HARD-ROCK MINING

Abstract

An economic examination of the historic, yet still applicable mining laws and regulations pertaining to hard-rock mining practices. The specific environmental and social implications of hard-rock mining techniques will be studied. Closing with the solutions to the economic externalities and the relevance of general policies to the modernized mining industry.

Winter, Stefinie L

Economics 471

Introduction

Historically, mining began in the United States before the War of 1812, utilizing a large scale of individuals and thereby creating jobs and aiding in incentivizing the economic growth of society. However, after the beginning of The Gold Rush, the individual level of mining morphed into a corporate phenomenon. This transformation led to the development of new technology and mining techniques, giving birth to the General Mining Laws and Regulations in the United States. These laws and regulations began with the General Mining Law of 1872; however, their primary goals have drastically changed as the outcome of mining proved to be more valuable. As recognition spread of the monetary values that accompanied the mining of earth elements, the General Mining Act of 1872 grew increasingly outdated and loopholes developed. The over-arching goal of this paper is to address, discuss, and argue why today's mining laws are outdated by illustrating the damages that have already been done due to their lack of updating.

Mining Brief

The history of surface mining began in Wisconsin during the 1820s, and rapidly developed popularity as started to spread northwest into Illinois, eventually reaching out into the west (Wisconsin-Mines). Generally, surface mining is defined as a mining technique that exposes the mineral deposits by the removal of topsoil and any overburden, which can ranges from rocks and soil to entire ecosystems. This technique can be divided into categories: open-pit, strip, and mountaintop removal. During open-pit mining, a cut, which later forms a quarry, is made at the ground's surface in preparation for the removal of valuable mineral(s) or ore(s). In both open-pit and strip-mining commercially valuable deposits are located near where the overburden is thinnest. Unlike open-pit, strip mining is done by the creation of repeating long narrow bands (Great Mining, n.d.). While each of these are environmentally invasive, they are trumped by mountaintop removal. Used to replace most underground mining retrieval methods, the mountaintop removal process begins by destroying the forest; then powerful explosives are applied to remove up to 800 feet of mountain rock; finally, draglines are used to dig into any remaining rock to reach the valuable deposits that are closer to the surface (Dawson et al., 2015).

The placer mining is a special method created to reach alluvial deposits of valuable minerals; usually located in a stream-bed or floodplain (Humphries & Vincent, 2001). Originally, placer mining involved miners taking a shovel to the stream bed sediment or floodplain and sifting the sediment in a sluice box. This type of mining has evolved to encompass technological machinery advances, (Butterman & Amey, 2005). Despite these advances the laws for placer mining have not been updated.

Further building on this the General Mining Act of 1872 was also not expanded to cover the mining of precious metals or stones and hard-rock minerals. These hard-rock minerals are commonly mined through methods known as underground mining. The methods of underground mining are otherwise referred to as lode mining, which is any non-placer mine. Underground mining is applied when hard-rock minerals and precious metals or stones are located far beneath earth's surface. Accessing the valuable ore, involves a decline with the aid of a box cut, portal (entrance) back to the surface. Then shafts are placed vertical and suck adjacent to the ore; then one of the three ventilation systems will be installed (Great Mining, n.d.).

Mining Policies

Introductory Thoughts

143 years ago President Grant enacted the General Mining Law of 1872, which set the price claim of hard-rock mining land between 2.50 and 5 dollars per acre with many of its contents still governing hard-rock mining today (Earthworks, 2015). The General Mining Law of 1872 also allows both foreign and domestic companies to take valuable hard-rock minerals from the land without paying any royalties. This law contains no environmental provisions, which ultimately allowed the hard-rock mining industry to consistently introduce havoc on water supplies, wildlife, and landscapes without consequences (Earthworks, 2015). According to the Environmental Protection Agency, it is responsible for 40 percent of the pollution found in Western watersheds. While in the political realm, it is considered to be one of the last remaining dinosaurs when it comes to public land giveaways. As mining progressed, the Mineral Leasing Act of 1920 was formed, which placed new regulations on oil, natural gas, oil shale, phosphate, and sodium resources.

However, after Rachel Carson introduced the first wave of eco-criticism with the publication of *Silent Spring* in 1932, an era of environmental progress began of which President Nixon aided in developing. This resulted in the development of the Environmental Protection Agency in 1970, National Environmental Policy Act of 1970, Clean Water Act of 1972, Resource Conservation & Recovery Act of 1976 (RECRA), Federal Land Policy & Management Act of 1976, as well as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 have all aided in correcting some of the hard-rock mining implications.

Clean Water Act

During the past 43 years, the Clean Water Act has gradually evolved from addressing single point sources of pollution to complex or multiple point sources of toxic pollution (CWA Section 402). In 1987, this act was amended to further accommodate for the establishment of water quality standards for toxic pollutants. These amendments in turn, gave way for a basis to control discharge sources in hard-rock mines. Additionally, Section 404 of the Clean Water Act, which pertains to the permitting of dredging and filling, implemented a set of 40 initiatives to protect valuable wetlands (EPA, 1997). However, this act does not protect groundwater sources from hard-rock mining practices and it does not clearly define how a mine should be reclaimed (Earthworks, 2015).

Comprehensive Environmental Response, Compensation, and Liability Act

Over the past decade, the Comprehensive Environmental Response, Compensation, and Liability Act or CERCLA, is known as the superfund program, which is utilized to respond to environmental threats in the hard-rock mining industry as well as any processing sites. Any site that falls into this superfund program, has posed a substantial threat to human health and/or the environment. Recently, federal agencies have been given permission to utilize CERCLA to enforce clean-up initiatives on their land (EPA, 1997).

Resource Conservation and Recovery Act

In the realm of rulemaking, Resource Conservation and Recovery Act has been designed to classify mining waste streams, which should be regulated as ***"hazardous waste"***. Congress amended RECRA in 1980 to include the Bevill exclusion for ***"solid***

waste from extraction, beneficiation, and processing of ores and minerals," which ultimately excluded waste associated with hard-rock mining from being regulated. After most of the hard-rock mining had been precluded, the EPA attempted to re-enforce regulations for hard-rock waste; this re-enforcement proposal was never acted upon. However, it did aid in providing a basis for regulations on a state level (EPA, 1997).

National Environmental Policy Act

The National Environmental Policy Act, also referred to as NEPA, requires federal agencies to formulate environmental impact statements (EIS) for actions that would affect the features of the human environment on a severe level. Additionally, any activities pertaining to hard-rock mining on lands (federal managed or tribal) may require an EIS be conducted to identify and determine the severity of potential impacts (EPA, 1997).

Concluding Thoughts

Albeit, the wave of eco-criticism brought about by Carson's *Silent Spring*, introduced a variety of federal regulations meant to provide both human and environmental protections, all of which have advanced over time to include loopholes, which do not necessarily adhere to the growth of the hard-rock mining operations. Alternatively, these acts have unveiled streams of potential threats to both human health and the environment. The EPA estimates there are over 200,000 abandoned hard-rock mines but only around 156 falls under their jurisdiction (EPA, 2004). Meaning that, approximately, there are 199,844 hard-rock mines that the above acts cannot be applied. Moreover, if the EPA were to recover all the sites that are currently under their jurisdiction, it would cost them \$15 to \$50 billion to complete. Consequently, the absence of regulations have led to many implications pertaining to sensitive lands, polluted water sources, fish and wildlife, and natural lands. Since 2007, various editions of a Hard-rock Mining and Reclamation Act has been displayed through Congress. However, every proposal: 2007, 2009, 2014, and 2015, has died either in committee or at the end of the Congressional season. The passing of this proposed act would have enabled the federal government to remove the patenting, creating royalty for both new mines and existing ones, and aid in the finances of cleaning up abandoned sites (Earthworks, 2015). Essentially, overpowering that of the General Mining Law of 1972 influence on hard-rock mining practices.

Implications & Externalities of Mining Techniques

Success Stories

Yellowstone National Park, was the first site to be declared a national park, and has successfully created job availability and brought in millions of tourism dollars to both Wyoming and Montana. The northeast corner of the park is lined with portions of the New World Mining District, which historically contained a majority of hard-rock mines along Henderson Mountain in Montana. Prior to the districts closure, the mining companies manufactured well over $215,000 in hard-rock minerals, ranking them the third largest producer of precious metals in Montana (Montana.gov, 2009). By 1996, this was one of the first many success stories for both past and present generations. The Trust for Public Land and the U.S. Forest Service worked jointly to purchase the mineral rights outside of Yellowstone, as major concern had developed over both old and new hard-rock waste potentially being sent into the park via Soda Butte Creek. This waste would have cost the park millions of dollars in tourist revenue, as a result of any lost activities and posed multiple threats to the landscapes and ecosystems of the park. In fact, the United Nations commented that Yellowstone could have been placed on the list of ***"In Danger"*** within the World Heritage Sites. As a result an agreement, or rather a federal buyout transpired, costing the government over $65 million and the mining companies $25 million in reclamation efforts (Repanshek, 2010). Although this agreement stopped the most detrimental impacts of hard-rock mining waste from entering the park, *figure 1*, provides evidence that there are still abandoned mines that sit crumbling approximately 3 miles from the park.

Figure 1: Shows the remains of one of the mines in Gallatin National Forest, Montana.

Since its discovery in 1876 by Frederick and Moses Manuel, the Homestake Gold Mine has produced over 40 million ounces of gold and is considered to be the largest iron-formation-hosted gold deposit in the world. After it was sold as an open-pit by the Manuel Brothers for $30,000, further deposits were discovered via underground methods, raising the price to 20 times the original selling price. Until its closure in 2002, the Homestake Gold Mine was not only the largest, but also the deepest gold mine in North America. Throughout its lifespan it produced roughly 300,000 ounces of gold per year (Lufkin, 2009). However, *figure 2*, hardly begins to showcase the amount of ecosystem that was demolished to locate further deposits and expand the mine.

Figure 2: Shows the Homestake Gold Mine, which is located in Lead, South Dakota.

Disaster Stories

Even though there have been a few success stories, there have been far greater implications as the hard-rock mining sector has grown, the detrimental implications of mining techniques have become increasingly more apparent. These implications extend to have impacts on not just the environment, but also major consequences on human health. Predominantly, both active and abandoned mines disrupt the immediate area at which they dominate. However, they also create paramount impacts on air and water quality, vegetation, aquatic and wildlife species, soil, as well as cultural resources. These impacts extend beyond the immediate area of disturbance (Committee on Hardrock Mining on Federal Lands, 1999). Since there are multiple stages in each mining technique, both environmental and human impacts could arise at any time during or after the technique is completed.

Presently, hard-rock mining has left ***"more than 10,000 miles of polluted streams, contaminated lakes, mountains reduced to craters and landscapes devoid of life where thriving forest and fragile deserts once existed"*** (Boulanger & Gorman, 2004). The policies addressed in the section entitled, Mining Laws, all attempted to ***"avoid, limit, control, or offset many of these potential impacts, but mining will, to some degree, always alter landscapes and environmental resources"*** (Committee on Hardrock Mining on Federal Lands, 1999). Although the Clean Water Act has been adapted to include more complex sources of toxic pollution, it does not protect groundwater sources from the implications of hard-rock mining practices. Moreover, the Bevill loophole added to the Resource Conservation and Recovery Act in 1980, allotted for the exclusion of hard-rock waste to be unregulated. Therefore, allowing for the release of toxic chemicals, such as cyanide and sulfuric acid, to reach water supply sources and led to the development of air pollution. The hard-rock minerals themselves contain toxic metals, like lead, and have the ability to threaten human health through the release of radioactive gases, arsenic, and mercury. Environmental and human health dangers in hard-rock mining can also develop from human error, such as poorly engineered mountains and collection of waste (Boulanger & Gorman, 2004).

While further environmental and human health dangers harbor upstream, there are implications already rushing into externalities downstream. Here, if mercury can be found in large quantities, it can be cause kidney, nervous system effects, and permanent brain damage. Whereas, in low quantities, an individual might develop a lower IQ, slowed development, and memory and language barriers. In 2001, the hard-rock mining industry released 4.3 million pounds into the air, water, and soil. These should be relatively clean and available for a basic human right. However, instead they are being contaminated by industries, such as hard-rock mining, and are being a tragedy of the commons. Additionally, mercury pollution can be ingested into the tissues of fish and wildlife, becoming part of the bio-magnification cycle, which allows mercury to be passed up the food chain. This eventually impacted the fish consumptions, as by 2002 state public health agencies issued 2,148 advisories (Boulanger & Gorman, 2004).

Acid mine drainage is a major concern in Montana, where there are 20,000 inactive and abandoned mine sites, which amounted to 1,118 miles of stream damage. This process is mostly common in underground mining, as it occurs as groundwater flows through mine channels, or as rain water percolating through waste rock, leach and tailing ponds (Boulanger & Gorman, 2004). Although acid mine drainage as resulted in elevated levels of chemicals in downstream water and sediment, it has not been studied comprehensively for human health implications. However, the environmental pollution associated with acid mine drainage have proven to be extensive through massive fish decline and cattle losses after water consumption. Moreover, cyanide pollution is often associated with acid mine drainage, as it is able to bio-accumulate and produce both dust as well as air pollution. In regards to these cyanide spills though, the hard-rock mining industry insists that none of their workers have been killed after working with the highly toxic cyanide. However, on a global scale, there have been tailing dam failures causing extensive fish depletion and spills from gold mines have hospitalized hundreds of individuals (Boulanger & Gorman, 2004).

If placer mining occurs in active streams, the sediment along the stream-bed would be disrupted, which ultimately would result in high turbidity. Recovery of the stream-bed and its inhabitants may return to its original characteristics unless it's disturbed during a year with low-precipitation. However, even if it returns to its original characteristics, it may continue to be incompatible for aquatic creatures until the turbidity returns to a lower level (Committee on Hardrock Mining on Federal Lands, 1999).

Furthermore, the last major human health externality that hard-rock mining produces as a whole is the threats to drinking water. Clean and safe drinking water is known to be the one irreplaceable natural resource required for life. The threat from hard-rock mining is deeply-rooted in the multiple opportunities for waste to imprint itself into the ecosystem cycles and, in turn, human life. According to Boulanger and Gorman, the Environmental Working Group identified 374 watersheds in the United States that are utilized for drinking water and impaired or threated by metal pollution. There is an opportunity to improve and learn from lessons of the past, but society as a whole needs to decide to move towards the implementations of solutions.

Solutions

Even though, mining still exists and is responsible for 15 percent of the United States' GDP, society can decide to make a move towards utilizing more alternatives pertaining to renewable energy (Central Intelligence Agency, 2014). Another suggested solution is to place the mineral rights under the umbrella of home property rights. Through applying this umbrella, the owner of the land wouldn't be subjected to the right of way. This decision, in turn, presents less negative externalities.

> ***"You may own your house, but someone else owns everything underneath it."***
>
> - ***J. Paul Getty***

Further options would be to expand the mining policies and regulations to adequately allow for coverage of the growth of peripheral operations, some of which were addressed in the energy section, doing this would present the opportunity to target the externalities themselves. Generally, applying hard-rock mining industry specific regulations to incorporate agencies to establish risks to the fullest, monitor pollutants, release information regarding environmental and health risks, but most importantly, lock-in an industry specific mine recovery fund.

Conclusion

Gradually, the individual level of mining transformed into a corporate phenomenon that today contributes 2.5155 trillion dollars to the United States economy.

However, hard-rock mining has introduced various and detrimental environmental and human health implications. These implications attached to valuable minerals are still amongst the most loosely regulated minable resource in the United States. The primary goals of regulation pertaining to hard-rock mining should be adapted to incorporate the environmental and human health damages, for both past and present sites.

> ***"Many millions of dollars have been invested by the [hard-rock] mining industry into the science of how to extract even smaller concentrations of gold from rock, but very little has gone into determining how to put the earth back together once it has been blasted, crushed, and saturated with chemicals"***
>
> \- ***Boulanger and Gorman***

Work Cited

Boulanger, A., & Gorman, A. (2004). Hardrock Mining: Risks to Community Health. *Bozeman, MT: Women's Voices for the Earth (available online at www. earthworksaction. org/pubs/MiningHealthReport. pdf)*.

Butterman, W. C., & Amey, E. B. (2005). *Mineral Commodity Profiles: Gold*. US Geological Survey.

Carter, B. (2012). Boom, bust, boom: a story about copper, the metal that runs the world. 1st Scribner hardcover ed. New York: Scribner.

Central Intelligence Agency. (2014, June 5). Retrieved March 10, 2015, from https://www.cia.gov/library/publications/the-world-factbook/

Committee on Hardrock Mining on Federal Lands. (1999). *Hardrock Mining on Federal Lands*. Retrieved from National Research Council website: http://www.nap.edu/catalog/9682.html

Dawson, R., Winters, P., & Matson, J. (2015). Mountain top removal. *Uhuru*, *10*(3), 12.

Earthworks. (2015, February 13). Earthworks. Retrieved from www.earthworksaction.org/library/detail/hardrock_mining_reform_and_reclamation_act_of_2015

Environmental Protection Agency: Office of Inspector General. (2004). *Nationwide Identification of Hardrock Mining Sites.* (2004-P-00005), from http://www.epa.gov/oig

Environmental Protection Agency. (1997). *EPA's National Hardrock Mining Framework.* 1-12. Retrieved from http://www.epa.gov/aml/policy/hardrock.pdf

Lufkin, J., Redden, J., Lisenbee, A., & Loomis, T. (2009). Guidebook to Geology of the Black Hills, South Dakota. Golden, CO: Golden.

Mining Techniques| Mining Methods. (n.d.). Retrieved March 20, 2015. Retrieved from http://www.greatmining.com/strip-mining.html

Montana Department of Environmental Quality (DEQ) - 154tech. (2009, November 6). Retrieved March 11, 2015, from http://www.deq.mt.gov/abandonedmines/linkdocs/154tech.mcpx

Humphries, M., & Vincent, C. H. (2001). Mining on Federal Lands. Congressional Research Service, Library of Congress.

Repanshek, K. (2010, June 15). Land Deal Closes The Book On the New World Mine Proposed on Yellowstone National Park's Doorstep. Retrieved March 11, 2015. Retrieved from http://www.nationalparkstraveler.com/2010/06/land-deal-closes-book-new-world-mine-proposed-yellowstone-national-parks-doorstep6045

Wisconsin-Mines. (n.d.). Retrieved March 20, 2015, from http://www.miningartifacts.org/Wisconsin-Mines.html