ICMM
International Council on Mining & Metals

InBrief

Trends in the mining and metals industry

Mining's contribution to sustainable development
October 2012

Trends in the mining and metals industry

InBrief

Introduction

Mining provides the building blocks for human development. The supply of metal and mineral products has underpinned human endeavour through millennia and will continue to play its role in meeting society's needs.

The need will remain strong, so satisfying demand requires finding and developing new mines, even as resource use becomes more efficient and recycling systems ramp up. Fortunately the geological supply of metals within the Earth remains robust and new technologies will help bring new deposits on stream. But these will increasingly be located in more remote regions, raising production and investment costs.

In this edition of the Mining's Contribution series, we discuss the key trends that mark today's mining and metals industry and, without attempting to predict the future, consider the where, the what, the who and the how of the mining industry today and as it goes forward into the future.

Mining's contribution to sustainable development

ICMM has commissioned this series of publications to describe mining and metals' contribution to sustainable development. It seeks to set out some of the more important benefits, costs, risks and responsibilities related to mining and metals in today's world.

The first in the series – *Mining's contribution to sustainable development* – provides an overview of the series and introduces the concept of contribution analysis. *The role of mining in national economies* examines the contribution of mining activities in all countries with an overview of the contribution to the global economy. *Trends in the mining and metals industry* provides a forward looking discussion of trends likely to govern the evolution of the industry over the next decade.

In *Uses of minerals and metals*, a treatment of the current and future contribution of minerals- and metals-based products to sustainable development is offered. Building on this theme, *The role of minerals and metals in a low carbon economy* focuses on the materials needed for the technologies to address the climate change challenge.

The next two titles in the series focus on the contribution of mining to people and the environment. *Human rights, social development and the mining and metals industry* focuses on the role of business in contributing to the realization of human rights. Whilst *Mining and the environment* looks at how mining companies are tackling the challenge of achieving a net positive contribution from their activities.

Together these discussions are intended as a starting point for the industry and others to more fully examine the contribution of mining and metals to sustainable development, a conversation that will continue for years to come. They are intended to stimulate an exchange of ideas leading to the development of innovative ways forward. The series was launched at the Rio+20 summit in June 2012 and individual titles are being released periodically.

About ICMM

The International Council on Mining and Metals (ICMM) was formed in 2001 to catalyze improved performance and enhance the contribution of mining, minerals and metals to sustainable development. Today, it brings together 22 mining and metals companies as well as 34 national and regional mining associations and global commodity associations. ICMM's member companies employ close to one million of the 2.5 million people working in the sector worldwide. These companies have some 800 operations in over 60 countries producing 30–40% of the world's hard mineral commodities including iron ore, gold, platinum and nickel. We engage with a broad range of stakeholders – governments, international organizations, communities and indigenous peoples organizations, investors, civil society and academia – in order to build meaningful relationships. Our vision is one of leading companies working together and with others to strengthen the contribution of mining, minerals and metals to sustainable development.

About the authors

This series has been developed by ICMM with input from members, subject matter experts and representatives of organizations we work with. ICMM would like to thank them all for their contributions. Information on the authors and reviewers for each title is provided on the back cover.

Population growth and urbanization

The sheer size of population growth and the speed of urbanization in China and other Asian countries, coupled with ongoing requirements in the developed world has created unprecedented demand for minerals and metals. Strong demand growth comes mainly from millions of aspiring individuals in emerging economies striving for a better material standard of living. Even with dramatic increases in recycling, an overall increase in newly mined materials is required to support the emergence of individuals, communities and countries from stagnation and poverty.

Minerals and metals are key to all services and infrastructure that are used by contemporary society: including shelter, food and water supply, sewage treatment, energy supply for a vast range of needs including heat and light, transportation, construction, manufacturing, education, health, communication, entertainment, the arts, tourism, and the vast range of associated consumer goods and services.

As the material standard of living grows, mineral and metal demand also expands. This pattern has been followed by all developing countries in history. Studies have now consistently demonstrated that when per capita income in a country reaches US$5,000–10,000 per year, metal demand increases particularly quickly. When populous countries such as China and India go through this development phase, the effects on metal demand are dramatic, as is shown in Figures 1 and 2.

From this perspective alone, only a prolonged global economic recession or a global environmental or social disaster would stop the overall growth in demand for minerals and metals in the foreseeable future. This is so even when there are swings in the global economy that result in peaks and troughs in demand.

The rise of the Chinese economy since the late twentieth century has been phenomenal. This growth is even more remarkable considering it started at close to zero only a half a century ago. Clearly a dominant driver is urban and related service infrastructure development as modernization takes place. This same pattern is beginning to occur in other emerging nations as well.

However, from a perspective that considers the past millennium, China is only regaining the strong position it once held. For this reason, economic growth in other newly-industrializing countries may not, for various cultural, economic and political reasons, match that of China. But there is no doubt that all countries have gone or will go through a metal intensive stage in their economic development. There is also no doubt the speed of this transition is increasing.

In response to changing global economic conditions, growth in China and other emerging nations will inevitably fluctuate going forward, and the rate will likely slow down. A decline from a 9% per year economic growth rate to the 7.5% target set by the Chinese authorities for 2012 is indicative of a soft landing in the short term and a continued emphasis on domestic consumption in the long term, all of which will combine to see continuing growth in demand for minerals and metals in the economies of China and other emerging nations.

In response to its need for minerals and metals, China has put security of supply high on its political agenda. It is spending large and increasing amounts on exploring for minerals inside China and is also reaching out to participate in the world's mining and metals industry.

Figure 1: Income trend growth thresholds

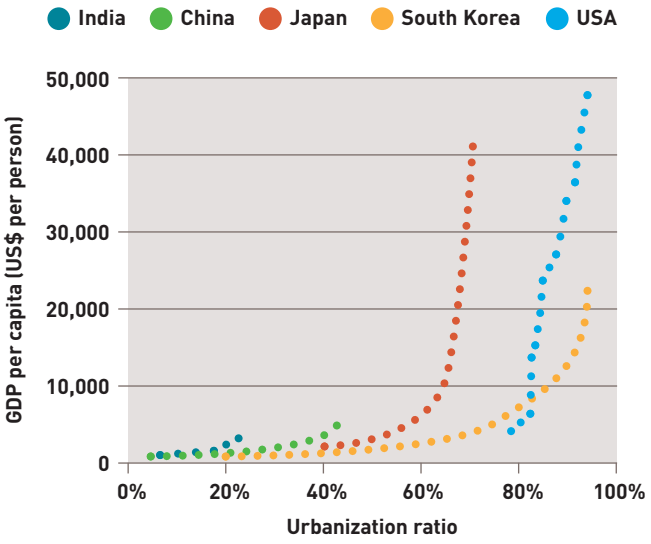
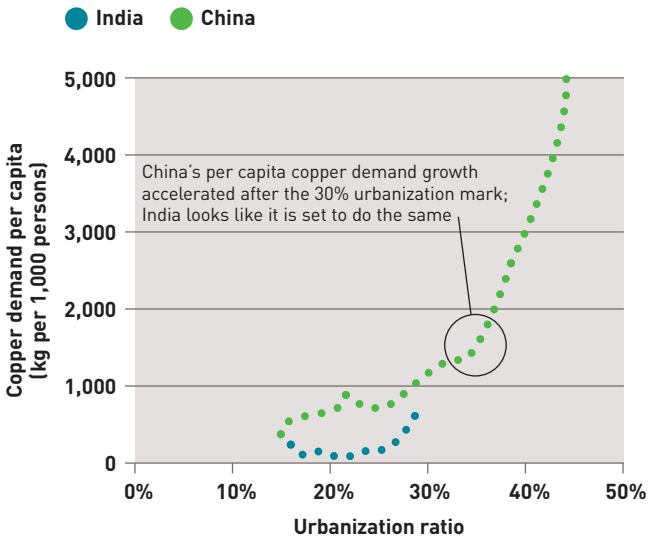


Figure 2: Commodity demand intensity correlates with growth thresholds



Source: Barclays Capital and the World Bank as summarized by M. L. Davis, speech to Bank of America – Merrill Lynch Global Metals & Mining Conference, Miami, 15 May 2012.

InBrief

Special characteristics of metals

Minerals in general and metals in particular have specific properties which give them a central role in everyday life and economic development. These are their high strength, durability, capacity to conduct heat and electricity, aesthetic appeal, and to date, reasonable cost with all factors considered.

Metals are elements and therefore have the potential to be indefinitely recyclable. While other materials can replace and substitute for metals, the scale and cost generally give metals a significant advantage.

Today's mining industry

Where – the changing centres of mining

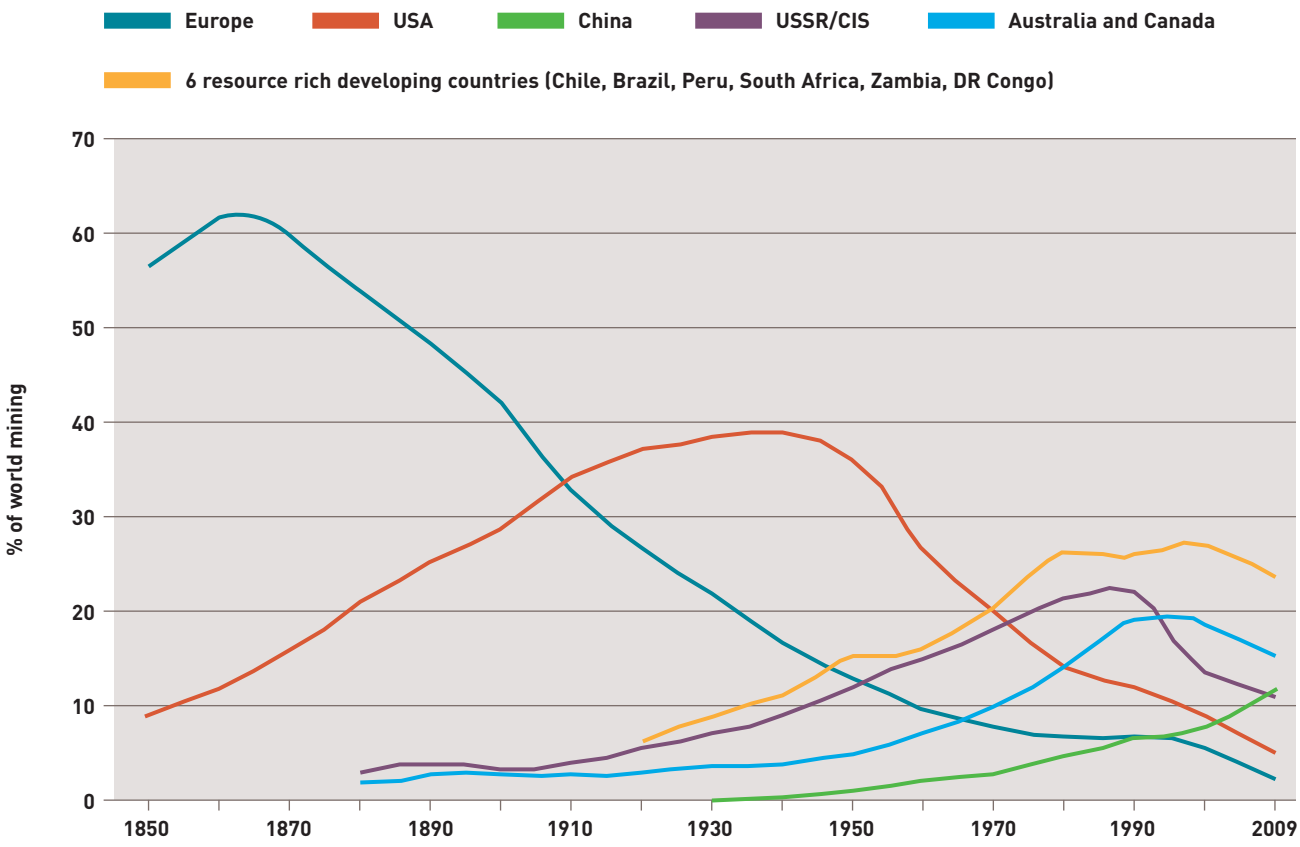
The search for metals has been international since antiquity. Mining turned truly global before most other branches of industry. Tracing the centre of gravity of global mining over the past two centuries demonstrates its role as a foundation of society throughout history. Figure 3 shows the percentage of world mining by region from 1850 to the present day and Figure 4 provides an overview of mining activities across the world.

Figure 3 shows that:

- by the late 19th century, the role of mining in Europe declined as the economic and political power passed to North America. The US in the late 19th and early 20th centuries then saw a dramatic increase – to be followed after World War 2 by the same dramatic decline experienced previously in Europe
- the shift of mining locations from developed to developing countries has been a trend from the mid 20th century.

Figure 3: Location of world mining by region, 1850 to the present

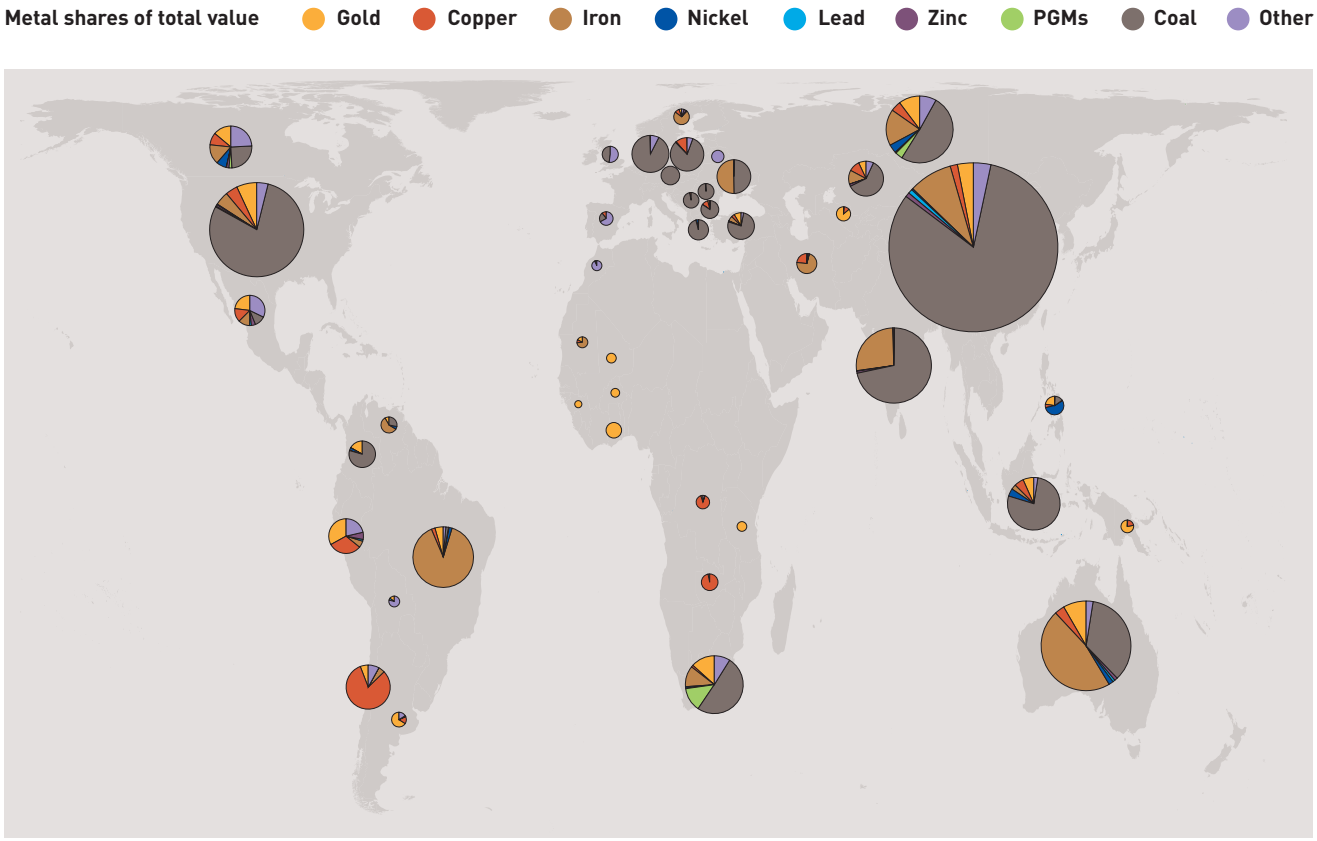
World mining is measured as the total value at the mine stage of all metals produced in all countries.



Source: Raw Materials Group, Stockholm, Sweden.

Figure 4: Global mining activities in 2011

The circles are proportional to the total value of all metals, industrial minerals and coal at the mine stage in all countries.



Source: Raw Materials Group, Stockholm, Sweden.

The most important mining countries in terms of mineral production today are shown in Figure 4. Many of them are now emerging economies, often found south of the equator. Likewise the largest mines are now to be found in developing countries.

In recent years huge investments have taken place in Latin America, Africa and parts of Asia and these are likely to escalate in the next ten years. Growth in exploration and mining interest in Africa, Latin America, and parts of Asia has been spurred by:

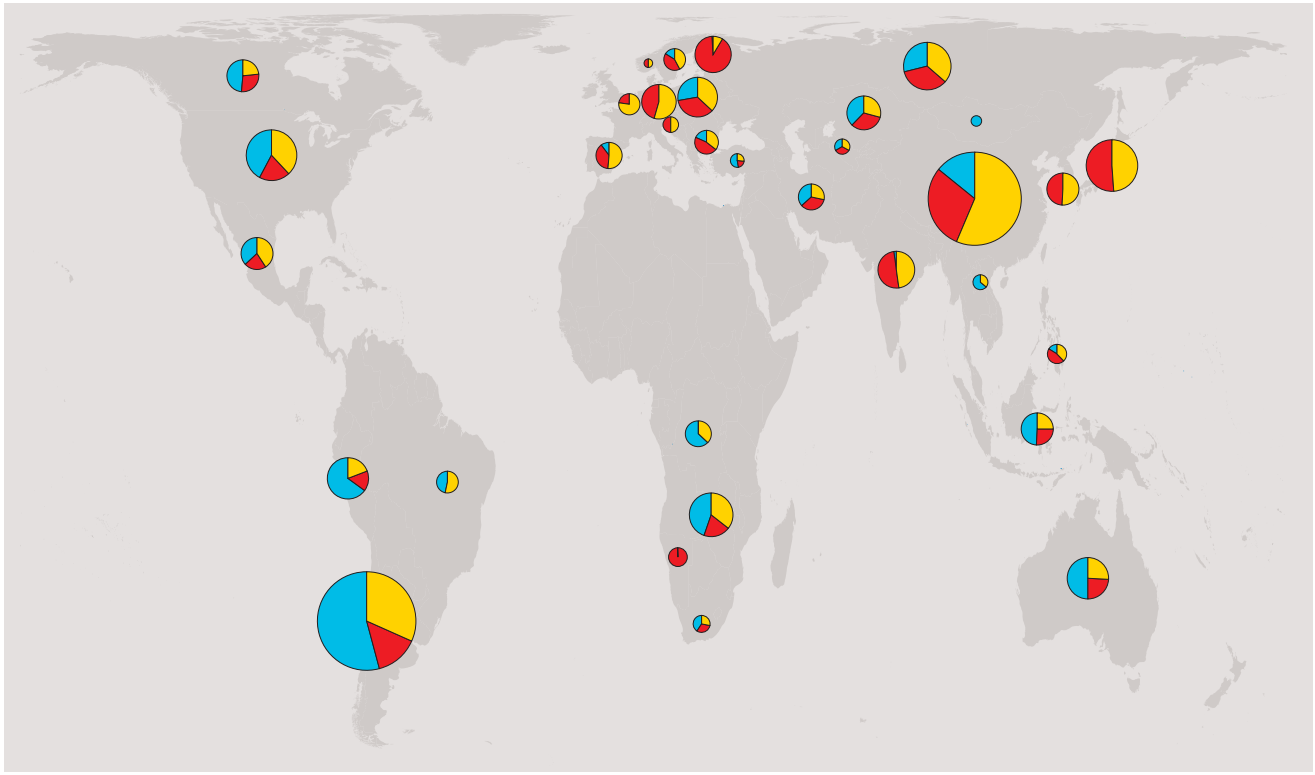
- the depletion of easily accessible mineral deposits in Europe and the US
- technological advances that led to the enhanced feasibility of mining previously inaccessible deposits in remote less developed regions
- the development of huge ocean going vessels in the late 20th century, initially for oil transport, which facilitated trade of bulk mineral commodities such as iron ore, coal and bauxite.

In terms of total value of mineral production, by 2011 Europe (excluding Russia) and the US were each contributing only 3.5% and 4.2% respectively of world metal mining by value, whereas resource-rich developing countries were contributing a little more than 22%. Of the developed countries, Australia and Canada accounted for 13.3% and 2.6% indicating the rise of Australia as a resource giant at a level of its own, mainly because of its quickly growing iron ore industry.

"In recent years huge investments have taken place in Latin America, Africa and parts of Asia and these are likely to escalate in the next ten years."

Figure 5: Balance of mine, smelter and refinery production of copper 2011

Mine production Smelter production Refinery production



Source: Raw Materials Group, Stockholm, Sweden.

China is the second giant at 12.7%, though this level appears to have now reached a plateau. All of the so-called BRIC countries are major mining countries, ranking among the top ten centres. They are also large and growing users of metals. If the coal industry is included, the world of mining is even further dominated by China as it contributes almost a third of all coal mining globally.

Over the past two centuries the locus of production has shifted slowly, but production has not been completely halted in any region including Europe where for example mine production of copper and iron ore is still 775,000 tonnes and 31 million tonnes respectively. Copper production has declined only 7% while iron ore production has been steady between 1995 and 2010. The Nordic countries have been mining metals for centuries and nowadays dominate European mining.

While mining has moved from developed to emerging economies, smelter and refinery production remains located mainly in developed countries, although this balance has already started to change with the quick growth of Chinese production of refined copper and aluminium. Figure 5 provides a global overview of the balance between mine, smelter and refinery production of copper.

"Smelter and refinery production remains located mainly in developed countries, although this balance has already started to change with the quick growth of Chinese production of refined copper and aluminium."

What – the metals and minerals produced

Figure 6 shows the value of global production. From this perspective, metal mining is dominated by iron ore, copper and gold which together account for 68% of the total value (US$854 billion) at the mine stage of all metals produced globally in 2011.

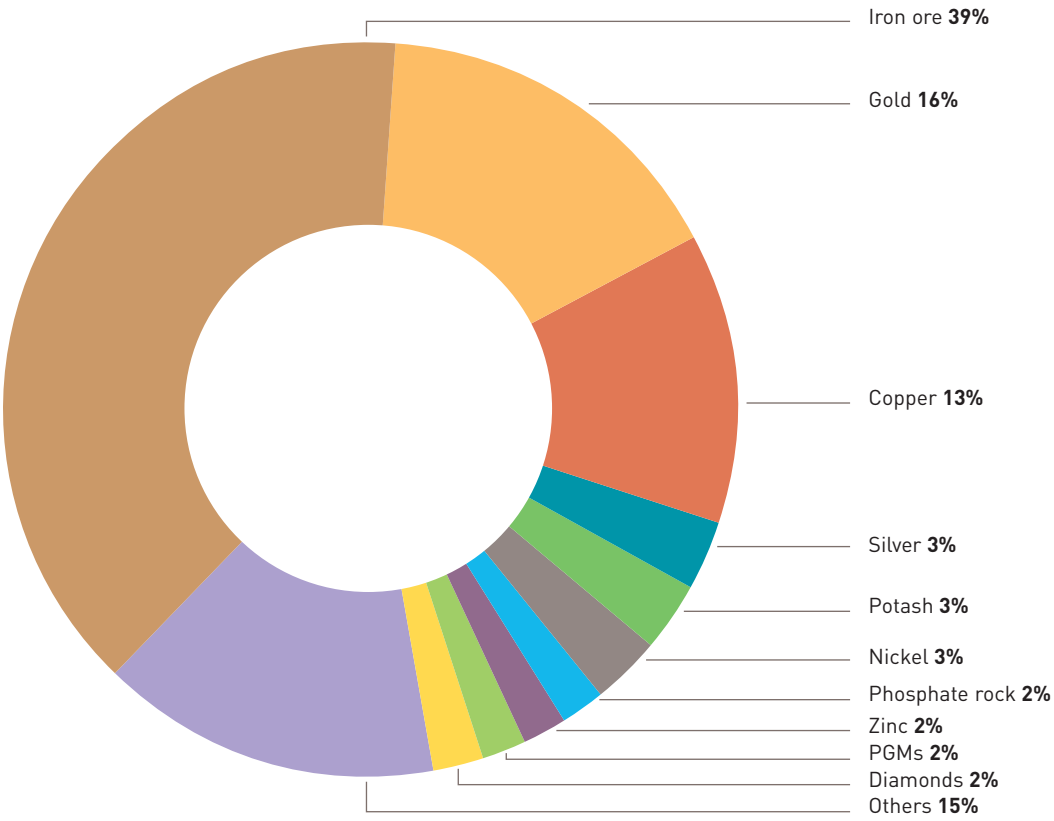
While the remaining 32% of the value of mine production may not be so economically important from a global perspective, these other minerals and metals play a vital strategic role. For example, nickel is central to stainless steel production; manganese, chromite and other alloying elements give steel various enhanced properties (strength, hardness); and PGMs are used in catalytic converters that reduce emissions from cars.

For each metal, the scale of production varies: 2,000 million tonnes of iron ore every year, a little less than 20 million tonnes of copper, 2,000 tonnes of gold, and only 200 tonnes of PGMs (platinum group metals, mainly platinum and palladium).

The increased output of metals and the increased value of most metals have resulted in a rise in value of the global metal and industrial minerals mining industry from US$214 billion in 2000 to US$644 billion by 2010.

"The increased output of metals and the increased value of most metals have resulted in a rise in value of the global metal and industrial minerals mining industry from US$214 billion in 2000 to US$644 billion by 2010."

Figure 6: Value of global production by metal in 2011



Source: Raw Materials Group, Stockholm, Sweden.

InBrief

Who - the corporate landscape

The mining and metals industry spans a complex interdependent web that includes a formal component and an informal component. At the core of the formal mining industry are categories of publicly-traded and state-owned companies (Table 1). Between them they employ about 2.5 million people worldwide. About half of these are employed by the global giants and seniors.

The global giants of the industry set criteria for the size of deposits that interest them, preferring projects with a lifespan of at least 20 years. As demand continues, it is likely that the mid-sized companies will become more important in taking on rejected but still viable projects. There is a shortage of these mid-size companies which could further hamper growth in the medium term.

The formal mining industry operates under legal and fiscal frameworks linked together by various national, regional and commodity-focused associations committed to representing the industry, protecting its interests and improving performance.

In contrast, artisanal and small-scale mining together comprise an informal component. There is typically no legal or fiscal framework although this is slowly changing as countries address the issue, recognizing the potential instability arising from the fact that hundreds of thousands of people in many countries work illegally and may fall prey to exploitation by criminal networks and armed groups.

The World Bank estimates that today 15 to 20 million artisanal and small scale miners operate in 30 countries, with about 80 to 100 million people depending on such mining for their livelihood. Working conditions of artisanal mining are typically harsh and returns borderline. However, during the price boom, which continues for gold, many ASM miners have become very well off in comparison to their societies. From a production value perspective, artisanal and small scale mining accounts for a significant proportion of total world production as shown below in Table 2.

Table 1: Profile of the formal mining industry

Company category	Approximate asset base	Approximate numbers of companies	Comment
Global	Exceeds US$10 billion	50	Global and senior companies which have access to the largest portion of available capital
Seniors	US$3 – US$10 billion	100	
Intermediates	US$1 – US$3 billion	350	Companies often on a growth path to become seniors
Juniors (producers)	US$500 million – US$1 billion	1,500	Companies which often have one mine
Juniors (exploration)	US$5 – US$500 million	2,500	Volatile and share market dependent; they are finders, not producers and their focus is on their exploration activities
Junior – juniors	Below US$5 million	1,500	Focus is on accessing venture capital and enhancing their stock price

Table 2: Artisanal and small scale mining proportion of world production of various metals in 2011

Metal	ASM share (%)	ASM production (tonnes)	Total world production (tonnes)
Tantalum	26	205	790
Tin	25	88,500	354,000
Gold	25	681	2,724
Tungsten	>6	>4,320	72,000
Iron ore	<4	<79,720,000	1,993,000,000
Lead	3	140,100	4,670,000
Zinc	1	129,640	12,964,000
Copper	0.5	80,175	16,035,000

Source: Polinares, Raw Materials Data.

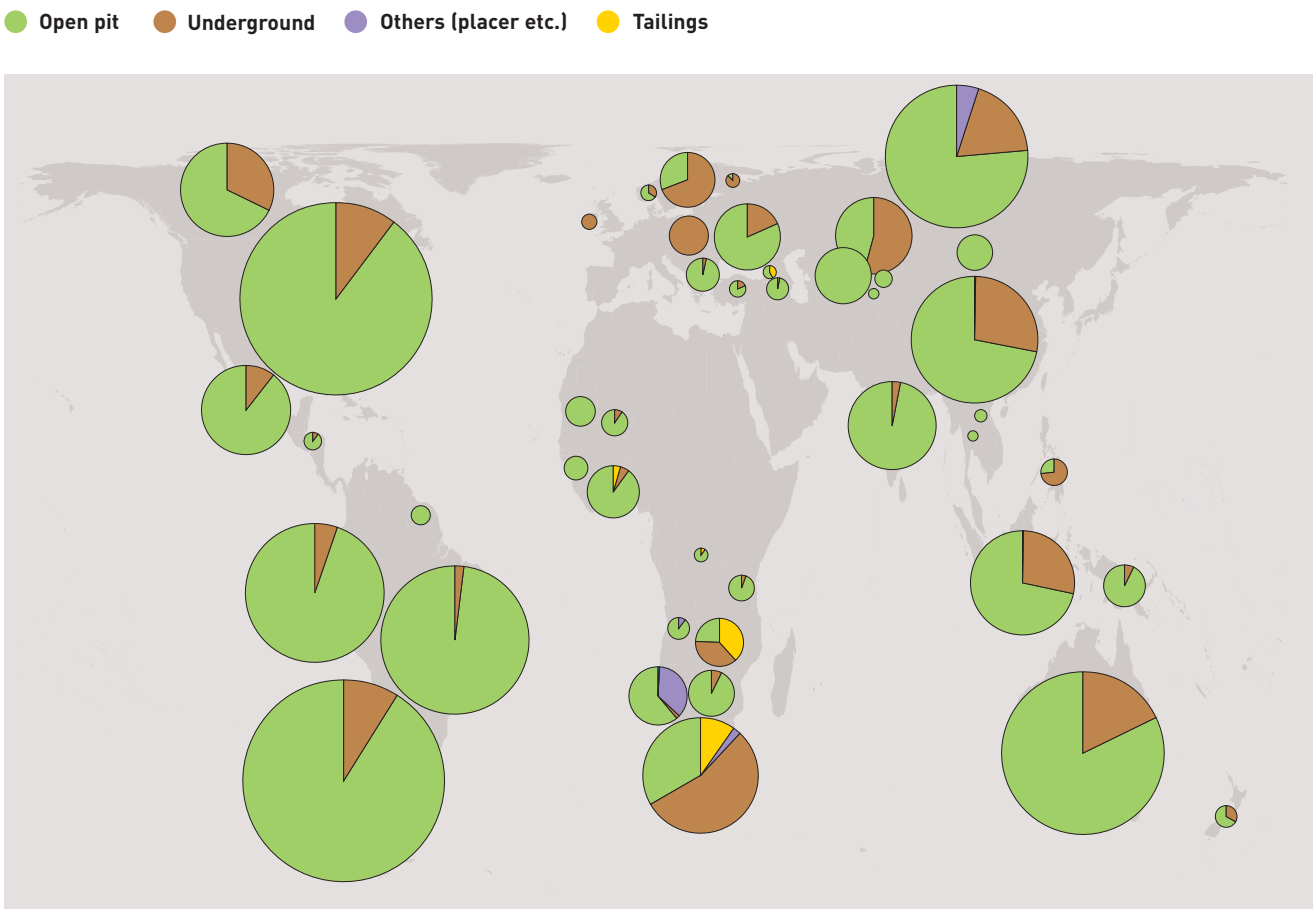
How – the changing technologies of extraction

Mine production has undergone important changes during the 20th century with a shift from underground to open pit mining techniques. Early in the century, underground mining dominated in developed countries, and as mining evolved in emerging economies, open-pit mining became more common. By 2010 the majority of the industrial mine operations of the world were open pit (Figure 8).

Most productivity increases in the past century have been achieved through the ability to process lower grade ores through more efficient mineral processing and the use of ever larger scale equipment. Thus technological developments have made it possible to mine ores of declining grades and more complex mineralogy without increasing costs. In most cases however, the technological progress has been made by small incremental developments rather than breakthroughs into entirely new processes.

"Most productivity increases in the past century have been achieved through the ability to process lower grade ores through more efficient mineral processing and the use of ever larger scale equipment."

Figure 8: Production by mining method 2011



Source: Raw Materials Group, Stockholm, Sweden.

A good example is the century-long improvement of production drilling. The trend to greater efficiency illustrated in Figure 9 is found in many aspects of mining equipment including haul trucks, crushers, conveyors and hoisting. In addition, the introduction of computer technology, remote control interfaces, satellite communications and robotics has led to greater safety, sophistication and productivity in mining, mineral processing, smelting and refining operations.

However, during the past decades, the mining industry has dedicated only small expenditures to research and development, compared to the 20% to 30% levels in other industries. With the dramatic and continuing increase in demand for mined products, an increasingly competitive market, and a growing recognition of the long-term nature of many environmental and social issues, leading companies are taking steps to speed up technological improvement.

The human resources challenge

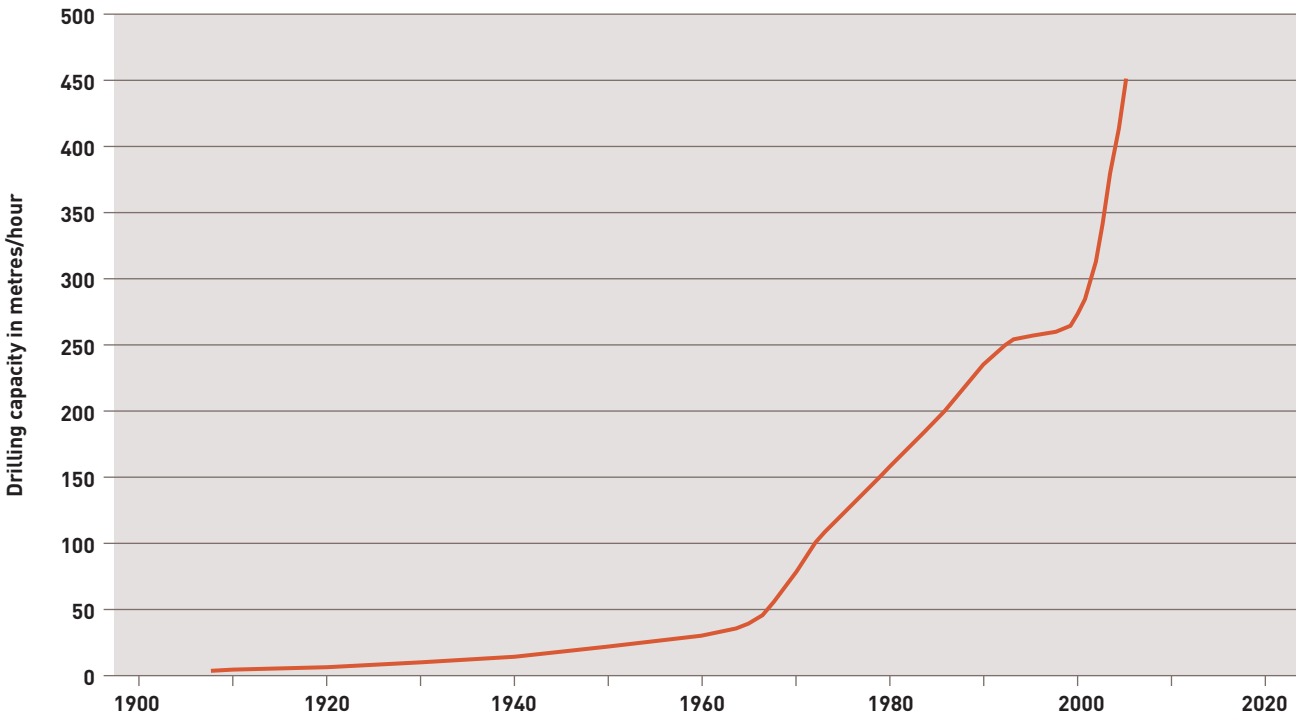
One implication of the increasing sophistication of mining is the ongoing need for highly skilled employees. Because of the cyclical, long-term nature of mining, the industry must compete for highly skilled people at all times, even when markets slump and activities slow down.

The total global pool of human resources is adequate from a simple numbers perspective. Within the industry there is significant mobility between projects and companies and expatriate employment is common. However, mining activities are culturally specific – that is, a mining engineer or tradesperson educated in the US may not have the cultural training and language skills to work effectively in China or India, and vice versa. Much of the available young talent pool is being trained in one culture while the needs are often in another.

Furthermore, for mining, there is a growing requirement for individuals who are not only technically excellent but also have social skills that facilitate relationship building with host communities and countries. Having key managers with these dual competencies is vital to the industry's ability to retain its licence to operate.

Labour costs, related to training and attracting needed skills in all countries as well as costs linked to socio-economic adjustment occurring in emerging nations, remains a major concern across the industry.

Figure 9: Rock drilling capacity, 1908–2005



Source: Atlas Copco.

Tomorrow's mining industry

Where – the trend to new frontiers

The trend of mine production moving to the emerging economies will continue. There are two major land areas in the world which have been less well explored than other regions: Africa and the Arctic including Siberia, Alaska, northern Canada, Greenland and the Nordic countries. In addition to this, there are opportunities for mineral extraction at the bottom of the deep seas. The first mining permits have recently been given in Papua New Guinea for mining at a water depth of 1,500 metres.

Looking ahead, it is possible to get an idea of where mine production in the next decade will be located by analysing investment flows. Current exploration projects also provide clues to where mining is going. During 2011 at least 136 new mining investment projects with a total estimated cost of US$74 billion were noted in company annual reports. The entire project investment pipeline was considerable – amounting to US$676 billion overall by the end of 2011. Some 73% of this is accounted for by the three most economically important metals: iron ore, copper and gold. Deteriorating global economic conditions have since caused companies to review investment plans and defer or reduce project developments.

Table 3 shows a breakdown of mine investment by region in 2011. If these investment figures are compared to the present share of mine production in each region, the following applies:

- it is likely that production in North America will grow as a share of total world production, 8% of total production today compared to 17% of the investment pipeline
- production in Latin America, Oceania (mainly Australia and PNG) and Europe (including all of Russia) will remain on more or less the same level (for Latin America, 25% of total production today compared to 28% in the investment pipeline, for Oceania 16% and 17% and for Europe 12% and 11% respectively)
- African production will grow. The region accounts for 10% of today's production and 15% of investments signalled by the project pipeline
- Chinese production is unlikely to grow as fast as it did during the past ten years, as increasing total production costs enhance the appeal of imports.

In 2011, the investment share of the top ten mining countries in terms of value of production reached 71%. This trend of more investments to a limited number of countries will most likely continue, and while capital expenditures have been curtailed in 2012, the growth inferred by these figures is likely to resume in due course.

Table 3: Project pipeline – mine investments by region 2011

Country	Investment (x US$ B)	Share (%)
Latin America	192	28
North America	124	18
Oceania	113	17
Africa	99	15
Europe	75	11
Asia	73	11
Total	676	100

Source: Raw Materials Group, Stockholm, Sweden.

"Looking ahead, it is possible to get an idea of where mine production in the next decade will be located by analysing investment flows. Current exploration projects also provide clues to where mining is going."

What – more of the same

Even with higher demand for energy minerals and for technologies requiring new minerals and metals previously not in demand, most production capacity into the future will be dedicated towards the same minerals and metals as today: coal, iron ore, copper, bauxite, phosphate, potash, as well as smaller but still large volumes of nickel, zinc and lead. For example iron ore demand in 2030 could reach as much as 3,500 million tonnes annually. And copper and nickel as much as 28 million tonnes and 3.8 million tonnes respectively.

Today's staples of iron ore, copper, gold and nickel, will remain the most important investment targets for mining companies. These premier metals account for 84% of the total future project pipeline. They also dominate the mining business in terms of the total value of output; cumulatively valued at US$606 billion or 71% of the total value of all non-fuel mineral production during 2011.

Additional metals, which are produced in small quantities, such as the so-called rare earths have recently attracted significant interest. These are produced in very limited quantities. A few small mines often cater for sizeable parts of total world production. As it takes more or less the same time to start a small or a large mine, temporary supply deficits and periods of high prices can easily evolve for these small-volume metals.

"Today's staples of iron ore, copper, gold and nickel, will remain the most important investment targets for mining companies. These premier metals account for 84% of the total future project pipeline."

Who – China and the new corporates

For reasons of geological endowment and the relative inefficiencies of its mining enterprises, China is expected to continue to import huge amounts of metals and minerals from overseas.

In 2011, the Chinese authorities set targets for its mining industry to strengthen control over mines in foreign countries. In the iron ore sector the goal was set at 50% of imports to come from mines under Chinese ownership or control. The Chinese entry into global mining has previously been constrained by barriers of culture, language, knowledge and skills deficits, political opposition and resource nationalism. However it seems inevitable that China will in due course overcome these drawbacks and within the present decade become an important global mining and exploration power.

With the continued economic growth of the emerging economies and their great geological potential, more of the future major mining companies will come from India, China and other developing countries, while the relative importance of corporations based in developed countries is likely to decrease. The political attention given to security of supply in China in particular, adds impetus to this trend.

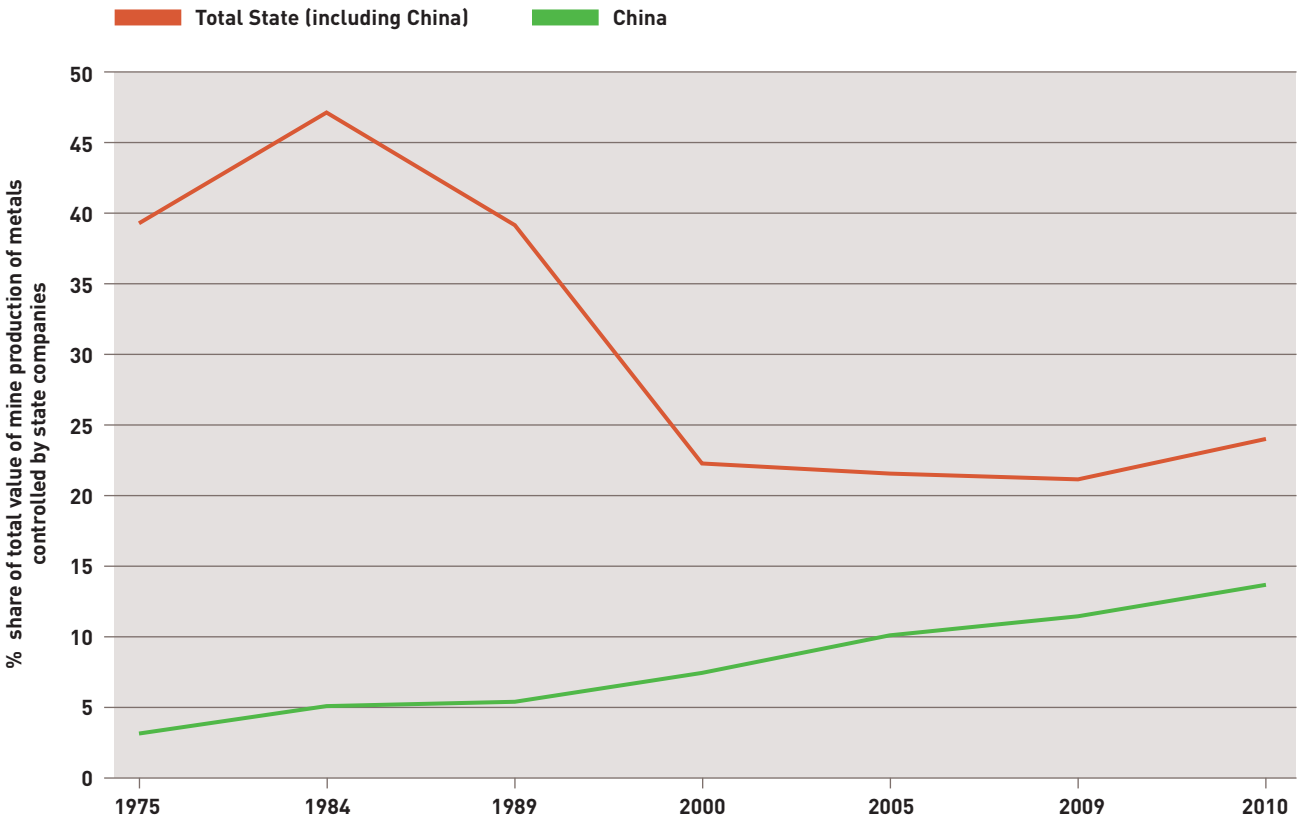
Given the role of mid-sized companies to serve as a link between the juniors and the majors, more medium-sized enterprises are likely to enter the global mining scene from the emerging economies. Some of these will be privately held, others will be publicly listed, yet others may be government owned.

Figure 10 shows how the proportion of the value of world mineral production controlled by state-owned enterprises has increased from a trough in the 2000s, mostly as a result of increased Chinese mine production. Although many state-owned mining companies were privatized over the past 20 years, in metals such as tin more than half of world production is still controlled by state-owned enterprises. The state-controlled share of world mine and metal production will most likely increase in the future.

Along with these changes to the corporate landscape, the investor community's interest in corporate transparency will also increase. Pressure to be more transparent will continue to grow as a means of ensuring markets function efficiently.

Another change is that there will be increasing involvement in extractive activities by companies whose main focus is later in the value chain – smelters, refiners, manufacturers and even commodity traders. This trend is already visible in the number of steel companies seeking to enter mining to secure their supplies of iron ore and coking coal at reasonable cost.

Figure 10: State mining over time



Source: Raw Materials Group, Stockholm, Sweden.

This trend was often the case in the past, with most steel companies in the former Soviet Union, China and India operating with backward integration into both iron ore and coal mines. While the steel sector in other countries severed these links in the name of specialization, backward integration remained intact in these countries. The idea of an integrated steel industry has largely spread from these same countries, further motivated by fears of being squeezed between customers and suppliers into no more than toll smelters.

At the same time, the steel and iron ore industries are fundamentally different and it is doubtful the two can always be efficiently combined in one company. Steel manufacturing must focus on understanding the changing demands of many customers while iron ore mining is about doing the same thing year-in and year-out in the most cost effective manner.

"Pressure to be more transparent will continue to grow as a means of ensuring markets function efficiently."

How - exploration holds the key

Exploration is conducted to a large extent by the juniors - small, flexible and nimble companies using risk capital to drive work with the chance of a big increase in share value if a good deposit is found. Because the juniors rely on the stock market for their funding, during the global financial crisis in 2008/09 it was almost impossible for them to get access to capital and their activities dwindled.

When this kind of drop in financing occurs few new deposits are found and fewer are available to bring into production in a timely manner. The flow of future new projects dwindles. As time passes, demand recovers which cannot be met driving prices up. In summary, expanded exploration efforts and success in finding new deposits is the key to secure future metal supplies.

Exploration expenditures vary widely from year to year, depending on metal price levels in previous years and do not necessarily reflect expected future demand for metals. Latin America and North America continue to be the two most attractive regions for exploration (both 26% of expenditures). Africa accounts for some 15% of global expenditure, supporting the belief that its mining sector will grow faster compared to the rest of the world.

At the present time a number of indicators give rise to on-going concern regarding the discovery of new deposits. Firstly, the rise of resource nationalism as reflected in ill-defined and insecure property rights in some countries has undermined confidence of the junior communities in terms of land access and has greatly curtailed the level of exploration activity in these cases. Secondly, the current unstable economic climate may well lend to reduced exploration budgets for non-precious metals and less available venture capital for markets. Together, these lead to inconsistent budgets year-on-year. Thirdly, with this instability, there is concern about recruitment of young people into the geosciences.

Drawing these ideas together, with the present system it will likely become increasingly difficult to maintain a steady flow of new deposits to meet the growing metals demand of the future.

"Exploration is conducted to a large extent by the so called juniors – small, flexible and nimble companies using risk capital to drive work with the chance of a big increase in share value if a good deposit is found."

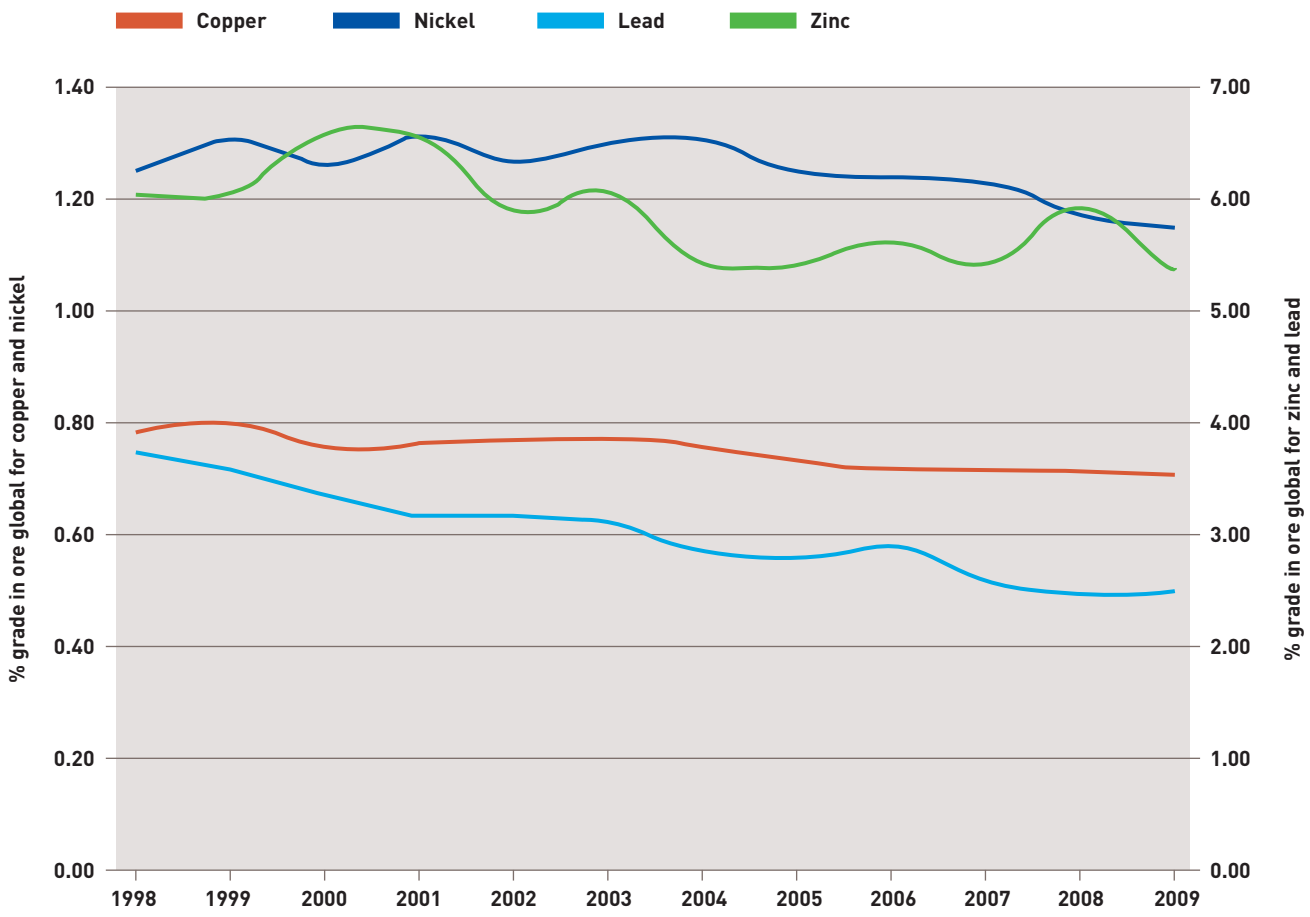
The outlook for metal prices

In spite of recent volatility and weakness, in the medium to long term, metal prices are likely to remain at a high level compared to the situation in 1980s, 1990s and the early 2000s. With rapidly growing demand and long response times to bring new mines on line, a gap has developed between demand and supply which has pushed prices up dramatically. But while there is upward pressure on prices, costs of production are also on the rise due to the following factors:

- as high grade deposits close to markets are mined out, more remote mines become economically viable with associated higher costs of the full range of support services including energy, transport, water supply, and labour
- ore grades are decreasing as richer deposits are mined out, as shown in Figure 11
- shallow deposits are depleted and are replaced by deeper lying deposits with higher extraction costs
- deposits with simple mineralogy are being superseded by those with complex ores that are more difficult to process
- society's expectation that mining operations meet more exacting environmental, social and cultural standards of performance
- increasing demands for new capital, stemming from the need for new processes, equipment and technology, as well as better trained staff necessary to operate modern mines.

Despite cyclical boom and slump, the global mining industry has managed to meet the challenges of variations in demand and serve as the foundation for increasing material standards of living for millions of people. For the future, the challenge of anticipating and meeting the increasing demand for mined products will continue as the industry evolves in step with a changing operating environment.

Figure 11: Declining ore grades



Source: Raw Materials Group, Stockholm, Sweden.

"For the future, the challenge of anticipating and meeting the increasing demand for mined products will continue as the industry evolves in step with a changing operating environment."

ICMM
35/38 Portman Square
London W1H 6LR
United Kingdom

Phone: +44 (0) 20 7467 5070
Fax: +44 (0) 20 7467 5071
Email: info@icmm.com

www.icmm.com

2012-10

References

Albanese, Tom and John McGagh, 2011.
Future trends in mining, Chapter 1.3 (pp. 21–38) *in* Darling, Peter (ed.), 2011. SME Mining Engineering Handbook, Society for Mining, Metallurgy, and Exploration, Inc.

Ericsson, Magnus, 2011.
Mineral supply from Africa: China's investment inroads to the African resource sector, The Journal of the Southern African Institute of Mining and Metallurgy, Vol 111, July 2011 pp 1–4.

Ericsson, Magnus and Frida Löf, 2011.
Overview of state ownership in the global minerals industry, Long term trends and future, Extractive Industries for Development Series # 20, World Bank, May 2011.

Polinares, (EU policy on natural resources), Final report Work Package 2, Henrike Sievers ed. Hannover 2012.

Randolph, Marcus, 2011.
Current trends in mining, Chapter 1.2 (pp. 11–20) *in* Darling, Peter (ed.), 2011. SME Mining Engineering Handbook, Society for Mining, Metallurgy, and Exploration, Inc.

Raw Materials Group, Raw Materials Data, Stockholm 2012.
www.rmg.se

Raw Materials Group, Who owns who in mining, Roskill Information Services, London 2001.

Winchester, Simon, *The man who loved China*, New York 2008. Harper Collins.

UNCTAD, The iron ore market 2011–2013, Geneva June 2012.

The original draft of this InBrief was prepared by Magnus Ericsson, Raw Materials Group, Stockholm, Sweden and Anthony Hodge, ICMM. Gary McMahon (World Bank), Peter van der Veen, John Tilton, and Edward Bickham served as expert external reviewers. ICMM reviewers included Anthony Hodge, Sven Lunsche, Ian Wood, Christopher Chambers and Andrew Parsons. It was edited by Hugh Leggatt and ICMM staff.

Published by International Council on Mining and Metals (ICMM), London, UK.