"The U.S., China and Rare Earth Metals"
The Future Of Green Technology, Military Tech, and a Potential Achilles' Heel to American Hegemony.

By

David Trigaux

A thesis submitted in partial fulfillment
of the requirements of the
University Honors Program
University of South Florida St. Petersburg

May 2nd 2012

Thesis Director: Thomas Smith Ph. D.
Director of the Honors Program and Associate Professor of Political Science

Committee Member: Dr. Ty Solomon, Visiting Assistant Professor of Political Science

University Honors Program
University of South Florida
St. Petersburg, Florida

CERTIFICATE OF APPROVAL

_____

HONORS THESIS

_____

This is to certify that the Honors Thesis of

David Trigaux

Has been approved by the Examining Committee
On May 2nd, 2012
As satisfying the thesis requirement
Of the University Honors Program
Examining Committee

_____

Thesis Director: Thomas Smith, Ph. D.
Professor of Political Theory, College of Arts and Sciences

_____

Thesis Committee Member: Ty Solomon, Ph. D.
Professor of Political Science, College of Arts and Sciences

What do a solar panel, a smart bomb, and a baseball bat have in common? They all require rare earth elements to create/manufacture. The United States is widely considered the hegemon of the world. The American economy, which was previously hemorrhaging jobs, and is now growing anemically, is still larger, more balanced and more advanced than its competitors, especially given the transition to and integration of advanced technology. Its military prowess is unmatched by any two competing nations combined, and its quality of life for its citizens remains one of the highest in the world. Air planes, tanks, solar panels, plasma screen TVs, smart phones; all conceived and designed in the United States. The small problem rests with rare earth metals. This collection of minerals that nobody has ever heard of are critical to building most of the high tech gadgets, appliances, and machinery that makes the United States what it is today, and that increasingly look to shape the future economically and militarily.

The stumbling block stands that the only large scale, commercially viable producer of these minerals is the People's Republic of China. After flooding the market to put their competition out of business in the early 1990s, China has systemically gained control over the entire sector of the economy concerning these minerals. Between 90% and 100% of all current commercially viable rare earth production occurs in China. As Deng Xiaoping declared in the 1970s, rare earth metals are to China as oil has become for many Middle Eastern nations; a resource to center economic growth around, and use as a tool of statecraft internationally that can demand respect and result in important concessions. Access to these critical minerals, which are not only

important in the petroleum refining process, but key to most current alternative energy sources, a plethora of new military applications, and basic consumer goods, will define the coming generation. Current American responses are limited and not commercially viable. The question stands however; how should the United States respond to these challenges, and move forward into the 21st century with its energy security and economic competitiveness intact? Can we mine our way out of this conundrum, or will our financial might prove useless in the face of an equal on the global market?

More importantly, does a question such as this force us to critically re-examine how we engage in the international arena? The complex interdisciplinary nature of the problem presented in this paper brings to the forefront the current consensuses that are shaping international relations today, and highlight the US-China relationship. The relationship between these two nations, widely viewed as pivotal to the direction of the 21st century, is currently dominated by rival camps divided by ideology and special interest, and less by what is actually going on within the People's Republic. The rare earth question presents a unique challenge to current solutions to the problem, which are largely couched in a realist worldview. Given that the US-China relationship is at the forefront of the debate concerning rare earths, a re-evaluation of how the U.S. engages with China is of paramount importance. Current interpretations are lacking, and in many cases detrimental, both to the overall relationship, and to the rare earth question. Is the solution new wine in an old realist, national security bottle? Or does the rare earth question force us to reconsider the very nature of security?

Section One: What Are We Talking About?

What is a rare earth metal? Good question. Survey the average American on the street, and they won't know. Some people will guess minerals like uranium or platinum, which stole headlines a few years ago with civil wars and violent upheavals occurring around the only major production sites such as in Africa, but they would be wrong. Sadly, the average citizen can't name a single one, let alone point them out on the periodic table.

A "rare earth" metal or element is one of seventeen elements that are at the bottom of the periodic table. "Rare Earths" is a term of art referring to these specific metals, some of which aren't entirely that rare. The term excludes elements like platinum, which are quite rare, but are referred to separately. Rare earth elements are often found in large deposits that have many different elements in the same deposit. One of the tricks to extracting and mining rare earth elements is the ability to separate them from one another. Rare earth metals are roughly divided into two categories, "light" and "heavy," which are usually found together.

In alphabetical order:

Cerium (Ce) is a commonly available element, and is easily accessible because it can be found high in the earth's crust. A significant advantage over most other rare earth metals is that cerium enjoys is that it is easy to process and refine, and by extension, use.[1] Its availability is a major factor in low prices for cerium on commodity markets.

Cerium has been found to be useful in a variety of ways, such as being a critical agent in polishing and making UV ray blocking glass, the production of catalytic converters, (used to reduce the pollution that comes from car emissions), as well as in re-chargeable batteries.[2] Similar to Scandium, Cerium is used for the production of energy efficient fluorescent and compact fluorescent light bulbs. As alternative energy demands increase, demand for Cerium will increase as it also serves a critical role in the creation of hydrogen fuel cells. [3]

Dysprosium - (Dy) is, according to the US Department of Energy, the most critical mineral resource to the United States because of its utility in clean energy technology and the vulnerability and shortness of its supply.[4] Recent increases in the demand for hybrid car production has strained supplies of Dysprosium even more. This will push up the price of the mineral on the commodity markets, increasing the cost of green technologies such as hybrid cars. The problem with Dysprosium is largely that it is not always found with other rare earths, so while a nation may produce a large amount of rare earths, in terms of tons produced, they may not have any mines that contain dysprosium.[5] The world's commercial supplies are exclusively in China. Even if other nations start producing large amounts of "rare earth metals," access to this specific metal will remain in the hands of the Chinese until a new source is found, if it even exists. The key is that small amounts of dysprosium prevent corrosion and increase the strength of magnets. Dysprosium based magnets are small, lightweight, and extremely powerful; necessary in the creation of things like computers, ipods, and smart

phones.[6] It is also needed for hybrid car engines, wind power turbines, computer memory chips and portable storage devices.

Erbium (Er) is a relatively scarce REE, with the unique properties that can absorb loose neurons very effectively, making it a somewhat successful substitute for Holmium.[7] Like Holmium, Erbium is used in nuclear power plants as control rods. It is also used in fiber optic cables for amplifying lasers to magnify the signal. Other uses include in welding, as a pink colorant in glass and ceramics, and dermatology.[8]

Europium (Eu) is both rare and expensive. The demand far exceeds the supply, even of current applications, not to mention potential uses. Europium is used, along with yttrium, to create red phosphors for televisions and computer screens, as well as energy efficient lighting.[9] Most people use products with Europium every day without knowing it, and the outlook is bleak to maintain current levels of supply.

Gadolinium (Gd) has a wide array of uses related to radioactive material, including radiation shielding in nuclear reactors in power plants. On a smaller scale, it is also used for MRI machines and X-rays in doctor's offices, CDs, and, like other rare earths, for phosphors for television and computer screens (in this case, for the color green).[10] Research has shown that Gadolinium might have a future as a way to replace HFCs in chemical refrigeration, which would reduce the environmental impact of the chemical cooling process. [11]

Holmium (Ho) is one of the rarest rare earths, and is also has the strongest

magnetic attraction of any element, “rare earth” or not. In deposits where it actually exists, it usually makes up less than two percent of the amalgamated minerals in the mine. [12]Holmium, despite its rareness, is very important to modern society. Most importantly, holmium’s ability to absorb large amounts of stray neutrons makes them valuable for nuclear control rods in nuclear power plants. Other uses include in lasers used for surgery and dentistry, and in fiber optics.[13] Other applications of holmium are not being researched because of the scarcity of the mineral.

Lanthanum (La) is one of the most available rare earth elements, and the most recognizable of the entire list. Lanthanum often composes between twenty and forty percent of rare earth deposits, and is therefore not in short supply, although that could change, given that it has a wide range of applications. Commercially, it is used in producing fiber optic cables, high intensity light projection, such as in movie theaters, various types of sensors, electron microscopes, and other consumer electronics. [14] The largest uses for Lanthanum, however, are in energy production and green technology. It is a rechargeable batteries, such as those in hybrid cars, cameras, and gaming console controllers, as well as in the refinement of petroleum to create gasoline. [15]

Lutetium (Lu) is another extremely scarce mineral, with world production averaging 10 metric tons per year.[16] This scarcity has made this mineral very expensive in commodity markets. Lutetium is useful as a chemical catalyst for the petroleum refining process, and can be used in cancer treatment and in PET scans.[17] If the supply increased, Lutetium could be used for computer memory chips, phosphors, and further

uses in medicine to save lives.

Neodymium (Nd) is another of the most important rare earth elements, especially for green technology. Neodymium is the most important rare earth in the manufacturing of high strength types of permanent magnets. These magnets are critical to modern high tech applications in all sectors of the economy, from cell phones, medical imaging devices, floppy and flash drives for computers, satellites, hybrid cars, and wind turbines.[18] Thankfully, Neodymium is one of the most highly concentrated and available of the rare earth elements. Given its large array of uses, demand for Neodymium is also high, and will grow exponentially with the transition to green energy production.

Praseodymium (Pr) is both rare, and easy to find. Praseodymium is found in almost all large rare earth deposits, but never in large amounts. The supply of Praseodymium is not a large problem, despite its rarity because there are relatively few applications, such as permanent magnets, coloring glass and ceramics, and some batteries.[19] The demand for Praseodymium is rapidly increasing in demand, as scientists find new uses for its magnetic properties.

Promethium (Pm) is one of the rarest elements around. (only about ½ a kilogram has been found in the earth's crust).[20] This radioactive element exists as an intermediate stage of radioactive decay of other elements. Demand for this element is non-existent given that it is virtually unusable. The element is mostly produced in laboratories from

nuclear waste that is being re-processed.[21]

Samarium (Sm) is heavily mined, but relatively scarce, rare earth. Samarium is primarily used, like neodymium, for the production of high strength permanent magnets. Samarium-cobalt magnets are somewhat weaker than neodymium magnets, but resist degradation and exposure to high temperatures much more effectively (Samarium magnets can withstand temperatures over 700 degrees C).[22] Other applications for Samarium include cancer fighting drugs, lasers, and control rods for nuclear power plants.[23] The demand for Samarium will increase significantly as super conductors begin to be used more.

Scandium (Sc) is one of the least known or utilized of the rare earth metals. What little Scandium that is produced is used by sports equipment manufacturers for things like aluminum baseball bats, and by the aerospace industry, as a key component in aluminum and titanium alloys.[24] Adding Scandium makes metal alloys lighter, without reducing the strength of the metal.

Terbium (Tb) is quite rare, and is one of the primary elements that the world supply is grossly inadequate to meet demand. Terbium has potent uses in fuel cell technology, which could be used to replace many modern fuel sources.[25] Terbium is the single most important element in the construction of fluorescent light bulb. This is the main source of its demand, and this is expected to grow substantially both due to cultural and legislative changes.[26] Other uses include serving as a yellow or green

phosphor in computer monitors and televisions.

Thulium (Tm) is exceedingly rare, the rarest of the rare earth elements. Like Promethium (Pr), it is so rare, so there aren't many uses for this element, and there is no real issues of supply and demand.[27] Uses for thulium exist, if it could be produced in higher quantities.

Ytterbium (Yb) is one of the few rare earth elements that is found more plentifully outside of China than inside it. Large deposits exist in Canada and Malaysia, but these are not being heavily exploited, leaving the Chinese in charge of the world supplies.[28] This lack of supply has curtailed the current use of this mineral, but the potential is almost endless. Ytterbium is an important component in solar electric cells, steel alloys, lasers, anti-forgery inks, night vision goggles, and stress measurement technology.[29]

Yttrium (Y) is one of the rarer of the rare earth elements. This frequently results in shortages as supply remains spotty and short. The trouble is that Yttrium is used for a variety of important uses. Originally used solely to create the phosphors needed for the color red in televisions, Yttrium is now used for high powered lasers, and energy efficient LED light bulbs. It is also used for optical lenses and other types of glass, to fortify ceramics, and in cancer fighting drugs. [30]

Section Two: What Can Rare Earths Do For You?

"To truly transform our economy, protect our security, and save our planet from the ravages of climate change, we need to ultimately make clean, renewable energy the profitable kind of energy." Barack Obama's address to a joint session of Congress Feb. 24, 2009 underscores a new mindset that has taken hold in at least western nations; "going green."[32] On the surface, this means shifting towards alternative and renewable sources of energy from oil, coal, and natural gas, increasing recycling, the use of energy efficient light bulbs, and more sustainable agricultural processes. New forms of energy, solar panels, wind turbines, and hydrogen cells are the heart of this movement, with little regard to the impact of the technology involved.[33] Even in the status quo, rare earths are needed in the refinement of petroleum, making them necessary for our current energy needs. "Since 2005, global investments in clean energy have grown by more than 230%, with worldwide investment in 2009 totaling more than $162billion. Projections for 2010 show that these investments could increase by 25%, reaching roughly $200 billion by the year's end"[34] This shift is large, growing, and here to stay, defining energy and economic policy for the near future.[35]

The shift to alternative energy is not random; a myriad of reasons exist to prefer cleaner, renewable forms of energy, anything that isn't natural gas, coal, or petroleum based. Despite what the American right wants everyone to believe, global warming is anthropogenic, and a danger to humanity. As the recent events in Japan have demonstrated, the first wave of supposedly clean energy, nuclear power, is not the ideal

solution. Nuclear power plants can't solve emissions from personal and commercial vehicles, not to mention the continuing issues with the radio-active waste from spent uranium.

Dependence on fossil fuels has its own drawbacks, before considering environmental concerns. Oil has become a must-have resource in the United States economy, and thus the United States is somewhat dependent on those with the capacity to produce oil for economic sustainability. This has proven to be true, as policies that anger oil producing countries have caused oil embargoes in the past, such as during the presidency of Jimmy Carter and OPEC. Even if there isn't an actual embargo, instability in the Middle East can cause prices to skyrocket, such as during the Arab Spring and the recent Libyan intervention.[36] If four dollar gas is expensive enough to become a political hot button issue, doubling or tripling the price would leave the United States destitute.

When the United States tries to find sources of oil outside of the traditional Middle Eastern nations, the political conundrum, and instability remains the same, if not worse. Rebel groups frequently cause the price of Nigerian oil to go up, a problem that plagues all African oil producing nations.[37] Venezuela produces oil in the Western Hemisphere, but Hugo Chavez is quite happy to use oil as political leverage against the United States.[38] The United States is putting more and more sanctions on Iran for its nuclear weapons program, and Israel is contemplating a first strike as its cyber-attacks against the Iranian nuclear program seem to have been unable to stop their progress. Neither of these actions is conducive to purchasing cheap, reliable oil from the Middle

East. Indeed, the financial effects of oil dependence in the Middle East are themselves destabilizing.[39]

Russia has large reserves, but has proven quite happy to use energy as a political tool, such as when it cut off natural gas supplies over a political disagreement with the Ukraine.[40] Despite the START treaty, and other goodwill measures, Putin immediately blames the United States for recent protests over recent election. US Russian relations are rocky at best, and volatile, even after substantial good will measures.[41] While Canada and some of the Nordic states do produce oil, they hardly have the capacity to meet all of the United States' need for oil, nor should any one nation be so dependent on one source, even if they are considered reliable and friendly.

The burning of fossil fuels, usually for energy production, has been directly attributed with the spread of global warming.[42] Despite the political battles about its existence, and the clever wording that tries to hide the impact of a heating planet in the fuzzy frame of "climate change," thousands of peer reviewed, qualified scientists generally agree that global warming is indeed happening, and that it is to an extent anthropogenic.[43] Large scale global warming could be catastrophic, dramatically changing global society as we know it.[44] Polar ice caps would melt killing species, and sea levels will rise world-wide; New York, London, Beijing, the world's largest economic hubs, will struggle to hold back the tides.[45] Coastal plains will be gone.[46] Next to go will be ports, transportation infrastructure, and productive farmland.[47] Extreme weather patterns would become the norm.[48] The world's oceans will acidify, biodiversity will be

reduced, and volcanic activity will increase dramatically.[49] This chaos will result in mass migrations.[50] These will cause resource conflicts that will be difficult to resolve rationally.[51] The time nears to effectively challenge the escalation of global warming's effects.[52] Alternatives to the status quo must be available and cost-effective.[53] Reducing the cost of alternative energy is key to providing the incentives necessary to get the Chinese, Indians, and other large and growing economies on board, so that their economic growth can continue with little interference while they curtail their emissions. The United States and others must have the rare earth metals to build such alternatives, dramatically change the culture and standard of living that its citizens enjoy, or find yet other solutions that don't require rare earth metals.[54] With a culture change of the magnitude required improbable, and the reliance on science that hasn't been thought up yet a less than idea option, the short term answer becomes evident.

Ironically, the very technologies that are reputed to save the world from global warming have their own environmental consequences. In short, 'green tech' requires toxic processes to function. To build any of the leading "green" technologies, increasing amounts of rare earth metals are required.[55] The mining, extraction, and processing of these metals presents a new environmental challenge; one that has been swept under the rug. In China, these environmental consequences are already being felt, with farmers in China and the water supplies for their farms being poisoned with mineral runoff that can be radioactive.[56] The implications of these policies include the impact of the rare earth metal industry on the surrounding areas, and their residents,

guaranteeing access to these minerals to build these technologies, and the movement of scientists/engineers and businesses to China.

Given the world's total energy production, alternative energy still constitutes a small fraction of the whole. In terms of rare earth metals, supply has at least reasonably met demand, but this is rapidly changing. As more technologies become commercially viable, and more nations join the green revolution, this demand is sure to skyrocket. Corresponding increases in supply are much more questionable, especially considering export restrictions and political implications, as well as overall extraction and refinement rates. [57]

For example, solar power has been touted as a new, clean, renewable technology that can help power houses and businesses individually, and also done in massive energy farms in regions that receive a lot of daily sun. Solar power converts energy from the sun, which isn't likely to run out of its heat any time soon. Rare Earth Metal indium is used to build thin-film solar panels. Using indium, because of its versatile properties, allows solar to be used in new and smaller places. Older or larger scale solar projects use tellurium, which also has restricted supplies. Substitutes for these two rare earths have distinctively lower energy conversion rates. [58]

Another recent example is the so-called "light bulb law," so dubbed by conservative small government, anti-regulation American politicians who recently failed to overturn it, a 2007 law set in motion the transition from the tradition light bulbs that

our parents had grown up with, towards much more efficient, energy conservative bulbs.[59] These bulbs will dramatically reduce the average household's energy use, but perceptively cost more due the individual on the shelf costs, as savings on energy bills aren't easily seen or itemized.[60] The drawback is that these bulbs require rare earth metals, which give them their distinct advantage over previous light bulb designs. Putting cutting edge light bulbs in every fixture across the United States will not only dramatically increase the demand for certain rare earth elements, but will also increase the challenge of securing enough rare earths to meet demands. The specific elements in question for energy efficient lighting are lanthanum, cerium, europium, terbium and yttrium. [61]

Rare earth metals are everywhere, often not more than a trace of them serving vital functions in modern technology. It is estimated that the judicious application of rare earth metals can reduce global emissions from cooling and storing food, and lead to magnetic refrigeration. Rare earth metal neodymium is used widely as miniaturized permanent magnets in hybrid motors and windmill turbines, including in the batteries and motors of the Toyota Prius and the Chevy Volt.[62] The list of their uses in the field of green technology is practically endless. The troubling trend is that 95% of world production is found in China, and businesses are increasingly moving to the source of their materials. [63]

In 2003, China produced only one percent of the world's solar panels but by 2009 its share rose to 43 percent. By contrast, since 2003, U.S. production of solar

panels fell from 14 percent to just four percent of the world's total.[63] In 2009, the Chinese government announced restrictions on the export of rare earths, ostensibly to encourage investment within China of industries using the metals. The rare earths neodymium and lanthanum are essential to the newest generation of batteries that power new hybrid and electric vehicles, U.S. auto companies are, in part, placing their hope in revitalizing the domestic auto industry on China's continued good will. [64]

Whether for the rare earths themselves or for final products made from them, import dependency in the face of such a high concentration of production would do little to alleviate energy security concerns now seen in terms of import dependency on the Middle East for oil. The political calculation becomes complicated, is a rare earth dependency better or worse than an oil dependency? In some ways, it is, because there are approximately 90 nations that export oil, and while many are in OPEC, and have sources of concern, such as those listed above, it is still better than dependence on a single source (for the foreseeable future), China. [65]

The implications of a rare earth shortage aren't strictly related to the environment, and energy dependence, but have distinct military implications as well that could threaten the position of the United States world's strongest military. The United States place in the world was assured by powerful and decisive deployments in World War One and World War Two. Our military expansion was built upon a large, powerful industrial base that created more, better weapons of war for our soldiers. During the World Wars, a well-organized draft that sent millions of men into battle in a

short amount of time proved decisive, but as the war ended, and soldiers drafted into service returned to civilian life, the U.S. technological superiority over its opponents provided it with sustained dominance over its enemies, even as the numerical size of the army declined. New technologies, such as the use of the airplane in combat, rocket launched missiles, radar systems, and later, GPS, precision guided missiles, missile defense systems, high tech tanks, lasers, and other technologies now make the difference between victory and defeat.[66]

The United States military now serves many important functions, deterring threats across the world. The United States projects its power internationally, through a network of bases and allied nations. Thus, the United States is a powerful player in all regions of the world, and often serves as a buffer against conflict in these regions.[67] US military presence serves as a buffer against Chinese military modernization in Eastern Asia, against an increasingly nationalist Russia in Europe, and smaller regional actors, such as Venezuela in South America and Iran in the Middle East. [68] The U.S. Navy is deployed all over the world, as the guarantor of international maritime trade routes.[69] The US Navy leads action against challenges to its maritime sovereignty on the other side of the globe, such as current action against Somali piracy.[70] Presence in regions across the world prevents escalation of potential crisis.[71] These could result in either a larger power fighting a smaller nation or nations (Russia and Georgia, Taiwan and China), religious opponents (Israel and Iran), or traditional foes (Ethiopia and Eretria, Venezuela and Colombia, India and Pakistan). [72] US projection is also key deterring

emerging threats such as terrorism and nuclear proliferation.[73] While not direct challenges to US primacy, both terrorism and nuclear proliferation can kill thousands. [74]

The US Air Force has a commanding lead over the rest of the world, in terms of both numbers and capabilities. American ground forces have few peers, and are unmatched in their ability to deploy to anywhere in the world at an equally unmatched pace. [75]

The only perceived challenge to the United States militarily comes from the People's Republic of China.[76] While the United States outspends all other nations in the world put together in terms of military spending, China follows as a close second, and has begun an extensive modernization program to boot.[77] The Chinese military however, is several decades behind the United States in air power and nuclear capabilities.[78] To compensate, China has begun the construction of access-denial technology, preventing the US from exercising its dominance in China's sphere of influence.[79] Chinese modernization efforts have a serious long-term advantage over the United States; access to rare earth metals, and a large concentration of rare earth chemists doing research.[80] This advantage, coupled with the U.S. losing access to rare earth metals, will even the odds much quicker than policymakers had previously anticipated. [81]

The largest example is US airpower. With every successive generation of military aircraft, the U.S. Air Force becomes more and more dependent on Rare Earth Metals.[82] As planes get faster and faster, they have to get lighter and lighter, while adding weight

from extra computers and other features on board.[83] To lighten the weight of the plane, scandium is used to produce lightweight aluminum alloys for the body of the plane. Rare Earth metals are also useful in fighter jet engines, and fuel cells.[84] For example, rare earths are required to producing miniaturized fins, and samarium is required to build the motors for the F-35 fighter jet.[85] F-35 jets are the next generation fighter jet that works together to form the dual plane combination that cements U.S. dominance in air power over the Russian PAK FA.[86]

Rare earth shortages don't just affect air power, also compromising the navigation system of Abrams Tanks, which need samarium cobalt magnets. The Abrams Tank is the primary offensive mechanized vehicle in the U.S. arsenal. The Aegis Spy 1 Radar also uses samarium.[87] Many naval ships require neodymium. Hell Fire missiles, satellites, night vision goggles, avionics, and precision guided munitions all require rare earth metals. [88]

American military superiority is based on technological advancement that outstrips the rest of the world. Command and control technology allows the U.S. to fight multiple wars at once and maintain readiness for other issues, as well as have overwhelming force against rising challengers. This technology helps the U.S. know who, where, and what is going to attack them, and respond effectively, regardless of the source of the threat.

Rare Earth Elements make this technological superiority possible.

To make matters worse, the defense industrial base is often a single market industry, dependent on government contracts for its business. If China tightens the export quotas further, major US defense contractors will be in trouble.[89] Every sector of the defense industrial base is dependent on rare earth metals. Without rare earths, these contractors can't build anything, which collapses the industry.[90]

Rare Earth shortages are actually already affecting our military, with shortages of lanthanum, cerium, europium and gadolinium happening in the status quo. This prevents us not only from building the next generation of high tech weaponry, but also from constructing more of the weapons and munitions that are needed in the status quo. As current weapon systems age and they can't be replaced, the US primacy will be undermined. Of special concern is that U.S. domestic mining doesn't produce "heavy" rare earth metals that are needed for many advanced components of military technologies. Given the nature of many military applications, substitutions aren't possible. [91]

Additional concern should be placed on the effects that this has on the economy. As mentioned above, rare earth metals are necessary in virtually every important sector of the economy, from health and energy to commercial electronics and aerospace and other high-tech manufacturing. Shortages of rare earth metals make every one of these products more expensive, as the cost of the materials will invariably trickle down to the consumers. Cost increases could make some of these industries unprofitable, causing layoffs. More importantly, the perception of a shortage in these areas could be equally as

devastating as an actual shortage. The free market economy is very susceptible to the manipulations of government-based corporations in China. A proposed solution-to refer China to the WTO-is unlikely to settle economic jitters, and could even worsen the situation because of retaliation from China.[92]

The shift of many industries that use rare earth metals to China creates a structural barrier to long-term US economic health and competitiveness.[93] The traditional narrative to explain American economic prosperity is the entrepreneurial spirit, creating the products of tomorrow. If the companies responsible for doing this leave the United States, then this recipe for success will no longer be viable.[94]

The current economic climate, complicated by the European debt crisis caused by Greece, Spain, Italy and others, economic stagnation in Japan, and instability in the oil markets and the Middle East, has put people on edge, and introduced great volatility into the stock markets, the confidence of investors, and everyday consumers. Some executives are even more worried about the rare earth shortage than the debt crisis, seeing it as a structural issue that doesn't have any easy or immediately foreseeable solution. [95]

Rare earth mining and the associated industries are actually very good for a national economy, a fact that diversifying the source could severely hurt. Rare earth mining is considered a multibillion dollar industry, and the industries that rely upon it are considered worth more than 4.8 trillion dollars. [96]Downstream industries

encompass the majority of the world's jobs and wealth. China is currently trapped in a demographic crisis, as large numbers of young college graduates are expecting high paying jobs as they enter the workforce, and the industries related to rare earths give them a convenient source of high wage careers. The Chinese model of maintaining high economic growth-to offset social tensions, is currently dependent on rare earths and their downstream industries, at least in part. China will need approximately 300 million jobs by 2020, which will help rebalance their economy to be less export driven. [97]

Section Three: What Happened?

Before we get to the proposed solutions, it is necessary to examine how the United States got into this mess. The first rare earth element-although they weren't called that at the time-was discovered in a mine in Sweden in the early 1700s. Beyond the unique and at the time unappreciated chemical properties of these elements, little scientific study was put into them, or investment into their extraction and refinement. In the 1830s and 40s, Carl Gustav Mosander, a Swedish chemist, using primitive techniques, separated Terbium, Cerium, Lanthanum, and Yttrium. Over the next 60 years, various elements were isolated by individuals around Europe, but there was a large amount of confusion, as different elements were given different names, and the methods of isolating them remained primitive. [98]

The Manhattan Project changed the face of geopolitical calculations, and gave the world the nuclear weapon. As a result of their experimentation, the scientists involved created ion exchange procedures in which to isolate specific elements. This procedure can be used on uranium for the nuclear devices, but also can be used to identify and isolate rare earth metals.[99] In the 1950s, more specialized methods of extraction and separation developed, making commercial applications for some rare earth metals practical.[100]

Until WWII, Brazil and British India gathered what little rare earth metals that were used from surface deposits. These were in non-commercial quantities, and only

contained a handful of the spectrum of rare earth elements, as by this point several elements had yet to be discovered. [101]

After WWII, production shifted to South Africa, a country that found a deposit of ore in another one of its mines. As the 1950s turned into the 1960s, American businesses embraced the newly opened Mountain Pass Mine in California, which would lead the world in rare earth production, eliminating most competitors until the mid 1980s. The mine had a large supply of light rare earth metals, and trace amounts of the other elements that had commercial uses, and dominated the market until the early 1990s.[102]

Both the first Bush administration and the Clinton administration's increased environmental regulations hampered operations and increased mineral costs produced in the United States. The emergence of Chinese production in the Inner Mongolia region collapsed the prices of rare earths. Facing low prices and high costs from environmental regulations, the Mountain Pass Mine closed in 2002, yielding the market to the Chinese. This was hardly headline news, and went unnoticed in the United States. The Chinese however, had other plans. [103]

Chinese premier Deng Xiaoping saw rare earth metals as a tool of economic growth, and strategic benefit as his nation emerged from the ravages of Maoism.[104] China was weak, over-populated, largely agricultural, and had few industries or exports of note.[105] Deng, using the Middle Eastern oil mogul-states as an example, put in place

state policies to invest heavily in the long term production, refinement, and eventual domination of the rare earth market.[106] Xiaoping's goal was to leverage Chinese control of the rare earth market to both increase the price of the mineral, and thus increase profits for his growing economy, and to lure the industries that depend on the minerals to produce their increasingly high tech goods to Chinese soil.[107]

These additional revenues could then be reinvested in other sectors of the economy.[108] This creates high tech jobs, and would help transform China from the land of sweatshops producing chachkas for Wal-Mart, to a high-tech powerhouse that led the world in the newest fields of innovation. Rare earth related industries contributed to the 'rise of China' as we know it today.

His plan worked. While Americans ignored the collapse of what they saw as an outdated relic from the environmentally destructive and labor intensive past that had no place in the information age, the Chinese cheered that they now controlled the ability to produce all of the devices the rest of the world was so dependent on for the information revolution.[109]

China now produces between 95% and 100 % of every rare earth element, cornering the market of every rare earth element.[110] The Chinese business model worked, and they current sit astride the market.[111] The world will, for now, have to live with Chinese domination of rare earth production.[113]

The Chinese however, do not have a monopoly on rare earth deposits.[113] Only

37% of world deposits of rare earth elements, obviously somewhat variant based on the specific element, reside in China. While that is a large quantity given the relative land mass of China compared to the rest of the planet, it is still far less than half the world's supply.[114] The main monopolies that the Chinese currently enjoy are not only mineral production based; the Chinese have monopolies on the world's rare earth refining, and as to today are the only nation that can commercially mass produce rare earth metals in sufficient quantities to meet global demand.[115] They also have a huge lead in rare earth chemistry, and in training scientists to work with rare earths. (The United States has a single university with a degree in rare earth chemistry, Colorado State School of Mining).[116]

Section Four: The Scramble

The challenges to Chinese dominance are many. In Australia, the Mount Weld and Nolan projects are perhaps the farthest along, and are able to compete in a limited manner with their Chinese equivalents.[117] Lynas Corp, the Australian company that dominates the rare earth sector down under, is currently negotiating to build the first refinery for rare earth metals outside of China, in Malaysia.[118] If successful, the refinery in Malaysia will be able to support about 1/6 of the world market, the first significant detraction from Chinese dominance in a decade.[119] The refinery, however, has been the subject of ongoing controversy.[120] The Malaysian government has been strict with Lynas on the environmental standards of the plant, and, after the Fukushima incident, widespread protests led to the Malaysian government to revoke Lynas's permits.[121] Residents around the proposed plant recall a now defunct Mitsubishi plant that caused leukemia, birth defects and a poisoning of the local soil and water supplies in the surrounding villages.[122] After an IAEA inspection, the plant resumed work, but long term plans for the storage of radioactive thorium remain elusive.[123]

Japan has discovered large deposits of rare earths under the ocean in its territorial waters, and is in the process of exploring how to mine minerals at the considerable depth in question.[124] Japan, a producer of high tech materials, considers itself very vulnerable to a rare earth metal shutoff, and has signed an agreement with Vietnam and India, to pool and coordinate their rare earth policies in an effort to reduce their vulnerability.[125] This arrangement is still in its infancy, as neither India nor

Vietnam can produce enough rare earth metals yet to make a meaningful impact on global markets. Vietnam's Lai Chau province has a reasonable amount of rare earth metals, but this province borders China, an additional security concern if relations sour in the region.[126]

Historical producers South Africa and Brazil are returning to the game, investing in their mining facilities, seeking to provide a cost effective alternative to Chinese domination, and hopefully a share of the high tech industries that have sprung up in China, which could catapult their economies forward in a similar fashion to the Chinese. Estonian production at Sillamae, processing the result of decades of uranium and other minerals, unintentionally unearthed tons of rare earths, which are now being exported. Estonian exports are estimated at about 3,000 tons a year, or 2% of the world's supplies.[127]

One of the most controversial sources of rare earth metals is Afghanistan. Once accused of invading Iraq for to secure oil reserves, the United States is now drawing criticism for trying to lock up the next critical resource, rare earths, by using its position in the nation to gain favorable mining contracts.[128] The evidence from these accusations seems slim, due to a large contract awarded to the Chinese by the Karzai administration to mine rare earths in the nation.[129] Criticism from the other side of the political spectrum has emerged, pointing towards a failure of leadership that let the Chinese secure access to this critical resource outside of their borders, while the United States has such a place of influence in the nation. [130]

This dispute is yet another layer on top of the many layered and complicated situation that is the allied occupation of Afghanistan. Many mining experts agree on two points, that the mineral wealth, if properly managed, could do wonders for the Afghan economy, and secondly, that a multitude of factors makes that unlikely to happen. First of all, the Afghans lack the infrastructure to allow profitable mining, such as electricity and railroads. Secondly, the territory identified as mineral rich is currently held by the Taliban, near the Helmand river, presenting security concerns, and political concerns as to where the mineral wealth will goes once it is mined from the earth, and what concessions will the Taliban expect for allowing the exploitation of their mineral wealth. Mining is a water intensive industry, and Afghanistan has precious little water as it is, and what little water they do have is channeled into small scale irrigation for agriculture. Major mining operations could bring the nation to its knees with thirst and hunger.[131, 132]

Corruption is already rampant in Afghanistan, ranked 179th in the world according to the Corruption Perceptions Index. As demonstrated by Nigeria and other states, and written about in the 2009 Transparency International Global Corruption Report, "countries relying on oil and mining revenues tend, with surprisingly few exceptions, to be poor, badly run and prone to violent instability: the infamous resource curse."[133] A sudden influx of resource wealth often dooms a nation to decades of corruption, poverty, and infighting. If somehow this was to be avoided, Dutch Disease would surely ensue. Afghanistan is not a manufacturing powerhouse, but as such, it would detrimentally affect the agricultural sector, which employs three in four Afghans,

and makes up a third of their economic growth. Afghani agriculture is fragile as it is, due to decades of insecurity. As these factors are already present in Afghanistan, they would be greatly exacerbated if large scale mining was attempted in the near future. [134]

Canada's Hoidas Lake project has some of the largest potential to challenge China for supremacy in producing at least some rare earths, but due to its remote location, and slow investment, the project is considered behind most other ventures. Other North American ventures include a Canadian funded venture in Nebraska's Pea Ridge Mine, and the Kvanejfeld project in southern Greenland. Pea Ridge mine however, is converting back to iron production, and the Kvanejfeld project is still in the exploratory stages, and suffers many of the remoteness issues of the Hoidas Lake project. In North America, the only current player of note in Molycorp, the current owner of the Mountain Pass Mine. Molycorp Inc. went public, and has at least technically re-opened the mine, dormant since 2002.

Molycorp successfully raised more than $500 million in private investment in order to re-open the mine at the beginning of 2011. [135] Molycorp is heralded as the savior of the United States, with numerous endorsements from politicians, and optimistic projections that have the company meeting American demand by the end of the decade.

Most industry experts, however, expect meaningful production to be at least five years away, [136] and other complications exist as well. With the migration of many industries that rely on rare earth metals to China, a domestic market for certain

minerals currently doesn't exist to support the expansion of the Molycorp mine. [137] Furthermore, the United States doesn't have any rare earth refinery capabilities, or any emerging on the horizon. Such a refinery would cost over 1 billion US dollars to build, a weighty sum that private investors seem unwilling to stomach.[138] While relying on an Australian run refinery is more geopolitically reliable than Chinese refineries, it is neither practical nor cost efficient to ship the minerals half way around the world, only to have them sent back.

Another large problem with Molycorp's Mountain Pass Mine is the content of the mine. The California mine can produce a competitive amount of several light rare earth metals, but is virtually lacking in heavy rare earth metals, the type needed in most military technologies. This doesn't allow the United States break the monopoly of several of the most highly sought rare earths.

Molycorp, furthermore, has other problems. Since raising large amounts of capital to open the mine in a large show of industry support and development, the now publicly traded Molycorp stock is plummeting. The mining company's stock lost over 30% of its value in the last few months of 2011, and is now trading below $40 a share. [140] A telling sign of things to come, insiders are leaving the company in droves. Despite a strong press presence, the company is taking too few concrete steps to re-assure investors of the financial future of the company. One fourth of the original investors have left the organization, and many don't expect the company to meet its proclaimed goals.[141]

Section Five: What Now?

Further troubling news is the rate of consumption. For example, reserves of indium are limited, and a 2007 study found that at current rates of consumption, known reserves of indium would last just thirteen years.[142] This trend is common across other rare earth metal supply chains, such as gallium, where demand from emerging green tech would substantially raise demand beyond the level of world production today. Demand for gallium would increase six fold by 2030, as well as large increases in the demand for other rare earths. Overall, the global rare earth shortage is likely to widen in the coming years due to cuts in production and exports by China. Numerically, supply stands at 156,200 tons, while demand stands at 177,200 tons. The production picture is much more complicated than simple tons of rare earths produced, as the supply of different minerals varies widely. [143]

The current solutions to the rare earth shortage are either uninspiring, failed, or insufficient.

As rare earth metals remain relatively expensive on the commodity markets, many projects have come together worldwide to attempt to break the Chinese monopoly. Over 200 mines are supposed to open by 2025, but the likelihood that this actually happens is highly questionable. As with Molycorp, the barriers to new mines are steep. A study by longtime industry expert Jack Lifton explains that about four percent of new companies or less than ten of the 244 companies that have launched in the last

three years will succeed.[144] With so many companies starting up, there simply isn't enough expertise to go around, leaving many companies with investors, and ore, but nobody to do anything with the rocks they pull out of the ground, or even to point out which rocks they should be extracting. Each mine is chemically different, exacerbating the problem.[145] The other primary barrier to startups remains refining capability, which resides solely in China until the Lynas refinery gets on its feet (Even then, the Lynas refinery is primarily designed to process Australian production of rare earths) . "The choke point for all the companies is the question of what they can do with the concentrated REM ore once it's above ground."[146] Lifton explained that "without separation capacity, all you have is a loss-making ore concentrate company."[147]

A barrier for entry, even to forming a mining company is the cost. "The capital costs are staggering for setting up mining, refining operations and infrastructure,"[148] Lifton explains. Convincing a collection of investors to put their money against the government based corporations in China isn't an easy sell. Investors like short term returns, something that rare earth mining, which takes anywhere from five to fifteen years to turn profitable, is not. Most investors don't want to wait a generation until their wealth begins to generate returns.[149, 150]

In the end, China will still control 100 percent of the market for three heavy rare earths; dysprosium, terbium and yttrium. These are some of the most in-demand metals, and significant sources outside of China haven't been discovered in commercially viable quantities as of yet. New mines in other countries aren't ideal for

military supply chains, as they can be coerced or cut off.[151]

Even more troubling is that China is not just reducing exports to fuel domestic demand, and to reduce environmental problems.[152] Furthermore, they are actively collecting a standing reserve of rare earth metals.[153] This could allow the Chinese to flood the market with rare earth metals to collapse the high prices for rare earths, putting competitors, who aren't supported by government subsidies, out of business quickly, and re-assert their control.[154] "China succeeded in driving others out of business once, and many fear that it could do it again."[155]

The US Department of Energy predicts that, given the multiple substantial barriers to breaking the dependence on China for rare earths.[156] "It could take 15 years to break America's dependence on Chinese supplies"[157]

Another feasible option besides building new mines is recycling, which makes logical sense given the extreme scarcity of some of the metals.[158] As usual though, cost and the will to do so remain seemingly omnipotent barriers that bar the way for effective recycling programs. Currently, less than 1% of the world's rare earth metals are recycled, according to the UN Environmental Program.[159] This is especially disturbing given that other metals are recycled anywhere from 25%-75% of the time. Japan is the pioneer here, engaging in what they call "urban mining." This unique practice, involving combing through trash dumps and landfills for precious metals in used electronics, is probably the best thing for the environment, re-using minerals that have already been

mined. Urban mining, however, without a public awareness program that actively encourages the citizenry to recycle their electronics, is very expensive, and doesn't result in the volume necessary, for example, to break Japan of its dependence on its largest geo-political competitor, China.[160]

Many hurdles exist to recycling programs in general, some of which are unavoidable. Some rare earth metals simply get used up, and dissipate, so there isn't anything left to recycle. If the metals haven't dissipated, recycling and reprocessing metals of this fashion isn't an area that has had many technological breakthroughs, so the technology may not even exist yet. The metals that are least likely to dissipate are often used in products that are expected to last for years like cars, solar panels, and wind turbines. Recycling when possible is obviously an environmentally friendly method of retrieving some rare earth metals, but can't be done in the volume or-for some metals-at all, needed to replace mining, or importing from China. [161]

If the metals are so hard to get, why use them? Some scientists are approaching the rare earth shortage looking for substitutions that are more easily accessed. The trouble is there are reasons that companies use rare earths instead of currently available materials. For some rare earths, there are no known substitutes. The lanthanides, for example, have unique chemical and magnetic capabilities that make them luminescent and effective at radioactive shielding that just haven't been found in any other elements.[162] Of the substitutes that do exist, they often come up short.[163]

The largest barrier to rare earth metal substitution is that the metals are often preferred to other materials is their miniaturization abilities, which are critical to making electronics small, without losing effectiveness. (Rare earth metals allowed computers to go from requiring their own rooms in buildings and their own air conditioning to a device in a backpack, placed on a lap, or largely replaceable by a cell phone.) [164]

An area that might have promise sometime down the road, once the technology can catch up, are synthetic substitutes. Researchers in the Netherlands believe that they have created a replacement for indium, with negligible loss in chemical properties. The cost of synthetically creating replacements on a large scale is daunting, but if the demand was high, the price might drop significantly. [165]

An idea that originated in Congress is the idea to copy China, and create an American Rare Earth Stockpile. Currently, the United States has reserves of critical resources like oil, which can be used to protect economic stability and to defend against embargoes, at least for a short time. Rare earth elements are not currently on this list of critical resources.[166] The most obvious problem is that if there is a shortage, stockpiling will both make the shortage worse, and is difficult to do, given the lack of available resources.[167] Additionally, experts predict that a cascade effect is likely to occur if the U.S. starts a rare earth stockpile. If one nation starts, other nations will have little choice but to follow suit, making a fragile supply and demand system collapse.[168]

It seems that one of the primary ways to end our reliance is to work with nations outside China to build up their mining, and refining capabilities. While this doesn't stop high tech jobs from going overseas, it does diversify where they are going, and reduce the geo-political implications of the Chinese monopoly. Currently, longtime U.S. ally Australia is the leading non-Chinese producer of rare earth metals. President Obama recognizes this, and during a recent visit to Australia to inaugurate a new military base, he also secured commitments from the Australian government for rare earth supplies in the event of a crisis.

Other allies such as India and South Africa are increasing their production, but would be less likely to give the US specific concession on rare earth metals. Nations such as Vietnam (and India) are increasing their supplies, but these have been at least partly promised in multilateral treaties (in this case with Japan). While production is being attempted in several nations in central Africa, "the competition for them (there) has fueled conflicts that have taken the lives of millions of civilians."[169]

While the rest of the world seeks a solution for the rare earth question, fears of China's intentions are growing. Commodity market speculators see the boom in competition for rare earths as an economic race that could re-define the global winners and losers. Few doubt that this rare earth race is happening, but the disagreement exists on China's intentions. Some, such as John Daly, a clean tech speculator, believe that while the 'West' has feared malevolent action by the Chinese government, they have performed as " a responsible member of the global economic community."[170]

Such optimism is very hard to justify, given recent events. China has flexed its muscle in international diplomatic sphere much more in the last few years, and, when challenged, hasn't hesitated to use whatever tools necessary to achieve favorable ends. Specifically concerning rare earth metals, on September 7th, 2010, a Chinese fishing boat was captured by Japanese naval patrols. The dispute erupted into an argument over the maritime borders of the two nations in the South China Sea. As the argument raged, state sponsored Chinese companies stopped exporting rare earth metals to Japan.[171, 172] The Japanese relented, and released the captain, a disturbing example of the political and economic power of rare earth metals. Such manipulation is the basis of a trade war that would, if it was between major players in the global economy, wreak havoc on trade patterns.[173]

Further worrying is the temporary export cut that happened in October 2011. China, declaring that they needed to preserve reserves for domestic consumption, instructed Baotou Steal Rare Earth, the world's largest rare earth company, to stop exporting rare earths for a month. This shocked global prices, and, according to the House Armed Services Committee, served as a "wakeup call" to add urgency to the drive to find new sources of rare earths.[174] The export ban was strategic, and likely telling of what China would ultimately like to see the global economy look like. Exports were only cut of unprocessed and raw materials, meaning that if a company wanted to buy rare earths, they could buy the finished products (phones, solar panels, etc.) from China, as the only remaining source.[175] Baotou issued a statement, saying that they cut exports for

a month to “stabilise the market and balance supply and demand,” likely an attempt to consolidate its control over its domestic rare earth industry, and shoot a shot across the bow of the hundreds of companies striving to join the sector.[176]

These recent actions by the People’s Republic of China have brought the issue to the forefront, and with no clear solution in sight, highlight the complicated US China relationship.

Section Six: A New Consensus?

The United States finds itself entering the second decade of the 21st century in a tumultuous world. Economic instability, international terrorism, the Arab Spring, failed states, political partisanship and environmental catastrophes (Oil spills in the Gulf, and the Tsunami that hit Japan, to name the largest) have policymakers and scholars on edge. With the present uncertain, its small wonder that structural problems such as the collapse of the American, and indeed, the world's non-Chinese rare earth sector have been ignored. Recent events have brought the US relationship with China into sharper focus, as the search for solutions continues.

The rare earth dilemma represents a perfect example of the largest source of competition that currently grips the world. Occurring in virtually every capital across the world, traditional notions of the structure of the international system are being challenged, and in some places, new institutions and concepts are emerging. This competition is a war of ideas, and the United States is the inadvertently on the defensive, as the Chinese advance across every continent. [177]

In 1992, Francis Fukuyama wrote a "The End of History and the Last Man," an expansion of his 1989 essay titled "The End of History," where he argued that, in a catchphrase, that the West had won the Cold War, and there was no possible alternative to liberalism.[178] With the victory of the United States and its allies (of many shapes, sizes, and political affiliations) the ideas that shaped the allies, and the ideology that

they advanced throughout the Cold War was now inevitable. The liberal economic and democratic model of governance had won, and it was only a matter of time until this became the final and only form of state in the world. This essay, and others of published around the same time, agreed that the international sphere would be defined by this combined liberal capitalist free market ideology, combined with democratic transitions, regardless of culture, history of democracy, or other factors.

This ideology, sometimes referred to as the Washington Consensus, is the foundational ideology behind much of the world's international bodies, and has been a dominant construct in foreign policy over the last fifty years. Institutions such as the International Monetary Fund, and the World Bank, aspects of the United Nations, the World Trade Organization, and numerous other international bodies are all rooted in the ideological consensus that came from a western victory in the Cold War.[179] The United States, and other western states, and international financial bodies, have especially been responsible for espousing these beliefs. Decades of underdeveloped nations seeking foreign aid were told to convert to democracy, and embrace capitalism, free markets, and to reduce social safety nets, subsidies, and other tariffs.[180] Other conditions such as human rights reform and other more "moralistic" requirements often accompanied the economic and political requirements. These changes were the conditions of foreign assistance which many nations desperately needed, and many complied. Those who resisted were often labeled pariah states, left of the mainstream international dialogue.[181] This consensus gave rise to various liberal ideas of

international relations, since if all states were gathering democratically with similar values, international organizations could have a great influence, and also produced several theories of international politics, such as “Democratic Peace” theory. [182]

Rare earth metals have a curious way of poking a significant hole in this consensus. A democratic populous doesn’t often think beyond their immediate pocket book needs, or what social or international issues that can be framed as important when the economy is strong. This short sightedness is at the root of the lack of planning by the US government on this issue. More importantly, the economic model supported by the “Washington Consensus” revealed the dual weakness in the model.

Extremely free and open markets where every nation specializes in what they are best at producing in the most efficient and profitable manner aren’t very effective for national defense. Energy, weapons, and many other supposed critical industries would be outsourced, and while they would be done more effectively, they wouldn’t be controllable by a specific nation in a time of crisis, allowing nations to utilize the imbalances and dependencies in international trade for aggressive purposes. Completely open markets, are therefore, not actually considered realistic in any school of international relations, especially not the dominant realist paradigm that focuses on the competition between states.

Therefore, if a free market doesn’t actually guarantee security or the perception of it in the international stage, what has the response been by states intent on maintaining

domestic control over key industries? Governments have by and large ensured that key sectors of the nation, such as the military industrial base, some energy, food, water, and other industries remain profitable and based in their state. In the event of trouble, a nation wants to ensure its basic functions remain intact. The main method of ensuring that these industries remain in the nation are government subsidies, or other forms of support that are cleverly disguised to avoid reprimand by international free trade bodies such as the World Trade Organization. Examples of this include state ownership of oil or natural gas companies, such as Mexico and Russia, subsidies to farmers in most countries, most notably the United States, and numerous military contracts and investments shrouded as classified for "national security." The modern concept of these critical pieces of infrastructure is expanding to include large corporations, the internet, and a host of other sectors. The expansion of the protection of these industries doesn't jive with the rhetoric of politicians who advocate a "free market" economy, or advocates of strict capitalism. The "Washington Consensus" therefore, has increasingly become much more talk, and much less walk. [183]

The hypocrisy of this stance has emerged in the form of the People's Republic of China. China has set out to demonstrate its combination of relatively open economics and close state control, combining the power of the state to further mostly free market ends as being both quite effective, and lacking the moralistic conditions of western powers and international financial institutions.[184] The financial crisis has given China the opportunity to more openly express the ideological position that it has been

espousing for many years; the west may have been right about reasonably free markets, but state dominance of the political system works wonderfully, and that all of the feel good conditions that western powers have the luxury of demanding are not necessary. There is finally an alternative. Foreign investment now flows from both east and west, and the Chinese often offer a better product with fewer strings attached.

This direct challenge to the current international order encompasses the various and competing concepts of "the rise of China." Several schools of thought exist, often tied to particular ideological traditions, think tanks, or have other obvious interests involved when they offer their analysis of what the rise of China will look like, and how the United States should engage it.[185] These schools of thought range from those who see Chinese military growth as a direct challenge to US hegemony, and as an attempt to gain military parity with the United States. Others see the economic competition, using any and all means to steal the advantage from the United States, whether it be supposed currency manipulation to using its advantage in rare earth mining and government incentives to lure high tech manufacturing from around the world to China, building things from solar panels and satellites to computers and televisions. [186]

This competition is founded in a realist interpretation of international relations, as are the above mentioned solutions to the rare earth crisis. Of particular note is the language used to describe them are couched in a realist mindset, combined with a bit of the American liberal tradition of strong alliances with certain other states. From an American perspective, the way we've been engaging the international community has

been inadequate to respond to the challenges of the 21st century, with rare earth metals serving as a microcosm of the long term trends for which the United States currently has no concrete answers. From the transition toward a green economy and energy dependence challenges, the continued occupation of Afghanistan, and the largest challenge of all, the "rise of China," rare earth metals display the problems with and short sighted nature of US policy. China is the source of the world's rare earth minerals for the foreseeable future, and the home to both a growing amount of the world's polluters and green tech manufacturers. To properly create a coherent rare earth policy, the U.S. China relationship must be re-examined.

Realism, considered the dominant and inevitable window through which to view and craft matters of state, that focuses on the interaction of states with other states, and less so on smaller actors, as well as the actions of states in the pursuit of their defined "national interests." At a very basic level, the very idea that the United States sees the existence of a monopoly in the rare earth sector based out of another country as a threat cements them in a realist or even neo-realist mindset. Other examples include the United States' desire to create a national reserve for rare earth metals, to maintain vital economic and military sectors in the event of an embargo or conflict, and the focus on inter-state relationships for a solution to primarily an economic issue. This raises the fundamental question, how does the United States view China, and how does this discourse and these representations constrain American thinking? And how does the American perspective of China affect how the Chinese respond to the United States?

Theorist Stephen Walt addresses several problems with the current study of security threats, citing among other problems a lack of short term analysis based on the desires and whims of those who fund the research done by security theorists, and overly mathematical analysis that remove the human element from international relationships.[187] Furthermore, the politicization of research has hampered developments in many fields. This is especially true of the rare earth metal quandary, as it gets absorbed by the traditional grand strategy views of the U.S. relationship to China.[188] Walt's starting premise in "The Renaissance of Security Studies," however, is one of the many reasons that traditional realists have been unable to come up with satisfactory answers to the rare earth conundrum. Walt argues that strictly military threats should be the focus of scholars, and other threats should be seen as of less important, for the coherence of the field of security studies. Rare earths strike at the heart of the problems with his analysis. Rare earths are critical for many modern military technologies, and project to become an even more important role in the future, yet as a resource, they are seen as an economic issue, not a military issue. The military can't fight without guns, and similarly, security can't be understood simply by looking at whom to point your guns at, and should instead include a broader array of considerations, at least protecting the supply chains for critical technologies, and perhaps other concerns, such as energy dependence, and economic stability; large potential triggers of military conflict. Now that the price of rare earths are increasing, and there is talk of scarcity, the defense industrial base, and their allied scholarly community have been some of the first into the

fray, demanding new solutions to the rare earth dilemma, the creation of stockpiles, and the increase in domestic mining. A longer term analysis and a broader look at what constitutes a threat would prevent this scramble, before it becomes a major problem. [189]

Another flaw with realism relates to its intensive focus on the interactions between states. Modern challenges, ranging from terrorism, immigration, economic crimes, cyber warfare, human trafficking, and the drug trade are not necessarily caused, or solved entirely by state to state interactions. Rare earth metals are technically owned by Chinese corporations, not the state itself, and as seen in Afghanistan, these corporations are scouring the world to increase their holdings. The large question with China becomes, where the state stops, and the governing boards of large corporations begin.

Other schools of international relations would encourage more engagement with the international sphere, and international institutions. Concerning rare earth metals, this might result in anything from a global reserve to an institution for regulating its trade. The unequal dispersal of critical resources around the world creates uneven distributions of economic and political power, and a little human nature and greed results an unwillingness to share. No nation will ever impoverish themselves to "spread the wealth," but international cooperation via international institutions is a potential avenue to address questions of inequality and the potential problems stemming from a critical resource monopoly.

The primary problem with international institutions is their inability to either coerce or cajole via incentives cooperation with the will or norm of international forums. This holds doubly true for world powers. The United Nations isn't equipped to handle resource monopolies, and given its structure and the absolute veto power wielded on the Security Council by the People's Republic of China, this is an unlikely source of resolution. Other bodies are equally ineffective, or ill-equipped to handle the problem. If any economy had a central position and role in the world economy and its possible hierarchy of centers, it is China."[190] This has proven true, with oil embargoes going unanswered by international institutions.

But what of the bilateral relationship between China and the United States? This relationship has gotten a lot of attention in the media in the last year, as legislation in congress sought trade restrictions against China, labeling it a currency manipulator. This debate largely rotated around the construction that the PRC is an enemy of the United States. A media storm that centers on the "big bad China" who is trying to subvert the American economy isn't just contained to our shores. Chinese America specialists look at domestic media and listen to American politicians speak, and must have felt accused, targeted and belittled. The ways in which the debate concerning China is portrayed in the United States is a decisive factor in how the Chinese view the United States, so the construction of a China threat may actually become a reality.[191]

All of this discourse focuses on a single overarching factor; the creation of an "Us" and "Them" separation. Modern "politics aims at the creation of unity in a context of

conflict and diversity; it is always concerned with the creation of an “us” by the determination of a “them”.”[192] This categorization is the basis of modern US Chinese relations, defined as a comparison of two unique (one familiar and the other mysterious and foreign) political entities. In the status quo, the realist lens identifies this dichotomy as a productive portrayal of the bilateral relations. Clearly defined threats are helpful for the analysis of realists, but often results in threats being created rather than identified.

The way that scholars in the United States construct China as a threat is very pervasive. Reading scholarly literature on the U.S-China relationship is virtually encompassed by "China threat" literature, dichotomizing the West as the self, and the People’s Republic of China as a distant ‘other.’ Originally, this discourse was perpetuated to bolster the dual ideas of American Exceptionalism, and American hegemony in a post-Cold War era.

This discursive construction, however, has deeper roots, that go back a century and a half to the first wave of Chinese immigration to the United States. Chinese laborers took jobs that the new settlers in California, and the rest of western America desperately needed. Their willingness to work for less undercut many middle and lower class jobs, and resulted in a resentment that translated into blatant racism.[193] A perfect example is the construction of the transcontinental railroad by a mostly Chinese workforce. The Chinese exclusion acts limited Chinese, and Asian immigration as a whole shortly thereafter, but the damage was done. The United States has been threatened economically by the Chinese for centuries, whether in person by the loss of

jobs in the United States, or the more abstract threat of a large, foreign nation having a position of power over American currency, and now, vital resources.[194] This largely orientalist construction of the Chinese has its roots in an imperialist mindset that denigrates non-Westerners.[195] Many of our conceptions of the Chinese as sneaky, manipulative (such as in relation to the US currency, and now, our rare earth supplies) and militaristic (such as interpretations of their military programs as a challenge to the U.S.) are imbedded in what Edward Said described as "orientalism."[196] This semi-paternal, semi racist mindset subtly makes actions by the PRC as threatening, because of who is doing them, and translates into how we view actions by the Chinese.[197] "Like orientalism, the U.S. construction of the Chinese "other" does not require that China acknowledge the validity of that dichotomous construction." [198]

This has created a self-fulfilling prophecy.[199] The realist quest for security has another casualty, for "so long as the United States continues to stake its self-identity on the realization of absolute security, no amount of Chinese cooperation would be enough" to overcome these constructions.[200]

The United States has always constructed itself as against someone as a leading part of its identity. The early colonists opposed the Native Americans, then the British. Soon after the British was the Western Native Americans, and moral crusade against slavery. The United States turned its newfound moral authority against imperialism, even though it began a series of imperialist wars and occupations. Two World Wars later left the United States locked in a titanic ideological and, in many nations, violent conflict

with the Soviet Union and Communism. “After the demise of the Soviet Union, the vacancy of other was to be filled by China, the "best candidate" the United States could find in the post-Cold War, unipolar world.”[201] “Only an uncertainty with potentially global consequences such as China could justify U.S. indispensability or its continued world dominance.”[202]

Many analysts who claim expertise on the Chinese have a problem identifying who “the Chinese” are, and what their self identity really is. The Han ethnic group is dominant in China, but is really an amalgamation of many groups, as being “Han” has social implications in China. But the Chinese nation isn’t about being a specific ethnic group, it’s about heritage. The Chinese see themselves as a rightful world power, whose empire was the envy of centuries of neighboring states. Thus, when the United States describes the 21st century as potentially defined by the “rise of China,” a Chinese scholar would likely correct them, describing it as the “re-emergence of China” to its proper place on the world stage. [203]

Thankfully, the realization of how the domestic constructions of the United States affect how other nations, specifically China, see them is seeping slowly into the mainstream of China analysts, but this discourse is still seeped with orientalist logic.[205] Robert Kagan describes how “The Chinese leadership may already believe the United States is its enemy, for instance, and there is nothing we can do to change that. Partly this is due to our actions -- such as the strengthening of the U.S.-Japanese military alliance, which began during the Clinton administration, and our recent efforts to

enhance strategic ties with India."[204]

Sadly, he goes on to say that the Chinese opposition to the United States rests in " our different forms of government, since autocratic rulers naturally feel threatened by a democratic superpower and its democratic allies"[205]

The focus on China relates to the perceptions that China has the necessary elements to contradict the 'western way' of doing things in the international sphere; that "contradicts Western liberalism as the reigning paradigm.[206] In an era of supposed universalizing cosmopolitanism, China demonstrates the potency and persistence of nationalism, and embodies an alternative to Western and especially U.S. conceptions of democracy and capitalism.[207] China has the technocratic and pragmatist qualities that the west values most in itself, but uses them to portray a world made in a different image than the American liberal vision.[208] Contrary to the assertions of Fukuyama that the end of the Cold War was the end of 'history,' "China is a reminder that history is not close to an end" [209]

Section Seven: The Way Forward

The rare earth conundrum isn't going anywhere. Chinese domination of the means of production is here to stay, efforts to solve them in the status quo like recycling, substitution, and mining abroad aren't going to cut it. The United States needs to move past the ideological notion that they, or any other state, is really a "free market economy," and start protecting and supporting its domestic rare earth mining capabilities, and build its own rare earth refinery. Changing the public notions that a "freer" economy isn't necessarily a better economy is a difficult battle, and will require dedicated leadership, with a clearly articulated message. In the mean time, President Obama should expand his diplomatic efforts to secure the rare earth trade with friendly nations, such as Canada and Australia, and promote recycling of rare earths and research into substitution. This would compliment his message of green energy and the new "green economy."

The short term solution, and the root cause of the problem lies with the bilateral relationship with China. If nothing else, focusing on this relationship could buy other solutions to the rare earth question time to come to fruition. The United States needs to re-evaluate how they view China, and embrace a more cosmopolitan ethic to move past its Orientalist assumptions. Embracing such an ethic would allow the United States to move past the political dialogues that construct China as the foreign menace, looming

across the Pacific Ocean. Instead of viewing our relationship in terms of cooperation or competition, the United States should embrace a policy of respect. The United States wants to be treated with respect from China, and can't claim the moral high ground in the international sphere until our actions support our desires. Recognizing that China not an emerging power such as Brazil, and is a re-emerging power, such as Germany or Japan after World War Two, instead of a pesky third world nation that wants its day in the sun, and treating it as such would go a long way towards stable and peaceful relations. Rare earth metals have the potential to re-shape the international order, and have already played an instrumental role in the ways in which humans interact with one another, and respond to global challenges. The peaceful, respectful development of this maligned sector of the economy is in the interest of everyone. If the cycle persists, it will only create a self-fulfilling prophecy.

End Notes:

1. Robert Beauford, “REEs, Chemistry and Applications” Rareearthelements.com http://rareearthelements.us/the_17_elements
2. Ibid
3. Ibid
4. Ibid
5. Ibid
6. Ibid
7. Ibid
8. Ibid
9. Ibid
10. Ibid
11. Ibid
12. Ibid
13. Ibid
14. Ibid
15. Ibid
16. Ibid
17. Ibid

18. Ibid

19. Ibid

20. Ibid

21. Ibid

22. Ibid

23. Ibid

24. Ibid

25. Ibid

26. Ibid

27. Ibid

28. Ibid

29. Ibid

30. Ibid

31. Ibid

32. Barack Obama. State of the Union Address, Feb. 24, 2009, Full Text available Politico.com http://www.politico.com/news/stories/0209/19280.html

33. John Seaman, “Rare Earths and Clean Energy: Analyzing China's Upper Hand,” Fellow in the Center for Asian Studies at the French Institute of International Relations, September 2010, http://www.ifri.org/?page=contribution-detail&id=6204&id_provenance=103&provenance_context_id=4

34. David Findley. "Nine challenges of alternative energy." Energy Analysis Program at the Lawrence Berkeley National Laboratory Post Carbon Institute. http://oilprice.com/Alternative-Energy/Renewable-Energy/Nine-Challenges-Facing-the-Alternative-Energy-Industry.html

35. Christine Parthemore, “Elements of Security: Mitigating the Risks of U.S. Dependence on Critical Minerals,”Fellow at the Center for a New American Security, “Elements of Security: Mitigating the Risks of U.S. Dependence on Critical Minerals,” May 2011 http://www.cnas.org/files/documents/publications/CNAS_Minerals_Parthemore_1.pdf]

36. Fareed Zakaria “Why Oil Prices Will Stay High,” January 15th, 2012 CNN

37. Steven Mufson, “Nigerian Rebels Drive Up Oil Prices” Washington Post, June 30, 2009 http://www.washingtonpost.com/wp-dyn/content/article/2009/06/29/AR2009062904111.html

38. Peter Brookes, “Uncle Sam’s Latin challenge” Heritage Foundation, S

39. Ariel Cohen, "The National Security Consequences of Oil Dependency" Heritage Lecture #1021 3/22/07 http://www.heritage.org/Research/NationalSecurity/hl1021.cfm]

40. Phillip Brix, “How could Africa's sun improve European Energy Security?“ April 2010 Editor of DESERTEC, ttp://www.worldsecuritynetwork.com/showArticle3.cfm?article_id=18369&topicID=73

41. Trend E. Tariverdiyeva “Eastern Europe fully dependent on Russian gas.” 6/4/2011, http://en.trend.az/capital/energy/1886541.html

42. Terry Deibel, “Foreign Affairs Strategy: Logic for American Statecraft” Professor of IR at National War College, 2007, pg 387-389

43. “Climate change as com-plex social issue” Talkingclimate.org, Climate Outreach and Information Network (COIN), the Public Interest Research Centre (PIRC) and the research group at the School of Sociology and Social Policy, Nottingham University. http://talkingclimate.org/guides/language-words-phrases/

44. Idean Salehyan “The New Myth About Climate Change”, Foreign Policy, August 2007, http://www.foreignpolicy.com/story/cms.php?story_id=3922]

45. Ibid

46. Op. cit. Deibel

47. Tom J. Chalko "Global Warming: Can Earth Explode?" MS, Engineering & PhD, Laser Holography, 2002, http://www.bioresonant.com/news.htm

48. Lester R. Brown "Plan B 3.0: Mobilizing to Save Civilization," Worldwatch Institute and the Earth Policy Institute, 2008 Pg 8

49. Christian Parenti "The Nation: The Case for EPA Action" the Nation, NPR

50. Oliver Tickell "On a planet 4C hotter, all we can prepare for is extinction" Center for Biological Diversity, PA Agrees to Review Ocean Acidification Impacts Under Clean Water Act: Agency Will Analyze Effects of CO2 Emissions on Water Quality, http://www.biologicaldiversity.org/news/press_releases/2009/ocean-acidification-01-27-2009.html

51. Nicholas Kristol "Scandal below the surface," New York Times, 10/31/2006 http://select.nytimes.com/2006/10/31/opinion/31kristof.html?_r=1

52. Ian Thompson, Canadian Forest Service, Mackey, Brendan. The Australian National University, The Fenner School of Environment and Society, College of Medicine, Biology and Environment, McNulty, Steven, USDA Forest Service, Mosseler, Alex, Canadian Forest Service, "Forest Resilience, Biodiversity, and Climate Change" 2009, Secretariat of the Convention on Biological Diversity

53. Walter Mead "The Death of Global Warming" Senior Fellow for U.S. Foreign Policy at the Council on Foreign Relations, , February 1, http://blogs.the-american-interest.com/wrm/2010/02/01/the-death-of-global-warming/

54. "Rare Earth Shortages May Damage Clean Tech Growth" Business Green, Urban Mining, Jan 10, 2012, DOE: http://urbanmining.org/2012/01/10/doe-rare-earth-shortages-may-damage-clean-tech-growth/

55. Op. Cit. Business Green

56. Keith Bradsher "China exerts control over its rare earth resources" New York Times, December 29th, 2010, http://www.nytimes.com/2010/12/30/business/global/30smuggle.html

57. James Kennedy "Critical and Strategic Failure in Rare Earth Resources" Wings Enterprises, 2011 http://www.energyfromthorium.com/TEAC1/06_Kennedy_rareEarth.pdf

58. Ibid

59. Stephen Dinan, "Congress fights incandescent light bulb ban" The Washington Times, December 16 2011 http://www.washingtontimes.com/news/2011/dec/16/congress-overturns-incandescent-light-bulb-ban/

60. Ibid

61. Op Cit. Kennedy

62. William Jasper, "US Hostage to Red China for Rare Earth Minerals" Jan 4th, 2011, The New American http://thenewamerican.com/usnews/politics/5742-us-hostage-to-red-china-for-rare-earth-minerals

63. Sterling Burnett "Will Green Energy Make the United States Less Secure?" National Center for Policy Analysis November 1st, 2011,

64. Ibid

65. Ibid

66. Op. Cit Kennedy

67. Robert Kagan "End of Dreams, Return of History" Senior Associate at the Carnegie Endowment for International Peace Policy Review 2007 http://www.hoover.org/publications/policyreview/8552512.html#n10

68. "US Naval Dominance And the Importance of Oceans" Stratfor Center for Global Intelligence http://www.stratfor.com/analysis/u_s_naval_dominance_and_importance_oceans

69. Op Cit. Kagan

70. William Wohlforth, "Unipolar stability: the rules of power analysis" Prof and Chair of Dept. of Government @ Dartmouth, Spring, , Harvard International Review, Vol. 29,

No. 1

71. Bradley Thayer “In Defense of Primacy, The National Interest,” Associate Professor in the Department of Defense and Strategic Studies at Missouri State University, December 2006 http://findarticles.com/p/articles/mi_m2751/is_86/ai_n27065796/

72. Niall Ferguson “A World without Power” Professor of history at New York University's Stern School of Business and senior fellow at the Hoover Institution at Stanford University , Foreign Policy, July 2004 http://www.foreignpolicy.com/articles/2004/07/01/a_world_without_power

73. Max Boot “Power for Good; Since the end of the Cold War, America the Indispensable” Senior fellow at the Council on Foreign Relations , The Weekly Standard, Vol. 11 No. 28 http://www.weeklystandard.com/Content/Protected/Articles/000/000/012/045ngvvc.asp

74. Stephen M. Walt “American Primacy,” Professor of international affairs at Harvard, professor of political science at the University of Chicago, assistant professor of politics and international affairs at Princeton, guest scholar at Brookings, associate at Carnegie Endowment for International Peace, Naval War College Review, Spring 2002, pgs 9-28

75. Daryl Grayson “The Myth of Air Power in the Persian Gulf War and the Future of Warfare,” Assistant Professor of Government and Research Fellow at the Rockefeller Center at Dartmouth, International Security, 26(2), Pg 57

76. Michael Richardson, "China's Chokehold On Rare-Earth Minerals Raises Concerns,” Michael, Senior research fellow at the Institute of South East Asian Studies in Singapore, 10/8/10, http://yaleglobal.yale.edu/content/chinas-rare-earth-minerals

77. Peter C. Dent, “HIGH PERFORMANCE MAGNET MATERIALS: RISKY SUPPLY CHAIN,” Vice President of Business Development at Electron Energy Corporation, August 2009, http://www.electronenergy.com/media/amp16708p27.pdf

78. William Clegg, “Rare Earth Elements and Geo-strategy” August 1, 2011 Pnyx, On Global Security and Politics,

79. Joseph Nye, “China’s century is not yet upon us” Sultan of Oman Professor of International Relations, Harvard John F. Kennedy School of Government, March 18, 2010, http://www.hks.harvard.edu/news-events/news/commentary/chinas-century-not-upon-us

80. Daniel H. Nexon, "The Balance of Power in the Balance," Asst. Prof. Dept. Gov't. and the School of Foreign Service @ Georgetown U, Vol 61, No 2, April, 2009

81. Robert D. Blackwill, “The Geopolitical Consequences of the World Economic Recession – A Caution,” former U.S. Ambassador to India, former Deputy National Security Advisor for Strategic Planning, Belfer Lecturer in International Security at Harvard University's John F. Kennedy School of Government, July 30, RAND Corporation, http://www.rand.org/pubs/occasional_papers/2009/RAND_OP275.pdf

82. Maj. Gen. Charles J. Dunlap “America’s asymmetric advantage,” Deputy judge advocate general of the Air Force 2006 http://www.armedforcesjournal.com/2006/09/2009013

83. “China Hold on Metals Worries Washington.” Rare Metals Blog, September 25, 2010. http://www.raremetalblog.com/2010/09/china-hold-on-metals-worries-washington-.html

84. David Joel Horowitz, “Robert Gates Retrospective” Horowitz Freedom Center and FrontPage Magazine. 8/25/2010 http://frontpagemag.com/2010/08/25/robert-gates-a-retrospective/2/?cid=67595

85. JR Dunn “Vanishing American Air Superiority.” American Thinker, March, 2010 http://www.americanthinker.com/2010/03/vanishing_american_air_superio.html

86. Michael J Hornitschek “War without Oil: A Catalyst for true Transformation” Feb. 17, 2006. http://www.nps.edu/cebrowski/Docs/sustainability/other%20articles/War%20Without%20Oil.pdf

87. Victoria Wu. “Australia Blocked Rare Earth Deal,” China Digital Times, Feb 16, 2011, http://chinadigitaltimes.net/china/rare-metals/

88. Vincent Fernando, “Key Components Of America's Military Are Now Dominated By

A Chinese Monopoly", Business Insider, Aug. 2, 2010. http://www.businessinsider.com/americas-best-military-technology-is-now-dependent-on-chinas-rare-earth-monopoly-2010-8

89. Steven Jiang and Eve Bowers "Global Trade Wars Turn up the Heat" CNN Money, October 21, 2010, http://money.cnn.com/2010/10/21/news/international/china_rare_earth_dispute/

90. Op Cit. Parthemore

91. Sauraw Jha "Did China overplay the rare earth hand?" The Diplomat. November 17th 2011, http://the-diplomat.com/2010/11/17/did-china-overplay-rare-earth-hand/

92. Ron Pernick and Clint Wilder "Renewable Energy World, Extinction or Innovation? U.S. Government Must Enact Clean Energy Policy," Contributing editors Clean Edge, Inc., July 23, 2007, http://www.renewableenergyworld.com/rea/news/reinsider/story?id=49399

93. Op Cit. Jha

94. Op Cit. Parthemore

95. Tom Bawden " Smartphone fears as China holds precious metals hostage." The Independent, Jan 9th, 2012 http://www.independent.co.uk/news/business/news/smartphone-fear-as-china-holds-precious-metals-key-6287088.html

96. Op Cit. Seaman

97. Ibid

98. Gschneidner KA, Cappellen, ed. (1987). "1787–1987 Two hundred Years of Rare Earths". Rare Earth Information Center, IPRT, North-Holland Introduction.

99. Daane F. Spedding "The Rare Earths", John Wiley & Sons, Inc., 1961

100. Gschneidner KA, Cappellen, ed. (1987). "1787–1987 Two hundred Years of Rare Earths". Rare Earth Information Center, IPRT, North-Holland, Introduction.

101.ER, Rose. Rare Earths of the Grenville Sub-Province Ontatio and Quebec. GSC Report Number 59-10. Ottawa: Geological Survey of Canada Department of Mines and Technical Surveys, 1960.

102.Michael Berry "Solving critical rare earth shortages" Jan. 10, 2012, Business Insider, http://www.businessinsider.com/solving-critical-rare-earth-metal-shortages-dr-michael-berry-and-chris-berry-2012-1

103.Dorothy Kosich "Rare Earths R&D funding critical to stemming brain drain in U.S. materials manufacturing," Mineweb, March 22, 2010, http://www.proactiveinvestors.com.au/companies/news/5830

104.Op Cit Jasper

105.Op Cit Burnett

106.James Areddy "China Builds Strategic Reserve of Rare Earth Metals" Wall Street Journal, Feb. 7th, http://online.wsj.com/article/SB10001424052748704124504576117511251161274.html

107.Op Cit. Seaman

108.Op Cit Clegg

109.Op Cit Berry

110.John C.K. Daly "China's Rare Earth Monopoly; For Now" August 12th, 2011, Oilprices.com, http://blog.cleantechies.com/2011/08/12/china-rare-earths-monopoly-for-now/

111.Hedrick J. Haxel G. and Orris J. "Rare earth elements critical resources for high technology." 2006, Reston Virginia, USGS Fact Sheet. "Haxel G, Hedrick J, Orris J. 2006. Rare earth elements critical resources for high technology. Reston (VA): United States Geological Survey. USGS Fact Sheet: 087-02.

112.Chao ECT, Back JM, Minkin J, Tatsumoto M, Junwen W, Conrad JE, McKee EH, Zonglin H, Qingrun M, "Sedimentary carbonate based giant Bayan ore deposits" United States Geological Survey Publications Warehouse. 29 February 2008

http://pubs.usgs.gov/bul/b2143/

113.Scott Jenkins "Rare-earth metals for the future: economics, workforce and R&D will determine the future of these critical technology metals." *Chemical Engineering* Oct. 2010: 17+.*Expanded Academic ASAP*. Web. 29 Sep. 2011.

114.Op Cit. Gschniedener,

115.Op Cit Berry

116.Op Cit Kosich

117.Op Cit. Clegg

118.Op Cit Bradsher

119.UPI Space Daily.com “Rare earths to be refined in Malaysia” Staff Writers Kuala Lumpur, Malaysia (UPI) Mar 9, 2011 <http://www.spacedaily.com/reports/Rare_earths_to_be_refined_in_Malaysia_999.html>//DoeS

120.Murray Coleman "Rare Earth ETF Jumps As Plans To Break China's Hold Suffer Setback", Barrons blog, June 30, 2011

121.Yoolim Lee "South China Villagers Slam Pollution From Rare Earth Mine." 22 February 2008. RFA English Website. 16 March 2008

122.Yoolim Lee "Malaysia Rare Earths in Largest Would-Be Refinery Incite Protest", Bloomberg Markets Magazine, May 31, 2011

123.International Atomic Energy Agency, Report on the Lynas Rare Earth Refinery in Kuatan, Malaysia. http://www.iaea.org/newscenter/news/pdf/lynas-report2011.pdf

124.Op Cit. Bradsher

125.Devin Powell "Rare earth elements plentiful in ocean sediments", ScienceNews, July 3rd, 2011

126.Michael Auslin “Japan’s Rare Earth Jolt” Wall Street Journal, October 13, 2010 http://online.wsj.com/article/SB10001424052748703440004575549061903720 95

0.html?mod=googlenews_wsj

127.Cheryl K. Rofer, and Tõnis Kaasik "Turning a Problem Into a Resource: Remediation and Waste Management at the Sillamäe Site, Estonia." Volume 28 of NATO science series: Disarmament technologies. Springer. p. 229

128.Emily Coppel "Potential Rare Earth Mines in Afghanistan" Potential Rare Earth Mines in Afghanistan,2/14/11, American Security Project http://americansecurityproject.org/blog/2011/potential-rare-earth-mines-in-afghanistan/

129.Bruce Mulliken "THE PRESIDENT'S CLEAN ENERGY BREAKTHROUGH." Green Energy News, 6/15/2010, http://www.green-energy-news.com/arch/nrgs2010/20100040.html,bs

130.Gordon Change "The Taliban: World's Next Minerals Superpower," Forbes Columnist 16 July 2010, http://www.forbes.com/2010/06/16/taliban-minerals-afghanistan-asia-opinions-columnists-gordon-g-chang.html,

131.Op Cit Coppel

132.Central Intelligence Agency, World Factbook. Afghanistan https://www.cia.gov/library/publications/the-world-factbook/geos/af.html

133.Simon Rogers "Transparency International Corruption Index" The Guardian, November 17th, 2009 http://www.guardian.co.uk/news/datablog/2009/nov/17/corruption-index-transparency-international#data

134.Op Cit Coppel

135.Ariel Schwartz "The new resource wars: what if china stops exporting rare elements?" FastCompany, Sept 23, 2010. http://www.fastcompany.com/1690821/the-new-resource-wars-what-happens-if-china-stops-exporting-rare-earth-elements

136.Op Cit. Wu

137.Op Cit. Seaman

138.Op Cit Kennedy

139.Ibid

140."8 Oversold Stocks Insiders Are Crazy About" Street Insider November 4, 2011 http://www.streetinsider.com/Corporate+News/Molycorp+(MCP)+Shares+Jumping%3B+Following+US+Stockpiling+Rumor,+CEO+Says+Not+Enough+Supply+to+Meet+Demand/6916352.html

141.IBN "Krugerrand Gold Coins Resources Stock Researcher Reveals Rare Earth Elements Hardship Through Broad Investigation Looking Into Significant Points" November 4th, 2011, http://www.pinky-violence.com/international-business-news/krugerrand-gold-coins-resources-stock-researcher-reveals-rare-earth-elements-hardship-through-broad-investigation-looking-into-significant-points/

142.Op Cit. Findley

143.Op Cit Jha

144.Alessandra Prentice "Most non-Chinese rare earth projects doomed: consultant" Reuters, November 1st, 2011, http://www.reuters.com/article/2011/11/01/us-rare-earths-lifton-idUSTRE7A03Q120111101

145.Ibid

146.Ibid

147.Ibid

148.Ibid

149.Op Cit Seaman

150.Op Cit Vincent

151.Jeremy Hsu "U.S. Military Supply of Rare Earth Elements Not Secure," Innovation News Daily senior writer, 9/11/2011 http://www.technewsdaily.com/us-military-fsupply-of-rare-earth-elements-not-secure-0430/

152.Op Cit Areddy

153.Op Cit Seaman

154.Op Cit Burnett

155.Op Cit Wu

156.Op Cit Jenkins

157.Jack Dini "China's Monopoly on Rare Earths" Canada Free Press Oct. 30, 2011, http://www.canadafreepress.com/index.php/article/41856

158.Op Cit Berry

159.Op Cit Burnett

160.Ibid

161.Op Cit Kennedy

162.Ibid

163.Op Cit Richardson

164.Op Cit Seaman

165.Dan Ciras "Solar Energy Rare Earth", Pierce, No Date. www.dicurdming.bligoo.com/solar-energy-rare-earth

166.Op Cit Kennedy

167.Raymond Barrett "An US REE Stockpile?" Nov. 5th, 2011, http://www.raremetalblog.com/2011/11/an-us-ree-stockpile.html

168.Op Cit Barrett

169.Haskell Sears Ward "Rare Earths are a No-Go in Central Africa," November 3rd, 2011, All Africa.com, http://allafrica.com/stories/201111031386.html

170.Op Cit Daly

171.Op Cit Wu

172.Op Cit Burnett

173.Op Cit Schwartz

174.Asher Berube “China bans Rare Earth exports” inPress, Nov. 4, 2011, http://www.raremetalblog.com/2011/11/high-quality-global-journalism-requires-investment.html

175.Armstrong Williams, “Trade War with China Looms” 10/24/11 The Cutting Edge, http://www.thecuttingedgenews.com/index.php?article=21827&pageid=&pagename=

176.Leslie Hook, “largest rare earth producer halts output” CNBC 10/24/11, http://www.cnbc.com/id/44953947/

177.Stefan Halper “The Beijing Consensus; Legitimizing Authoritarianism In Our Time” Basic Books, 2010 pg 9

178.Ibid pg 7

179.Ibid pg 34

180.Ibid pg 37

181.Ibid pg 98

182.Ibid pg 58

183.Ibid pg 173

184.John King Fairbank and Merle Goldman “China, a New History” 2nd Enlarged Edition, Belknap Press of Harvard University Press, Cambridge Massachusetts, 2006 pg 334

185.Op Cit Halper pg 122

186.Ibid 123

187.Stephen Walt. “The Renaissance of Security Studies” International Studies Quarterly, Vol. 35, No. 2 (Jun., 1991), pp. 211-239

188.Op Cit Halper pg 255

189.Ibid

190.Andre Gunder Frank, , ReOrient: Global Economy in the Asian Age, Pg 47

191.Chengxin Pan. "The 'China Threat' in American Self-Imagination: The Discursive Construction of Other as Power Politics" Department of Political Science and International Relations, Faculty of Arts, Australian National University, 2004, Introduction

192.Chantal Mouffe "Deliberative Democracy or Agonistic Pluralism" Institute of Advanced Studies, Vienna, 2000 http://www.ihs.ac.at/publications/pol/pw_72.pdf

193.John W. Dower. "War without Mercy; Race and Power in the Pacific War" Pantheon Books, New York, 1986 pg 14

194.Ibid 15

195.Edward Said "Orientalism" Columbia University, November 1978 pg 3-4

196.Danielle Sered. "Orientalism" Rhodes Scholar Postcolonial Studies at Emory University, 1996 http://www.english.emory.edu/Bahri/Orientalism.html

197.Op Cit. Pan

198.Op Cit Pan

199.Op Cit. Pan

200.Op Cit Pan

201.Op Cit Pan

202.Op Cit. Pan

203.Op Cit. Frank Intro

204.Robert Kagan, "The Illusion of 'Managing' China," Senior Associate at the Carnegie Endowment for International Peace, Washington Post, May 15th, 2005,

http://www.washingtonpost.com/wp-dyn/content/article/2005/05/13/AR2005051301405.html

205.Ibid

206.Op Cit. Pan

207.Ibid

208.Op Cit Halper

209.Ibid