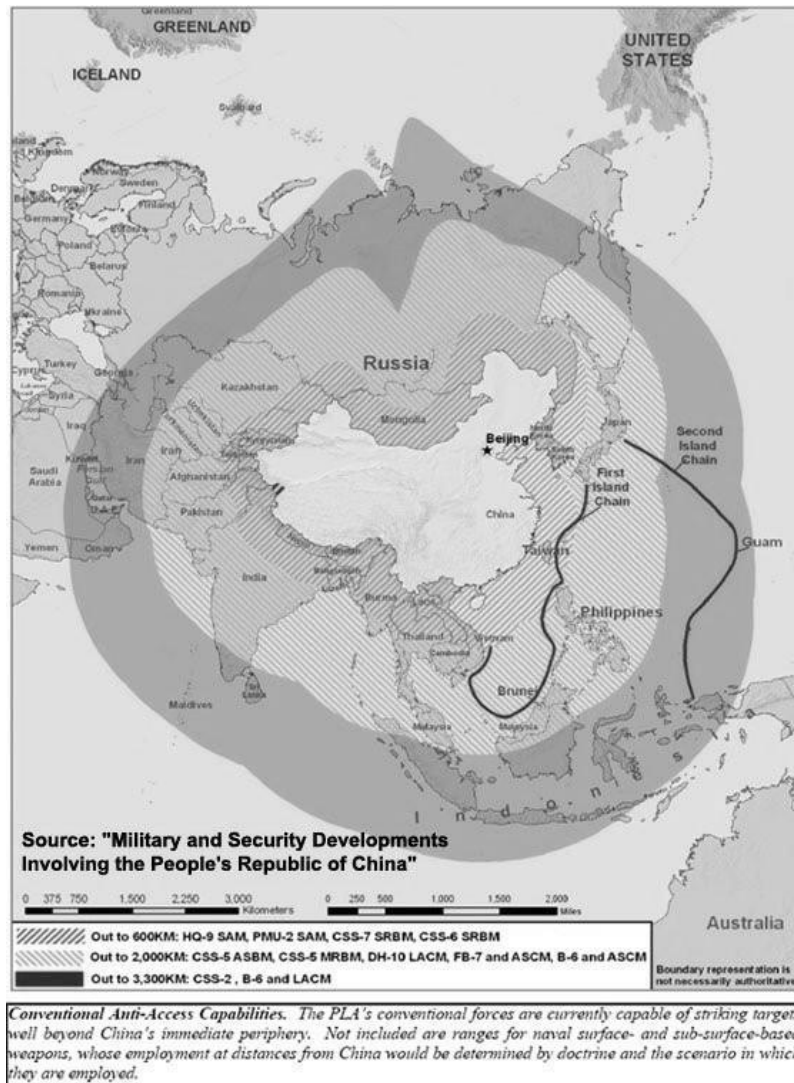


Figure 9: Second Island Chain and Chinese Ballistic Missile Ranges⁷⁴

All the Chinese need to complete the development of their blue-water capabilities is anti-submarine and air defense systems and these are now procurement priorities of the Chinese Navy. The Chinese did procure a Ukrainian carrier back in 2002 and fourteen Sukhoi (Su)-33 Fighters from Russia they want to modify for carrier service.⁷⁵ All of these actions indicate a nation who desires to compete on the global stage and possibly threaten U.S. global hegemony, especially with their heavy economic investment on the African continent.

The Chinese have been participating in UN Peacekeeping Missions since 1990 and in Africa since 2004, when it first supported a UN mission in Burundi. The list of UN missions they support is extensive, but support for African countries in possession of REE amounts to only Mozambique and Sierra Leone. The Chinese support UN peacekeeping missions for a variety of reasons, but when asked China says it is trying to be a responsible power. Alternative viewpoints suggest UN missions are the build a bridge to gain access to various natural resources, REEs being just one type. As of 2007, China ranked twelfth in contributions to UN missions.⁷⁶

As one of the five permanent members of the UN Security Council, China has contributed the most troops to peacekeeping missions. Making large contributions to UN missions is not without its perks. In November 2006, Dr. Margret Chan was appointed to position of Director-General for the World Health Organization (WHO). Since the People Liberation Army (PLA) is not an expeditionary organization and serving in peacekeeping roles provides several opportunities like officers working in a coalition environment or soldiers training and testing new equipment, such as the American's Global Positioning System (GPS).⁷⁷

In 2007, China lost a member of the PLA to an Israeli Air strike in Lebanon, raising the total to eight Chinese peacekeepers killed since 1990. China has contributed a total of 1,600 peacekeepers to UN missions over the last decade specifically in Africa and the Middle East. The Chinese act mainly in support roles providing medical, transportation, and engineering services. Chinese soldiers are generally well received throughout Africa.⁷⁸ This altruistic Chinese behavior falls in line with their champion of the developing world concept, but a more critical eye may

conclude that this peacekeeping support is an attempt to improve African infrastructure in preparation for exploitation of natural resources, like minerals deposits bearing REEs.

The Washington Post views China's benign intentions towards the world with great skepticism. They point out that of the ten peacekeeping missions the Chinese supported in 2009, most were in African countries. The Post speculates China only participates in African UN missions to gain access to the rich natural resources located there. The Post further asserts that China has shown little interest in supporting the war in Afghanistan, possibly still embittered by the 1999 bombing of their embassy in Belgrade during the Kosovo crisis.⁷⁹

Other Foreign Competition

Iran has established a foothold on the African continent around the Horn of Africa (HOR) and in Central Africa for quite some time. Iran has a growing naval presence in countries such as Sudan, Eritrea, and Djibouti. Djibouti currently has good relations with the United States and is the only African nation hosting a permanent U.S. military presence via the Combined Joint Task Force – Horn of Africa (CJTF-HOA). As of March 2009, the Iranian Navy has extended its capabilities out to the southern shores of the Red Sea. Iranian vessels have been seen in Port Sudan and in the Eritrean port city of Assab supposedly to protect the local oil refinery there.⁸⁰

An Oxford Analytica article attributes Iran's interest in Africa to be more pragmatic than what appears on the surface. Iran knows that retaining good relations with countries like South Africa is critical, since that relationship constitutes twenty-three percent of Iranian oil exports. Iran desires to legitimize its nuclear program by seeking support from countries belonging to the Non-Aligned Movement (NAM), most of which come from Africa. Iranian President Rafsanjani secured support for issue in exchange

for future economic trade with several African countries.⁸¹ No specific mention has been made regarding REEs, but as mentioned above, REEs are essential to many of the technologies that support a viable nuclear program.

India is trying to inject themselves into the African market against a very aggressive competitor, China. In 2009, India's investments amounted to about two billion in comparison to China's eight billion for the same timeframe. Traditionally, India's strongest African partner has been the country of Mauritius. Investment there has been executed through an economic mechanism called Foreign Direct Investment (FDI). FDI sent to Africa amounts to nine percent of their total global investments during the period of 1996 to 2005. India, like China, has a growing need for access to various natural resources. Although much of India's focus has been more on energy resources such as oil and coal, REEs are just as critical to the expansion of their technological and nuclear ambitions too.⁸²

African Challenges

The development of infrastructure is critical to the economic prosperity of the African continent. Beginning in the 1850s, European countries established a rail network spanning some 90,000 kilometers (kms). Since many African nations were dominated by different European powers this network of railroads was never interconnected. After the European departure many railways have fallen into disrepair. From the mid-nineties forward, many partnerships were formed to ensure economic growth in Africa. Upgrading rail access to remote mines is essential if countries hope to get their commodities to market and has revitalized about 89,000 kms of that old network. Sub-Saharan Africa has the lowest density of rail networks in the world ranging from two point nine (2.9) kms per every thousand square kms.⁸³

China, India, and the World Bank are the biggest investors in the infrastructure of Sub-Saharan Africa. China invested both money and technical expertise in modernizing some 1,300 kms of the Benguela railway going from Angola to the Congo in order to gain better access to oil and mineral resources in that region. China also offered Nigeria a billion dollar loan to improve their rail network to better access the oil supply. China offered the Democratic Republic of the Congo (DRC) a similar deal worth five billion to improve 3,200 kms of the Mombassa-Kampala railway to gain access to the mines there as well. These improvements orchestrated by the China Railway Group (CRG) who announced in 2007 their intentions to increase their investments from five percent to twenty percent by 2012.⁸⁴

Both China and India made significant strides investing in Africa's future. The development of Export Processing Zones (EPZs) has not worked as well in Africa as hoped. The failure is related to weak institutions and poor implementation of governmental policies relating to commerce. Corruption is still a major issue all across Africa. As a result of poor leadership in several African countries, it becomes difficult to properly distribute wealth to where it is needed. Increased education is needed to create a more skilled workforce to attract further investment on the continent.⁸⁵ In 2005, India joined the African Capacity Building Foundation (ACBF) to help build transportation infrastructure as a prelude to future investments.⁸⁶

The 2010 AFRICOM Posture Statement outlines four priorities taken from President Obama's July 2009 speech given in Ghana. The point germane to this discussion is priority number two, "Fostering sustained economic growth and development".⁸⁷ Implementing this priority requires building strong rapport with African

nations in possession of REEs. Currently, Chinese efforts run contrary to this priority with the consequences of creating serious international tensions. Looking at the REE access issue from this perspective, some focus should be placed on the following statement. “In many cases, undiversified economies, high unemployment, and corruption, have prevented the wealth generated by Africa’s natural resources from finding its way to the neediest segments of African societies.”⁸⁸ The take-away from this is that most African countries appear to be suffering from an internal lack of sound leadership, not an infusion of money.

Greg Mills, Director of the Brenthurst Foundation, has a firm grasp of the internal factors that keep Africa in poverty. From a social perspective, Africans seem to have many deep-rooted scars from colonialism. They still live in a neo-patrimonial culture that precipitates nepotism and corruption because the power base is vested mainly in the executive portion of African governments. These entities lack a commitment to the general welfare and the people accept this behavior because the condition has been prevalent for multiple generations. Mills points out that Africa has been endowed with many financial resources and access to the global marketplace, but by not embracing democratic principles their leaders often retain national wealth for themselves and the country’s elites.⁸⁹

Mills goes on to say that foreign investors have allowed African leaders to make bad choices with their new found wealth by not imposing conditions on how to use this income to improve their country. As mentioned before, the Chinese tend to be oblivious to this kind of behavior, possibly because they do the same thing back home. In contrast, the U.S. tends to restrain its investments pending the implementation of

positive behaviors, such as improved human rights, or the prevention of genocide.

Perhaps, the U.S. should not impose its values so narrowly in order to gain access to critical mineral resources such as REEs.⁹⁰

The trials and tribulations surrounding the petroleum industry should not be forgotten when considering the development of REEs in Africa. The country of Nigeria can serve as a backdrop for identifying many lessons learned regarding the ill effects of foreign procurement of a natural resource, oil in this case. Five major oil corporations established production in the Niger River Delta. The results of their activities created political, social, and environmental damage in their wake. Pollution resulting from oil drilling contaminated local drinking water and created an adverse affect on fishing and agriculture ventures to the point that Nigeria must now import most of its foodstuffs. Oil companies solicited the Nigerian Government's to subdue local protestors and went so far as to create splinter groups to oppose those protestors through various means of coercion. These behaviors created a negative social malaise resulting in property loss, prostitution, and the birth of illegitimate children conceived by foreign workers.⁹¹

The U.S. Department of State can use Title 22 monies, in conjunction with military support from ARFICOM, to mitigate some of these challenges and negotiate better access to REEs. Title 22, subsection 2293 outlines the long-term development assistance that has been appropriated for sub-Saharan Africa. Subsection 2293(a) (3) talks about, "...a process that builds upon the needs and capabilities of the African people, promotes sustained and equitable economic growth, preserves the environment, and protects the rights of the individual." Subsection 2293 (i) (1) (B) (iii) further delineates, "Support for special training and education efforts to improve the

capacity of countries in sub-Saharan Africa to manage their own environments and natural resources.”⁹² Corrupt governments, fear of neo-colonialism, and a lack of modern infrastructure has prohibited African nations from coming to the forefront of international politics and economic affairs. It is in the vital interests of the United States to consider all of the above-mentioned tools if it seeks greater economic access to the African continent.

Summary and Conclusions

This paper provided some historical context regarding competition for natural resources along with a brief history of REEs. It identified past policies that limited domestic mineral procurement and talked about the legislative actions taken to remedy the situation. Alternative sources of supply were discussed along with the current global demand. Competition for African REEs is shaped by a multitude of political, economic, and social forces. Lastly, the United States must make some difficult choices regarding how to best deal with the current Chinese embargo on REEs, determine if Africa is the best alternative source of supply, or decide if the time is ripe to disengage the concept of globalization and embrace a more self-sufficient posture regarding mineral resources.

Africa has several REE deposits that could provide the U.S. with an alternate source supply if properly engaged (see Figures 5 and 6 above). However, the Chinese, Indians, Iranians, North and South Koreans, Canadians, and Australians have already established lucrative and long-term business relationships in Africa to obtain part of this REE supply base. The desire to obtain REEs from Africa must be compared to the global supply in other areas, like Canada and Australia with whom there are already have strong trade relations, to determine where the greatest economic advantages lie.

The African continent has unlimited potential for further social, political, and economic growth. Since the end of European colonialism many opportunities have been afforded to African nations to improve their overall standing in world affairs. Two things seem to constrain successful economic growth in Africa. First, poor infrastructure is not able to interconnect all the activities of African nations due to inadequate roads, railways, and ports. Second, poor leadership creates internal struggles directed against many African governments; Zimbabwe offers a current example of such behavior.

The U.S. must also be wary of the growth of the Chinese Navy and its ever growing presences in Africa. Although their presences seems benign, securing access to port facilities in Africa extends the global reach of the Chinese military and may threaten the long-term political influence of the United States in world affairs. Rather than reacting to this challenge in a forceful and overt manner, perhaps the solution lies in a soft power approach working through the various political institutions already engaged in Africa, such as the UN and the AU to resolve any future acts of Chinese aggression.

Recommendations

If the United States wants to compete for access to rare earth elements on the African continent it must engage in a more flexible and open approach than it has used in the past. The U.S. must be less focused on selling its brand of democracy to the rest of the world and more focused on assisting African nations to establish stable forms of government, able to care for their people and guarantee their internal security. Before engaging in diplomacy with any African country, the U.S. should develop a deep appreciation for the culture of that country and assist them to develop a political structure that fits their own social construct rather than imposing our values as the

universal model. The newly formed AFRICOM can help to exert American influence in a more tempered manner by conducting military exercises and training exchange programs across the Continent.

Leveraging various regional economic institutions in Africa like ECOWAS, COMESA, and EAU may open doors to REE minerals depending upon which country you are soliciting resources from. The approach taken with each country needs to be tailored to each unique socio-economic situation. As mentioned earlier, South Africa and Malawi seem to be the most viable options for REE procurement from Africa in the short-term.

The newly discovered domestic REE sources must be further explored before seeking new foreign sources of supply. Remember, both options take considerable time to reach full production capacity. The Iron Hill, Colorado mine, along with the older Mountain Pass, California site, appears to offer the best prospects for obtaining self-sufficiency regarding domestic REE procurement. The United States must learn a valuable lesson from this recent REE embargo. National security is not a commodity for sale to the lowest bidder. The international market place can provide almost any commodity, but the key to a nation's long-term survival depends upon having its own diverse economic base as well as unlimited access to strategic mineral resources. Both Africa and the United States can take advantage and learn from this most recent incident in world affairs.

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