2014

# Transparency in mineral extraction: the commodity story, the Dodd-Frank, and the emergence of 'conflict-free'

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**Transparency in Mineral Extraction:**
**The Commodity Story, the Dodd-Frank, and the Emergence of 'Conflict-Free'**

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Accepted in Partial Completion
Of the Requirements for the Degree
Master of Science

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May 16, 2014

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**A Thesis**
**Presented to**
**The Faculty of**
**Western Washington University**

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**Abstract**

The U.S. Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 includes two sections impacting the nonfuel minerals industries: the first targets 'conflict minerals,' and the second is centered on extractive industry transparency. Seeking to explain the importance of extractive industries in the creation of the modern context, my thesis begins with the commodity story of digital technology. In an era characterized by an increased curiosity into the origin of things, my work focuses on the resource geographies of minerals under neoliberalism to explain the reasons bringing extractive industry transparency onto the global agenda. After situating the issue within the global historical context and exploring the environmental and social injustices associated with mineral extraction, the importance of transparency initiatives is clear. The conflict minerals law is designed to sever the link between armed conflict in the Democratic Republic of Congo and the trade of minerals necessary in digital technology. In doing so, measures included in the law will help inform consumers whether or not producers of digital technology are sourcing minerals from belligerents in central Africa. The very process this U.S. legislation seeks to disentangle is the global commodity chain created by the expansion of neoliberal capitalism. My research illuminates the challenges in the first attempt to systematically certify metallic minerals as well as the political mechanisms currently underway to increase transparency in nonfuel mineral extraction and production.

## Acknowledgements

This work would not be possible without the insight, expertise, and dedication of my committee members. I greatly appreciate the enduring support of my advisor Dr. Grace Wang. Dr. David Rossiter was invaluable in the theoretical framing of this thesis and Dr. Vernon Johnson provided key political insight and support. All three of my committee members were extremely dedicated to seeing this project through and I am most grateful for their insightful contributions and encouragement. Graduate program advisor Dr. Andy Bach was very helpful and supportive throughout this process. My fellow geography graduate students offered both inspiration and critique for which I am most grateful. And I am very appreciative of the support from my family and my friends, and for the moments in life that inspire and persuade the journey.

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## Acronyms

ASM –Artisanal Small-Scale Mining
BGR - German Federal Institute for Geosciences and Natural Resources
CFS – Conflict-Free Smelter
CTC – Certified Trading Chains
DRC – Democratic Republic of Congo
EICC – Electronics Industry Citizens Coalition
EITI – Extractive Industry Transparency Initiative
EPA – Environmental Protection Agency
FDI – Foreign Direct Investment
GeSI – Global e-Sustainability Initiative
ICGLR – International Council on Great Lakes Region of Africa
IGO – Intergovernmental Organization
IMF – International Monetary Fund
ITRI – International Tin Research Institute
iTSCi – ITRI Supply Chain Initiative
MMSD – Minerals, Mining, and Sustainable Development Project
MONUSCO – United Nations Organization Stabilization Mission in the DR Congo
NGO – Nongovernmental Organization
OECD – Organization for Economic Co-operation and Development
PGM – Platinum Group Metals
REE – Rare Earth Elements
RUF – Revolutionary United Front in Sierra Leone
RPF – Rwandan Patriotic Front
SEC – U.S. Securities and Exchange Commission
TIC – Tantalum-Niobium International Study Center
UNITA – National Union for the Total Independence of Angola
USGS – United States Geological Survey
UN – United Nations
UNECA – United Nations Economic Commission for Africa
UNEP – United Nations Environment Programme

# Chapter 1
# Introduction

In the upcoming months, a new label will appear on products probably not known to have controversial origins. Smartphones, laptops, MP3s, gaming systems, and other electronics will soon be labeled and consumers will be able to exercise consumer choice and use purchase power against violence and human rights abuses. Sometime after June 2, 2014, the label 'DRC conflict-free' will be affixed to consumer electronics products that meet the requirements put forth by the U.S. Dodd-Frank Wall Street Reform and Consumer Protection Act passed by Congress and signed into law by President Obama in July 2010. Section 1502 entitled, Conflict Minerals, requires any U.S. company using the minerals, tin, tantalum, tungsten, or gold that files an annual report with the Securities and Exchange Commission (SEC) to state whether or not their products use these that are traded to finance armed groups and perpetuate the violence in the eastern Democratic Republic of Congo (DRC). If a company can retrace their product and ensure the raw materials used were not purchased from warlords in the DRC or adjoining countries, then the product can be labeled 'DRC conflict-free.'

In the age of globalization the story of the commodity is complexly interwoven the world over. Enlightened consumers are increasingly inquisitive of the origin of things and the means of production. An object is the embodiment of processes according to historical materialists (Swyngedouw 2000). The object, or the commodity, is a result of multiple processes or social relationships and therefore has a 'life' told in a commodity biography or story (Bridge and Smith 2003). Often, the tales of resource geographies of specific commodities reveal the uneven character of globalization, "a window through which to understand the sociocultural construction and regulation of economies" (Bridge and Smith 2003, 258). As Swyngedouw (2000) explains:

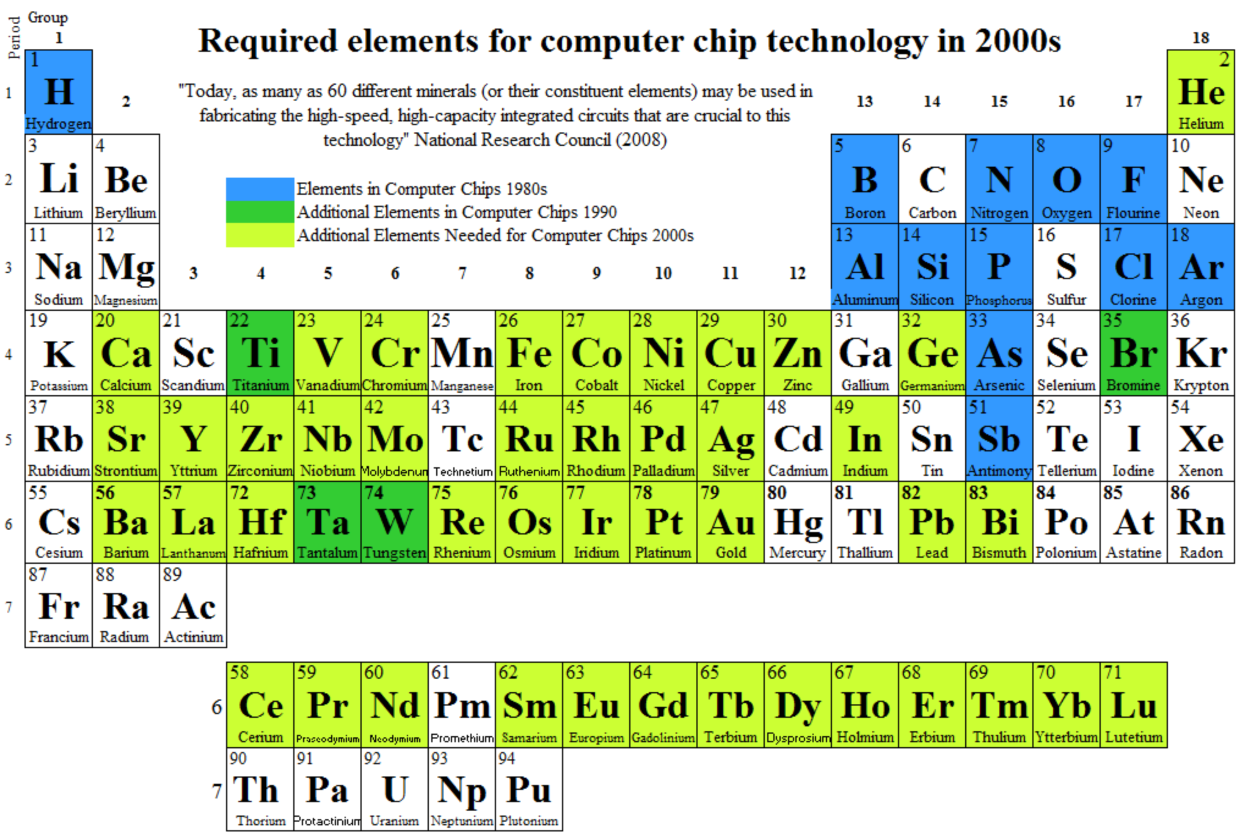
> "If I were to reconstruct the myriad social relations through which coffee becomes the drink I drink, I would uncover a historical geography of the world that would simultaneously provide powerful insights into the many mechanisms of economic exploitation, social domination, profit-making, uneven development, ecological transformation and the like" (45).

Through the commodity story, one can answer questions of geographic provenance, environmental and social impacts of production, as well as the power dynamics at play to replicate social conditions. In the digital age, our commodities are computers, televisions, cell phones, and smartphones.

Transcending geographic space and time, the computer and the cellular phone are influential products that have drastically reshaped social, cultural, and economic dimensions of human life in the past two decades. In 2009, 438 million new consumer electronics were sold in the United States (EPA website 2012). According to Reuters (2008), over one billion computers were in use worldwide, with the number projected to double by 2014. A CBS report in 2010 claimed 4.6 billion cell phone subscribers worldwide, and in October 2012, over one billion Smartphone users worldwide. According to the U.S. Census Bureau (2012), 78.9 percent of all households have a computer, and 67 percent of people age 25-44 have a Smartphone. Given that these commodities have infiltrated most aspects of human and social life in most parts of the world, it seems only fitting to inquire into the 'life' of these products.

In the words of the National Research Council (2008), "the advent of the Information Age has demanded an ever-wider range of metallic and nonmetallic minerals to perform essential functions in new products such as computers, cellular telephone and transportation equipment" (vii). As technology advances, so do the number of minerals necessary. The minerals within computer chip technology have dramatically increased in the past three decades from twelve elements in the 1980s to over sixty elements from the periodic table in the first decade of the twenty-first century as shown in Figure 1.1 (National Research Council 2008). While the retracing of the lives of popular consumer products has become an increasingly popular activity, how many people ask where their copper comes from? Or tantalum? Or indium? Or tin? Or rare earth elements (REE)? All serve an essential role in not only digital technology but also alternative and renewable energy technologies.

**Figure 1.1. Elements in Computer Chip Technology**




Source: National Research Council. 2008. *Minerals, Critical Minerals, and the U.S. Economy*. Washington DC: National Academies Press.

This advancing technology relies on approximately 60 kinds of metals and each comes from a diversity of geologic environments (National Research Council 2008). Like fuel minerals, nonfuel mineral ore deposits are situated in a limited spatial extent based on geomorphology and time. As Bridge (2004b) astutely points out, "geographies of mining are inescapably a function of the location of mineral reserves" (415). For example, volcanogenic massive sulfides host copper and lead/zinc deposits; layered mafic intrusions host a majority of the platinum group metals and chromium; porphyry deposits host much of the world's copper and molybdenum; carbonatite deposits host concentrations of rare earth elements; and pegmatite deposits contain niobium and tantalum (Craig, Vaughan, and Skinner 2000). Mining, like oil extraction, is spatially bound and politically constrained. Because the commodity embodies 60 minerals, the spatial extent of mining must be researched. Unlike manufacturing or assembly processes, raw material extraction sites cannot be easily changed, especially with the more geochemically scarce minerals. There can be no 'locally produced.'

In a review by Bridge (2004a), he classifies four distinct perspectives commonly found in research on mining within the discipline of geography, including: technological, public policy, structural political economy, and cultural. My thesis seeks to employ the third approach of structural political economy by "highlighting themes of external control, resource rights, and environmental justice" (Bridge 2004a, 205). This approach is essential to address why transparency in extractive industries is important, mainly because of the global pressure to extract resources under neoliberalism, the expansion of the free trade, and the liberalization of markets to encourage foreign direct investment. Spatially-bound and politically constrained, minerals have shaped the geopolitical landscape more than any other product, yet the global commodity chain of metals remains understudied and unlabeled.

### *Utility of Commodity Story*

The commodity story has become an effective tool at tying an exploitative production process to a product that can serve to help emancipate global populations by elucidating the conditions within the production process. From the commodity story, there has been an increase in the push for transparency in production processes that have led to certification measures to differentiate products based on social and environmental practices. Bridge and Smith (2003) note the utility of the commodity story:

> "One response among those seeking more ethical, egalitarian, or less socioeconomically harmful methods of production has been to make the geographical life of a commodity more transparent: increased interest in management devices such as traceability, certification, and 'chains of custody'" (259).

By tying a specific commodity to an exploitative production process, increased transparency and certification regarding the conditions of production have emerged.

Over the past half-century, tales of injustices surrounding the acquisition of certain commodities for First World consumption have sparked activism. Certification and labeling have emerged as instruments to differentiate in the production process of commodities. Labeling establishes a specific marking to distinguish products as meeting specific requirements while certification requires a third party auditor to ensure the requirements are met (Auld, Gulbrandsen, and McDermott 2008). Labeling mechanisms like fair trade date back more than 60 years (Moore 2004) with the first fair trade certified agricultural commodity being coffee in 1973 (Conroy 2007); it now extends to other products grown in the equatorial and tropical regions like bananas, tea, sugar, cocoa, honey, pineapples, mangoes, and orange juice (Jaffee, Kloppenburg, and Monroy 2004). Agricultural certifications now include: organic, non-GMO, locally grown, cage-free, free range, and sustainably harvested.

According to Conroy (2007), the 'certification revolution' is upon us. As Taylor (2005) explains:

> "Certification and labeling initiatives worldwide gain growing attention as promising market-based instruments which harness globalization's own mechanisms to address the very social injustice and environmental degradation globalization fosters" (129).

The aim of labeling is "to make consumers see the effects of the production system that the shiny new product (and its advertisement campaign) hides from us" (Eden 2011, 171). While labeling extends to a vast array of products, minerals and metals are not yet included in the movement. Initiatives like Alliance for Responsible Mining (ARM) and Fairmined Gold are underway for the certification of gold produced in a more ecologically and socially minded mode yet currently, there are no means to differentiate other metals or purchase according to certain practices. We have yet to see the labeling of metallic products. By first teasing out some of the minerals essential in modernity, the thesis turns to the African continent.

With vast amounts of mineral resources, the African continent as a whole has struggled to translate resource wealth into social development. This phenomenon is pervasive throughout the world in what has become known as the 'resource curse' where the most resource rich countries tend to be the poorest in standard of living and social development. In fact, resources that are easily lootable, (i.e. diamonds, gold, and coltan) have instigated bloody conflicts for control over natural resources that result in war economies. Such is the case of diamonds from Sierra Leone and Liberia in the 1990s. According to United Nations Economic Commission for Africa (2009), 88 percent of the global diamond reserves are on the African continent (see Table 2.5). Of those, many derived revenue for armed groups like the UNITA in Angola, and the Revolutionary United Front (RUF) in Sierra Leone. The RUF made "rape and dismemberment its signature…you couldn't dream up a crueler or more jarring context for a stone that is a symbol of love" (Grant and Taylor 2004, 391). According to Bain & Company (2013), annual trade in diamond jewelry exceeded U.S. $72.1 billion.

Non-governmental organizations (NGOs) and international lobbying efforts for human rights led successful campaigns tying the product, the exquisite diamond, to bloody conflicts in Africa. De Beers controls nearly 90 percent of the raw diamonds traded worldwide, allowing the company to artificially inflate the price by limiting the quantity on the market (Hart 2001). NGO campaigns targeted the company and brought the issue of blood diamonds into the consciousness of consumers through campaigns like Fatal Transactions with the message, "consuming is killing" (Le Billon 2006, 778). The idea behind the push is that, "concerned citizens will help keep the industry honest" (Grant and Taylor 2004, 390). Tying the product to the production process increased consumer awareness of the inadvertent consequences of diamond consumption and demand, which in turn pressured companies and international stakeholders to address the problem. The campaigns proved successful in pushing diamond certification onto the global agenda by raising awareness of the atrocities surrounding diamond mining in Sierra Leone, Liberia, Angola, and the Democratic Republic of Congo. The result was the formation of the Kimberley Process Certification Scheme (KP) in 2003, a voluntary alliance between diamond exporting countries, diamond importing countries, and the diamond industry (Grant and Taylor 2004; Wright 2004; Le Billon 2006; Bieri 2010).

Though implementation has not been without problems, the case of diamonds stands as a testament to the utility of the commodity story in unveiling inequalities in the globalized world-system and thus inspiring international civil society movements to address the problems through certification and labeling. A *Time* Magazine article in July 2009 titled, "First Blood Diamonds, Now Blood Computers?" calls attention to the conflicts in the Democratic Republic of Congo perpetuated by the trade of minerals necessary for computers, cell phones, iPods, gaming stations, and smartphones. The trade of minerals funds armed groups active in the area where over 5 million people have died and hundreds of thousands raped in the past two decades. The conflict is not because of the minerals, but the trade provides revenue for the various warring factions active in the area. As in the case of diamonds, by connecting a product, in this case the computer or cell phone, to bloodshed has resulted in an increased push for transparency and certification from international civil societies. *'Blood in the Mobile'* is a UK-based NGO focused on revealing the linkages between mobile technology and armed conflict in the eastern DRC; it is also a film released in 2011 by Danish filmmaker Frank Poulsen that traces the production of his Nokia phone into the mines of the eastern DRC. These are two examples explicitly tying digital technology to armed conflict in the DRC to raise awareness to then pressure companies and governments to tackle the problem.

In 2010 Congress passed and President Obama signed into law the Dodd-Frank Wall Street Reform and Consumer Protection Act. Among the sweeping financial reform measures were two sections impacting the extractives industries, metal processors, and end product manufacturers in a widespread call for corporate accountability and transparency. Section 1502, 'Conflict Minerals,' requires any publicly traded American company using:

tin, tantalum, tungsten, or gold, to submit annual reports demonstrating due diligence in the sourcing of materials to ensure warlords in the Democratic Republic of Congo and adjoining countries are not profiting from the trade of minerals. It does not prohibit the use conflict minerals but instead requires disclosure of that information. Section 1504 entitled, 'Disclosure of Payments by Resource Extraction Issuers,' requires extractive industry transparency in payments made to foreign governments by fuel and nonfuel mineral extraction companies operating in the territory for exploration, permitting, and mineral concessions rent (H.R. 4173). These laws have resounding impact on a global commodity chain that is understudied, the chain of metallic mineral supply and production.

The broad research question examined in my work is: What factors led to an emergence of conflict minerals and extractive industries transparency initiatives included in the Dodd-Frank Wall Street Reform? Or put another way by David Harvey (2005), what are the "origins, rise, and implications" (2) of the legislation? To better understand the context, I will answer the question, why is transparency in extractive industries important? To begin, I trace the origin to the structural inequalities under globalization as explained by Marxist geography and world-systems theory - particularly the juxtaposed positions of the resource consumers in the core, and the resource producers in the periphery. World-systems analysis stresses that an individual entity cannot be perceived without looking at the greater global context in which it is embedded. I present the mineral necessities for modern infrastructure followed by the environmental and social externalities associated with mining, paying particular attention to the marked distinction in social development between resource producer and resource consumer that is summarized by the 'resource curse.' I use theory from Marxist geography to highlight the production process and the social and economic conditions formed through historic processes of resource consumption and exploitation, particularly the uneven power relations. Using historic materialism and the political economy, I discursively evaluate the modern context of mineral extraction.

To address these questions, the first part of chapter 2 situates the research within the theoretical views of a globalized world in historic context. With particular attention paid to resources, in the second part of the chapter I present mineral necessity in society to illustrate the power dynamics embodied within minerals that has thus transformed physical space for the acquisition of raw materials, which inherently impacts society. By establishing the pivotal role of minerals and thus the power of the structural political economy, chapter 2 answers why transparency in extractive industries is important. By teasing out the inherent power structure surrounding minerals acquisition, the second half of the thesis then turns to a case study on the Democratic Republic of the Congo in chapter 3 and specifically, the conflict minerals law in chapter 4 to illustrate how NGOs and international governance are "tackling conflict minerals." The very process this U.S. law seeks to disentangle is the complex global commodity chain neoliberal capitalist expansion has created. Chapter 5 summarizes current events in the certification of minerals and concludes with paths forward. Through the lens of geography, particular attention is paid to the historic geopolitics of the African continent, the resource wealth, the underdevelopment, and the initiatives underway to bandage the resource curse.

I use the commodity story because it is an effective tool to tie a product to a process; also because its use has incited movements for transparency of consumer goods. The conflict minerals law calls into question the 'life' of the metallic commodities: tin, tantalum, tungsten, and gold. This law is requiring companies to uncover the 'biography' of their products.  The commodity story of digital technology encompasses not only the minerals under scrutiny (the three Ts), but also nearly 60 other elements essential to the functionality of the product.  Retracing metallic production lines is the most complicated undertaking yet seen in the world of certification.  It is transparency measures and certification schemes that counter the long held neoliberal capitalist ideology and perhaps the best chance at "harnessing consumer power to address dysfunctional elements of the economy" (Eden 2011, 169).  And it is through purchase power that consumers can exercise choice against the predatory practices of the capitalist world economy.

## Chapter 2
## Theories of Globalization and Minerals

*"To produce nature as resources is an exercise of power"* (Bridge 2007, 864).

In the past half-century, human rights and the environment have become important topics on the global political agenda. The devastation of World War II brought about changes in the international arena with the creation of international forums for the promotion of peace such as the United Nations (UN). In 1948, the UN adopted the Universal Declaration of Human Rights, thereby establishing the doctrine of human rights in, "recognition of inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world" (UN 1948). This marked the beginning of discourse regarding human equality on a global scale. In the decades that followed, human rights and the environment came to be a centerpiece of the global agenda and popular rhetoric. During this time arose a lens for looking at social and environmental inequalities across global space. This chapter looks first at Marxist geography, followed by a brief historical discussion of the making of modern world-system. The second part of the chapter then looks at mining and the asymmetrical relations of power within the landscapes of mineral extraction. This chapter answers why transparency is important in extractive industries by elucidating the externalities and the historic legacies of resources.

### *Marxist Geography*

Marxist geography arose from the 1960s. The 1950s and 1960s were the growth decades for the advanced capitalism countries. There was also a paradigm shift, ushering in an era of increased concern for the planet and the global inhabitants. Desegregation in the

1950s and the Civil Rights Movement of the 1960s gave rise to a push by many for equality and universal human rights. National liberation movements were also underway in much of the colonized world (Amin 1997; Swyngedouw 2000; Johnson 2003). The historic institutions were under attack in much of the world. At the same time, there was a battle being played out between the two most powerful ideologies, that of capitalism and communism. From this era was borne the Marxist lens for studying the geographic inequalities under the system of capitalism.

The foundation of capitalism is the need to derive profit at every tier in the trade hierarchy; it also requires continuous input of raw materials, and raw materials at cheaper prices to maximize profit (Wallerstein 1974; Peet 1975; Harvey 1984). As Peet (1975) argues, "inequality and poverty are vital to the normal operation of capitalist economies" (567). The capitalist system is based upon unequal exchange. As Wallerstein (1974) asserts, unequal exchange is:

> "Necessary for the expansion of a world market if the primary consideration is profit. Without unequal exchange, it would not be profitable to expand the size of the division of labour. And without such expansion, it would not be profitable to maintain a capitalist world economy, which would then either disintegrate or revert to the form of a redistributive world empire" (5).

This concept of the need for hierarchical relations is fundamental in understanding the making of the modern world.

The concept of the core and the periphery date back hundreds of years. Historic labor and resource acquisitions resulted in uneven patterns of development (Wallerstein 1974). Modern disparities in the wealth of nations follow similar geographic patterns of colonialism. Typified by polarizations in civil society, material wealth and social development, the core (the First World) is comprised of the industrialized, developed, wealthy consumer societies while the periphery (the Third World) is composed of the developing countries that provide labor and natural resources for the core (Wallerstein 1974). Core countries enrich themselves, while at the same time stifling the development of the periphery (Smith 2012). These distinctions are also referred to as the global South or the global North. We will return to this at the end of this chapter and in subsequent chapters.

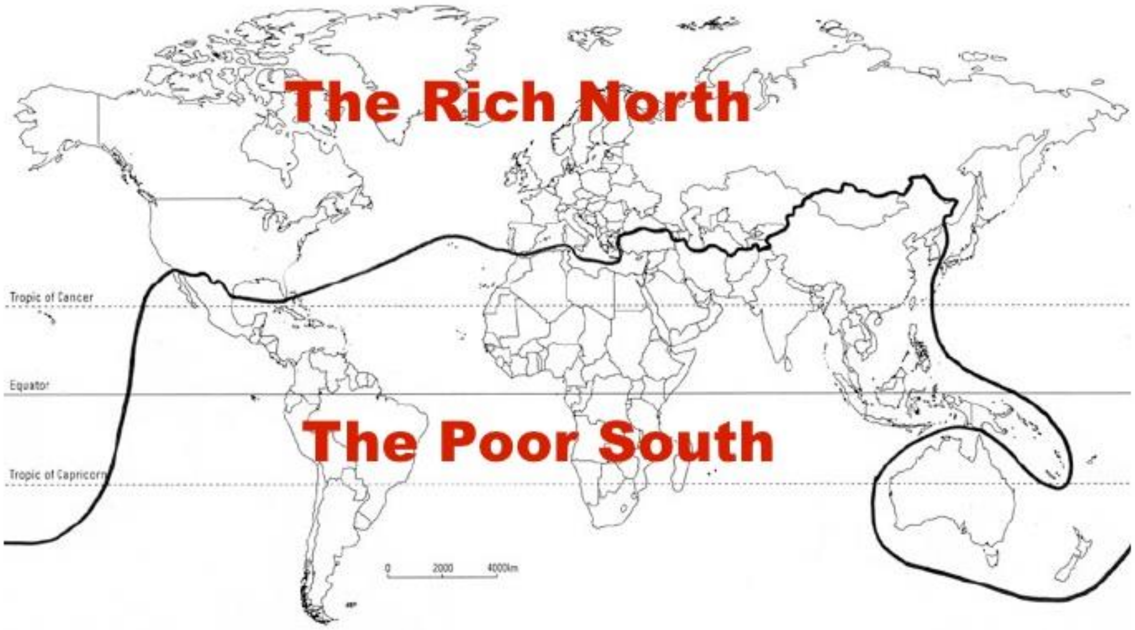
Marxist geography was, "the most exciting approach around in the 1970s and early 1980s…offer[ing] a comprehension of why, where, and how deep perverse injustices and inequalities persist" (Swyngedouw 2000, 41-43). Marxist geography deals with "themes of geographically uneven development, colonialism, and territorial struggle" (Cox 2005, 2). Scholars such as Harvey, Wallerstein, Amin, Frank, and Arrighi adopted a Marxist framework to address issues of inequality in labor, material conditions, and political and social development and how these conditions were manifest in, and shaped by, geographic space. Using Marxist geography, this thesis examines the inequalities born under European colonialism and capitalist expansion as told by world-systems analysis. As Swyngedouw (2000) argues, the contribution of Marxist geography is, "the production of a truly humanizing geography" (43).

***Historical Distinctions of Core and Periphery***

For millennia, resources have been an impetus for settlements, migrations and war. According to Walker (2001), "natural resource exploitation has been central to the story of capitalist development" (167). World-systems theorists claim the modern capitalist world-system dates back to the European mercantile system (1500-1800) that dominated the Atlantic trade with resources coming from the periphery in the Americas and returned to the European centers, or the core (Wallerstein 1974; Amin 1997). Colonies allowed for the establishment of trade networks and local populations were forced to labor and extract resources for the distant monarchs. Through the exploitation of people and places, resources were fed back to Europe and enhanced the power of the country, creating greater means and incentives for continued colonization.

The pervasive undertone of the time was that people and places were for the exploitation of the great world powers, what later became known as the core. Brutality again indigenous populations typically accompanied the establishment of colonies. Through superior armament and infectious germs, European explorers were able to suppress native populations all over the world to obtain resources including human labor resources, rubber, timber, spices, and precious metals (Rodney 1972; Diamond 1997). Despite critique in the field of geography as an environmental determinist or social Darwinist (Ould-Mey 2003), Jared Diamond's book *Guns, Germs, and Steel*, elicits critical thinking about the history of humankind in relation to available resources; particularly highlighted is the notion that metals and guns used by historic civilizations were a determinant in the trajectory of social and economic development (Diamond 1997). As Bakker and Bridge (2006) note, "it is through the socioeconomic production of nature that the geographically uneven character of capitalist development takes shape" (9). These historical processes of resource reallocation created a bifurcation in development that persists into modern times, that of resource consumer and resource producer, the core and the periphery (Wallerstein 1974).

**Figure 2.1. Map of the Brandt Line**




**Source:** http://www.geographyalltheway.com/ib/geography/ib_development/patterns_in_development.htm

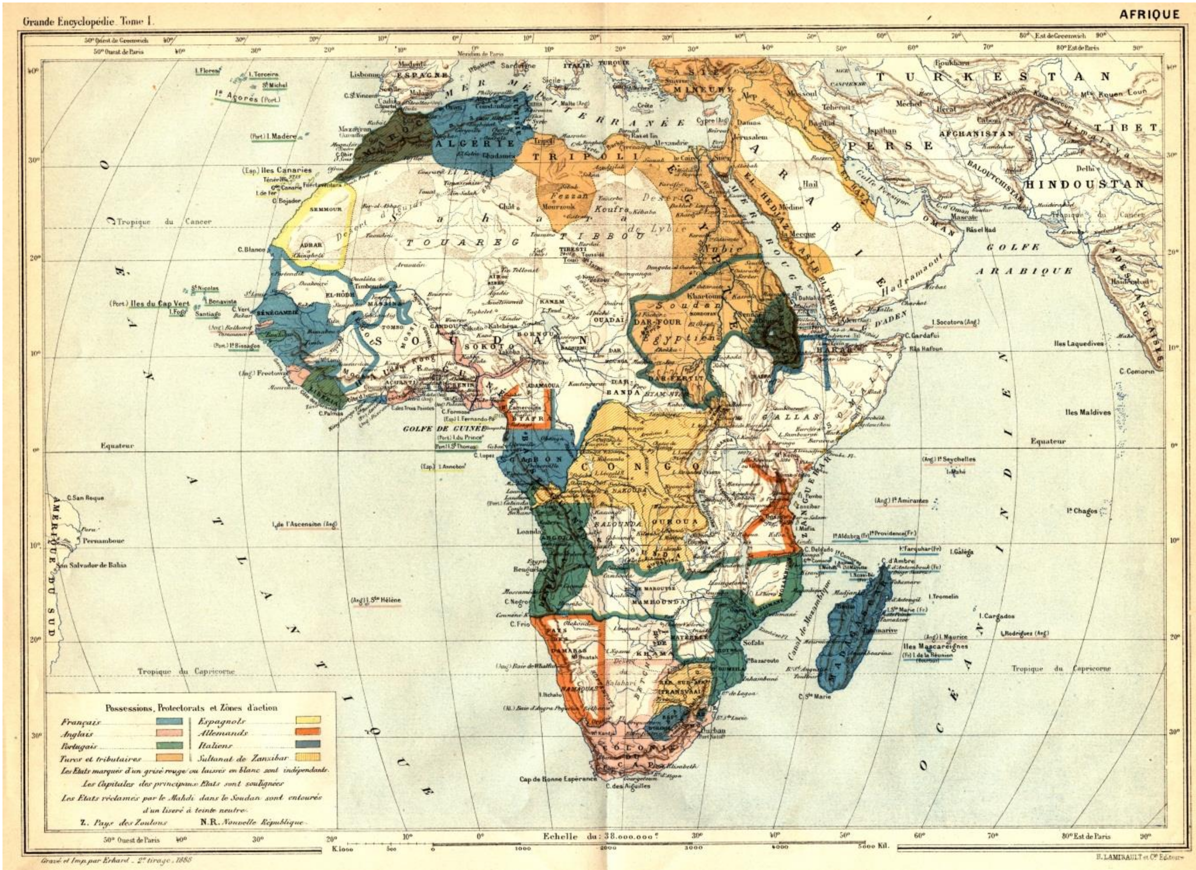
Another historical phase of capitalism was the 'classical model' (1800-1945) (Amin 1997). In this era the lines of development and the distinction of the core-periphery or the global North and global South became deeply entrenched. The consumer societies built during the industrial revolution required vast amounts of resources from the colonized peripheries (Rodney 1972). As Smith (2012) notes,

> "Through colonization, core states enriched themselves and simultaneously retarded the growth of peripheral states by forcing them onto political and social paths that made technological advancement and competition with the core difficult, if not impossible" (243).

The peripheral locations were the agriculture and mineral resource producers and did not experience industrialization (Amin 1997). With the industrial revolution underway in the core, the resource needs of the United States and Europe were met from the periphery (Rodney 1972). In regards to the end of the nineteenth century Harvey (1984) argues, "the struggle for control over access to raw materials, labor supplies, and markets was struggle for command over territory" (3). This era was a time of intense European colonization, particularly in the late-nineteenth century Scramble for Africa.

The African continent is plagued by the legacies of conquest and colonialism that are not too far back in the history books. The resource wealth of Africa was long recognized by invaders. Labor resources were needed for agricultural production and infrastructure development these needs were met on the African continent with the Arabian slave traders in East Africa and in the transatlantic slave trade. Africa was a continent with hundreds of diverse language and cultural groups and the vast land was divvied up among a handful of European powers in the late nineteenth century in what has become known as the Scramble for Africa when Europeans powers sat down at the Berlin Conference of 1884 (Hochschild 1999). Lines were drawn across the enormous African continent designating which of a handful of monarchs would possess the territory to exploit the resource wealth and cheap labor. Colonizers forced labor for the extraction of abundant resources like rubber, timber, gold, diamonds, and copper (Rodney 1972). Particularly brutal and deadly was the iniquitous rule of the Belgian King Leopold II in what is now called the Democratic Republic of Congo discussed at length in chapters 3 and 4. The map below shows the division of the continent.

**Figure 2.2. Map of Colonial Africa**




Source: http://img.lib.msu.edu/branches/map/AfJPEGs/728a-b_ae25g7v1_l.jpg

This was the era of the Industrial Revolution, when the ability to mass-produce metals was discovered, and also important was the increased comprehension of the elements, their properties, and the creation of Mendeleev's periodic table in 1869 (Kean 2010). Advancements in metallurgy and beneficiation allowed an increasing number of metallic elements to be isolated and studied. Mastery of the periodic table, scientific innovations and technological advancements correspond to change in resource demand. Discovery of the unique geology throughout the African continent lured prospectors. With wars afoot in Europe, resources were needed and Africa was where they were found. According to Lynch

(2002), between the late 1880s and the later 1920s, “the era of mass consumption was born” (180). During this period of time, the global consumption of copper grew by a factor of eight (Lynch 2002). In this era, the valuable copper deposits of the Democratic Republic of Congo were realized, in addition to the numerous other mineral deposits on the African continent (American Geological Institute 1910).

Also during this time, the predominant ideology was encapsulated in what became known as eugenics, a study of genetic superiority where Homo sapiens were measured and categorized. Through systematic study of the distinctions among the races of Homo sapiens, the study of eugenics became a sort of ‘scientific racism,’ and a self-fulfilling prophecy of European colonialists that validated there continued exploitative practices throughout the world. It is during this colonial era when the distinctions of the core-periphery, resource consumer-resource producer, became deeply entrenched.

***World War II and the Cold War***

World War II transitioned the power structures of international affairs. Nazi Germany demonstrated the catastrophic consequences of practicing scientific racism and racial hygiene (Stearns 2011). Post-World War II era (1945-1990) represents the third stage of capitalism when geographic spaces were divided along ideological lines. Strategic mineral stockpiling began during this era. The United States emerged as a major global power representing the ‘free’ capitalist world. Countries of the West (the Allies) formed charters to create intergovernmental organizations for the promotion of peace such as the UN and financial institutions such as the World Bank and the International Monetary Fund (IMF) to stabilize global currency (Ould-Mey 2003). Colonialism had paved the way for universal capitalism. In 1950, most of the African continent was still under European colonial rule, however as nationalist movements gained momentum, the West was extremely fearful that the USSR's stronghold of power would spread communism.

In the 1950s and 1960s, revolutions against colonialism were underway throughout the world and especially on the African continent. Nationalist movements compounded the fear that communism would spread to the newly liberalized territories. The premise of theoretical Marxism is human equality. Many nationalism movements found that appealing and adopted a socialist ideology. In the United States, equality was also on the agenda as the Civil Rights Movement gained prominence. In general, the 1960s were characterized by an elevated consciousness regarding environmental degradation, social and civil injustices, and human rights. Environmental and social injustices occurring in peripheral locations sparked activism for equality and gave rise to demand for transparency in the production process of commodities (Moore 2004).

However there was also the backlash by the establishment to preserve social structures and institutions that were under attack in most of the world. Fearing that nationalism and civil rights movements would spread Soviet ideology, in the United States even accusation of being a communist could land you in prison. Many conflicts, military intervention and involvement during this time period were to prevent the spread of communism, as is the case with Vietnam, Afghanistan, and Korea.

The Cold War became a competition between East-West sponsorship of the newly liberalized territories. The West feared the nationalism movements would deny access to valuable resources to which the western core had become accustomed. The term 'resource wars' itself is derived from this era to describe the contest between the Communist East and the Capitalist West over access to Middle Eastern oil and African minerals (Le Billon 2004).

And it is from this context that the Marxist lens for geographic research emerged, stressing the role of the structural political economy in shaping the human experience throughout the world.

***Neoliberal Globalization***

In the 1970s, the theoretical doctrine of neoliberalism, "characterized by strong private property rights, free-markets, and free trade" (Harvey 2005, 2), emerged from the Chicago School of Economics. Despite the inclusion of the term liberal, neoliberalism more closely aligns with the conservative viewpoint that government should have limited involvement in matters of the economy. Harvey (2005) traces the roots of neoliberalism to Milton Friedman and the Chicago School of Economics in the 1970s. The first grand neoliberal experiment was in Chile when Pinochet assumed power in 1975. The Chicago Boys and Chilean economists worked with the IMF on restructuring the economy according to the principles like free trade and free market (Harvey 2005; Klein 2007). An essential component of neoliberal reform is the privatization of fuel and nonfuel mineral concessions to encourage foreign direct investment. The experiment showed potential in the first couple years, and attracted the attention of U.S. President Ronald Reagan and Great Britain's Margaret Thatcher, who later adopted the principles (Harvey 2005).

In the midst of neoliberal reform, the alternative economic system, Communism, collapsed with the fall of the Berlin Wall in 1989 and the dissolution of the USSR in 1991. Capitalism was the victor, resulting in the worldwide espousal of, "deregulation, privatization, and withdrawal of state from many areas of social provision" (Harvey 2005, 3). The post-Cold War era from 1990 onward is characterized by intensified globalization (Amin 1997). Harvey (2003) suggests the power of the United States in this era contributed to the rapid dissemination of neoliberal principles to the rest of the world through a form of 'New Imperialism,' explained as one motivated by the maintenance of power on the global scale involving the universalization of consumerism and the dispersal of political doctrines motivated by economic interests (Harvey 2003; Harvey 2005).

As economists Krugman and Venables (1995) note, "global economic integration leads to uneven development" (859). Neoliberalism restructured global commodity chains due to the increased profitability through the reorganization and extension of production lines into peripheral locations. Cheap fuel costs segregated manufacturing lines to capitalize on discrepancies in labor costs and little to no costly environmental regulations abroad. Global commodity chains are comprised of linkages, each a step in the production process to transform a raw material into a consumer good or a finished commodity (Wallerstein 1974; Hopkins and Wallerstein 1986; Gereffi 1999). From raw material producer to trader, transporter, manufacturer, distributer, to consumer, each make a link in the chain and each are subject to potential exploitative practices due to the need for profit at every level in the production hierarchy. Through neoliberal capitalism, the commodity chain became excessively global in scale. These "distanciated resource geographies" (Bridge 2007), span oceans, continents, and can perhaps travel up to tens of thousands of miles around the globe prior to consumption.

In neoliberal reform, the role of the private company changed to become powerful transnational actors. Corporations now transcend political boundaries and often supersede the power of governments, forcing a surrender of sovereignty to the global market economy (Nef 2002). Neoliberal reform led to the creation of an international ruling elite, wherein the governments of countries in the periphery or semi-periphery are closely aligned with international business interests. This form of rule is referred to as crony capitalism (Krugman 2002). Because of this, it is important to know what companies are involved in what ways. The Iraq War cast speculation on what corporations were profiting from war. From defense weapons contractors like Halliburton to contract militaries, to contract defense logistics coordinators, to infrastructure development contracts to oil companies standing to gain significantly, speculations flew regarding the tie between corporate interests and political action.

***Monopolies of the Core***

Amin (1997) presents the five monopolies of the center (core) in the age of globalization:

> "a) Technological monopoly;
> b) Financial control of worldwide financial markets;
> c) Monopolistic access to the planet's natural resources;
> d) Media and communication monopolies; and
> e) Monopolies over weapons of mass destruction" (4-5).

These monopolies allow for the maintenance of power by the core. Particularly relevant are, "financial control of worldwide financial markets" to gain access to these resources by encouragement of foreign direct investment, to maintain, "monopolistic access to the planet's resources." It can be argued that the logic of the system was devised to maintain monetary prowess of the core, by designing a system to self-perpetuate wealth. The core possessed the technological knowledge to transform nature into resources. Through expansion of extraction processes on a global scale, the core maintained economic control often supported by military action. These monopolies of the center (core) will be referred to in the second section of this chapter on mining and the need for transparency in extractive industries.

**Part II – Mining**

To begin this section on mining, I must start with a brief discussion on mining and capitalism. Mining has played a pivotal role in transforming nature into material wealth and social development. In the perspective of Marx, "human history has been made possible only by the metabolization of the environment through human action" (Heynen and Robbins 2005, 5). This 'metabolism of nature' is what constructs and constitutes everything in the material world (Bridge and Smith 2003; Heynen and Robbins 2005; Bridge 2009). Nature must be manipulated and transformed by humans to obtain a resource, as the frequently referenced quote of Zimmerman (1951) succinctly states, *"resources are not, they become"* (Hanink 2000; Bridge 2004b; Le Billon 2007). Value originates in the utilitarian purposes or cultural symbolism of the commodity. Recognition of the value of natural resources is socially embedded and conditional based on culture, society, history, technology, and geography (Hanink 2000). Technology to transform nature into resources is perhaps one of the biggest hurdles for many countries suffering from what is known as the resource curse. We will return to at the end of this chapter.

As Walker (2001) asserts, "the natural basis of economic activity [is] the ability of economies to convert nature into things of human value" (168). The global political economy is inextricably tied to the mining industry and vice versa. Raw material extraction is the foundation of profit. Mining companies transform nature (i.e. a rock) into a useful metallic product (i.e. steel) then derive revenue for conducting that transformation. The global markets for supply and demand dictate the price of metals. The price of metals dictates the economic feasibility of mining a deposit, distinguishing reserves from resources (though I will not deal with this but merely point out the distinction). When the price of a metal hits a critical threshold, suddenly deposits once thought uneconomically feasible can be mined at a profit. When the price of gold went from under U.S. $600 per ounce in 2006 to U.S. $1,900 per ounce in 2011, the profitability and incentives to mine drastically shifted. The same is true with tantalum when in 2000 the price jumped from U.S. $30 per pound to U.S. $300 per pound almost overnight, which will be discussed in subsequent chapters. Thus the exploitation of nature and the landscapes of mining are inextricably tied to metal markets and the global political economy.

***Neoliberalism in Mining***

Globally, the mining industry is expanding exponentially, 'dwarfing' the mines of yesteryear. Emerging markets began exploding in the twenty-first century, causing a boom in demand for metals and minerals (Bridge 2004b; Mudd and Ward 2008; Crowson 2011; Mudd 2012). High grade, untapped mineral reserves tend to be in undeveloped equatorial areas such as the islands of the South Pacific, sub-Saharan Africa, and South America, and the northern latitude regions of Russia, Canada, and Alaska, and the island continent of Australia. Capitalizing on the reduced cost of labor and less stringent environmental and labor regulations outside the U.S. and other Western powers, mining investment in neoliberal globalization is infiltrating remote corners of the world. These new 'bonanza geographies' in extractive industry investment are a product of the transition to economic liberalization in most of the world (Bridge 2004b).

Neoliberalism ushered in a reordering of investment capital and distant natural resource extraction locations. Due to the "hegemonic role of the global financial institutions," countries opened their border to foreign direct investment in the mining sector (Nef 2002, 59). Since 1985, more than 90 countries have revised mining policies or adopted new mining codes that encourage foreign direct investment (Bridge 2004b). Adopting neoliberal principles, many countries began privatizing formerly public sectors and opened mineral concessions for international investment. The appendix features a series of tables and charts on the use of minerals and the geographic distribution of mine production to contextualize the importance of mining. Table 2.1 below shows the distribution of mining investment capital based on *Engineering & Mining Journal's* "Annual Survey of Mining Investment." The statistics provided are for iron ore, copper, gold, nickel, uranium, lead/zinc, platinum group metals (PGMs), diamonds, and a miscellaneous category with a total investment value of U.S. $791 billion in 2013. The average cost of projects under construction is U.S. $930 million (Ericsson and Larsson 2013).

**Table 2.1. Mining Investment by Region**

| | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Region | Investment (US$ billion) | Share (percent) | Investment (US$ billion) | Share (percent) | Investment (US$ billion) | Share (percent) | Investment (US$ billion) | Share (percent) | Investment (US$ billion) | Share (percent) |
| Africa | 68 | 15 | 80 | 14 | 99 | 15 | 106 | 14 | 110 | 14 |
| Asia | 65 | 14 | 73 | 13 | 73 | 11 | 75 | 10 | 72 | 9 |
| Europe | 50 | 11 | 62 | 11 | 75 | 11 | 77 | 10 | 103 | 13 |
| Latin America | 134 | 29 | 180 | 32 | 192 | 28 | 210 | 29 | 229 | 29 |
| North America | 77 | 16 | 86 | 15 | 124 | 18 | 146 | 18 | 161 | 20 |
| Oceania | 71 | 15 | 81 | 15 | 113 | 17 | 121 | 17 | 116 | 15 |
| **Total** | **465** | | **562** | | **676** | | **735** | | **791** | |

Source: Ericsson, M. and Larsson, V. (2010-2014). E&MJ's Annual Survey of Global Mining Investment. *Engineering and Mining Journal*. Available at: http://emj.epubxp.com/i/239773/27

Table 2.1 shows that the highest percentage of mining investment is in Latin America especially due to the porphyry copper deposits of the Andes, where 28.8 percent of the world's copper is concentrated (National Research Council 1975). African mining investment was 14 percent of the total mining investment based on share in billions of dollars. These figures are based on information that is disclosed, leaving large gaps in data because much information is not disclosed. From initial mineral discovery to actual production can take decades and hundreds of thousands of dollars, even as high as U.S. $4.1 billion (Ericsson and Larsson 2008). Despite influx of investment through the leasing of mineral concessions, for many countries, the wealth is not translating into social prosperity and development. Instead of bolstering the wealth and prosperity of the community in which the mine operates, more often the local population is excluded from rights to the territory and left to deal with the environmental pollutants when the mine closes. The acronym NIMBY stands for 'not in my backyard,' sums up the general sentiment regarding mining and mineral production. In the words of Kesler (2010),

> "Mineral exploration and production of all types is opposed by the general public in most parts of the world. This trend is especially strong in the US, which consumes the largest share of the Earth's resources but refuses to take on its share of the environmental burden of producing them" (128).

Minerals are essential to modern civilization yet face great scrutiny due to environmental and health risks associated with the extraction of minerals (Rankin 2011). Marxist geography highlights the role of the structural political economy in shaping the environmental and social inequalities of both local and global landscapes. Bridge (2002) and Bridge (2004b) study the transformative impacts on the environment due to foreign direct investment in the mining sector and, "how processes of economic globalization drive environmental outcomes" (Bridge 2002, 361). As Bunker and Ciccantell (2005) write:

> "Thus globalization emerges as the intensification and expansion of material processes of production and exchange requiring greater volumes of a greater variety of materials, which may be available only by extending extraction and transport across ever-broader portions of global space…The extraction of natural resources for globalized raw material markets imposes significant disruptions and inequalities on local ecological and social systems. Large-scale extraction tends to increase the damage to local systems. Understanding these dynamics requires close attention to

> the complex inter-weavings of matter and space with economy and society" (Bunker and Ciccantell 2005, 6-7).

Mining is perhaps the most prominent visual manifestation of the infiltration of global capitalism. Political ecology stresses that environmental degradation is the result of political actions. Peet, Robbins, and Watts (2011) claim the adverse environmental outcomes are part of the 'logic' of capitalism, not "an unfortunate accident" (26).

***Impacts of Mining***

The chemical weathering of rocks associated with mining was not fully understood until the 1980s (Bridge 2004a); however it was recognized early in human history that mining activity stifled aquatic life. Published posthumously in 1556, Georgius Agricola, the 'Founder of Mineralogy' wrote:

> "The strongest argument of the detractors is that the fields are devastated by mining operations, for which reason formerly Italians were warned by law that no one should dig the earth for metals and so injure their very fertile fields, their vineyards, and their olive groves. Also they argue the woods and groves are cut down, for there is need an endless amount of wood for timbers, machines, and the smelting of metals. And when the woods and groves are felled, then are exterminated the beasts and birds, many of which furnish a pleasant and agreeable food for man. Further, when the ores are washed, the water which has been used poisons the brooks and streams, and either destroys the fish or drives them away. Therefore the inhabitants of these regions, on account of the devastation of their fields, woods, groves, brooks and rivers, find great difficulty in procuring the necessaries of life, and by reason of the destruction of the timber they are forced to greater expense in erecting buildings. Thus it is said, it is clear to all that there is greater detriment from mining than the value of metals which the mining produces" (Agricola 1556, 8).

Landscape change and loss of biodiversity are visual manifestations of the impacts of mining however less apparent are the environmental toxins resulting from chemical weathering of natural minerals. Sulfide minerals host a majority of metal ores including copper, nickel, and lead and upon exposure to air oxidation of minerals produces sulfuric acid. Also toxic are the reagents used, like cyanide, mercury, and arsenic used in gold extraction and sulfuric acid used in copper extraction. Suspended heavy metals are released into alluvial settings (Deju 1974; National Research Council 1975; Ripley, Redman, and Crowder 1996; Bridge 2004a). Mining also produces large amounts of waste rock called tailings. To prevent the toxic reaction of sulfide oxidation, tailings containment ponds are built to keep the reactive rock saturated in perpetuity. However, despite the best efforts to remediate the natural reaction, tailings dams do fail, sending a toxic slough of materials into the surrounding watersheds (Rico, Benito, Salgueiro, Diez-Herrero, and Pereira 2008). In extreme cases, entire fluvial environments have been contaminated and result in sterilization of the watershed.

Polluted water kills aquatic life and thus stifles the ability of indigenous communities to provide the basic needs of the people. Lacking political clout, many indigenous communities are subjugated to the power of the market. Despite local opposition to mining, contracts often supersede the local and the industrial scale projects are permitted to operate. Other land uses are non-permissible if a mine operation is present. Without political voice or representation, indigenous people in peripheral locations are often relocated. For example, in the legitimate mining sector of the Democratic Republic of Congo, the Tenke Fungurume Mine began a large-scale copper and cobalt mining operation in 2009. There are also sixty rural communities within the concession. Relocation of nearly 100,000 people will happen in phased approaches as the mine metabolizes the ore and expands (Tenke Fungurume Mining 2012). The mine is expected to produce for 40 years. In the words of Peet, Robbins, and Watts (2011),

> "Consider, for example, the monopoly of force required to take control of large areas of land for surface mining, to exclude traditional or nearby inhabitants, and to enforce exclusive rights to exploit the land through large-

> scale construction of open pits, the removal of mountain tops, or the saturation of the land with acids for in-situ leaching of minerals. Such power is further extended by stifling or controlling resistance to the health and ecosystem costs such development entails, either through the legal protection of the rights to exploit the land, or more dramatically through the collaboration of state force to put down or silence opposition" (2).

The asymmetrical relations of power are especially prominent in issues on mining and the environment (Bridge and McManus 2000).

To address the inherent exploitative processes and acknowledging the externalities and uneven power dynamics, nine large mining companies and the World Business Council on Sustainable Development (WBCSD) launched the global mining initiative (GMI) in 1998 that commenced the Mining, Minerals, and Sustainable Development project, often called MMSD (Rankin 2011). Companies must evaluate the local context of the extraction site, ensure environmental mitigation measures, and incur cleanup costs by reserving money from the initial investment; it also attempts to ensure resource extraction benefits the local community where the company operates (MMSD 2003; Rankin 2011). This is a key point in addressing the uneven landscape of mineral production. In order to better understand the scope and scale of mineral extraction, attention now turns to use of minerals and metals.

***Mineral Use***

The National Research Council (2008) reports that annually over 25,000 pounds of nonfuel minerals are required per person in the United States. The estimate for nonfuel minerals includes: construction materials like stone, gravel, and sand, nonmetals like salts and fertilizers, and metals (Bridge 2004; Minerals Information Institute 2012). Table 2.2 shows the U.S. per capita mineral needs for a lifetime according to Minerals Information

Institute (2012) and table 2.3 gives the U.S. annual per capita consumption of metals. These figures are based on infrastructure, transportation, electricity, and commercial enterprise.

**Table 2.2. US Per Capita Mineral Needs**

| Mineral | Lbs in Lifetime |
|---|---|
| Salt | 31,577 |
| Clay | 12,132 |
| Zinc | 512 |
| Stone, Sand, Gravel | 1,090,000 |
| Lead | 831 |
| Cement | 40,053 |
| Iron Ore | 26,591 |
| Bauxite (Aluminum) | 6,063 |
| Coal | 504,192 |
| Phosphate Rock | 17,617 |
| Gold | 0.09563 |
| Copper | 969 |
| **Total** | **1,730,537** |

**Table 2.3. US Annual Per Capita Consumption of Metals**

| Metal | Lbs |
|---|---|
| Iron Ore | 340 |
| Aluminum | 77 |
| Copper | 12 |
| Lead | 11 |
| Zinc | 7 |
| Manganese | 6 |
| Other Metals | 25 |
| **Total** | **478** |

Source: Mineral Information Institute. 2012. Minerals Education Coalition. The Society for Mining, Metallurgy and Exploration Foundation available at: www.mii.org/pdfs/baby.pdf

As Agricola wrote in 1556, "without metals, 'Men would pass a horrible and wretched existence in the midst of wild beasts'" (Agricola 1556; Bridge and McManus 2000). The use of metals is a prerequisite for infrastructure and social development however mineral deposits are finite. Population projections coupled with expanding consumer economies mandate increased mineral production particularly for metals. Backman (2008) contends a two to three fold increase in metal consumption by 2050. Based on current infrastructure, mass transit, electricity transmission, and other consumer goods, Gordon, Bertram, and Graedel (2006) find "~200-kgs of copper per capita are needed to supply the services employed by the residents of wealthy nations" and if nations such as South Africa and China are to reach this same standard, seven times as much copper will be needed

(1214). Gerst and Graedel (2008) find that if the global population is to achieve the same standard of living as the developed world, 3-9 times as many metal stocks will be needed (7038). Gordon, Bertram, and Graedel (2006) also claim the copper content of the lithosphere is equivalent to that already extracted. Estimates for remaining metal stocks range from about 20 years for strontium, 30 years for silver, arsenic, antimony, indium, gold and tin, to over 1,000 years for iodine (Kesler 2010).

The United Nations Environment Program (UNEP) International Panel for Sustainable Resource Management identifies metals as a major sustainability challenge in the 21st century (UNEP 2012). Metals are the foundation of advanced civilizations; metal consumption is directly correlated to development. According to the UN group, "economic development is deeply coupled with the use of metals...metals are a core, centre-piece of the global economy…but metals are also part of the challenge society is facing in its transition to a low carbon, resource efficient 21st Green Economy" (UNEP 2012). Metals require more energy in production than either ceramics or plastics (Norgate 2010). The production of metals is inherently polluting, however they are necessary. The World Bank Group (2004) explains the contradiction: "consumption of finite resources could be considered sustainable if it improves the welfare of future generations…the objective is sustainable development of human societies, communities, and environments" (7). Therefore resource consumption in the short term for infrastructure development will lead to more sustainable societies in the long run.

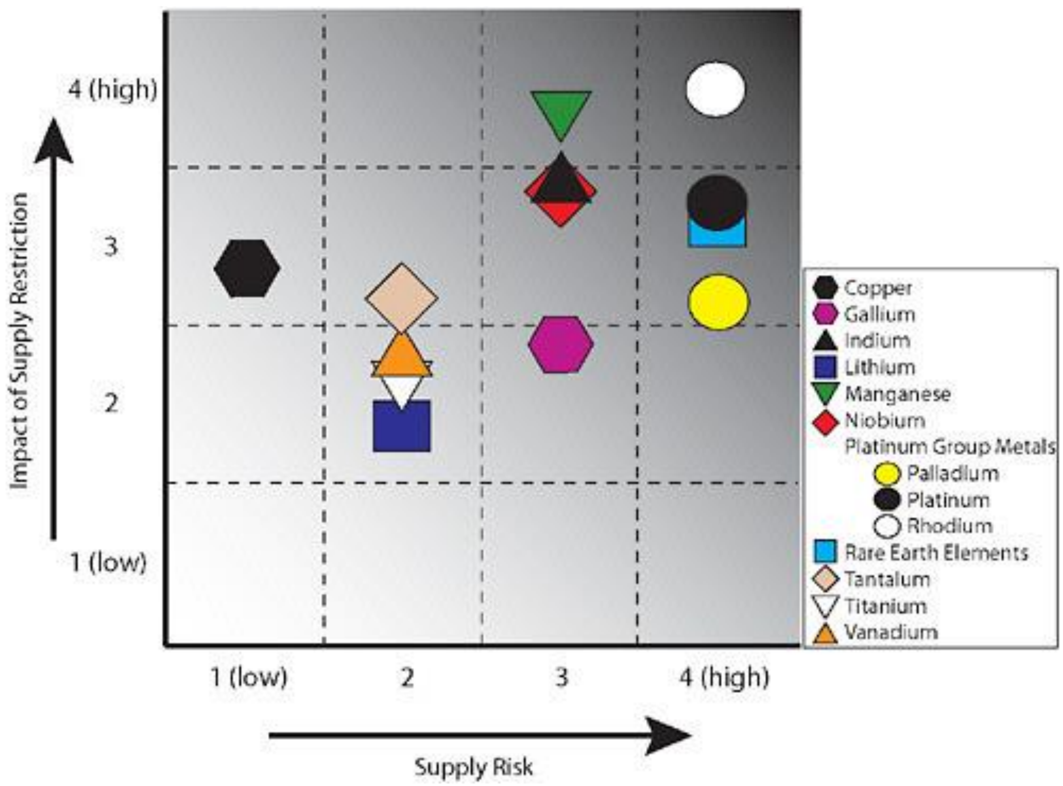
In regards to sustainability, a large challenge facing the future is our dependence on fossil fuels. Scholars from a diversity of fields including geology, economics, political science, sociology, and geography study oil, natural gas, and other fuel sources in attempts to tackle the imminent reality of finite fuel resources. Alternative energy sources like wind, solar, geothermal, and hydroelectric and electric cars lower dependence on fossil fuels, however, nonfuel minerals such as cobalt, copper, nickel, tin, zinc, indium, lithium, platinum group metals (PGM), niobium, tantalum, and rare earth elements (REE) are all essential for renewable energy and pollution control technology as well as digital technology (USGS 2010; USGS 2011). These 'tech' metals (Lifton 2008) are crucial in the transitioning towards a 'green' economy as deemed necessary by the UN Rio + 20 (2012); they are also essential to digital technology (Hagelüken and Meskers 2010).

***Strategic and Critical Minerals***

As noted by the National Research Council (1975), "minerals are the staff of civilized living" (1). In fact, the acquisition of minerals is a matter of national security, particularly minerals that have an integral function in society (i.e. inability to substitute in specific application) and those with limited occurrence in concentrated ore deposits for exploitation. The rarity of some minerals, domestic production shortfalls, and application for advanced weaponry, nuclear and aerospace technologies denote a mineral as 'strategic'. Critical minerals are vital in application with limited or no substitutability, and those with supply vulnerability and the potential for supply restriction (Anderson 1993; National Research Council 2008). New innovations in both digital and 'green' technologies are reliant upon minerals with particular properties, some which have no substitute. Increased knowledge of chemical and physical properties of specific metals created integral roles in certain applications, such as indium in liquid crystal displays (LCDs), platinum group metals in catalytic converters, and tantalum in capacitors used in electronics (National Research Council 2008).

The National Research Council (2008) assesses eleven minerals using various metrics including necessity in application, access and acquisition, and substitution. The criticality of these minerals is analyzed using a framework of five dimensions of primary availability including: geologic, technical, environmental and social, political, and economic availability. Based on how essential the minerals are in specific applications and the vulnerability to supply restriction, the research findings are presented in the criticality matrix in Figure 2.3 which was derived from metrics presented in Table 2.4.

**Figure 2.3: Criticality Matrix**




Source: National Research Council. 2008. *Minerals, Critical Minerals and the US Economy.* Washington DC: National Academies Press. pg. 165.

**Table 2.4 Criticality Indicators for Selected Minerals and Metals**

| | Copper | PGMs | REEs | Niobium | Gallium | Indium | Lithium | Manganese | Tantalum | Titanium Mineral Concentrates | Titanium Metal | Vanadium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Relevant for Vertical Axis** | | | | | | | | | | | | |
| US consumption (million $, 2006) | 16,625 | 1832 | >1000 | 173 | 10 | 107 | Not estimated | 314 | 164 | Not estimated | 3255 | 68 |
| Percent US consumption in which existing uses for which substitution is difficult or impossible (4 in matrix) | 15 | 55-99 depending on PGM | 44 | 32 | ~40 (indium-dependent) | ~10 | 0 | 90 | 90 | 10 (for pigments) | 90 | 11 |
| Importance of growth in emerging uses that could overwhelm existing global production capacity (1=low; 4=high) | 1 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 2 | 2 |
| **Relevant for Horizontal Axis** | | | | | | | | | | | | |
| Percent U.S. import dependence (2006) | 40 | 95 (Pt) 82 (Pd) | 100 | 100 | 99 | 100 | >50 | 100 | 87 | 71 | Net exporter | 100 |
| Ratio of world reserves-to-production | 31 | 139 | 715 | 73 | NA | 6 | 194 | 40 | 33 | 122 | NA | 208 |
| Ratio of world reserves base-to-production | 61 | 156 | 1220 | 87 | NA | 13 | 521 | 473 | 116 | 241 | NA | 609 |
| World byproduct production as percent of world primary production | Small | Primary co-products | Primary co-products | NA | ~100 | Most | Nil | Nil | Nil | Small | NA | Most |
| U.S. secondary production from old scrap, as percent of U.S. apparent consumption | 7 | Significant | Small | ~20 | 0 | small | Insignificant | Negligible | 13 | NA | <1 percent | Small |

Source: National Research Council. (2008). *Minerals, Critical Minerals, and the U.S. Economy*. Washington DC: National Academies Press. 114-117.

Particularly noteworthy in this study is tantalum, a critical mineral for the U.S. economy, and a 'conflict mineral' from the Democratic Republic of Congo. We will return to this in chapter 3 and 4. The limited geospatial locations and necessity for the functioning of modern society deem them critical. Supply shortages can have drastic consequences on the global market depending on alternative sources of the mineral. The greater the criticality of the mineral and the more limited in geographic occurrence, the more the global political economy is interested in the acquisition and future supply of the minerals. Foreign policy reflects availability of resource access, particularly where substitutions are difficult or impossible.

To contextualize the power dynamic behind the acquisition of minerals, the United States relies on foreign imports for over 80 percent of strategic minerals which include: cobalt, manganese, platinum group metals, rare earths, tantalum, and yttrium. Also, China supplies nearly half of the minerals that the US is 100 percent reliant upon. Butts, Bankus, and Norris of the U.S. Army War College (2011) claim,

> "United States vulnerability to a loss of access to these important mineral supplies is more pronounced today than at any time since the end of the Cold War. The uneven distribution of strategic mineral reserves and their concentration in a handful of politically unstable or potentially hostile countries makes it necessary that U.S. policymakers recognize the security of resource supply as a top national security issue" (2).

Appendix 1 outlines the use of minerals in specific applications and Appendix 2 provides a series of charts depicting the mine production of selected minerals. All the minerals used by the National Research Council (2008) are included in addition to the conflict minerals and minerals concentrated on the African continent. Chinese mine production is particularly striking in comparison to other countries. The concept of strategic and critical minerals will be discussed again in subsequent chapters on the Democratic Republic of Congo, the resource wealth, and the deal between DRC and China.

***Critical Minerals on the African Continent***

The discussion of critical minerals above is to contextualize the scale and power in reference to metallic minerals. Of the critical minerals assessed, platinum group metals, chromium, manganese, and vanadium, a majority of the global occurrence is on the African continent. Cobalt is mentioned in Butts, Bankus, and Norris (2011), yet was not used in the study by the National Research Council (2008). Most of the global cobalt reserves are in the Democratic Republic of Congo. Table 2.5 below is on an Africa mining report from the United Nations Economic Commission for Africa (2009).

**Table 2.5 Africa's Contribution to Global Mineral Production**

| Mineral | African Percent of World Production | Rank | African Percent of World Reserves | Rank |
|---|---|---|---|---|
| Platinum Group Metals | 54 Percent | 1 | 60+ Percent | 1 |
| Phosphate | 27 Percent | 1 | 66 Percent | 1 |
| Gold | 20 Percent | 1 | 42 Percent | 1 |
| Chromium | 40 Percent | 1 | 44 Percent | 1 |
| Manganese | 28 Percent | 2 | 82 Percent | 1 |
| Vanadium | 51 Percent | 1 | 95 Percent | 1 |
| Cobalt | 18 Percent | 1 | 55+ Percent | 1 |
| Diamonds | 78 Percent | 1 | 88 Percent | 1 |
| Aluminum | 4 Percent | 7 | 45 Percent | 1 |

Source: United Nations Economic Commission for Africa (2009). *Africa Review Report on Mining (Executive Summary)*. Available at: http://new.uneca.org/Portals/3/documents/AfricanReviewReport-on-MiningSummary.pdf

The largest reserves of platinum group metals, gold, diamonds, chromium, manganese, and vanadium, are found on the African continent as demonstrated in Table 2.5. In addition, seventeen percent of the global supply of uranium is from Africa (UNECA 2009). Limited geologic exploration and mapping of the continent means the estimates could be low.  Also, some countries like Russia and China claim statistics on mineral reserves (i.e. diamonds) is a "matter of 'national security' and therefore cannot be revealed" (Grant and Taylor 2004).  To reiterate one of the monopolies of the core from Amin (1997), "monopolistic access to the planet's natural resources" is especially relevant in this context.

The acquisition of minerals shapes the international political economy.  Because these minerals are necessary in application, the world economy will scour the earth to find sources at the cheapest cost possible.  In the words of Anderson (1993), "the new world order has also been seen as the era of resource geopolitics" (207), and is especially prominent when discussing oil yet holds true for nonfuel mineral resources.  With the known resource bounty, "Africa's extractive sector has become the epicenter of a global resource scramble" (Ushie 2013, 1).  With global mining industries eager to invest in the rich deposits on the African continent, there is an ever-present phenomenon known as the resource curse in which the countries with abundant resource wealth tend to be impoverished.  Also known as the 'paradox of plenty,' the correlation between resource wealth and poverty is more apparent than resource wealth and socio-economic development.

***The Resource Curse***

The World Bank has long proclaimed economic growth and poverty reduction can be achieved through resource development (Pegg 2005; Pegg 2006).  Australia, Canada, and the United States are historic examples used by proponents to demonstrate how resources transformed their societies into prosperous nations (Walker 2001).  Chile and Botswana are used as current examples of countries that have transformed natural resource wealth into social development (World Bank 2011).  However, as Pegg (2006) notes, "mining is more likely to lead to poverty exacerbation than it is to poverty reduction" (376).  Both the World

Bank and the UN have adopted millennial goals to end poverty by 2015, however, "they fail to link poverty to the whole array of liberalization reforms" (Ould-Mey 2003, 480). Ould-Mey (2003) postulates that despite the Bretton Woods system of fixed exchange, currency devaluation plays a significant role in declining terms of trade of resource exports from the global South, leaving those countries more heavily indebted to the IMF and World Bank, thereby exacerbating the divide. 12 of the 25 countries most reliant on mineral exports are highly indebted, poor countries according to the World Bank (Bridge 2007). The negative correlation between resource wealth and economic prosperity has become known as the paradox of plenty or the resource curse.

More than 3.5 billion people live in resource rich countries where fuel and nonfuel mineral resources are prevalent (Extractive Industry Transparency Initiative (EITI) website). Originating with *The Resource Curse Thesis* by Auty (1993), the general trend is that countries endowed with oil, minerals or timber have more poverty while the wealthy countries tend to be resource-poor. Stressing the contradiction of "raw materials wealth and development for colonized peripheries" (Ciccantell 2012, 383), the resource curse highlights this marked distinction in social development between resource producer and resource consumer (Auty 1993; Sachs and Warner 1997). According to Collier (2007), "the societies of the bottom billion are disproportionately in this category of resource-rich poverty: about 29 percent of the people in the bottom billion live in countries in which resource wealth dominates the economy" (39). Countries with a majority of their economy dependent upon mineral revenues tend to have slow economic growth and maintain their status as underdeveloped while countries with limited natural resources tend to vastly outperform those countries with great mineral wealth (Auty 1993; Sachs and Warner 1997; DiJohn 2002).

There are varying explanations as to why this correlation exists. In regards to oil, Ross (2001) suggests two explanations for the rentier state: "oil wealth makes states less democratic and those that suggest oil wealth causes governments to do a poorer job of promoting economic development" (330). Ross (1999) presents another explanation for the resource curse stating that, "a state's inability to enforce property rights may directly or indirectly lead to a resource curse" (298). If a government acquires external funding, i.e. resource rents, they do not tax and are therefore not accountable to the society. The resource curse is attributed to lack of political development and lack of mechanisms by the state to capture revenue from governance over society. Basically, the money from the lease of mineral resources eliminates the need for states to enter into a quid pro quo relationship in which revenues are exchanged for social services (i.e. infrastructure, education, sanitation, access to clean water) that translate into social development.

One of the major reasons the resource curse is common is because there is a lack of democracy and the people have limited political power to hold their government accountable and push for change. Authoritarian governments are typical in resource rich countries, especially in countries with oil wealth. Ross (2001) notes, "citizens in resource-rich states may want democracy as much as citizens elsewhere, but resource wealth may allow their governments to spend more on internal security and so block the population's democratic aspirations" (335). Governments can maintain their hold on power through sales of resources to international buyers in exchange for the purchase of weapons. Amassing weapons and trained military personnel are key to maintaining power by suppressing the internal opposition to their rule. If the government is closely aligned with business elites and the military, it takes on the form of bureaucratic authoritarianism similar to that which arose from the neoliberal experiment of Pinochet in Chile and popular movements such as labor movements are suppressed (Collier 2001). The payment of mineral rents to foreign governments provides revenue for the procurement of arms that could then be used against the people.

Mineral economies are particularly susceptible to corruption. A mineral economy classified by the World Bank, "when mineral production constitutes at least 10 percent of gross domestic production and where mineral exports comprise at least 40 percent of total exports" (DiJohn 2002, 2). Table 2.6 presents the countries that are most reliant upon the export of metallic minerals according to the International Council on Mining and Metals (2012).

**Table 2.6: Reliance on Export of Metallic Minerals**

| Rank and Country | | GDP/capita (PPP at current prices, 2009 US$) | Mineral Export Contribution 1996 (%) | Mineral Export Contribution 2005 (%) | Mineral Export Contribution 2010 (%) | Change in Mineral Contribution 1996-2010 (Percentage Points) |
|---|---|---|---|---|---|---|
| 1 | Botswana | 13,384 | 58.7 | 86.5 | 83.7 | 25 |
| 2 | Zambia | 1,430 | 79.4 | 64 | 83.6 | 4 |
| 3 | Dem. Rep. of Congo | 319 | 72.4 | 70.2 | 78.3 | 6 |
| 4 | Mongolia | 3,522 | 60.3 | 70.1 | 77.6 | 17 |
| 5 | Suriname | - | 68 | 64.3 | 75.4 | 7 |
| 6 | French Polynesia | - | 69.2 | 55.3 | 67.1 | -2 |
| 7 | Chile | 14,311 | 47.7 | 56.5 | 65.9 | 18 |
| 8 | Guinea | 1,048 | 77.1 | 84 | 65.2 | -12 |
| 9 | Peru | 8,629 | 48.3 | 57.9 | 62.7 | 14 |
| 10 | Mauritania | 1,929 | 36.1 | 49.3 | 60.4 | 24 |
| 11 | Northern Mariana Islands | - | 3.3 | 4.5 | 58.9 | 56 |
| 12 | Mozambique | 855 | 6.1 | 66.9 | 57 | 51 |
| 13 | Mali | 1,186 | 8.5 | 37.2 | 54.8 | 46 |
| 14 | Sierra Leone | 808 | 30.6 | 58.2 | 54.3 | 24 |
| 15 | Papua New Guinea | 2,281 | 24.5 | 39.2 | 54 | 30 |
| 16 | Namibia | 6,410 | 36.2 | 41.2 | 53.4 | 17 |
| 17 | Nauru | - | 73.1 | 25.2 | 50.8 | -22 |
| 18 | Armenia | 5,279 | 23.9 | 39.8 | 50.6 | 27 |
| 19 | Jamaica | 7,633 | 49.7 | 68.5 | 49.6 | 0 |
| 20 | Cuba | - | 15.1 | 39.2 | 47.7 | 33 |

Source: International Council of Mining and Metals (ICMM). (2012). *The Role of Mining in National Economies.*

Note the position of the Democratic Republic of the Congo and the GDP per capita. As exporters of raw materials, mineral economies lack the infrastructure for processing and refining and therefore cannot capture the value-added along the commodity chain. Economic diversification is essential if mineral economies are to translate resource wealth into social development (Hanink 2000). One plausible explanation for the resource curse is that,

> "Dependence on mining rent alone can hamper development by shifting focus from broader economic development issues and the expansion of other productive sectors. This often relates to the so called Dutch Disease or the Resource Curse in which high mineral revenues limit structural diversification; and economies fail to translate resource abundance into sustainable growth that uplifts people's lives" (United Nations Economic Commission for Africa 2009, 4).

Producers of raw materials lack the technological innovations to transform nature into a thing of human value. Note the position of Botswana and the GDP per capita in the table above.

Botswana transformed poverty into prosperity using its diamond resources. One reason Botswana was successful is because the diamond cutter facilities are located in the capital city Gaborone (Oppenheimer 2008). This allows Botswana to capture the value-added along the commodity chain by transforming a raw material into a finished product. Noting that most of the countries reliant on metallic exports are on the African continent suggests another reason why transparency in extractive sectors is important.

Mineral economies are particularly susceptible to corruption and conflicts arising over control of the resources. As Collier (2007) suggests, "the heart of the resource curse is that resource rents make democracy malfunction" (42). Jensen and Wantchekon (2004) find "that African rentier economies tend to generate authoritarian governments or undermine democratic governance" (817). They go on to explain, "an abundance of natural resources increases competition for control of the state, which is linked to high levels of political violence and the use of resource rents by ruling parties to maintain their hold on political power" (Jenson and Wantchekon 2004, 818). DiJohn (2002) finds two variants: "first, mineral-rich late developers are more prone to violence; second, mineral-dominant economies generate higher levels of corruption and lower rates of long-term growth" (1). Power-seeking, rent-seeking and corruption are predominant drivers perpetuating the resource curse. Because the trade of minerals can be highly lucrative, corruption is common in extractive industries and in mineral economies, as is violent conflict over control of resources.

The resource curse has been extrapolated to explain the atrocities in Sierra Leone and Angola over control of diamonds, and to describe the current situation in the Democratic Republic of Congo. As Le Billon (2008) explains,

> “Resource dependence creates a context for the emergence of armed conflicts through its negative effects on economic performance and the quality of governing institutions. Rather than simply explaining war through greed-driven belligerents motivated by lootable resources, this argument emphasizes resource dependence as both reflecting and shaping conditions that increase vulnerability to armed conflict” (347).

Le Billon (2004) finds the greatest risk for looting is when the resources are in closer proximity to foreign markets than their own government and markets. In the case of the Democratic Republic of Congo, this is especially true. Guenther (2008) quotes the conclusion of Collier, “’the true cause of much civil conflict is not the loud discourse of grievance but the silent force of greed’” (348). One feature that can be helpful in capturing resource rents and use the capital to improve the social welfare of the population is transparency.

***Global Witness and Extractive Industry Transparency***

Corruption in extractive industries and mineral economies is common. Industrial transparency is increasingly needed to demonstrate corporate and government accountability for actions and anti-corruption in the international political arena. Extractive industries and raw material trade are particularly susceptible to corruption. Transparency is a means to ensure best business practice and perhaps ameliorate the resource curse.

Global Witness is a London-based NGO founded in 1993 that has been at the forefront of exposing the linkages between natural resource exploitation, human rights abuses, and political corruption. From Global Witness website:

> “For 19 years, Global Witness has run pioneering campaigns against natural resource-related conflict and corruption and associated environmental and human rights abuses. From Cambodia to Congo, Sierra Leone to Angola, we have exposed the brutality and injustice that results from the fight to access and control natural resource

> wealth, and have sought to bring the perpetrators of this corruption and conflict to book.
>
> Our work has revealed how, rather than benefiting a country's citizens, abundant timber, diamonds, minerals, oil and other natural resources can incentivize corruption, destabilize governments, and lead to war. Through our investigations, advocacy and campaigning, we seek solutions to the 'resource curse' so that citizens of resource-rich countries can get a fair share of their country's wealth."

Global Witness has played an integral role in bringing corruption in extractive industries onto the global agenda. In 1998 the NGO was instrumental in exposing blood diamonds and pushing the issue onto the international agenda (Bieri 2010). In 1999, Global Witness published a report called "A Crude Awakening" outlining the connection between big oil companies and the elite of Angola during the 40-year long civil war (Publish What You Pay website 2014). This spurred the initiation of the 'Publish What You Pay' campaign in 2002 by not only Global Witness, Open Society Institute, Oxfam GB, Save the Children UK and Transparency International UK. The global network is now comprised of more than 750 member organizations from 57 countries (Global Witness website; Publish What You Pay website). Also in 2002 at the Johannesburg World Summit on Sustainable Development, Tony Blair announced the formation of the Extractive Industries Transparency Initiative (EITI). The EITI, "sets global standard for transparency in oil, gas, and mining [and] aims to strengthen governance by improving transparency and accountability in the extractives sector" (EITI Website). The EITI requires that extractive industries of fuel and nonfuel mineral resources disclose payments made to governments, and governments disclose payments made by companies operating in their territory. There are currently 35 member countries dedicated to being transparent in mineral transactions.

Returning to the Wall Street Reform law section 1504 requires disclosure of payments by mining companies made to governments for fuel and nonfuel mineral resource concessions. Mineral economies are prone to corruption and section 1504 is designed to show transparency in large-scale extraction because the translation of mineral wealth into a social development is far trend as the resource curse literature suggests. According to Ould-Mey (2003), "resource transfer from the South to the North is increasing poverty, which in turn is driving corruption as a terrible consequence of fierce competition for increasingly scarce resources" (481). The mining industry argued against the disclosure require because there could be a breach in contracts of confidentiality with some countries, and second, many companies lobbied to be exempt from reporting unless the payment exceeded U.S. $1 million (Ushie 2013). In August of 2012 the Securities and Exchange Commission issued the final rule that any payment equal to or exceeding $100,000 needed to be disclosed regardless of confidentiality requests (Ernst and Young 2012). Such initiatives will afford opportunities for developing countries such as those of Africa to transform the resources into social development, from the 'curse' into a 'blessing' (Ushie 2012). Transparency specifically targets large-scale extraction to show the amount of resource rent being paid. On the other end of the spectrum is artisanal small-scale mining, like in the Democratic Republic of Congo.

***In Summary***

This chapter looked at historical context that led to the emergence of globalization and presented some key concepts that will be returned to throughout the remainder of the thesis. First is the entrenchment of inequality in the global landscape. Second are the implications of the ideological standoff between the communist and capitalist ideologies during the Cold War. Third is the role of the corporation in transcending international boundaries. Fourth, the power behind the acquisition of minerals, especially those vital in application and limited in global occurrence. These concepts will be touched upon in chapter 3 as we turn to the Democratic Republic of Congo.

Returning to the Dodd-Frank Reform and Consumer Protection Act, section 1502 conflict minerals, requires supply chain transparency of mineral origin to ensure consumer products are not funding the perpetuation of human atrocities and societal detriment in the Democratic Republic of Congo. Chapter 3 gives a brief history and geography of the DRC and the Great Lakes Region of Africa to help contextualize the 'illegal exploitation of mineral wealth,' as outlined by the UN Panel of Experts in 2001, and situate the conflict minerals, tin, tantalum and tungsten. Metal use, the distribution of mining investment, critical minerals, and the concentration of minerals reserves on the African continent illustrate the power dynamics at play in the acquisition of minerals. This will help inform the remainder of the thesis that examines the context of one of the newest certifications, conflict-free minerals from the Democratic Republic of Congo and adjoining countries. While the Kimberley Process Certification Scheme for conflict-free diamonds has demonstrated a voluntary means of ensuring the origin of diamonds, the certification of conflict minerals is far more complicated. As chapter 4 explains, the challenges of implementing conflict minerals are numerous.

## Chapter 3
## The Democratic Republic of Congo

*"Resource abundance may be more of a curse than a blessing"*
(DiJohn 2002, 1)

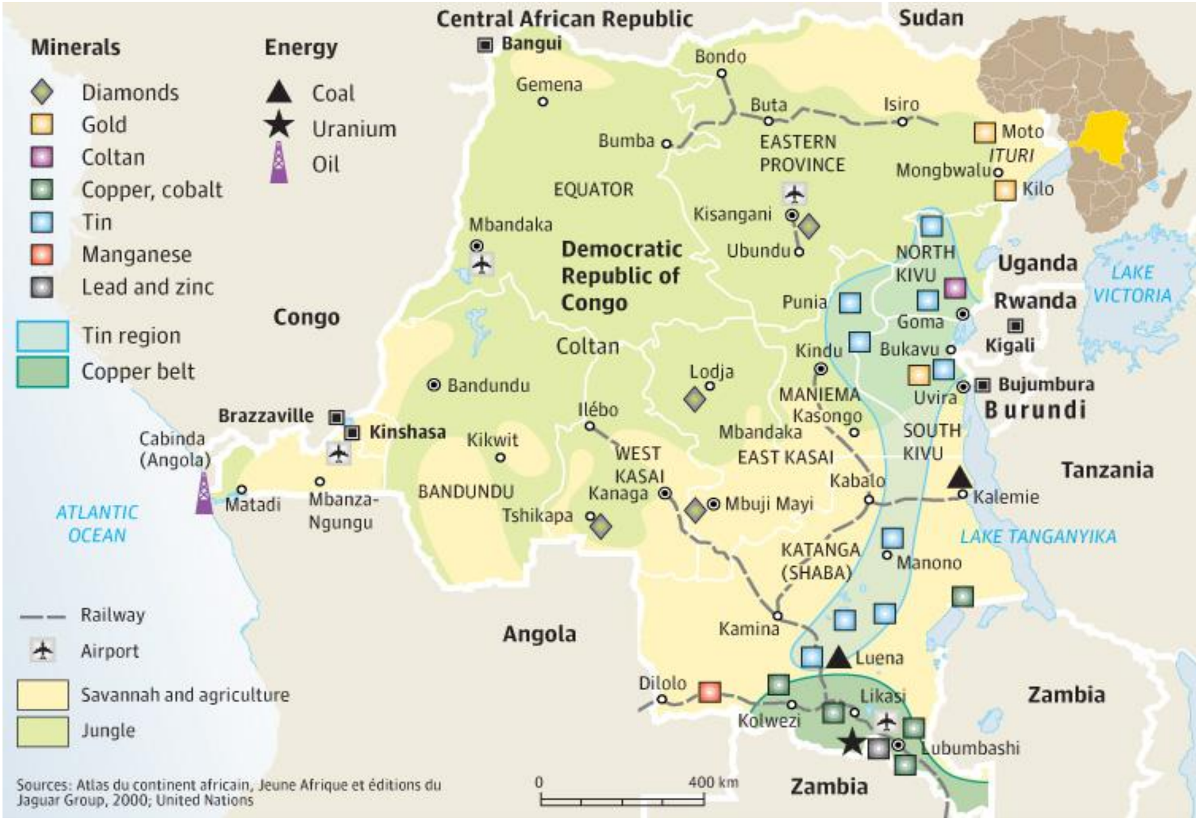
### *Resource Wealth of the DRC*

The Democratic Republic of Congo is the poster child of the resource curse. It is one of the richest countries in terms of resource wealth, yet poorest monetarily behind neighboring Burundi (CIA Factbook). Underground the Democratic Republic of Congo is a vast expanse of mineral riches unsurpassed elsewhere on the planet with an estimated value of $24 trillion (Morgan 2009). Resources include: diamonds, gold, copper, zinc, uranium, cobalt, chromium, manganese, and nickel (Vehnamaki 2002). In the south, the Katanga province hosts a geologic formation known as the Central Africa Copper Belt that extends southward to Zimbabwe. Also called the greenstone belt, this formation is rich in copper-cobalt deposits where the grade of copper is eight times higher than elsewhere in the world (USGS 2000; Key, De Waele, and Liyungu 2004). Current estimates suggest this geologic formation contains over 50 percent of the world's cobalt reserves (USGS 2010). Also, there is the niobium-tantalum pegmatite craton estimated to contain eighty percent of the global coltan reserves (Pole Institute 2002). However estimates vary for the size of reserves of coltan (columbite – tantalite) until further mineralogical surveys are conducted. Other noteworthy deposits include germanium, uranium, and thorium. Corresponding with the Great Rift Valley, in the eastern DRC are rich deposits of tin, tantalum, and tungsten.

Mineral deposits tend to correspond with plate boundaries or aged rock enriched through the passage of time as secondary accumulation of minerals. The three forces creating ore mineralization are plate tectonics, volcanism, and time; the Congo has all three, corresponding to the divergent plate boundary of the Great Rift Valley. According to Meyer (1985) most ore deposits occur "near the interface between the solid earth and its fluid envelopes, either at the earth's surface or not far below it" (1421). The entirety of the Great Rift Valley is endowed with various mineral deposits attributed to the geomorphology of the region, specifically the Great Lakes Region of Africa. Geologic maps of Africa reveal this correlation.

According to U.S. Geological Survey statistics for 2008, the DRC contributed 45 percent of the total world's cobalt produced, 30 percent of the industrial diamonds, 6 percent of gem-quality diamonds, 2 percent of the world's copper, and most pertinent to this research, 9 percent of the world's tantalum (USGS 2010). In 2009, "cobalt accounted for 38 percent of the total value of exports; copper, 35 percent; crude petroleum, 12 percent, and diamond, 11 percent" (USGS 2011). The USGS is currently conducting mineralogical studies to assess the ore deposits of the DRC for minerals such as: tantalum, niobium, rare earth elements, and platinum-group metals. The creation of a map was mandated as part of the Dodd-Frank conflict minerals law. By conducting core samples and surveys of mineral deposits and ascertaining grade and extent of ore bodies, there will be greater potential for investment with the data. Figure 3.1 is a map of the mineral wealth of the DRC.

**Figure 3.1: Mineral Wealth of the Democratic Republic of Congo**



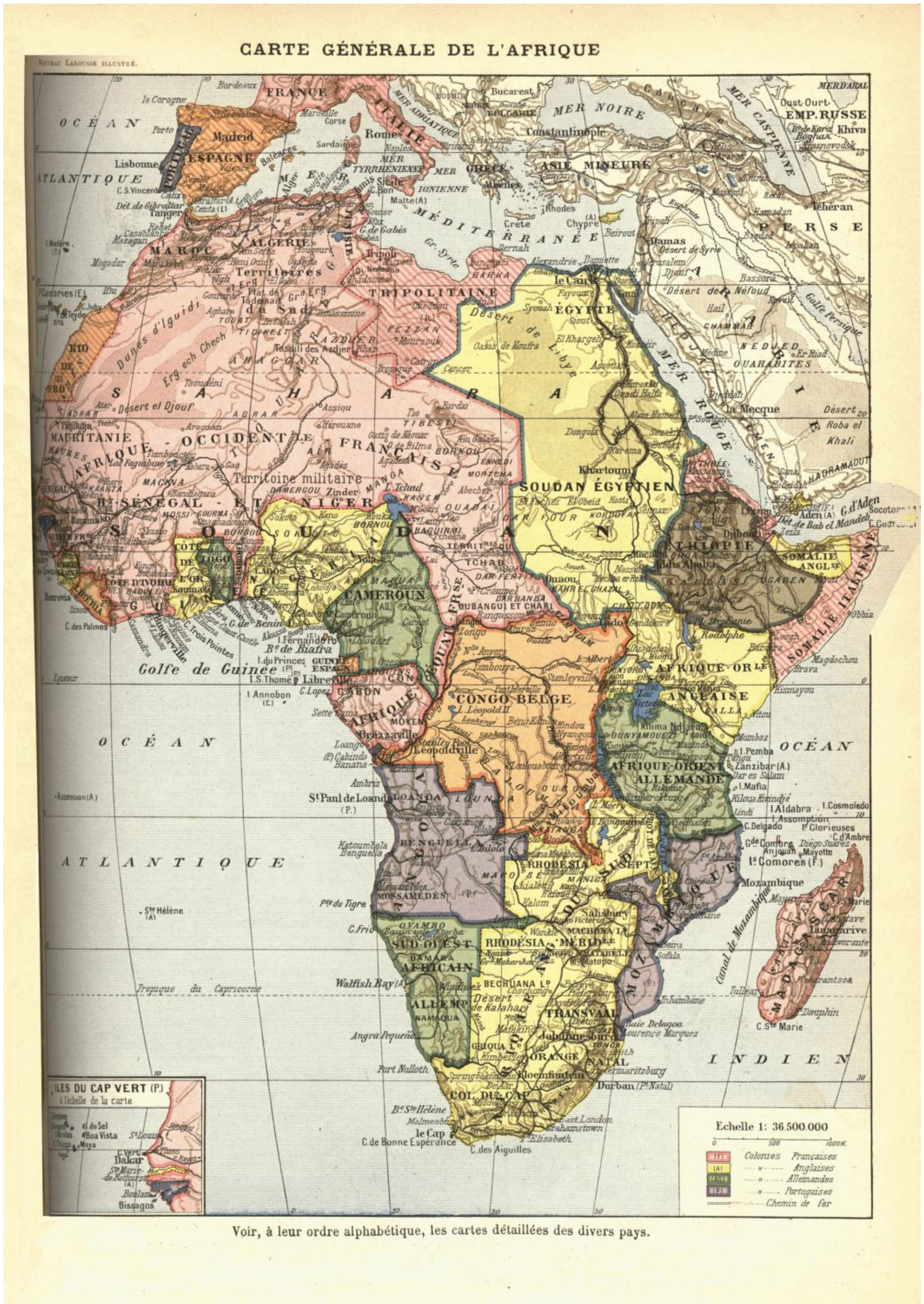

Source: Atlas du continent africain, 2000. Jeune Afrique et éditions du Jaguar Group, 2000; United Nations

There are two distinct modes of production in the Democratic Republic of Congo. There is the industrial mining sector that requires contracts to operate concessions and there is the artisanal mining sector. There are both legitimate and illegitimate mining by artisanal mining and this distinction is scrutinized in the conflict minerals due diligence procedures. The eastern DRC is the region most affected by conflict and the area where the minerals tin, tantalum, tungsten, and gold are mined, and all of the production is by artisanal means.

***Geography and Brief Colonial History***

The DRC is the 11th largest country in terms of land area. The landmass formerly known as the Belgian Congo, the Congo Free State, and recently Zaire straddles the equator and occupies a large portion of equatorial sub-Saharan Africa. The capital city of Kinshasa is located on the Congo River in the west just inland of the Atlantic Ocean, of which the DRC has very little shoreline. The eastern border of the DRC is the Albertine Rift, where the earth is slowly tearing apart. The divergent plate boundaries of the Great Rift Valley extend nearly 4,000 miles from Turkey to Mozambique (Baker, Mohr, & Williams 1972). Faulting of the Great Rift Valley causes weakening or straining of the lithosphere, inducing volcanism and other geographic phenomenon. One of the world's most active volcanoes, Nyiragonga (featured as the cover story of *National Geographic* Magazine in April 2011) is situated in the DRC just north of the Goma, DRC that shares a border with Gisenyi, Rwanda. 14,000 homes were destroyed and 350,000 people fled the eruption of 2002 (Finkle 2011). Goma is a hub of the mineral trade that will be discussed later. Now known as the Democratic Republic of Congo, this territory was created by European powers through the colonialism in the Scramble for Africa in the late 1800s.

**Figure 3.2. Map of Colonial Africa Circa 1898**




Source: Carte Générale de l'Afrique, 1898. In *Nouveau Larousse illustré; dictionnaire universel encyclopédique, publié sous la direction de Claude Augé*. Paris: Librairie Larousse. 1898-1904.

The Congo basin was virtually unexplored by Europeans until the late 1800's. Henry Morton Stanley was commissioned by the King Leopold II of Belgium to survey and acquire as much of the Congo region as possible. Through a series of treaties with various indigenous people of the Congo region, in 1878 the entire Congo basin, a landmass larger than all of Western Europe, was conferred to Belgian King as his personal property under the auspice of a humanitarian mission (Hochschild 1999). Figure 3.2 shows a map of colonial Africa. The Congo basin and the extent of the Belgian King's domain is shown in orange. The great resource wealth was discovered by the first explorers yet the cataracts of the lower Congo River prevented easy transportation of resources from the Congolese basin to European markets. Railroads were surveyed and constructed soon after acquisition of the territory, and the exploitation of natural resources began (Hochschild 1999).

The Democratic Republic of Congo is marred by the horrors of colonial conquest. According to Mullins and Rothe (2008), "the Congo claims one of the harshest and bloodiest colonial histories in central Africa" (88). The labor of the Congolese provided natural resource wealth in the form of ivory, rubber, diamonds, and gold for the Belgian King's personal financial gain, estimated at U.S. $25 million over his 15-year rule. As industrialization spread, Europeans grew increasingly wealthy with the resources recovered through colonial escapades. According to Moore (2001),

> "At the height of the 19$^{th}$ century scramble for Africa – part of the most intense phase of global economic liberalization and integration until the age of neoliberalism – the death of perhaps 10 million hewers of rubber and ivory while the king of a late-industrialising and colonizing Belgium jumped on the colonial bandwagon signified the worst consequences of global reach" (919).

King Leopold's rule left scars throughout the continent. Stearns (2011) claims the brutality under the rule of King Leopold II, "prompted the first international human rights campaign led by missionaries and activists, including Mark Twain and Arthur Conan Doyle" (7). Dismemberment became a common form of punishment for failure to gather enough rubber under the iniquitous rule of the Belgian King (Hochschild 1998; Moore 2001; Kabemba 2006). This is the same brutality employed in the present-day conflict zones of both the DRC and Sierra Leone; both conflicts are perpetuated by control of resources. King Leopold was stripped of his property in 1908 and the territory became known as the Belgian Congo.

During the beginning of the century when eugenics was viewed as a true science, people were captured and put on display in human zoos. In 1906, Ota Benga, a Congo pygmy, was put on display in the Bronx Zoo alongside an orangutan so onlookers could marvel at the similarities. It was also during this era when the Belgians began systematically stereotyping and categorizing the people of the eastern portions of the Belgian Congo into the Hutu or the Tutsi. The Tutsi minority were the descendants of Ethiopian pastoralists with fairer skin tones and narrower features, more closely resembled Europeans and were given more power and opportunity during colonial rule because they were thought to be genetically superior. While the categories did precede the Belgians, the active classification by the Belgians into Hutu and Tutsi has had serious repercussions on the region (Stearns 2011).

***World War II and Post-Colonialism***

The Congo remained under Belgium rule for decades. Following World War I, Germany lost colonies in Africa; neighboring Rwanda and Burundi were transferred to Belgian control and Tanzania was transferred to British rule. During World War II, Congolese Uranium-235 was used in the atomic bombs dropped on Nagasaki and Hiroshima

(Seay 2012). With the knowledge of the valuable minerals, “at the beginning of the Cold War, the playing out of the ‘great contest’ between the USA and the USSR had particularly tumultuous effects in the Congo” (Moore 2001, 919).

By the time the Belgian Congo gained independence in 1960, it already exhibited the characteristics of a failed state (Kabemba 2006). According to Stearns (2011), “by the time they were forced to hand over power, Belgium had set the new nation up to fail” (7). Patrice Lumumba was the prime minister elected in the first free elections of the Congo in June of 1960. He advocated equality and freedom and while he tried to maintain political neutrality, he had communist leanings, fighting alongside Che Guevara. Nationalism movements were viewed as a threat. According to Kabemba (2006), “as soon as the nationalist movements started to challenge the Belgian interests in the Congo, the United States began to show interest in the country” (102). This era was a violent time in most of the world because the fear of communism infiltrated most western politics of that time. Patrice Lumumba was arrested and later assassinated in January 1961.

***The Reign of Mobutu***

Following the assassination of Lumumba, the West largely supported General Joseph Desire Mobutu’s ascension to power. He assumed the role of leader in 1965 and changed the name from the Belgian Congo to Zaire in 1971 (Stearns 2011). The reign of Mobutu is characteristic of many resource rich countries, as Jenson and Wantchekon (2004) note, resource wealth leads to the emergence of authoritarian governments. Mobutu’s regime is characterized as an oppressive and violent dictatorship using the proclamation,

> "Debrouillez-vous (fend for yourselves)…he was brutal; murdered anyone who opposed him, and tried to gain legitimacy among his people by claiming that his was 'African authenticity' and as assertion of autonomy from outsiders (though clearly they depended on US aid)" (Mantz 2008, 44).

Mobutu allegedly embezzled over $5 billion from trade and extraction of mineral, timber, and rubber resources over his 30-year reign (Kabemba 2006).

Mobutu's regime epitomizes the reasons why transparency in extractive industries is needed. Kleptocracy is a government characterized by the systematic stealing of state funds for the personal benefit of the leaders and elites. Mineral economies are prone to corruption and particularly susceptible to crony capitalism, a term referring to a capitalist system where the government is in close association with business elites. State-owned concessions are contracted to close affiliates, friends, and family in a structure of mutual benefit (Krugman 2002). Elites are tied in business with the state for mineral concessions and leasing opportunities.

Mobutu was largely supported by the West for the procurement of resources during the Cold War era, particularly uranium and cobalt (Seay 2012). Due to the strategic importance of alliances during the Cold War, Mobutu's government was supported by the United States. However, after the disintegration of the Soviet Union and the fall of communism, "both the rise of neoliberalism and the end of the Cold War forced Mobutu to liberalise the economy" (Moore 2001, 919). According to Kabemba (2006),

> "Zaire had accumulated an external state debt amounting to $8 billion. As a result, the IMF and World Bank refused to advance any further loans until Mobutu agreed to the privatization of state owned mineral conglomerates" (104).

The West turned a blind eye on their 'ally' during the rising instabilities in the Great Lakes Region, ultimately leading the Africa's World War (Kabemba 2006).

***Post-Rwandan Genocide and Africa's World War***

The situation in the eastern Congo cannot be examined without understanding the impact of the Rwandan genocide in 1994 on the Great Lakes Region of Africa. In the span of 100 days from April to July, an estimated 800,000 Rwandan Tutsis and complacent Hutus were killed, many hacked to death by machetes (Gourevitch 1998; Prunier 2009; Stearns 2011). Millions fled the systematic slaughter by the extremist Hutus, crossing the border into the eastern portions of then Zaire (now DRC). Refugee cities became established almost overnight. The influx of population strained resources and the camps struggled to accommodate the needs of patients and people. Prunier (2009) suggests that over thirty-five refugee camps of various sizes were established throughout eastern Zaire totaling several million. And when the perpetrators of genocide, the Interahamwe and Impuzamugambi Hutu armies were driven from Rwandan soil, it was into eastern Zaire (DRC) the armies went. The refugee camps became grounds for continued organization of various armed groups. According to Gourevitch (1998):

> "The Rwandese genocide and its consequences did not *cause* the implosion of the Congo basin and its periphery. It acted as a *catalyst*, precipitating a crisis that had been latent for a good many years and that later reached far beyond its Great Lakes locus. This is why the situation became so serious. The Rwandese genocide has been both a product and a further cause of an enormous Africa crisis: its very occurrence was a symptom, its nontreatment spread the disease" (Prunier 2009, xxxi).

Following the Rwandan genocide and ensuing displacement of people fleeing the violence into neighboring countries, the eastern DRC was the setting of the African World War and the commencement of the atrocities that continue to characterize the context in the eastern DRC. The root of the genocide is the underlying tensions between the Hutu and Tutsi. The

Tutsi Rwandan Patriotic Front (RPF) took power following the genocide with Paul Kagame as the head. Hutus continued to flee.

From 1994 to 2003, the African World War (also called the Second Congolese War) took place with little attention from Western media. Armed groups from Zimbabwe, Angola, Zambia, Uganda, Rwanda, and Burundi all had descended upon the eastern portions of the DRC, then known as Zaire (Prunier 2009). The thirty-two year reign of former kleptocratic leader Mobutu invigorated insurgencies from the east and south as some twenty-five armies from eight countries engaged in fighting in the eastern DRC. With the collapse of the USSR, the Soviet threat no longer existed so the strategic partnership with the West for mineral resources was no longer needed. France, persuaded to protect a francophone, was the only Western power to come to the aid (Kabemba 2006). Forces invaded from Uganda and Rwanda and Laurent Kabila stormed the capital Kinshasa in 1997 (Kabemba 2006; Mullins and Rothe 2008). Mobutu fled, and mining companies assumed mineral concessions would be opened (Moore 2001). The First Congo War ended in 1997 when the government of Mobutu Sese Seko was toppled and he fled (Stearns 2011). Laurent Kabila assumed power and there was a lull in fighting until 1998; he subsequently changed the name to Democratic Republic of Congo. In the midst of the war President Laurent Kabila, also presumed to have nationalist tendencies, was assassinated by a bodyguard in 2001. According to Kabemba (2006),

> "For the West, any government in the DRC must maintain the kind of friendly and constructive relations with Western powers that serves their interests, which may not necessarily be identical with those of the Congolese people. Lumumba and Laurent Kabila, who attempted to oppose the Western interests, were killed" (113).

This point is key to understand the international meddling in the DRC.

***Current Context***

While the war officially ended in 2003, militants and rebels are still present throughout the eastern DRC in what Stearns (2011) calls the third episode of war. The Oxford Poverty and Human Development Initiative uses three dimensions to assess poverty: education, health, and standard of living. 73.2 percent of the population in the DRC lives in poverty as assessed by the multidimensional poverty, with 79.6 percent people at or below U.S. $2 per day (OPHI 2011). In the eastern DRC, it is much lower. It is important that we distinguish the regions of the Congo. The western region near the capital of Kinshasa is relatively stable and there are large-scale mining operations. The eastern DRC is the loci of the fighting and violence of the past two decades, particularly the provinces of North Kivu, South Kivu, and Maniema. Rwanda and Uganda forces have significantly impacted the instability of the region and have funded their insurgencies by trading minerals for arms. To reiterate Le Billon (2004), the greatest risk of looting is when the resources are in closer proximity to foreign markets than their own government and markets.

The current situation in the eastern Congo is characterized by, "widespread massacres of unarmed civilians, mass rape of a genocidal character, mutilation, forced slavery (be it in mines or brothels) and even cannibalism" (Mullins and Rothe 2008, 81). In the eastern DRC, there is limited choice, no security, and vague hope of a future on a day-to-day basis. Whole villages are massacred, children dismembered, and the women raped. Rape is used as a means of societal detriment, spreading HIV throughout the populace, and destroying the already challenging notion of societal semblance. Women who have been raped are disgraced, often left by their family. Many children are left without parents, families, and villages. They are disenfranchised and hungry. Militant groups offer a place for these children, giving them food, security, and a 'family' to be a part of, as long as they will kill indiscriminately. Choice, future, and security are nuanced. The only choice in this context is that of a child soldier, or a miner.

The war caused mass displacement and the warring factions deterred people from investing in farming because their crops would likely be stolen by occupying armies. The instability in the region caused a transition from agriculture as the primary means of subsistence into a lifestyle dominated by resource extraction through artisanal small-scale mining (Jackson 2003). Due to the primitive means of extraction, the buyer-driven market allows for the entry of numerous workers and the opportunity for the individual to capitalize on the resource trade (Gereffi 1999; Jackson 2003). Artisanal small-scale mining provides revenue in a place with few alternatives since the agricultural legacy was destroyed by continued war. According to Seay (2012), "the militarized mineral trade is much more a symptom of the Congolese state's weakness and inability to govern than it is its cause" (17).

***Mining as the Option***

Artisanal small-scale mining (ASM) is a way for people to use their labor to transform nature into wealth. According to Marxist thought, labor is the only thing you can own. ASM is a subsistence-based practice using primitive tools such as picks and shovels. Globally, the Mining, Minerals, and Sustainable Development Project (MMSD) estimates that artisanal small-scale mining involves 13 million people directly with 80-100 million being reliant upon the practice for sustenance (MMSD 2003). This statistic is slightly outdated yet demonstrates the importance of this form of resource extraction for many communities throughout the world.

In the DRC, the World Bank estimates there are up to 2 million artisanal miners with 10 million people economically reliant on mining, or nearly 16 percent of the population (ITRI 2008; ITRI 2009). According to the USGS (2011), most of the diamonds, gold, niobium, tantalum, tin, and tungsten mined in the DRC were produced by artisanal small-scale miners. Artisanal mining in the DRC was also significant in the production of cobalt (USGS 2011). The Pole Institute (2010) based in Goma, DRC estimates that nearly 1,000,000 people in the eastern DRC rely on mining as a means of subsistence. Mining and the trade of minerals provide a means for economic subsistence in a place with little financial alternative. Brunnschweiler and Bulte (2008) make a particularly cogent claim,

> "It may also be the case that conflict makes countries dependent on resource extraction…If so, resources are not a curse to development, but rather a safety net to support people and economies under adverse circumstances" (617).

Mining is a means of survival. The next chapter looks first at the international acknowledgement of the problem, specifies the minerals outlined in the Dodd-Frank conflict minerals law, the use of these minerals, and is followed by the different approaches to tackling the problem.

## Chapter 4
## Conflict Minerals: The Players and the Implementation

*"Without willing markets, even the most valuable mineral resources are worthless"* (Mullins and Rothe 2008, 82).

United Nations Security Council released the Final Report of the Panel of Experts on the Illegal Exploitation of Natural Resources and Other Forms of Wealth of DR Congo in October 2001. The link between the trade of minerals and violent conflict was explicitly revealed in the report, yet the precise method to tackle the trade of minerals eluded international players. This report articulates the transnational actors involved including: the elite networks in Zimbabwe, smuggling cartels in Lebanon, HC Starck representatives, Congolese government officials, Rwandan military and Ugandan armies yet a decade later, the humanitarian crisis continues and militant groups are still collecting revenue through the trade of minerals. A long-standing fear in tackling conflict minerals was the possibility that a de facto embargo would occur on all minerals from central Africa. In the 2001 UN report, the Russian government cautioned to ensure a de facto embargo on minerals from sub-Saharan Africa did not result. As Hayes and Burge from the Flora and Fauna Institute (2003) note, "when business income is removed and boycotts are enforced, poverty increases and the struggle to seize control of resources may escalate. Therefore, far from tackling the problem, sanctions may exacerbate the underlying cause" (Hayes and Burge 2003, 38). Human rights groups argued that a de facto embargo would result, jeopardizing the ability of already impoverished people to provide sustenance.

The UN report demonstrated the scope and scale of the mineral trade originating in the Democratic Republic of Congo yet the minerals are dispersed, transported, and traded throughout the region including: Burundi, Rwanda, Uganda, Zimbabwe, Angola, Central African Republic, Kenya, Mozambique, Congo, United Republic of Tanzania, and Zambia (UN Security Council 2003). According to Asiimwe (2004), the UN report explains how,

> "The 'elite' networks expertly orchestrated the systematic plunder of the resources in the DRC…The DRC Government-sponsored elite network depends heavily on a relationship with Zimbabwean political, military and commercial interests. It highlights the transfer of US $5 billion worth of assets from the state mining sector to private companies within the last three years. This network perpetuates instability in order to prolong its economic control over the resources of the DRC" (195).

The elite networks within Africa are intricately tied with global transnational elites in the "systematic plunder" of resources. Corruption is rampant and minerals are traded for arms.

NGOs brought attention to the situation highlighting the need for corporate accountability in the acquisition of raw materials for production of popular consumer products, particularly digital technology. Blood in the Mobile is a UK-based NGO that led a successful campaign tying the product to the process and pushing the industry address the issue and clean up its act. Enough Project's campaign "Raise Hope for the Congo" with John Prendergast, amnesty International, Human Rights Watch, author and philanthropist Lisa Shannon, and Global Witness all played an integral part in bringing the issue of conflict minerals to consumer consciousness and government action. With the help of congressional representative Jim McDermott of Washington State, the successful lobbying campaigns resulted in the addition of Section 1502, conflict minerals, to the Wall Street Reform Bill signed into law by President Obama in July 2010.

A main motive in the Wall Street Reform was to curtail the predatory and exploitative practices under neoliberal globalization that resulted in the economic downturn but also in blatant human rights abuses on the other side of the globe. Section 1502 places the responsibility on the producers of consumer goods (especially electronics companies) in a 'name and shame' game to ensure of the minerals used are not blood minerals (Shannon 2012). If the end-producer (i.e. a cell phone company) does not want their brand name connected with blood in the Congo, the company must retrace the globalized production line to ensure that the minerals used in their products did not fund military and armed groups in the eastern Democratic Republic of Congo and adjoining countries. A company will be able to label its products as 'DRC conflict-free' if they can attest to the provenance of the mineral. The Dodd-Frank sets forth the label to mean:

> ***DRC Conflict Free*** is defined as, "the products that do not contain minerals that directly or indirectly finance or benefit armed groups in the Democratic Republic of Congo or an adjoining country."

The provision is designed to curtail the illegal exploitation of these minerals from the Democratic Republic of the Congo, to ensure U.S. corporations are not profiting from the exploitation of mineral resources and that U.S. electronics consumers are not inadvertently contributing to the human atrocities perpetrated by militants in the eastern DRC. The law places the responsibility of supply chain sourcing on the end-product producers to ensure the mineral trade in no way provides revenue to one of eight armed groups active in the eastern provinces of North Kivu, South Kivu, and Maniema. The law requires disclosure of due diligence in sourcing of minerals; it does not prohibit the use merely requires disclosure and labeling on websites. In order to establish what is meant by the terms, the definition given within the text of the legislation will be explicitly outlined below:

> ***Under the Control of Armed Groups*** "means areas within the Democratic Republic of Congo or adjoining country in which armed groups—A) physically control mines or force labor of civilians to mine, transport, or sell conflict minerals; B)tax, extort, or

> control any part of trade routes for conflict minerals, including the entire trade route from a Conflict Zone Mine to the point of export from the Democratic Republic of the Congo or an adjoining country; or C) tax, extort, or control trading facilities, in whole or in part, including the point of export from the Democratic Republic of the Congo or adjoining country."

The aim of the act is to deprive the militant groups of revenue through the illegal exploitation of mineral wealth. To understand the context of the mineral and the daunting task of retracing the global commodity chain, the conflict minerals are outlined below.

***Section 1502: Conflict Minerals***

> ***Conflict Mineral*** "means A) columbite-tantalite (coltan), cassiterite, gold, wolframite, or their derivatives; or B) any other mineral or its derivative determined by the Secretary of State to be financing conflict in the Democratic Republic of the Congo or an adjoining country."

*Coltan* is the African word for the mineral columbite-tantalite containing both niobium (formerly called columbium) and tantalum. Cassiterite is the principle ore of tin (gold is omitted from this discussion), and wolframite, the principle ore of tungsten. To contextualize the scope and scale of the mineral trade from the Congo, under section 1502, any publicly traded American company using the metals tin, tantalum, tungsten, or gold in their product or production process must exercise due diligence in sourcing their minerals to make sure the trade is not directly or indirectly funding armed groups in the Democratic Republic of the Congo or adjoining countries. The threes Ts are outlined below.

**Tin**

Tin is a malleable, corrosion resistant metal with a low melting point. It was one of the first metals smelted by humans and alloyed with copper to create bronze. Early applications included armor (hence 'tin soldier') and flatware until the 19th century. Pewter is an alloy composed predominantly of tin. Steel cans are coated with tin for food production to prevent corrosion. Tin is used as a solder to replace toxic lead, particularly noteworthy is the use of tin solder in electronic circuit boards. Domestic consumption of the metal was U.S. $575 million in 2008 and the major uses of tin were: solders, 29 percent; metal containers, 21 percent; transportation, 14 percent; construction, 11 percent; and other uses accounted for 25 percent. 1993 is the last time tin was mined in the US (USGS 2010).

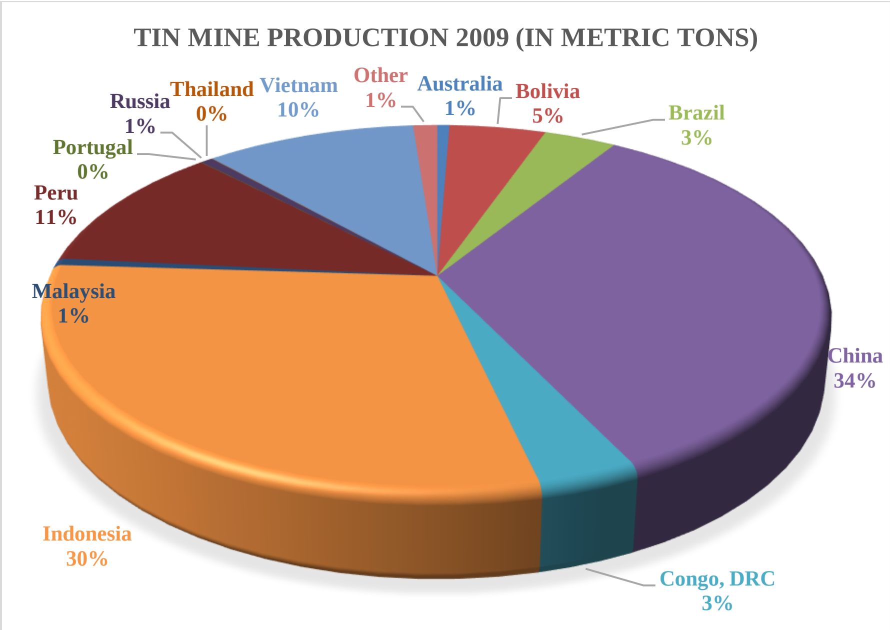
Most tin is found within the mineral cassiterite. Famous cassiterite deposits include the Cornwall deposit in England and the LLallagua deposit in Bolivia (Chesterman 1978). In the 1940s, the DRC was the second largest producer of tin behind Bolivia (ITRI 2008; Mukasa and Buraye 2009). USGS statistics from 2008 indicate that the DRC produced 4 percent of the global supply of tin. USGS statistics from 2012 show that tin from the DRC constitutes a lesser percent of the global market than prior to the U.S. conflict minerals law.

**Table 4.1. Tin Mine Production 2006-2013**

| Tin Mine Production (in metric tons of tin content) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **Average** |
| Australia | 2,000 | 2,100 | 1,800 | 1,400 | 7,000 | 6,500 | 5,000 | 5,900 | 3,963 |
| Bolivia | 18,000 | 16,000 | 17,000 | 19,000 | 20,200 | 20,300 | 19,700 | 18,000 | 18,525 |
| Brazil | 12,000 | 10,000 | 12,000 | 13,000 | 11,000 | 11,000 | 10,800 | 11,900 | 11,463 |
| Burma | - | - | - | - | - | - | 11,000 | 11,000 | 2,750 |
| China | 125,000 | 135,000 | 110,000 | 115,000 | 120,000 | 120,000 | 110,000 | 100,000 | 116,875 |
| Congo, DRC | 2,800 | 3,500 | 12,000 | 9,400 | 6,700 | 2,900 | 4,000 | 4,000 | 5,663 |
| Indonesia | 90,000 | 102,000 | 96,000 | 55,000 | 56,000 | 42,000 | 41,000 | 40,000 | 65,250 |
| Laos | - | - | - | - | - | - | 800 | 800 | 200 |
| Malaysia | 3,000 | 2,500 | 2,200 | 2,380 | 1,770 | 3,350 | 3,000 | 3,700 | 2,738 |
| Peru | 38,000 | 39,000 | 39,000 | 37,500 | 33,800 | 28,900 | 570 | 570 | 27,168 |
| Portugal | 200 | 100 | 100 | 30 | 30 | - | 26,100 | 26,100 | 6,583 |
| Russia | 3,000 | 2,500 | 1,500 | 1,200 | 1,100 | 160 | 280 | 300 | 1,255 |
| Rwanda | - | - | - | - | - | 1,400 | 2,300 | 1,600 | 663 |
| Thailand | 200 | 100 | 100 | 120 | 150 | 200 | 300 | 300 | 184 |
| Vietnam | 3,500 | 3,500 | 3,500 | 3,500 | 5,500 | 5,400 | 5,400 | 5,400 | 4,463 |
| Other | 4,000 | 4,000 | 4,000 | 2,000 | 2,000 | 2,000 | 73 | 70 | 2,268 |
| **Total** | **301,700** | **320,300** | **299,200** | **259,530** | **265,250** | **244,110** | **240,323** | **229,640** | **270,007** |

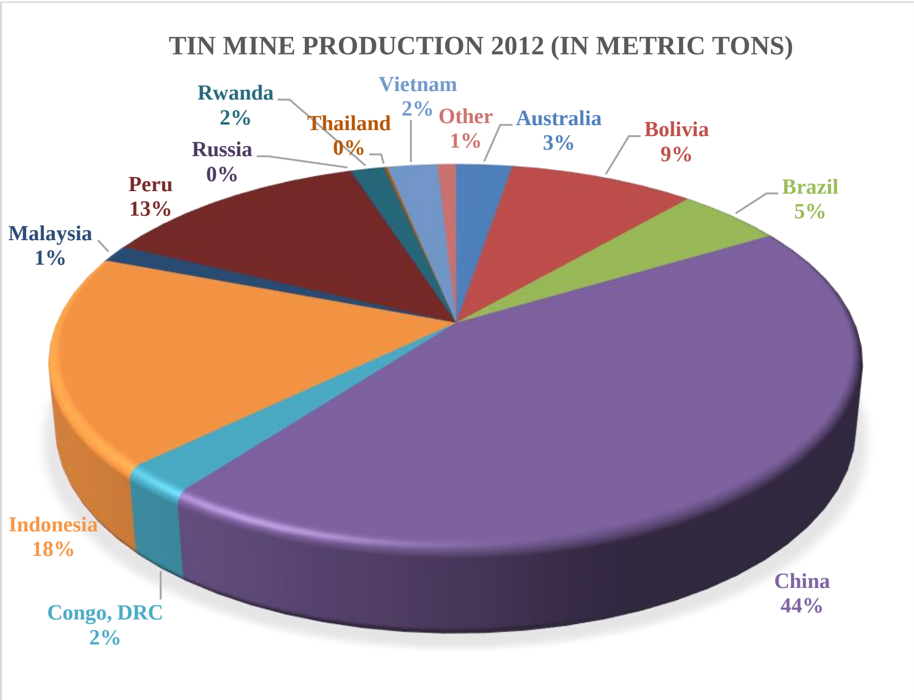
Source: USGS Mineral Commodity Summaries 2006-2014.

**Figure 4.1. Tin Mine Production in 2009**




Source: USGS Mineral Commodity Summaries 2010.

**Figure 4.2. Tin Mine Production in 2012**




Source: USGS Mineral Commodity Summaries 2013.

In the eastern region of the DRC is the tin belt. The most conflict-affected provinces, North Kivu, South Kivu, and Maniema, are the largest cassiterite (tin ore) producing areas with between 200 and 350 mining sites throughout the eastern provinces (ITRI 2009; Freedman 2011). According to the international tin industry group, ITRI, there is no formalized mining of cassiterite in the DRC; it is all artisanal means in these areas (ITRI 2009). Though the tin trade in the DRC is ten times greater, tantalum has gained the most notoriety due to its importance in specific digital applications.

**Tantalum**

Coltan is the African term for the mineral **col**umbite-**tan**talite, the "blood diamond of the digital age" (Mantz 2008, 36). Columbite, now called niobium, is used to create superalloys of steel with the strength and corrosion resistance necessary for aerospace technologies, nuclear reactors, chemical processing, and other applications requiring extreme temperature resistance (National Research Council 2008; USGS 2010). Tantalum is used in similar applications as niobium in the chemical and metallurgical industries. According to the US -based Cabot Corporation, one of the leading processors of tantalum, 40 percent of tantalum is used in: semiconductors, aerospace, energy and ballistics applications, and pharmaceutical processing while 60 percent of tantalum is used in electronics (Cabot Website 2011).

Coltan, the central African colloquialism for columbite-tantalite, is primarily used for tantalum content. Tantalum is essential in one specific application as capacitors, which are essential in pocket-sized electronics products. Tantalum was first used for capacitors in the 1940s (USGS 2010). The tantalum capacitor is what allows for the miniaturization of electronics due to its ability to encapsulate and instantaneously retransmit electronic charge

(USGS 2010) and thus allows for cellphone, iPods, computers, and any other electronic gadget to instantly power on.

In the midst of the second Congolese War, the price of tantalum (in coltan) exploded ten-fold in 2000, going from U.S. $30 per pound to U.S. $300. This jump in price is attributed to the rise in consumer electronics like gaming systems and cellular telephones. Mantz equates the price increase with the Christmas demand for the newly released of PlayStation 2, and "the DRC became a logical place to fill in the supply gap" (Mantz 2008). The financial incentive to extract coltan drove more into mining.

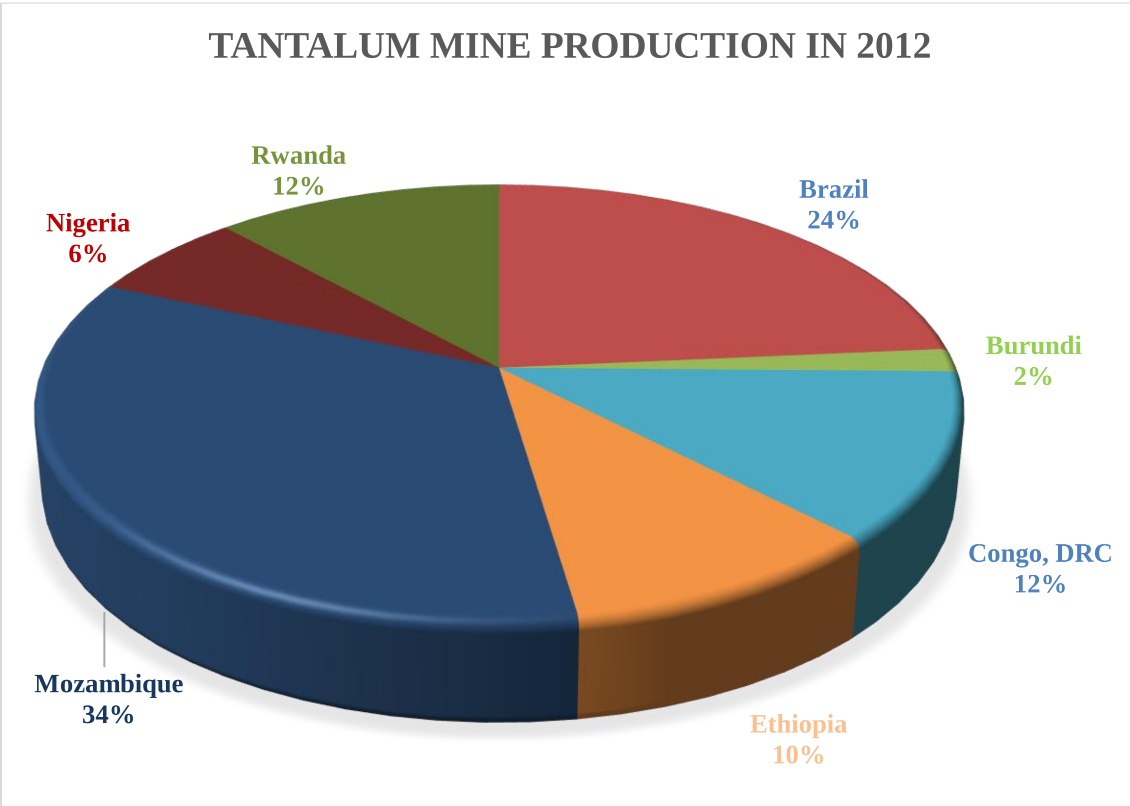
Tantalum has one of the highest melting points of all the metals, an important attribute in electronics. According to Cabot corporation website, 2 million pounds of tantalum was used to produce 20 billion capacitors. If each capacitor is equal, an average of 625 capacitors are made with every ounce of tantalum. Each capacitor contains a mere 45 milligrams of tantalum per capacitor. Aluminum and ceramics capacitors can be substituted yet would compromise the minute size of the electronics (USGS 2013). Tantalum is necessary as long as consumers demand small, effective digital devices. The National Research Council (2008) reports that,

> "Tantalum is essential for the dielectric resonators in 2.2 gigahertz cellular base stations. Although some substitutes for tantalum exist, they result in a loss of performance (i.e., more dropped calls) or shorter battery life" (2008).

It is critical in this application that uses the compound barium-zinc-tantalum oxide ($Ba_3ZnTa_2O_9$) and "substitutes for tantalum in this compound have proved ineffective" (National Research Council 2008). Where there is demand, the market will find a way to fulfill that demand.

The US is 100% reliant on imports of tantalum (USGS 2013). Tantalum is found in geologic association with tin and tungsten and is less prevalent on a global scale than tin. Trace amounts of tantalum are found throughout the world, yet high concentrations of the mineral are found and produced predominantly in Brazil, Russia, China, and Australia. Tantalum can also be recovered from tin slag as a byproduct in the smelting of tin. In Thailand and Malaysia tantalum is obtained in tin processing and typically very low grade.

**Figure 4.3. Tantalum Mine Production in 2012**




Source: USGS Mineral Commodity Summaries 2013

Other tantalum producing countries in Africa include: Ethiopia, Nigeria, Zimbabwe, Mozambique, Namibia, South Africa, and Egypt. Hayes and Burge (2003) from the Flora and Fauna Institute contend, "African tantalum is of long-term strategic importance" (37).

According to USGS, in 2008 the DRC contributed 9 percent of the world's tantalum and neighboring Rwanda also contributed 9 percent. The vast discrepancies in the data demonstrates the inability to understand the complexity of the mineral trade within central Africa, let alone the greater context of the global mineral trade. Seay (2012) claims Rwanda has no coltan mining itself, it merely trades Congolese minerals.

**Tungsten**

Wolframite, the principle ore of tungsten, is also commonly associated with tin and tantalum (USGS 2000; USGS 2013). Tungsten was first used as the filament in incandescent light bulbs; it has the highest melting point of all elements, making it ideal for high heat applications. Tungsten carbide has strength and density comparable to diamonds, making it ideal for mining drill bits, dental tools, and the tools used in machining of printed circuit boards. Other applications include: lead-free bullets, ballpoint pens, and in applications similar to niobium and tantalum requiring heat and corrosion resistance coatings. Other applications include: "phosphorescent chemicals in pigments, X-ray screens, television picture tubes, and fluorescent lighting. Tungsten is also used militarily as a heavy-metal alloy in armor- piercing ordnance and tank shielding" (USGS 2000; USGS 2013). Tungsten also makes cell phones vibrate. The Great Lakes Region of Africa contributed roughly 3 percent of the world's tungsten in 2008, though there are vast discrepancies in statistics. Appendix 1 provides additional information on mineral use geographic provenance and Appendix 2 includes a chart on the distribution of mine production from 2006-2013. Table 4.3 below is based on USGS statistics of tungsten mine production yet lacks statistics for the central Africa.

**Table 4.3. Tungsten Mine Production 2006-2013**

| Tungsten Mine Production (in metric tons of tungsten content) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | Average |
| Austria | 1,300 | 1,200 | 1,100 | 1,000 | 1,000 | 1,100 | 1,100 | 800 | 1,075 |
| Bolivia | 870 | 1,100 | 1,100 | 900 | 1,200 | 1,100 | 1,100 | 1,200 | 1,071 |
| Canada | 2,560 | 2,700 | 2,300 | 2,000 | 420 | 1,970 | 2,000 | 2,200 | 2,019 |
| China | 79,000 | 41,000 | 43,500 | 47,000 | 59,000 | 61,800 | 62,000 | 60,000 | 56,663 |
| Korea, North | 600 | 600 | - | - | - | - | - | - | 150 |
| Portugal | 780 | 850 | 850 | 850 | 1,200 | 820 | 820 | 800 | 871 |
| Russia | 4,000 | 3,200 | 3,000 | 2,400 | 2,800 | 3,500 | 3,500 | 2,500 | 3,113 |
| Other | 1,680 | 3,880 | 4,100 | 3,700 | 3,200 | 2,700 | 3,000 | 3,500 | 3,220 |
| **Total** | **90,790** | **54,530** | **55,950** | **57,850** | **68,820** | **72,990** | **73,520** | **71,000** | **68,181** |

Source: USGS Mineral Commodity Summaries 2006-2014.

The diversity of applications for tin, tantalum, tungsten, and gold demonstrates how many of our commodities contain these products. To return to the original inquiry into the story behind the commodity, the text of the law states, ‘any company using tin, tantalum, tungsten or gold’ is having a widespread impact due to the complexity of the global commodity chain and is requiring a multitude of companies to uncover the ‘life’ of their products. From Kraft to Tiffany’s, Rio Tinto to Apple, the widespread impact on the mining industry, smelting, metal processing, refining, and end component manufacturers led to industrial uproar and lobbying efforts which resulted in a period for public comment to SEC, a round table discussion, and the final rules for implementation were released in two years later in August 2012.

The global commodity chain of conflict minerals can be broken down into a six step process: the mines, trading houses, exporters, transit countries, refiners, and electronics companies (Prendergast and Lezhnev 2009). Many companies had previously argued that the commodity chain was too complex to figure out the source of their minerals and ensure they were not conflict minerals. While there are intermediaries within the different steps of the production process, this simplified version of the commodity chain from Enough Project, a main NGO pushing for the conflict minerals law, provides the basic steps in the production of nature into a resource and then into a digital commodity. To tackle conflict minerals, certification must happen at each step in the global commodity chain to ensure the efficacy. Prior to this law, there were many other industrial and IGO initiatives under way to sever the link between conflict and minerals. The next section breaks down the various methods to tackle certification at each level in the production hierarchy.

***Tackling Conflict Minerals: Industrial and IGO Initiatives***

Following the UN report from 2001, several industrial and intergovernmental initiatives were drafted to tackle the problem. The Organization for Economic Co-operation and Development (OECD) was formed in 1961 by those countries supporting both democracy and the free market. OECD Due Diligence identifies a five-step framework to provide a means for companies to assess their suppliers and the behavior of linkages in the commodity chain including a third-party audit and a report on due diligence in supply chain. The OECD Due Diligence was adopted as the framework to assess conflict minerals and endorsed by the 11 member states of the International Council on the Great Lakes Region (ICGLR), the document urges that,

> "Downstream companies [metal traders and exchanges, component manufacturers, product manufacturers, original equipment manufacturers (OEMs) and retailers] should establish internal controls over their immediate suppliers and may coordinate efforts through industry-wide initiatives to build leverage over sub-suppliers, overcome practical challenges and effectively discharge the due diligence recommendations contained in this Guidance" (OECD 2010, 19).

The OECD Due Diligence (2013) provides companies with a framework to understand the potential entry points of conflict minerals into the supply chain and serves as an overall guide to the sourcing of minerals.

The German Federal Institute for Geosciences and Natural Resources (BGR) sponsored the drafting of a chain of custody procedure called ‘certified trading chains’ (CTC) in mineral production which will be used in the tagging and tracking of ore bags (Johnson 2010). The method of tracking the bags of ores consists of ensuring the extraction site is not under the control of rebels or governmental armies, sealing and tagging the bag of ore, and tracking the bag as it travels to processing facility. The BGR also sponsored Nicholas Garrett to report on the Extractive Industry Transparency Initiative (EITI) and Certified Trading Chains (CTC). The EITI is a voluntary affiliation where countries report earnings for oil, gas, coal and ore minerals as a means of demonstrating anti-corruption and good business practices as discussed at the end of chapter 2. The EITI partnered with the German ‘Certified Trading Chains in Mineral Production’ to craft a pilot project for certification of Rwandan minerals (Garrett 2008). The Rwandan Geology and Mining Authority (OGMR) has been working with the German Federal Institute for Geosciences and Natural Resources (BGR) on the implementation of said certification scheme. (Rwanda was a German colony until World War I, perhaps explaining the sponsorship).

In attempts to tackle conflict minerals, UN group of experts suggested that the tin industry initiate a solution for themselves to keep conflict tin out of the supply chain (Freedman 2011). The tin industry, known as ITRI, is a coalition that “directly, or indirectly represents the interests of ‘importers, processing industries and consumers’ of Congolese cassiterite as well as the miners and downstream users of time” (ITRI 2009). The ITRI Tin Supply Chain Initiative (iTSCi) was established as a procedural means of verifying transparency in sourcing of minerals by providing a phased approach beginning with, 'official documentation in the formalized supply chain' including: licensing, legitimacy, authorization, and provenance (ITRI 2009). The Tantalum-Niobium International Research Center (TIC) is co-funding the iTSCi, which has been adopted as the means of certification based on principles including supply chain mapping, chain-of custody, legitimacy, business ethics, and avoidance of conflict finance. In January 2011, a Rwandan news source announced the commencement of mineral tagging, thus implementing the iTSCi certification scheme based off that which the OECD devised, and marked the first attempt to verify the origin of a metallic mineral.

Retracing the convoluted web of globalized metal production is especially complicated, far more complex than niche markets like coffee, timber, or diamonds. To tackle blood diamonds, the three largest diamond producers, South Africa, Botswana, and Namibia began talks in 2000 with the three largest diamond traders and consumers, US, Belgium, and the UK (Wright 2004). In 2002, fifty-four governments, the EU on behalf of member countries, the worldwide diamond industry, and over 100 civil society groups represented by NGOs adopted the Kimberley Process Certification Scheme (KP) covering the international trade of rough diamonds (Wright 2004). The KP is "not legally binding treaty between sovereign states…rather it is a set of politically-binding minimum common standards" including the way member states handle imports and exports (Wright 2004, 699). The diamonds must be accompanied by a certificate of origin using independent auditors for certification. The UN was intentionally NOT involved because, "mainly [due to] the need for swift, effective action" yet the process was 'blessed' by the general assembly (Wright

2004, 701). In the case of diamonds, they represent a niche market. Metal production and trading is far more complex.

Some products have successfully implemented certification and a standard practice for labeling however, Young and Dias (2011) contend, "materials exhibiting fundamentally different physical structures demand different strategies for effective LCM" under the theories of industrial ecology (8). 'Materials stewardship' distinguishes based on composition – cellular, molecular, and metallic – and the means of tracking and tracing the potential pitfalls in certification procedures. Timber and coffee are 'cellular' which uses chain-of-custody certification for tracking; molecular-scale materials are diamonds, also using chain-of-custody through the Kimberley Process. Diamonds and timber retain composition throughout the production process whereas metals undergo entire transformation. According to Young and Dias (2011), "the physical aspects of the metal supply chain, such as the mixing of sources and transformation of minerals to metals, create the biggest challenges to life cycle management (LCM) of these 'conflict minerals'" (Young and Dias 2011, 1). Resolve research group (2010) comments the major challenge of implementation is the 'extreme complexity' of the electronics supply chain' and second, global metal markets mix together supplies of metals from all over the world in global pools (Resolve 2010; Young and Dias 2011). Thus, the greatest challenge in metallic certification is in the smelting process.

***Analytical Fingerprinting and Conflict-Free Smelters***

German Federal Institute for Geosciences and Natural Resources (BGR) sponsored procedural undertakings to fingerprint the mineral 'coltan' by extracting core samples from mineral enriched areas. These core samples offer a chemical signature of minerals from the

DRC, Rwanda, and other global deposits to distinguish ores based on chemical signature, giving its provenance (BGR 2008). The analytical fingerprinting is useful because,

> "About 40% of the world tantalum production originates in African countries, especially in the DRC… 'coltan' has been identified as a suitable object for a pilot study on the development of a methodological approach capable of distinguishing the origin of ore concentrates in Central Africa" (BGR 2010, 1).

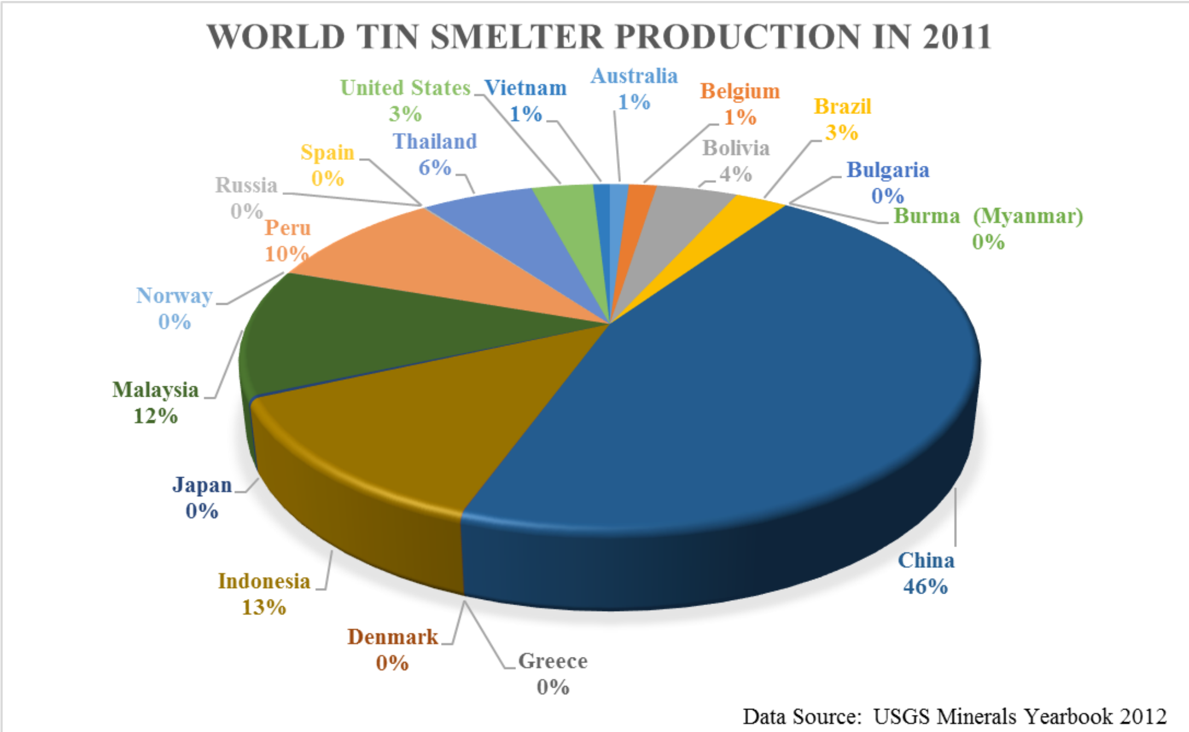
The database will include over 5,700 samples of tantalite ore from 110 sites as a means of comparison if the source is contested. According to BGR (2010), the analytical fingerprinting program was to be extended to tin by the end of 2011 and tungsten was targeted by 2012 or 2013.

The provenance of the ore must be verified prior to smelting because the chemical fingerprint disappears in the process (Resolve 2010). The National Research Council (1975) notes, "reduction to the metallic state involves energy expenditure for breaking chemical bonds of nearly every atom present" (1). Because the metals are heat-treated, melted, and alloyed, the composition is altered and the chemical signature disintegrates in the smelting and refining process. If the rock is not designated conflict-free on the ground, it will go to a smelter and be mixed with other ores, thus contaminating batches of refined metals. If an end-user electronics company desires the designation conflict-free, the commodity chain linkages must go back to the smelter to ensure provenance of ore materials. The smelter product, the refined metals then alloyed and fashioned into components for minute electronics devices, can all be certified as conflict-free. Therefore it is the smelting process that serves as a bottleneck in the certification of conflict minerals. A company can claim 'DRC conflict-free' if the entire stock of ore which enters the smelter and is processed at is also designated to be conflict-free.

The electronics industry, acknowledging the inherent environmental and social externalities associated with raw material extraction and manufacture, formed the Global e-Sustainability Initiative (GeSI) in 2001 and in 2004, the Electronics Industry Citizen Coalition (EICC) was formed and now includes over fifty global electronics companies. The smelter is the bottleneck in conflict minerals certification. All ore entering the smelter must be certified in order for the product to be certified and labeled as conflict-free. The GeSI and the EICC are in the process of implementing a voluntary conflict-free smelter (CFS) program and in December of 2010, the first tantalum assessment was completed and the conflict-free smelter program was launched. By the end of the first quarter of 2011, the two alliances were projected to publish a list of conflict-free tantalum smelters (Resolve 2010). The target date for the commencement of tin, tungsten and gold smelter audits is 2011. The GeSI and EICC announced in May 2012 the first conflict-free smelters for tin and tantalum, establishing a conflict-free material supply from the DRC. Audits are conducted by independent third party and based on the assessments, the smelter can gain the designation as conflict-free. Purchasers can then choose a compliant smelter or persuade key manufacturers in backward linkages to buy from certain smelters based on the assessment (GeSI 2010).

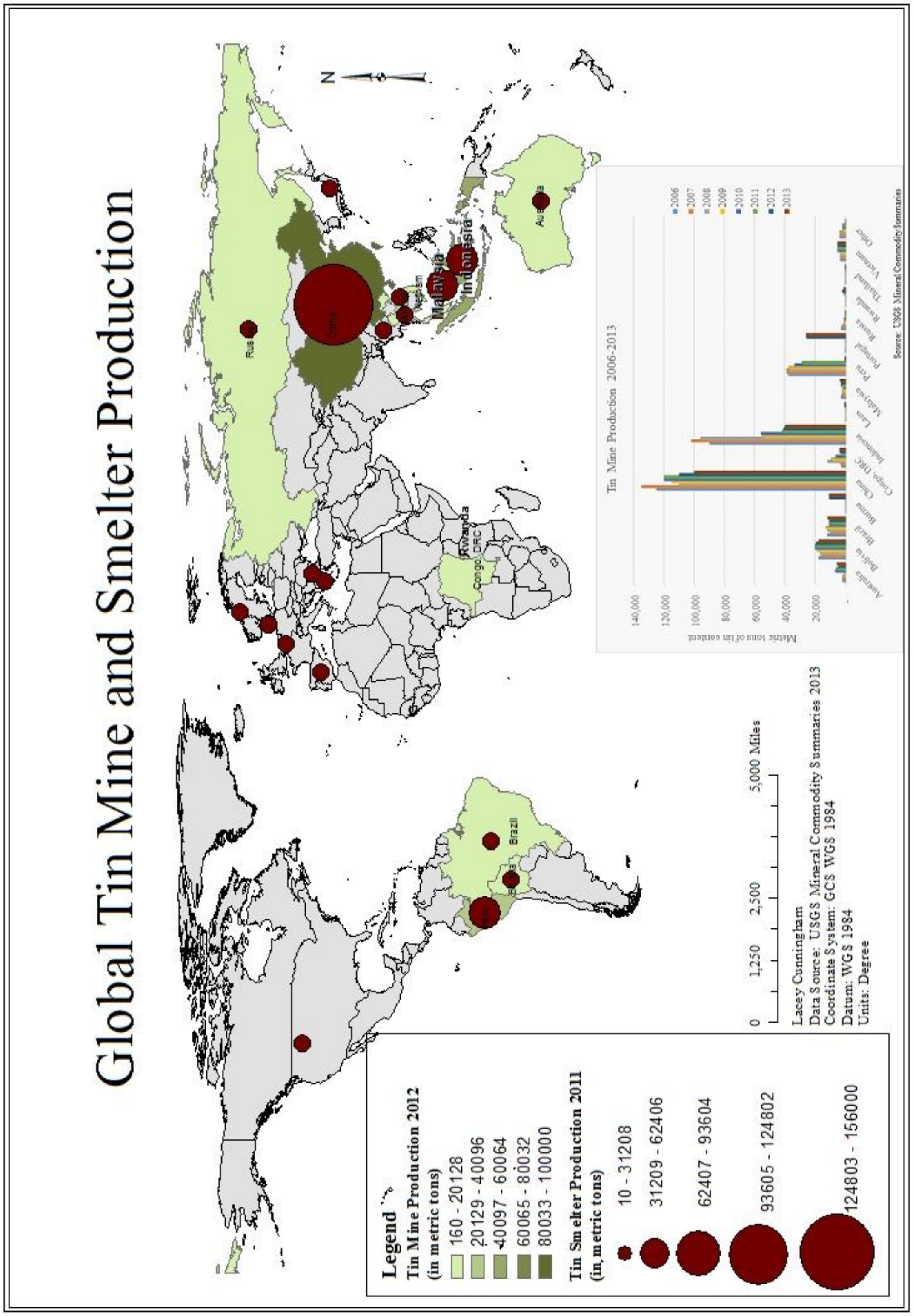
The processing of ores occurs in spatially specified locations. Figure 4.4 below shows the global distribution of tin smelters followed by a map of global tin mine and smelter production.

**Figure 4.4. World Tin Smelter Production**



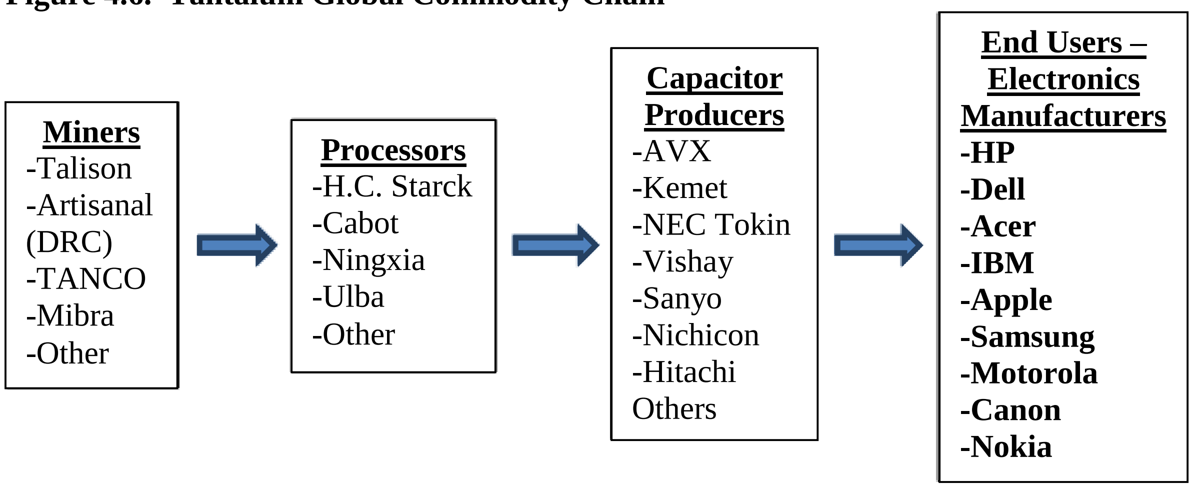

In order to have a stock of conflict-free tin available for end-producers desiring the label conflict-free, smelters in the countries listed above must conflict free smelters. Figure 4.5 below gives a map of global tin mine and smelter production.

**Figure 4.5. Map of Global Tin Mine and Smelter Production**



Retracing the 'life' of a product through the global commodity chain is forcing American companies to exercise power in a multinational context. This provides fascinating insight into the globalized marketplace for minerals as this undertaking poses multiple challenges unforeseen in the world of certification as no processed mineral has yet to incur systematic certifications of origin. Figure 4.6 below shows the global commodity chain of tantalum to illustrate the different tiers in the production process and the companies that end user electronics manufacturers must exercise control over in order to attain a 'conflict-free' label.

**Figure 4.6. Tantalum Global Commodity Chain**




Source: Ma, T. (2009). "China and Congo's Coltan Connection" *Futuregram 09-003*, The Project 2049 Institute.

The tantalum commodity chain represents a niche market and is relatively simplistic in comparison to that of gold, tin, or tungsten. Tantalum is a privately-traded commodity; it is not sold on a metal exchange market nor are the sales of tantalum publicly disclosed. This is one of the reasons tantalum (coltan) became the most prominent of the conflict minerals. There are three main processors of tantalum, the German-based H.C. Starck, the United States-based Cabot Performance Materials, and Ningxia Non-ferrous Metals of China.

According to Hayes and Burge (2003), “it is in the tantalum industry’s interests to gain legitimate access to a regular supply and to contribute to the stability of the international market” (42). Because it is a niche market, the tantalum industry has the potential to contribute greatly to a legitimate marketplace.

***Impact of Conflict Minerals Law***

The conflict minerals provision caused a stir in both industrial groups as well as human rights advocacy groups. Industrial groups argued that certification would be too costly (Global Witness 2012; Seay 2012). Many argued the implementation period was too short, and because industries would scramble to find conflict-free sources, a de facto embargo would result. Even with the passage of the conflict minerals law, the Malaysian Smelting Company stopped purchase of minerals from central Africa (Seay 2012). Verbruggen, Francq, and Cuvelier (2011) caution that minerals from other continents should not be certified as conflict-free because that could dissuade companies altogether from purchasing African tantalum, thereby imparting a de facto embargo.

Following the inclusion of conflict minerals in the Dodd-Frank in 2010, the Pole Institute on the ground in the Congo suggested the law aimed to make corporations accountable did effectively place an embargo on central African minerals. Goma is a border town of the DRC and Rwanda situated on the north side of Lake Kivu. Without airplanes flying the minerals from Goma, no traded goods return to the area (Seay 2012). The very population this legislation is aiming to protect was adversely impacted. A long standing fear, following the signing of the Dodd-Frank in September 2010, DRC President Joseph Kabila banned mining activity in the eastern DRC, in North Kivu, South Kivu, and Maniema provinces while the industrial-scale, ‘legitimate’ mines in Kasai and Katanga provinces remained opened (Rudahigwa 2010). The ban remained in effect for several months.

The short time span to begin implementation of conflict minerals caused an industrial uproar until concerned parties, particularly mining and manufacturing industry representatives, could congregate and clarify what exactly was meant by 'any company that uses tin, tantalum, tungsten or gold.' Lobbying efforts for the delay were partially due to the way metals are purchased on global commodity markets. Most metallic commodities are traded in 18-month to multiple-year contracts with many international players. The original time allotted for implementation was 270 day, which would require companies to retrace their product through the component manufacture to ascertain information on the supply the refined metal. Smelters that are extremely energy-intensive and cannot operate without supply contracts.

The complexity of certification and the industrial need for clarification led to a delay in implementation. The SEC was open to public comments that were made available on the SEC website. With over 15,000 comments regarding the provision, a round table discussion that was held in October 2011 (6 months after the original date of intended enactment as given in Dodd-Frank) to deliberate on the procedural means of implementing the conflict minerals law. Attendees included representatives from General Electric Company, Kraft Foods, Boeing, AngloGold Ashanti Limited Mining Company, Signet Jewelers, and other industrial sectors, and representatives from the two major NGOs fighting to have conflict minerals brought onto the international agenda, Global Witness and Enough Project. The U.S. Securities and Exchange Commission (SEC) rules on the implementation of 'DRC conflict-free' was released sixteen months late.

In August 2012, the final procedures were outlined in a lengthy report (~350 pages) from the SEC. The procedures require third-party auditors to oversee the certification process. A *Wall Street Journal* article 23 August 2012 claims the cost of certification to companies will be between U.S. $3 billion and U.S. $4 billion initially with annual costs more than U.S. $200 million. This estimate was much higher than the original figure put forth by the SEC. As Eden (2011) notes, certification costs money and the cost of this process would likely be reflected in the price of the consumer product. Lobbying efforts from big box stores resulted in their exclusion from the mandates. Because stores like Wal-Mart, Target, and Best Buy affix their store brand name to generic products but do not exercise control over the production process of those products, they were excluded from the requirements of due diligence (e.g. a Best Buy TV, a Wal-Mart stereo, or a Target alarm clock). Company representatives claim the corporations will do what it can to ensure the sourcing of minerals, yet they will not be subject to the same labeling rules.

The idea behind the 'name and shame' game is to tie a commodity to an exploitative practice to target producers of the commodities. Exposure of corporate practices and a tie to a brand name will dissuade the conscientious consumer from purchasing their product (Conroy 2007). The very technology created by these minerals from all over the world are the same technologies that will "keep the industry honest" (Grant and Taylor 2004, 390). The internet has changed the world in countless ways but in particular, the availability of information and the creation of an avenue for international discussions of concerned citizens. It is a global information superhighway to find out what your various companies are doing. The same is true with the push for transparency in extractive industries. Using corporate branding can bring about negative campaigning and a push from consumers for companies to change actions. As Le Billon (2004) notes,

> "Competing businesses convinced of their own powerlessness assert their neutrality and continue to serve as intermediaries between local actors and global consumers; leaving a wide gap of accountability that an economically disempowered population cannot easily fill" (7).

Solutions for Hope is an industrial initiative established by Motorola Solutions in a "unique approach to mineral sourcing in the region utilizes a closed-pipe supply line and a defined set of key suppliers – mines (including artisanal cooperatives), smelter/processor, component manufacturer and end user – identified in advance of initiating the project" (Solutions for Hope website). Any company involved in the mineral extraction, processing, or manufacturing may join. The current members are outlined below in Table 4.3 below.

**Table 4.3. Companies Participating in 'Solutions for Hope'**

| |
|---|
| AVX |
| Cooperative Des Artisanaux Miniers du Congo (CDMC) |
| F&X |
| FairPhone |
| Flextronics |
| Foxconn |
| Global Advanced Mining (GAM) |
| HP |
| Intel |
| Mining Minerals Resources (MMR) |
| Motorola Mobility |
| Motorola Solutions |
| Nokia |
| Research in Motion (RIM |

Source: Solutions for Hope Website.

There have been several front runners in the effort to eradicate conflict minerals from their products including Intel, HP, Apple, and GE; they have also been key advocates for the establishment of more conflict-free, legitimate commodity chain. According to Lezhnev and

and Hullmuth (2012) from the Enough Project, at the forefront of implementing the conflict minerals provision are Intel, HP, SanDisk, Phillips, AMD, RIM, Acer, Dell, Apple, Microsoft, Motorola, Nokia, and Panasonic with over 30 percent progress towards responsible sourcing of conflict minerals, while Nintendo has made no progress. The conflict minerals law by no means prevents the trade of tin, tantalum, tungsten or gold from the DRC. Many reputable companies have set up closed-circuit buying markets with the company operating the entire chain of production, from the mine to transporter, to processor, to manufacturer, to assembly of final product. Since the initial signing of the law, coverage of the conflict in the DRC and the issue of conflict minerals has dramatically increased. Fiscal year 2013 will be the first year in which companies are required to disclose sourcing so it is anticipated that by June 2, 2014, the first disclosure will be made and the conflict-free label will be affixed to consumer products in the following months.

In a path towards creating a more fair, sustainable, and conflict-free digital device was the formation of the Dutch company Fairphone. Fairphone is creating a 'fair' smartphone using innovative design, responsibly sourced minerals, conflict-free minerals, and accountability in end-of-life recycling. The company required 25,000 preorders to begin manufacturing the Fairphone and on January 31, 2014, the last of the first batch of phones was shipped (Fairphone website 2014). This demonstrates how NGOs are seeking alternative approaches to address the inherent inequality in the globalized world-system.

# Chapter 5
# Discussion and Conclusions

The United Nations Environment Program (UNEP) International Panel for Sustainable Resource Management identifies metals as a major sustainability challenge in the 21$^{st}$ century (UNEP 2012). While there is a popular notion that recycling will resolve many of the issues of finite material consumption, in the words of Kesler (2010), "recycling and substitution postpone the problem of exhaustion, but do not resolve it" (109). Metal recycling for some metals proves effective (e.g. copper is 100% recyclable without degradation) however, for many of the minor metals used in alloys, recovery is virtually impossible due to the tiny proportion of the mineral and energy expenditure required. Recycling technologies for many metals are energy intensive, inefficient, and costly.

Current recycling technology is inadequate and economically inefficient for the recovery and reuse of many metals within electronics. Reck and Graedel (2012) claim modern technology has created a conundrum: "the more intricate the product and the more diverse the materials set it uses, the better it is likely to perform, but the more difficult it is to recycle so as to preserve the resources that were essential to making it work in the first place" (691). For many of the 60 plus elements needed for computer chip technology, the amount of each is too small to warrant effective recycling. The amount of energy it takes to re-extract the mineral from the alloy in which it was embedded makes it virtually impossible. Until recycling technology proves effective for tech metals, the first use must be perceived as the only use. The prevalence of electronics, high rates of replacement technology, constant upgrades in cellular phone packages, transition to smartphone technology, and because recycling technology is not yet sufficient, virgin ores are needed to create new digital devices.  However, recycling technology will improve and many in the field of industrial ecology are working to design products with the end-of-life in mind.

There is no argument against the need for mining; to reiterate the words of Agricola in 1556, "without metals, 'men would suffer a horrible and wretched existence in the midst of wild beasts'" (Agricola 1556; Bridge and McManus 2000).  Metals are the foundation of advanced civilizations; metal consumption is directly correlated to development.  Based on demand from emerging economies, Backman (2008) contends a two to three fold increase in metal consumption by 2050.  Gerst and Graedel (2008) claim 3-9 times as much metal stocks will be needed (7038).  Based on current infrastructure, mass transit, electricity transmission, and other consumer goods, Gordon et al. (2006) find seven times as much copper will be needed if South Africa and China are to reach the same standard of living (1214).  The consumption of finite nonfuel mineral resources for the explosion of global capitalism in China is requiring not only the expansion of mining projects throughout the territory, but also throughout the world, particularly Africa.

Appendix 1 features the use and geographic distribution of selected minerals. Appendix 2 provides a series of charts on global mine production for each of the selected minerals.  The minerals were chosen for several reasons; first the conflict minerals; second, minerals essential in their role in digital technology, alternative energy production, rechargeable batteries, or modern infrastructure; third, the eleven minerals outlined by the National Research Council (2008) *Minerals, Critical Minerals, and the US Economy*; fourth, the minerals with a large concentration on the African continent are included, i.e. cobalt in the Congo and diamonds throughout Africa; and fifth, the tables and charts include mineral ores that must be processed to derive a byproduct metal, i.e. indium is a byproduct from the mining and processing of zinc. The appendices are an essential component of this research and their relegation to the back of the paper is by no means an indication of their importance. The tables and charts bolster the arguments about the importance of specific minerals, the limited geographic occurrence, the power of the world-system that follows the minerals, and therefore the importance of transparency in extractive practices.

In the appendices, China stands out particularly for the production of rare-earths, tin, tungsten, vanadium, zinc, the refining of indium and the smelting of aluminum. The lack of environmental and social scrutiny of extractive practices in the Chinese marketplace provides not only a place to extract resources, but also a way for companies to launder minerals derived from contested origins. China is the hub of international manufacturing with exponentially increasing prowess in the international market. China poses a major hurdle in the implementation of the conflict minerals provisions for several reasons but primarily because Chinese manufacturing dominates the world market especially for electronics production. Second, U.S. companies must exercise control over the production line in China. And third, China has a contract with the DRC for minerals in exchange for infrastructure development.

***China in the Congo***

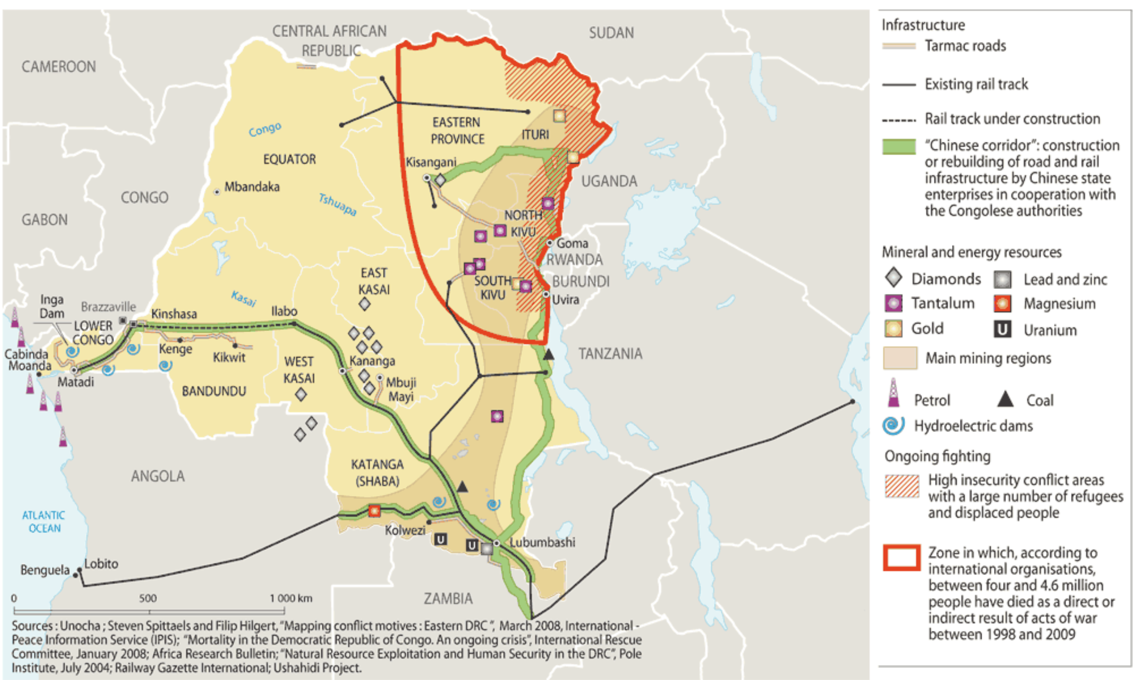
> *"The vitality of a powerful nation depends on its ability to secure access to the strategic resources necessary to sustain its economy and produce effective weapons for defense. This is especially true for the world's two largest economies, those of the United States and China"* (Butts, Bankus, and Norris 2011, 1).

China's burgeoning economy is redefining the Brandt Line from its previous classification within the 'poor global South' into a wealthy global power. China's demand for and acquisition of minerals is increasingly important. The international trade landscape is transitioning from Western-centric importers of sub-Saharan Africa's minerals to Eastern locations of China and India (Guenther 2008). Africa is at the center of a new resource scramble and the new competition between East and West. The dynamics are shifting from the East-West competition of the Cold War Era to an East-West competition with the development of Asian economies, especially in China. The emerging economies of both China and India require resources to feed the development. Because the use of metals is coupled with economic development, the resource needs must be met by expanding extraction to greater and greater spatial scales. As Ushie (2013) claims, "Africa's extractive sector has become the epicenter of a global resource scramble" (1).

Collier (2008) concurs the growth of China's economy offers a new competition for African resources as opposed to the Eurocentric oligopoly over Africa. As Guenther (2008) notes, "in 2003, China accounted for more than 100 percent of the growth in world demand for commodities exported by DRC" (357). Exports of mineral raw materials from DRC to China grew by a factor of 3.5 between 2008 and 2009 to 892 billion Congolese Francs (Guenther 2008). As discussed in the second part of chapter 2, many of the U.S. strategic and critical mineral needs are either mined in China, or smelted in China. According to Butts, Bankus, and Norris (2011), "China's resulting role in the mineral trade has increased Western security community concern over strategic minerals to its highest point since the end of the Cold War" (2).

Congolese President Joseph Kabila signed an agreement with China to trade minerals ion exchange for infrastructure development in 2008. Figure 5.1 shows a map of the road that is being built by financing from the Chinese in exchange for rights to the Congo mineral concessions.   "In the Democratic Republic of Congo alone, Beijing has signed deals in which around U.S. $8 billion of transport infrastructure will be built in return for extraction rights" (Collier 2008, 207).  Collier contends the 'path of progress' for Africa perhaps lies in the Chinese model of direct foreign investment in infrastructure in exchange for minerals.  This method circumvents the IMF and World Bank requirements of first demonstrating democracy and political efficacy prior to obtaining the necessary loans for rebuilding the disrepair of the infrastructure in the DRC.  As President Zuma of South Africa famously commented, "you cannot eat democracy."   The Chinese Road will provide a means for future improvements in development and the necessary prerequisite for a successful trade of minerals.

**Figure 5.1.  Map of the Chinese Road in DRC**




PHILIPPE REKACEWICZ

Source:  Rekacewicz, P.  2008.  DRC Minerals and Infrastructure.  *Le Monde Diplomatique.*

The road being built in the DRC is one example of China's strategic move to acquire rights to minerals. This method circumvents the tedious and complex means by which least developed countries obtain infrastructure develop loans under the precepts of the IMF and World Bank. According to Collier (2008), "quite possibly, the new competition for Africa between rising Asia and the Organization for Economic Development (OECD) may leave a much better legacy than earlier scrambles" (207), suggesting that the Chinese approach might better serve the people of the Congo. With infrastructure development, the Congolese will have greater opportunities for transportation within their territory and can serve as an essential step towards translating resource wealth into social development. Since the investments are not coming in the form of money but instead in the form of construction and infrastructure development, perhaps corruption will not be as rampant as it is with the direct transfer of capital. This will perhaps bolster the ability of the Congolese people to capture some of the money from the mineral resource wealth.

According to the UNEP, "economic development is deeply coupled with the use of metals…metals are a core, centre-piece of the global economy" (UNEP 2012). Despite the environmental externalities inherent in the practice of mining, resource consumption in the short term for infrastructure development will lead to more sustainable human societies in the long run. Infrastructure development then leads to economic development and social development, then consumption of metals will lead to poverty eradication, as is the goal of both the World Bank and the UN. If it be the case that infrastructure will lead to the alleviation of poverty through the consumption of metals, then mining and consumption of metals on increasingly spatial scales is necessary. These two points illuminate the importance of local mineral development projects. If the prerequisite for sustainable human societies is infrastructure and the consumption of metals for infrastructure leads to social development and poverty alleviation, and if a cure for the resource curse is capturing the value-added from the transformation of nature into a resource, then by locating the refining and processing facilities within the territory of the mineral extraction site, the population will be able to build infrastructure for themselves as well as capture the value-added from exporting more refined products. Perhaps this is the path towards curing the resource curse in many areas such as the DRC.

***Return to the Story Behind the Commodity***

Commodity stories are tales of resource geographies in a globalized world. The discipline of geography offers a unique lens to encompass the diversity of the field. "Linked to political geographies by concerns over territoriality and proprietorship, to economic geographies through networks of production and consumption, to social and cultural geographies by collective practice and meaning making, and to environmental geographies through the modification of natural systems, the study of resource geographies requires consideration of both the 'human' and the 'physical' sides of the discipline" (Rossiter 2010, 2446). Because an object is the embodiment of processes according to historical materialists, the lens of the commodity affords insight into both the physical side of the discipline through mineralogical comprehension, and the social side including the material construction of the product and the political and economic systems in which that production takes place. Geographical research affords opportunities to weave together a diversity of research address modern challenges such as the social and environmental injustices associated with neoliberal production of nature.

To restate Zimmerman (1951) succinct words, “resources are not, they become.” In advanced globalization, the transformation of nature into a resource and a resource into a commodity, involves an intricate web of international transactions. Our digital commodities are a culmination of pieces of rock from all over the world. Retracing the commodity chain of the cell phone to the metal to the rock illustrate the complexity of trade networks in the globalized system. These neoliberal constructs capitalize on unequal exchange and declining terms of trade. Because fuel costs are relatively low, it is profitable to ship rocks thousands of miles, refine and process them into metals in another location, then ship for component manufacture, ship again for end-product assembly, and then again for consumption. Each link in the global commodity chain of metal is profitable enough that transportation costs are not a barrier. Vast amounts of energy and fossil fuels for transportation are necessary for the international production of metals. This is an inherent flaw in the application of the word ‘sustainable’ to global enterprises because as of yet, we have not resolved the necessity for nonrenewable fuel resources for transportation. Without the ability and/or relatively cheap costs of fuel for transportation, rocks and metals would not be transported in the manner they are now.

Mining is the first step in the global commodity chain and therefore the cost of raw materials extraction must be kept to a minimum. Minimal costs are met in locations with less stringent environmental and social regulation and where foreign direct investment is encouraged. More than 90 countries revised their mining codes since 1985 due to the espousal of neoliberalism (Bridge 2004b). A guiding precept is deregulation and privatization of mineral concessions. The capital-intensity of mining and forestry can lead to corruption in public officials and conflict over control of the resource. If a government derives revenue from mineral concessions, authoritarian rulers can emerge and their reign sponsored and maintained by external, international investment capital, sometimes even despite blatant human rights abuses. If a government is not accountable to the people, social development is stifled if not destroyed, poverty is rampant, and alternative ways to meet basic needs are met, which creates the context for armed groups to gain access to and control of resources that capture a high price on the global market. Resources can be traded for weapons, and more weapons propagate continued violence. To reiterate the words of Bridge (2007), "to produce nature as resources is an exercise of power" (864).

Fluctuations in metal prices impact the spatial extent and intensity of mineral extraction, revealing the inextricable connection between the metal markets and global landscapes. The entire process of mining is one motivated by global neoliberal capitalism. The expansion of the commodity chain became cost effective for the companies operating from within Western venues. To return to Amin's monopolies of the center, monopoly over access to resources and ability to create weapons of mass destruction. Under neoliberal capitalism, most populations of the world are in some way pulled into the greater globalized world. Societies formerly excluded are now infiltrated by the doctrine of the free-market, what the global political economy will pay for their goods or service. The hierarchy of global capitalism mandates declining terms of trade and unequal exchange. Mineral deposits are spatially bound and politically constrained. Without reliable access to minerals, the economy would be jeopardized; access to critical minerals is in fact a matter of national security especially for the world powers.

All mining decisions are motivated by the global political economy, demonstrating the asymmetrical power relations in a global capitalist society. In this thesis, I focused on the role of the structural political economy to, "highlight themes of external control, resource rights, and environmental justice" (Bridge 2004a, 205). Mining and other natural resource extraction industries are more capital-intensive than any other industry and transform the landscape more than any other industry. The force exuded by mining companies over territory and the ensuing impact on the environment and the cultures reliant upon that geographic space. Corruption and violence often result from the exploitation of nature and the inequality of power in the context of neoliberal globalization. The environmental and social externalities and corruption are all reasons why transparency in extractive industries is important.

The story of metallic commodities reveals the complex web of resource geographies in an age of neoliberal globalization. In this case, the lens of the digital commodity exposes the plethora of elements from the periodic table needed in the creation and functionality of the device. Exposure of the commodity's constituent parts reveals the diversity of mineral extraction locations throughout the world. Popular journals have inquired about the topic including the *New York Times* article, "How Green is my iPad?" (4 April 2010) or the *Mother Jones* article, "Your Smartphone's Dirty, Radioactive Secret" (23 November 2013). The fall 2010 issue of *Virginia Quarterly Review* entitled, "The Price of Paperless: Inside the Mines that Feed the Tech Revolution," provides case studies on lithium mining in Bolivia, copper mining in Chile, lead in Kosovo, tin mining in the Democratic Republic of Congo, and the mineral potential of Afghanistan to illuminate the impacts of resource extraction for minerals necessary in high tech applications. The October 2013 edition of *National Geographic* presents "The Price of Precious," an article covering the militarized mining in the eastern Democratic Republic of Congo. All of these articles call attention to the environmental and social injustice surrounding the extraction and production of now mandatory digital products. Contributing to greater literatures on resource geographies in globalization, this research illuminates the multitude of mineral landscapes required for production of a commodity such as a smartphone. The ultimate goal of my research is to inform discourse on resource geographies for the production of metals in advanced globalization.

As technology advances, so do the number of minerals necessary. Minerals are necessary; the global demand for resources shapes geopolitics. Scrutiny of the environmental and social externalities and the underlying geopolitical structures within extractive industries is necessary in a globalized world pushing for more fair, sustainable, and transparent consumer products. The very subject of this research inquiry would not be possible without these minerals from all over the world. One of the many conundrums of the modern world is that my entire master's thesis is only possible because of the very minerals of inquiry. However it is also through this technology that the production process is transparent. Through transparency and disclosure of payments made to foreign governments, civil society can be made aware of what corporate actions and keep companies honest and accountable for their actions.

***Current Events***

The changing state of affairs in the Congo and on the global market was a challenge in this research. However, some changes were welcome ideological shifts. In November 2013, the UN changed its long time stance as peacekeepers and engaged in battle with the armed group known as M-23. Reports suggest the UN successfully disbanded the militant group. If the UN continues to engage the armed groups, hopefully the resistance will force other armed groups to disband and cease terrorization of the population. If the conflict minerals law proves effective, revenue will be removed from militants and armed groups. Minerals will still be sourced from the area, but only those bagged and tagged with a certificate of origin will be purchased by global smelters seeking 'conflict-free' status. The situation in the Congo is still tenuous, but perhaps UN engagement will improve the situation.

***Concluding Remarks***

Over the past decade, intergovernmental organizations (IGOs), NGOs and industrial groups have tried to tackle conflict minerals, however, the global commodity chain of metals is exceedingly complex, especially in neoliberal capitalism. The economic downturn of 2008 demonstrated capitalism gone awry and the pitfalls in unregulated economic activity. The mitigation techniques were designed to curtail fraudulent business practices were encapsulated in the Dodd-Frank. Sections 1502 and 1504 were included within the sweeping Wall Street Reform measures and both require corporate transparency in extractive practices. The impact of these laws is reverberating throughout the globalized system.

This thesis explored the reasons why extractive industry transparency is important. Novelty in research is in the timeliness of this geographic inquiry into the globalized production process of minerals, particularly minerals critical to the functioning modernity. Second, I focused on the conflict minerals law to articulate the complexity of the global commodity chain of metals and challenge of implementing the first systematic certification of metallic products. The inclusion of the measures in the Dodd-Frank stands as a testament to the utility of the commodity story in typing an exploitative production process to a product. As in the case of diamonds, by connecting a product, in this case the computer or cell phone, to bloodshed has resulted in an increased push for transparency and certification from NGOs and international civil societies. NGO campaigns raised consumer awareness and successfully pushed conflict minerals onto the global agenda and included within the Dodd-Frank. Corporate reputation and branding will be put to the test.

Material goods can inadvertently perpetuate atrocities abroad due to discrepancies and inequalities within the global capitalist system. Because of this powerful dynamic in the capitalist world-system, corporations (without accountability) can wreak havoc on places formerly excluded from the world market. The stories behind the creation of the commodities often highlight tales of global inequality, environmental destruction, and human rights violations, have led to the emergence of transparency and accountability of corporate actors. The story of metallic commodities reveals the complex web of resource geographies in an age of globalization. We are inherently reliant upon foreign supplies of essential materials for modern technology; our lifestyles and consumer actions are thus intertwined with those of the central African in the complex web of the international political economy. The hope is that through certification and labeling of the minerals tin, tantalum, tungsten, and gold, the gender –based violence and death with cease in the Democratic Republic of Congo.

In the upcoming months, the new label will appear on products such as smartphones, laptops, and other electronics. By June 2, 2014, any U.S. company using tin, tantalum, tungsten, or gold, will file an annual report with the Securities and Exchange Commission stating whether or not their products use minerals that finance armed groups in the

Democratic Republic of Congo or adjoining country. If a company can retrace their product and ensure the raw materials used were not purchased from warlords in the DRC or adjoining countries, then the product can be labeled 'conflict-free.' The first reports must be filed with the SEC by June 2, 2014 and thereafter the label, 'DRC conflict-free' will be attached to consumer electronics products.

To restate the words of Taylor (2005), "certification and labeling initiatives worldwide gain growing attention as promising market-based instruments which harness globalization's own mechanisms to address the very social injustice and environmental degradation globalization fosters" (129). In an era with people seeking more socially and environmentally benign product, transparency in the production process provides a means to demonstrate acceptable social and environmental practices of extraction, harvesting, living wages, and to ensure the product was not derived through conflict that may have cost the life of someone on the African continent.

**Further information is available at the following websites:**

Blood in the Mobile website. http://bloodinthemobile.org/

Conflict-Free Sourcing website (by EICC and GeSI). http://www.conflictfreesourcing.org/

Enough Project website. http://www.enoughproject.org/conflicts/eastern_congo

Extractive Industry Transparency Initiative website. http://eiti.org/eiti/summary

Fairphone website. http://www.fairphone.com/

Global Witness website. http://www.globalwitness.org/campaigns/conflict/conflict-minerals

Kimberley Process Certification Scheme website. http://www.kimberleyprocess.com/

Mineral Information Institute website. http://www.mii.org/pdfs/percapita.pdf

Publish What You Pay website. http://www.publishwhatyoupay.org/

Solutions for Hope website. http://solutions-network.org/site-solutionsforhope/participants/

Tantalum-Niobium International Research Center (TIC) website. http://tanb.org/coltan

Transparency International website. http://www.transparency.org/research/cpi/overview

U.S. Geological Survey Minerals Information. http://minerals.usgs.gov/minerals/pubs/mcs/

## Appendix 1 - Mineral Use and Geographic Distribution

| Element | Atomic # | Use and Products | U.S. Import Reliance (%) | Geologic Provenence | Geography of Mining | Notes |
|---|---|---|---|---|---|---|
| Aluminum (Al)[1] | 13 | Light-weight high-density applications especially aerospace; product packaging; cans; foil | 100% import reliance for bauxite and alumina | Bauxite is aluminum ore, typically found in layers and is stripped mined; alumina is the refined ore (aluminum oxide) and aluminum is the refined metal. | Western Australia, Brazil, China, Jamaica | 3rd most abundant element, found in 270 minerals. Hall-Heroult process of smelting alumina (the oxide) requires vast amounts of electricity, either coal powered plants or hydroelectric projects. Takes 15 kilowatt hours/kilogram of metal produced. |
| Chromium (Cr)° | 24 | Stainless steel and superalloys require chromium; ferrochromium used for stainless and heat-resistant applications | 70 | Chromite is primary ore which is iron chromium oxide ($FeCr_2O_4$) | Kazakhstan and South Africa account for ~95% of world's chromium, also Russia and Mexico | There is no substitute for chromium in stainless steel, the primary end-use |
| Cobalt (Co)° | 27 | Superalloys for aircraft gas turbine engines; cemented carbides for cutting and wear-resistence such as diamond cutting tools; chemical applications; magnets; batteries; prosthetics; pigments for paints | 78 | DRC (sediment-hosted stratiform copper deposits); Australia (nickle-bearing laterite deposits); magmatic nickel-copper sulfide deposits | Democratic Repulic of Congo, China, Norway, Russia, Finland | Not mined in US since 1971. 45.6% of cobalt reserves are in DRC |
| Copper (Cu)* | 29 | Electric and electronics products; telecommunications; power cables; water and drain pipes; cooling and refrigeration tubes; industrial machinery; treated wood; sprayed on boats to prevent barnacles | 35 | Native form; porphyry deposits; volcanogenic massive sulfides; hydrothermal veins; secondary mineralizations (i.e. greenstone belts) | Greenstone belt in DRC/Zambia has eight times the grade found elsewhere in the world. Major porphyry desposits correspond to the Ring of Fire: Chile, Peru, Mexico, US, Canada. | Excellent conductivity properties, anti-microbial, 100% recyclable |
| Gallium (Ga)* | 31 | Integrated circuits (IC), laser diodes (61%), light-emitting diodes (LEDs) and photovoltaics (solar panels); aerospace and defense applications; industrial and medical equipment; telecommunications and high-performace computers; high-speed wireless infrastructure and satellites | 99 | Byproduct in processing of sphalerite (zinc ore) and bauxite (aluminum ore) with average of 50 parts per million gallium contained in bauxite | China, Germany, UK, Kazakhstan, Ukraine, Hungary, Japan, the Republic of Korea, Russia, Canada | Smartphones use ten times as much gallium arsenide (GaAs) as other cellular phones. |

## Appendix 1 - Mineral Use and Geographic Distribution

| Element | Atomic # | Use and Products | U.S. Import Reliance (%) | Geologic Provenence | Geography of Mining | Notes |
|---|---|---|---|---|---|---|
| Indium (In)* | 49 | Indium tin oxide (ITO) thin-film coatings used in liquid crystal displays (LCDs) for electrical conductivity in flat-panel displays, television screens, touchscreens for Smartphones and iPads, and solar panels | 100 | Byproduct of base metal sulphide smelting, commonly the zinc ore sphalerite | China, the Republic of Korea, Japan, Canada, and Belgium | Average content of indium within sphalerite ranges from 1 to 100 parts per million |
| Lithium (Li)* | 3 | Ceramics, lubricating greases, aluminum production, air treatment, and pharmaceuticals; primary use is in batteries; rechargeable lithium-ion batteries, particularly in portable electronics, electric tools, electric vehicles, and storage for grid | Withheld for proprietary purposes | Lithium carbonate subsurface brines, lithium chloride, and lithium hydroxide | Chile, Australia, China, Argentina, Portugal, Zimbabwe, and Brazil (Bolivia and DRC also have noteworthy and considerable deposits) | "Lithium supply security has become a top priority for Asian technology companies" (USGS 2014) |
| Manganese (Mn)*° | 25 | Necessary for the manufacture of steel, dry cell batteries, brick coloring, plant fertilizers and in animal feed; used in machinery, construction, and transportation, primarily in the production of steel | 100 | Pyrolusite ($MnO_2$) is the main ore; manganese occurs in close proximity to iron ores; also oolitic deposits (manganese nodules) on the seafloor | South Africa (estimated to have 75% of world resources), China, Australia, Gabon, Indian, Brazil, and Ukraine | Manganese is essential in the production of iron and steel. 12th most abundant element in the earth's crust |
| Niobium (Nb)* | 41 | Alloyed with steel for applications requiring extreme heat and corrosion-resistance; primarily used in steels and superalloys in the aerospace industry, energy production, chemical processing industries | 100 | Found as the mineral pyrochlore in carbonatite rocks; columbite-tantalite (called coltan in central Africa); | Brazil (92% of world supply in 2011), Canada, Germany. The US also has resources. Also found in coltan from the DRC yet was not included in law. | Found in the conflict mineral mineral coltan, however not included in legislation; formerly known as columbium |
| Platinum group metals (PGMs)*° | 45 - Ru; 46 - Rh; 46 - Pa; 76 - Os; 77 - Ir; 78 - Pt | Used in catalytic converters to reduce harmful emissions; used as catalysts in production of chemicals; in the refining of petroleum; used in electronics sectors for increased storage capacity in computers and used in manufacture of LCDs and flat-screens; jewelry | 91-54 depending on metal | The layered mafic intrusions of the Merensky Reef deposit of the Bushveld Complex in South Africa contain an estimated 95% of the global reserves of PGM (USGS 2013). | South Africa, Stillwater Complex in Montana | Include platinum, palladium, rhodium, ruthenium, iridium, and osmium. "They are essential in catalytic converters for exhaust pollution control and for this application, there are no substitutes" (National Research Council 2008). |

## Appendix 1 - Mineral Use and Geographic Distribution

| Element | Atomic # | Use and Products | U.S. Import Reliance (%) | Geologic Provenence | Geography of Mining | Notes |
|---|---|---|---|---|---|---|
| Rare earth elements (REEs)* | 57 - 71 | Supermagents used in wind turbines and electric cars; color cathode-ray tubes and liquid crystal displays used in computers and televisions; fiber-optic telecommunication cables; batteries; magnetic refrigeration; high-temperature superconductivity | Insufficient info available for calculation | Carbonatite volcanoes, a low-temperature carbon-based volcano; bastnäsite deposits are the primary source; monazite deposits are the other source; also found in apatite, cheralite, eudialyte, loparite, phosporites, and rare-earth-bearing clays | 95% of REEs come from China, Mountain Pass Mine in California was closed in 1996 due to environmental concerns yet reopened in 2011 prompted by supply vulnerability from China's cut back on exports | Geochemically abundant but lack high concentrations for exploitation. The lanthanide series (57-71). Sometimes includes Yttrium (39) and/or Hafnium (72). (La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, sometimes Y and Hf) |
| Tantalum (Ta)*^ | 73 | Capacitors (60%) used in Smartphones, cell phones, computers, gaiming stations, MP3 players; automotive electronics; used in carbides; can substitute aluminum or ceramics in capactiros but would compromise miniature size and would result in more dropped calls; also used in high-temperature and corrosion-resistant applications | 100 | Coltan (columbite-tantalite) in central Africa; tantalite | China, Estonia, Germany, Kazakhstan, DRC, Rwanda | No US mine production since 1959. Associated with tin and tungsten |
| Tin (Sn)^2 | 50 | Originally used as armor (hence tin soldier), alloyed with copper for bronze, alloyed with small portion of copper, antimony, bismuth or lead to make pewter; lead-free solders, especially those used in electronics; coating for cans | 75 | Cassiterite is the primary ore | Peru, Bolivia, Indonesia, China, DRC. Famous historic deposits in Cornwall, England | Last mined in US in 1970. EU outlawed lead used in solders in electronics in 2010; tin solders are the alternative. |
| Titanium (Ti)* | 22 | Paints and pigments (95%), used for manufacture of carbides, chemicals, and metals, and within welding rod coatings; aerospace industry; chemical processing; coated textiles; used in power generation, medical, marine, sporting goods, plastics, varnishes, printing ink, and sunscreens | 77 | Ilmenite and rutile are primary ores. Consumed as titanium mineral concentrates or titanium sponge | South Africa, China, Australia, Canada, Mozambique. Producers of sponge metal are China, Japan, Russia, Kazakhstan, Ukraine, and the US | Strong tensile strength; light-weight, high-stength; |

## Appendix 1 - Mineral Use and Geographic Distribution

| Element | Atomic # | Use and Products | U.S. Import Reliance (%) | Geologic Provenence | Geography of Mining | Notes |
|---|---|---|---|---|---|---|
| Tungsten (W)^ | 74 | Originally used as incandescent light-bulb filament; strength comparable to diamonds in tungsten carbide; tungsten carbide used in mining drill bits, dental tools, machining parts, and oil-well drilling; lead-free bullets | 42 | Vein/stockwork, skarn, porphyry, and strata-bound deposits | China, Bolivia, Canada, Germany, DRC | Dense, corrosion-resistant, and highest melting point of all metals. |
| Vanadium (Va)*° | 23 | Alloying agent for steel and iron accounted for 93% US consumption; used as catalysts in some chemical processes; used in aerospace titanium alloys and there is no substitute in this applications | 100 | Recovered as byproduct or coproduct of another mineral; found in phosphate rock deposits, titaniferous magnetite, and uraniferous sandstone and siltstone; found in bauxite and coal and petroleum | China, South Africa, Russia, Republic of Korea, Canada, Austria, Czech Republic | First used in Model-Ts |
| Zinc (Zn)[1] | 30 | Used in galvanization for corrosion protection (82%); galvanized steel used in auto and construction industries; used to make brass and bronze; diecasting, chemicals, and semiconductors; sunscreens | 74 | Primary ore is sphalerite; found in lead-zinc Mississippi Valley-type carbonate deposits; limestone infused with lead and zinc sulfide ores | US (Tennessee, Missouri, and Idaho), Australia, Bolivia, Canada, China, India, Ireland, Kazakhstan, Mexico, Peru | Indium and gallium are byproducts of zinc production |

^ Conflict minerals from DRC or adjoining countries

* Critical mineral as assessed by the National Research Council (2008)

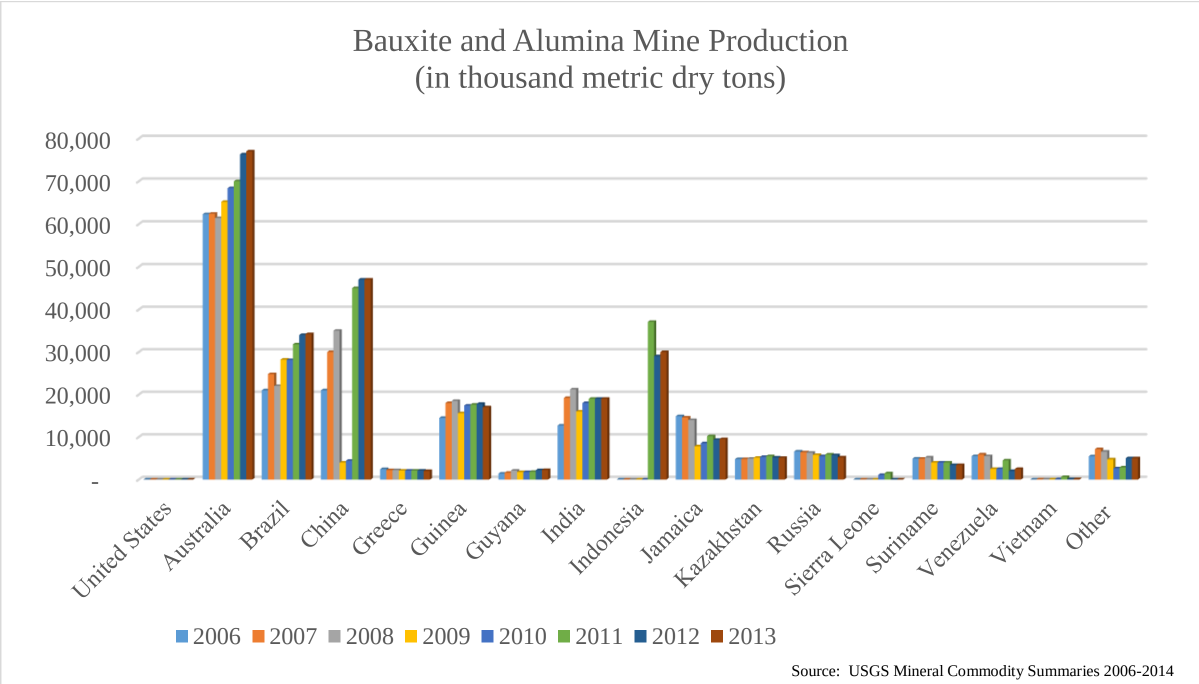
° Majority of reserves occur on African continent according to United Nations Economic Commission for Africa (2009)

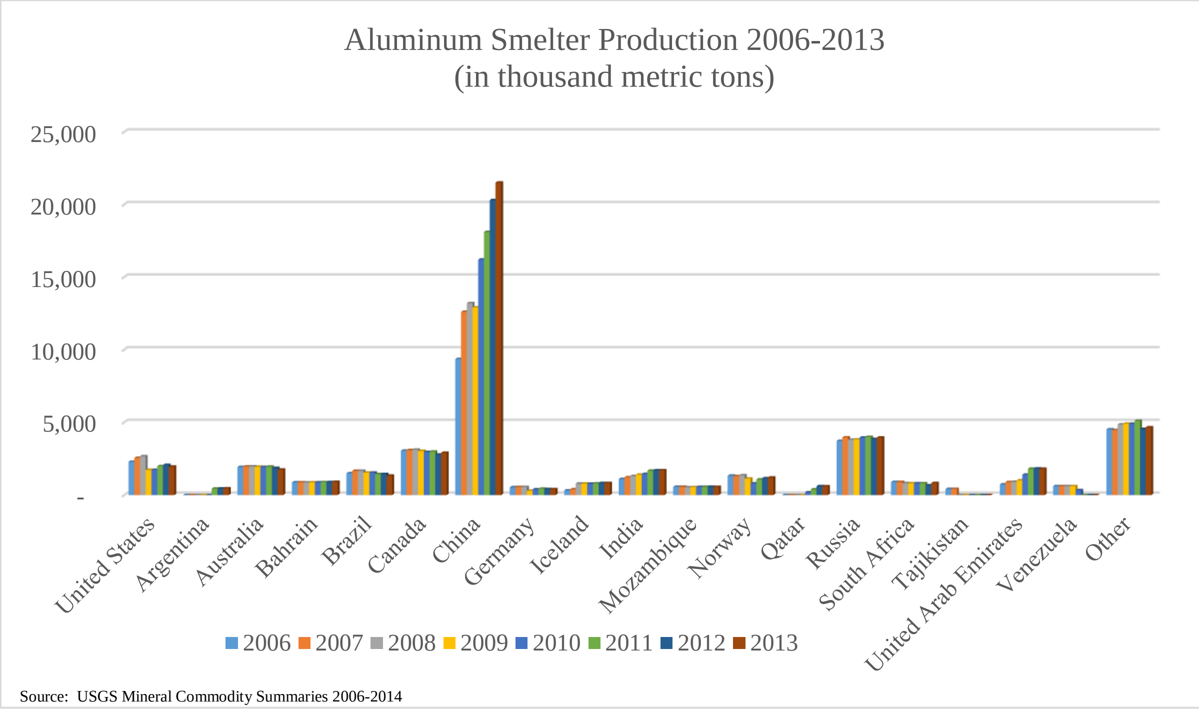
[1] Processing of ore yields mineral by-product concentrates such as gallium, indium, and vanadium

[2] Processing of ore yields mineral by-products such as tantalum

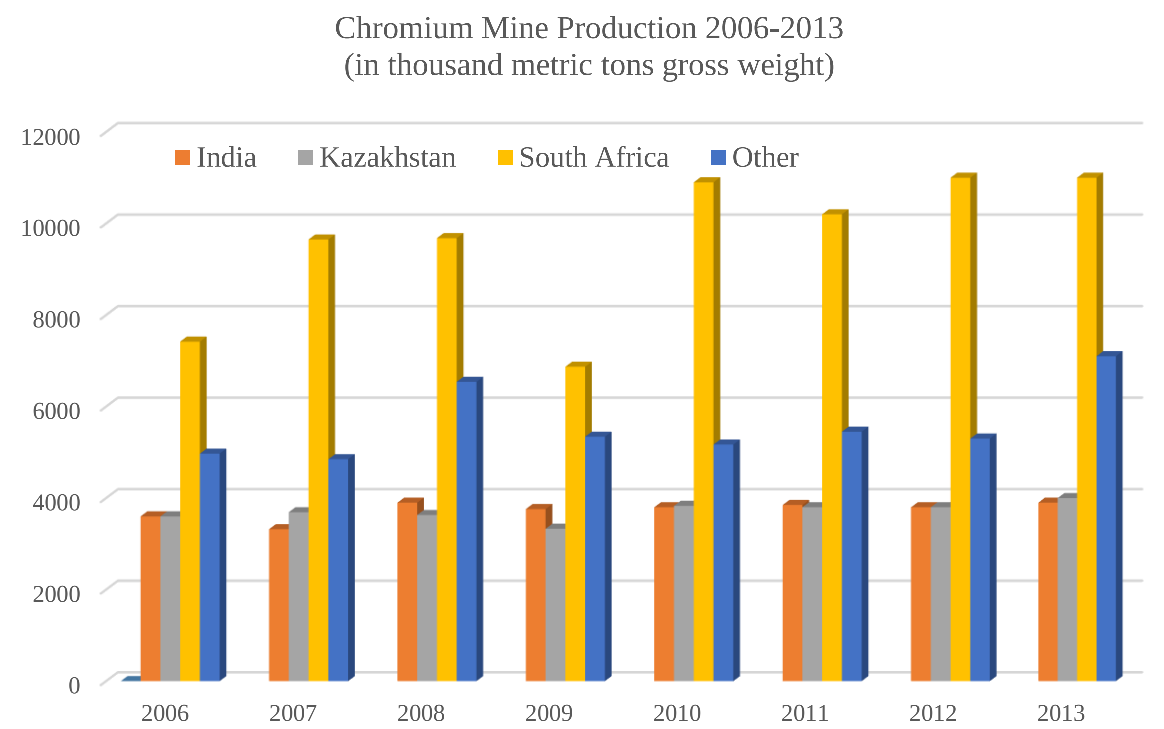
Sources: National Research Council (2008); United Nations Economic Commision for Africa (2009); USGS Mineral Commodity Summaries (2010-2014)

## Appendix 2 – Mineral Distribution and Production:  Aluminum



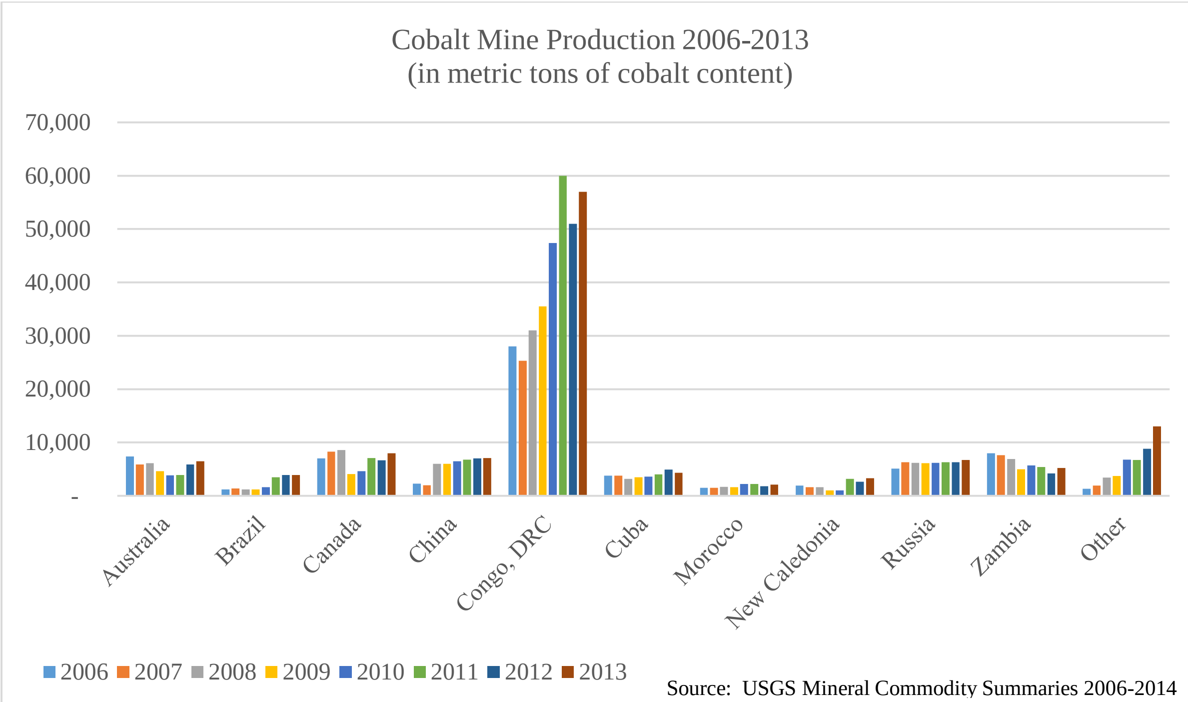



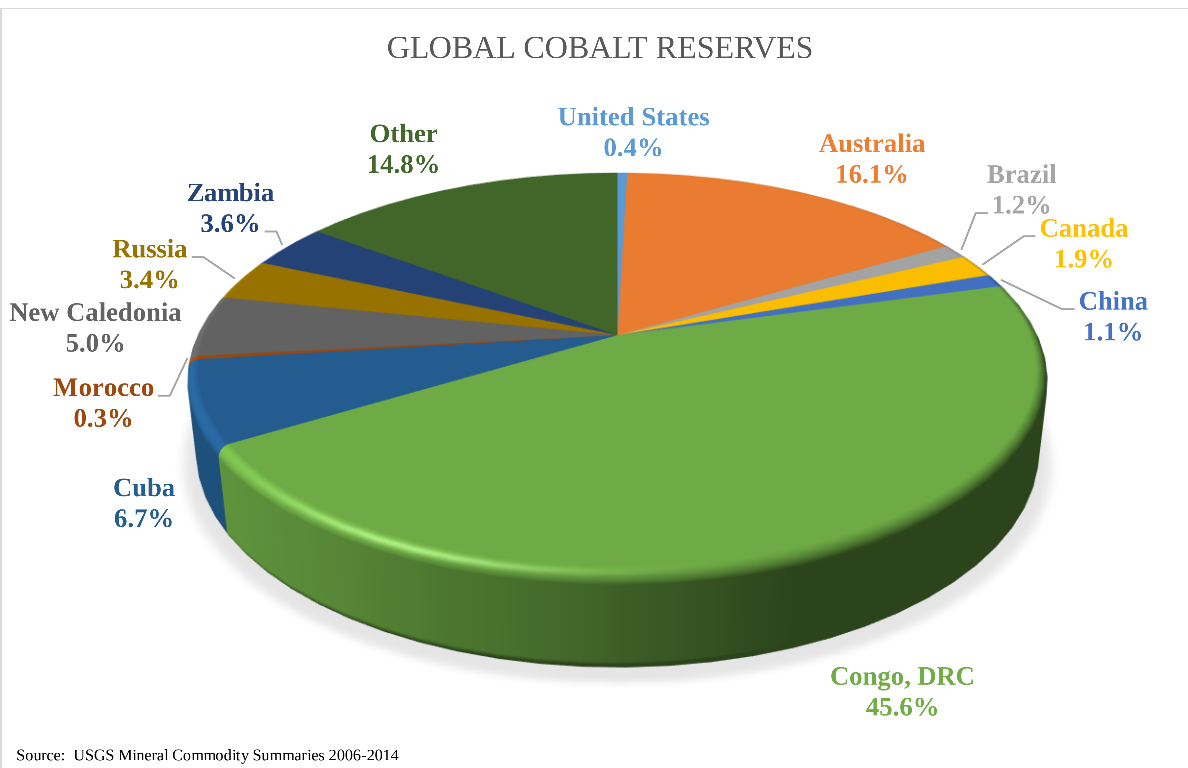
## Appendix 2 – Mineral Distribution and Production: Chromium



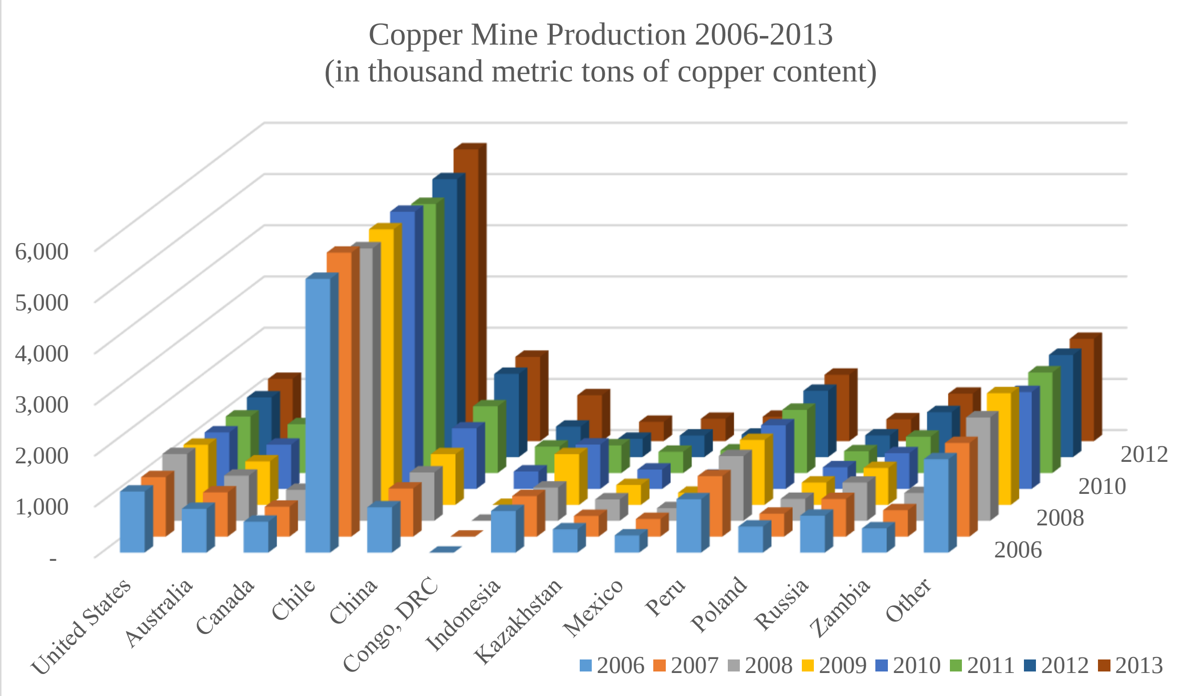

Source: USGS Mineral Commodity Summaries 2006-2014

## Appendix 2 – Mineral Distribution and Production: Cobalt

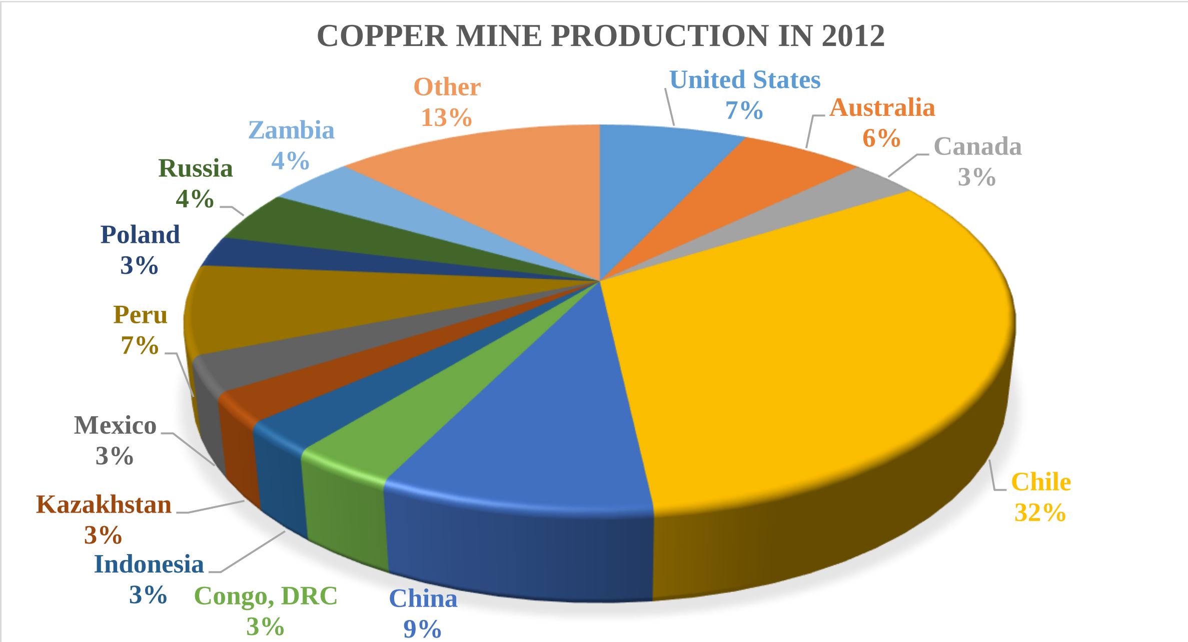


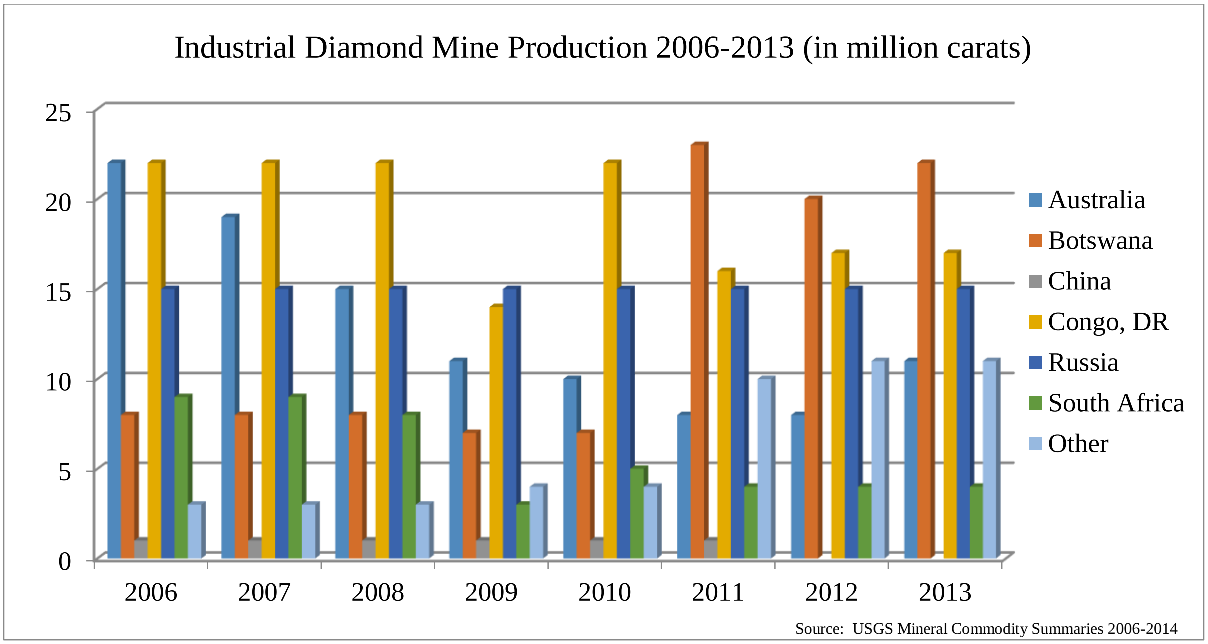
## Appendix 2 – Mineral Distribution and Production:  Copper

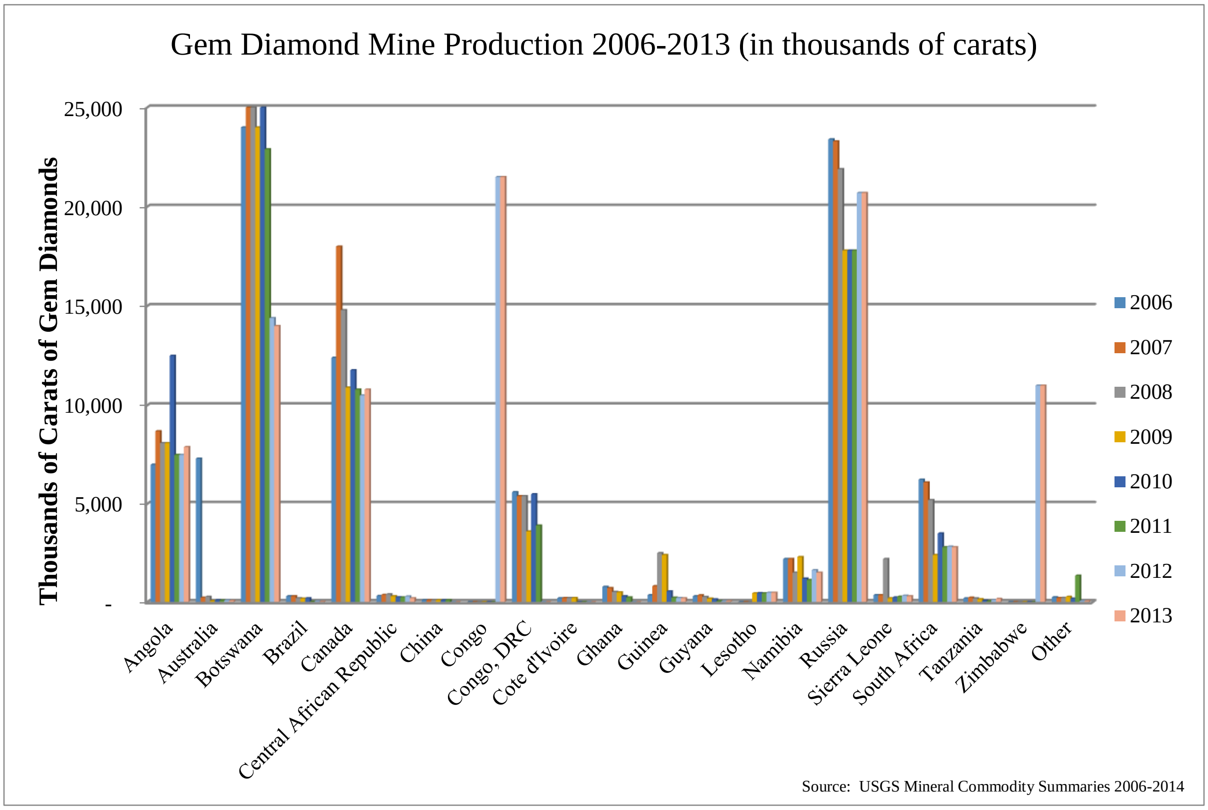



Source:  USGS Mineral Commodity Summaries 2006-2014

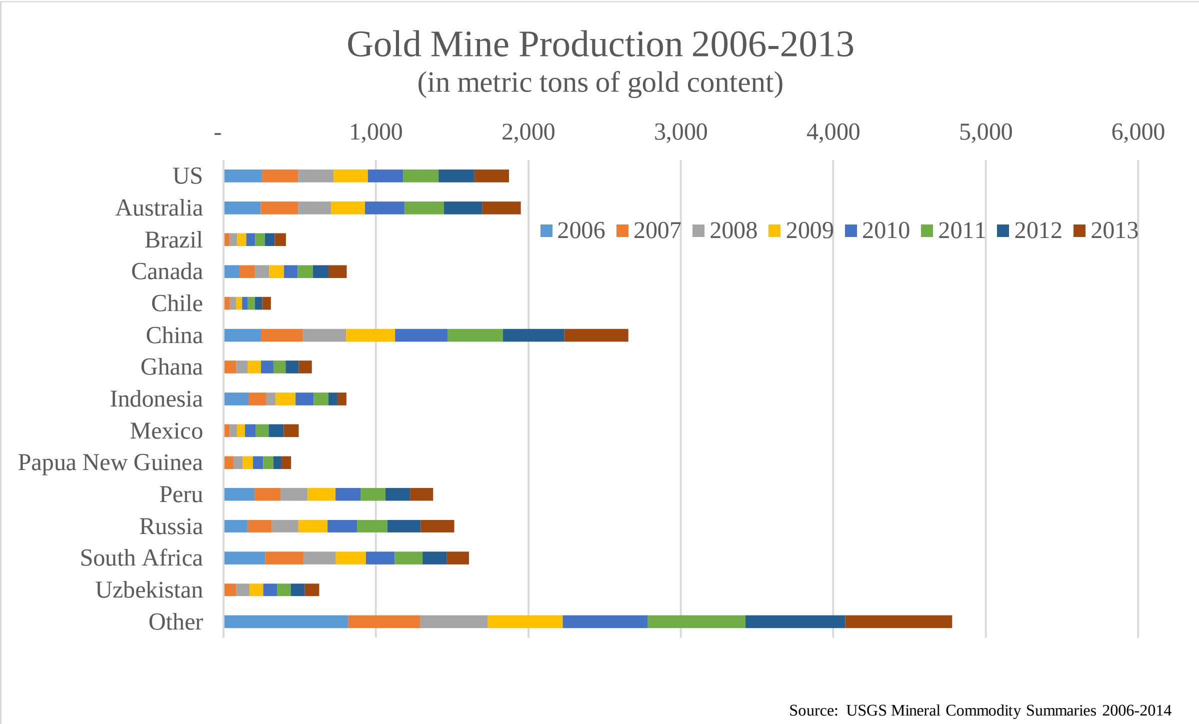


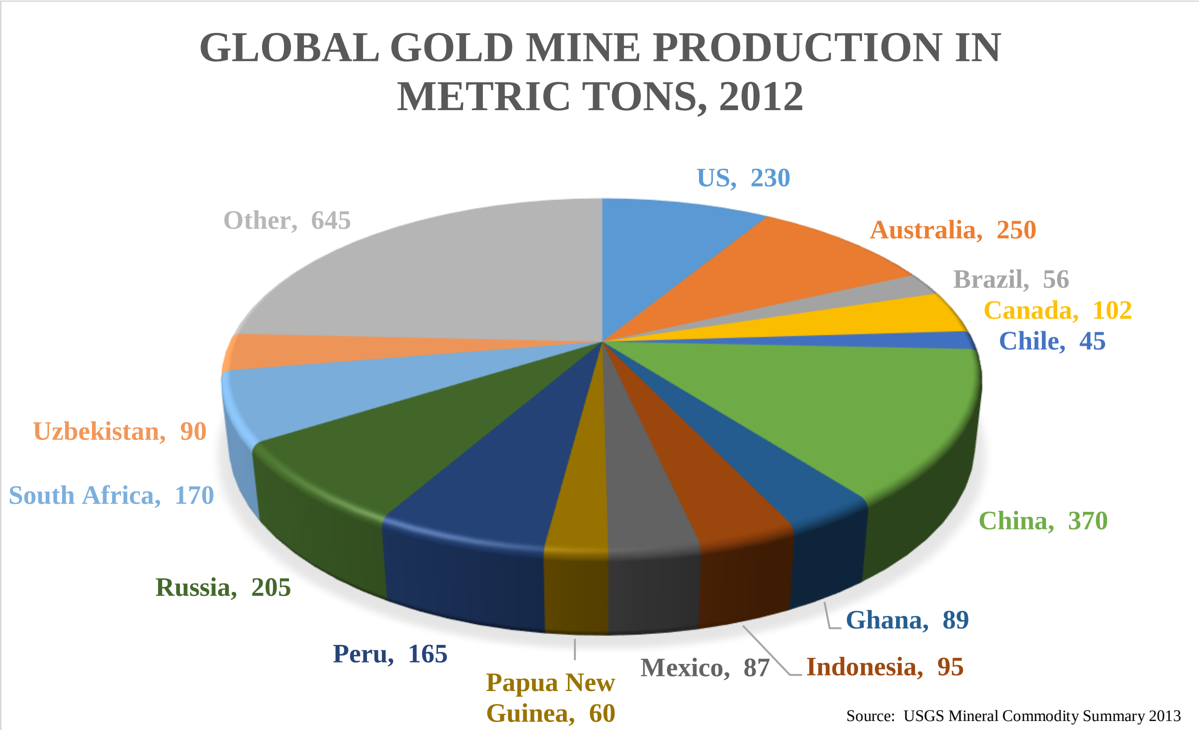
## Appendix 2 – Mineral Distribution and Production: Diamonds



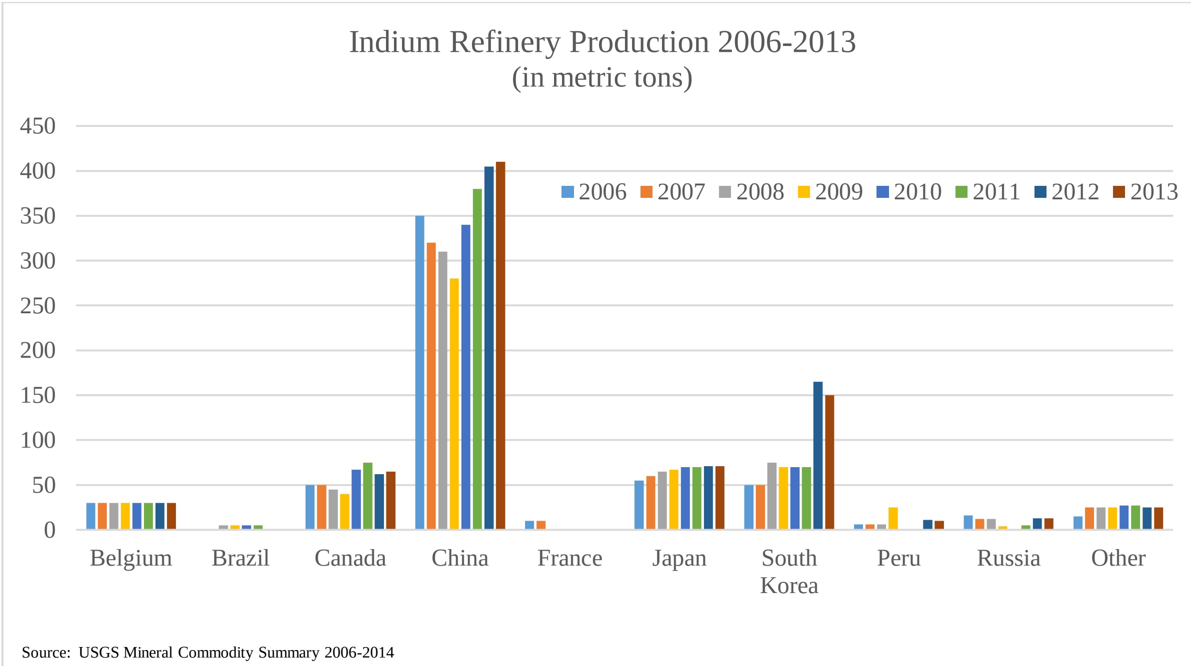



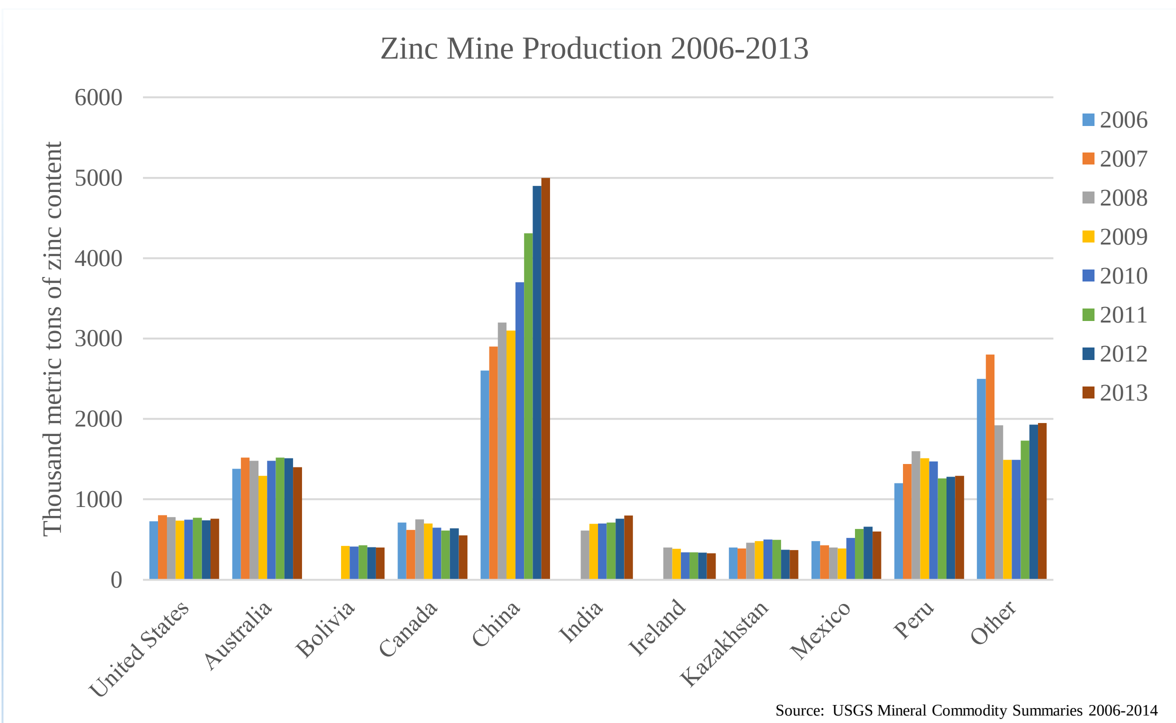
## Appendix 2 – Mineral Distribution and Production:  Gold



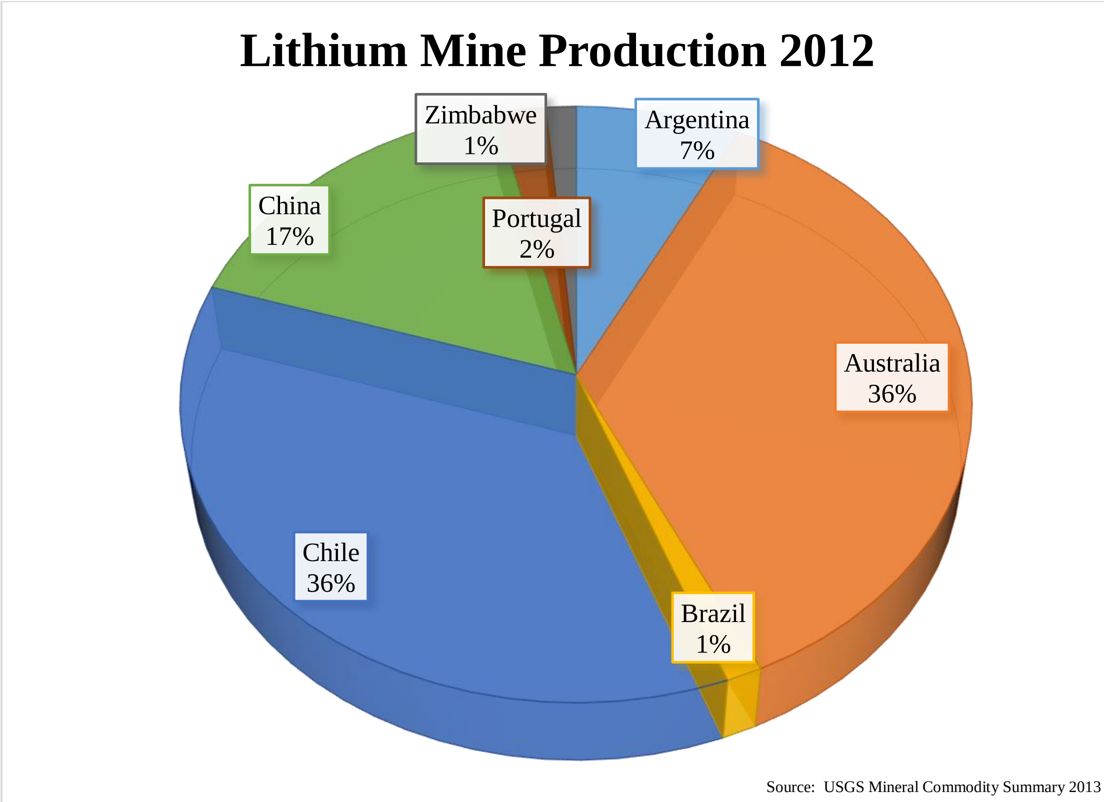
**Appendix 2 – Mineral Distribution and Production: Indium and Zinc**



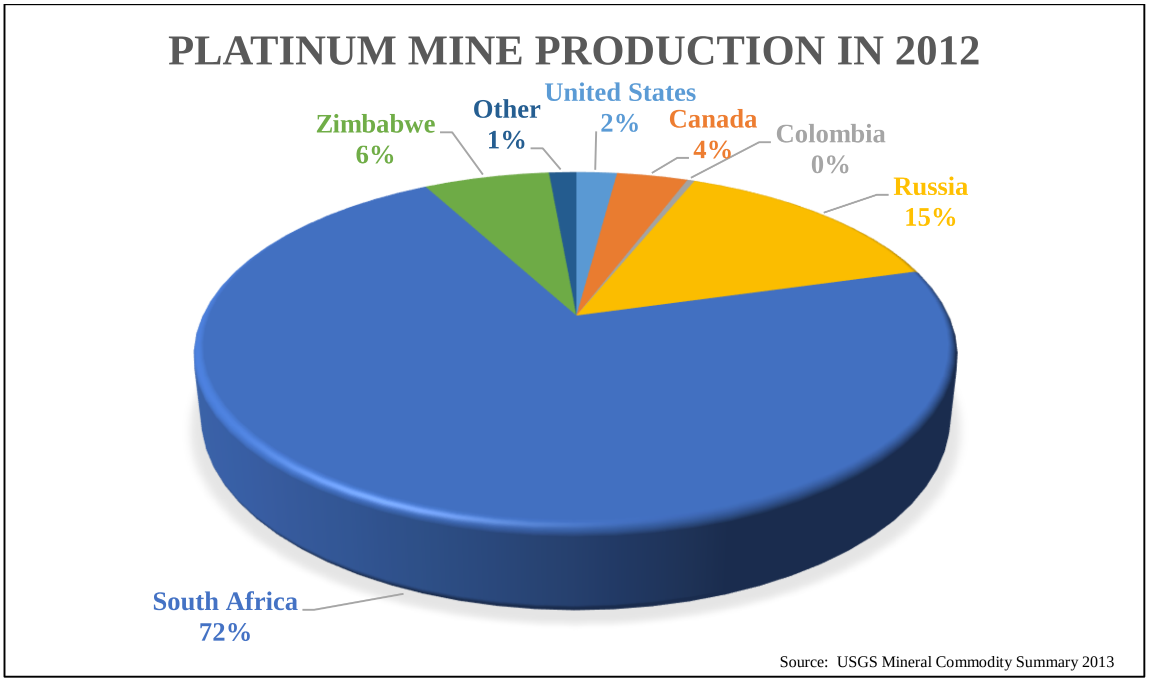



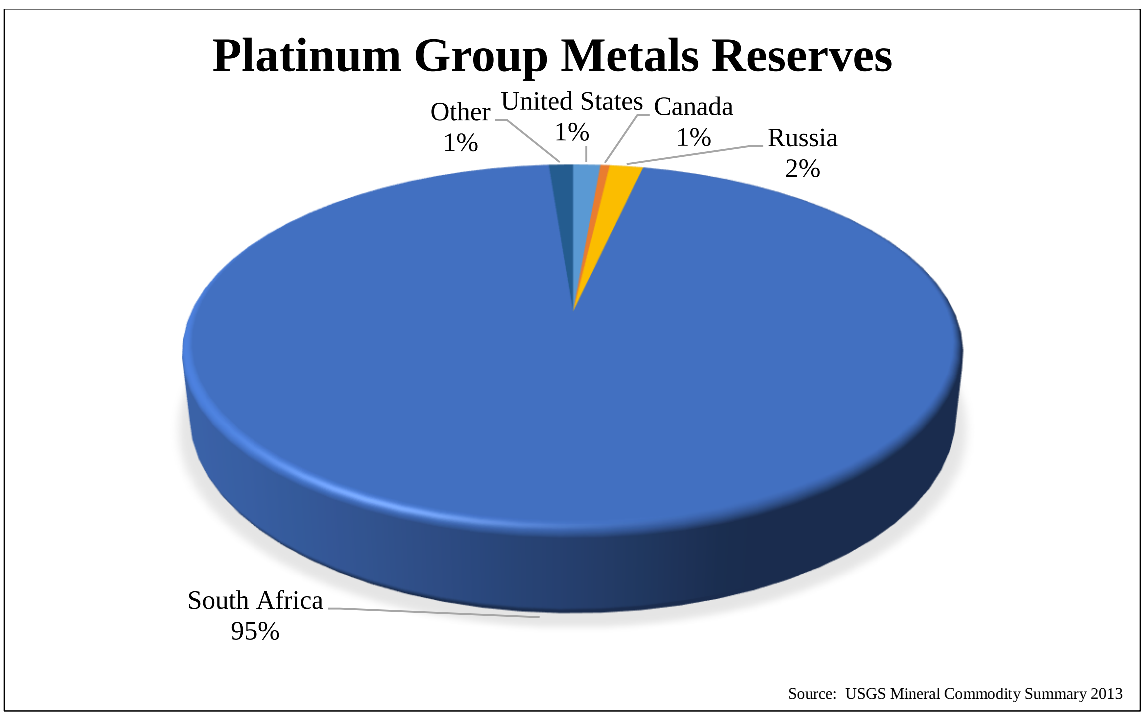

*Indium is a byproduct of zinc ore mining and processing

**Appendix 2 – Mineral Distribution and Production: Lithium**

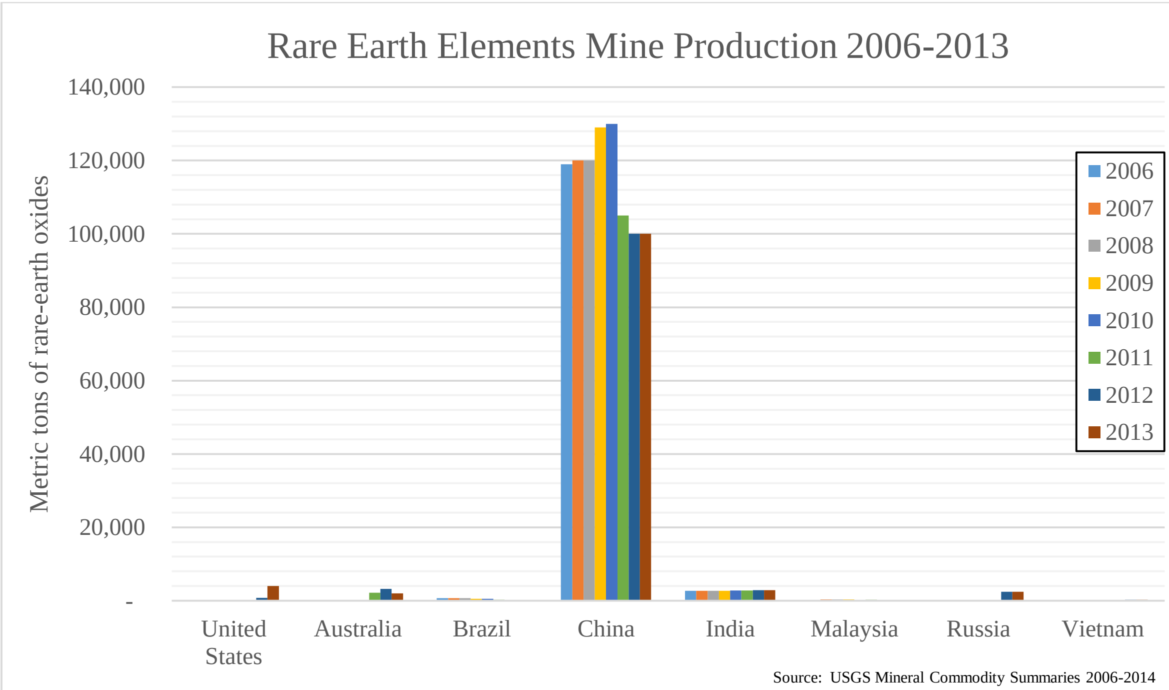


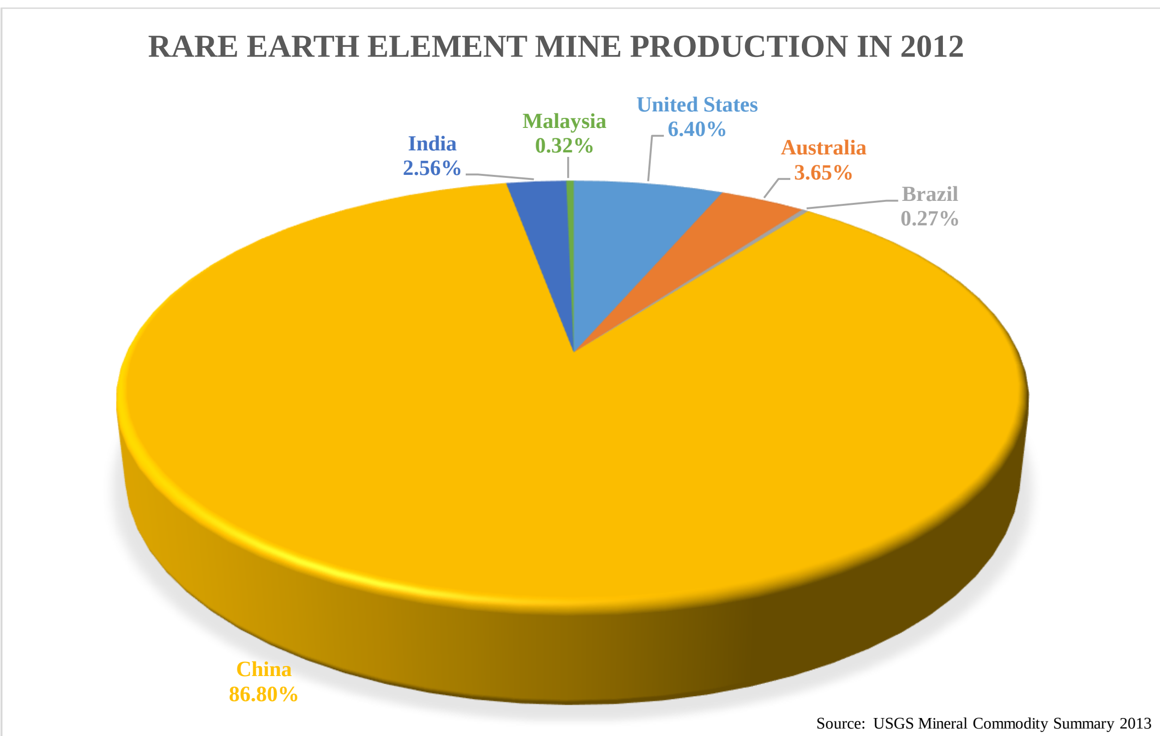
**Appendix 2 – Mineral Distribution and Production: Platinum Groups Metals (PGM)**



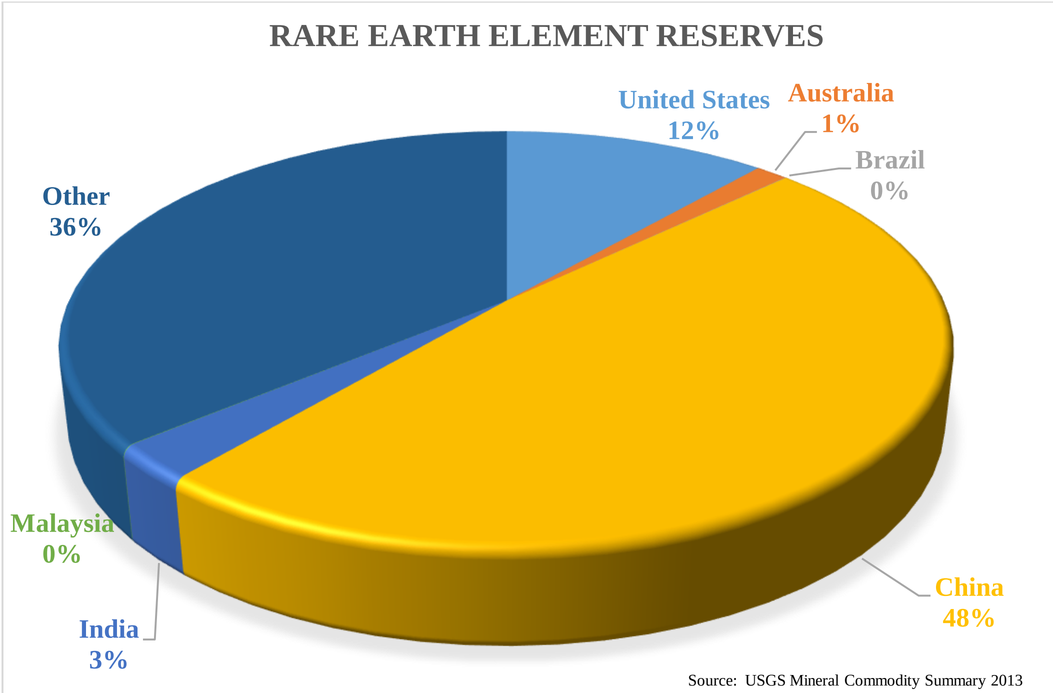



## Appendix 2 – Mineral Distribution and Production: Rare Earth Elements (REE)

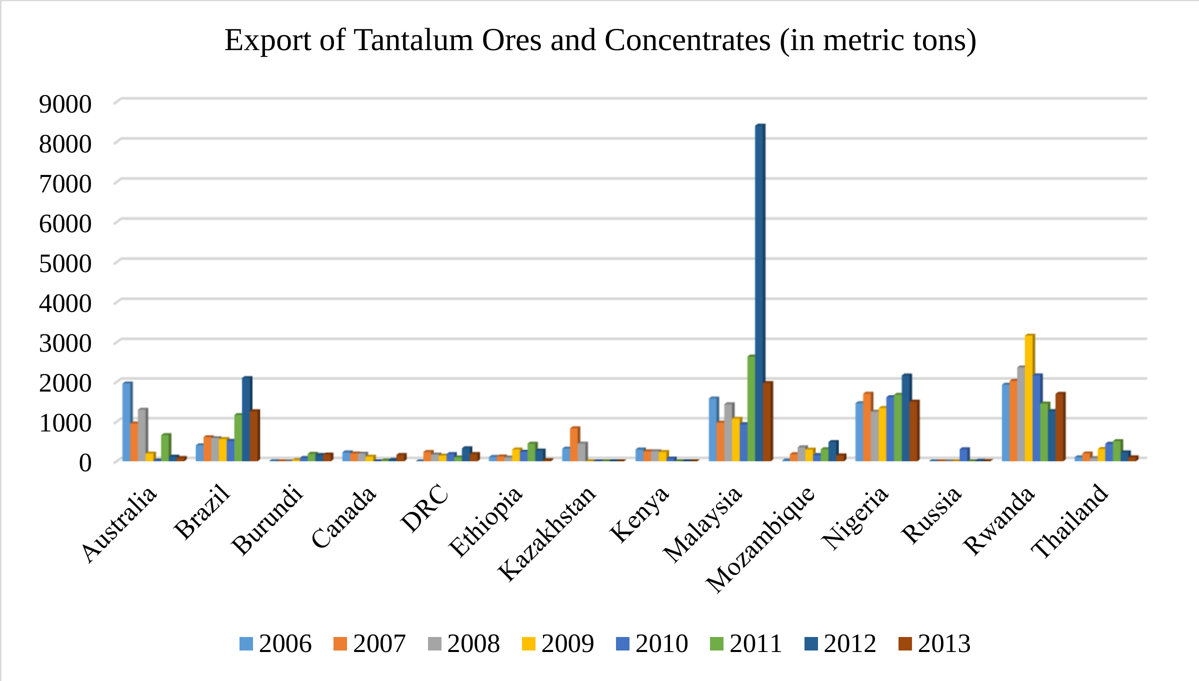


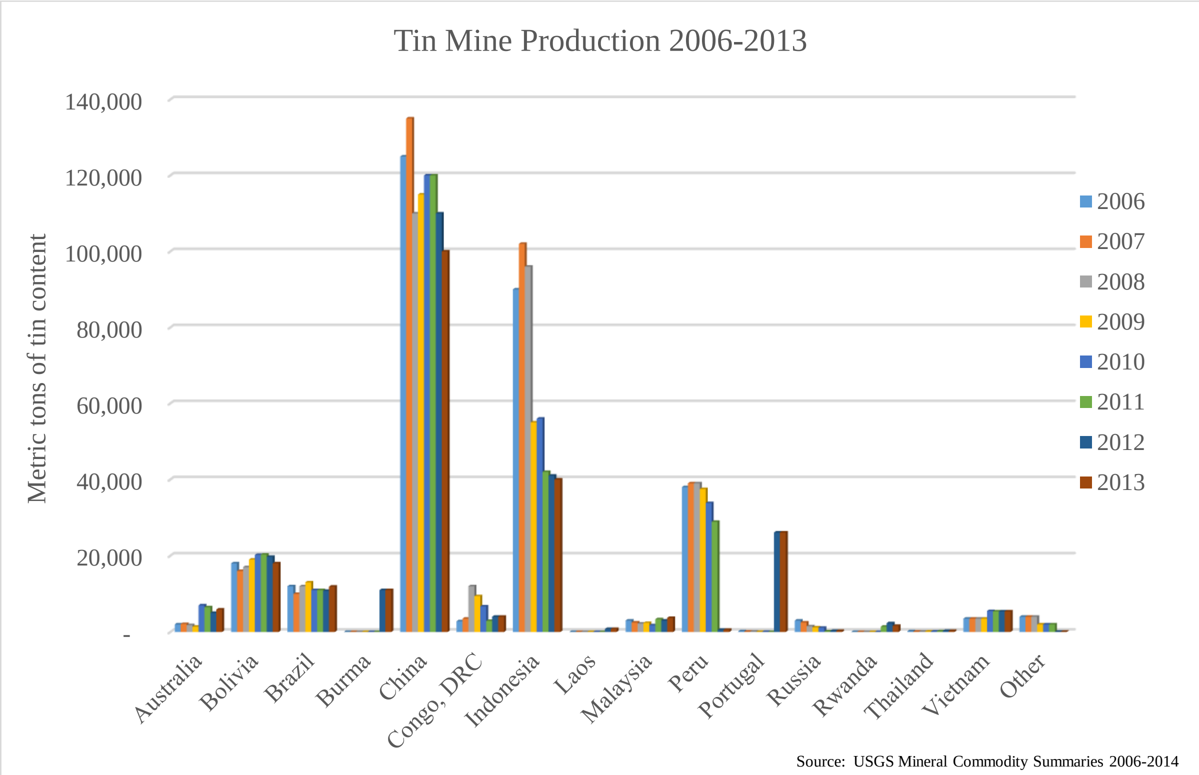



**Appendix 2 – Mineral Distribution and Production: Rare Earth Elements (REE)**

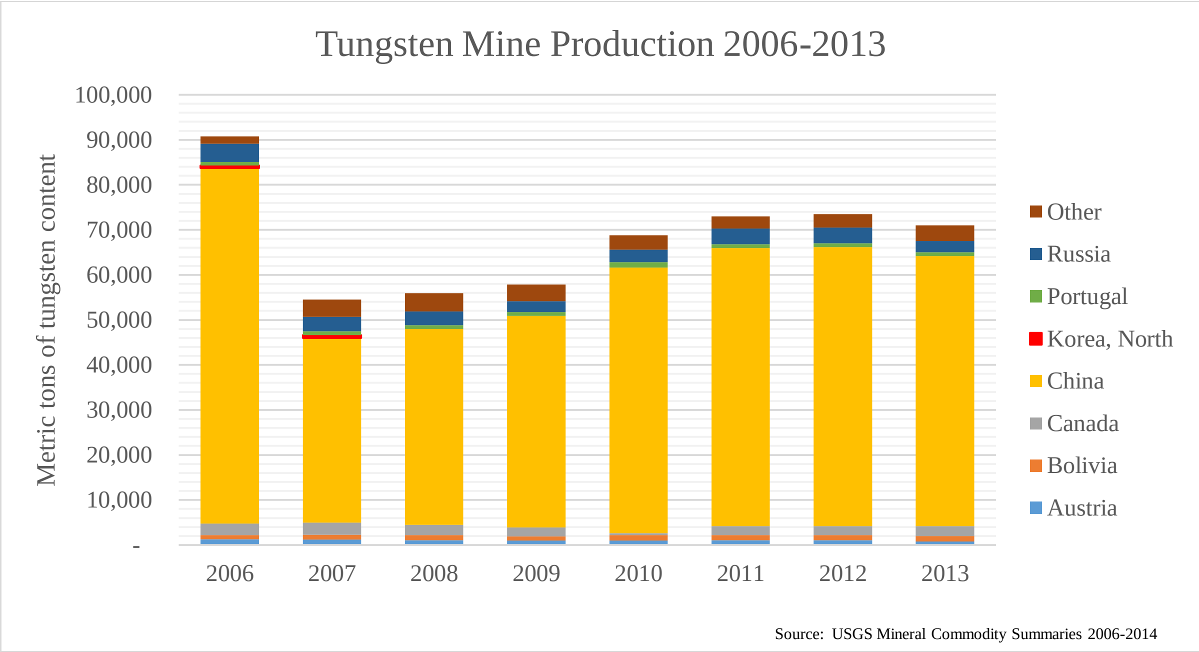


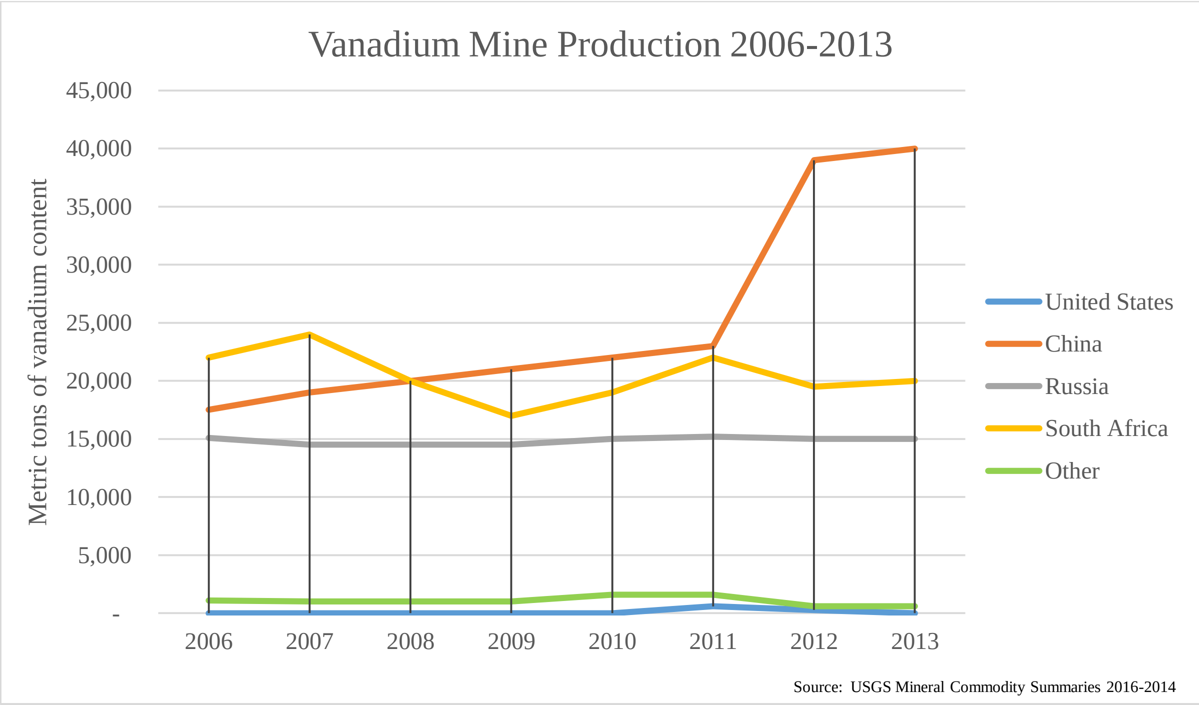
**Appendix 2 – Mineral Distribution and Production: Tantalum and Tin**



**Appendix 2 – Mineral Distribution and Production: Tungsten and Vanadium**



## Appendix 3 – Mineral Crustal Abundance and Ore Grade

**The mean composition of the Earth's crust**

| Geochemically abundant elements | | | Geochemically scarce elements | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| >0.1 wt | | | >10 ppm | | | >1 ppm | | | <1 ppm | | |
| O | 45.5 | wt% | F | 544 | ppm | Pb | 13 | ppm | Tl | 0.7 | ppm |
| Si | 27.2 | wt% | Ba | 390 | ppm | Pr | 9.1 | ppm | Tm | 0.5 | ppm |
| Al | 8.3 | wt% | Sr | 384 | ppm | B | 9.0 | ppm | I | 0.46 | ppm |
| Fe | 6.2 | wt% | S | 340 | ppm | Th | 8.1 | ppm | Y | 0.31 | ppm |
| Ca | 4.66 | wt% | C | 180 | ppm | Sm | 7.0 | ppm | In | 0.24 | ppm |
| Mg | 2.76 | wt% | Zr | 162 | ppm | Gd | 6.1 | ppm | Sb | 0.2 | ppm |
| Na | 2.27 | wt% | V | 136 | ppm | Er | 3.5 | ppm | Cd | 0.16 | ppm |
| K | 1.84 | wt% | Cl | 126 | ppm | Yb | 3.1 | ppm | Hg | 0.08 | ppm |
| Ti | 0.632 | wt% | Cr | 122 | ppm | Hf | 3.0 | ppm | Ag | 0.08 | ppm |
| P | 0.112 | wt% | Ni | 99 | ppm | Cs | 2.6 | ppm | Se | 0.05 | ppm |
| Mn | 0.106 | wt% | Rb | 78 | ppm | Br | 2.5 | ppm | Pd | 0.015 | ppm |
| | | | Zn | 76 | ppm | U | 2.3 | ppm | Pt | 0.010 | ppm |
| | | | Cu | 68 | ppm | Eu | 2.1 | ppm | Bi | 0.008 | ppm |
| | | | Ce | 66 | ppm | Sn | 2.1 | ppm | Os | 0.005 | ppm |
| | | | Nd | 40 | ppm | Be | 2.0 | ppm | Au | 0.004 | ppm |
| | | | La | 35 | ppm | As | 1.8 | ppm | Ir | 0.001 | ppm |
| | | | Co | 29 | ppm | Ta | 1.7 | ppm | Te | 0.001 | ppm |
| | | | Sc | 25 | ppm | Ge | 1.5 | ppm | Re | 0.0007 | ppm |
| | | | Nb | 20 | ppm | Ho | 1.3 | ppm | Rh | 0.0001 | ppm |
| | | | Ga | 19 | ppm | W | 1.2 | ppm | | | |
| | | | N | 19 | ppm | Tb | 1.2 | ppm | | | |
| | | | Li | 18 | ppm | Mo | 1.2 | ppm | | | |

From: Rankin, W.J. 2011. *Minerals, Metals, and Sustainability: Meeting Future Material Needs*. CRC Press: Taylor & Francis Group. Pg 70. Source: Greenwood and Earnshaw (1984).

Conflict Minerals from DRC and adjoining countries
Platinum Group Metals predominantly from South Africa
Rare Earth Elements (REEs)

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