Mining, Society, and a Sustainable World

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Editor

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1. Artisanal miners working in tailings pond of AngloGold Ashanti's Obuasi Mine, Obuasi, Ghana (photo credit: K. Slack, 2005).
2. Open pit copper mining operation, Zaldívar, Chile (photo credit: J.P. Richards, 1995).
3. Artisanal miners panning for diamonds Democratic Republic of the Congo (photo credit: M. Mazalto, 2008).
4. International Space Station photograph of the Bingham Canyon copper mine, Utah (Public domain image from NASA Earth Observatory: 2007).

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Foreword

"I sit on a man's back, choking him and making him carry me, and yet assure myself and others that I am very sorry for him and wish to ease his lot by all possible means – except by getting off his back." *Leo Tolstoy - Writings on Civil Disobedience and Non-Violence (1886).*

In today's world where sustainable development has become a critical security concept for the well-being of the environment and society, the man Tolstoy depicts might well be interchangeable for either the planet in terms of its carrying-capacity or its beneficiary, society.

While it is arguable that mining is neither inherently sustainable nor unsustainable (O'Faircheallaigh, this volume), exploration, production, and consumption of non-renewable resources over time makes the industry ultimately unsustainable if it results in negative socio-economic impact (Waye et al., this volume). This invariably leads to definitions of sustainability in terms of the financial benefits that can accrue from transforming natural capital into human capital, theoretically creating intergenerational benefits (ibid.). Such a definition of sustainability is inherently utilitarian, assuming the English political philosopher Jeremy Bentham's suggestion that human nature avoids pain for the pursuit of pleasure, and that legislators should therefore base decisions on the greatest happiness for the greatest number of people (Bentham 1996).

Gro Harlem Brundtland defined sustainable development as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs," which Waye et al. (this volume) suggest creates sufficient ambiguity to create competing claims as to what is sustainable. On the basis of mining being sustainable if revenues are collected to promote sustainable objectives elsewhere in the community (ibid.), one therefore needs to ask: To what extent is the environment perishable? What beneficial trade-offs would make this acceptable?

Rio Tinto Chairman Paul Skinner notably defined the role of business by standing monetarist economist Milton Friedman on his head. Rather than using Friedman's quote, "The business of business is business," Skinner told the 2004 annual gathering of the Businesses for Social Responsibility conference in New York: "The business of business is sustainable business." (http://www.riotinto.com/media/speeches_2268.asp).

"If our business disappears, so does our contribution to the world's social, environmental and economic needs," said Skinner. There would be no return on shareholder investment and no employment of people, let alone development of their skills and experience. Provision of society's basic essentials and necessities would cease, as would the company's support for economic and infrastructure development, healthcare, and education programmes, Skinner asserted. "Similarly, if we go out of business we will not find new methods and better technologies for combating climate change and preserving or repairing the environment," added Skinner (ibid.).

This point straddles the delicate bridge between corporate social responsibility (CSR) and sustainable development where, quite simply CSR should require companies not to amass their profits by externalizing their costs onto society and the environment. Were these costs instead factored back into a company's balance sheets and monetized, investors would need to re-examine social and environmental performance in ascertaining the real value of the company and its products. In essence this is the reasoning behind the triple bottom-line (e.g., Elkington 1994).

If the analogy of the man carrying Tolstoy refers directly to the planet's carrying-capacity to maintain consumption and production, then "steady-state stewardship" and "ecosystem viability" (Ernst, this volume) are vital concepts – but are they attainable? Mining's ecosystems impact is highly visible, concentrated scars that directly generate deforestation, erosion, soil degradation, and toxic discharge (Mazalto, this volume).

If the world's population is anticipated to increase over 50% by 2050, pushing toward 10 billion people, that 20% of the current population which already consumes 70% of the world's resources (Ernst, this volume) may require some introspection. Indeed, at current extraction rates, it is not unlikely that global copper and zinc resources could be exhausted considerably before 2100, with a similar scenario facing all Australia's mineral resources (Mining Environmental Management July 2008).

Although the argument exists that other deposits may exist elsewhere, notably the ocean floor, achieving any kind of stability in mineral resource development requires immediate research in science and technology to achieve efficient recycling and conservation of natural materials (ibid.). Nevertheless, one should caution with architect and sustainability guru William McDonough's observations that much of society's efforts toward sustainable development are doing "bad but less badly" rather than actually doing good (McDonough and Braungart 2002).

Notably, the mining and metals industry could do well to note McDonough's concept of recycling versus downcycling. Recycling restores the product back to its original integrity, whereas most of what society actually calls recycling is in fact "downcycling", whereby the material becomes of a lesser quality grade, and after a few cycles of downcycling is no longer re-usable (ibid.).

One of the first applications of the term "sustainability" was in Germany in 1713, when von Carlowitz prescribed that the silver mines of Freiberg should not witness the felling of trees faster than re-growth. Such intragenerational and intergenerational resource planning has also been evident in the forestry cycle of Cyprus,

which has consumed its forests sixteen times over while sustaining 3,000 years of the island's copper production (Wagner and Wellmer, this volume).

Such sustainability touches on basic human rights, enabling people to achieve economic prosperity and strive toward social justice, basic aims of the 1992 Rio Earth Summit's Agenda 21, and also the Brundtland Report 'Our Common Future' five years earlier that first clearly defined sustainable development (ibid.).

To return to the non-renewable and unsustainable pattern of consumption, the 1,000 year-old Rammelsberg polymetallic and precious metals mine, which was exploited from 968AD to 1988, reveals that a once steady annual average production of 20,000 tonnes/year tripled to 60,000 tonnes/year around 1850, and 100,000 tonnes/year production by the 1930s, before tripling again over the next two decades to 300,000 tonnes/year by the early 1950s (ibid.). In short, the past fifty years has witnessed more consumption than during the previous collective history of mankind, heralding what has now been described as a new geological period in history – the Anthropocene period, starting in the 1800s where mankind began to have a significant global impact on planet Earth (ibid.). Yet these production increases occurred in the industrialized countries and outstripped world population growth regardless of the West's own slow demographic growth (ibid.).

Other common assumptions surround thinking on mining's effects on society and its role in sustainable development. To state that countries like Canada, the USA, and Australia were built on mining, creating the assumption that mineral development is an automatic development driver, could be erroneous. Rather than mineral development per se, the economies of Canada, Australia, and the USA benefited from the "institutional capital" that enabled capital accumulation and its subsequent (distributive) benefits (Slack, this volume).

Indeed, academics and writers elsewhere question the relevance of systemic economic thinking when faced with the world's ecological and social challenges, in particular questioning the viability of traditional concepts of growth (e.g., Victor 2008; Brown and Garver 2009). Rather than measured in terms of benefits, growth is measured "in terms of exchanges of money" (Brown and Garver 2009, p. 9), and, according to this logic, even the cost of cleaning up the Exxon Valdez oil spill off Alaska (US$500 million) added to the region's GDP growth (ibid.). Even for measuring mining's impact on society, GDP growth does not factor distribution, meaning "inequity, poverty and outright starvation often can, and do, rise at the same time that overall economic activity increases." (Ibid p.10.)

However, society's own anthropological journey from Stone Age through Bronze Age to Iron Age and beyond is a trans-historical demonstration of how mineral development is inextricably linked to societal development. From a development perspective, defining economic and societal sustainability through the transformation of natural capital into social or economic capital pivots around the essential and conflicting problem surrounding the "Resource Curse" thesis, which argues that natural resources have a negative effect on economic growth and development (e.g., Auty 1993; Sachs and Warner 1995). However, Davis (this volume) shows that positive growth is likely to be of more benefit to resource-based nations than negative growth; he thus takes issue with the Resource Curse theory, suggesting instead that

attention should focus more on the problems of boom–bust cycles in resource-based economies.

An export-dependent economy would likely lead to unequal economic development unless it has a developed internal economy (Crowson, this volume). Good governance in host countries is likely an essential pre-requisite to investment (Hilson and Maconachie, this volume) and, certainly, voluntary principles such as the Extractive Industries Transparency Initiative (EITI) require some existing good governance in order to progress further accountability and transparency measures, including for World Bank and Western government purposes (ibid.).

Nevertheless, one could argue that even the best intentioned voluntary guidelines and principles to promote sustainable societal and economic impacts on a region, even in developed countries, do not make for good governance, nor are they destined to succeed. Closure of the Polaris and Nanisivik mines in northern Canada witnessed a quick fade-out of economic benefits when it came to wealth creation in the Arctic Inuit communities, due to an overemphasis at project conception stage on the benefits of the multiplier effects (Bowes-Lyon et al., this volume).

In the structural global economy where the World Bank has been a major proponent of mining and resource development for developing countries, mining has seldom provided such envisaged benefits as direct employment of the local population, because mining recruits few direct employees and, invariably, local inhabitants do not possess the education or skills required to operate and manage a capital intensive mining project. Instead, an assumed multiplier effect is anticipated to create indirect jobs created by the project's existence (Slack, this volume). However, the ultimate experience of the Arctic communities highlights the need to realistically factor-in the multiplier effect (Bowes-Lyon et al., this volume).

In Peru, the World Bank and International Monetary Fund's Poverty Reduction Strategy Papers assumed that mining would create employment, but did not elaborate any strategy. Because neither institution monitors the impacts of the projects they fund, no stakeholder transparency regarding monitoring, information-sharing, and results can be created for constructing future cost-benefit analyses, either at national or project-level (Slack, this volume). The World Bank's own Extractive Industries Review recommended that it cease funding oil and coal projects due to the lack of benefits created, advice the Bank chose to ignore (Davis, this volume).

Ultimately while there may be no growth that is actually "bad for the poor", positive growth is assumed to be better than negative growth. However, lessons could be learned for implementing pro-growth policies in extractive economies, and a sustained extraction economy requires foreign direct investment to support continued domestic exploration and resource development, rather than to concentrate on political and institutional shortcomings (Davis, this volume).

Limits to growth can vary. Despite Chile's status as the world's largest copper producer, Chile's severely depleted groundwater reserves will lessen the country's ability to resolve its internal wealth inequality, where the poorest 10% owns only 1.2% of Chile's wealth compared to the richest 10% who own half that nation's wealth (Slack, this volume).

Similarly, boom–bust cycles need to be studied (Davis, this volume). Botswana recently found itself at the front end of a boom cycle based on diamond mining, and needs to learn how to encourage its extractive industry to grow in a steady and persistent manner (ibid.).

To avoid the Resource Curse and provide positive socio-economic impacts requires constructive interventions. Clusters in the form of government, company, and voluntary sector partnerships, such as Chile's mining clusters that encouraged growth of small and medium-sized enterprises (SME) are recommended to deepen governance reforms (McPhail, this volume; also see Singh and Evans, this volume). Such reforms can be achieved especially where regional or local development agencies engage to co-ordinate economic diversification and poverty reduction, which could include planning infrastructure development to enable local development (ibid.).

Reinvestment of government revenues is critical, and Ghana is one example of a country that has done little to return investment to its mining communities (McPhail, this volume). This leads to the assertion that if policy-makers adopted the thinking of nineteenth century American economist Henry George, where land is a public good whose use should be taxed such that revenues can be recycled via regulatory and taxation policy instruments for the public good at local and national levels, then benefits can in fact be derived through mining a non-renewable and at first sight unsustainable resource (Waye et al., this volume). Ultimately, mining can be considered sustainable if the derived revenues from mining are collected and used to promote sustainable objectives at community and national levels, particularly through regulation and taxation measures that encourage the investment climate (ibid.).

Government transparency and clear, enforceable regulations would appear to be paramount requirements if developing countries are to benefit from development of their natural resources. An improved investment climate for mining can contribute to better macro-economic policies, and mining was the core of economic recovery in the four countries studied by the International Council on Mining and Metals (ICMM) (Tanzania, Peru, Ghana, and Chile; McPhail, this volume). The ICMM identified six factors that play a critical role in poverty reduction, the most important being adequacy and fairness of tax regimes and revenue allocation systems. In contrast, land use and property rights conflicts, environmental damage, artisanal and large-scale mining conflict, and mine closure issues can cause or extenuate poverty (ibid.).

On an environmental or ecological level of analysis, Wagner and Wellmer (this volume) recommend that the Earth's carrying-capacity would benefit from a four-tier hierarchy of resources for political decision-making, especially where future population growth will require more arable land that in turn will cause more deforestation and soil erosion. Four natural resources, water, soil, clean air, and energy are considered, and the authors identify a principle of vertical substitution: "Lower value resources should wherever possible replace higher value resources." The lowest level 4 represents waste and residues from primary use that can be used in secondary applications; level 3 identifies bulk raw materials from the Earth (such as

clay, basalt, and granite), nitrate from the air for fertilizer, and boron, potassium, rock salt, and magnesium from the sea; level 2 includes other less abundant natural resources and pure scrap; while the highest level is energy (Wagner and Wellmer, this volume).

Mineral development has been a force for social transformation, but the "take, make, consume, waste" paradigm has not been sustainable, both degrading the environment and creating a wide gap between rich and poor (Singh and Evans, this volume). While resource development is neither a de facto curse nor panacea, production complexes or "clusters" can help stimulate sustainable economic growth in the regions and areas where they are based. These clusters can take the form of groups of industries whose linkages mutually reinforce and enhance their competitive advantage, and which are composed of diverse groups that incorporate primary, secondary, and supporting industries (ibid.).

Singh and Evans (this volume) define sustainable development as containing three key propositions: economic growth, environmental stewardship, and CSR. For clusters to work in developing countries, policy-makers must recognize how resource-based economies move from a simple extraction mode (in which they export resources while importing equipment) to a balanced economy that includes export of associated goods and services, and which is neither import nor export-dependent (ibid.).

Far from proving to be a resource curse, South Africa's mining experience has enabled the country's economic diversification in which, since 1993, the non-mineral sector has played a slightly larger role in the country's GDP (Dane, this volume). In addition, the 2002 Mineral Resources and Petroleum Development Act has promoted longer term sustainability (ibid.). Under this legislation, social and labour plans are required to be developed, and Dane uses the Landau colliery for his case study, where poor planning historically has not benefited the local population. Recent stakeholder engagement between communities, governments, NGOs, and mining companies, among other private sector players, has helped transform the mining industry, aligning its socio-economic goals with the government. Enhancing black empowerment through SMEs and other roll-out to business hubs should also help sustain the local economy after the mine's closure in 2025 (ibid.).

O'Faircheallaigh (this volume) identifies nine policy process variables as a precursor to on-going comparative public policy studies to illustrate how the policy-making process can guide mining towards a sustainable future. Weak public policy in Papua New Guinea allowed the OK Tedi copper mine to wreak environmental damage on two local rivers, while colonial treatment by the UK, Australia, and New Zealand of Pacific island-state Nauru's phosphate mines did not enhance that country's economy prior to its independence in 1968. The Nauru government's own policies of investment created an unsustainable wealth once the phosphate ran out, because no viable internal economy was promoted in the aftermath of independence (ibid.). Indeed, it could appear that there is an illusory link between the practice of policy-making for the minerals and energy industry, and the theoretical

conversion of natural capital from an unsustainable physical resource into social capital that provides for long-term livelihoods, and that can subsequently be deemed sustainable.

Away from the public policy process, greening of the mining supply chain and processes emphasises the reciprocal causation between change of management attitudes and commitment to re-thinking how they do business in order to be more eco-efficient. Suppliers need to understand the role they can play in educating and partnering with a mine's management team, thereby often improving the longevity of a mine's lifecycle (Guerin, this volume). Greater stakeholder engagement is needed in developing new sustainable processes as part of an integrated response from management that will demonstrate a clear commitment to sustainable development. Management needs to work closely with suppliers to identify new processes and initiatives, whether for improving air quality, energy efficiency, and materials efficiency, while minimizing waste and improving water efficiency and waste management (ibid.). In turn, this should not only reduce costs, but will enable companies to contribute more to a region's economic and social fabric (ibid.).

Similarly, mine closure has changed in focus from factors of salvaging and removing equipment to the whole ecosystem, requiring the consideration of social and economic issues where governments would be well-advised to publish guidelines and regulations (Otto, this volume). Public policy can facilitate best practice by encouraging good mine design, such as properly engineered tailings dumps that will prevent costly acid drainage while permitting the future recovery of metals. Cost estimates for closure and reclamation should be included in mine plans (ibid.).

The voluntary Equator Principles adopted by financial institutions for extractive and other projects request that their borrowers abide by environmental and other regulations, and devise decommissioning plans to reduce the negative environmental and public effects mine closure would otherwise cause. The lesson for jurisdictions is the need to seek financial assurance for efficient closure and reclamation, whether through surety bonds, certificates of deposit, trust funds, insurance policy, or simply depositing cash with the jurisdiction's Treasurer, to secure against the mine claiming effective bankruptcy which would prevent the mine from being properly reclaimed (Otto, this volume).

It can start to be seen how public policy can turn mining into a development lever (Mazalto, this volume), at least economically. But government effectiveness is paramount, and intervention primarily rests at the national institutional level, with informal powers or influence residing at transnational or multilateral levels such as the OECD, World Bank, and so forth, who help devise CSR policies (ibid.).

The Democratic Republic of Congo demonstrates this point when the World Bank returned its attention to the country after 2001, the extractive industry having abandoned it in the early 1990s (Mazalto, this volume). In this case, responsibility for resolving environmental problems is not so clear-cut: is it the national government, private sector, or international finance institution that should bear the responsibility? Congo's new democratic government implemented a Mining Law at national level and, to reverse the loss of a country's environmental resources, the

United Nations Environment Programme and UN Development Programme established a Poverty and Environmental Facility to reduce poverty in a bid to enhance implementation of the UN's Millennium Development Goals (ibid.). Arguably, because the state itself is too weak to enforce its own regulations across the country—particularly in the North and South Kivu artisanal mining regions, where commodity price rises for the metal tantalum (coltan; essential to mobile communications and computers) has been and remains the cause for armed conflict and human rights atrocities—the development of norms at transnational level benefit the transnational community (ibid.).

The environmental–development axis is critical because socio-economic development requires an environmental input. Not only is sustainable development a global phenomenon, but it requires some deconstruction in terms of priorities and the public policy-making decisions required to mitigate externalized social and environmental costs. For example, should ecosystems and biodiversity take priority (Waye et al., this volume) over any other issue?

There can be little doubt that as a wealth resource, mineral resources should enable growth. Regardless of whether the natural resources are located in a developed country such as Canada (e.g., having to balance the pros and cons of the environmental costs of mining Alberta's oil sands), or in a Least Developed Country such as Tanzania, any responsible government should carefully weigh the environmental costs against likely social and economic benefits. Growth for and in itself may bring only short-term and artificial benefits, especially if they subsequently exacerbate climate change. One could argue that there are alternatives, for example, to fossil fuels, but there are no alternatives to water, which may yet become a scarce resource essential to life due to over-consumption and depletion due to serious climate change.

In the structural economy, good governance requiring accountability and transparency is required to mediate competing claims for resources historically made by companies, foreign governments, host governments, financial institutions, and the local or regional inhabitants. Where national governments are strong enough to prioritize how to distribute the benefits of their natural resources, transforming these into social capital, they will need to decide what are the essential components of future sustainable development in their region or society. For example, is it combating malaria, HIV/AIDS, and tuberculosis; advancing education; rolling-out economic benefits to foster SME growth and create internal markets; infrastructure development; or adapting to climate change?

In a globalizing society, sustainable development is a global and critical security issue, where to a greater or lesser degree we are all Tolstoy feeling sorry for the man carrying us on his back, and wanting to ease his lot by all possible means.

In order to do this, a serious debate about modern and future security needs to take place in order to harmonize energy and mineral resource security with environmental, human, political, economic, and societal security.

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Introduction

Few people would deny that mined materials are an essential, if not foundational part of modern economies and civilizations. But in the same way that few meat eaters like to think of what happens in slaughterhouses, few book readers like to think of clear-cut forests, and few vegetable eaters like to think of the effects of fertilizers, pesticides, weed killers, and monoculture on the environment, few of us, as beneficiaries of the products of mining, like the idea of mining itself. And indeed it is true that historically, and continuing today in some parts of the world, the mining industry has been responsible for egregious human rights abuses and unnecessarily negative environmental impacts. Such malpractices date back at least to the Romans, who used slave labour in most of their mines and caused severe (if localized) environmental degradation.

However, the modern mining industry has learned from almost 40 years of environmental activism that it can no longer pollute with impunity, and it has found itself relatively able to respond to these concerns over environmental degradation by approaching them as engineering problems with scientific solutions. Where the mining industry has been less successful to date is in regard to the social impacts of its activities. Social activism, in its modern form, has appeared relatively recently (within the last 20 or so years), and has focused primarily on the rights of indigenous people, who commonly find themselves in the path of large-scale mining developments, often in the more remote parts of the world. Staffed primarily by geologists, engineers, and accountants, mining companies have struggled to understand and deal with these "soft" issues, increasingly to their detriment (an increasing number of mining projects have been halted by social opposition in recent years: for example, Tambo Grande in Péru, and Esquel in Argentina).

This book aims to explore these broader implications of the mining and minerals industry, from social, economic, and sustainable development perspectives, with a view to identifying the most pressing issues, reviewing current best practices, and proposing ways forward. The book is structured in four parts: (1) the role of mining in developed and developing economies; (2) the role of mining in sustainable development; (3) mining and the environment; and (4) mining and society.

The authors of the sixteen chapters contained herein are all practitioners or researchers in these fields, and have all approached their topics with vision and foresight. My only request to each author prior to writing was to be positivist and

solution-oriented in their thinking, although some topics, such as the parlous state of mining in the Democratic Republic of the Congo (DRC), leave one hard pressed for optimism.

The first part of the book looks at mineral resources and economics from a global perspective. The first three chapters by Philip Crowson, Graham Davis, and Kathryn McPhail all tackle the "Resource Curse" paradigm, which holds that natural resource extraction hurts rather than helps build a nation's economy. Crowson examines a number of historical examples of mineral booms, and concludes that, while some did indeed result in impoverishment, others were more positive and provided the foundation for continued post-mineral growth. Crowson concludes that the key to a successful outcome depends mainly on institutional factors in the host country, and especially a government's control of rent-seeking behaviour.

Davis focuses on the impacts of resource extraction on the poor. Like Crowson, he finds examples of both positive and negative impacts, but notes that these impacts commonly relate to national economic trends such as growth spells and recessions. He finds that the poor fare similarly in extractive as in non-extractive economies during positive growth spells, in most cases benefiting but in some cases not. Conversely, the poor tend to fare badly during periods of negative growth. Thus, the poor will be disadvantaged in countries afflicted by the Resource Curse, wherein negative economic growth is caused by poor management of the extractive sector.

Kathryn McPhail describes an initiative undertaken by the International Council on Mining and Metals (ICMM) to explore the factors that control whether or not resource-rich developing countries experience the Resource Curse, and to identify ways in which the mining industry can contribute to poverty reduction at national and local levels. The study concluded that keys to success were mainly institutional (as found by Crowson), including improvements in governance, legislative reform, and fiscal management. However, McPhail notes that industry also has an important leadership role in promoting these outcomes, especially at regional and local levels.

Keith Slack takes a different viewpoint on resource-based development, and calls on development planners to explain more clearly how mining will contribute to national development, and to assess more robustly the industry's long-term costs and benefits. He argues that much of what is called "sustainable development" in relation to mining is a pretense, and while there may be other legitimate reasons for supporting mine development, raising expectations in terms of sustainability may not serve the industry's or a country's best interests.

Markus Wagner and Fred Wellmer consider natural resources in terms of a hierarchy of value and substitutability. Energy resources form the highest tier in this hierarchy, naturally occurring deposits of raw materials the next, materials in unlimited abundance such as sand or components that can be derived from air or seawater form the third level, and waste and residual materials comprise the fourth, lowest level. The authors advocate conservation of top tier resources and substitution where possible with materials from lower levels, in order to maximize resource efficiency. They also argue that resource efficiency should be measured in terms of energy efficiency to reflect the supremacy of energy in the hierarchy of natural resources.

The second part of the book focuses on mining in relation to sustainable development. Gary Ernst continues the theme of the pre-eminence of energy as the key to human development, and discusses limitations on energy availability and use in thermodynamic terms. He identifies only nuclear fusion and solar-based energy (sunlight, but also wind, waves, biofuels) as being effectively unlimited or truly renewable. However, he warns that it may not be energy supply that ultimately limits human development, but rather the impacts that our activities have on the biosphere. Like Wagner and Wellmer, Ernst advocates conservation, resource substitution, and improved efficiency as the keys to long-term sustainability.

Arianna Waye and coauthors start with the tenet that mining can contribute to sustainable development if the revenues generated are appropriately invested. They then examine the effects of various external fiscal and geopolitical parameters on the willingness of companies to invest in mining activities. A key finding, well known but rarely acted upon, is that the actual level of taxation is not as important as the stability of tax regimes in guiding investment decisions. This suggests that more revenue could be generated for sustainable development objectives from the extractive industries when political, regulatory, and fiscal environments are stable.

Again starting from the principle that natural resources can be the springboard for sustainable development, Indira Singh and Jim Evans examine the use of industry "clusters" for maximizing the economic benefits than can be derived from primary resource industries such as mining, agriculture, and forestry. Key to this concept is that focused, cluster-based economic activity can develop beyond the primary sector, and may be sustained even after the original resource has been depleted. This is the ultimate test of a resource industry's contribution to sustainable development—does the benefit survive after mining ceases?

The third part of the book examines the impact of mining on the environment. As noted above, modern mining companies are quite deeply engaged in improving their environmental performance, and the first two chapters in this part examine these trends. The third chapter exposes the problems continuing in other parts of the world where the environmental revolution has yet to take hold.

Turlough Guerin views the environmental performance of the mining industry from the perspective of fuel and lubricant supply and handling. Wastage and spillage of these components are major factors in a mine's environmental performance, and Guerin approaches this problem in terms of a petroleum-based hydrocarbon life-cycle, seeking eco-efficiencies at each stage in the cycle.

Jim Otto examines trends in legislation and practice for mine closure and reclamation, and considers the roles of various stakeholders, such as mining companies, employees, nearby communities, and governments. Standards, certainly in developed countries, have changed dramatically since the walk-away practices of only a few decades ago, and today companies talk about "planning for closure" from the outset, before mining even begins. Some jurisdictions also require bonds to be posted against future closure and reclamation costs, and Otto examines the pros and cons of the various methods used to determine the amount of money required to cover these costs at the end of the mine life.

Marie Mazalto takes us on a visit to the Democratic Republic of the Congo to examine the state of the environment in this resource-rich country's mining regions. The ravages of two decades of civil war and political unrest have gutted the once world class mining operations of the Copperbelt in the southwest of the country, and have fuelled terrible violence in the coltan mining areas in the east. Environmental considerations have been far from the minds of people trying simply to survive under these conditions, and widespread pollution has resulted. Since the return of relative peace to the Congo, The World Bank and other international financial institutions have also returned to the DRC with new tools to improve "good governance", and mining investments have recommenced. Mazalto shows that, based on data from an audit conducted for the Bank, extensive damage has been done to the environment in these mining regions, which may be next to impossible to repair. Close cooperation between donor organizations and the DRC government will be required if improvements are to be seen in this new phase of resource development.

The final part of the book examines the interplay between mining and society, at both local and national scales. Turlough Guerin leads this part with a chapter on stakeholder engagement and eco-efficiency as a means of promoting corporate responsibility in the minerals sector. Guerin examines several examples of positive engagement between mine or processing plant operators and local communities that have resulted in improved efficiencies, for example in water conservation and waste management. However, he notes that the will to do this must be instilled in senior management, who must make the pursuit of such opportunities a priority.

Léa-Marie Bowes-Lyon and co-authors have taken a retrospective view of the socio-economic impacts of mining at two sites in the Canadian High Arctic. The Polaris and Nanisivik lead-zinc mines both operated over similar 20-year time-spans and both closed in 2002. Polaris was located at some distance from the nearest community, Resolute, whereas Nanisivik was located just outside the community of Arctic Bay. Surveys of these mining communities revealed that, while the mines had contributed to increased incomes and other modest benefits for members of these communities while in operation, few of these benefits have persisted since mine closure. As such, this model for mine operations in remote regions has not contributed to *sustainable* development at the local scale. Recommendations for improved performance in the future include better community consultation and participation, and provision of training in business and technical skills that can be transferable to other economic activities after mining ceases.

Anthony Dane has also examined the socio-economic effects of mining, this time in relation to an operating coal mine in South Africa. He reports on a study undertaken by the parent company, Anglo American, using the methodology of ICMM's Resource Endowment Initiative, to measure the contribution of the mine to the Millennium Development Goals and the creation of sustainable communities (post mine closure). While many successes are reported, Dane notes (like Bowes-Lyon et al.) that the main areas of deficiency have been in community engagement, as well as engagement with other stakeholders such as government and non-governmental organizations, which has led to sub-optimal redistribution of the wealth generated by mining.

Ciaran O'Faircheallaigh examines the critical role of public policies and so of public policy processes in shaping sustainable outcomes from the extractive resource industries. Poorly developed policies can result in mine failures or unsustainable consequences, whereas well-crafted policies can support social, economic, cultural, and environmental sustainability. He identifies nine process variables that are critical to successful policy development and implementation, including stakeholder engagement in the process, and provision of adequate funding and time. He argues that radical change is required in existing policy processes if public policies are to enhance the potential of mining to contribute to sustainable development.

Gavin Hilson and Roy Maconachie close out the book with a critical analysis of the effectiveness in sub-Saharan Africa of the Extractive Industries Transparency Initiative (EITI), which was launched in 2002 at the World Summit on Sustainable Development in Johannesburg. The stated aim of the EITI is to improve economic development in resource-rich countries through "good governance", but Hilson and Maconachie doubt that the EITI on its own can produce the required changes, especially in relation to reducing corruption and improving resource management.

Thus, this book explores a wide range of issues surrounding the role of mining and minerals in the context of development, sustainable or otherwise. While several chapters note considerable progress, especially in regard to environmental performance, improved social outcomes, in particular for indigenous peoples or impoverished populations, remain largely conceptual, and fully unrealized in parts of sub-Saharan Africa. The outlook of this book is intended to be positivist, and it is hoped that the problems identified in each of the chapters will serve as a spur to the pursuit of solutions, rather than simply as a justification for opposing mining. Environmental and social activism is a valuable piece of the picture, and is largely responsible for the dramatic improvements in industry performance over the last 40 years, especially in relation to the environment. But the stick must be balanced with a carrot, and encouragement is often lacking for those companies who make real efforts to change. We here offer kudos to those who are making this effort, but warn that "sustainable development" is not a final destination but a path—there will always be room for further improvement.

Jeremy P. Richards

Part I
The Role of Mining in Developed and Developing Economies

The Resource Curse: A Modern Myth?

Phillip Crowson

Is there any thing whereof it may be said, See, this is new? It hath been already of old time, which was before us.
(Ecclesiastes: Chapter 1, verse 10)

Abstract This chapter concentrates on the economic importance and impact of mineral development rather than its social and environmental effects. It first examines statistics on mineral dependency, demonstrating that many commonly used measures underestimate the contribution of minerals to economic activity. It then looks at the ways in which the development of mineral wealth can affect resource-rich countries for good or ill. Some historical examples of mineral development show that the issues raised today were no less relevant in times past. Changes in transport and communication technologies, and in the capital intensity of minerals extraction and processing over the past century and beyond have, however, reduced the prospects for strong multiplier effects of mining in many host countries. Far more than in the past, the main economic benefits to host countries are likely to be through their fiscal receipts and capture of mineral rents. The extent to which those benefits are realized consequently depends on the nature of their institutions and governance.

1 Introduction

In recent years a substantial body of literature has examined the impact of mineral development in resource rich countries. Rather than provide here a long list of references on this and later comments, readers are directed to Paul Stevens' useful survey of the extensive literature (Stevens 2007a). Commentators are divided between those who argue with conviction that mineral wealth is a blessing and those who

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maintain with vehemence that its development is an unmitigated curse. These opposing viewpoints, and especially those that maintain the existence of a resource curse, a term first coined by Richard Auty in 1993 (see Stevens 2007a), are often a cloak for more visceral beliefs about the role and desirability of mineral development by multinational companies to serve global markets. Much of the recent commentary is concerned with oil and gas rich states rather than with putative hosts for hard-rock minerals, and the inherent differences between petroleum and non-fuel minerals are brushed aside. Sudden access to any new source of wealth nonetheless creates problems for economic management and for social stability, whatever the size of the unit involved, from an individual through to a nation. In that regard new mineral wealth is no different from any other apparent windfall.

The debate about the economic impact of mining, like so much else today, adopts too short a time perspective. This is not to follow Mao Tse-Tung's belief that it is too early to ascertain the effects of the French Revolution, but to recognize that short and medium term impacts may often differ from those that mature over longer periods. Policy makers and commentators increasingly seek instant answers and solutions. What matters, however, is not the short term, but how any potentially adverse economic and social impacts of development are eventually resolved. In some states, their resolution may be inhibited by underlying political, social, and ethnic strains and stresses. In those countries the curse is not mineral wealth but related to far more deep-seated, and often insoluble issues. Many mineral-rich countries have avoided or minimized any adverse consequences of natural resource development, both historically and more recently. Other countries may not, however, be able or willing to copy them.

2 The Importance of Mining

2.1 The Nature of Mining as an Economic Activity

The main distinguishing features of mining are its dependence on depleting natural resources, and, in some instances, its scale relative to the host economy. Extractive industries also differ from others in the importance of economic rent in their value added. Unless manufacturing and service industries enjoy a unique competitive advantage such as a tariff barrier or patent protection, their economic rents are gradually competed away. The relative costs of production of the mining industry are dictated not so much by the costs of labour and intermediate goods and services used, as by the characteristics of the underlying resources. Those persist over the life of a project, although potential economic rent can be enhanced by skilful management, or whittled away through mismanagement. A marginal project whose production costs, including the opportunity cost of its capital, equal its revenues, earns no rent.

Most attention is focused on the development of major export-oriented mines by multinational companies, but by no means all mining and minerals investments

are of that nature. Construction materials and industrial minerals of all types are mined, often by domestic companies for local or regional markets, and there is a large artisanal mining sector in many countries. Much foreign investment is in gold mining, whose economics differ in many respects from those of the major metals, even if its potential impacts do not.

Mining is an important contributor to economic activity in many countries, both developed and developing, although the measures of its importance that are most widely used tend to understate its role. Most econometric analysis of the relationship between minerals extraction and economic development (e.g., Sachs and Warner 1995, 1997a, b; World Bank 2002; Collier and Goderis 2007a, b) has concentrated on export data and on readily available price series. One frequently used source in such econometric analysis is the World Bank's publication, World Development Indicators (World Bank 2007), which shows annual exports of ores and metals as percentages of total merchandise exports. The coverage of the World Bank's series is relatively narrow. It embraces just Section 27 (crude fertilizers, minerals not elsewhere specified), Section 28 (metalliferous ores, scrap), and Section 68 (non-ferrous metals) of the Standard International Trade Classification. It omits coal, precious stones, and gold (but not gold ores and concentrates), as well as the first-stage products of mining, such as inorganic chemicals (which include some primary products like alumina), manufactured fertilizers, coke, cement, and some construction materials. Paradoxically iron and steel are not included, whereas non-ferrous metals and their semi-fabricated products are. Non-ferrous waste and scrap, which arise mainly in consuming countries, are included. The narrow coverage of the data used naturally influences the analyses, probably introducing a bias against picking up any potential benefits of mining.

2.2 Mineral Exports

Table 1 shows the size and composition of mineral exports, much more broadly defined, from a wide range of countries, developed as well as developing. Everything covered in the World Bank's definition is included as well as the other minerals and their first stage products mentioned in the previous paragraph, except that both ferrous and non-ferrous waste and scrap are excluded. The precise definitions are shown below the table. Iron and steel are not included, although their raw materials are. Developing countries are included where their mineral exports exceeded $20 million in 2004 and data are available. Lack of data from 1978 onwards, notwithstanding the attention paid to its mining sector by the World Bank and other international agencies, explains the omission of the Democratic Republic of the Congo. The broad coverage throws up a few apparent oddities, such as India's large export of precious stones, based on its gem cutting industry, and Trinidad and Tobago's exports of inorganic chemicals.

Table 1 brings out the importance of precious metals and gemstones for many developing countries. They accounted for one fifth of the $304 billion of exports

Table 1 The size and percentage composition of mineral exports in 2004

Country	Percentages of total mineral exports								Value
	Precious metals and stones	Metallic ores and concentrates	Non-ferrous metals	Fertilizers	Crude minerals	Inorganic chemicals	Coal and coke	Mineral manufactures	Total $ million
Algeria	0	0	12	28	1	59	0	0	228
Argentina	8	49	21	5	2	9	1	6	1,854
Armenia	95	0	5	0	0	0	0	0	232
Australia	14	33	18	0	1	1	31	0	31,828
Belarus	0	0	2	73	4	2	1	18	1,186
Bolivia	27	42	25	0	2	2	0	1	466
Botswana (2001)	93	5	0	0	2	1	0	0	2,284
Brazil	5	53	22	1	4	4	0	10	10,814
Bulgaria	0	3	78	6	3	3	1	6	1,225
Burundi	99	1	0	0	0	0	0	0	44
Canada	19	12	41	9	3	6	6	5	26,093
Central African Rep (2005)	23	0	66	0	11	0	0	0	173
Chile	3	37	56	1	0	3	0	0	17,168
China (inc Taiwan)	7	2	29	5	4	13	26	13	29,473
Colombia	24	0	2	1	1	2	64	6	2,886
Cote d'Ivoire (2003)	26	1	1	37	7	9	0	21	57
Dominican Republic (2001)	2	0	9	14	29	8	0	38	27
Finland	3	0	63	4	4	15	0	10	2,928
Gabon	0	97	0	0	0	0	0	2	156
Ghana	77	11	2	0	7	3	0	1	174
Greece	0	8	62	3	8	1	0	17	1,706
Guatemala	0	0	12	16	9	19	0	42	53
Guinea (2002)	28	51	0	0	3	18	0	0	503

Table 1 (continued)

Country	Percentages of total mineral exports								Value
	Precious metals and stones	Metallic ores and concentrates	Non-ferrous metals	Fertilizers	Crude minerals	Inorganic chemicals	Coal and coke	Mineral manufactures	Total $ million
Guyana	87	12	0	0	1	0	0	0	217
India	61	22	7	0	4	2	0	4	17,165
Indonesia	3	32	22	1	1	3	34	4	8,228
Ireland	1	50	10	1	6	6	7	19	984
Jamaica (2002)	0	99	0	0	0	1	0	0	718
Jordan	6	0	3	67	1	17	0	5	865
Kazakhstan	10	20	47	1	3	11	8	0	3,475
Kenya	6	0	11	0	56	4	0	22	162
Krygyzstan	89	0	2	0	1	1	0	6	325
Macedonia	1	1	10	1	23	5	2	57	69
Madagascar	35	25	5	0	32	1	0	1	28
Malaysia	17	1	47	8	3	10	0	14	2,540
Mali (2001)	100	0	0	0	0	0	0	0	432
Mauritius	75	0	1	16	2	4	0	3	64
Mexico	22	15	23	0	7	11	0	21	4,016
Mongolia	39	52	1	0	4	0	3	0	583
Morocco	3	3	5	45	3	39	0	2	1,898
Mozambique	0	1	99	0	0	0	0	0	367
Namibia (2003)	62	18	10	0	6	0	0	3	267
New Caledonia	0	100	0	0	0	0	0	0	302
New Zealand	19	1	72	0	3	1	0	3	885
Nicaragua	91	0	1	0	3	4	0	1	50
Niger (2003)	1	98	0	0	1	0	0	0	115
Norway	3	0	79	0	6	10	0	1	6,312
Oman	2	6	21	0	14	9	0	48	201

Table 1 (continued)

Country	Percentages of total mineral exports								Value
	Precious metals and stones	Metallic ores and concentrates	Non-ferrous metals	Fertilizers	Crude minerals	Inorganic chemicals	Coal and coke	Mineral manufactures	Total $ million
Pakistan	3	19	3	8	12	5	2	48	112
Papua New Guinea (2003)	66	33	0	0	0	0	0	0	1,190
Peru	38	32	28	0	0	1	0	1	7,201
Philippines	9	8	61	7	3	3	0	9	973
Poland	5	1	30	5	2	5	43	10	6,371
Portugal	7	15	23	5	6	5	0	39	1,354
Romania	0	9	47	25	2	10	1	6	1,049
Russian Federation	8	3	51	14	1	5	16	2	20,852
Saudi Arabia	16	2	11	33	3	21	0	14	1,389
Senegal	0	0	1	24	9	56	0	9	321
Serbia and Montenegro	0	2	77	3	1	4	1	12	470
South Africa	48	10	16	1	2	5	17	2	14,513
Spain	2	2	26	4	9	6	2	49	8,357
Sri Lanka	55	2	34	0	2	2	0	6	404
Sudan	98	2	0	0	0	0	0	0	48
Suriname (2001)	0	99	0	0	0	1	0	0	240
Sweden	9	22	48	2	3	6	1	10	3,768
Tajikistan(2000)	6	0	94	0	0	0	0	0	398
Tanzania	97	0	2	0	0	0	0	0	628
Thailand	39	0	20	1	11	5	0	24	2,721
Togo	0	0	0	33	0	0	0	67	145
Trinidad and Tobago	0	0	0	10	0	88	0	2	1,047
Tunisia	1	2	1	50	3	32	0	11	917
Turkey	3	7	23	1	14	3	0	49	2,924

Table 1 (continued)

Country	Percentages of total mineral exports								Value
	Precious metals and stones	Metallic ores and concentrates	Non-ferrous metals	Fertilizers	Crude minerals	Inorganic chemicals	Coal and coke	Mineral manufactures	Total $ million
Uganda	93	0	0	1	2	0	0	3	66
Ukraine	0	23	11	19	6	14	23	4	3,881
United States	38	5	19	8	5	11	7	7	37,890
Venezuela	4	8	58	5	1	7	9	8	1,627
Zambia	4	4	86	4	1	0	0	1	738
Zimbabwe	7	40	32	1	11	1	6	3	521
Totals	20	16	29	5	3	7	12	7	304,005

Definitions:
Precious metals and stones: S.I.T.C Rev 3 (UN Code 30262)—289, Precious metal ores and concentrates; 667, Pearls and precious stones; 681, Silver, platinum and other metals of the platinum group; 971, Gold, non-monetary, excluding ores.
Metallic ores and concentrates: S.I.T.C Rev 3—281, Iron ore and concentrates; 283, Copper ores, concentrates; 284, Nickel ores, concentrates; 285, Aluminium ore, concentrate etc.; 286, Uranium, thorium ores, etc.; 287, Ore, concentrates, base metals.
Non-ferrous metals: S.I.T.C Rev 3—682, Copper; 683, Nickel; 684, Aluminium; 685, Lead: 686, Zinc; 687, Tin; 689, Miscellaneous non-ferrous base metals.
Fertilizers: S.I.T.C Rev 3—272, Fertilizers, crude; 562, Manufactured fertilizers.
Crude minerals: S.I.T.C Rev 3—273, Stone, sand and gravel; 274, Sulphur, unroasted iron pyrites; 277, Natural abrasives not elsewhere specified; 278, Other crude minerals.
Inorganic chemicals: S.I.T.C Rev 3—522, Inorganic chemical elements; 523, Metallic salts, inorganic acids.
Coal and coke: S.I.T.C Rev 3—321, Coal, not agglomerated; 322, Briquettes, Lignite, Peat; 323, Coke, Semi-coke, Retort carbon.
Mineral manufactures: S.I.T.C Rev 3—661, Lime, cement, construction materials; 662, Clay, refractory, construction materials; 663, Mineral manufactures not elsewhere specified.
Source: United Nations, United Nations Common Database, June 2007, ESDS International, (MIMAS) University of Manchester.