World Mineral Production

2004–2008

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BRITISH GEOLOGICAL SURVEY

WORLD MINERAL PRODUCTION 2004–08

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PREFACE

This volume is the latest in the series *World Mineral Production*, published by the British Geological Survey. It comprises the most recent addition to a continuous dataset on global mineral production which stretches back to 1913, which includes the preceding titles *World Mineral Statistics* and *Statistical Summary of the Minerals Industry*

This publication is compiled from a comprehensive database, maintained by the British Geological Survey, through which we aim to provide a reliable, comprehensive and continuous set of data covering most of the minerals that enter international trade. In this volume we have set out the production figures by country for more than 70 mineral commodities, over the five-year period from 2004 to 2008. We have also included reviews on selected minerals and metals, which provide information on uses, prices, recent production trends and industry events in 2009. The objective of this series remains to present the latest production information obtained from official bodies in individual countries, although other sources are also used to ensure completeness and accuracy. The cooperation afforded to the British Geological Survey by numerous national and international organisations is gratefully acknowledged.

Although the global recession, which took hold in the latter part of 2008, is clearly indicated by reductions in production of certain minerals and metals when compared to the previous year, perhaps surprisingly other commodities actually saw increases in output for the year as a whole. This may reflect the suddenness of the onset of the recession with production falling rapidly towards the end of 2008 from previously high levels. For example, the mine production of nickel in 2008 fell by four per cent compared to 2007: the first time it has dropped since 1999. Mine production of tin fell by ten per cent in 2008; the biggest year-on-year drop for more than two decades. By contrast, the production of iron ore increased again by seven per cent in 2008 to reach its highest recorded annual output for the seventh consecutive year. Mine production of uranium increased by six per cent in 2008, reaching its highest level of output since 1989. This reflects the generally higher levels of demand for uranium for nuclear power generation.

Over the five years recorded in this volume iron ore production has increased by 59 per cent, primarily driven by high demand in emerging economies, particularly China and India. It is notable that the so-called BRIC countries (Brazil, Russia, India and China) appear amongst the top five producers of virtually all the commodities reported here. Although slowed by the economic problems of 2008/9, the growth experienced by these countries continues to have a significant influence on the demand for minerals.

The maintenance of secure long-term supplies of metals and minerals continued to cause concern. In November 2008 the European Commission published the *Raw Materials Initiative – meeting our critical needs for growth and jobs in Europe*, which aims to ensure EU access to raw materials from international markets, to foster supplies from indigenous sources and to boost resource efficiency and promote recycling. This is likely to lead to new policies and associated research designed to secure supplies required by the EU economy, especially those needed for environmental technology.

In addition to our regular publications, we are continuing to add to our *Commodity Profile* series with the addition of *Cobalt* and *Platinum* during 2009. Further new profiles and updates will be added during 2010. The British Geological Survey's database can also provide special reports tailored to users' needs on individual commodities or regions.

I would welcome any criticisms and suggestions that might help us to meet your changing needs, particularly with respect to the coverage of statistics and the format in which they are made available.

John N Ludden
Executive Director

British Geological Survey
Keyworth
Nottingham

January 2010

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EXPLANATORY NOTES

Coverage

World Mineral Production covers the majority of economically important mineral commodities. For each commodity constant efforts are made to ensure that as many producing countries as possible are reported. For some commodities, where statistics on production are not publicly available, estimates are made. Users of this compilation are advised that more statistical information than can be included in a publication of this nature is held in the British Geological Survey files and is available for consultation. Historical data (1913-1970) can be obtained from the predecessors to this series entitled *World Mineral Statistics* and the *Statistical Summary of the Mineral Industry*.

Arrangement of countries

Countries are ordered alphabetically in geographical groupings as follows:

Europe
Africa
North and Central America, including the Caribbean
South America
Asia
Australasia, including the Pacific Islands

So far as possible the nomenclature follows the London Diplomatic List.

Metals

Mine production of many metals is expressed in terms of metal content. This is clearly indicated at the head of the table, adjacent to the unit used. For aluminium, cobalt, copper, iron, lead, nickel, tin and zinc, mine production and metal production are shown in separate tables. Unless otherwise specified, metal production statistics relate to metal recovered from both domestic and imported materials, whether primary or secondary, but exclude remelted material.

World totals

For certain minerals and metals no world total is shown due to the non-availability of certain individual country totals.

Exclusion of Warranty

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Acknowledgements

Compilation of this volume of mineral statistics has been possible only by obtaining information from a very large number of organisations throughout the world, chiefly home and overseas government departments and specialist national or international authorities concerned with particular sectors of the minerals or metals industries. To all these bodies the British Geological Survey expresses its grateful acknowledgement for the information made available, whether in published form or provided by direct correspondence. Particular acknowledgement is made to the Mines Departments and other government agencies of many countries whose regular statements, yearbooks and other reports are worthy of direct consultations by readers in search of detail.

Specialist commodity organisations which have kindly allowed information to be reproduced include the International Copper Study Group, the International Lead and Zinc Study Group, the International Nickel Study Group and the International Fertilizer Industry Association Ltd. In a few instances, information on specific commodities has been obtained directly from company sources. The co-operation of other members of the International Consultative Group on Non-Ferrous Metal Statistics is also gratefully acknowledged.

Supplementary information is also obtained from publications dealing with a wider range of commodities such as Société de l'Industrie Minérale, *Annuaire Statistique Mondial des Minerais et Métaux;* World Bureau of Metal Statistics, *World Metal Statistics* and, *Metallstatistik;* publications of the Interstate Statistical Committee of the CIS, the United States Geological Survey, and UN agencies.

In addition, information has been obtained from the websites of the following organisations, companies, statistical offices and government departments: United Nations; Kaolin & Plastic Clays Europe; International Iron and Steel Institute; Kimberley Process; Eurofer; World Nuclear Association; Organisation of the Petroleum Exporting Countries; Eurostat; European Aggregates Association; South East Asia Iron and Steel Institute; Instituto Latinoamericano del Fierro y el Acero; RNC Gold; Glencairn Gold; Glamis Gold; Goldcorp; Break Water Resources; Inmet Mining; Stillwater Mining; Aluminium de Grece; New Boliden; Eurozinc Mining Corporation; Qatar Steel Company; Institute of Argentinean Petroleum and Gas, Argentina; Institute of Argentinean Steel, Argentina; Northern Territory Government, Australia; Department of Primary Industries Victoria, Australia; Mineral Resources Tasmania, Australia; Australian Bureau of Agricultural & Resource Economics; Vereinigung der Osterreichishen Zementindustrie, Austria; Energy Bangla, Bangladesh; Petrobangla, Bangladesh; Central Bank of Barbados; Federation de l'Industrie Cimentiere Belge, Belgium; Statistics Belgium; Instituto Nacional de Estatistica Boliva; Cámara Boliviana de Hidrocarburos, Bolivia; Departamento Nacional De Producao Mineral, Brazil; Grupo Paranapanema, Brazil; Agencia Nacional do Petroleo, Brazil; Associação Brasileira do Aluminio, Brazil; Natural Resources Canada; Statistics Canada; Canadian Association of Petroleum Producers; Mineral Resources of Quebec, Canada; Chilean Copper Commission; China Mining Association; Ministerio De Minas Y Energia, Columbia; Unidad de Planeación Minero Energética, Columbia; Oficina Nacional de Estadisticas, Cuba; Czech Republic Statistical Office; Statistics Denmark; Banco Central de la Republica Dominicana, Dominican Republic, Banco Central del Ecuador; Geological Survey of Finland; New Boliden, Finland; Federation des Minerais, Mineraux Industrielles et Metaux non Ferreux, France; Comite Professionel de Petrole, France; Ministere de l'Economie, des Finances et de l'Industrie, France; Unicem, France; Infociments, France; Statistisches Bundesamt Deutschland, Germany; National Statistical Service of Greece; National Bank of Guyana; Ministerio de Energia y Minas, Guatemala; Federacciai, Italy; Unione Petrolifera, Italy; Istituto Nazionale di Statistica, Italy; Salt Industry Centre, Japan; Korea Institute of Geoscience and Mineral Resources, Republic of Korea; Statistical Office of Kosovo; Statec, Luxembourg; Bank Negara Malaysia; Pemex, Mexico; Secteria de Economia, Mexico; Servicio Geologico de Mexico; Statistics Office of Montenegro; Ministry of Mines and Energy, Namibia; Centraal Bureau voor de Statistiek, Netherlands; Staatstoezicht op de Mijnen, Netherlands; Ministry of Economic Development, New Zealand; Central Bank, Nicaragua; Statistisk Sentralbyra, Norway; Ministry of National Economy, Oman; Direccion de Estadistica y Censo, Panama; Chamber of Mines and Petroleum, Papua New Guinea; PeruPetro; Ministerio de Energia y Minas, Peru; Sociedad Nacional de Mineria Petroleo y Energia, Peru; Mines and Geosciences Bureau, Philippines; Instituto Nacional de Estatistica, Portugal; Statistical Office of the Republic of Serbia; Unesid, Spain; Rio Narcea, Spain; Lundin Mining; Spain; Staatsolie Maatschappij, Suriname; Sveriges Geologiska Undersokning, Sweden; Jernkontoret, Sweden; Statistiska Centralbyran, Sweden; Bank of Thailand; Central Bank of Trinidad and Tobago; Department of Business, Enterprise and Regulatory Reform, United Kingdom; Office for National Statistics, United Kingdom; Energy Information Administration, United States of America; Direccion Nacional de Mineria y Geologia, Uruguay; General Statistics Office, Vietnam; Central Statistical Organisation, Republic of Yemen.

Units

The Statistics shown in this volume are expressed in metric units. The following factors are given for converting to non-metric units:

tonnes × 0.9842 = long tons
tonnes × 1.1023 = short tons
kilograms × 2.2046 = pounds
kilograms × 32.1507 = troy ounces
cubic metres × 35.3147 = cubic feet
1 tonne of crude petroleum equals on average 7 barrels of crude petroleum.
1 flask mercury = 34.5 kilograms
1 metric ton unit = 10 kilograms

Symbols

...	figures not available
0	quantity less than half unit shown
—	nil
*	estimated
BGS	British Geological Survey
c.i.f	Cost, Insurance, and Freight. The seller's price includes the cost of the goods, the insurance of the goods to their destination port, and the cost of freight.
f.o.b.	Free On Board. The seller is responsible for the costs of delivering goods to the ship. The buyer is responsible for transportation and insurance costs from that point.
TWh	Terawatt hours (1 TWh = 1 thousand million kilowatt hours)

BAUXITE – ALUMINA – ALUMINIUM

Characteristics

Bauxite, the most common ore of aluminium, is a hard, reddish, clay-like material. It was first discovered near the village of Les Baux in southern France. Bauxite occurs in three main forms: gibbsite (aluminium hydroxide), böhmite and diaspore (both aluminium-oxide-hydroxides). Gibbsite is the dominant form mined. Bauxite is a residual type of ore deposit that has been left on the land surface following intense weathering and the removal by leaching of other minerals. Consequently, it tends to occur mainly in tropical and sub-tropical regions such as the Caribbean, parts of Africa, South America, and Australia. The largest reserves of bauxite are in Guinea (7400 million tonnes), Australia (5800 million tonnes), Vietnam (2100 million tonnes), Jamaica (2000 million tonnes) and Brazil (1900 million tonnes (Bray, 2009).

Alumina (aluminium oxide) is a white granular material produced from bauxite by the Bayer refining process, which involves dissolving the bauxite in caustic soda at high temperature and pressure. Aluminium hydroxide is then precipitated from the liquid and this is calcined to form aluminium oxide powder.

Aluminium metal is produced by the electrolysis of alumina dissolved in a molten salt in a smelter. This process is a very large consumer of electrical power and as a consequence the availability of cheap electricity tends to determine the location of aluminium smelters.

Pure aluminium is a silver-white metal with many desirable characteristics. It is light, non-toxic, non-magnetic and non-sparking. It is easily formed, machined or cast, and forms alloys with many other metals such as copper, magnesium, and silicon. Aluminium and most of its alloys are highly resistant to corrosion. It is also a very good conductor of electricity (IAI, 2009).

Uses

Bauxite is primarily used to produce alumina through the Bayer process. However, between five and 15 per cent of bauxite is of non-metallurgical grade and most of this is calcined into 'brown fused alumina' for use in the abrasive or refractory markets.

Approximately 90 per cent of alumina produced in the world is used in the production of aluminium metal through smelting. Some of the remaining 10 per cent is calcined at higher temperatures than smelter grade alumina and is used for a wide range of refractory and ceramic purposes. Fused alumina is formed in electric arc furnaces at high temperatures and is used in the manufacture of abrasives and refractories (Tran, 2007).

Aluminium is, in terms of tonnage, the most widely used non-ferrous metal. It is used extensively in the transport manufacturing industry (most importantly in the aerospace industry but also in road vehicles, trains and ships), packaging (cans, foil), water treatment, construction (windows, doors, wire), cooking utensils, electrical transmission lines, electronics, CDs and transistors. It is also used in paints and rocket fuel. In most uses it is alloyed with small amounts of other metals such as magnesium and manganese. Recycling is an important feature of aluminium use and recycled metal (including manufacturing scrap) contributes about 27 per cent to global production (IAI, 2009).

World production in 2008

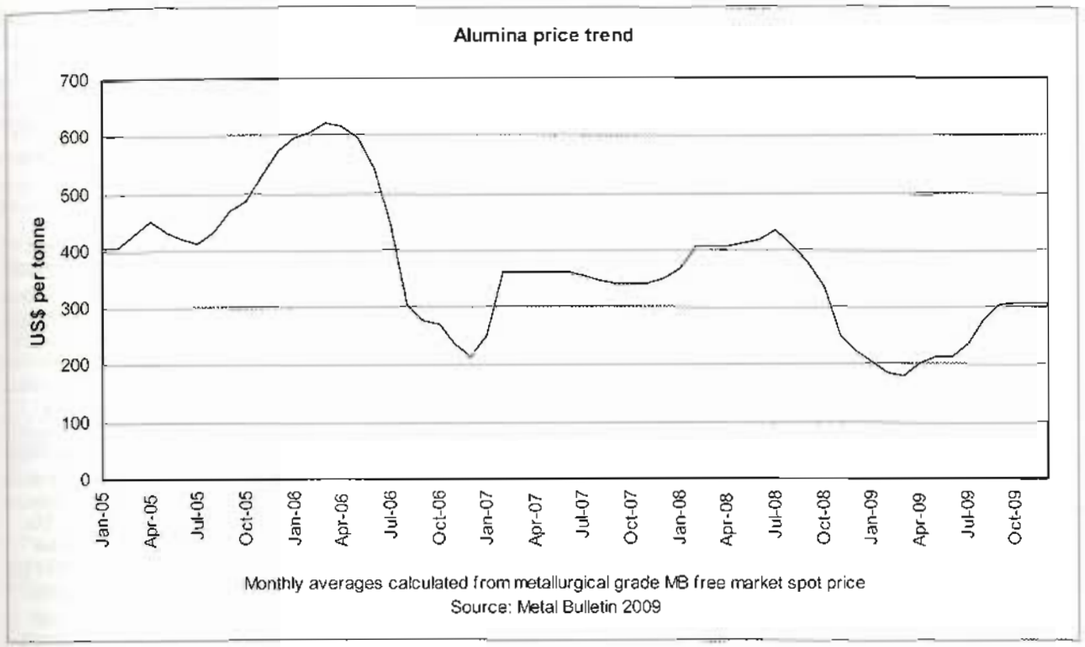
Australia continued to be the world's largest bauxite miner, by some considerable margin, in 2008. Despite the recession, production here increased by four per cent between 2007 and 2008 and 14 per cent between 2004 and 2008. However, its contribution to the world's total production has fallen slightly from 34 per cent in 2004 to 31 per cent in 2008. Brazil continued to be the second largest producer of bauxite with 13 per cent of the world's total. Its output in 2008 increased by ten per cent compared to 2007, and has increased by 37 per cent over five years. In 2008, the third biggest producer was China, with ten per cent of the world's output. Production here is also increasing year-on-year, with a six per cent increase between 2007 and 2008, and 23 per cent over five years. India's output in 2008 showed a significant drop compared to 2007 although production levels were similar to 2006. Indonesia, Guinea and Jamaica complete the world's top seven producers.

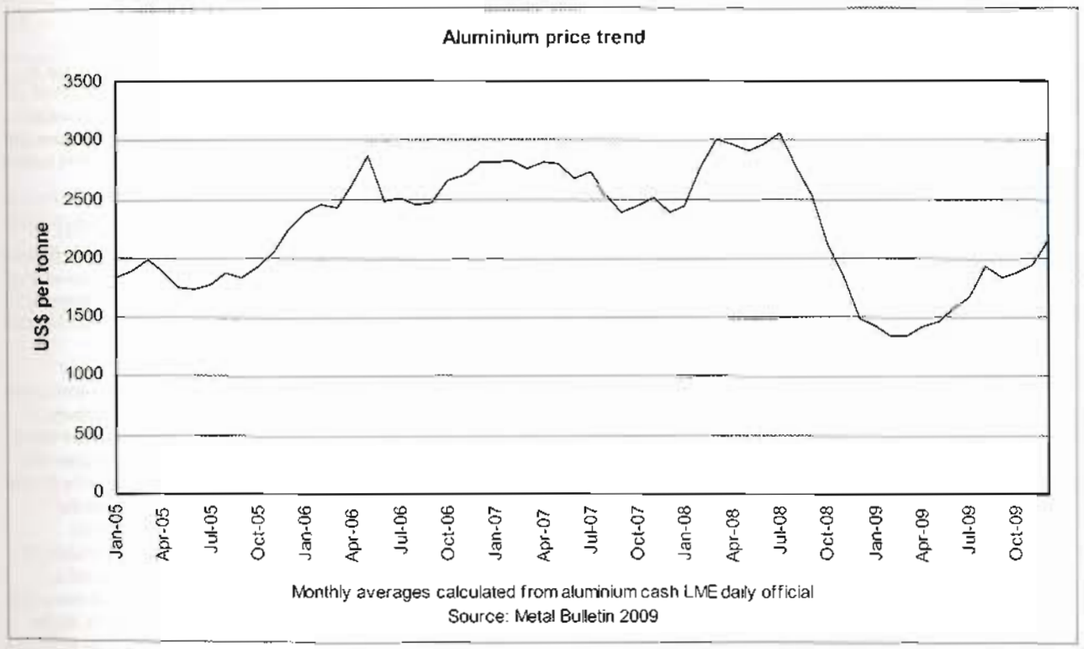
The world's total production of alumina (aluminium oxide) continued its upward trend in 2008, increasing by a further six per cent compared with 2007 and 32 per cent compared with 2004. As in 2007, China was the world's biggest producer in 2008, with another increase of 17 per cent over 2007. Its output has increased by a staggering 226 per cent in five years and China now contributes 28 per cent of the world's total. Australia, the world's second largest producer with 24 per cent of the total, also continued to raise production in 2008 with an increase of three per cent compared to the previous year. Brazil remained the third biggest producer, with an increase in 2008 of 11 per cent compared to 2007. Over five years Brazil's output has grown by 53 per cent and it now contributes ten per cent to the world's total. The USA, Jamaica, Russia and India are the next largest producers contributing five or four per cent each to the total.

Despite the recession starting to take hold in the latter part of 2008, the world's production of primary aluminium actually increased during the year as a whole by three per cent compared to 2007, continuing a trend which has seen a 31 per cent increase in five years. China remained the world's largest producer, with 33 per cent of the world's total and a further increase of five per cent in 2008 compared to 2007. Production in China has increased by 97 per cent between 2004 and 2008; however, this is not the largest five year percentage increase. That honour goes to Iceland where production has increased by 167 per cent over the five-year period. Iceland is followed by Azerbaijan where production has increased by 109 per cent during the same period, although each still only contributes two per cent to the world's total. The world's second largest producer is Russia, with 11 per cent of the total, followed by Canada (eight per cent), the USA (seven per cent) and Australia (five per cent).

Prices

Metallurgical grade bauxite is mostly traded on long-term contracts and typical prices are not published. During 2008, prices for many commodities increased, including non-metallurgical bauxite. By August, Chinese calcined bauxite generally traded in the range US$550 to US$650 per tonne, with Guyanan calcined bauxite slightly higher (Dickson, 2008). However, as the global recession took hold, prices slipped to around US$550 per tonne in January 2009 (Industrial Minerals, 2009a) and to US$400–US$535 per tonne by the end of the year.





Spot prices for metallurgical grade alumina fell during the latter part of 2008 and continued to fall during the first part of 2009 reaching a low of US$170–US$185 per tonne during March 2009, the lowest price since January 2003. However, prices subsequently recovered to end 2009 at US$295–US$315 per tonne (Metal Bulletin online, 2009).

The London Metal Exchange official daily cash price for aluminium ingot continued its sharp decline during the early months of 2009, reaching a low of US$1253 per tonne in February, a drop of 62 per cent from its peak of US$3290 per tonne in July 2008. During the latter part of 2009, however, the price experienced a generally upward trend, finishing 2009 at US$2200 per tonne. This is a 76 per cent increase from its low in February although still a third lower than its 2008 peak (Metal Bulletin online, 2009).

Both the trends for alumina and aluminium are due to the global economic recession which caused the demand for aluminium metal to fall considerably, resulting in a supply surplus for most of the year. Signs of economic recovery in the latter part of 2009, and reductions in production caused by the

temporary closure of a number of plants, have enabled prices to recover to some degree.

Industry events in 2009

The first part of 2009 was characterised by collapsing demand for aluminium metal and falling prices as a result of the global recession, which forced all producers into extensive cost-cutting measures and reductions in outputs. By the end of March as much as 6.5 million tonnes per year of capacity had been curtailed (Platts, 2009) with, for example, UC Rusal reducing production by 7.2 per cent in the first quarter (Metal Bulletin, 2009a); Rio Tinto Alcan cutting aluminium production by the equivalent of 11 per cent per annum (Jacoby, 2009); Norsk Hydro cutting output by 30 per cent (Cavallaro, 2009a); Alcoa reducing annualised output by 18 per cent (Jennemann, 2009a); and Century Aluminium in the USA cutting production by 28 per cent and closing its Ravenwood Smelter (Metal Bulletin, 2009a). In addition, Rio Tinto announced a 23 per cent cut in output from its Weipa bauxite mine and a delay to the expansion plans at its Yarwun alumina refinery, both in Australia (Metal Bulletin, 2009b). The bauxite and alumina industry in Jamaica was reported to be particularly hard hit with a halving of alumina production, a temporary suspension of bauxite mining and the government considering selling its minority share in one operation on the island (Jennemann, 2009b).

Smelting operations at Anglesey Aluminium Metal's plant in the UK (Rio Tinto Alcan/Kaiser JV) ceased at the end of September 2009, as forecast for some time, when its power supply contract with the nearby nuclear power station came to an end. Some stand-alone casting and re-melting operations will continue, albeit with a much reduced workforce (Anglesey Aluminium Metal, 2009).

Non-metallurgical alumina production was also hit with Rio Tinto Alcan reporting a 15 per cent cut in production at its Gardanne plant in France (Industrial Minerals, 2009b). Bosai Minerals Group in Guyana announced a 30 per cent reduction in output of refractory grade bauxite due to the declining demand (Industrial Minerals, 2009c).

Concerns were also raised throughout the year regarding the profitability and debt levels of several major corporations producing aluminium with the president of Rio Tinto Alcan quoted as saying that more than 70 per cent of the industry was making a loss during the early part of the year (Sergeant, 2009a). The most notable of these problems were experienced by the two largest aluminium producers, Rio Tinto (following its acquisition of Alcan in 2007) and UC Rusal. Rio Tinto planned to ease its debt problem through a controversial US$20 billion deal with Chinalco, but disapproval of shareholders and competition authorities eventually resulted in the deal being cancelled. Instead Rio Tinto sold several downstream aluminium assets, entered an iron ore JV in Australia with rival BHP Billiton and raised US$15 billion of capital from its shareholders (Sergeant, 2009b). UC Rusal, meanwhile, converted part of its debt to Onexim into shares, and 'restructured' its remaining US$16.8 billion debt with its various lenders (Mason, 2009a). Both of these make Alcoa's US$1.1 billion capital raising exercise in March look relatively small (Sergeant, 2009a).

Its debts were not the only problems experienced by UC Rusal during the year with a state committee in Nigeria recommending that the National Council seize the aluminium smelter in that country as a consequence of UC Rusal's lack of investment (Metal Bulletin, 2009c), a court in Guinea cancelling the 2006 sale of the Friguia alumina refinery to UC Rusal (Paxton, 2009), a temporary threat to power supplies in Russia following an explosion at the Sayano-Shushenskaya hydropower plant (Cavallaro, 2009b) and a strike by workers at the Aroaima mine in Guyana over wages and job cuts (Mineweb, 2009). Alcoa's workers at the Italian smelters in Portovesme and Fusina also went on strike in November over plans to suspend production at the plants and amid fears that the closures may become permanent (Mason, 2009b).

In April, a group of around 100 Maoist rebels attacked the Koraput bauxite mine in Orissa, India killing 10 policemen and forcing the mine to close temporarily. The mine operator, National Aluminium Co Ltd (Nalco), confirmed that the rebels had attempted to loot the company's explosives depot and that nearly 60 employees had been trapped at one point (Industrial Minerals 2009d).

However, there was also some positive news, particularly during the latter part of the year when many alumina refineries and aluminium smelters re-opened in response to the recovery in prices. Emirates Aluminium (Emal) started production at its new smelter in the United Arab Emirates, the largest single-site aluminium smelter in the world, ahead of schedule. The first phase has a production capacity of 700 000 tonnes per year, but phase two will increase that to 1.4 million tonnes per year by 2014 (Metal Bulletin, 2009d). Qatalum commenced installation of carbon anodes at its 585 000 tonnes per year greenfield aluminium smelter at Mesaieed, Qatar in November with the first metal production expected soon (Metal Bulletin, 2009e).

Alcoa has commenced commissioning work at its Juruti bauxite mine and the Alumar alumina refinery expansion in Brazil (Batten, 2009). Work has started on the construction of a new aluminium smelter near the port city of Asalouyeh in Iran, which will have an initial capacity of 103 000 tonnes per year with the possibility of future expansion to 310 000 tonnes per year (Metal Bulletin, 2009f).

Bharat Aluminium (a subsidiary of Vedanta Resources) suffered a setback at its new aluminium smelter which is under construction at Korba, India when a chimney at the associated power plant collapsed killing at least 30 workers. However, start-up for the 325 000 tonnes per year smelter is still forecast for October 2010 (Metal Bulletin, 2009g).

Cape Alumina announced that it expected to start construction on its Pisolite Hills bauxite mine in Queensland Australia in 2011 (Metal Bulletin, 2009h). Norsk Hydro announced that it had signed a memorandum of understanding to consider the possibility of building an aluminium smelter in Angola (Metal Bulletin, 2009i), while Rio Tinto Alcan signed a similar memorandum to build a second aluminium plant, with associated hydroelectric dam and seaport, in the Republic of Cameroon (Metal Bulletin, 2009j). Atlantic has signed a memorandum of understanding to develop a bauxite mine and associated infrastructure in Vietnam (Svircas, 2009). Alcoa has agreed with Saudi Arabian Mining Co (Maaden) to build a US$10.8 billion aluminium complex in Saudi Arabia to include a bauxite mine, a 1.8 million tonnes per year alumina refinery and a 740 000 tonnes per year aluminium smelter. Financing has still to be secured, but first production is targeted for 2013 (Laessing, 2009).

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Production of bauxite

tonnes

Country	2004	2005	2006	2007	2008
Bosnia & Herzegovina	916 900	1 031 600	854 047	866 933	780 274
France	170 000	175 000	160 000	* 160 000	* 160 000
Greece	2 396 065	2 441 443	2 162 900	2 093 433	2 174 000
Hungary	646 726	535 337	507 259	515 061	511 337
Montenegro	—	—	659 370	667 053	671 811
Russia	6 017 600	6 409 300	6 399 200	6 053 900	* 6 000 000
Serbia and Montenegro	610 000	672 345	—	—	—
Turkey	365 836	356 480	771 227	863 404	* 900 000
Ghana	498 060	606 700	841 775	1 033 368	516 487
Guinea	18 795 500	19 237 300	18 783 928	18 519 010	17 682 300
Mozambique	6 723	9 518	11 069	8 650	5 443
Sierra Leone	—	—	1 071 140	1 169 036	954 370
Tanzania	..	1 640	5 373	5 003	20 601
Jamaica	13 296 481	14 116 393	14 865 351	14 567 738	14 636 102
USA (a)	259 870	121 187	361 047	128 742	89 626
Brazil (b)	20 511 800	22 364 600	23 236 300	25 460 700	28 087 500
Guyana	1 478 897	1 694 126	1 478 670	2 242 928	2 092 237
Suriname	4 087 107	4 756 998	4 945 353	5 273 195	5 333 031
Venezuela	5 814 705	5 900 000	5 928 000	5 323 300	* 5 300 000
China	17 518 000	17 408 200	18 981 600	20 446 000	* 21 600 000
India (c)	11 964 011	12 595 803	15 732 535	23 084 677	15 457 000
Indonesia	1 330 827	* 2 700 000	* 9 000 000	* 16 000 000	* 18 000 000
Iran (d)	419 955	437 595	* 440 000	520 800	* 520 000
Iraq	—	—	—	—	4 928
Kazakhstan	4 705 400	4 815 400	4 883 800	4 962 600	5 160 100
Malaysia	2 040	4 735	91 806	156 785	295 176
Pakistan (e)	4 847	6 504	7 831	18 082	36 000
Vietnam	* 20 000	55 000	60 000	* 80 000	* 80 000
Australia	56 593 000	59 959 000	61 781 000	62 428 000	64 633 000
World Total	168 000 000	178 000 000	194 000 000	213 000 000	212 000 000

Note(s)
(1) This table includes production of refractory bauxite

(a) Data for Alabama only
(b) Including beneficiated and direct shipping ore
(c) Years ended 31 March following that stated
(d) Years ended 20 March following that stated
(e) Years ended 30 June of that stated

Production of alumina

tonnes (Al_2O_3 content)

Country	2004	2005	2006	2007	2008
Azerbaijan	232 300	314 764	362 665	184 500	164 879
Bosnia & Herzegovina	356 844	447 260	393 580	303 799	* 294 500
France	* 600 000	* 600 000	* 636 000	* 500 000	* 500 000
Germany	* 835 000	* 830 000	* 850 000	* 900 000	* 900 000
Greece	514 000	511 100	509 800	515 600	504 400
Hungary	* 304 000	* 270 000	* 270 000	* 300 000	* 330 000
Ireland, Republic of	* 1 500 000	* 1 800 000	1 800 000	1 800 000	1 800 000
Italy	1 064 000	1 070 000	1 090 000	1 327 000	* 1 100 000
Montenegro	—	—	236 740	240 186	220 426
Romania	560 243	689 329	622 083	22 830	344
Russia	3 269 416	3 259 216	3 265 216	3 332 308	* 3 200 000
Serbia and Montenegro	245 005	235 196	—	—	—
Spain	* 1 400 000	* 1 400 000	* 1 400 000	* 1 450 000	* 1 450 000
Turkey	169 991	112 558	150 117	163 435	* 150 000
Ukraine	1 562 970	1 632 020	1 671 620	1 655 718	1 671 800
Guinea	778 000	722 400	555 000	542 073	593 900
Canada	1 328 842	1 400 340	1 476 959	1 454 390	1 521 500
Jamaica	4 022 722	4 085 634	4 099 548	3 940 589	3 995 358
USA	5 354 000	5 215 000	4 696 000	4 236 000	4 298 000
Brazil	5 126 500	5 191 100	6 735 000	7 077 600	7 822 300
Suriname	2 014 622	1 939 615	2 151 148	2 178 472	2 153 968
Venezuela	* 1 900 000	1 931 000	1 920 000	* 1 800 000	* 1 800 000
China	6 980 000	8 592 200	13 256 900	19 453 000	22 788 100
India	2 974 000	3 066 000	3 077 000	3 208 000	* 3 000 000
Iran (a)	137 002	130 100	167 783	220 000	* 220 000
Japan	780 000	* 780 000	* 780 000	* 780 000	* 780 000
Kazakhstan	1 467 966	1 505 415	1 514 509	1 544 462	1 607 829
Australia	16 700 000	17 704 000	18 312 000	18 844 000	19 446 000
World Total	62 200 000	65 400 000	72 000 000	78 000 000	82 300 000

Note(s)
(1) Where possible figures in this table show the alumina equivalent (Al_2O_3) of total hydrate produced, whether or not calcined

(a) Years ended 20 March following that stated

Production of primary aluminium

tonnes

Country	2004	2005	2006	2007	2008
Azerbaijan	29 537	31 762	31 852	39 241	61 604
Bosnia & Herzegovina	121 294	131 094	136 190	147 193	155 900
France	447 000	440 000	442 879	430 159	431 600
Germany	667 800	647 900	515 539	551 000	605 880
Greece	166 634	165 300	164 500	167 937	162 339
Hungary	34 400	31 000	300	—	—
Iceland	284 700	273 318	328 424	446 297	761 204
Italy	195 400	192 900	194 200	179 500	186 400
Montenegro	—	—	121 762	135 151	111 513
Netherlands	330 000	333 820	285 317	296 900	320 000
Norway	1 318 000	1 391 000	1 383 000	1 362 000	1 368 000
Poland	58 931	54 508	57 620	58 736	47 543
Romania	222 347	258 000	277 382	289 388	289 740
Russia	3 594 747	3 647 061	3 117 249	3 955 417	4 193 000
Serbia and Montenegro	115 080	116 994	—	—	—
Slovakia	156 893	159 203	158 289	160 461	162 995
Slovenia	120 700	120 642	118 682	111 016	83 300
Spain	397 500	395 000	367 400	405 100	407 700
Sweden	100 591	102 107	101 668	99 842	81 913
Switzerland	44 879	44 800	12 000	—	—
Turkey	64 002	59 000	60 000	63 400	60 400
Ukraine	113 212	114 213	112 952	113 437	86 100
United Kingdom	359 631	368 477	360 325	364 595	316 000
Cameroon	85 900	86 400	88 400	87 000	89 700
Egypt	216 000	243 800	252 300	258 300	259 200
Ghana	—	13 400	75 800	12 900	9 300
Mozambique	547 100	553 700	564 000	559 900	536 000
Nigeria	—	—	—	—	20 000
South Africa	866 074	846 213	895 000	899 000	811 000
Canada	2 592 160	2 894 204	3 051 128	3 082 625	3 120 148
USA	2 516 400	2 481 000	2 283 800	2 553 900	2 658 300
Argentina	273 575	275 071	277 800	292 744	399 715
Brazil	1 457 400	1 497 600	1 604 500	1 654 800	1 661 000
Venezuela	631 100	624 000	617 100	615 700	607 800
Bahrain	530 000	749 987	872 393	865 883	871 658
China	6 688 800	7 806 000	9 358 400	12 558 600	13 176 600
Dubai	671 915	724 565	789 341	889 548	891 723
India (a)	883 960	930 543	1 113 849	1 239 581	* 1 051 740
India	5 917	7 214	9 947	9 377	8 170
Indonesia	240 800	252 300	250 300	* 242 400	242 500
Iran (b)	212 602	218 754	205 462	215 981	* 248 000
Japan	6 433	6 400	6 500	6 600	6 600
Kazakhstan	—	—	—	...	104 000
Oman	—	—	—	—	49 000
Tajikistan	358 082	379 630	413 800	419 060	399 500
Australia	1 895 000	1 903 000	1 929 000	1 957 000	1 974 000
New Zealand	350 299	351 449	335 300	351 100	315 500
World Total	30 000 000	31 900 000	33 300 000	38 100 000	39 400 000

Note(s)
(a) Years ended 31 March following that stated
(b) Years ended 20 March following that stated

Mine production of antimony

tonnes (metal content)

Country	2004	2005	2006	2007	2008
Russia	* 3 000	* 3 000	* 3 000	* 3 000	* 3 000
Turkey	* 700	* 1 200	* 1 100	* 1 200	* 1 300
South Africa	4 967	5 979	* 4 362	* 3 354	* 3 500
Canada	105	79	269	193	116
Guatemala	2 686	1 007	—	365	—
Mexico	503	565	778	414	380
Bolivia	3 036	5 204	5 460	3 881	3 910
Peru (a)	465	807	691	590	531
China	125 433	151 457	156 200	163 000	183 000
Kyrgyzstan	* 1 500	* 1 500	* 1 500	* 1 500	* 1 500
Pakistan (b)	—	5	91	119	* 100
Tajikistan	4 069	4 073	3 480	* 3 500	* 3 500
Thailand	61	415	1 639	—	—
Australia (b)	157	192	* 230	767	1 688
World Total	147 000	175 000	179 000	182 000	203 000

Note(s)
(1) This table includes antimony content of antimonial lead alloys
(2) In addition, Hungary is believed to produce antimony

(a) Including Sb content of antimonial lead plus Sb content of ores for export
(b) Years ended 30 June of that stated

Production of white arsenic

tonnes

Country	2004	2005	2006	2007	2008
Belgium	* 1 000	* 1 000	* 1 000	* 1 000	* 1 000
Portugal	* 15	* 15	* 15	* 15	* 15
Russia	* 1 500	* 1 500	* 1 500	* 1 500	* 1 500
Namibia	1 264	29	—	610	574
Canada	* 250	* 250	* 250	* 250	* 250
Mexico	2 415	2 197	2 106	677	—
Bolivia	168	120	90	—	—
Chile (a)	* 10 000	* 10 000	* 10 000	* 10 000	* 10 000
Peru	3 037	3 150	4 399	4 321	4 822
China	* 30 000	* 30 000	* 30 000	* 25 000	* 25 000
Iran (b)	89	* 100	* 100	* 100	* 100
Japan	* 40	* 40	* 40	* 40	* 40
Kazakhstan	* 1 500	* 1 500	* 1 500	* 1 500	* 1 500

Note(s)
(1) This table includes calculated trioxide equivalent of arsenic metal produced except where this would involve double counting
(2) In addition to the countries listed, Austria, Finland, Hungary, Spain and the United Kingdom are believed to produce arsenic

(a) Exports
(b) Orpiment and realgar concentrates

Production of asbestos

tonnes

Country	2004	2005	2006	2007	2008
Greece	* 4 000	—	—	—	—
Russia	923 000	* 925 000	* 925 000	1 025 000	1 017 000
Serbia	—	—	4 500	—	—
Serbia and Montenegro	7 300	4 080	—	—	—
Zimbabwe					
Chrysotile	104 457	122 041	96 956	90 339	* 50 000
Canada					
Chrysotile	220 000	* 186 000	* 185 000	* 185 000	* 175 000
Argentina	267	260	299	282	* 280
Brazil	252 067	236 047	227 304	254 204	287 673
Colombia (a)	* 60 000	* 60 000	* 60 000	* 60 000	* 60 000
China	438 962	332 407	360 000	* 390 000	* 380 000
India					
Amphibole (b)	6 392	2 323	390	261	325
Iran (c)	1 300	1 300	—	—	—
Kazakhstan	346 500	305 500	314 700	292 600	230 100
Pakistan (d)	380	—	—	—	—
World Total	2 400 000	2 200 000	2 200 000	2 300 000	2 200 000

Note(s)
(1) In addition to the countries listed, Romania is believed to produce asbestos

(a) Crude
(b) Years ended 31 March following that stated
(c) Years ended 20 March following that stated
(d) Years ended 30 June of that stated

Production of barytes

tonnes

Country	2004	2005	2006	2007	2008
Bosnia & Herzegovina	63	160	190	37	54
Bulgaria	75 400	76 600	74 500	50 900	40 100
France	81 000	* 81 000	* 40 000	—	—
Germany	93 624	88 591	85 524	88 265	78 941
Italy	12 258	7 312	* 7 000	* 7 000	* 7 000
Poland	3 183	2 357	2 034	2 000	2 200
Russia	63 400	63 400	63 000	64 000	* 65 000
Slovakia	25 000	26 589	57 000	58 000	20 000
Spain	40 776	42 792	45 001	26 770	* 11 110
Turkey	134 504	157 200	160 000	150 000	150 000
United Kingdom	61 000	64 000	48 000	53 000	43 000
Algeria	47 753	54 773	64 787	63 098	60 088
Egypt	...	.	...	50	1 080
Morocco	511 800	597 600	628 400	664 708	725 060
Nigeria	* 15 000	* 30 000	30 011	18 047	* 20 000
Tunisia	1 813	—	—	—	—
Zimbabwe	3 486	—	—	—	—
Canada	21 000	23 000	21 000	9 000	12 300
Mexico	306 668	268 657	199 605	185 921	140 066
USA (a)	532 000	489 000	598 000	455 000	* 615 000
Argentina	2 762	3 355	6 276	3 798	3 000
Bolivia	5 774	11 379	8 943	8 245	8 000
Brazil (b)	50 430	42 924	47 611	37 000	42 000
Chile	31	91	375	77	—
Colombia	* 2 000	* 2 000	* 2 000	* 2 000	* 2 000
Ecuador	3 694	—	—	—	—
Peru	9 610	26 985	1 899	27 369	42 960
Afghanistan	* 2 000	* 1 500	* 1 500	* 1 500	* 1 500
Burma	2 200	2 100	2 900	6 800	5 700
China	3 700 000	4 100 000	4 600 000	4 300 000	5 000 000
India (c)	1 159 031	1 156 227	1 680 695	1 071 765	1 676 213
Iran (d)	207 466	231 184	226 032	249 495	* 250 000
Kazakhstan	310 700	268 700	261 100	280 300	492 200
Laos	10 470	28 500	29 000	29 000	29 000
Malaysia	—	—	910	—	4 372
Pakistan (e)	44 071	42 087	44 183	46 155	50 000
Saudi Arabia	30 000	30 000	23 308	30 000	30 000
Thailand	211 278	3 989	4 549	8 631	9 180
Vietnam	101 000	116 000	90 000	90 000	80 000
Australia	* 29 000	18 020	* 18 000	* 12 600	* 22 400
World Total	7 900 000	8 200 000	9 200 000	8 100 000	9 700 000

Note(s)
(1) This table may include small quantities of witherite
(2) In addition to the countries listed, Cuba is believed to produce barytes

(a) Sold or used by producers
(b) Including beneficiated and directly shipped material
(c) Years ended 31 March following that stated
(d) Years ended 20 March following that stated
(e) Years ended 30 June of that stated

Production of bentonite and fuller's earth

tonnes

Country	2004	2005	2006	2007	2008
Armenia					
Bentonite	561	732	720	1 129	896
Azerbaijan					
Bentonite	54 900	53 700	40 600	50 459	40 683
Bosnia & Herzegovina					
Bentonite	24 353	24 882	24 645	32 912	31 232
Bulgaria					
Bentonite	224 900	181 200	134 500	99 000	178 700
Croatia					
Bentonite	15 674	17 391	16 410	19 578	19 759
Cyprus					
Bentonite	155 717	172 366	150 620	154 655	155 125
Czech Republic					
Bentonite	224 000	216 000	267 000	335 000	174 000
Denmark					
Bentonite	18 352	18 515	19 211	20 093	22 458
Georgia					
Bentonite	1 804	7 876	4 487	—	—
Germany					
Bentonite	404 549	352 374	363 998	384 709	414 333
Greece					
Bentonite	1 030 556	1 124 795	* 1 200 000	(a) 1 389 800	(a) 1 525 000
Hungary					
Bentonite	9 300	4 900	6 635	54 231	7 464
Italy					
Bentonite	437 659	445 573	469 654	599 735	281 119
Fuller's earth	300	...	...	.	..
Macedonia					
Bentonite	16 373	14 958	20 353	22 509	13 689
Poland	66 143	86 331	97 900	105 943	121 031
Romania					
Bentonite	18 161	18 190	21 165	16 911	16 638
Russia					
Bentonite	* 500 000	* 500 000	456 000	* 460 000	* 460 000
Slovakia					
Bentonite	98 000	97 000	136 000	149 000	145 000
Spain					
Bentonite	156 760	163 290	154 746	147 253	152 927
Attapulgite	20 796	20 565	20 933	24 615	27 348
Sepiolite	655 346	807 820	806 345	717 728	737 659
Turkey					
Bentonite	643 153	582 735	* 600 000	748 170	683 253
Sepiolite	* 10 000	* 10 000	* 10 000	* 10 000	* 10 000
Ukraine					
Bentonite	* 25 000	* 25 000	* 25 000	* 25 000	* 25 000
United Kingdom					
Fuller's earth (b)	27 540	6 200	—	—	—
Algeria					
Bentonite	32 200	29 029	27 110	32 600	30 595
Fuller's earth	2 284	831	—	—	—
Egypt					
Bentonite	26 000	* 26 000	* 28 000	29 800	32 000
Morocco					
Bentonite	40 000	64 000	21 100	136 097	50 125
Fuller's earth (c)	28 700	30 600	29 400	121 737	140 875
Mozambique					
Bentonite	578	547	692	762	614
Senegal					
Attapulgite	* 180 000	127 000	140 000	* 150 000	166 900
South Africa					
Bentonite	55 859	139 883	32 878	45 778	44 067
Attapulgite	20 419	34 340	49 225	65 402	69 876

Production of bentonite and fuller's earth

tonnes

Country	2004	2005	2006	2007	2008
Guatemala					
Bentonite	81 688	135 451	20 034	259 799	62 749
Mexico					
Bentonite	564 015	425 630	435 273	613 895	374 933
Fuller's earth	129 502	107 265	102 400	34 175	66 123
USA					
Bentonite (d)	4 060 000	4 710 000	4 940 000	4 820 000	* 4 870 000
Fuller's earth (d)	3 260 000	2 730 000	2 540 000	2 660 000	* 2 630 000
Argentina					
Bentonite	163 028	247 101	256 165	250 260	265 782
Fuller's earth	1 500	* 1 500	* 1 500	* 1 500	* 1 500
Brazil					
Bentonite	432 224	459 679	419 214	329 647	* 400 000
Chile					
Bentonite	101	—	—	533	—
Colombia					
Bentonite	* 8 500	* 8 500	* 8 500	* 8 500	* 8 500
Peru					
Bentonite	10 510	14 663	14 590	21 451	31 557
Burma					
Bentonite (e)	* 800	* 800	* 800	* 800	* 800
China					
Bentonite	2 250 000	2 300 000	3 200 000	* 3 300 000	* 3 300 000
India					
Bentonite (e)	* 360 000	* 580 000	* 550 000	* 630 000	* 710 000
Fuller's earth (e)	* 144 000	* 93 000	* 50 000	* 80 000	* 24 000
Indonesia					
Bentonite	* 5 000	* 5 000	* 5 500	* 5 500	* 5 500
Iran					
Bentonite (f)	176 425	261 888	186 323	254 084	...
Iraq					
Bentonite	...	..	.	570	1 605
Japan					
Bentonite	455 282	421 629	* 425 000	* 430 000	* 430 000
Fuller's earth	109 657	* 110 000	* 110 000	* 110 000	* 110 000
Korea, Republic of					
Bentonite	99 173	85 177	61 137	56 429	71 052
Fuller's earth	26 487	84 632	46 314	65 136	70 711
Pakistan					
Bentonite (g)	6 316	15 671	20 088	33 177	31 000
Fuller's earth (g)	13 986	17 001	16 209	11 378	11 000
Philippines					
Bentonite	3 556	* 2 000	1 000	1 148	1 422
Thailand					
Bentonite	1 350	32 500	1 200	650	210
Uzbekistan					
Bentonite	* 25 000	* 35 000	* 40 000	* 40 000	* 40 000
Vietnam					
Bentonite	* 20 000	* 20 000	* 20 000	* 20 000	* 20 000

Production of bentonite and fuller's earth

tonnes

Country	2004	2005	2006	2007	2008
Australia					
Bentonite (g)	264 038	227 433	* 125 600	* 116 300	* 80 400
Fuller's earth	10 142	9 784	* 10 000	* 10 000	* 10 000
New Zealand					
Bentonite	10 050	7 590	3 028	6 154	753
World Total Bentonite	13 300 000	14 400 000	15 100 000	16 300 000	15 600 000
World Total Fuller's Earth (a)	4 600 000	4 200 000	3 900 000	4 100 000	4 100 000

Note(s)
(1) Bentonites consist of montmorillonite (one of the smectite group of clay minerals) and occur in two main varieties, calcium, bentonite, the most commonly occurring, and sodium bentonite, industrially the more important
(2) Calcium bentonite can be converted to sodium bentonite by a sodium-exchange process
(3) In some countries, such as the United Kingdom, calcium bentonite is known as fuller's earth, a term which is also used to refer attapulgite, a mineralogically distinct clay mineral but exhibiting similar properties
(4) In addition to the countries listed, Austria is believed to produce bentonite and France may produce fuller's earth

(a) Including attapulgite and sepiolite
(b) Saleable production based on data from producing companies
(c) Smectite
(d) Sold or used by producers
(e) Years ended 31 March following that stated
(f) Years ended 20 March following that stated
(g) Years ended 30 June of that stated

Production of beryl

tonnes

Country	2004	2005	2006	2007	2008
Madagascar (a)	12	* 1	* 1	* 1	* 1
Mozambique	45	146	16	31	8
Uganda	207	19	2	2	—
Zambia	8	* 10	* 10	* 10	* 10
USA	2 210	2 780	3 830	3 810	* 3 900
Brazil	* 4	* 4	* 4	* 4	* 4
China	* 500	* 500	* 500	* 500	* 500

Note(s)
(a) Includes ornamental and industrial products

Mine production of bismuth

tonnes (metal content)

Country	2004	2005	2006	2007	2008
Bulgaria	* 40	* 40	* 45	* 45	* 45
Romania	* 40	* 40	* 40	* 40	* 40
Russia	* 50	* 50	* 55	* 55	* 70
Canada	223	170	214	145	71
Mexico	1 014	970	1 186	1 170	1 132
Bolivia	62	44	155	147	150
Peru (a)	988	952	1 081	1 114	1 061
China (b)	1 857	1 886	1 900	1 900	1 900
Japan (a)	522	463	425	408	480
Kazakhstan	* 150	* 140	* 140	* 145	* 150
Australia	* 100	* 100	* 100	* 100	* 100
World Total	5 000	4 900	5 300	5 300	5 200

Note(s)
(1) The figures in this table are in some instances derived from reported bismuth content of refined and impure metal plus recoverable in ores and concentrates exported
(2) Production for some countries may include bismuth produced from imported ores but it is thought that any resulting duplication is insignificant in the countries shown
(3) In addition to the countries listed, Brazil is believed to produce bismuth

(a) Metal production
(b) Exports of metal have always been higher than mine production in recent years

Production of borates

tonnes

Country	2004	2005	2006	2007	2008
Russia	* 500 000	* 400 000	* 400 000	* 400 000	* 400 000
Turkey	1 727 000	2 087 000	2 373 345	1 997 163	2 139 224
USA (a)	1 210 000	1 150 000	* 1 150 000	* 1 150 000	* 1 150 000
Argentina	821 031	632 792	533 535	669 578	669 578
Bolivia	68 031	63 499	50 727	79 531	* 90 000
Chile	594 191	460 683	459 645	535 071	590 999
Peru	192 335	32 611	—	233 991	349 891
China	* 275 000	* 280 000	* 290 000	* 290 000	* 280 000
Iran (b)	2 142	1 660	1 974	1 603	* 1 600
Kazakhstan	* 30 000	* 30 000	* 30 000	* 30 000	* 30 000

Note(s)
(a) Sold or used by producers
(b) Years ended 20 March following that stated

Production of bromine

kilograms

Country	2004	2005	2006	2007	2008
Russia	* 60 000	* 60 000	* 60 000	* 60 000	* 60 000
Spain	* 100 000	* 100 000	* 100 000	* 100 000	* 100 000
Ukraine	1 878 000	3 138 000	* 700 000	* 1 800 000	* 400 000
USA (a)	222 000 000	226 000 000	243 000 000	* 235 000 000	* 230 000 000
China	* 80 000 000	* 105 000 000	* 124 000 000	* 130 000 000	* 135 000 000
India (b)	1 730 000	2 424 000	2 138 000	1 664 640	2 118 740
Israel	202 000 000	207 048 000	179 493 000	159 395 000	164 042 000
Japan	* 20 000 000	* 20 000 000	* 20 000 000	* 20 000 000	* 20 000 000
Jordan	46 339	89 785	94 500	85 105	105 600
World Total	528 000 000	564 000 000	570 000 000	548 000 000	552 000 000

Note(s)
(a) Elemental bromine sold as such or used in the preparation of bromine compounds by primary producers
(b) Years ended 31 March following that stated

Production of cadmium

tonnes

Country	2004	2005	2006	2007	2008
Bulgaria	356	319	320	318	376
France	* 120	* 100	* 90	* 50	* 50
Germany	* 500	* 490	* 490	* 475	* 420
Netherlands	493	494	524	495	* 480
Norway	141	153	125	269	178
Poland	356	408	373	421	603
Russia	532	621	690	810	* 800
Canada (a)	1 880	1 727	2 090	1 388	1 409
Mexico	1 594	1 627	1 399	1 605	1 550
USA (a)	1 480	1 470	723	735	* 745
Argentina	39	56	6	6	* 6
Brazil	187	200	* 200	* 200	* 200
Peru	532	481	416	347	371
China	4 528	4 080	3 791	4 215	* 4 300
India (b)	480	406	481	589	503
Japan	2 233	2 297	2 286	1 939	2 126
Kazakhstan	2 358	1 624	1 140	996	996
Korea, Dem. P.R. of	* 200	* 200	* 200	* 200	* 200
Korea, Republic of	2 362	2 582	3 320	2 846	3 090
Australia	347	358	329	351	* 330
World Total	20 700	19 700	19 000	18 300	18 700

Note(s)
(1) Data in this table excludes secondary metal unless otherwise stated

(a) Including cadmium sponge and/or secondary metal
(b) Years ended 31 March following that stated

Production of chromium ores and concentrates

tonnes

Country	2004	2005	2006	2007	2008
Albania	160 300	170 000	201 120	323 570	203 850
Finland	580 000	572 000	549 000	556 000	614 000
Russia	447 300	772 000	966 095	776 681	913 000
Turkey	506 421	858 729	1 059 901	1 678 932	1 885 712
Madagascar	77 386	93 384	116 290	122 260	84 000
South Africa	7 676 799	7 502 762	7 418 326	9 646 958	9 682 640
Sudan	26 000	21 654	24 200	37 656	31 890
Zimbabwe	668 391	614 720	700 001	663 593	484 482
Cuba	42 487	14 792	5 047	—	—
Brazil	593 476	616 534	562 739	627 772	* 700 000
Afghanistan	6 591	6 818	* 6 800	* 6 800	* 6 800
Burma (a)	* 360	* 410	* 390	* 400	* 400
China	230 000	220 000	220 000	220 000	220 000
India (a)	3 621 394	3 714 284	5 295 551	4 798 515	3 771 000
Iran (b) (c)	134 872	224 911	236 397	139 114	* 140 000
Kazakhstan	3 287 100	3 581 242	3 366 078	3 687 200	3 551 700
Oman	28 700	34 000	276 300	407 700	813 670
Pakistan (d)	29 230	56 359	64 572	104 141	115 000
Philippines (b)	42 139	36 070	46 728	31 593	15 268
United Arab Emirates	7 089	—	—	19 000	34 350
Vietnam	82 000	5 700	3 400	2 800	* 1 000
Australia	110 273	90 260	107 103	118 093	56 982
World Total	18 000 000	19 200 000	21 200 000	24 000 000	23 300 000

Note(s)
(1) In addition to the countries listed, Bulgaria is believed to produce chromite

(a) Years ended 31 March following that stated
(b) Including foundry sand and/or lumpy ore
(c) Years ended 20 March following that stated
(d) Years ended 30 June of that stated

COAL

Characteristics

Coal is a combustible sedimentary rock made of lithified plant remains. A coal seam is formed by the alteration of dead plant material that initially accumulates as peat on the land surface. As the peat becomes buried beneath younger sediments the temperature increases with increasing depth of burial. Peat is sequentially altered by 'coalification', a process involving the loss of water and volatile components, through brown coals to black coals.

The physical and chemical properties of coal, that is coal quality, determine whether a coal can be used commercially. Calorific value, or the heat energy given off by the combustion of a unit quantity of fuel, is one of the main quality criteria used by coal consumers. Coal quality is important as it affects the operation of plant, and thus the costs of generating power, through its impact on the costs of both maintenance and conformity with environmental legislation. Chlorine and sulphur are both detrimental in coal, causing pollution as well as corrosion in boilers.

Based on the physical properties of different bituminous coals, a fundamental distinction is made worldwide between steam coal (or thermal coal), used for burning in boilers, chiefly for electricity generation, and coking coal, which is used to make coke for the metallurgical industries. Coking coal produces coke with sufficient strength to support the loads imposed within a blast furnace. Steam coal tends to have calorific values at the lower end of the range.

Uses

Power generation is the primary use for coal. Roughly 41 per cent of electricity worldwide (World Coal Institute, 2009a), is generated from coal and this may be considerably higher in many individual countries. In the USA, for example, 29 per cent of the electricity generated is through coal-fired power stations (World Coal Institute, 2009b) and in China, 81 per cent (World Coal Institute, 2009b). Approximately 26.5 per cent of world primary energy consumption is from coal (World Coal Institute, 2009a).

Almost two-thirds of world steel production is made from iron produced in blast furnaces which use coal, mainly in the form of coke. Coke is made from coking coals, which are characterised by their chemical and physical properties: they are low in sulphur and phosphorus, liquefy when heated in the absence of air and solidify into hard, porous lumps. The lumps of coke are produced by processing coal in a series of coke ovens with an oxygen-deficient atmosphere in order to concentrate the carbon. The coke has a high energy value and provides the permeability, heat and gases which are required to reduce and melt the iron ore, pellets and sinter consumed in iron-making. Another, less-used, method is pulverised coal injection, which can utilise a wide range of coals, including the less-expensive steam coal. About a third of world steel production comes from scrap in electric arc furnaces, and it follows that much of the electricity for this process is produced from coal.

Liquid fuels derived from coal are sulphur-free and have low levels of nitrogen oxides and particulate matter. Coal may be converted into liquid fuel (and other products such as waxes, lubricants and chemicals) by two methods: direct liquefaction, where coal is dissolved in solvents at high temperature and pressure; and indirect liquefaction, which gasifies the coal to produce a 'syngas' which is then condensed over a catalyst (the Fischer-Tropsch process). The Fischer-Tropsch process produces a clean, high-quality product, whilst the liquid fuel produced through the direct process requires further refining. The South African company, Sasol, is the sole producer of liquid fuel and chemicals from coal on a commercial scale.

Coal is used as an energy source in cement production — a process that requires a large amount of energy. The coal consumed is half the mass of cement produced. Coal may also be gasified to produce a combination of hydrogen and carbon monoxide, which may be used for a range of purposes such as industrial heating, electricity generation and manufacture of chemicals. It is the source of numerous chemicals, as by-products, which are used in soap, pharmaceutical products, solvents, plastics, dyes and synthetic fibres. Coal is used in alumina refineries and in the production of activated carbon, carbon fibre and silicon metal.

World production in 2008

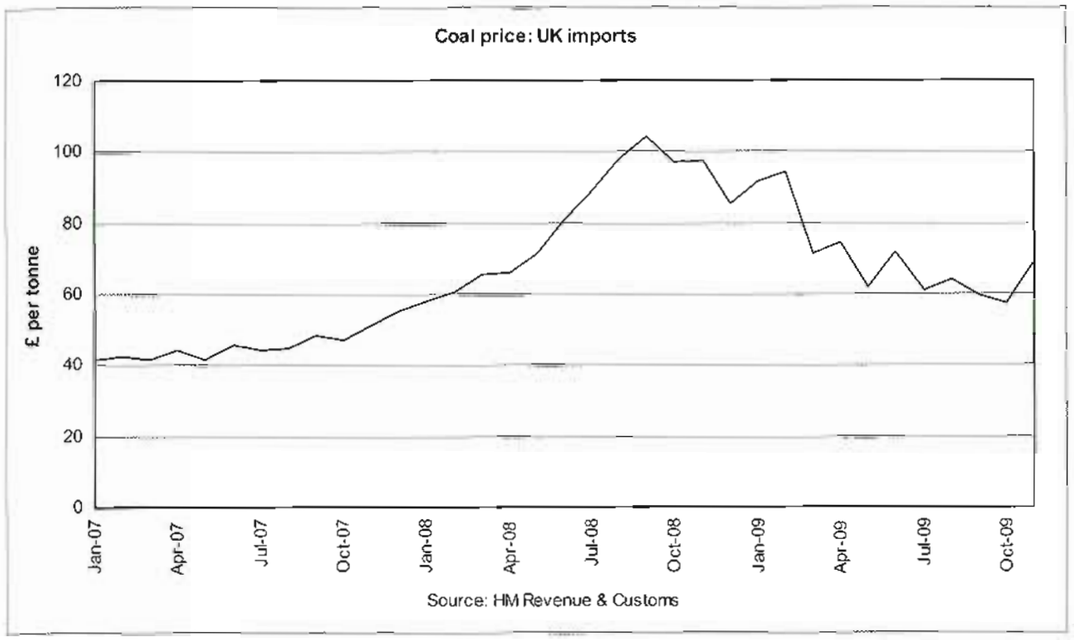
In 2008, world coal production was 6618 million tonnes; this is an increase of 2036 million tonnes compared to the previous year. During the period 2004–2005, the world production had risen by five to six per cent each year; however, the percentage increase for 2008, of three per cent, is in line with the slower rate of increase since 2006. China continues to be the largest producer with 2622 million tonnes, which is almost 40 per cent of total world production. Between 2004 and 2008, China's production increased 34 per cent, although the rates of increase have reduced over that period. The increase in 2008 is three per cent compared to 2007. The USA remains the second largest producer of coal with 1065 million tonnes, with India third at 527 million tonnes. This represents 16 per cent and almost 8 per cent of total world coal production respectively.

Coal production in Europe remains fairly static with an increase between 2007 and 2008 of just under one per cent and an increase of three per cent between 2004 and 2008. The largest producer of coal in Europe is Russia which has had a 3.8 per cent increase in production between 2007 and 2008 and growth of 15.6 per cent since 2004. Although all are small producers, Montenegro, Macedonia, Slovakia, Turkey and Bosnia & Herzegovina, show the biggest percentage increases in output during 2008, with Spain and Serbia showing the biggest percentage decreases in production.

Asia had the largest growth in coal production of all the regions of the world. The increase between 2007 and 2008 was four per cent and between 2004 and 2008 production has grown by 34 per cent. The biggest increase in production during 2007 and 2008 in the region was Bangladesh at 55 per cent. Kazakhstan also shows one of the largest increases in production at 22 per cent between 2007 and 2008, followed by Bhutan whose production for 2008 was 17.5 per cent higher than 2007.

The majority of coal production in 2008 in the Americas was from the USA; where output increased by 14 per cent between 2007 and 2008. Although significantly smaller producers than the USA, there are other countries in this region which have shown substantial growth in their outputs between 2004 and 2008. These include Chile at 279 per cent growth, Peru at 136 per cent and Argentina with 108 per cent.

Australia is the world's fourth largest producer of coal but its rate of growth in 2008 was only three per cent compared to the previous year. New Zealand's production of coal increased



between 2007 and 2008 by five per cent, but its output since 2004 has decreased overall by almost five per cent.

Africa's coal production showed a slight increase of 1.7 per cent in the period 2007 to 2008. Africa's biggest producer, South Africa, decreased its output by four per cent in this period. The biggest increase, at 60 per cent between 2007 and 2008, was Mozambique which also had the largest growth in production between 2004 and 2008 at 128 per cent.

Prices

The price of coal is determined by a range of factors including coal type, net calorific value and content of impurities such as sulphur. Additionally, the cost of transportation comprises a large portion of the delivered price of coal. Coal is chiefly sold under long-term contracts that 'fix' the price of coal over the term of the contract, usually with an escalator based on inflation. Prices are normally quoted on a well-established world spot market.

During 2008, coal remained the fastest growing fuel for the sixth consecutive year, growing by 3.1 per cent with coal prices growing more rapidly than any other fossil fuel. China remained the world's largest consumer of coal at 43 per cent of the market.

The BP Statistical review of World Energy 2009 shows the value of coal increasing between 2007 and 2008 by 62 per cent in North West Europe, 56 per cent in US Central Appalachian, 51 per cent for coking coal in Japan and 43 per cent for steam coal in Japan. However, during the second half of 2008, the global economy began to slow, perhaps in part due to high energy costs It is the recession, triggered by the financial crisis in September 2008, which continued to influence the value of coal during 2009 (BP, 2009).

Towards the end of 2009, the price of coal stabilised and increased in December to US$77.56 (RB™ Index US$/t Global Coal Data) (Global Coal, 2009) and this is also reflected in the price of imports to the UK (HM Revenue & Customs, 2009).

Analysts from JP Morgan predict that thermal coal, will rise from US$70 to US$85 per tonne in 2010. This is based on predictions of rebounding demand in China and India. China's needs are driven by closure of its mines in the Shanxi region due to safety improvements and its rise in electricity generation, which is dependant on coal (Mason, 2009).

Industry events in 2009

In 2008, coal continued to be the fastest growing fuel with prices soaring in response to increased demand from developing nations such as China, India, Indonesia, Russia and Kazakhstan. The end of 2008, however, saw the collapse of stock markets and a worldwide economic slowdown which affected coal prices at the end of the year and continued to negatively influence the market value of coal in 2009. Demand for coal fell and production levels followed, compounded by the over-production in 2007 and 2008 which had led to excess coal stocks. Furthermore, trade in coke has fallen because it is used in the production of steel, which has also been affected by the global downturn.

Coal prices recovered during 2009 and growth in output is expected to continue for use in electricity generation. This is especially true in Vietnam and Indonesia which have plans to bring new coal-fired generator plants on line before 2030. China also continues to rely on coal for its electricity needs, because of its limited reserves of oil and gas. Individual countries have started to introduce packages to encourage economic recovery which will increase demand for steel and therefore coal.

In Mozambique, the government has announced that it has secured US$500 million from the Dutch and Danish Governments, along with the EU, to build a railway to link the coal-rich Moatize mines to Nacala Port by 2015. This investment should facilitate mineral exportation when the Moatize mines reach their full production capacity. This

follows on from Vale's announcement of its intention to invest US$595 million in the Moatize coal project. Also in Mozambique, Riverside Mining Ltd has formed a joint venture with Tata Steel Ltd at Benga. Reserves are estimated at 273.3 million tonnes. The company has also identified another 1700 million tonne project at the Zambeze property next to the Benga project (Mining Journal Online, 2009a).

In Indonesia, Churchill Mining plc has published its probable reserves estimate for the East Kutai project at 956 million tonnes of thermal coal. This is based on indicated and measures resources of in excess of 1300 million tonnes and overall resources estimated at 3000 million tonnes (Mining Journal Online, 2009b). JFE Steel Corp, the Japanese Steel company has paid a US$550 million for a 30 per cent share in the Byerwen Coal Project in Queensland's Bowen Basin. The development of this project will make it one of Australia's largest coal mines. The company has also agreed a 2 million tonnes per year coking coal agreement with the owner QCoal Pty Ltd (Mining Journal Online, 2009c).

In Panama, in July, Minera Panama entered into a joint development agreement with Suez Energy Central America to develop a 300 Megawatt coal-fired power plant at Punta Rincon in the Caribbean, within 25 km of the Mina de Cobre Panama copper project. The new power plant, will feed excess power to the Panamanian grid. Suez is the world's largest independent power producer (Mining Journal Online, 2009d).

China continued to increase its international coal mining assets throughout 2009. Yanzhou Coal Mining Co made a (US$2.9 billion) takeover bid for the Australian Felix Resources. The deal proceeded but only after inspection by Australia's Foreign Investment Review Board and on the condition that Yanzhou listed its Australia interests on the local exchange (Mining Journal Online, 2009e).

The National Energy Administration (NEA) of China has published statistics on its power consumption in 2009. Consumption grew by 6 per cent in 2009, reaching 3.6 billion Megawatt hours. Its capacity to generate energy has risen 10 per cent to 874 Gigawatts by the end of 2009. China continues to invest heavily in its power stations and distribution grid. China also closed a number of coal-fired power stations in 2009, bringing total closures to 60 Gigawatts since 2006. However, 80 per cent of China's power is still generated from coal (Bloomberg, 2009).

The UK Government announced that there will be no new British coal-fired power stations without carbon capture and storage (CCS) technology, and that there will be a full scale retrofit of CCS within five years of "technology being independently judged as technically and commercially proven". Coal currently accounts for 30 per cent (29 Gigawatts) of the UK's electricity capacity, generating 13 per cent of the UK's electricity in 2008. There are plans to reduce this by 21 Gigawatts as stations close in response to EU controls on sulphur and nitrogen emissions (Department of Energy and Climate Change, 2009).

GDF Suez's Belgian arm, Electrabel, will have a 73 per cent stake in a new renewable joint venture with Ackermans & van Haaren. The venture, called Max Green will launch its first project in 2010 with the conversion of a 180 Megawatt coal-fired power station to biomass (Reuters UK, 2009).

India's environment minister announced a voluntary carbon intensity reduction of 20 to 25 per cent below 2005 levels by 2020. This will be achieved by vehicle fuel efficiencies, an energy efficient building code and by introducing clean-coal technologies to half of all new coal-fired power plants. Despite this, coal will still account for 55 per cent of India's power supply by 2030. India plans to add 78.7 Gigawatts of power generation up to March 2012, primarily from coal (Energy Efficiency and Climate Change Newsletter, 2009).

The United Nations Climate Change Conference in December at Copenhagen struggled to set a timetable for a treaty. "Time Magazine" wrote on the conference that "the very struggle to reach agreement demonstrates that climate policy has finally come of age. The negotiations at Copenhagen were so contentious because of the very real impact the proposals have". The next conference will be in December 2010 in Mexico City where countries will be tasked with filling in details sketched out by the Copenhagen Accord (Morton Andersen, 2009).

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Production of coal

tonnes

Country	2004	2005	2006	2007	2008
Albania					
Lignite	20 000	19 000	* 20 000	* 20 000	* 20 000
Austria	235 397	13 931	7 854	—	—
Bosnia & Herzegovina					
Brown coal & lignite	8 896 257	9 144 850	9 958 024	9 762 800	11 221 305
Bulgaria					
Anthracite & bituminous	170 000	—	—	—	—
Lignite	23 384 500	22 146 100	22 749 500	25 325 000	26 007 800
Brown coal	2 724 200	2 469 200	2 556 900	2 833 500	2 643 200
Czech Republic					
Bituminous	14 648 000	12 778 000	13 017 000	12 462 000	12 197 000
Lignite	450 000	467 000	459 000	437 000	416 000
Brown coal	47 840 000	48 658 000	48 915 000	49 134 000	47 456 000
France					
Anthracite & bituminous	200 000	—	—	—	—
Georgia	8 100	5 100	8 284	18 891	...
Germany					
Anthracite & bituminous	25 871 882	24 909 867	20 882 119	21 531 956	17 171 232
Brown coal	181 926 060	177 907 945	176 324 117	180 411 991	175 313 020
Greece					
Lignite	71 237 228	70 600 000	64 800 000	66 100 000	64 521 000
Hungary					
Bituminous	280 000	—	—	—	—
Lignite	8 470 258	8 153 968	8 467 220	8 351 563	8 041 168
Brown coal	2 500 000	1 426 000	1 431 700	1 450 400	1 386 140
Kosovo					
Lignite	(a) —	(a) —	(a) —	(a) —	7 842 000
Macedonia					
Lignite	7 129 535	6 879 726	6 650 182	6 569 220	7 669 103
Montenegro					
Lignite	—	—	1 502 334	1 195 515	1 740 076
Norway					
Bituminous (b)	3 018 500	1 667 000	2 359 000	3 223 000	3 429 000
Poland					
Bituminous	100 087 100	97 903 730	95 222 512	88 313 369	84 345 443
Lignite	61 197 500	61 636 445	60 844 278	57 537 727	59 668 166
Romania					
Anthracite & bituminous	3 016 000	3 079 000	—	—	—
Lignite	29 726 895	28 491 480	32 753 526	35 671 000	34 529 000
Brown coal	220 157	62 609	* 58 000	97 000	205 000
Russia	282 000 000	299 000 000	310 000 000	314 000 000	326 000 000
Serbia					
Bituminous	—	—	65 000	58 000	66 000
Lignite	—	—	36 404 000	36 803 000	(c)(d) 31 332 000
Brown coal	—	—	316 000	204 000	.
Serbia and Montenegro					
Bituminous	72 152	65 000	—	—	—
Lignite	35 267 074	35 853 000	—	—	—
Brown coal	352 474	363 000	—	—	—
Slovakia					
Lignite	289 000	35 000	6 000	20 000	87 000
Brown coal	2 523 000	2 268 000	2 016 000	1 839 000	2 075 000
Slovenia					
Lignite	4 195 953	3 945 100	3 932 842	4 037 766	4 008 440
Brown coal	611 349	594 456	587 912	483 417	488 830
Spain					
Anthracite	3 692 220	3 888 838	3 775 504	3 439 879	3 148 603
Bituminous	5 220 407	4 664 589	4 572 350	4 304 938	4 156 918
Sub-bituminous	3 426 001	3 354 014	3 221 083	3 182 556	2 896 654
Lignite	8 146 908	7 587 113	6 859 641	6 112 946	—
Turkey					
Anthracite	2 842 952	2 785 505	3 070 793	3 230 787	3 343 409
Bituminous	738 915	737 701	.	...	.
Lignite	43 754 159	60 867 574	61 010 000	74 316 728	86 074 626

Production of coal

tonnes

Country	2004	2005	2006	2007	2008
Ukraine					
Bituminous	79 629 000	78 425 000	80 200 000	75 538 400	77 802 200
Lignite	523 000	313 000	231 000	182 000	.
United Kingdom					
Bituminous (e)	25 096 000	20 498 000	18 517 000	17 070 000	17 912 000
Botswana	913 087	984 876	962 427	828 164	909 511
Congo, Democratic Republic					
Bituminous	* 37 000	* 37 000	* 37 000	* 37 000	* 37 000
Egypt	100 000	75 000	* 75 000	* 75 000	* 75 000
Malawi	40 891	51 870	60 408	58 550	* 59 000
Mozambique					
Bituminous	16 525	3 417	40 953	23 602	37 700
Niger	200 384	182 060	176 320	171 296	182 912
Nigeria					
Sub-bituminous	* 10 000	* 10 000	* 10 000	* 10 000	* 10 000
South Africa					
Anthracite	1 486 619	1 639 414	1 584 424	2 348 955	2 207 304
Bituminous	241 884 911	242 724 560	243 197 975	245 251 281	250 006 054
Swaziland					
Bituminous	488 314	221 701	310 570	241 283	174 807
Tanzania					
Bituminous	65 041	30 795	17 940	27 198	15 242
Zambia					
Bituminous	* 240 000	* 240 000	* 210 000	* 220 000	* 220 000
Zimbabwe					
Bituminous	3 797 669	2 890 662	2 107 115	2 100 000	1 700 000
Canada					
Bituminous	29 284 000	30 741 000	29 409 000	32 810 000	32 185 000
Sub-bituminous	25 147 000	25 742 000	26 153 000	26 011 000	26 000 000
Lignite	11 588 000	11 017 000	10 440 000	10 541 000	9 921 000
Mexico					
Bituminous	12 034 844	11 749 126	10 882 685	11 886 757	15 894 060
USA					
Anthracite (f)	1 542 000	1 542 000	1 395 000	1 413 000	1 555 000
Bituminous (f)	509 384 000	518 193 000	509 512 000	482 428 000	507 488 000
Sub-bituminous	422 204 000	430 648 000	467 510 000	475 101 000	487 801 000
Lignite	75 750 000	76 113 000	76 430 000	71 305 900	* 68 675 000
Argentina					
Bituminous	120 060	320 000	295 333	250 000	* 250 000
Brazil					
Bituminous & lignite (g)	5 408 278	6 048 105	6 215 258	5 998 354	6 518 733
Chile					
Bituminous	140 186	138 056	98 673	184 122	212 375
Lignite	98 121	594 309	575 071	103 871	321 417
Colombia					
Bituminous	53 888 000	59 675 000	66 192 000	69 902 000	73 502 075
Peru	57 759	29 535	107 091	100 594	136 435
Venezuela					
Bituminous	8 107 304	7 194 882	7 458 873	8 038 000	* 6 400 000
Bangladesh (h)	64 605	87 143	303 016	388 376	602 092
Bhutan	29 631	85 279	97 965	105 261	123 704
Burma (i)	237 949	229 647	331 445	283 703	* 300 000
China	1 960 000 000	2 205 000 000	2 373 000 000	2 536 000 000	2 621 832 300
India					
Bituminous (i)	382 615 000	407 039 000	430 832 000	457 003 000	493 220 000
Lignite (i)	30 337 000	30 066 000	31 285 000	33 980 000	33 364 000
Indonesia	132 352 025	152 722 438	193 761 311	217 409 663	225 000 000
Iran					
Bituminous (k)	2 079 604	1 898 417	2 432 000	2 525 000	* 2 500 000
Japan					
Bituminous	1 339 447	1 146 491	1 341 000	* 1 340 000	* 1 340 000

Production of coal

tonnes

Country	2004	2005	2006	2007	2008
Kazakhstan					
Bituminous	82 929 900	81 869 200	* 91 500 000	94 013 800	106 295 600
Lignite	3 945 200	4 498 500	4 655 100	4 370 100	4 776 700
Korea, Dem. P.R. of					
Anthracite	16 300 000	16 500 000	17 200 000	17 100 000	* 17 100 000
Lignite	6 500 000	7 000 000	7 500 000	7 000 000	* 7 000 000
Korea, Republic of					
Anthracite	3 191 212	2 831 658	2 823 990	2 886 000	2 773 000
Kyrgyzstan	456 300	300 000	300 000	400 000	...
Laos	332 907	232 934	233 000	* 580 000	* 600 000
Malaysia	389 176	789 356	901 801	1 063 078	1 161 024
Mongolia					
Anthracite & semi-bituminous	.	...	...	4 664 900	5 228 000
Brown coal & lignite	(o) 6 865 000	(o) 7 517 100	(o) 8 074 100	4 572 700	4 843 900
Nepal					
Sub-bituminous (l)	10 459	9 259	11 963	16 374	13 845
Pakistan (m) (h)	3 325 408	3 367 021	3 880 604	3 702 162	4 066 000
Philippines					
Bituminous	2 484 239	2 878 625	2 300 341	3 401 136	3 609 316
Tajikistan	88 300	94 900	218 000	268 000	...
Thailand					
Lignite	20 059 845	20 878 176	19 070 608	18 239 176	18 095 335
Uzbekistan					
Bituminous	* 81 000	95 040	99 200	* 100 000	* 100 000
Lignite	* 2 700 000	3 072 960	2 720 000	* 2 700 000	* 3 000 000
Vietnam					
Anthracite	27 349 000	34 093 000	38 778 000	42 483 000	39 777 000
Australia					
Bituminous (n)	294 810 000	308 000 000	315 000 000	325 000 000	333 000 000
Brown coal (h)	66 343 000	67 152 000	67 737 000	65 613 000	66 033 000
New Zealand					
Bituminous	2 526 613	2 543 404	2 863 029	2 019 430	2 476 848
Sub-bituminous	2 389 352	2 477 312	2 653 516	2 555 830	2 179 081
Lignite	239 429	246 445	251 366	260 148	253 492
World Total	5 548 000 000	5 897 000 000	6 187 000 000	6 415 000 000	6 619 000 000

Note(s)

(1) There is no international agreement as to the separate definition of lignite and brown coal. In some cases they are distinguished. Elsewhere both may be aggregated under one or other term

(a) Previously included with Serbia
(b) Spitzbergen: not including production from mines controlled by Russia
(c) Including brown coal
(d) Excluding production in Kosovo
(e) Including anthracite
(f) Includes a small amount of refuse recovery
(g) Including beneficiated and directly shipped material
(h) Years ended 30 June of that stated
(i) Years ended 31 March following that stated
(k) Years ended 20 March following that stated
(l) Years ended 15 July of that shown
(m) Including lignite
(n) Including sub-bituminous
(o) Coal, all forms

COBALT

Characteristics

Cobalt is a lustrous, greyish-silver, brittle metal. It is also very hard and can take a high polish. It retains its strength at high temperatures and it has fairly low thermal and electrical conductivities. Cobalt is also ferromagnetic, and therefore is capable of being magnetised. Other properties that are important in industrial applications are its ability to form alloys with many other metals, where it imparts strength, and the ability to maintain its magnetic properties at high temperatures.

A wide range of minerals contain cobalt although many are rare or unique to individual localities. There are approximately 30 principal cobalt-bearing minerals and over a hundred more which contain minor amounts of the metal or include cobalt as a substitute for other elements. Cobalt can substitute for transition metals in many minerals and chemical compounds and is commonly found in the place of iron and nickel as they share many similar properties. Common cobalt-bearing minerals include erythrite ($Co_3(AsO_4)_2\,8H_2O$), skutterudite ($(Co,Ni)As_3$), cobaltite (CoAsS) and carrollite ($Cu(Co,Ni)_2S_4$).

Cobalt is almost always extracted as a by- or co-product of mining for other metals, chiefly nickel and copper. Economic concentrations of cobalt can be found in three different geological settings: sediment hosted, for example in the Central African Copperbelt, the world's most important cobalt resource; hydrothermal and volcanogenic, for example at Bou Azzer in Morocco, which hosts the only mine in the world where cobalt is produced as a primary product; and magmatic sulphide and related laterite deposits, for example nickel sulphide bodies in Cuba, New Caledonia, Australia and Russia.

Large quantities of cobalt also occur on the sea floor, contained within manganese nodules and cobalt-rich crusts, although these are not economically viable with current technology and economic conditions.

Uses

As pure metal, cobalt has a very limited range of uses, but it is extensively used as an alloying metal. It is valued for its ability to produce very hard superalloys with useful magnetic properties and resistance to high temperatures. Cobalt is used in the manufacture of chemical compounds for a wide range of industrial uses. Rechargeable batteries consume the largest proportion of cobalt in this sector. It is also used as a pigment in glass, enamels, pottery and china. The Cobalt Development Institute (CDI) estimates global end-use of primary cobalt to be: batteries 27 per cent, superalloys 19 per cent, hard materials 14 per cent, pigments 10 per cent, catalysts nine per cent, magnets seven per cent and high-speed steels four per cent.

World production in 2008

Cobalt is mined in 14 countries, mainly as a by-product of copper and nickel mining, and production (of both mined ore and refined metal) has doubled in ten years between 1999 and 2008. According to the CDI, in 2008, 50 per cent of the world's cobalt was extracted as a by-product of nickel mining. Morocco is currently the only producer of primary cobalt (from cobalt arsenide minerals). Total world mine production of cobalt in 2008 was approximately 65 000 tonnes (cobalt content of concentrates), five per cent more than in 2007. Over 45 per cent of the world's cobalt ore is mined in the Democratic Republic of Congo (DRC) where an estimated 31 000 tonnes were produced in 2008, 23 per cent more than in 2007. Canada, Australia and Brazil produce almost another third of world production between them, with Australian production rising by eight per cent in 2008 and Canadian production dropping by 0.6 per cent. Russia, which used to be the world's third largest producer, is now seventh, and continued a trend of large declines in production with a 30 per cent fall in output between 2007 and 2008.

Only about 75 per cent of total mine production is recovered as marketable product. Often the rate of cobalt recovery from nickel laterite ore is low and only a fraction of the total is recovered. However, this situation is changing due to advances in heap leaching and other processing technology. The rise in cobalt production during 2008 can in part be attributed to new technology allowing previously uneconomic laterite deposits to be exploited.

In 2008, total world production of refined cobalt was 56 100 tonnes, a six per cent increase on the 2007 total. One third of the world's refined cobalt comes from China where more refined cobalt metal than cobalt ore is produced. China has secured many life-of-mine or long-term contracts with cobalt producers in other countries (such as Australia and the DRC) to ship cobalt concentrates to China to ensure sufficient supply to their smelters. Refined cobalt production in Finland and Norway (combined) makes up a further quarter of world cobalt metal production, although neither country mines cobalt themselves. In 2008, 34 per cent of refined cobalt production was based on imported material processed by countries that do not mine cobalt ore.

Prices

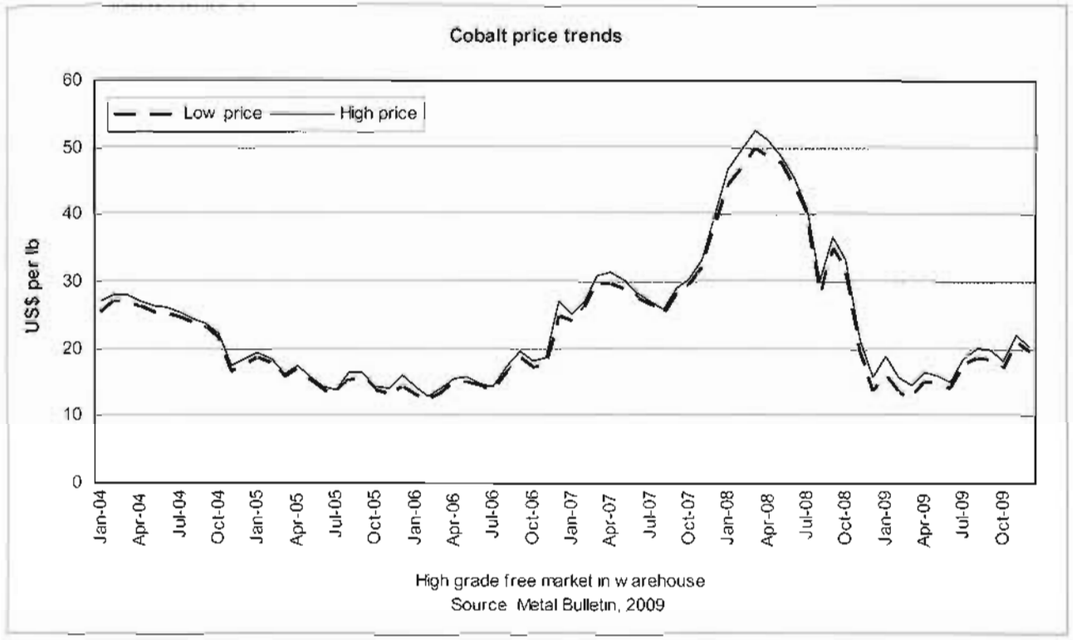
Cobalt prices have long been volatile and first surged but then dropped significantly during 2007 and 2008. Average prices in 2008 were 30 per cent higher than the previous year, despite the monthly average price for December 2008 having dropped by 60 per cent year-on-year to US$14.5 per pound. The price for high-grade cobalt peaked at over US$50 per pound in March 2008 (Metal Bulletin, 2009). The fall in prices which began in October 2008 was primarily in response to the global economic downturn. However, analysts had been predicting a drop in cobalt prices due to a surplus in supply from new mines. By December 2008 the low cobalt prices had forced closure of many uneconomic projects and mines.

During 2009 prices gradually increased driven by high demand, although they remained highly volatile due to continuing uncertainties in supply and demand for the metal. Supplies of cobalt ore continue to be strongly controlled by the situation in the DRC, where about half of the new projects due to come on stream within the next few years are located. A ban (now lifted) on exports of raw ore from Katanga province was also in place throughout 2008 in an attempt to add value to the ore in-country.

Prices of refined cobalt are strongly controlled by demand from the chemical sector, particularly for new applications, such as rechargeable batteries and as a catalyst in gas-to-liquid technology.

Industry events in 2009

The economic downturn during 2009 significantly affected the cobalt market. The Cobalt Development Institute reported a drop of 15 per cent for the production of cobalt in the first half of 2009 (CDI, 2009a). Several operations were affected by the



High grade free market in warehouse
Source Metal Bulletin, 2009

drop in both demand and price of the metal. Ravensthorpe nickel mine in Australia was closed in January 2009 after costing its owners, BHP Billiton, over US$2 billion; the mine is now to be sold to First Quantum Minerals Ltd for US$340 million (Regan & Thomas, 2009, Hinde 2009). BHP Billiton has also sold its Yabulu nickel-cobalt processing unit. Many nickel-cobalt operations have suffered in the recession due to the severe slump in the price of nickel. In particular the Avebury nickel mine, Tasmania, Australia, owned by OZ Minerals, which was mothballed in late 2008. Several copper-cobalt operations in central Africa were also mothballed or closed due to low copper prices. For example, Zambia's largest cobalt producer, Chambishi Metals, closed its furnace from December 2008 to November 2009 and, although it has subsequently reopened, it still operates at a reduced level due to low prices (Mfula & Jukwey, 2009).

Despite difficult economic conditions for cobalt during 2009, many projects continued to be developed. Sherritt International proceeded with the development of the Ambatovy nickel-cobalt laterite deposit, which it claims could be the world's largest laterite nickel mine by 2014 (Sherrit International Corporation, 2009). Talvivaara Mining continued work on the Talvivaara nickel-cobalt sulphide deposit and have reported good results from the company's bio-heap-leaching processing techniques; the mine is set to reach full production in 2010 (Talvivaara Mining Company, 2009). A high-grade cobalt deposit in Idaho, USA, also continued to be developed by Formation Capital Corporation. A bankable feasibility study has been completed and the project has been approved by the United States Forest Service, allowing construction of the mine to commence. Cobalt production is scheduled to begin in 2010 (Formation Metals, 2009, Northern Miner 2009). Geovic Mining Corp worked towards its goal of becoming the world's largest cobalt mining company by developing the Nakmouna cobalt-nickel-manganese deposit in Cameroon. During 2009, work on the licence area was delayed due to weak commodity and credit markets but pilot processing tests were undertaken and work continued to complete a feasibility study (Geovic Mining Corp, 2009). Further work was also carried out on several nickel-cobalt laterite deposits in the Philippines and Papua New Guinea.

Several large cobalt production operations that were due to come on stream in the DRC during 2009 have run into problems due to a review of mining contracts in the country. Consequently, the licence held by First Quantum for the Kolwezi tailings project was suspended with the Ministry of Mines claiming that First Quantum had failed to meets its contractual obligations to complete the construction of the tailings processing facility by the end of 2009. The operation, which was to work old copper tailings for cobalt and, according to First Quantum, was to be one of the largest and lowest-cost producers of cobalt in the world. Kolwezi has now been sealed off by the government and First Quantum is involved in international arbitration proceedings (Mining Journal, 2009).

The giant Tenke Fungurume project has also run into difficulties. This new copper-cobalt mine, which began mining in March 2009, is one of the last remaining contracts to be finalised by the DRC's review process. The original deadline of October 12, by which date the mine owners, Freeport McMoRan and Lundin Mining, were supposed to have completed their negotiations with the government, has long since past with no resolution in sight. If the review process is not finished by the end of the first quarter of 2010 it will severely disrupt the mine's development (French & Galloway, 2009).

One of the fastest growing uses for cobalt, lithium ion battery production, continued to rapidly grow during 2009. Nissan announced plans to build the first European lithium ion battery manufacturing facility in the UK and another in Portugal. The USA and Japan have also both recently seen large ramp-ups in lithium ion battery production capacity which could lead to increased demand for cobalt (CDI, 2009b).

The London Metal Exchange has pushed ahead its plans to launch trading in cobalt futures due to industry demand for the metal. Originally due to be launched in mid 2009, the LME has postponed this until February 2010 (LME, 2009).

Reductions in global cobalt stockpiles have been reported during 2009. Stockpiles held by the USA are reported to be 310 tonnes as of August 2009 (Shed, 2009). The CDI also reported that Russia is reducing its stockpile but, with the rise in the consumption of raw materials, a number of other nations are reviewing their position on cobalt stockpiling (Weight, 2009).

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Mine production of cobalt

tonnes (metal content)

Country	2004	2005	2006	2007	2008
Russia (a)	4 527	4 748	4 759	3 587	2 502
Botswana	223	326	303	242	337
Congo, Democratic Republic	* 20 200	* 24 500	* 27 100	25 300	31 000
Morocco	1 600	1 600	* 1 100	1 290	1 257
South Africa (a)	309	268	267	307	244
Zambia	5 791	5 422	4 648	4 229	3 841
Zimbabwe	59	275	26	29	28
Canada	5 060	5 767	7 115	8 692	8 644
Cuba	3 554	3 768	4 150	3 977	3 428
Brazil	4 300	* 4 300	* 4 300	* 4 300	* 4 300
China	1 253	2 104	1 840	* 2 000	* 2 000
Indonesia	* 650	* 650	* 650	* 650	* 650
Australia (b)	2 004	5 198	* 5 736	* 5 325	* 5 770
New Caledonia	2 726	1 769	1 629	1 620	869
World Total	52 000	61 000	64 000	62 000	65 000

Note(s)
(1) There is frequently a considerable disparity between the cobalt content of ore raised and cobalt actually recovered
(2) Figures in this table relate where possible to cobalt recovered. The principal exceptions to this are Brazil and New Caledonia, the figures for which relate to cobalt in ore raised

(a) Metal
(b) Years ended 30 June of that stated

Production of cobalt metal

tonnes

Country	2004	2005	2006	2007	2008
Belgium (a)	2 947	3 298	2 840	2 825	3 020
Finland	7 893	8 171	8 582	9 173	9 645
Norway	4 670	5 021	4 927	3 939	3 719
Russia	4 524	4 748	4 759	3 587	2 502
Congo, Democratic Republic (b)	735	600	550	608	300
Morocco	1 593	1 613	1 405	1 573	1 791
South Africa (c)	329	268	267	307	244
Uganda	459	638	689	636	662
Zambia	5 791	5 422	4 665	4 435	3 841
Canada (d)	5 144	5 090	5 180	5 620	5 605
Brazil	1 155	1 136	902	1 148	994
China (a)	* 8 000	* 12 700	* 12 700	13 245	18 239
India	545	1 220	1 184	980	858
Japan	421	471	920	1 085	1 071
Australia	3 879	3 150	3 696	3 684	3 617
World Total	48 100	53 500	53 300	52 800	56 100

Note(s)
(1) In addition to the production listed above, several countries, including the United Kingdom, Finland and France, are known to produce substantial amounts of cobalt compounds

(a) Some metal production in China is recorded in Belgium
(b) Excludes white alloy and matte which are believed to be further processed in Belgium and elsewhere
(c) Includes metal and metal contained in sulphate
(d) Including oxides

COPPER

Characteristics

Copper is a reddish, malleable and ductile metal valued for its excellent thermal and electrical conductive properties and its resistance to corrosion. Copper combines with a number of elements to form a wide variety of copper minerals and ores. More than 150 copper-bearing minerals have been identified, although only a small number of these, chief of which is chalcopyrite ($CuFeS_2$), are of economic importance.

The upper parts of orebodies often also contain 'oxide' ore minerals such as malachite and chrysocolla. These are underlain by a layer of 'sulphide enrichment' characterised by the sulphide mineral, chalcocite. Types of copper orebody include: porphyry deposits, typical of North and South America, where disseminated copper minerals are associated with igneous intrusions; stratabound orebodies, where the copper occurs in sedimentary rocks; and volcanic-hosted massive sulphide (VMS) deposits, in which copper is associated with other base metal sulphides such as lead and zinc. The largest reserves are in Chile (160 million tonnes), Peru (60 million tonnes), Mexico (38 million tonnes), Indonesia (36 million tonnes) and USA (35 million tonnes) (USGS, 2009).

Uses

The ability to conduct electricity and heat are two of the most important properties of copper, since about 40 per cent (in Europe) of all copper produced is used in electrical and electronic applications (International Copper Study Group, 2007). When alloyed with other metals it acquires additional properties including increased hardness, tensile strength, and improved corrosion resistance. Brass and bronze are two of the most important alloys of copper. Copper's malleability and ease of use in machines during the fabrication process allows for a high production rate of accurate copper shapes for a relatively lower cost than that of its substitutes. Copper is a major industrial metal, ranking third after iron and aluminium in terms of quantity consumed.

Statistics for the final applications of copper products vary widely: in the USA the dominant sector is 'construction' (50 per cent), in Europe it is 'transport' (41 per cent) and in Asia 'electrical' (33 per cent) (International Copper Study Group, 2007). These differences are at least partly caused by differing statistical methodologies. The chief immediate use of copper is in electrical circuits, wiring and cables, regardless of the final application. Copper is used in many forms in buildings including wire, plumbing pipes and fittings, electrical outlets, switches, and locks. Construction of an average modern house requires at least 200 kilograms of copper metal. Copper roofing is highly rated for its corrosion resistance and architectural characteristics. Copper is the best electrical conductor after silver and is widely used in the production of energy efficient power circuits. Copper wire is extensively used in telecommunications and is essential for computer networks.

World production in 2008

Copper is produced in about fifty countries. Nine countries account for about 80 per cent of world mine production. Each of these nine countries produces over 500 000 tonnes of copper per year. Of these countries the USA, Peru, China, Russia, Indonesia, Canada and Zambia all produced more mined copper in 2008 than in 2007.

In the last 20 years, copper production has almost doubled from 8.8 million tonnes in 1988 to more than 15 million tonnes in 2008. This sustained rise can be attributed to the steady increase in copper demand from growing economies around the world. The proportion of copper mined in South America has increased from about a quarter to nearly a half of total world production. This is largely due to an increase in production from Chile, from 17 per cent of world production in 1988 to 34 per cent in 2008. Total production from North and Central America has not increased significantly, despite a significant rise in Mexican output. The contribution from Asia has been increasing and Africa's copper production has also risen in recent years driven by Zambia and the Democratic Republic of Congo (DRC). Zambia's mine production has increased by 87 per cent from 307 834 tonnes in 2002 to 575 000 tonnes in 2008. The DRC copper production has risen rapidly during the last five years as stability returned to the country, following five years of war. DRC, which has the potential to become a major copper producer, increased copper production from 28 000 tonnes in 2002 to 229 000 tonnes in 2008

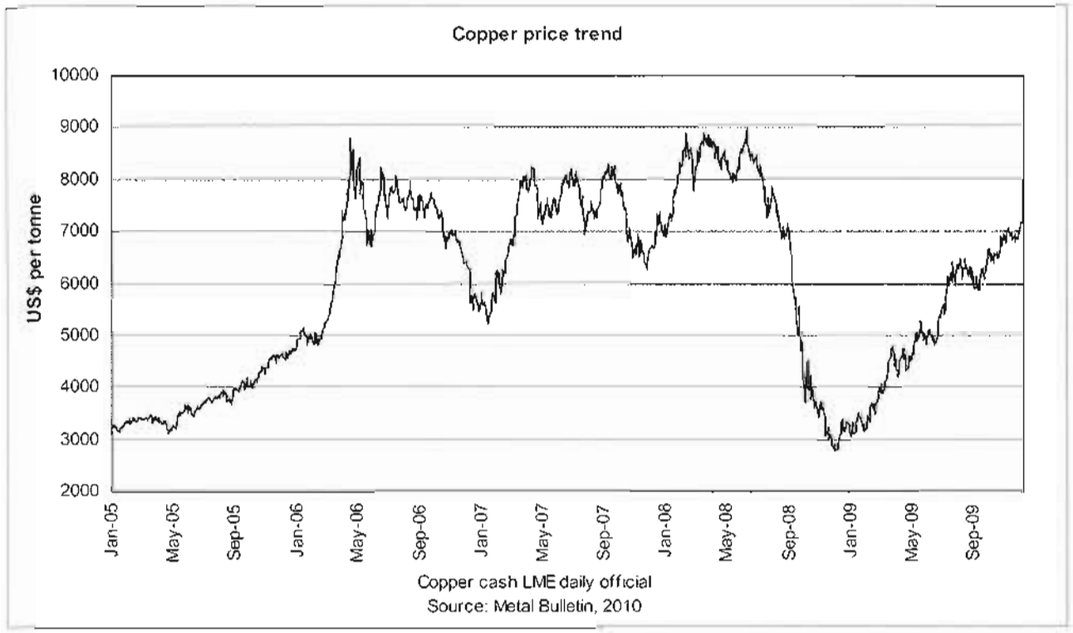
Copper mine production depends on a relatively small number of large production units. It is therefore vulnerable to disruptions caused by strikes, natural disasters and concerns over supplies of energy and water. Improved mining and extraction techniques now allow copper from low grade ores, which were previously considered as waste, to be extracted using chemical and bio-leaching techniques. However, in many cases the leach cycle may be measured in years, resulting in a considerable lag time in copper metal production by these methods.

Total world copper mine production in 2008 was 15.5 million tonnes. Chile is the largest copper-producing country, with an output of 5.3 million tonnes in 2008. Total world production of smelter copper was 12.5 million tonnes in 2008, with Asia contributing 49 per cent to the world's total. During the last 10–15 years mine production statistics have become decoupled from total smelter production, whereas prior to 1990 the two correlated closely. This divergence is explained by the increasing use of chemical extraction techniques which compete with conventional smelter production. Total world refined copper production was 18 million tonnes in 2008, from 45 countries. Copper produced from leaching of ores accounted for 17 per cent of refined copper production in 2008 (International Copper Study Group, 2009). The difference between mine and refinery production is attributed to the contribution of secondary refined (scrap) copper to the total. Recycling of old scrap provides about 35 per cent of annual copper consumption (International Copper Study Group, 2009).

Prices

The price paid for copper on the metal exchanges primarily reflects global balances of copper supply and demand, but may be significantly affected by speculative activity, currency exchange rates and market news. Copper demand and price typically reflect global economic cycles, and as a result the copper price has historically experienced major fluctuations. All copper prices quoted are based on the London Metal Exchange (LME) cash daily official price, in US dollars per tonne, as quoted by Metal Bulletin (2010).

Following the all-time record high copper price of US$8985 per tonne attained in July 2008, prices declined sharply over the remainder of the year in response to the



deteriorating global economic climate. By December prices had fallen below US$3000 per tonne, the lowest price since September 2004 and a fall of around 69 per cent from the July 2008 peak.

Copper prices began to recover during January 2009 in anticipation that the US government economic rescue package, including major infrastructure projects could stimulate demand for industrial metals (Metal Markets, 2009a). Prices fluctuated but generally trended upwards during February as stockpiles reduced in Asia, suggesting stronger demand from China (Metal Markets, 2009b). Gains were also supported by apparent improving demand for industrial metals. Prices in March were sustained by declining warehouse inventories and an announcement from the Chinese Central Bank that the economy was possibly stabilising (Metal Markets, 2009c). Towards the end of March copper prices increased with news of greater imports of refined copper into China during February and plans to relieve US banks of toxic assets (Metal Markets, 2009d).

Copper prices continued to increase during April in anticipation of greater demand for metals from China as a result of a possible economic stimulus package (Metal Markets, 2009e). During the second half of April prices declined in response to slowing Chinese economic growth, negative US unemployment and housing figures, strengthening of the US dollar and fears over the impact of swine flu on the global economy (Metal Markets, 2009f,g). Prices fluctuated during May, reacting to Chinese manufacturing figures and news of US retail sales (Metal Markets, 2009h). Copper prices during the second of half of May generally increased as the US dollar weakened, LME warehouse inventories declined and positive economic news pushed prices higher (Metal Markets, 2009i,j). Copper prices fluctuated during June largely reflecting variation in the strength of the US dollar and warehouse inventories.

During early July copper prices declined on news of US and European unemployment figures and predictions that copper demand would fall during 2009 (Metal Markets, 2009k).

During the remainder of July prices increased approaching US$6000 per tonne as the US dollar strengthened and equity markets improved. News of increased Chinese demand during June and production problems at the Colalhuasi Mine in Chile also drove copper prices upwards (Metal Markets, 2009l). Prices during August fluctuated but generally increased exceeding US$6000 per tonne on news of rises in French and German GDP and increasing US house sales (Metal Markets, 2009m). During September prices were generally on a downward trend, reflecting demand concerns, as LME inventories reached their highest level in four months (Metal Markets, 2009n).

Copper prices started below US$6000 per tonne in October, but began to rise as the US dollar weakened and news of possible strike action in Chile reached markets. News of higher than expected Chinese copper imports during September and reduced output caused by strikes at copper mines in Chile and Peru sent prices above US$6500 per tonne (Metal Markets, 2009o). Prices continued to increase during November reaching a 14-month high and exceeding US$6900 per tonne as the US dollar weakened boosting investment demand. Potential strike action in Chile, positive retail data from China and the US and the strength of the US dollar influenced the copper price during the first half of December (Metal Markets, 2009p). By the end of December copper prices had reached a 16-month high, trading above US$7300 per tonne in response to a favourable investment outlook for 2010 and threats of strike action at the Chuquicamata Mine in Chile. Although copper prices increased significantly during 2009, the average annual price was approximately US$5200 per tonne, around 25 per cent lower than during 2008.

Industry events in 2009

A significant factor influencing the sharp rise in copper prices during 2009 was increased imports of refined copper to China. Increased Chinese demand for copper is attributed to a number of factors including the country's economic stimulus programme, strategic stockpiling of copper and reduced scrap

availability (Lampard, 2009). Closure of mine capacity during the second half of 2008, as copper demand declined and prices plummeted, also supported prices during 2009.

Mine capacity cutbacks continued into 2009. Notably, BHP Billtion announced that its Pinto Valley operation in Arizona would be placed on care and maintainace (BHP Billiton, 2009). A number of other companies froze investments or announced capacity cutbacks during 2009. Grupo Mexico announced that it is shutting its Cananea Mine in Mexico where miners have been on strike since 2007 and have caused extensive damage to the site (Randewich and Campbell, 2009). Production at Escondida, in Chile, the world's largest copper mine, fell by 21 per cent during the first nine months of 2009 as a result of lower ore grades and mill problems (Egan, 2009). Labour disputes in South America affected the copper market during 2009. In October BHP Billiton announced a force majeure on copper supplies from its Olympic Dam Mine, due to damage to the main haulage shaft (Regan, 2009). A 42-day strike at BHP Billiton's Spence Mine in Chile resulted in more than 20 000 tonnes of lost copper production (Gardner, 2009). Strike action also threatened to spread to other mines owned by the company.

Despite the uncertain economic conditions a number of new mines and expansions added to capacity during 2009. The Lumwana Mine in Zambia, which started production at the end of 2008, continued to ramp up production during 2009. Initial production results were considerably lower than expected due to equipment availability difficulties and lower metal recovery from mixed sulphide-oxide ore (Equinox Minerals Ltd, 2009). OZ Minerals' Prominent Hill Mine in Australia was commissioned during 2009. Production during 2009 was expected to be between 85 000–100 000 tonnes of copper (OZ Minerals, 2009).

The Tenke-Fungurume copper-cobalt mine in the Democratic Republic of Congo produced its first copper cathode in March 2009. Freeport-McMoran Copper & Gold Inc. which owns the operation expects production to reach full annual capacity of 115 000 tonnes of copper in the second half of 2009 (Freeport-McMoran, 2009). A long-awaited investment agreement has been approved between the Mongolian Government, Ivanhoe Mines and Rio Tinto to develop the world-class Oyu Tolgoi copper-gold deposit. Production is expected to commence in 2013. Once the operation reaches full production the mine is expected to produce 450 000 tonnes of copper annually (Rio Tinto, 2009).

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Mine production of copper

tonnes (metal content)

Country	2004	2005	2006	2007	2008
Albania	642	1 696	400	1 300	* 1 000
Armenia	17 700	16 400	17 800	17 400	18 540
Bulgaria	79 600	82 700	99 000	99 000	93 000
Cyprus	—	—	900	2 900	3 000
Finland	15 500	15 000	13 000	13 600	13 300
Georgia	* 12 000	* 6 000	14 600	11 000	18 700
Macedonia	—	4 799	7 054	7 029	8 051
Poland	530 768	511 799	497 200	451 900	429 400
Portugal	95 700	89 541	78 576	90 182	89 026
Romania	20 380	16 286	12 535	2 213	308
Russia	630 000	640 000	675 000	690 000	705 000
Serbia	—	—	11 100	16 500	17 600
Serbia and Montenegro	13 800	11 600	—	—	—
Spain	1 308	7 358	8 700	6 281	7 071
Sweden	82 415	87 068	86 746	62 905	57 688
Turkey	49 800	54 100	46 400	81 400	83 300
Botswana	21 195	26 704	24 255	19 996	23 146
Congo, Democratic Republic	69 600	98 000	131 400	148 000	229 000
Mauritania	.	..	5 031	28 755	33 600
Morocco	2 900	3 200	4 600	4 774	5 055
Namibia	11 174	10 157	6 262	5 800	8 800
South Africa	85 710	85 000	89 700	97 000	* 110 000
Tanzania	4 240	3 661	3 285	3 276	2 500
Zambia	410 300	465 002	515 618	523 435	575 000
Zimbabwe	2 383	2 570	2 581	2 700	2 800
Canada	562 795	595 383	603 295	596 249	606 999
Mexico	405 539	429 042	334 129	337 527	246 593
USA	1 160 000	1 140 000	1 197 000	1 169 000	1 310 000
Argentina	177 143	187 317	180 144	180 223	156 900
Brazil	103 153	133 325	147 836	205 728	216 000
Chile	5 412 500	5 320 500	5 360 800	5 557 000	5 330 300
Colombia	1 600	1 800	600	840	1 100
Peru	1 035 574	1 009 898	1 048 472	1 190 274	1 267 867
Burma	31 800	34 500	19 500	15 100	6 900
China	754 200	776 000	889 000	946 400	1 022 500
India (a)	30 072	28 602	34 120	36 293	31 073
Indonesia	840 318	1 063 849	817 796	796 899	655 046
Iran	153 000	149 900	216 200	249 100	242 400
Japan	1 000	* 1 000	* 300	—	—
Kazakhstan	461 800	401 700	446 300	406 500	421 700
Korea, Dem P R of	* 12 000	* 12 000	* 12 000	* 12 000	* 12 000
Laos	1 700	30 480	60 803	62 541	89 004
Mongolia	129 990	126 560	129 675	130 165	126 980
Oman	—	—	—	9 100	16 800
Pakistan	14 700	17 700	18 700	18 800	18 700
Philippines	15 984	16 320	17 161	22 862	21 235
Saudi Arabia	652	668	730	737	1 465
Uzbekistan	* 80 000	* 80 000	* 80 000	* 80 000	* 80 000
Vietnam	2 000	3 100	11 400	12 500	6 000
Australia	854 000	935 000	878 000	871 000	886 000
Papua New Guinea	173 370	192 978	194 355	169 184	159 650
World Total	14 600 000	14 900 000	15 100 000	15 500 000	15 500 000

Note(s)
(a) Years ended 31 March following that stated

Smelter production of copper

tonnes

Country	2004	2005	2006	2007	2008
Armenia	9 470	9 881	8 791	6 954	6 480
Bulgaria	215 800	225 000	217 000	217 600	257 100
Finland	151 647	157 933	164 306	118 911	142 154
Germany	278 600	257 200	273 800	275 300	295 000
Norway	35 643	38 681	39 700	34 200	37 000
Poland	547 228	555 681	555 907	518 303	492 942
Romania	61	—	—	—	—
Russia	661 900	695 500	635 000	650 000	627 000
Serbia	—	—	40 000	30 200	31 900
Serbia and Montenegro	13 900	30 000	—	—	—
Slovakia	...	...	—	20 485	27 337
Spain	224 249	284 215	263 662	257 348	259 897
Sweden	174 459	168 763	129 951	148 835	136 409
Turkey	34 700	27 700	26 300	17 900	38 000
Botswana	21 200	28 100	29 700	13 400	10 900
Congo, Democratic Republic (a)	20 000	10 000	10 000	1 800	800
Namibia	24 704	21 699	21 918	20 600	19 500
South Africa	89 300	105 500	98 900	111 900	94 800
Zambia (a)	280 100	244 800	289 700	224 000	232 000
Canada	446 209	441 325	484 675	470 713	443 789
Mexico	298 702	340 462	298 526	294 746	230 056
USA	542 100	523 000	501 000	620 600	571 700
Brazil	208 020	199 043	219 684	218 000	227 800
Chile	1 517 600	1 558 100	1 565 400	1 514 300	1 369 200
Peru	320 135	321 968	322 188	236 809	306 583
China	1 502 900	1 751 500	1 917 500	2 111 500	2 507 000
India	399 600	482 300	609 600	699 900	651 000
Indonesia	211 600	275 000	201 200	277 000	254 000
Iran	134 100	170 200	177 500	180 300	179 600
Japan	1 220 448	1 266 432	1 361 771	1 383 372	1 335 846
Kazakhstan	444 537	404 817	424 784	392 834	392 575
Korea, Dem. P.R. of	* 10 000	* 10 000	* 10 000	* 10 000	* 10 000
Korea, Republic of	392 500	436 600	449 200	475 000	500 100
Oman	17 100	24 500	20 710	13 940	11 906
Pakistan	13 000	18 600	23 600	18 200	17 800
Philippines	217 300	201 300	239 600	219 900	239 700
Thailand	17 700	28 600	1 000	5 600	—
Uzbekistan	103 400	115 000	93 000	90 200	90 100
Vietnam	—	—	—	—	2 200
Australia	443 000	410 000	377 000	399 000	449 000
World Total	11 200 000	11 800 000	12 100 000	12 300 000	12 500 000

Note(s)

(1) This table shows primary metal in the form of blister and anode produced from concentrates, and may include copper produced from scrap but this is excluded when it can be separately identified

(a) Including leach cathodes

Production of refined copper

tonnes

Country	2004	2005	2006	2007	2008
Austria	74 200	72 300	72 600	81 400	106 700
Belgium	383 000	382 900	378 600	394 000	395 800
Bulgaria	55 300	60 100	65 600	70 000	126 700
Cyprus	1 344	—	880	3 012	2 986
Finland	132 384	132 126	137 961	109 870	131 249
Germany	652 600	638 800	662 338	665 517	689 763
Italy	33 600	32 200	36 400	28 600	24 200
Norway	35 643	38 681	39 700	34 200	37 000
Poland	550 066	560 256	556 625	532 975	526 808
Romania	24 526	20 739	21 583	18 289	14 120
Russia	919 000	934 900	943 200	949 000	862 000
Serbia	—	—	41 400	31 600	33 800
Serbia and Montenegro	11 998	31 300	—	—	—
Spain	228 466	313 105	299 146	308 372	319 050
Sweden	235 620	223 482	229 241	213 894	227 774
Turkey	63 800	94 900	105 800	99 600	89 100
Ukraine	5 500	13 600	17 300	19 500	21 700
Congo, Democratic Republic	20 000	20 000	24 200	32 800	63 700
Egypt	* 16 000	18 469	* 18 000	* 18 000	* 18 000
South Africa	87 300	98 600	100 300	110 700	92 900
Zambia	409 500	445 600	497 200	523 400	575 000
Zimbabwe	5 800	6 000	6 700	6 000	3 100
Canada	526 955	515 223	500 463	453 453	442 138
Mexico	333 700	377 500	303 626	329 746	265 056
USA	1 306 000	1 255 000	1 250 300	1 310 800	1 267 100
Argentina	* 16 000	* 16 000	* 16 000	* 16 000	* 16 000
Brazil	208 020	199 043	219 684	218 000	227 800
Chile	2 836 700	2 824 000	2 811 300	2 936 500	3 060 300
Peru	505 306	510 392	507 710	413 907	463 933
Burma	31 800	34 500	19 500	15 100	6 900
China	2 198 700	2 606 800	3 002 100	3 499 400	3 779 300
India (a)	413 354	529 248	510 623	501 485	323 000
Indonesia	210 500	262 900	217 600	256 900	253 400
Iran	152 500	178 000	200 900	204 100	210 000
Japan	1 380 144	1 395 284	1 532 055	1 576 818	1 539 957
Kazakhstan	445 792	418 865	429 729	408 026	400 270
Korea, Dem. P.R. of	* 15 000	* 15 000	* 15 000	* 15 000	* 15 000
Korea, Republic of	495 952	526 563	561 500	566 400	514 243
Laos	—	30 480	60 803	62 541	64 075
Mongolia	2 376	2 475	2 618	3 007	2 587
Oman	15 090	24 500	20 710	13 940	11 906
Philippines	174 600	172 000	181 000	160 200	174 600
Thailand	20 000	26 100	27 050	12 714	438
Uzbekistan	103 800	115 000	92 800	89 600	* 90 000
Vietnam	—	—	—	—	2 200
Australia	498 000	469 000	429 000	442 000	503 000
World Total	15 800 000	16 600 000	17 200 000	17 800 000	18 000 000

Note(s)

(1) Figures relate to both primary and secondary refined copper, whether electrolytic or fire refined. Metal recovered from secondary materials by remelting alone is excluded

(2) In addition to the countries listed, Albania and Colombia produce refined copper

(a) Years ended 31 March following that stated

Production of diamond

carats

Country	2004	2005	2006	2007	2008
Russia	38 865 770	38 000 990	38 360 810	38 291 200	36 925 150
Angola	6 146 361	7 079 121	9 175 061	9 701 709	8 906 974
Botswana	31 125 000	31 889 771	34 293 401	33 639 000	32 595 000
Cameroon (a)	12 000	* 12 000	* 12 000	* 12 000	* 12 000
Central African Republic	354 703	382 756	419 528	467 711	377 209
Congo, Democratic Republic	30 040 479	33 054 998	28 990 241	28 452 496	33 401 928
Ghana	905 344	1 065 923	959 405	839 235	598 042
Guinea	739 784	548 522	473 862	1 018 723	3 098 490
Ivory Coast	* 300 000	* 300 000	* 300 000	* 300 000	* 300 000
Lesotho	26 607	52 036	231 325	229 077	253 054
Liberia	11 000	11 000	11 000	21 699	46 963
Namibia	2 003 868	1 902 484	2 356 285	2 266 100	2 435 195
Sierra Leone	693 104	668 807	582 324	603 698	371 290
South Africa	14 294 662	15 775 720	15 152 801	15 247 122	12 901 018
Tanzania	303 920	219 640	272 204	282 786	235 654
Togo	123 106	11 773	25 368	13 452	8 787
Zimbabwe	44 454	243 928	1 046 025	695 016	797 198
Canada	12 618 080	12 314 000	13 233 813	17 007 850	14 802 699
Brazil	* 300 000	207 836	181 350	182 031	* 150 000
Guyana	454 940	356 948	340 544	268 925	168 926
Venezuela	40 036	55 154	27 598	14 502	9 381
China	* 1 060 000	* 1 060 000	* 1 065 000	* 1 070 000	* 1 070 000
India (b)	78 315	44 170	2 180	586	498
Indonesia	* 30 000	21 606	46 856	22 980	27 688
Australia	20 620 000	30 678 000	29 308 000	19 231 000	15 670 000
World Total	161 200 000	176 000 000	176 900 000	169 900 000	165 200 000

Note(s)
(1) This table does not show production of synthetic diamond
(2) So far as possible the amounts shown include estimates for illegal production

(a) Including artisanal production
(b) Years ended 31 March following that stated

Production of diatomite

tonnes

Country	2004	2005	2006	2007	2008
Commonwealth of Independent States (b)	* 80 000	* 80 000	* 80 000	* 80 000	* 80 000
Czech Republic	3 800	4 100	4 827	3 600	4 100
Denmark					
Moler (a)	188 000	209 000	196 000	201 000	210 000
France	* 75 000	* 75 000	* 75 000	* 75 000	* 75 000
Hungary	1 640	2 190	495	1 424	—
Iceland	20 625	—	—	—	—
Poland	800	500	600	* 600	* 600
Romania	20 626	1 402	1 719	2 057	—
Spain (c)	33 799	39 101	52 123	45 480	46 192
Algeria	2 665	1 814	1 800	1 902	1 677
Ethiopia	2 000	420	—	—	—
Kenya	330	243	185	201	72
Mozambique	.	.	..	651	379
Costa Rica	27 000	27 000	26 000	25 000	24 000
Mexico	59 818	62 132	62 948	82 519	128 536
USA (d)	620 000	653 000	799 000	687 000	* 653 000
Argentina	8 180	34 045	38 543	49 604	* 50 000
Brazil	7 200	7 670	8 968	5 555	...
Chile	30 015	27 091	19 104	25 405	25 497
Colombia	* 4 000	* 4 000	* 4 000	* 4 000	* 40 000
Peru	* 35 000	* 35 000	* 35 000	21 603	12 200
China	370 000	400 000	* 420 000	* 420 000	* 440 000
Iran (e)	1 000	1 450	13 400	300	...
Japan	126 255	130 005	* 130 000	* 120 000	* 115 000
Korea, Republic of	2 441	2 193	3 460	2 360	2 540
Saudi Arabia	* 1 000	* 1 000	* 1 000	* 1 000	* 1 000
Thailand	1 372	990	1 344	1 260	4 075
Vietnam	* 10 000	* 10 000	* 10 000	* 10 000	* 10 000
Australia (f)	34 571	33 827	* 34 000	* 34 000	* 33 000
World Total	1 767 000	1 843 000	2 020 000	1 902 000	1 962 000

Note(s)
(1) In addition to the countries listed, Egypt and Turkey are believed to produce diatomite

(a) Moler is an impure diatomite containing a large proportion of clay
(b) Diatomite is produced in Armenia, Georgia and Russia but information is not available to provide estimates for individual countries
(c) Including Tripoli
(d) Sold or used by producers
(e) Years ended 20 March following that stated
(f) Years ended 30 June of that stated

Production of feldspar

tonnes

Country	2004	2005	2006	2007	2008
Bulgaria	86 608	72 867	93 091	* 90 000	* 90 000
Czech Republic	488 000	472 000	487 000	514 000	488 000
Finland	44 495	42 783	43 187	48 980	45 250
France	628 000	651 000	* 650 000	* 650 000	* 650 000
Germany	182 842	168 640	167 332	171 303	161 416
Greece	88 274	100 586	* 100 000	95 000	82 000
Italy	3 251 264	3 995 233	4 600 903	4 726 908	* 5 000 000

Production of feldspar

tonnes

Country	2004	2005	2006	2007	2008
Macedonia	22 921	27 076	38 124	32 814	28 920
Norway	67 000	* 67 000	65 000	65 000	62 000
Poland	373 459	426 914	457 600	501 800	* 545 000
Portugal	221 312	238 843	257 570	371 952	* 370 000
Romania	60 924	74 927	33 100	41 477	22 995
Russia	156 391	* 160 000	* 160 000	* 160 000	* 160 000
Serbia	—	—	* 3 500	* 3 500	* 3 500
Serbia and Montenegro	* 3 500	* 3 500	—	—	—
Spain	552 507	650 061	696 912	682 884	* 632 120
Sweden	38 000	30 000	24 000	25 000	22 000
Turkey	4 600 000	4 750 000	5 500 000	6 000 000	* 6 000 000
Ukraine	48 800	63 930	67 313	76 305	83 420
United Kingdom (a)	2 274	1 835	1 441	1 112	430
Algeria	.	43 872	65 615	83 208	115 938
Egypt	178 249	357 134	* 360 000	135 290	168 673
Ethiopia	445	544	500	566	523
Morocco	26 800	* 31 000	* 34 000	37 955	30 080
South Africa	53 721	56 574	76 722	90 312	105 815
Zimbabwe	79	—	—	—	—
Cuba	10 515	8 020	5 500	5 600	4 300
Guatemala	4 473	3 808	17 176	10 480	45 854
Mexico	364 166	373 411	459 209	438 696	445 519
USA	770 000	750 000	760 000	730 000	* 600 000
Argentina	125 684	151 307	170 728	291 562	* 300 000
Brazil	280 293	196 419	166 418	182 168	* 190 000
Chile	4 838	5 820	5 847	6 704	17 834
Colombia	* 100 000	* 100 000	* 100 000	* 100 000	* 100 000
Ecuador	53 469	38 249	67 844	68 000	* 70 000
Peru	6 005	9 038	9 287	15 450	13 333
Uruguay	1 950	2 150	2 470	2 050	* 2 000
Venezuela	175 864	202 000	* 200 000	* 200 000	* 200 000
Burma	* 10 000	* 10 000	* 10 000	* 10 000	* 10 000
China	2 300 000	2 300 000	* 2 350 000	* 2 400 000	* 2 400 000
India (c)	379 055	426 498	479 715	410 926	373 924
Indonesia	* 24 000	* 24 000	* 25 000	* 25 000	* 25 000
Iran (d)	248 710	286 033	411 807	512 261	.
Japan (e)	* 889 000	* 800 000	* 800 000	* 750 000	* 750 000
Jordan	13 063	1 000	11 054	9 800	2 950
Korea, Republic of	541 788	508 644	427 378	398 513	344 257
Malaysia	79 220	117 180	142 358	358 585	457 377
Pakistan (b)	30 373	25 032	22 435	26 120	19 000
Philippines	32 106	11 853	15 176	14 837	15 838
Saudi Arabia	37 400	42 587	46 700	46 200	* 46 000
Sri Lanka	38 600	45 492	56 864	46 583	55 212
Taiwan	900	—	—	—	4 379
Thailand	1 001 053	1 149 717	1 067 684	684 668	670 618
Uzbekistan	* 4 300	* 4 300	* 4 300	* 4 300	* 4 300
Vietnam	* 180 000	* 200 000	* 200 000	* 200 000	* 200 000
Australia (b)	108 073	95 362	* 100 000	* 105 000	* 102 000
World Total	18 991 000	20 374 000	22 118 000	22 659 000	22 830 000

Note(s)
(1) In addition to the countries listed, Slovakia is believed to produce feldspar

(a) China stone
(b) Years ended 30 June of that stated
(c) Years ended 31 March following that stated
(d) Years ended 20 March following that stated
(e) Including weathered granite feldspar

Production of fluorspar

tonnes

Country	2004	2005	2006	2007	2008
France	70 000	53 000	* 40 000	—	—
Germany	33 203	35 364	53 009	54 359	48 519
Italy	24 339	70 326	* 15 000	—	—
Romania	* 15 000	—	—	—	—
Russia	226 400	245 500	* 210 000	* 180 000	* 269 000
Spain	145 694	144 126	144 845	156 970	148 207
Turkey	880	—	—	—	—
United Kingdom	50 080	56 417	49 676	44 936	36 801
Egypt	891	549	* 550	* 500	470
Kenya (a)	117 986	109 594	132 030	85 115	130 100
Morocco	107 200	114 700	103 300	78 817	56 724
Namibia	104 785	114 886	132 249	118 766	* 118 000
South Africa	264 900	265 600	270 000	* 295 000	* 295 000
Mexico	842 698	875 450	936 433	933 361	1 057 649
Argentina	6 189	7 502	8 278	9 735	* 10 000
Brazil (b)	57 772	66 512	63 604	65 526	63 573
China	2 500 000	2 700 000	3 000 000	3 200 000	3 250 000
India (c)	14 008	5 577	2 053	3 502	2 201
Iran (d)	41 220	64 601	58 871	68 192	* 68 000
Kazakhstan	* 4 000	4 750	* 30 000	64 000	66 300
Korea, Dem. P.R. of	* 12 000	* 12 500	* 12 500	* 12 500	* 12 500
Kyrgyzstan	* 4 000	* 4 000	* 4 000	* 4 000	* 4 000
Mongolia	354 900	367 500	377 000	376 800	* 387 900
Pakistan (e)	1 026	* 1 040	2 839	1 551	* 1 400
Thailand	2 375	295	3 240	1 820	29 529
Vietnam	* 4 000	* 4 000	* 4 000	* 4 000	* 4 000
World Total	5 000 000	5 300 000	5 700 000	5 800 000	6 100 000

Note(s)
(1) In addition to the countries listed, Bulgaria is believed to produce fluorspar
(2) In addition, the USA produced the following amounts of fluorspar equivalent in fluorosilicic acid derived from processing phosphate rock ('000 t): 2004: 90, 2005: 86, 2006: 70; 2007: 83, 2008: 82

(a) Exports
(b) Including beneficiated and directly shipped material
(c) Years ended 31 March following that stated
(d) Years ended 20 March following that stated
(e) Years ended 30 June of that stated

Production of germanium metal

tonnes

Country	2004	2005	2006	2007	2008
USA (a)	4	5	5	5	5
China	* 30	* 35	* 100	* 100	* 100
Japan	1	2	2	1	...

Note(s)
(1) Significant quantities of germanium are also believed to be recovered from imported or domestic material in France, Germany, Russia and to a lesser extent in Italy

(a) Including production of secondary metal

GOLD

Characteristics

Gold is a soft, malleable, bright yellow metallic element unaffected by air and most reagents. Gold occurs in its native state or in combination with other elements such as silver. Gold is highly valued as an asset or investment commodity and is extensively used in jewellery and for industrial applications.

Uses

Gold is a long established, universally accepted store of value, widely traded internationally. Gold is seen as a safe haven in times of financial and political uncertainty since it is not at risk of becoming worthless, unlike currency and other assets. Gold is increasingly being used to diversify investment portfolios, as a currency and as a hedge against inflation. The centre of world gold trading is the London Bullion Market, on which the gold price is fixed twice daily. The fix is used as a benchmark for pricing the majority of gold products and derivatives throughout the world's markets. Jewellery production accounts for the largest use of gold, representing 68 per cent of total demand, followed by investment demand (19 per cent) and industrial demand (14 per cent) (World Gold Council, 2009). In Asia and the Middle East gold jewellery is commonly bought as an investment or store of value. Gold has a wide range of industrial uses, dominated by the electrical sector, in which it is valued for its excellent thermal and electrical properties. A significant amount of gold is consumed in dentistry and medicine. Research is continually finding new applications for gold including catalysts and in nanotechnology.

World production in 2008

Gold production is recorded in more than 85 countries while several countries also produce substantial quantities of gold from small operations which are not recorded in official statistics. Six countries produce more than a 100 000 kilograms (metal content) of gold annually, or 57 per cent of world mine production. World mine production, which had been rising for around 20 years, peaked in 2000 at 2560 tonnes. Annual mine production in 2008 was 2290 tonnes, a fall of 270 tonnes since 2000 and its lowest level for 12 years. High gold prices in the late 1970s and early 1980s resulted in steadily increasing global production to the peak in 2000. Production subsequently levelled out and began to decline reflecting the low gold price between 1997 and 2001, investor uncertainty resulting from the Bre-X scandal (a major mining fraud) and diminishing reserves. The depressed gold price led to a lack of exploration and development during this period, resulting in few new discoveries and depletion of reserves. Following this period of declining exploration budgets, which reached a low in 2002, exploration expenditure began to increase in response to dwindling gold reserves, higher gold prices and increasing investor interest.

South Africa dominated world gold production for many decades and in 1970 was producing over 1000 tonnes annually, equating to 60 per cent of world production. South African output has since been declining whilst many other countries have expanded production. The decline in South African gold production is attributed to the mature nature of the mines and declining reserves, high production costs and accidents. South Africa experienced a further 15 per cent fall in gold production from 252 tonnes in 2007 to 213 tonnes in 2008, largely attributed to safety problems and significant power shortages. In 2007 China became the world's largest gold producer, as a result of dramatic increases in production in recent years. Its output reached 285 tonnes in 2008, a four per cent increase on the previous year. China's gold production increased by 26 per cent between 2004 and 2008 and the Chinese Government has been highly supportive of gold exploration leading to a rapidly expanding resource base (Mining Journal, 2007).

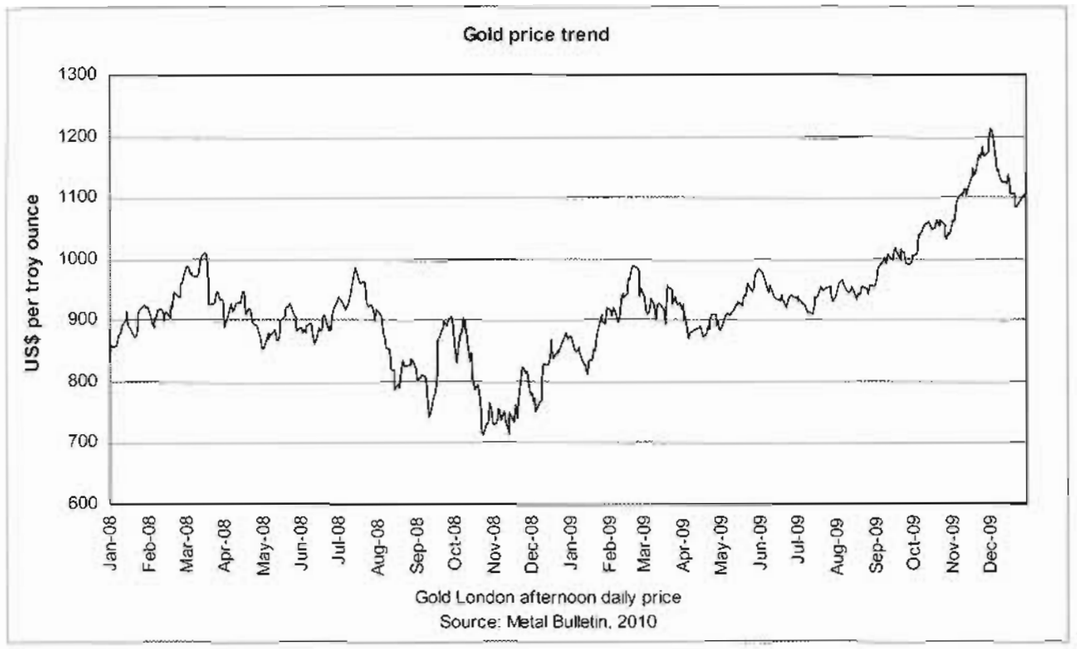
Other traditionally dominant gold producers, including Australia, USA and Canada, are rapidly losing ground to new producers. US gold output declined by one per cent in 2008. Canadian output by six per cent and Australian output by 13 per cent. In recent years Indonesia has experienced an exceptional rise in production from only three tonnes in 1985 to 143 tonnes in 2005, largely from the giant Grasberg Mine (World Gold Council, 2006). Notably Indonesian production fell by more than 53 tonnes in 2008 to 64 tonnes largely as a result of lower ore grades at Grasberg. Peru, which is now the world's fifth largest gold producer, has increased production from 24 tonnes in 1992 to more than 200 tonnes in recent years, thanks to new large-scale mines such as Yanacocha. Peruvian production increased from 170 tonnes in 2007 to 180 tonnes in 2008 as a result of a plant upgrade at Yanacocha. Russian gold production increased by nine percent in 2008 as a result of the opening of the new Kupol Mine in the far east of the country (Mining Exploration News, 2009). In addition to primary production, recycling is a significant source of gold, annually contributing around 28 per cent to global supply (World Gold Council, 2009).

Prices

The gold market is characterised by substantial above-ground reserves, held mainly by banks. If some of these are released into the world market the gold price may be significantly affected. The gold price can be volatile but has strengthened considerably in recent years due to declining mine output, increasing jewellery demand, extensive speculative activity and new gold investment products, devaluation of the US dollar (which underpins the gold price), lower interest rates and geopolitical tensions. All gold prices quoted are based on the London afternoon daily price, in US dollars per troy ounce, as quoted by Metal Bulletin (2010).

Following a period of depressed gold prices between 1987 and 1999, when the price of gold fell by 40 per cent, the gold market has significantly improved in recent years. Since 2001, the gold price has increased dramatically, rising from an average annual price of US$271 per troy ounce to US$695 per troy ounce in 2007. Strong prices continued into 2008 with the gold price exceeding the previous record of US$850 per troy ounce set in January 1980 and reaching an all-time nominal high of US$1002 per troy ounce. The average price of gold during 2008 was US$871 per troy ounce.

The gold price fell during the first half of January 2009 before recovering in response to the increasing severity of the recession and a decline in equity markets (Metal Markets, 2009a). Prices continued to rise during February as investors turned to gold as a safe haven because of US inflationary fears and falling markets. Accordingly gold reached its highest price since July 2008 of US$989 per troy ounce. Towards the end of February prices declined as demand for gold reduced as equity markets recovered (Metal Markets, 2009b). Prices fluctuated during March in response to US unemployment news and the varying strength of the US dollar before declining into April on expectations that US Government recovery plans would improve credit markets and reduce investment demand for metals (Metal Markets, 2009c).



In mid April the gold price fell as the markets reacted to news that the US Government economic stimulus package may be taking effect (Metal Markets, 2009d). Later in the month an announcement from the International Monetary Fund predicting further contraction of the global economy pushed gold prices higher (Metal Markets, 2009e). Prices during May trended upwards reaching US$976 per troy ounce as the US dollar weakened and news of a fall in US retail sales during April affected equity markets (Metal Markets, 2009f). During early June the gold price was primarily influenced by the strength of the US dollar. By mid June a number of factors were causing the gold price to strengthen including geopolitical tensions over South Korea and the news that the H1N1 influenza had reached pandemic levels (Metal Markets, 2009g). Strengthening of the US dollar at the end of June reduced demand for precious metals as an alternative investment, sending the gold price lower (Metal Markets, 2009h).

The gold price continued to fall during July as the US dollar strengthened and oil prices fell (Metal Markets, 2009i). From mid July weakening of the US dollar strengthened gold prices, with markets reacting to an announcement from the US Federal Reserve on interest rates (Metal Markets, 2009j). During August gold prices remained around the US$950 per troy ounce price point reacting to the strength of the US dollar, equity markets, declining oil prices and unemployment news (Metal Markets, 2009k,l). Gold prices increased during September, following the oil price and reacting to the weaker US dollar, eventually breaching US$1000 per troy ounce (Metal Markets, 2009m). On the 8th September gold attained an all-time nominal high fix of $US1004.50 per troy ounce in London, exceeding the previous high for 2009 of $US994 per troy ounce reached in February and the previous all-time high reached in 2008 (The Northern Miner, 2009). The gold price fluctuated around US$1000 troy ounce, reaching US$1016 troy ounce as the US dollar weakened and on signs that inflation could increase (Metal Markets, 2009n). A strengthening US dollar during the later part of September saw gold trading in the mid US$990s per troy ounce.

By early October gold was trading in excess of US$1000 per troy ounce. Prices began to climb reaching as high of US$1062 per troy ounce as the US dollar weakened on reports of talks between major oil producing countries on the future of the US dollar as the currency in which oil is traded (Metal Markets, 2009o). Prices declined towards the end of the month as the US dollar recovered, before climbing steeply during early November and exceeding US$1100 per troy ounce for the first time. The gold price continued to accelerate upwards during November as the US dollar weakened, the increasing US trade deficit became apparent and concerns over Dubai's debt crisis affected the markets (Metal Markets, 2009p,q). By the end of November gold had reached US$1183 per troy ounce. In early December the gold price reached a new all-time high of more than US$1200 per troy ounce as the US dollar weakened and a major bank predicted that the gold price would remain strong during 2010 (Metal Markets, 2009r). The peak in the gold price was followed by a sharp correction, with prices falling below US$1100 per troy ounce as the US dollar recovered with signs of improvement in the US economy. The average price of gold during 2009 was US$970 per troy ounce, an 11 per cent increase on 2008.

Industry events in 2009

Dehedging, a process whereby producers settle forward sales obligations, has been a prominent feature of the gold market in recent years. Since 2000 the increasing difference between lower forward selling prices and rising spot gold prices has led to producers reducing their volume of forward sales (Berg, 2007; Pieterse, 2007). Dehedging impacts on the spot market by effectively reducing the amount of global mine production available (Berg, 2007). Dehedging continued during 2009 as miners tried to take advantage of soaring gold prices. The global hedge book stood at 100 million troy ounces in 2001 but has shrunk drastically, reaching 11.5 million troy ounces at the end of the September 2009 (Mining Journal, 2009; Turner and Reeve, 2009). In early December 2009 Barrick Gold Corporation, one of the largest gold hedgers, announced that it had completely eliminated its hedge book (French, 2009).

Central bank gold sales declined during 2008 and were very small in the first half of 2009. For the first time since 1987 central banks were gold buyers during 2009 (Christian, 2009). China has been expanding its gold reserves in recent years, acquiring gold from the domestic producers and the Chinese market. Its reserves now stand at more than 1000 tonnes making it the world's fifth largest gold holder (Cang and Hornby, 2009).

A number of new mines were being developed or came on stream during 2009. One of the largest mines to commence production was Newmont Mining Corporations Boddington gold mine in Western Australia. Once in full production Boddington will be Australia's largest gold mine. The deposit has reserves of 20.1 million troy ounces of gold and is projected to have an annual production of 1 million troy ounces (Newmont, 2009). Barrick Gold Corporation announced that its Pascua Lama gold-silver project is proceeding to production. Once developed the huge Pascua Lama mine is expected to have an annual production of between 750 000–800 000 troy ounces of gold. In 2009 Barrick Gold Corporation also produced the first gold from its new Buzwagi Mine in Tanzania. Barrick Gold Corporation also has two other major projects in construction: Cortez Hills in Nevada and Pueblo Viejo in the Dominican Republic (Barrick, 2009).

Africa was the focus of numerous developments during 2009. Resolute Mining produced the first gold at its Syama Mine in Mali (Resolute, 2009). The Freda Rebecca gold mine in Zimbabwe, which closed two years ago because of the unstable political climate re-opened during 2009 (Mwana Africa, 2009). In Egypt, Centamin Egypt Limited produced the first gold at its Sukari gold project, the country's first modern commercial gold operation (Centamin Egypt Limited, 2009). Cluff Gold plc successfully commissioned its Kalsaka Mine in Burkina Faso during 2009 (Cluff Gold, 2009). Gold production has commenced at the Kilimapesa mining project in Kenya, a 50-50 joint venture between Goldplat plc and International Gold Exploration AB (Goldplat, 2009).

In Europe Ariana Resources produced the first gold from trial processing of ore at its Kiziltepe project in western Turkey and gold production commenced at Lappland Gold Miners AB Blaiken Mine in Sweden (Ariana Resources, 2009; Lappland Gold Miners, 2009).

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Mine production of gold

kilograms (metal content)

Country	2004	2005	2006	2007	2008
Armenia	2 112	1 373	867	565	* 565
Bulgaria	2 431	3 868	3 818	3 964	4 160
Finland	* 1 300	* 1 300	5 292	4 621	4 148
Georgia	1 377	1 620	2 400	3 100	* 3 100
Greenland	1 560	1 828	2 324	1 835	1 648
Poland (a)	527	713	1 700	883	902
Romania	1 430	* 500	* 500	* 500	* 500
Russia	169 297	163 186	159 340	156 912	172 600
Serbia (a)	—	—	* 330	* 330	* 330
Serbia and Montenegro (a)	328	* 330	—	—	—
Slovakia	107	109	84	92	198
Spain	5 248	2 145	1 565	—	—
Sweden	6 564	6 564	6 848	5 159	5 341
Turkey	3 260	4 170	8 040	9 920	11 120
Algeria	597	641	377	236	647
Botswana	162	2 709	3 020	2 722	3 176
Burkina Faso	1 008	1 397	1 571	2 200	* 2 300
Burundi	3 229	3 905	4 313	2 423	2 170
Cameroon	600	600	* 600	* 600	* 600
Congo	160	120	100	100	* 100
Congo, Democratic Republic	* 10 500	* 9 000	* 11 700	* 10 200	* 10 000
Equatorial Guinea	150	200	150	100	100
Ethiopia (b)	3 490	3 726	3 828	* 3 300	3 631
Gabon	300	* 300	* 300	* 300	* 300
Ghana	63 139	66 852	72 323	83 558	80 503
Guinea	11 100	25 097	16 922	15 465	* 20 000
Ivory Coast	1 219	1 638	1 323	1 243	1 694
Kenya (c)	567	616	432	3 023	340
Liberia	110	25	9	284	569
Madagascar	40	55	130	210	* 210
Mali	37 911	44 230	58 382	52 753	52 700
Mauritania	—	—	322	2 332	5 528
Morocco (a)	1 493	* 1 200	* 1 000	771	587
Mozambique	56	63	85	97	298
Namibia	2 205	2 649	2 790	2 496	2 126
Niger	1 590	4 962	2 615	3 427	2 314
Nigeria	* 30	* 40	40	180	200
Senegal	* 600	* 600	* 600	* 600	* 600
Sierra Leone	24	48	65	193	178
South Africa	337 223	294 803	272 128	252 345	212 744
Sudan	4 239	4 739	3 246	2 701	2 276
Tanzania	48 176	47 270	39 750	40 193	36 434
Togo		6 179	7 184	10 159	* 10 000
Uganda (c)	1 447	1 500	2 192	2 543	1 860
Zambia (d)	* —	443	964	1 269	1 693
Zimbabwe	21 330	13 453	11 354	7 018	3 576

Mine production of gold

kilograms (metal content)

Country	2004	2005	2006	2007	2008
Canada	130 727	120 541	104 448	102 377	95 736
Costa Rica	* 150	540	1 780	1 036	198
Guatemala	—	741	5 036	7 100	7 448
Honduras	3 683	4 439	4 055	3 012	1 846
Jamaica	20	—	—	—	—
Mexico	21 818	26 782	35 899	39 355	50 365
Nicaragua	4 064	3 674	3 395	3 330	2 960
USA	257 905	255 757	251 853	238 136	234 600
Argentina	28 496	27 904	44 131	42 021	39 797
Bolivia	6 165	8 871	9 628	8 818	8 431
Brazil	47 596	38 293	40 075	49 600	* 54 000
Chile	39 986	40 447	42 100	41 528	39 162
Colombia	37 738	35 783	15 683	15 483	34 321
Ecuador	5 128	5 228	5 338	3 186	3 240
French Guiana	2 773	1 955	* 2 000	* 2 000	* 2 000
Guyana	11 478	5 668	6 405	7 412	8 131
Peru	173 219	207 822	202 822	170 128	179 870
Suriname	8 513	10 619	10 426	8 585	10 290
Uruguay	1 758	2 930	* 2 800	3 172	2 429
Venezuela	9 690	* 10 000	* 13 200	* 9 500	* 8 700
Burma (a)	* 100	* 100	* 100	* 100	* 100
China (a)	212 350	255 000	247 500	275 000	285 000
India (e)	3 526	3 047	2 488	2 858	2 462
Indonesia	92 936	143 205	85 411	117 854	64 390
Iran (a)	* 900	275	850	850	* 850
Japan	7 936	8 319	8 904	8 869	6 868
Kazakhstan (a)	* 19 000	* 18 000	22 564	21 824	20 825
Korea, Republic of	233	260	277	162	175
Kyrgyzstan	21 395	16 751	10 301	10 559	18 132
Laos	4 392	6 338	6 068	4 161	4 333
Malaysia	4 221	4 250	3 496	2 913	2 490
Mongolia	19 418	24 122	21 267	17 473	15 184
Oman	192	350	358	248	118
Philippines	35 464	37 490	36 141	38 792	35 568
Saudi Arabia	8 268	7 457	5 182	4 438	4 527
Tajikistan	2 161	1 927	1 920	* 1 920	* 1 920
Thailand	4 507	4 393	3 470	3 401	2 721
Uzbekistan	88 350	84 210	76 620	72 850	* 73 000
Vietnam	* 2 000	* 3 000	* 3 000	* 3 000	* 3 000
Australia	259 000	263 000	247 000	247 000	215 000
Fiji	4 033	2 793	1 403	29	700
New Zealand	10 151	10 583	10 618	10 638	16 274
Papua New Guinea	73 500	68 200	58 349	57 549	67 436
Solomon Islands	60	20	20	93	141
World Total	2 410 000	2 500 000	2 370 000	2 350 000	2 290 000

Note(s)
(1) In several countries substantial amounts of gold produced in small operations are not recorded in the official statistics used when compiling this table
(2) In addition to the countries listed, Central African Republic, Eritrea, Taiwan and Ukraine produce less than 100 kg gold per year
(3) Greece and Norway are believed to produce gold

(a) Metal production
(b) Years ended 7 July of that stated
(c) Exports
(d) Contained in blister copper, refinery mud's and electrolytic copper
(e) Years ended 31 March following that stated

Production of graphite

tonnes

Country	2004	2005	2006	2007	2008
Czech Republic	5 000	3 000	5 000	3 000	3 000
Germany	3 155	2 638	—	—	—
Norway	6 000	9 000	9 000	3 000	4 100
Romania	395	486	—	—	—
Russia	13 550	* 14 000	* 14 000	* 14 000	* 14 000
Turkey	* 1 000	* 1 100	1 200	* 1 500	* 1 500
Ukraine	10 960	10 400	5 800	* 6 000	* 6 000
Madagascar	7 770	6 400	4 857	* 5 000	* 5 000
Zimbabwe	10 267	4 298	6 588	* 6 600	* 6 600
Canada	* 15 000	* 17 000	15 000	15 000	20 000
Mexico	14 769	12 357	11 773	9 900	7 229
Brazil (a)	76 332	75 515	76 194	77 163	80 500
China (b)	1 450 000	1 650 000	1 730 000	1 800 000	1 800 000
India (c) (d)	108 150	125 651	162 293	116 007	134 257
Korea, Dem. P.R. of	* 30 000	* 30 000	* 30 000	* 30 000	* 30 000
Korea, Republic of	247	39	68	52	73
Sri Lanka	5 374	4 370	5 756	9 593	6 615
World Total	1 800 000	2 000 000	2 100 000	2 100 000	2 100 000

Note(s)
(1) This table includes all forms of amorphous and crystalline graphite but excludes synthetic material
(2) In addition to the countries listed, Egypt, Namibia and the USA are believed to produce graphite

(a) Including beneficiated and directly shipped material
(b) Including flake graphite
(c) Crude
(d) Years ended 31 March following that stated

Production of gypsum

tonnes

Country	2004	2005	2006	2007	2008
Austria					
Gypsum	920 809	911 162	936 072	1 006 416	1 022 983
Anhydrite	117 318	106 032	135 380	57 428	64 276
Azerbaijan	884	28 242	35 034	22 037	38 375
Bosnia & Herzegovina	139 520	152 939	131 936	154 294	150 039
Bulgaria	175 900	187 700	215 800	234 300	21 200
Croatia	193 263	196 133	170 351	170 721	* 170 000
Cyprus	255 000	215 500	270 000	330 000	412 000
Czech Republic	68 000	24 000	19 000	66 000	35 000
France (a)	* 5 700 000	4 902 498	* 4 800 000	* 4 800 000	2 339 380
Georgia	1 707	238	123	.	—
Germany (a)	1 579 000	1 644 000	1 771 000	1 898 000	2 112 000
Greece	856 606	865 216	* 850 000	836 967	830 000
Hungary (a)	55 000	19 000	30 000	26 000	15 940
Ireland, Republic of	* 650 000	* 700 000	* 700 000	* 700 000	* 600 000
Italy	1 615 287	* 1 600 000	1 600 000	* 1 600 000	* 1 600 000
Latvia (a)	225 742	* 220 000	* 230 000	230 000	* 230 000
Macedonia	165 416	190 232	267 760	255 500	242 400
Moldova	491 000	562 700	725 900	* 725 000	* 725 000
Poland					
Gypsum	970 786	1 048 000	1 172 000	1 298 000	(a) 1 499 901
Anhydrite	196 000	195 000	181 000	194 000	.
Portugal	461 212	389 180	366 599	* 400 000	* 400 000
Romania	490 372	532 867	615 072	1 004 150	832 248
Russia	2 076 800	* 2 200 000	* 2 200 000	* 2 300 000	* 2 400 000
Serbia	—	—	* 42 000	* 42 000	* 42 000
Serbia and Montenegro	42 471	* 42 000	—	—	—
Slovakia (a)	125 000	107 500	126 200	151 000	152 000
Spain	12 533 972	14 453 053	14 596 559	15 000 000	* 15 000 000
Switzerland	300 000	300 000	300 000	300 000	* 300 000
Turkey	250 099	* 500 000	* 800 000	* 770 000	.
Ukraine	601 000	656 000	375 900	741 580	1 158 410
United Kingdom	1 686 000	* 1 700 000	* 1 700 000	* 1 700 000	* 1 700 000
Algeria	467 352	857 502	1 033 107	1 198 303	1 671 651
Egypt	7 634 000	3 290 000	* 3 300 000	3 085 000	2 400 000
Eritrea	1 054	212	396	548	..
Ethiopia (b)	51 200	34 729	38 809	29 886	32 989
Kenya	* 8 900	* 9 100	* 9 100	* 9 600	* 9 600
Libya	* 175 000	* 175 000	* 200 000	* 240 000	* 240 000
Madagascar	500	500	500	500	* 500
Mauritania	* 40 000	43 266	45 222	49 229	44 428
Morocco	* 600 000	* 600 000	* 600 000	* 600 000	* 600 000
Niger	34 944	17 417	13 043	4 615	8 661
Somalia	* 1 500	* 1 500	* 1 500	* 1 500	* 1 500
South Africa	452 271	547 581	554 020	643 630	571 343
Sudan	* 5 000	* 5 000	7 000	7 974	* 8 000
Tanzania	59 231	63 377	32 798	2 730	55 730
Tunisia	109 000	113 000	151 000	157 000	...
Uganda	181	285	121	168	84
Canada (a)	9 205 000	8 272 000	9 072 000	7 638 000	5 797 000
Cuba	84 800	73 100	72 500	80 200	110 000
Dominican Republic	435 723	352 242	238 429	* 216 000	* 183 000
El Salvador	* 6 000	* 6 000	* 6 000	* 6 000	* 6 000
Guatemala	106 140	349 589	226 800	495 335	127 387
Honduras	* 5 725	* 5 700	* 5 500	* 5 500	* 5 500
Jamaica	283 352	302 066	364 432	227 697	238 274
Mexico	9 221 458	6 251 969	6 075 893	6 918 973	6 933 279
Nicaragua	36 466	36 456	42 191	43 300	49 900
USA	17 200 000	21 100 000	21 100 000	17 900 000	* 12 700 000
Argentina	674 935	1 073 286	1 202 812	1 226 530	1 253 884
Brazil	1 474 911	1 582 248	1 711 671	1 923 119	* 2 000 000
Chile	630 444	660 753	845 331	773 119	773 749
Colombia	* 560 000	* 700 000	* 700 000	* 700 000	* 700 000
Ecuador	232	1 310	1 478	* 1 500	* 1 500
Paraguay	* 4 500	* 4 500	* 4 500	* 4 500	* 4 500

Production of gypsum

tonnes

Country	2004	2005	2006	2007	2008
Peru	432 259	334 595	394 289	329 687	495 212
Venezuela	4 000	6 000	* 7 000	* 7 000	* 7 000
Bhutan	131 236	150 585	204 198	189 198	248 445
Burma (c)	71 155	67 522	68 651	75 116	* 75 000
China	29 520 000	32 000 000	35 000 000	* 37 000 000	* 35 000 000
India (c)(d)	3 689 927	3 291 478	3 005 572	2 606 788	* 3 600 000
Indonesia	* 6 000	* 6 000	* 6 000	* 6 000	* 6 000
Iran (e)	14 394 537	11 195 745	10 761 107	11 930 563	* 12 000 000
Iraq	..	...	...	1 285 000	1 279 000
Israel	124 678	106 798	110 754	82 974	9 975
Jordan	135 331	344 911	333 710	287 789	231 771
Kazakhstan	396 200	516 600	649 400	653 600	696 900
Laos	236 000	239 000	206 100	232 300	* 230 000
Mongolia	30 050	81 223	60 400	* 60 000	* 60 000
Oman	103 000	133 100	254 000	187 200	* 190 000
Pakistan (f)	467 065	552 496	601 027	624 120	660 000
Saudi Arabia	641 000	713 000	* 750 000	* 750 000	* 750 000
Sri Lanka	—	272	548	—	617
Syria	431 561	467 000	443 800	447 900	572 886
Tajikistan	57 000	8 500	..	.	..
Thailand					
Gypsum	7 619 205	7 113 073	8 354 901	8 643 391	8 500 401
Anhydrite	531 660	537 781	560 339	692 877	488 681
Uzbekistan	* 80 000	* 80 000	* 80 000	* 80 000	* 80 000
Vietnam	* 5 000	* 5 000	* 5 000	* 5 000	* 5 000
Yemen, Republic of	60 000	72 000	81 000	92 000	104 000
Australia (f)	4 325 100	3 881 600	4 264 900	3 896 100	3 392 900
World Total	146 000 000	143 100 000	149 200 000	151 400 000	140 400 000

Note(s)
(1) Some countries produce large quantities of synthetic gypsum. Where possible, this output is excluded from the table

(a) Including anhydrite
(b) Years ended 7 July of that stated
(c) Years ended 31 March following that stated
(d) Including selenite
(e) Years ended 20 March following that stated
(f) Years ended 30 June of that stated

Production of iodine

kilograms

Country	2004	2005	2006	2007	2008
Azerbaijan	—	—	—	21 500	116 400
Russia	105 000	* 105 000	* 105 000	* 105 000	* 105 000
USA	1 130 000	1 570 000	* 1 220 000	* 1 200 000	* 1 200 000
Chile	14 931 000	15 346 000	16 494 000	15 473 000	15 503 000
China	* 550 000	* 550 000	* 560 000	* 570 000	* 570 000
Indonesia	* 75 000	* 75 000	* 75 000	* 75 000	* 75 000
Japan	7 264 000	8 095 000	8 724 000	9 282 000	9 500 000
Turkmenistan	* 250 000	* 270 000	* 270 000	* 270 000	* 500 000
Uzbekistan	* 2 000	* 2 000	* 2 000	* 2 000	* 2 000
World Total	24 300 000	26 000 000	27 500 000	27 000 000	27 600 000

IRON ORE

Characteristics

The pure form of iron is a lustrous silver metal with a greyish tinge. It readily oxidises in air and is only very rarely found as native metal. As a ferromagnetic element it has magnetic properties. Iron is abundant (around five per cent) in the Earth's crust and its minerals vary greatly in their composition and appearance.

The most common ore minerals are the oxides, particularly magnetite (Fe_3O_4) and hematite (Fe_2O_3), which can vary in colour from grey to yellow or red. Other common ores include the hydrated oxides, goethite (FeO(OH)) and limonite ($FeO(OH)\cdot nH_2O$), and the carbonate mineral siderite ($FeCO_3$). The most economically important iron ore deposits are known as banded iron formations (BIF). These are found in Proterozoic rocks (2500–524 million years old) formed by deposition of iron oxides on the sea bed in a reducing environment. The largest examples are from the Hamersley Province, Western Australia and the Lake Superior District, USA.

Economic deposits are usually those that have been enriched by natural processes to grades of around 65 per cent iron. Magmatic deposits can also be the source of large quantities of magnetite where the mineral is segregated in a large magma chamber; the largest magmatic iron ore deposit is at Kiruna in Sweden. World reserves of iron ore are 150 000 million tonnes of ore containing 73 000 million tonnes of iron. Ukraine holds the world's largest reserves of ore with 30 000 million tonnes (19 per cent of the world total). Russia is the second largest and China the third with 25 000 million and 21 000 million tonnes respectively (Jorgenson, 2009).

Uses

Around 98 per cent of iron ore is used to make steel and goes directly to primary steel plants. The ore is first smelted to iron, known as pig iron, before it is processed into steel. The iron product can be in the form of blast furnace iron (BFI), where the ore is smelted with limestone and coke to produce liquid iron, or direct reduced iron (DRI). Here the ore is heated and reduced using natural gas to produce iron pellets. Scrap iron and steel is melted in an electric arc furnace. To produce steel, liquid iron is treated in a converter to reduce its carbon content and adjust the alloy composition. Steel has numerous varied uses and, depending on the alloy, many different properties. The most common steel alloys are plain-carbon steel (up to 2.1 per cent carbon), stainless steel (alloyed with chromium and nickel), high-strength low-alloy steel (HSLA) with low levels of carbon, and tool steel, which is very hard due to heat-treatment.

Pig iron can also be remelted, reducing the carbon and silicon contents, to produce cast iron: this is more brittle than steel but is suitable for many engineering uses such as machinery and car parts (such as engine blocks), street furniture, and pipes.

The remaining two per cent has many minor uses including as a pigment, as an additive to cement, in magnets, in industrial processes, as an ingredient in fertilizers, in catalysts and as a radioactive tracer for use in medicine and biochemical research.

World production in 2008

World production of iron ore rose to 2188 million tonnes in 2008, a seven per cent increase on 2007. The increase in production was driven predominantly by high demand from China and, to a lesser extent, India despite the start of the economic recession late in 2008. Production has struggled to keep up with world demand (mainly from China) despite oversupply in the market due to severely reduced sales in early 2009. The highest iron ore production rates ever recorded occurred again in 2008, for the seventh consecutive year, with production rising by 59 per cent since 2004. China was once again the world's largest producer with a 16.5 per cent increase in production compared to 2007, and 166 per cent increase compared to 2004. This increase has mainly been achieved by significant investment at existing operations by big companies and a very fast expansion by small producers, as well as technological breakthroughs leading to development of new low-grade deposits. New regulations leading to the phasing out of many smaller less efficient operations has, however, led to a reduction in year-on-year growth falling by 40 per cent from 2005 to 2006, 20 per cent from 2006 to 2007 and 17 per cent from 2007 to 2008. Brazil, the world's second largest producer, increased production by four per cent, a much lower year-on-year increase than in previous years due to production being slashed by Vale's Brazilian operations in the end of 2008 as oversupply in the iron ore market led to producers attempting to lower their stockpiles. Vale shut four of its Brazilian pellet plants and two iron ore mines.

Australia, the world's third largest producer, increased its production by 14.5 per cent in 2008 compared to 2007: a larger increase than the 8.7 per cent achieved between 2006 and 2007. This was due to the completion by Rio Tinto and BHP Billiton of improvements to infrastructure in the Pilbara region and production commencing from Fortescue's Cloudbreak Mine.

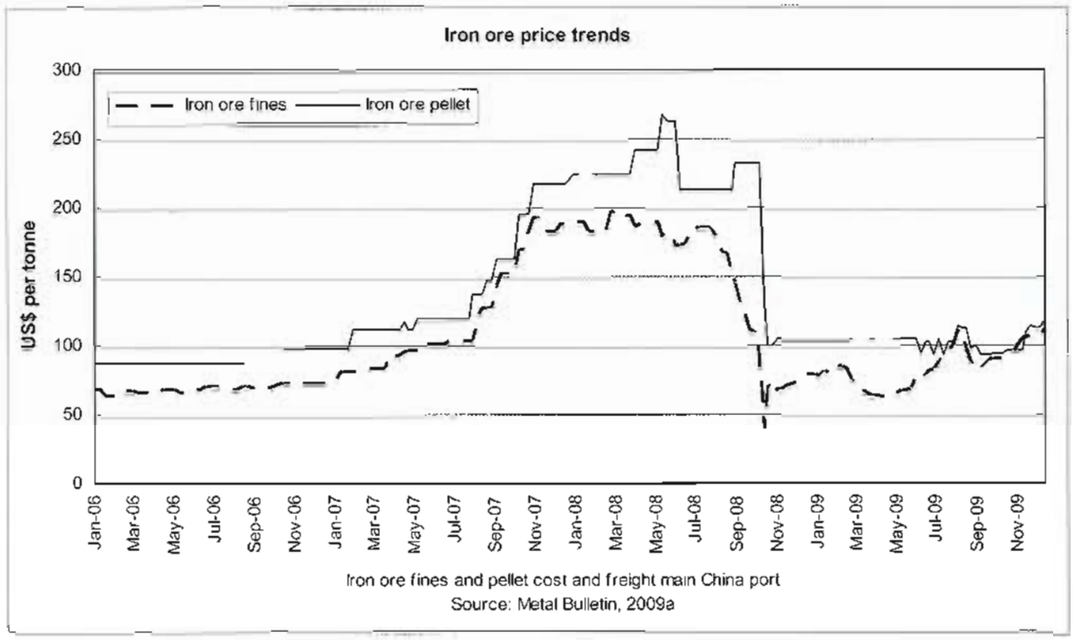
African production was mixed in 2008. In South Africa, the world's eighth largest producer, production rose by 16 per cent compared to 2007: a significant rise compared to previous years mainly due to the completion of several expansion projects by Kumba Iron Ore Ltd. Mauritania, Africa's second largest iron ore producer, saw production fall by seven per cent due to political unrest causing disruption to mining operations.

European production fell by 4.5 per cent in 2008 compared to 2007, the first time production has dropped since 2003. This was due to the difficult economic conditions faced by producers in the second half of 2008. Production from the CIS also fell by 5.6 per cent with output in Russia, the world's fifth largest producer, falling by five per cent, as a result of increased competition from China.

Production in the USA, the world's seventh largest producer, fell by three per cent, continuing a trend experienced since 2004. Canada's iron ore production also decreased, dropping year-on-year by 5.7 per cent.

Prices

Iron ore trade is characterised by consumers having fixed contracts with producers, which are negotiated annually. Historically iron ore has rarely been traded through spot prices on the open market. However, price volatility and a failure by producers to fix a contract price with China this year led to a record amount of ore being traded on the spot market. The price of iron ore continued to be unpredictable in 2009, after remaining relatively constant for several years until 2006. Prices rose sharply through the first half of 2007, remained high until around September of 2008 then dropped back to 2006 levels or lower. Price increases during 2009 have been



Iron ore fines and pellet cost and freight main China port
Source: Metal Bulletin, 2009a

relatively modest but remain volatile and heavily dependant on demand from China and, to a lesser extent, India. Many steel mills and consumers of iron ore have accepted a 33 per cent cut in price from producers compared to 2008's record prices: however, China has demanded further cuts of up to 40 per cent.

Industry events in 2009

Despite the extremely poor economic conditions during 2009, iron ore production increased with companies reporting recorded production, large-scale investments in infrastructure and new joint ventures. However, it was difficult to foresee any positive news at the start of 2009 when the global economic crises was deeply affecting many commodities. January saw Rio Tinto report its biggest fall in quarterly iron ore output as it attempted to reduce costs in an effort to pay off large debts (Paul, 2009). Rio Tinto also reported that 4400 jobs would be lost from its iron ore businesses in the Pilbara (Australia), Brazil, Guinea and Canada (Haycock, 2009a). Production was universally cut by major producers in an effort to reduce oversupply in the iron ore market generated by the sudden drop in sales. Vale, the world's number one iron ore producer, announced in April it was cutting production by 25 per cent by closing high cost operations and stopping the production of low grade ores (Wills, 2009). Meanwhile, in Australia exports of iron ore from ports in the Pilbara region fell by 14 per cent compared to the previous months due to low demand from Japan, South Korea and Taiwan.

Despite lower commodities prices, a constant high demand from China and continued growth in the Chinese economy led to increased iron ore output by the major producers. In April, China's iron ore imports reached record levels at 57 million tonnes, a 33 per cent rise compared to the previous year (Metal Bulletin, 2009b). Despite efforts by the China Iron and Steel Association to lower iron ore imports in order to strengthen its position in price negotiations, high levels of imports continued thoughout the year; during the first six months of the year imports were up by 29.3 per cent on 2008 figures (Cang & Stanwey, 2009). Despite production cuts early in the year, Australia's iron ore output was eight per cent higher for the September quarter compared to 2008, reflecting an overall rise in output for 2009 mainly due to increased demand from China. However, earnings from iron ore exports fell by 26 per cent for the same quarter reflecting a significant drop in prices for iron ore products (Jacoby, 2009a). Vale also reported record levels of Chinese iron ore imports. However, on a net basis the company also reported that world demand for iron ore dropped in 2009 with a 28.5 per cent decrease in sales in the second quarter (Sergeant, 2009).

The uncertainty caused by the economic downturn and increased iron ore demand from China during 2009 also led to a very uncertain year for iron ore pricing. The first contract agreed this year was between Rio Tinto and Japan's Nippon Steel for a 33 per cent reduction in the benchmark price (Thomas, et al, 2009). Similar agreements were quickly made by BHP and Vale with other Japanese and South Korean steel producers. The China Iron and Steel Association, however, refused to accept these cuts and demanded that prices be cut by 40–45 per cent, back to 2007 levels, resulting in a prolonged period of negotiations. This situation came to a head in July when members of the Rio Tinto negotiation team were arrested by the Chinese authorities on charges of industrial espionage. This led to Rio Tinto pulling out of negotiations, along with other major producers, without a price being agreed for 2009 (Taylor & Hornby, 2009). As a result, significant quantities of ore were traded at spot prices during the year leading to speculation that it could mark the end of the benchmark pricing system.

Generally there was little activity in iron ore merger and acquisitions during 2009 but due to increasing demand Chinese companies have been aggressively pursuing investment opportunities in iron ore. February saw the announcement of a potential partnership between Rio Tinto and Chinalco, with Chinalco agreeing to invest US$19.5 billion in Rio Tinto (Rio Tinto, 2009). However, this deal fell through and in June Rio Tinto announced that it was instead pursuing a joint venture with BHP Billiton (Haycock,

2009b). This would see the two companies combine their operations in the Pilbara region, Australia. The deal, worth US$116 billion, has yet to receive regulatory approval but, if it goes ahead, the two companies could mine 350 million tonnes of ore per year (Urqhuhart, 2009). Other companies to see Chinese investment during 2009 included Fortescue Metals Group, which received US$364 million from Chinese steelmaker Maker Hunan Valin Iron and Steel Group (Louthean, 2009).

Rio Tinto's Simandou project suffered a setback in 2009 after the Guinean government gave the rights to a disputed area of the resource, previously owned by Rio Tinto, to the Benny Steinmetz Group. The concessions were taken away from Rio Tinto as it had not followed the country's mining code which requires exploration and development of the entire concession. Rio Tinto has spent US$450 million on exploration at Simandou and considers it to be the world's largest undeveloped iron ore deposit (Onstad, 2009). Vale has invested heavily in iron ore handling infrastructure with the purchase of 16 vessels capable of carrying 400 000 tonnes each of iron ore and is close to completing work on a major marine terminal and thermoelectric plant in Rio de Janeiro (Berryman, 2009). BHP Billiton has commissioned its Newmont Mining Hub which is to be the centre of its iron ore mining, crushing and screening actives in the Pilbara region, Australia. The Hub is part of BHP Billiton's Rapid Growth Project 4 which will see iron ore production capacity in the Pilbara region rise to 155 million tones per annum (Jacoby, 2009b).

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Production of iron ore

tonnes

Country	2004	2005	2006	2007	2008
Austria (a)	1 889 419	2 047 950	2 092 996	2 152 825	2 032 671
Azerbaijan	19 100	7 300	11 300	17 600	28 100
Bosnia & Herzegovina	280 596	3 045 654	3 439 587	2 943 963	2 667 359
Bulgaria	82 700	—	—	—	—
Germany (b) (c)	412 238	362 106	416 000	421 711	455 100
Norway	586 100	713 000	620 000	630 000	746 000
Romania	231 417	220 788	122 684	8 157	—
Russia	97 100 000	95 100 000	102 000 000	105 000 000	99 900 000
Slovakia	305 072	258 500	311 000	349 000	392 000
Spain	10 879	—	—	—	—
Sweden	22 272 000	23 255 000	23 302 000	24 714 000	23 888 000
Turkey	3 856 536	3 889 934	3 251 969	4 549 556	3 990 110
Ukraine	66 000 000	69 456 000	74 000 000	77 930 000	72 688 000
United Kingdom	* 500	354	341	* 300	145
Algeria	1 754 300	1 878 800	2 339 637	1 982 101	2 077 000
Egypt	2 287 000	1 599 000	* 2 200 000	2 184 729	1 810 606
Mauritania	10 674 000	10 752 000	11 155 000	11 815 000	10 968 000
Morocco	12 200	16 300	35 500	47 958	22 878
Nigeria	8 479	8 479	8 818	9 000	* 9 000
South Africa (e)	39 322 048	39 542 072	41 326 036	42 100 887	48 982 537
Tunisia	256 000	206 400	217 300	180 600	108 300
Uganda	—	209	—	366	1 740
Zimbabwe	228 731	224 229	104 459	* 104 000	* 104 000
Canada (f)	28 596 000	28 343 000	34 094 000	33 158 000	31 273 000
Cuba	19 700	18 900	7 800	3 300	—
Guatemala	2 823	11 268	7 341	31 006	452
Mexico	13 369 000	14 468 000	14 568 000	16 540 000	11 709 000
USA	54 724 000	54 300 000	52 700 000	52 500 000	54 000 000
Brazil	261 696 128	281 462 088	317 800 229	354 674 378	368 800 000
Chile	8 003 491	7 862 000	8 629 000	8 817 700	9 315 580
Colombia	507 711	607 559	644 015	623 930	475 273
Peru	5 228 800	5 614 900	5 885 000	6 277 000	6 348 000
Venezuela	19 196 231	21 179 000	22 100 000	* 20 650 000	* 20 000 000
Bhutan	—	5 679	...	—	—
China	310 104 800	420 492 700	588 171 400	707 073 000	824 011 100
India (g)	145 942 000	165 230 000	187 696 000	206 452 000	218 554 000
Indonesia	89 664	32 203	5 489	—	—
Iran (h)	18 204 658	26 243 837	31 537 545	35 195 000	...
Iraq	...	..	...	40 000	3 000
Kazakhstan	20 302 500	19 471 100	18 254 900	19 582 200	* 21 500 000
Korea, Dem. P R of	* 1 100 000	* 1 200 000	* 1 200 000	* 1 200 000	* 1 200 000
Korea, Republic of	226 287	212 971	227 437	290 802	365 883
Malaysia (f)	663 732	949 605	667 082	802 030	981 932
Mongolia	33 498	167 700	180 000	265 100	1 387 400
Pakistan (d)	84 946	104 278	131 259	125 879	* 130 000
Thailand	135 580	230 946	264 289	1 554 860	1 709 750
Vietnam	1 205 400	1 435 000	* 1 600 000	* 1 200 000	* 1 200 000
Australia	234 002 000	261 796 000	275 042 000	299 038 000	342 514 000
New Zealand	2 329 417	2 207 244	2 146 496	1 723 726	2 020 227
World Total	1 373 000 000	1 566 000 000	1 831 000 000	2 045 000 000	2 188 000 000

Note(s)
(a) Including micaceous iron oxide
(b) Including manganiferous iron ore
(c) Used as aggregate in the construction industry
(d) Years ended 30 June of that stated
(e) Including by-product magnetite
(f) Including by-product iron ore
(g) Years ended 31 March following that stated
(h) Years ended 20 March following that stated

Production of pig iron

tonnes

Country	2004	2005	2006	2007	2008
Austria	4 846 740	5 444 000	5 547 000	5 908 000	5 795 000
Belgium	8 224 000	7 254 000	7 516 000	6 577 000	6 977 000
Bosnia & Herzegovina	* 60 000	* 60 000	* 60 000	* 60 000	* 60 000
Bulgaria	1 158 000	1 150 000	1 147 000	1 069 000	441 000
Czech Republic	5 385 000	4 627 000	5 192 000	5 287 000	4 737 000
Finland	3 036 566	3 056 165	3 157 894	2 915 130	2 942 946
France	13 087 705	12 595 584	12 873 900	12 425 703	11 371 879
Germany	30 628 000	29 294 000	30 940 000	31 700 000	29 105 000
Hungary	1 350 000	1 329 000	1 340 000	1 393 655	1 288 758
Italy	10 566 000	11 392 000	11 500 000	11 100 000	10 300 000
Netherlands	6 011 000	6 031 000	5 417 000	6 412 000	6 130 000
Norway	* 100 000	* 100 000	* 100 000	* 100 000	* 100 000
Poland	6 292 341	4 476 831	5 332 632	5 804 418	4 933 781
Romania	4 243 956	4 097 998	3 945 975	3 923 244	2 957 715
Russia	53 461 000	51 750 000	55 022 000	51 500 000	48 300 000
Serbia	—	—	1 529 177	1 485 000	1 582 000
Serbia and Montenegro	959 019	1 115 195	—	—	—
Slovakia	3 765 000	3 681 000	4 145 000	4 012 000	3 529 000
Spain	4 036 000	4 160 000	3 432 000	3 976 000	3 995 000
Sweden	3 992 000	3 844 000	3 701 000	3 947 000	3 708 000
Switzerland	1 000 000	1 158 000	1 252 000	1 264 000	1 312 000
Turkey	5 835 889	5 398 500	5 952 000	6 235 537	6 697 372
Ukraine	31 000 000	31 700 000	32 900 000	35 650 000	30 991 000
United Kingdom	10 179 600	10 188 800	10 695 700	10 959 800	10 136 800
Algeria	692 800	791 400	1 093 000	1 193 000	690 000
Egypt	* 4 000 000	4 000 000	* 4 200 000	* 3 786 000	* 3 543 000
Libya	1 586 000	1 700 000	1 633 000	1 660 000	1 569 000
Morocco	15 000	15 000	* 15 000	* 15 000	* 15 000
South Africa	7 644 000	7 900 000	7 913 000	7 094 000	6 540 000
Zimbabwe	145 000	* 145 000	38 000	38 000	1 000
Canada	9 919 000	8 865 000	8 751 000	9 490 000	9 744 000
Mexico	10 622 823	10 020 339	9 956 777	10 343 007	10 462 198
Trinidad & Tobago	2 336 500	2 055 300	2 071 500	2 062 800	1 601 000
USA	42 291 000	37 222 000	37 903 000	36 300 000	35 600 000
Argentina	4 147 500	4 466 500	4 437 400	4 389 100	4 428 000
Brazil	34 558 000	33 884 000	32 452 000	35 571 000	34 871 000
Chile	1 137 000	1 074 000	1 115 000	1 147 000	1 150 000
Colombia	287 900	325 200	352 600	340 900	308 100
Paraguay	119 000	123 000	128 000	110 000	95 000
Peru	371 800	385 700	427 100	495 500	466 000
Venezuela	7 740 500	8 986 800	8 571 500	7 435 300	6 827 200
Burma	* 40 000	* 40 000	* 40 000	* 40 000	* 40 000
China	268 309 900	343 751 900	412 451 900	469 446 300	470 674 100
India	34 238 000	39 177 000	43 288 000	46 884 000	49 050 000
Indonesia	1 436 000	1 268 000	1 200 000	1 321 000	1 300 000
Iran	8 533 000	9 178 000	8 970 000	9 609 000	9 600 000
Japan	82 974 493	83 058 130	84 270 419	86 770 755	86 171 136
Kazakhstan	4 283 142	3 582 198	3 369 395	3 795 352	3 105 548
Korea, Dem. P.R. of	* 250 000	* 250 000	* 250 000	* 250 000	* 250 000
Korea, Republic of	27 555 998	27 309 000	27 559 407	29 436 783	31 042 782
Malaysia	1 710 000	1 350 000	1 277 000	1 872 000	1 900 000
Pakistan	* 1 000 000	* 1 000 000	* 850 000	* 900 000	* 900 000
Qatar	830 000	815 382	876 885	1 296 000	1 680 838
Saudi Arabia	3 406 000	3 626 000	3 581 000	4 101 000	4 500 000
Taiwan	10 354 000	9 447 000	10 407 000	10 518 000	9 800 000
Vietnam	187 000	202 000	211 000	170 000	..
Australia	6 428 000	6 212 000	6 433 000	6 351 000	6 057 000
New Zealand	719 000	652 000	664 000	679 000	622 000
World Total	789 100 000	856 800 000	939 500 000	1 008 600 000	992 200 000

Note(s)
(1) The data in this table include sponge iron and direct reduced iron (DRI), where these have been separately identified

Production of crude steel

tonnes

Country	2004	2005	2006	2007	2008
Albania	120 000	179 524	205 534	263 271	300 000
Austria	6 529 000	7 031 000	7 129 000	7 577 000	7 593 000
Azerbaijan	90 400	286 100	335 300	273 393	74 801
Belarus	1 920 019	2 075 523	2 135 651	2 214 019	2 478 131
Belgium	11 697 000	10 422 000	11 631 000	10 692 000	10 673 000
Bosnia & Herzegovina	75 000	289 000	469 122	513 867	587 878
Bulgaria	2 106 000	1 969 000	2 102 000	1 909 000	1 330 000
Croatia	85 947	73 640	80 516	76 252	121 759
Czech Republic	7 033 000	6 189 000	6 862 000	7 059 000	6 387 000
Finland	4 832 427	4 738 446	5 053 714	4 430 726	4 416 792
France	20 770 252	19 480 777	19 852 125	19 249 862	17 879 161
Germany	46 374 000	44 524 000	47 223 000	48 550 000	45 832 000
Greece	1 967 000	2 266 000	2 416 000	2 554 000	2 477 000
Hungary	1 944 017	2 004 250	2 084 000	2 227 000	2 096 000
Italy	28 603 000	29 349 000	31 624 000	31 506 000	30 589 000
Latvia	550 000	550 000	* 690 000	* 696 000	* 635 000
Luxembourg	2 684 000	2 194 000	2 802 000	2 858 000	2 582 000
Macedonia	319 873	321 170	326 484	370 317	344 866
Moldova	1 011 000	1 016 000	784 000	965 000	865 000
Montenegro	—	—	193 165	173 849	201 623
Netherlands	6 848 000	6 919 000	6 372 000	7 368 000	6 853 000
Norway	725 000	705 000	684 000	708 000	560 000
Poland	10 578 482	8 335 898	9 991 638	10 630 716	10 380 738
Portugal	1 400 000	1 400 000	1 400 000	1 400 000	1 400 000
Romania	6 076 600	6 280 000	6 266 036	6 269 486	5 035 164
Russia	65 582 851	66 300 000	70 800 000	72 400 000	68 700 000
Serbia	—	—	1 630 000	1 478 000	1 662 000
Serbia and Montenegro	1 175 000	1 292 000	—	—	—
Slovakia	4 454 000	4 485 000	5 093 000	5 082 000	4 489 000
Slovenia	565 000	582 000	628 000	638 000	640 000
Spain	17 700 000	17 825 000	18 391 000	18 998 000	18 640 000
Sweden	5 978 000	5 725 600	5 466 100	5 672 900	5 196 000
Switzerland	1 000 000	1 158 000	1 252 000	1 264 000	1 312 000
Turkey	19 868 118	20 961 240	23 307 523	25 760 889	26 809 050
Ukraine	38 738 000	38 641 000	40 892 000	43 646 655	38 111 250
United Kingdom	13 765 700	13 238 900	13 904 600	14 392 300	13 520 500
Algeria	1 014 000	1 007 000	1 158 000	1 278 000	646 000
Egypt	4 810 000	5 603 000	6 045 000	6 224 000	6 198 000
Libya	1 026 000	1 255 000	1 151 000	1 250 000	1 137 000
Morocco	.	205 000	314 000	512 000	478 000
Nigeria	40 000	100 000	100 000	100 000	100 000
South Africa	9 500 000	9 494 000	9 721 000	9 098 000	8 550 000
Tunisia	69 900	65 700	67 700	60 900	150 000
Zimbabwe	135 000	107 000	24 000	23 000	—
Canada	16 428 000	15 327 000	15 493 000	15 572 000	15 130 000
Cuba	193 151	245 076	257 200	262 400	273 800
Dominican Republic	* 61 000	* 66 000	* 81 000	* 75 000	* 68 000
El Salvador	60 000	48 000	72 000	73 000	70 000
Guatemala	232 000	207 000	292 000	349 000	300 000
Mexico	16 737 037	16 282 299	16 446 939	17 572 676	17 229 615
Trinidad & Tobago	789 800	712 000	673 000	694 600	489 600
USA	99 681 000	94 897 000	98 557 000	98 102 000	91 490 000
Argentina	5 125 200	5 382 000	5 532 700	5 387 600	5 231 000
Brazil	32 909 000	31 610 000	30 901 000	33 782 000	33 716 000
Chile	1 579 000	1 541 000	1 607 000	1 689 000	1 560 000
Colombia	806 000	1 007 000	1 211 000	1 253 000	1 125 000
Ecuador	71 600	82 500	86 400	87 100	129 100
Paraguay	115 200	100 600	103 400	109 100	82 800
Peru	726 300	789 500	900 700	857 000	1 001 900
Uruguay	58 000	64 000	56 700	71 100	85 700
Venezuela	4 561 000	4 907 400	4 692 800	5 005 300	4 224 500

Production of crude steel

tonnes

Country	2004	2005	2006	2007	2008
China	282 911 000	353 239 800	419 148 500	489 660 000	500 488 000
India	32 626 000	45 780 000	49 450 000	53 080 000	55 050 000
Indonesia	3 681 865	3 675 442	3 756 347	4 016 034	3 600 000
Iran	8 682 000	9 404 000	9 789 000	10 051 000	9 964 000
Israel	* 280 000	* 300 000	* 300 000	* 300 000	* 300 000
Japan	112 717 664	112 471 374	116 226 201	120 202 937	118 739 328
Jordan	* 140 000	150 000	150 000	150 000	150 000
Kazakhstan	5 371 698	4 476 642	4 244 521	4 784 105	4 243 582
Korea, Dem P.R. of	* 300 000	* 300 000	* 300 000	* 300 000	* 300 000
Korea, Republic of	47 520 871	47 820 037	48 455 454	51 517 309	53 322 000
Kuwait	* 200 000	* 450 000	* 500 000	* 500 000	* 500 000
Malaysia	5 698 000	5 296 000	5 834 000	6 895 000	6 100 000
Mongolia	35 000	35 000	35 000	35 000	35 000
Pakistan	1 145 000	825 000	1 040 000	1 090 000	1 000 000
Philippines	400 000	470 000	558 000	718 000	1 000 000
Qatar	1 089 000	1 057 000	1 039 220	1 174 917	1 434 652
Saudi Arabia	3 902 000	4 186 000	3 974 000	4 644 000	4 667 000
Singapore	610 000	572 000	607 000	640 000	764 000
Syria	* 70 000	* 70 000	* 70 000	* 70 000	* 70 000
Taiwan	19 592 755	18 563 247	20 093 857	20 898 385	20 210 000
Thailand	4 533 000	5 161 000	4 914 000	5 565 000	5 500 000
United Arab Emirates	* 90 000	* 90 000	* 90 000	* 90 000	* 90 000
Uzbekistan	602 000	595 000	730 000	649 000	682 000
Vietnam	689 000	890 000	1 869 000	2 024 000	2 230 000
Australia	8 104 000	7 789 000	7 937 000	8 047 000	7 625 000
New Zealand	885 000	889 000	810 000	845 000	799 000
World Total	1 072 000 000	1 144 000 000	1 248 000 000	1 347 000 000	1 329 000 000

Note(s)
(1) Unless otherwise indicated, these figures include production from scrap
(2) Small amounts of steel are believed to be produced in Azerbaijan, Burma, DR Congo, Estonia, Ghana, Kenya, Mauritania, Sri Lanka and Uganda

Production of ferro-alloys

tonnes

Country	2004	2005	2006	2007	2008
Albania					
Ferro-chrome	47 700	35 780	17 040	—	8 390
Armenia					
Ferro-molybdenum	* 2 700	* 5 000	* 4 900	5 977	5 323
Austria					
Ferro-molybdenum	4 700	5 000	5 000	5 000	4 500
Ferro-nickel	1 900	2 500	2 500	3 000	2 000
Ferro-vanadium	5 800	6 250	6 250	6 500	6 300
Bulgaria					
Ferro-silicon	* 10 000	* 10 000	* 10 000	* 10 000	* 10 000
Czech Republic					
Ferro-vanadium	* 3 400	* 2 600	* 2 800	* 1 700	* 2 800
Finland					
Ferro-chrome	264 492	234 881	243 350	241 760	233 550
France					
Ferro-manganese & spiegeleisen	110 072	109 111	139 533	98 066	* 100 000
Ferro-silico-manganese	64 100	52 300	63 300	* 65 000	* 65 000
Ferro-silicon	* 87 000	* 67 000	* 67 000	* 71 000	* 70 000
Silicon metal	* 85 000	* 100 000	* 100 000	* 120 000	* 120 000
Georgia					
Ferro-manganese	12 821	13 945	5 130	10 204	* 10 000
Ferro-silico-manganese	93 830	109 414	116 945	107 986	123 468
Germany					
Ferro-chrome	24 857	22 672	26 710	22 030	26 960
Other ferro-alloys	* 26 000	* 25 000	* 20 500	* 20 000	* 20 000
Silicon metal	28 773	29 349	29 865	29 379	29 092
Greece					
Ferro-nickel	90 600	* 96 000	* 89 000	93 300	83 200
Iceland					
Ferro-silicon	119 389	114 844	113 798	114 886	107 882
Italy					
Ferro-manganese	38 000	32 000	* 30 000	* 30 000	* 30 000
Ferro-silico-manganese	108 000	99 000	96 600	87 000	87 000
Macedonia					
Ferro-nickel	5 313	8 141	10 942	15 321	15 026
Ferro-silicon	66 769	71 249	59 023	78 892	97 605
Norway					
Ferro-manganese	* 130 000	* 130 000	* 130 000	* 130 000	* 130 000
Ferro-silico-manganese	* 260 000	* 290 000	* 310 000	* 280 000	* 260 000
Ferro-silicon	389 599	329 316	123 819	170 024	185 344
Other ferro-alloys	* 60 000	* 60 000	* 60 000	* 62 000	* 60 000
Silicon metal	193 566	178 572	* 150 000	* 140 000	* 155 000
Poland					
Ferro-manganese	46 898	7 782	4 089	2 093	8 475
Ferro-silico-manganese	29 600	10 242	3 310	15 590	25 061
Ferro-silicon	83 552	65 118	13 034	58 538	56 031
Other ferro-alloys	1 419	3 663	4 488	6 255	2 948
Romania					
Ferro-chrome	—	—	—	—	6 179
Ferro-manganese	191	18 625	3 777	—	—
Ferro-silico-manganese	194 754	100 957	66 476	26 868	9 979
Russia					
Spiegeleisen	* 7 000	* 7 000	* 7 000	* 7 000	* 7 000
Ferro-chrome	453 639	511 600	500 837	564 474	475 686
Ferro-silico-chrome	83 372	74 150	92 404	97 915	72 050
Ferro-manganese	* 108 000	* 108 000	* 125 000	* 120 000	* 120 000
Ferro-silico-manganese	* 50 000	* 70 000	* 70 000	* 70 000	* 70 000
Ferro-nickel	* 36 000	* 36 000	* 20 795	* 49 000	* 50 000
Ferro-silicon	720 000	* 742 000	* 750 000	* 750 000	* 750 000
Other ferro-alloys	* 36 000	* 34 900	* 35 000	* 35 000	* 35 000
Silicon metal	* 45 000	* 45 000	* 45 000	* 45 000	* 45 000
Slovakia					
Ferro-chrome	1 784	867	19	—	—
Ferro-silico-manganese	64 862	47 843	59 128	71 587	
Ferro-silicon	34 684	16 512	16 155	8 583	20 679
Other ferro-alloys	68 096	48 161	65 498	74 065	
Slovenia					
Ferro-silicon	22 482	15 529	12 550	* 6 000	* —

Production of ferro-alloys

tonnes

Country	2004	2005	2006	2007	2008
Spain					
Ferro-manganese	* 35 000	* 35 000	* 35 000	* 35 000	* 35 000
Ferro-silico-manganese	* 100 000	* 100 000	* 100 000	* 100 000	* 100 000
Ferro-silicon	* 60 000	* 60 000	* 60 000	* 60 000	* 60 000
Silicon metal	* 25 000	* 25 000	* 25 000	* 25 000	* 25 000
Sweden					
Ferro-chrome	127 300	127 500	136 400	124 400	118 700
Ferro-silicon	18 500	9 800	4 600	4 300	—
Turkey					
Ferro-chrome	33 686	26 043	67 975	69 730	75 840
Ferro-silico-chrome	5 560	6 695	7 310	6 624	6 094
Ukraine					
Spiegeleisen	* 5 000	* 5 000	* 5 000	—	—
Ferro-manganese	498 800	359 000	373 000	368 321	361 501
Ferro-silico-manganese	1 088 600	1 045 900	1 168 000	1 281 073	958 667
Ferro-nickel	78 000	* 80 000	* 90 000	95 619	97 848
Ferro-silicon	324 700	227 500	169 000	218 485	201 706
Other ferro-alloys	...	87 985	133 402	53 174	43 127
Egypt					
Ferro-silicon (a)	* 55 000	55 000	* 50 000	* 50 000	* 50 000
Other ferro-alloys (a)	* 30 000	* 30 000	* 30 000	* 30 000	* 30 000
South Africa					
Ferro-chrome	3 031 515	2 811 836	2 893 400	3 551 983	3 268 659
Ferro-manganese	611 914	570 574	* 600 000	* 672 000	* 498 000
Ferro-silico-manganese	373 928	275 324	* 350 000	* 355 000	* 263 000
Ferro-silicon	140 600	127 000	* 140 000	* 140 000	* 137 000
Ferro-vanadium	20 000	19 000	18 000	* 18 000	* 18 000
Silicon metal	50 500	53 500	* 50 000	* 50 108	* 49 146
Swaziland					
Ferro-vanadium	1 150	345	—	—	—
Zimbabwe					
Ferro-chrome	218 065	218 143	200 673	200 833	151 729
Ferro-silico-chrome	987	4 882	1 024	3 097	2 390
Canada					
Ferro-niobium	* 5 300	* 4 800	* 6 400	* 6 500	* 6 600
Ferro-silicon	* 70 000	* 70 000	* 70 000	* 70 000	* 70 000
Silicon metal	* 30 000	* 30 000	* 30 000	* 30 000	* 30 000
Dominican Republic					
Ferro-nickel	75 764	73 962	76 659	75 069	* 54 880
Mexico					
Ferro-manganese	72 471	89 642	64 318	74 578	97 366
Ferro-silico-manganese	103 206	104 780	97 457	109 286	114 320
USA					
Ferro-silicon	170 592	209 000	253 000	271 000	287 000
Silicon metal	144 489	148 000	* 148 000	* 150 000	* 150 000
Argentina					
Ferro-silico-manganese	* 24 000	* 24 000	* 24 000	* 24 000	* 24 000
Ferro-silicon	* 10 000	* 10 000	* 10 000	* 10 000	* 10 000
Brazil					
Ferro-chrome	204 626	185 533	158 585	177 656	209 273
Ferro-silico-chrome	11 560	16 683	8 221	12 943	13 674
Ferro-silico-magnesium	37 031	43 980	31 314	30 221	30 800
Ferro-manganese	179 971	257 083	61 434	135 757	149 900
Ferro-silico-manganese	285 629	341 565	198 753	225 373	238 000
Ferro-nickel	20 338	21 200	27 600	28 900	26 300
Ferro-niobium	35 863	58 616	60 826	71 676	81 600
Ferro-silicon	177 245	199 856	196 814	196 403	183 000
Other ferro-alloys	45 868	42 588	44 280	45 330	47 800
Silicon metal	219 813	229 294	226 380	225 120	219 600
Chile					
Ferro-molybdenum	5 762	...	..	...	..
Colombia					
Ferro-nickel	111 700	122 700	118 900	114 600	216 000

Production of ferro-alloys

tonnes

Country	2004	2005	2006	2007	2008
Venezuela					
Ferro-manganese	* 15 000	* 15 000	* 15 000	* 15 000	* 15 000
Ferro-silico-manganese	* 35 000	* 35 000	* 35 000	* 35 000	* 35 000
Ferro-nickel	67 796	56 300	57 000	* 53 500	* 53 000
Ferro-silicon	* 92 000	* 95 000	* 95 000	* 94 000	* 94 000
Bhutan					
Ferro-silicon	21 147	* 20 000	* 20 000	* 21 000	...
China					
Ferro-chrome	635 000	854 000	1 042 500	1 296 000	1 505 800
Ferro-silico-chrome	105 000	48 000	35 000	38 700	72 300
Other ferro-alloys	7 930 000	9 798 000	13 223 000	16 165 000	16 722 000
Silicon metal	* 660 000	* 650 000	* 730 000	* 820 000	* 820 000
India					
Ferro-aluminium (b)	5 917	7 214	9 947	9 377	8 170
Ferro-chrome (b)	594 994	662 297	801 368	948 601	817 239
Ferro-silico-magnesium (b)	7 092	11 171	11 387	13 525	13 400
Ferro-manganese (b)	270 234	273 057	296 726	391 210	384 577
Ferro-silico-manganese (b)	498 047	596 372	782 962	911 402	891 458
Ferro-molybdenum (b)	2 864	2 827	3 120	2 899	2 162
Ferro-silicon (b)	99 296	90 652	92 632	83 716	99 595
Ferro-titanium (b)	512	735	1 761	1 937	1 661
Ferro-vanadium (b)	826	877	1 139	1 585	1 501
Other ferro-alloys (b)	211	225	409	362	541
Indonesia					
Ferro-manganese	* 12 000	* 12 000	* 12 000	* 12 000	* 12 000
Ferro-silico-manganese	* 7 000	* 4 000	* 5 000	* 6 000	* 6 000
Ferro-nickel	39 538	20 036	14 774	18 532	17 566
Iran					
Ferro-chrome (c)	7 750	* 8 000	* 8 000	* 8 000	* 5 000
Ferro-silicon (c)	50 140	* 50 000	* 50 000	* 50 000	* 50 000
Japan					
Ferro-chrome	13 472	12 367	13 056	12 016	13 888
Ferro-manganese	437 389	448 616	406 162	420 151	431 181
Ferro-silico-manganese	73 041	94 725	59 424	52 901	58 884
Ferro-molybdenum	3 323	4 019	4 229	4 573	4 554
Ferro-nickel	374 213	391 074	335 884	351 503	301 361
Ferro-vanadium	2 178	2 360	2 042	3 205	3 477
Other ferro-alloys	7 321	10 057	13 123	13 982	14 478
Kazakhstan					
Ferro-chrome	1 080 993	1 156 167	1 190 673	1 307 536	1 220 315
Ferro-silico-chrome	104 800	97 870	117 607	145 685	133 828
Ferro-silico-manganese	155 324	170 001	218 323	188 445	179 939
Ferro-silicon	103 580	104 186	85 924	59 886	54 964
Other ferro-alloys	.	...	1 787	1 222	1 473
Korea, Dem. P.R. of					
Ferro-alloys	* 10 000	* 10 000	* 10 000	* 10 000	* 10 000
Korea, Republic of					
Ferro-manganese	165 525	124 000	169 202	209 321	251 125
Ferro-silico-manganese	82 917	74 000	94 119	105 607	76 184
Australia					
Ferro-manganese (a)	133 985	166 513	114 715	133 816	128 000
Ferro-silico-manganese (a)	116 630	96 575	103 207	105 800	126 000
Silicon metal	* 30 000	* 30 000	* 30 000	* 30 000	* 30 000
New Caledonia					
Ferro-nickel	151 296	172 067	180 724	170 870	148 970

Note(s)
(a) Years ended 30 June of that stated
(b) Years ended 31 March following that stated
(c) Years ended 20 March following that stated

Production of kaolin

tonnes

Country	2004	2005	2006	2007	2008
Albania	300 000	310 000	* 300 000	* 300 000	* 300 000
Austria	16 345	16 410	17 431	16 929	16 460
Belgium	* 300 000	* 300 000	* 300 000	* 300 000	* 300 000
Bosnia & Herzegovina	13 500	14 500	69 643	188 033	259 325
Bulgaria	* 190 000	* 200 000	* 240 000	* 240 000	* 220 000
Czech Republic (a)	596 000	649 000	673 000	682 000	672 000
France	316 000	319 464	* 300 000	307 253	* 300 000
Germany (b)	3 751 874	3 767 662	3 815 173	3 842 514	3 622 159
Greece	53 438	49 912	* 40 000	30 000	4 360
Hungary	3 300	1 300	1 350	2 136	—
Italy	246 608	183 804	* 180 000	* 180 000	* 180 000
Poland (c)	130 596	159 207	148 579	153 670	165 615
Portugal	152 077	164 072	167 792	* 170 000	* 170 000
Romania	22 338	26 772	11 063	7 576	3 060
Russia	* 45 000	* 45 000	* 45 000	* 45 000	* 45 000
Serbia	—	—	214 735	97 432	398 917
Serbia and Montenegro	108 000	135 000	—	—	—
Slovakia	46 000	31 000	58 000	46 000	44 000
Spain (c)	437 990	463 398	476 327	426 124	* 430 000
Turkey	536 008	615 271	* 600 000	456 238	232 746
Ukraine (a)	202 300	216 600	251 000	244 000	240 000
United Kingdom (d) (e)	1 944 955	1 910 874	1 762 328	1 671 426	1 355 365
Algeria	27 700	34 386	32 523	106 567	50 788
Egypt	250 000	415 400	* 400 000	331 671	523 327
Eritrea	50	518	118	17	...
Ethiopia (f)	4 251	3 726	1 641	4 000	1 300
Kenya	* 760	* 780	* 780	* 1 000	* 1 000
Nigeria	92 875	* 92 000	96 590	60 000	. .
South Africa	81 901	59 356	51 602	51 218	39 506
Sudan	.	...	11 641	27 846	* 28 000
Uganda	537	55	—	8 152	3 738
Cuba	4 128	3 457	1 700	2 000	—
Guatemala	—	4 107	4 395	28 225	2 803
Mexico	654 711	877 147	961 800	970 598	690 366
USA (g)	7 760 000	7 800 000	7 470 000	7 110 000	* 6 750 000
Argentina	39 072	54 903	49 619	69 354	* 55 000
Brazil (a)	2 381 000	2 410 000	2 455 000	2 480 000	2 670 000
Chile	51 769	15 183	44 642	87 901	63 526
Ecuador	5 646	25 078	11 504	18 618	13 000
Paraguay	* 66 600	* 66 600	* 66 000	* 66 000	* 66 000
Peru	2 720	1 200	1 022	4 772	13 215
Venezuela	* 10 000	* 10 000	* 10 000	* 10 000	* 10 000
Bangladesh (h)	13 113	13 738	19 766	* 20 000	* 20 000
China	3 120 000	3 120 000	3 270 000	2 781 000	* 3 000 000
India (i)(j)	220 262	238 759	273 262	264 444	* 95 000
Indonesia	* 15 000	* 15 000	* 15 000	* 15 000	* 15 000
Iran (k)	596 886	531 109	803 270	947 884	* 950 000
Iraq	.	. .		3 545	1 524
Japan	11 553	* 12 000	* 12 000	* 12 000	* 12 000
Jordan	216 566	168 264	112 787	100 584	181 018
Kazakhstan	* 10 000	* 10 000	5 000	5 000	5 000
Korea, Republic of	936 537	1 074 936	958 836	1 053 576	1 182 299
Malaysia	326 928	494 511	341 223	587 508	506 642
Pakistan (h)	25 204	37 732	53 051	30 979	32 000
Philippines	3 240	6 927	2 232	2 200	2 391
Saudi Arabia	2 135	1 489	3 957	4 415	4 400
Sri Lanka	16 233	9 914	10 914	11 178	10 039
Taiwan	35 001	9 423	4 107	5 060	33 745
Thailand (a)	200 671	156 853	157 900	159 186	162 215
Uzbekistan (i)	* 150 000	* 150 000	* 150 000	* 150 000	* 150 000
Vietnam	741 200	780 000	* 800 000	* 800 000	.

Production of kaolin

tonnes

Country	2004	2005	2006	2007	2008
Australia (h) (l)	285 543	231 611	182 304	213 605	181 655
New Zealand	15 250	15 750	14 864	14 130	12 761
World Total	27 800 000	28 500 000	28 500 000	28 000 000	27 400 000

Note(s)
(1) In addition to the countries listed Denmark is believed to produce kaolin

(a) Beneficiated
(b) Washed and dried
(c) Washed
(d) Sales
(e) Dry weight
(f) Years ended 7 July of that stated
(g) Sold or used by producers
(h) Years ended 30 June of that stated
(i) Beneficiated, excludes directly used natural kaolin
(j) Years ended 31 March following that stated
(k) Years ended 20 March following that stated
(l) Excluding New South Wales

LEAD

Characteristics

Lead is a dense, bluish-white metal with little mechanical strength and virtually no elasticity. It is extremely soft and highly malleable, with a low melting point. When freshly cut the surface has a metallic lustre, but this quickly tarnishes to dull grey when exposed to air. It has poor electrical conductivity compared to other metals. Lead is a potent neurotoxin that accumulates in soft tissues and bone over time, and this has lead to increasing restriction in its usage in recent years.

Lead is rarely found as native (free) metal, but is usually extracted from sulphide ores, in which the most common lead mineral is galena (lead sulphide, PbS). It is usually found in association with other metallic sulphide minerals, most frequently those of zinc and copper, but also precious metals. Silver commonly occurs in galena both in solid solution and as a sulphide phase. Galena is the chief source of commercial silver output. Other economic lead ore minerals include cerussite (lead carbonate, $PbCO_3$) and anglesite (lead sulphate, $PbSO_4$), commonly found as weathering products overlying sulphide ore bodies. In terms of mine output lead is almost always a co-product with other base metals.

Lead is obtained from galena by smelting. This involves roasting the ore to remove the sulphur and to obtain lead oxide, which is then reacted with coke in a furnace. The resulting lead bullion contains many impurities such as silver and gold (hence the name bullion) as well as antimony, arsenic, copper, tin and zinc. These impurities are then removed by various refining steps to obtain pure lead (International Lead Association, 2009).

World reserves of lead are 79 million tonnes, of which Australia holds 24 million tonnes, China 11 million tonnes and USA 7.7 million tonnes (USGS, 2009).

Uses

Current global use of lead (International Lead Zinc Study Group (ILZSG), 2009):

- lead-acid batteries (80 per cent)
- rolled extrusions (6 per cent)
- pigments (5 per cent)
- shot/ammunition (3 per cent)
- alloys (including casting) (2 per cent)
- cable sheathing (1 per cent)
- miscellaneous (3 per cent)

The most important use of lead is in lead-acid batteries which provide ancillary electrical power in virtually all road vehicles and also in electrically-driven vehicles. They also provide emergency power in the event of power failure. Lead's softness and low melting point makes it very easy to work, hence it has a long history of exploitation. Its high resistance to corrosion makes it ideal for weather-proofing buildings and for equipment used in the manufacture of acids. Lead's high density means that it absorbs radiation and noise. It is thus used as radiation shielding in medical applications and the nuclear industry, and in sound-proofing. Lead chromate (yellow) and lead molybdate (red/orange) are used as colouring pigments for ceramic glazes, plastics and to a lesser extent under current legislation, paints e.g. in road paint. Lead oxide (PbO) in glass reduces the transmission of radiation, and glasses for television and computer screens may contain up to 22 per cent PbO. Other minor uses include weights and molten lead is used as a coolant in fast reactors. (Thornton et al., 2001).

Owing to its toxicity, lead use has become more strictly regulated and restricted over the last 30 years. Initially, the change was due to the requirement of US lead consumers to comply with environmental regulations which significantly reduced or eliminated the use of lead in non-battery products, including as a petrol additive, in paints, solders, and water systems. Lead use is being further curtailed by the European Union's RoHS Directive which came into force on 1 July 2006. Lead may still be found in harmful quantities in stoneware, vinyl (such as that used for tubing and the insulation of electrical cords), and in brass manufactured in China. Throughout 2006–2007, many children's toys made in China were recalled due to lead in paint used to colour the product; e.g. the toy firm Mattel recalled 55 000 Chinese-made toys in the US after lead contamination fears (BBC News, 25 October 2007).

World production in 2008

World mined production of lead was four million tonnes in 2008 (metal content). This represents a seven per cent increase since 2007 and a 24 per cent increase since 2004. Primary (mined) lead production is dominated by China, which accounts for nearly 40 per cent of world production, almost two and a half times as much as the next largest lead-mining country, Australia.

Worldwide production of refined lead was 9.4 million tonnes in 2008, a 15 per cent increase over 2007 production. Production has increased 33 per cent since 2004. China is the top producing country with 3.2 million tonnes in 2008. This represents a 15 per cent increase on 2007 and a 67 per cent increase since 2004. The USA was the second largest producer with 1.3 million tonnes (less than half of Chinese production) and Germany, third, with production of 0.4 million tonnes.

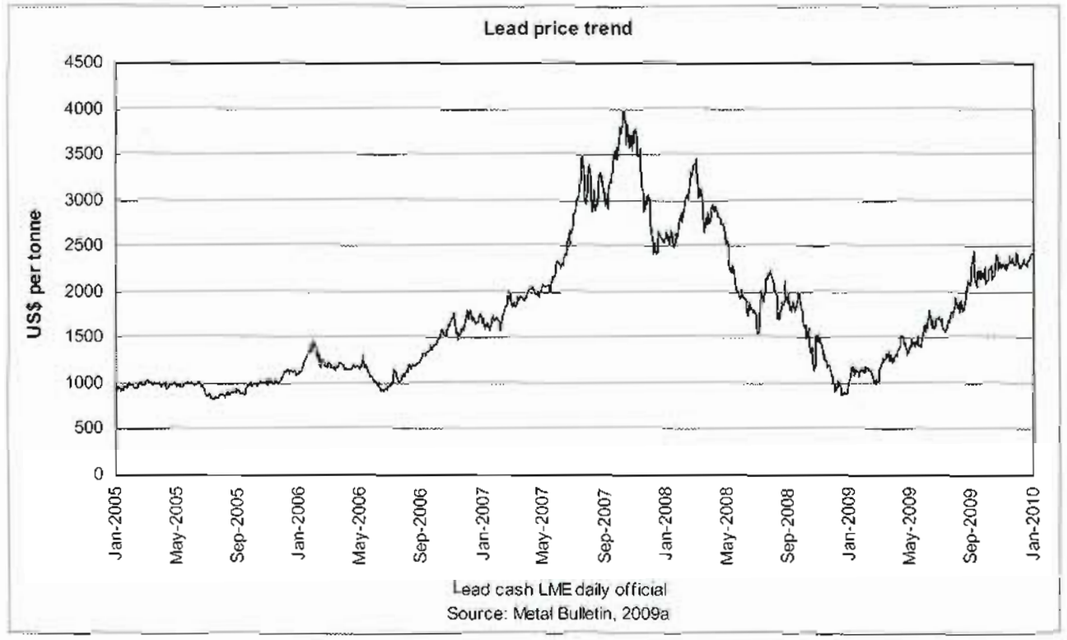
It is estimated that worldwide more than 50 per cent of refined lead produced is from recycled material. Producing lead in this way requires around one third of the energy needed to extract it from its ores (International Lead Association, 2009).

Prices

Prices have more than doubled over the course of 2009; rising from around US$1000 per tonne in January 2009 to around the US$2400 per tonne by the end of the year, almost as high as the price at the beginning of 2008. The prices rose fairly steadily from early March 2009, until October 2009 when they started to level out again (Metal Bulletin, 2009a).

The smelter cuts and closures caused by the low lead prices in the early part of 2009 meant that the market was not swamped with oversupply, which supported the price from dropping further (Metal Bulletin, 2009b). However, the lead market surplus was still a reported 51 000 tonnes according to the ILZSG during the January to October period, compared with a 33 000 tonne deficit over the same period in 2008. These increasing lead stock levels were mainly due to increased Chinese production compensating for the drop-off in the rest of the world (Metal Bulletin, 2009c).

Despite the supply surplus, prices rose on the LME due mainly to speculative interest. This resulted in a price gap between the London and Shanghai metal exchanges (Metal Bulletin, 2009d) encouraging lead imports into China that were up



nearly 1500 per cent compared to 2008. However, by June the gap had narrowed again such that no lead was traded for almost a month in Shanghai (Metal Bulletin, 2009e). By the year end the gap was widening again, thereby encouraging Chinese stockpiling of lead again, even with the 10 per cent export tax (in existence since 2007) still in place (Metal Bulletin, 2009d).

Perhaps surprisingly the unexpected closure of 400–600 thousand tonnes of lead smelting capacity in China due to pollution issues did not have a huge effect on the prices, mainly because the news was followed by the announcement of additional planned Chinese smelter capacity of over one million tonnes coming online to replace them (O'Donovan, 2009).

Industry events in 2009

In the early part of the year, the low lead price forced continuing operational cuts and closures. These included Doe Run which cut mine output by 17 per cent (Metal Bulletin, 2009f), Teck suspending its Pend Oreille Mine in Washington state (Northern Miner, 2008) and in April, Glencore put its Iscaycruz Mine in Peru on temporary suspension citing the still reduced global prices (Metal Bulletin, 2009g). The opening of Xstrata's Handlebar Hill Mine was also delayed, as was the Black Angel Mine in Greenland (White, 2009). It was not until around August that the price had risen high enough to enable the re-start of some of these operations.

It was also in August that lead pollution from smelters was investigated in various Chinese provinces, causing the shutdown of up an estimated 400 000–700 000 tonnes per year of lead smelting capacity (Welch, 2009). However, fewer supply concerns resulted than was expected following the report of an additional Chinese smelter capacity of over one million tonnes coming online to replace them (Metal Bulletin, 2009h). In June, Glencore put its Portovesme lead smelter in Sardina on temporary care and maintenance due to lack of demand (Metal Bulletin, 2009i) and Doe Run shut its La Oroya Smelter in Peru due to concentrate shortages and to perform an environmental clean-up operation, although it was reopened again in September (Metal Bulletin, 2009j).

Meanwhile, also in August, Magellan Metals (a subsidiary of Ivernia Inc) received final approval for the shipment of its lead carbonate concentrate out in leak-proof bags through the port of Freemantle following a lead-poisoning incident last year (Mining Journal, 2009a). They then announced plans to reopen their Magellan mine, which, once it reaches full production, could produce two per cent of the world's lead per year (Metal Bulletin, 2009k). Earlier in the year, Xstrata also received approval to reopen its McArthur River expansion which had been rejected last year following insufficient environmental assessments. The company aims to convert the underground mine to open pit which involves temporarily diverting the course of the McArthur River (Mining Journal, 2009b).

In terms of industry mergers, two that were still unresolved from last year finally did not go ahead: the hostile bid of CBH to take over Perilya, was withdrawn in January (Mining Journal, 2009c) and the HudBay Mineral's attempted merger with Lundin Mining was called off in February after shareholder dissent, the board resigned a month later (Mining Journal, 2009d). In October, Xstrata withdrew its proposed merger with Anglo American, which it had initiated in June (Wilshaw, 2009). The floundering Oz Minerals (formed during the Zinifex and Oxiana merger in July 2008) was taken over by the Chinese company Minmetals following shareholder approval in August 2009 (Ritchie, 2009).

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Mine production of lead

tonnes (metal content)

Country	2004	2005	2006	2007	2008
Bosnia & Herzegovina	900	1 100	1 152	4 633	6 029
Bulgaria	* 19 400	* 18 500	* 16 000	* 17 600	* 15 800
Greece	—	3 000	10 400	13 400	14 000
Ireland, Republic of	63 800	72 200	61 800	56 800	50 200
Italy	800	* 800	* 800	* 800	* 800
Macedonia	—	—	9 349	29 221	40 441
Poland	86 000	78 980	77 450	74 200	61 110
Portugal	—	—	—	—	1 000
Romania	18 297	11 610	6 269	784	—
Russia	23 200	36 400	34 000	48 000	60 000
Serbia	—	—	1 400	1 600	1 600
Serbia and Montenegro	* 900	1 300	—	—	—
Sweden	54 347	60 445	55 644	63 224	63 489
Turkey	18 792	11 341	14 000	14 000	18 000
United Kingdom	* 500	* 400	* 400	* 100	* 100
Morocco	41 400	46 000	41 300	41 976	33 477
Namibia	14 338	14 320	11 830	10 500	14 000
Nigeria	...	400	1 300	4 500	10 700
South Africa	37 485	42 159	48 273	41 857	46 440
Tunisia	5 332	8 407	—	—	—
Canada	76 730	79 254	83 096	75 135	98 974
Guatemala	47	23	28	363	..
Honduras	8 877	10 488	11 775	10 215	12 545
Mexico	118 484	134 388	135 025	137 133	141 173
USA	445 000	436 500	429 300	433 800	423 000
Argentina	9 551	10 683	12 064	17 045	20 788
Bolivia	10 252	11 231	11 955	22 798	81 550
Brazil	14 737	16 063	16 007	15 522	16 000
Chile	2 286	878	672	1 305	3 985
Peru	306 211	319 345	313 332	329 154	345 109
Burma	* 2 000	* 2 000	* 2 000	* 2 000	* 3 000
China	997 200	1 142 000	1 331 000	1 402 000	1 546 000
India (a)	52 200	61 655	67 331	78 887	80 729
Iran (b)	21 000	21 179	30 000	31 864	* 30 000
Japan	5 500	3 400	800	—	—
Kazakhstan	44 135	45 370	48 100	40 200	38 800
Korea, Dem P.R. of	* 20 000	* 20 000	* 25 000	* 35 000	* 35 000
Korea, Republic of	40	50	17	12	225
Vietnam	* 8 100	* 6 900	* 9 500	* 2 400	* —
Australia	674 000	767 000	668 000	641 000	650 000
World Total	3 200 000	3 500 000	3 600 000	3 700 000	4 000 000

Note(s)
(a) Years ended 31 March following that stated
(b) Years ended 20 March following that stated

Production of refined lead

tonnes

Country	2004	2005	2006	2007	2008
Austria	* 26 000	* 24 000	* 22 000	* 22 000	22 000
Belgium	86 000	103 000	101 000	117 000	104 000
Bulgaria	66 000	81 000	76 000	87 000	90 900
Czech Republic	* 25 000	26 000	26 100	26 000	26 000
Estonia	3 000	7 000	9 000	10 000	10 000
France	89 000	* 90 000	* 88 000	* 88 000	82 000
Germany	413 500	417 700	379 000	405 070	415 100
Greece	* 3 000	* —	* 6 000	* 11 000	* 11 000
Ireland, Republic of	19 600	22 500	21 700	22 500	20 000
Italy	201 600	211 000	190 500	211 800	199 900
Macedonia	3 591	—	—	—	—
Netherlands	* 17 000	* 17 000	* 16 000	* 16 000	* 16 000
Poland	73 900	81 000	73 000	104 200	108 300
Portugal	4 000	3 000	3 000	5 000	* 5 000
Romania	37 600	37 900	34 133	39 369	39 596
Russia	66 000	65 700	80 000	103 000	123 000
Serbia and Montenegro	800	—	—	—	—
Slovenia	15 000	15 000	15 000	15 000	15 000
Spain	105 600	110 000	129 000	128 000	125 000
Sweden	73 548	72 760	70 239	69 730	56 812
Switzerland	9 300	9 600	* 9 000	* 9 000	* 8 000
Turkey	* 6 000	* 6 000	* 6 000	* 6 000	* 6 000
Ukraine	* 15 000	61 400	56 300	62 100	54 700
United Kingdom	245 938	304 350	318 703	263 391	283 000
Algeria	* 6 000	* 6 000	* 6 000	* 6 000	* 6 000
Kenya	* 1 000	* 1 000	* 1 000	* 1 000	* 1 000
Morocco	25 000	54 000	45 000	45 000	41 000
Nigeria	* 5 000	* 5 000	* 5 000	* 5 000	* 5 000
South Africa	64 000	65 300	67 000	59 000	62 000
Zambia	500	500	500	500	500
Canada	241 169	230 237	250 464	236 688	259 074
El Salvador	10 000	10 000	10 000	10 000	10 000
Mexico	217 400	213 700	232 300	198 293	206 364
USA (a)	1 262 000	1 293 000	1 297 000	1 303 000	1 280 500
Argentina	49 111	45 607	47 100	46 000	48 400
Brazil (b)	137 121	104 904	142 653	142 540	143 000
Colombia	* 9 000	* 10 000	* 10 000	* 10 000	* 10 000
Peru	118 970	122 079	120 311	116 774	114 259
Venezuela	* 35 000	* 35 000	* 36 000	* 36 000	* 37 000
Burma	300	500	500	200	200
China	1 934 500	2 391 400	2 714 900	2 788 300	3 206 400
India	49 000	59 000	104 000	124 000	138 000
Indonesia	20 000	18 000	18 000	18 000	18 000
Iran	54 000	71 000	74 000	78 000	78 000
Israel	27 000	28 000	25 000	25 000	27 000
Japan	282 900	274 600	280 000	276 300	279 500
Kazakhstan	156 600	135 400	115 974	117 641	105 766
Korea, Dem. P.R. of	9 000	9 000	8 000	7 000	7 000
Korea, Republic of	243 000	256 000	240 000	260 000	270 000
Malaysia	54 000	42 000	44 000	17 000	* 25 000
Pakistan	* 2 000	* 2 000	* 2 000	* 2 000	* 2 000
Philippines	* 29 000	* 30 000	* 30 000	* 34 000	* 34 000
Saudi Arabia	32 000	36 000	38 000	45 000	48 000
Taiwan	* 56 000	* 55 000	* 54 000	* 54 000	* 56 000
Thailand	57 500	61 100	61 160	73 159	73 303
United Arab Emirates	2 000	* 2 000	* 2 000	* 2 000	* 2 000

Production of refined lead

tonnes

Country	2004	2005	2006	2007	2008
Australia	274 000	267 000	241 000	239 000	260 000
New Zealand	* 8 000	* 9 000	* 11 000	* 11 000	* 11 000
World Total	7 000 000	7 700 000	8 100 000	8 200 000	9 400 000

Note(s)
(1) Figures relate to both primary and secondary refined lead and include the lead content of antimonial lead. Metal recovered from materials by remelting alone is excluded

(a) Excluding lead content of primary antimonial lead
(b) Including scrap for direct use

Production of lithium minerals

tonnes

Country	2004	2005	2006	2007	2008
Portugal					
Lepidolite	28 696	26 185	28 497	34 755	35 000
Spain					
Lepidolite	3 226	6 751	8 339	10 326	9 342
Zimbabwe	13 710	37 499	...	...	...
Canada	* 22 500	* 22 500	* 22 500	* 22 500	* 22 500
USA (a)	* 1 500	* 1 500	* 1 500	* 1 500	* 1 500
Argentina (b) (c)	11 273	15 700	16 560	* 17 000	* 20 000
Brazil					
Spodumene	9 064	8 924	8 585	7 991	* 7 500
Chile (c)	43 971	43 595	50 035	59 637	56 881
China	* 36 000	* 37 000	* 37 000	* 38 000	* 40 000
Australia					
Spodumene	118 451	173 635	222 101	245 279	239 528
World Total (Li Content)	15 200	17 100	18 300	20 600	20 600

Note(s)
(1) In addition to the countries listed, Russia also produces lithium minerals

(a) Li content
(b) Chloride
(c) Carbonate

Production of magnesite

tonnes

Country	2004	2005	2006	2007	2008
Austria	715 459	693 754	769 188	811 556	837 476
Greece	552 300	471 000	463 277	351 414	361 165
Netherlands (a)	245 495	285 336	293 006	* 245 000	* 245 000
Poland	57 900	55 300	63 000	65 000	* 60 000
Russia	* 2 600 000	* 2 600 000	* 2 600 000	* 2 600 000	* 2 600 000
Slovakia	965 900	920 100	941 100	957 000	1 347 000
Spain	567 504	556 129	520 646	463 850	* 436 000
Turkey	3 732 952	2 372 206	2 088 033	1 984 908	2 143 047
South Africa	65 900	54 800	* 55 000	* 55 000	* 55 000
Zimbabwe	749	864	939	* 940	* 940
Canada (b)	* 180 000	* 180 000	* 180 000	* 180 000	* 180 000
Guatemala	8 000	5 636	1 084	7 612	.
Brazil (c)	366 174	386 759	382 718	399 314	387 000
Colombia	36 000	38 000	40 000	42 000	* 44 000
China	13 310 000	15 440 000	13 640 000	* 13 600 000	* 13 600 000
India (d)	383 953	340 674	238 981	247 527	247 421
Iran (e)	88 194	94 850	187 764	112 229	* 110 000
Korea, Dem. P.R of	* 1 200 000	* 1 200 000	* 1 200 000	* 1 200 000	* 1 200 000
Pakistan (f)	6 074	3 029	2 446	3 445	4 000
Philippines	3 201	2 413	3 630	3 600	3 976
Saudi Arabia	—	45 000	...		.
Australia	586 393	631 572	482 027	343 424	* 150 000
World Total	25 700 000	26 400 000	24 200 000	23 700 000	24 000 000

Note(s)
(1) In addition to the countries listed, Bulgaria is believed to produce magnesite

(a) Chloride produced from solution mining
(b) Officially described as magnesitic dolomite and brucite
(c) Including beneficiated and directly shipped material
(d) Years ended 31 March following that stated
(e) Years ended 20 March following that stated
(f) Years ended 30 June of that stated

Production of primary magnesium metal

tonnes

Country	2004	2005	2006	2007	2008
Russia	* 35 000	* 38 000	* 35 000	* 33 000	* 30 000
Serbia	—	—	* 500	* 500	* 500
Serbia and Montenegro	* 500	* 500	—	—	—
Ukraine	—	2 900	2 000	2 000	* 2 000
Canada	* 40 000	* 45 000	* 45 000	* 8 000	—
USA	* 30 000	* 40 000	* 40 000	* 40 000	* 40 000
Brazil	3 000	3 000	5 000	5 000	5 000
China	442 400	467 600	525 600	659 300	664 000
India	* 200	* 200	* 200	* 200	* 200
Israel	28 000	27 853	24 581	29 168	32 051
Kazakhstan (a)	18 000	20 000	21 000	* 25 000	* 25 000

Note(s)
(a) Not marketed as metal but used in titanium production

Production of manganese ore

tonnes

Country	2004	2005	2006	2007	2008
Bulgaria	27 800	38 500	20 500	27 900	39 100
Georgia (a)	218 500	251 800	328 643	368 394	* 370 000
Hungary	49 000	50 000	50 000	51 000	49 579
Italy	714	632	...	...	...
Romania	79 130	72 000	60 107	49 350	43 590
Russia	44 400	* 44 000	* 44 000	* 44 000	* 44 000
Turkey	13 751	4 751	. .	...	...
Ukraine (a)	2 273 100	2 260 000	1 606 000	1 720 000	* 1 400 000
Egypt	46 450	22 971	16 500	13 000	7 320
Gabon	2 459 170	2 752 987	2 978 972	3 333 800	* 3 250 000
Ghana	1 597 085	1 719 589	1 578 128	1 173 486	1 090 122
Ivory Coast	—	* 36 500	56 829	80 402	148 120
Morocco	9 000	10 000	2 500	41 628	102 285
Namibia	—	7 320	18 918	47 620	28 237
South Africa					
Metallurgical	4 264 762	4 599 289	5 201 162	5 982 190	6 797 732
Chemical	17 194	12 810	12 176	12 950	9 327
Sudan	...	...	—	400	* 400
Mexico	381 982	371 054	344 662	418 342	477 147
Brazil	3 143 000	3 200 000	3 128 000	1 866 000	3 210 000
Chile	25 801	39 786	37 169	26 808	5 096
China	* 5 500 000	* 7 500 000	* 8 000 000	* 10 000 000	* 14 000 000
India (b)	2 386 396	1 906 353	2 115 507	2 550 560	2 616 000
Iran (c)	128 924	114 708	70 471	103 441	* 100 000
Kazakhstan	2 318 100	2 207 700	2 531 100	2 482 000	2 485 000
Malaysia	...	—	6 500	56 500	536 675
Thailand	4 550	88 500	1 000	9 500	111 000
Australia	3 401 000	3 829 000	4 567 000	5 289 000	4 838 000
World Total	28 400 000	31 100 000	32 800 000	35 700 000	41 800 000

Note(s)
(1) In addition to the countries listed, Colombia, Cuba and Vietnam are believed to produce manganese ore

(a) Marketable
(b) Years ended 31 March following that stated
(c) Years ended 20 March following that stated

Production of mercury

kilograms

Country	2004	2005	2006	2007	2008
Finland	23 500	34 200	22 820	45 195	33 120
Russia	* 50 000	* 50 000	* 50 000	* 50 000	* 50 000
Algeria	67 200	300	—	—	—
Morocco	* 10 000	* 10 000	* 10 000	* 10 000	* 10 000
Mexico	* 15 000	* 6 000	* 8 000	21 355	* 58 000
USA	* 15 000	* 15 000	* 15 000	* 15 000	* 15 000
Chile (a)	* 50 000	* 50 000	* 50 000	* 50 000	* 50 000
China	1 140 000	1 094 000	760 000	798 000	* 600 000
Kyrgyzstan	488 100	304 000	* 250 000	* 250 000	* 250 000
Tajikistan	* 30 000	* 30 000	* 30 000	* 30 000	* 30 000
World Total	1 900 000	1 600 000	1 200 000	1 200 000	1 100 000

Note(s)
(1) Several countries are believed to have unrecorded production of mercury from copper electrowinning processes and by recovery from effluents

(a) From copper solvent extraction and electrowinning processes

Production of mica

tonnes

Country	2004	2005	2006	2007	2008
Finland	9 250	9 500	8 097	11 449	10 706
France (a)	19 000	* 20 000	* 20 000	* 20 000	* 20 000
Russia	8 474	* 9 000	* 11 000	* 12 000	* 10 000
Serbia	—	—	* 140	* 140	* 140
Serbia and Montenegro	140	* 140	—	—	—
Spain (a)	7 825	4 043	4 496	5 569	4 254
Egypt	...	.	..	200	50
Madagascar	* 90	* 90	* 90	* 90	* 90
South Africa	285	924	828	419	393
Canada	* 17 500	* 17 500	* 17 500	* 17 500	* 18 000
Mexico	424	120	150	9 600	5 000
USA (b) (a)	99 000	78 000	110 000	97 000	* 99 000
Argentina	2 518	4 101	6 223	10 171	* 10 000
Brazil	* 4 000	* 4 000	* 4 000	* 4 000	* 4 000
China (c)	* 92 000	* 89 000	* 94 000	* 93 000	* 139 000
India (d)	3 773	2 116	1 411	1 242	1 176
Iran (e)	7 032	6 810	4 440	1 800	..
Korea, Republic of (f)	59 238	36 623	30 356	42 385	49 474
Malaysia (g)	3 544	4 544	5 152	6 118	5 593
Sri Lanka	1 365	1 800	2 600	3 224	2 364
Taiwan	2 979	8 608	4 841	3 387	3 179
Australia	383	737	—	—	—
World Total	340 000	300 000	330 000	340 000	360 000

Note(s)
(1) In addition to the countries listed, Romania is believed to produce mica

(a) Including mica recovered from mica schists and/or kaolin beneficiation
(b) Sold or used by producers
(c) Conservative BGS estimates, based on exports
(d) Years ended 31 March following that stated
(e) Years ended 20 March following that stated
(f) Mainly sericite
(g) Sericite

Mine production of molybdenum

tonnes (metal content)

Country	2004	2005	2006	2007	2008
Armenia	2 950	3 030	4 090	4 385	4 472
Russia	4 800	4 800	4 800	* 4 800	* 4 800
Canada	9 519	7 935	7 723	6 819	9 332
Mexico	3 731	4 245	2 519	6 491	7 812
USA	41 500	58 000	59 800	57 000	* 61 400
Argentina	—	—	—	—	228
Chile	41 883	47 885	43 158	44 775	33 639
Peru	14 246	17 325	17 209	16 787	16 721
China	38 430	30 000	43 900	* 67 700	* 81 000
Iran (a)	1 890	2 476	3 574	8 933	..
Kazakhstan	...	..	400	800	* 800
Kyrgyzstan	* 250	* 250	* 250	* 250	* 250
Mongolia	1 103	1 188	1 404	1 978	1 900
Uzbekistan	* 500	* 575	* 600	* 600	* 600
World Total	161 000	178 000	189 000	221 000	223 000

Note(s)
(1) In addition to the countries listed, Australia, Georgia, India, Democratic P.R of Korea, Romania and Tajikistan are believed to produce molybdenum

(a) Years ended 20 March following that stated

Production of nepheline syenite

tonnes

Country	2004	2005	2006	2007	2008
Norway	329 000	320 000	312 000	312 000	346 000
Russia (a)	1 023 257	* 1 000 000	* 1 000 000	* 1 000 000	* 1 000 000
Canada	699 000	745 000	719 000	690 000	734 000
Iran	63 798	6 000	4 000	75 000	...

Note(s)
(a) Nepheline concentrates

NICKEL

Characteristics

Nickel is hard and corrosion resistant and has a relatively high melting point of 1453°C, nearly as high as that of iron. It is, nevertheless, malleable and ductile allowing it to be readily worked into sheets or wire. It has excellent strength and toughness at extremes temperatures. It has low thermal and electrical conductivities, and is capable of being magnetised although not as strongly as iron. It is very durable as a pure metal, and alloys readily with many other metals.

Nickel occurs in the Earth's crust principally as oxides, sulphides and silicates. The majority of economic nickel deposits occur in two geological environments. These are magmatic sulphide deposits and lateritic deposits. Sulphide deposits may be formed during slow crystallisation of a magma body at depth or in ancient lava flows. The principal ore mineral is pentlandite $[(Ni,Fe)_9S_8]$. Nickel-bearing lateritic ores are formed by tropical and sub-tropical surface weathering. The principal ore minerals are nickeliferous limonite [(Fe,Ni)O(OH)] and garnierite (a hydrous nickel silicate). Mining exploits both sulphide and laterite ores in almost equal proportions although laterites currently account for around 70 per cent of known nickel resources. The rapid development of nickeliferous pig-iron production in China has made the economic exploitation of lower grade oxide ores possible.

Nickel ores are widespread, but the principal nickel mining countries are Russia, Canada, Australia, Indonesia, New Caledonia, Colombia and Brazil. Important nickel refineries treating imported raw materials operate in Norway, Finland, France, Japan and the United Kingdom.

Nickel is normally extracted from sulphide ores using pyrometallurgical processes (smelting) followed by electrolytic refining. Lateritic ores may be smelted directly to ferronickel or treated by hydrometallurgical leaching processes, using either ammonia or acids. New bioleaching methods are currently under development for the treatment of low-grade ores and waste dumps.

Primary nickel is marketed as nickel metal with varying purities, and as nickel oxides. Ferronickel, with a nickel content of 25 to 40 per cent, is an intermediate product that is added to alloy steel melts particularly in the production of stainless steel.

Nickel in the form of scrapped alloy steel or nickel-based alloy is readily recycled, and large tonnages of this material are used to supplement newly mined metal.

Uses

Nickel is used as pure metal only in electroplating applications for corrosion resistance e.g. medical equipment, scissors and cosmetic applications such as domestic fittings and vehicle parts, giving them a hard, tarnish-resistant surface. More than 80 per cent of nickel production is combined with other metals, especially iron, chromium and copper, to form alloys. Nickel adds toughness, strength, rust resistance and other electrical, magnetic and heat resistant properties. Stainless steels containing, typically, 8–12 per cent nickel, account for about two-thirds of nickel consumption (International Nickel Study Group, 2008) and are used in construction, the chemical and food-processing industries and household products. Nickel-based high-performance alloys are critical in the aerospace industry. Nickel is also used in the manufacture of rechargeable (nickel–cadmium) batteries, in computer hard discs, in coinage, jewellery and in electrical components.

World production in 2008

World nickel mine production was 1 531 000 tonnes in 2008, a decrease of 69 000 tonnes or 4.3 per cent from 2007. This is the first time nickel production has dropped since 1999 when it decreased by 26 000 tonnes, 2 per cent, from 1998. The world's largest nickel producer in 2008 was Russia with 277 000 tonnes and 18 per cent of world production. It was followed by Canada with 260 000 tonnes (17 per cent of world production), Australia with 200 000 tonnes (13 per cent) and Indonesia with 180 000 tonnes (12 per cent). These top four producers together contributed nearly 60 per cent of the total world nickel mine output.

Australia's nickel production has increased by nine per cent since 2007 after decreasing slightly in the previous two years. It is once again the world's third largest producer after being temporarily supplanted by Indonesia in 2007. Indonesia's production has fallen by four per cent, the first decrease since 2004. Russia's production has once again decreased and was 13 per cent lower than its peak of 320 000 tonnes in 2006.

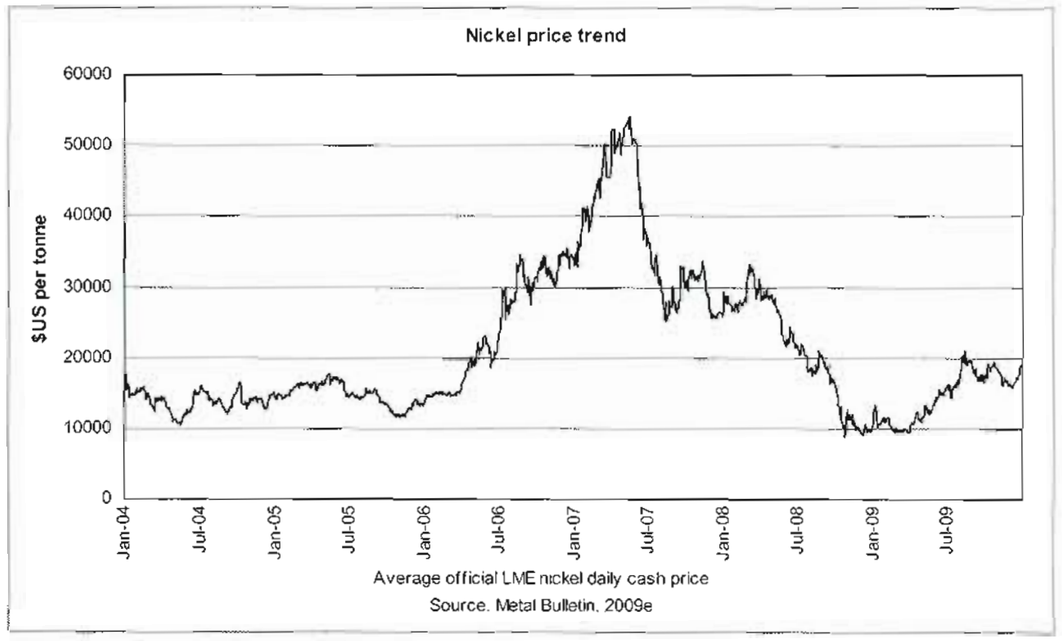
Refinery nickel production has also decreased, with world production of 1 381 000 tonnes, 60 000 tonnes (3.6 per cent) less than in 2007. The largest producer was Russia with 19 per cent of production. China produced 15 per cent of the world's refined nickel despite only producing five per cent of the world's mine production so output is predominantly based on imported raw materials. Other major producers were Canada (12 per cent of world production), Japan (11 per cent) and Australia (8 per cent). Japanese output was entirely based on imported raw materials.

Prices

The price of nickel has experienced periods of volatility over the last twenty years. The price decrease in the first half of the 1990s was attributed to the economic collapse of the former 'Eastern Bloc' countries which caused a surge of nickel exports, driving down nickel prices below the cash costs of production and resulting in reduced nickel production in the 'West' (International Nickel Study Group, 2008a). Until 2003 the nickel cash price remained below US$10 000 per tonne. The price began to escalate dramatically from November 2005, continuing throughout 2006 and into 2007, reaching an all time high of US$54 200 per tonne in May 2007 before falling back by the end of the year. The economic downturn of 2008 pushed the nickel price as low as US$8805 per tonne, more than 600 per cent below the high of 2007.

Nickel is one of the commodities worst hit by the economic downturn with its price falls preceding and lasting longer than those of other base metals. Prices have improved during 2009, mainly driven by improved investment demand, Chinese imports and a recovery in the stainless steel sector (Mineweb, 2009a).

The beginning of 2009 saw a sharp price decrease with prices falling from more than US$13 000 per tonne in early January to US$10 000 per tonne the following week. The price had increased slightly, to just over US$11 000 per tonne, by the beginning of February but declined to around US$9500 per tonne from the middle of February until the end of March. This price decrease was due to London Metal Exchange (LME) warehouse inventories expanding to 88 728 tonnes, the



highest level in over thirteen years (Metal Markets, 2009a). Prices began to rise again in April despite gains in inventories (Metal Markets, 2009b) and continued to gradually increase until the middle of July. During this period nickel traded around US$16 000 per tonne due to increased investor confidence and a weaker US dollar (Metal markets, 2009c).

Prices increased sharply between the beginning and middle of August reaching US$21 000 per tonne despite other base metal prices falling. Nickel gained due to supply disruptions after a strike in Newfoundland and closures for scheduled maintenance at mines and processors in Canada (Metal Markets, 2009d). The improvement in price permitted lower cost new projects to advance, although was not sufficient to bring those with idled capacity back online (Mineweb, 2009a). Following the high of August, the price decreased, averaging about US$18 000 per tonne during September. The price decline was due to higher than normal deliveries into Rotterdam made by Norilsk Nickel leading to elevated nickel stocks on the LME (Metal Bulletin, 2009). The price increased again in mid October reaching US$19 400 per tonne. During November the nickel price gradually fell to about US$16 000 per tonne due to rising warehouse inventories. Despite further stockpile gains in December prices increased again to finish the year at US$18 480 per tonne, an increase of 69 per cent since the beginning of the year.

Although the nickel price has been relatively strong, it remains well below the levels of a couple of years ago. The nickel market remains under pressure due to swollen LME inventories of more than 143 000 tonnes, the highest levels since January 1995 and only 10 000 tonnes less than the record of 15 254 tonnes in November 1994 (Mineweb, 2009b). The gain in LME inventories implies that demand is still weak outside China and unless demand from the stainless steel sector improves the outlook for nickel is not as positive as for some other metals (Mineweb, 2009b).

Industry events in 2009

The nickel industry was one of the hardest hit by the economic downturn and although prices recovered during the year, 2009 has still seen several mine closures and deferments of new projects. The improvement in nickel prices towards the end of 2009 has resulted in some projects restarting and new projects commencing.

Brazilian Vale Inco's production decreased substantially in 2009 due to ongoing strikes at its Voisey's Bay and Sudbury operations in Canada. The strikes started in July after the United Steel Workers and Vale could not reach agreement on a new labour contract (Mineweb, 2009c). Vale Inco shutdown the majority of its Sudbury operations in May due to low demand for nickel. Partial production of copper had resumed by October but not nickel (Metal Bulletin, 2009b). Vale Inco is also being sued by International Royalty and minority partner Altius for reportedly under-reporting millions in net smelter returns. If the lawsuit is successful, International Royalty calculates its share of the royalty underpayment up until 30 June 2009 would exceed US$26 million before the deduction of royalty taxes (Mineweb, 2009c).

During 2009 Xstrata Nickel undertook restructuring of its operations in response to challenging market conditions. It was announced in February that its Canadian Sudbury operations would be restructured resulting in the Fraser Mine complex being placed on care and maintenance, a reduction in shifts at the Strathcona Mill and the Fraser-Morgan development project being deferred. In April the company also planned to mothball its Sinclair Mine in Western Australia and to defer plans for an underground mine on the site. In August the Falcondo ferronickel operations in the Dominican Republic were suspended (Xstrata, 2009). Xstrata has also been affected by labour issues with workers striking at its Sudbury operations in July. This dispute has not yet been resolved although negotiations began in mid December (Mineweb, 2009d).

Norilsk Nickel, the Russia-based world's top nickel producer, closed its Lake Johnston and Black Swan nickel sulphide mines during 2009. These closures, in addition to Silver Swan, Waterloo and Cawse in 2008, mean Norilsk has no nickel production in Australia (Haycock, 2009a).

BHP Billiton, the world's third largest nickel producer, announced in May that it would be placing its Rocky Reward Mine in Western Australia on care and maintenance due to the weak nickel price. Plans were also made to scale down its Mount Keith operation although the company said the economic viability of the mine would be ensured (Haycock, 2009b). BHP Billiton sold its Ravensthorpe nickel laterite project in Western Australia to First Quantum for US$340 million in December (Mineweb, 2009e). The mine is expected to produce 39 000 tonnes of nickel per year for the first five years after operations restart. BHP Billiton spent US$2 billion on the project and mothballed it in February 2009, nine months after commissioning (Mineweb, 2009e). In November First Quantum announced the go-ahead for the Kevitsa project in Finland which will produce mainly nickel but also copper and gold (Mineweb, 2009f).

BHP Billiton sold its Australian Yabulu refinery in July and at the end of December pulled out of a US$2 billion project in the Philippines. BHP Billiton still produces about ten per cent of the world's nickel from its operations in Colombia and Australia but these recent sales suggest BHP Billiton may be looking to exit the nickel business as early as next year (Mineweb, 2009g).

Mincor suspended its Kambalda Mittel operations in Western Australia at the end of 2008 and the mine has been placed on care and maintenance. However, promising drilling results from their South Miitel exploration program are bolstering the case to reopen the mine early next year (Haycock, 2009c).

In October Mirabela Nickel confirmed it had commissioned its Santa Rita nickel sulphide mine which has approval for a production capacity of 6.4 million tonnes of ore per year. The deposit is claimed be the largest disseminated nickel sulphide deposit in South America and the largest greenfield discovery in the past decade. The project is expected to be in full production within a year (Mineweb, 2009h).

Resource figures were released by Duluth Metals for its part of the Duluth Complex, Minnesota, in October with an indicated resource of 550 million tonnes at 0.2% nickel. This complex is thought to represent one of the largest undeveloped repositories of nickel, copper and PGM in the world and may eventually support up to four separate mines (Mineweb, 2009i).

A number of large-scale nickel laterite projects are due to come on stream in the next few years. These include Vale's Goro project in New Caledonia, one of the largest undeveloped lateritic nickel deposits in the world. The project has experienced technical difficulties this year and escalating costs. The project is due to commence in January 2010 with a planned capacity of 60 000 tonnes of nickel per year as well as 3000 to 4000 tonnes of cobalt (Mineweb, 2009j). This project, and others like it, depends on the viability of the high pressure acid leach (HPAL) production technique. If this method proves effective these new projects could result in large supply increases with a significant impact on the nickel price (Metal Bulletin, 2009d).

European Nickel is seeking financing for its Çaldag nickel laterite project in Turkey. Jiangxi Rare Earth and Rare Metals Tungsten Group Co Ltd signed a heads of agreement in July and at the end of December JP Morgan Asset Management increased its holding to 10.15 per cent (Mining Journal, 2009a). The project is ready to be developed when funding is secured (Metal Bulletin, 2009c). Once in production this deposit is planned to produce 20 400 tonnes of nickel per year in the form of intermediate mixed hydroxide. It will be the world's first commercial-scale nickel laterite heap-leach operation (European Nickel, 2009)

Brazil has a highly prospective nickel laterite province, in the region of Para towards the north of the country, with several new projects currently under feasibility study such as the Serra do Tapa and Vale dos Sonhos. Exploration at Horizonte's Lontra project has demonstrated promising results with the best interval showing 13.83 metres at 1.4% nickel (Mineweb, 2009k).

The Indonesian North Maluku nickel laterite project being developed by Weda Bay Minerals consortium (made up of Japan's Miitsubishi and France's Eramet and Antam) is expected to come on stream, at the end of 2011, a year ahead of schedule (Mineweb, 2009l).

Intex Resources is planning to spend an estimated US$2.9 billion on a HPAL facility for their Mindoro project in the Philippines. The first stage of the plant is planned to produce up to 40 000 tonnes of nickel per year and 80 000 tonnes by the second stage (Mineweb, 2009l). Beron Nickel Corporation's laterite operation in the Philippines was closed in February due to poor demand and falling prices (Mining Journal, 2009b).

Heron Resources has continued exploration on its five nickel laterite deposits which make up part of their Kalgoorlie project in Western Australia. The resource estimate was updated to 959 million tonnes at 0.74% nickel (MiningNews.net, 2009). Metal X completed its feasibility study on the Wingellina laterite deposit in Australia in 2008 and is currently working towards obtaining environmental and mining approvals (Svircas, 2009).

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Mine production of nickel

tonnes (metal content)

Country	2004	2005	2006	2007	2008
Finland	3 400	3 400	3 000	3 600	4 000
Greece	19 000	20 400	21 700	21 200	18 600
Macedonia	4 900	7 800	10 900	15 000	15 000
Norway	382	342	320	378	377
Russia	315 000	315 000	320 000	279 800	277 000
Spain	—	5 380	6 398	6 630	8 136
Turkey	—	700	1 900	1 700	—
Ukraine	* 6 000	* 6 000	* 12 000	* 12 000	* 8 000
Botswana	22 292	28 212	26 762	22 844	28 940
Morocco	100	100	100	100	100
South Africa (a)	39 851	42 497	41 599	37 877	31 700
Zimbabwe	9 776	7 799	8 825	8 582	6 400
Canada	186 694	198 932	232 948	254 915	259 588
Cuba	71 900	* 73 800	73 400	73 900	67 300
Dominican Republic	29 242	28 298	29 675	29 100	18 800
Brazil	44 928	74 198	82 492	58 317	58 500
Colombia	75 100	89 000	94 100	100 500	77 000
Venezuela	19 000	18 500	18 200	17 200	11 900
China	75 600	72 700	82 100	66 400	71 500
Indonesia	142 700	150 000	150 000	188 400	180 300
Kazakhstan	—	* 500	* 1 000	* 1 200	* 1 600
Philippines	16 973	22 560	64 705	91 367	83 895
Australia	187 000	189 000	185 000	184 000	200 000
New Caledonia	119 199	111 939	102 986	125 364	102 583
World Total	1 389 000	1 467 000	1 570 000	1 600 000	1 531 000

Note(s)
(a) Includes metal and metal content of sulphate and concentrates

Smelter/refinery production of nickel

tonnes

Country	2004	2005	2006	2007	2008
Austria	1 300	1 000	900	900	900
Finland	49 580	39 159	47 469	55 000	51 963
France	12 103	12 684	13 700	14 800	13 500
Greece	18 116	19 235	17 700	18 668	16 640
Macedonia	5 300	8 100	10 900	15 000	15 000
Norway	71 410	85 374	82 257	87 600	88 700
Russia	265 500	273 700	278 600	269 800	256 500
Ukraine	4 800	13 000	15 900	20 600	24 700
United Kingdom	38 600	37 100	36 800	34 050	38 700
South Africa	39 851	42 392	41 600	37 900	31 700
Zimbabwe	16 200	15 900	13 200	14 000	11 300
Canada	151 518	139 683	146 899	153 647	167 732
Cuba	38 800	39 100	* 42 000	* 41 500	35 600
Dominican Republic	29 477	28 668	29 675	29 130	18 782
Brazil	32 101	36 315	36 569	34 954	36 000
Colombia	48 016	52 749	51 137	49 312	41 638
Venezuela	19 000	18 500	18 200	17 200	11 900
China	72 600	97 800	136 600	199 300	200 300
Indonesia	7 945	7 300	14 474	18 532	17 566
Japan	169 500	163 243	149 954	161 200	156 500
Australia	122 000	121 000	116 000	114 000	108 000
New Caledonia	43 016	46 738	48 723	44 954	37 467
World Total	1 257 000	1 299 000	1 349 000	1 432 000	1 381 000

Note(s)
(1) Data relate to refined nickel plus the nickel content of ferro-nickel, nickel oxide and nickel salts

Production of perlite

tonnes

Country	2004	2005	2006	2007	2008
Armenia	29 996	49 963	* 50 000	* 50 000	* 50 000
Bulgaria	8 500	15 300	4 500	13 900	7 400
Georgia	* 5 000	* 5 000	* 5 000	—	—
Greece	1 053 388	1 075 129	* 1 100 000	1 100 000	1 000 000
Hungary	65 000	69 900	71 019	67 542	132 000
Italy	* 60 000	* 60 000	* 60 000	* 60 000	* 60 000
Russia	* 45 000	* 45 000	* 45 000	* 45 000	* 45 000
Slovakia	23 840	8 630	10 560	20 000	25 000
Turkey	133 829	156 935	* 160 000	* 160 000	* 160 000
Ukraine	* 26 000	38 200	36 400	* 36 000	* 36 000
South Africa	* 400	* 400	* 400	* 400	* 400
Mexico	188 027	91 724	81 719	54 405	43 180
USA	508 000	508 000	454 000	409 000	* 449 000
Argentina	21 193	21 991	25 146	35 838	* 40 000
China	* 700 000	* 700 000	* 700 000	* 700 000	* 700 000
India (a)	355	122	68	—	—
Iran (b)	31 259	30 051	30 050	47 422	* 47 000
Japan	* 240 000	* 240 000	* 240 000	* 230 000	* 230 000
Philippines	12 100	9 700	9 600	9 900	10 100
Thailand	26 400	14 500	22 000	6 400	7 000
Australia (c)	9 952	10 634	12 057	8 546	6 942
New Zealand	5 600	7 310	3 552	7 873	—

Note(s)
(1) In addition to the countries listed, Algeria, Canada, Iceland, Mozambique and former Yugoslavia are believed to produce perlite

(a) Years ended 31 March following that stated
(b) Years ended 20 March following that stated
(c) Years ended 30 June of that stated

Production of crude petroleum

tonnes

Country	2004	2005	2006	2007	2008
Albania	399 740	349 116	316 190	281 147	* 210 000
Austria	981 588	933 040	856 270	853 549	861 639
Azerbaijan	15 348 800	22 214 200	32 185 900	42 523 200	44 395 400
Belarus	1 804 040	1 785 020	1 780 040	1 760 020	1 740 020
Bulgaria	33 100	30 000	27 500	25 700	23 000
Croatia	1 037 787	980 486	950 859	911 207	867 027
Czech Republic	299 000	306 000	259 000	240 000	236 000
Denmark	19 446 000	18 822 000	17 068 000	15 552 000	14 338 000
Estonia (a)	1 314 000	1 690 000	1 624 000	1 901 600	1 845 200
France	1 288 000	1 179 000	1 100 000	1 013 000	975 000
Georgia	97 600	66 600	63 506	63 850	95 219
Germany	3 515 537	3 815 173	3 514 284	3 414 590	3 053 998
Greece	143 000	135 000	93 000	80 000	66 000
Hungary	1 076 844	947 542	886 000	838 672	774 590
Italy	5 445 000	6 100 000	5 800 000	5 800 000	5 200 000
Lithuania	301 874	216 634	180 894	154 449	127 658
Netherlands	2 890 979	2 268 746	2 022 475	2 576 222	2 162 000
Norway	150 974 000	139 802 000	136 695 000	125 763 000	116 864 000
Poland	886 188	847 844	795 742	720 603	754 907
Romania	5 462 000	5 215 000	4 777 000	4 837 000	4 528 000
Russia	459 000 000	470 000 000	481 000 000	491 000 000	488 000 000
Serbia	—	—	654 288	639 089	636 383
Serbia and Montenegro	652 270	648 000	—	—	—
Slovakia	42 410	35 000	30 520	23 000	21 000
Spain	262 707	166 014	143 432	143 123	127 285
Turkey	2 275 529	2 280 764	2 175 353	2 131 288	2 222 594
Ukraine	4 314 200	4 413 800	4 506 000	4 459 000	4 328 000
United Kingdom	88 715 159	78 162 720	70 896 809	70 959 333	65 293 585
Algeria	81 760 000	84 821 000	85 036 000	86 100 000	85 600 000
Angola	48 200 000	61 200 000	69 700 000	84 300 000	92 200 000
Cameroon	4 500 000	4 200 000	4 400 000	4 200 000	4 300 000
Chad	8 800 000	9 100 000	8 000 000	7 500 000	6 700 000
Congo	11 209 000	12 700 000	13 500 000	11 500 000	12 900 000
Congo, Democratic Republic	1 380 000	1 230 000	1 230 000	* 1 105 000	995 273
Egypt	35 400 000	33 990 000	33 700 000	34 100 000	34 600 000
Equatorial Guinea	17 100 000	18 500 000	17 700 000	18 200 000	17 900 000
Gabon	11 800 000	11 700 000	11 700 000	11 500 000	11 800 000
Ghana	351 000	301 000	301 000	301 000	301 000
Ivory Coast	1 754 000	1 954 000	3 106 000	2 423 000	2 965 000
Libya	76 600 000	82 100 000	85 600 000	86 000 000	86 200 000
Mauritania	—	—	1 523 000	739 507	592 679
Morocco	32 300	32 300	11 200	11 100	9 000
Nigeria	124 266 540	125 347 780	120 000 000	114 200 000	105 300 000
Senegal	27 300	50 600	52 400	42 900	13 400
South Africa	1 060 000	1 113 500	721 000	502 000	403 000
Sudan	14 900 000	15 000 000	16 300 000	23 100 000	23 700 000
Tunisia	3 400 000	3 459 000	3 261 300	4 545 800	* 4 200 000
Barbados	51 696	47 861	47 133	40 253	39 760
Canada	122 500 000	127 400 000	131 600 000	137 300 000	135 600 000
Cuba	3 253 000	2 935 100	2 900 000	2 905 000	3 003 100
Guatemala	1 024 000	933 000	816 000	774 500	715 400
Mexico	197 750 000	194 390 000	190 410 000	179 450 000	163 220 000
Trinidad & Tobago	6 332 472	7 444 890	7 355 280	6 183 900	5 904 500
USA	333 800 000	318 580 000	315 576 700	315 244 529	309 499 555
Argentina	35 910 829	34 117 773	33 806 223	32 959 940	32 365 564
Bolivia	1 891 000	1 957 000	1 888 000	1 907 000	1 806 400
Brazil	79 820 000	88 600 000	93 600 000	94 800 000	98 500 000
Chile	183 000	171 000	150 000	132 000	137 000
Colombia	27 200 000	27 100 000	27 200 000	27 400 000	30 300 000
Ecuador	26 826 000	27 085 000	27 291 000	26 021 000	25 765 000
Peru	4 637 000	5 484 000	5 696 000	5 612 000	5 916 000
Suriname	661 000	707 000	774 000	877 500	951 000
Venezuela	150 000 000	151 000 000	144 200 000	133 900 000	131 600 000

Production of crude petroleum

tonnes

Country	2004	2005	2006	2007	2008
Afghanistan	.	.	.	* 3 000	* 3 000
Bahrain	1 867 000	1 822 000	1 790 000	1 721 000	1 368 000
Brunei	10 300 000	10 100 000	10 903 000	9 639 000	8 500 000
Burma	1 044 000	1 100 000	1 080 000	1 080 000	* 1 100 000
China (b)	175 873 300	181 352 900	184 765 700	186 656 900	189 728 200
East Timor	168 000	136 000	119 000	57 000	...
India (c)	34 015 000	32 190 000	33 988 000	34 117 000	33 505 000
Indonesia	54 870 000	52 943 000	50 281 000	47 719 000	49 140 000
Iran	209 700 000	206 200 000	208 000 000	209 700 000	209 800 000
Iraq	100 000 000	90 000 000	98 100 000	105 300 000	119 300 000
Israel	3 155	3 114	3 500	11 700	2 200
Japan	783 000	834 000	818 000	876 000	899 000
Jordan	1 200	1 200	1 400	1 200	2 200
Kazakhstan	59 484 800	61 486 000	65 003 100	67 125 300	70 671 000
Kuwait (d)	122 300 000	129 300 000	132 700 000	129 900 000	137 300 000
Kyrgyzstan	73 800	100 000	100 000	100 000	...
Malaysia	36 400 000	33 600 000	31 900 000	32 600 000	33 200 000
Mongolia	29 700	28 000	52 000	117 000	162 000
Oman	38 900 000	38 600 000	36 750 000	35 350 000	37 700 000
Pakistan (e)	3 017 000	3 216 000	3 191 000	3 282 000	4 747 000
Philippines	624 000	794 000	728 000	815 000	902 000
Qatar	46 000 000	47 300 000	50 900 000	53 600 000	60 800 000
Saudi Arabia (d)	506 000 000	526 800 000	514 300 000	494 200 000	515 300 000
Syria	24 700 000	22 531 000	19 427 500	18 600 000	18 900 559
Taiwan	44 563	32 389	23 564	17 778	16 134
Tajikistan	18 900	21 700	23 700	24 400	* 24 000
Thailand	8 300 000	9 900 000	11 400 000	11 500 000	12 400 000
Turkmenistan	9 600 000	9 500 000	9 200 000	9 800 000	10 200 000
United Arab Emirates	124 700 000	129 000 000	139 000 000	136 400 000	139 500 000
Uzbekistan	6 600 000	5 400 000	5 400 000	4 900 000	4 800 000
Vietnam	20 051 000	18 519 000	16 800 000	15 920 000	14 850 000
Yemen, Republic of	19 329 000	19 132 000	17 429 000	15 300 000	14 100 000
Australia	20 748 000	21 439 000	20 605 000	21 567 000	21 569 000
New Zealand	913 600	855 000	819 000	1 875 000	2 709 000
Papua New Guinea	1 984 000	2 191 000	2 290 000	2 153 000	1 950 000
World Total	3 841 000 000	3 875 000 000	3 897 000 000	3 887 000 000	3 911 000 000

Note(s)
(1) The figures shown in this table include natural gas liquids

(a) From oil shale
(b) Including oil from shale and coal
(c) Years ended 31 March following that stated
(d) Including shares of production from the Neutral Zone
(e) Years ended 30 June of that stated

Production of natural gas

million m^3

Country	2004	2005	2006	2007	2008
Albania	12	11	11	11	13
Austria	2 011	1 654	1 765	1 835	1 544
Azerbaijan	4 995	5 732	6 080	10 832	16 337
Belarus	245	228	219	201	203
Bulgaria	333	573	519	295	218
Croatia	2 198	2 384	2 714	2 892	2 625
Czech Republic	175	356	148	148	167
Denmark	8 946	9 909	9 861	8 760	9 564
France	1 325	1 089	1 167	1 023	925
Georgia	11	15	21	18	33
Germany	20 381	19 143	19 798	18 075	16 547
Greece	23	16	* 16	21	14
Hungary	3 112	3 041	3 254	2 653	2 703
Ireland, Republic of (a)	848	570	500	519	506
Italy	12 961	11 977	11 000	9 700	9 300
Netherlands	81 499	74 460	73 300	72 431	80 388
Norway	78 351	84 702	87 600	89 700	99 200
Poland	5 630	5 742	5 651	5 653	5 382
Romania	13 246	12 637	12 422	11 981	11 520
Russia	633 000	641 000	656 000	653 000	664 000
Serbia	—	—	280	274	282
Serbia and Montenegro	318	282	—	—	—
Slovakia	179	211	135	195	111
Slovenia	6	6	4	3	3
Spain	370	174	118	22	46
Turkey	344	484	307	839	894
Ukraine	20 192	20 787	21 094	21 104	21 444
United Kingdom	101 571	93 505	84 748	77 350	75 382
Algeria	82 009	89 235	88 209	* 84 827	* 86 505
Angola	750	650	680	830	680
Egypt	33 000	42 500	54 700	55 700	58 900
Equatorial Guinea	412	678	438	1 369	* 1 300
Gabon	144	151	155	167	* 170
Ivory Coast	2 000	2 200	2 200	1 574	* 1 500
Libya	8 060	11 300	13 195	15 280	15 900
Morocco	40	40	56	61	50
Nigeria	22 388	22 400	28 500	32 500	32 825
South Africa	1 800	1 900	1 700	1 600	1 500
Tunisia	2 827	2 873	2 394	2 285	...
Barbados	21	24	23	* 21	* 21
Canada	175 364	176 510	176 808	174 334	167 515
Cuba	704	743	1 091	1 218	1 161
Mexico	42 700	45 000	51 600	54 000	54 900
Trinidad & Tobago	29 628	33 270	40 082	41 766	42 910
USA (b)	526 000	511 000	524 000	540 000	582 000
Argentina	52 385	51 573	51 778	51 007	50 509
Bolivia	10 257	12 536	13 433	14 301	14 895
Brazil	11 900	12 200	12 700	12 710	15 510
Chile	2 106	2 394	2 199	2 015	1 828
Colombia	6 400	6 700	7 000	7 500	9 100
Ecuador	170	255	283	295	* 300
Peru	849	1 586	1 784	* 2 700	* 3 200
Venezuela	28 400	27 400	31 500	32 100	31 500
Afghanistan	.	* 50	* 50	* 50	* 50
Bahrain	11 595	12 692	13 436	11 433	12 320
Bangladesh (c)	12 827	13 783	14 921	15 920	17 015
Brunei	12 200	12 000	12 135	11 718	12 100
Burma	10 200	12 200	12 600	13 500	12 400
China	41 460	49 320	58 553	69 200	76 100
East Timor	* 4 000	* 4 000	4 132	4 826	..
India (d)	30 820	32 202	31 747	32 274	31 804
Indonesia	85 839	84 571	80 501	76 703	78 516
Iran	89 663	103 500	108 600	111 900	116 300
Iraq	1 000	1 450	1 450	1 460	1 880

Production of natural gas

million m^3

Country	2004	2005	2006	2007	2008
Israel	1 192	1 656	2 313	2 758	3 436
Japan	2 794	3 263	3 302	3 708	3 735
Jordan	294	242	251	220	...
Kazakhstan	11 598	14 023	26 382	29 562	32 889
Kuwait (e)	10 900	12 300	12 410	12 060	12 700
Kyrgyzstan	29	30	20	10	...
Malaysia	53 670	59 880	59 640	60 780	57 630
Oman	18 000	19 600	25 657	26 107	25 968
Pakistan (c)	34 058	38 085	39 645	40 028	41 178
Philippines	2 480	3 285	3 077	3 689	3 883
Qatar	33 300	45 800	50 700	63 200	76 600
Saudi Arabia (e)	65 680	71 240	73 461	74 420	80 440
Syria	8 200	6 300	8 272	7 825	7 574
Taiwan	796	548	463	417	357
Tajikistan	34	27	18	15	...
Thailand	22 317	23 676	24 492	25 538	27 267
Turkmenistan	52 800	57 000	60 400	65 400	66 100
United Arab Emirates	46 290	47 790	48 790	50 290	50 240
Uzbekistan	59 900	59 700	55 400	59 100	62 200
Vietnam	6 269	6 440	7 000	7 080	7 944
Australia	35 257	37 129	38 885	39 955	38 256
New Zealand	4 115	3 862	3 983	4 310	3 995
Papua New Guinea	156	154	153	126	148
World Total	2 802 000	2 884 000	2 988 000	3 045 000	3 155 000

Note(s)
(1) So far as possible the figures in this table exclude flared or reinjected gas

(a) Sales
(b) Dry gas
(c) Years ended 30 June of that stated
(d) Years ended 31 March following that stated
(e) Including one-half of the output of the Neutral Zone

Production of phosphate rock

tonnes

Country	2004	2005	2006	2007	2008
Finland	838 000	822 987	857 922	830 989	780 000
Russia	11 345 300	11 317 400	10 812 800	10 936 500	9 810 200
Algeria	784 000	902 300	1 510 233	1 800 025	1 805 000
Burkina Faso	2 400	* 2 400	* 2 400	* 2 400	* 2 400
Egypt	2 218 900	2 620 900	2 176 900	2 504 000	3 178 900
Morocco	26 675 000	28 788 000	27 097 000	27 834 000	24 861 000
Senegal					
Phosphate rock	1 576 000	1 451 000	584 000	691 300	645 000
Aluminium phosphate (a)	1 600	1 520	1 500	* 1 500	* 1 500
South Africa	2 735 150	2 576 885	2 628 714	2 555 723	2 286 794
Tanzania	6 570	7 096	2 881	8 261	28 684
Togo	1 115 200	1 047 893	1 156 500	750 100	842 500
Tunisia	8 050 800	8 220 400	7 838 000	8 002 000	7 691 700
Zimbabwe	83 391	45 705	65 838	54 800	23 600
Canada	1 064 000	888 000	530 000	682 000	983 000
Mexico	350	350	7 500	47 721	969 094
USA	35 800 000	36 300 000	30 100 000	29 700 000	* 30 900 000
Brazil (b)	5 689 000	5 631 000	5 932 000	6 185 000	6 343 000
Chile	21 465	20 363	13 836	25 073	41 186
Colombia	* 43 000	* 43 000	* 43 000	* 43 000	* 43 000
Peru	45 504	—	—	—	—
Venezuela	300 057	392 000	400 000	* 400 000	* 400 000
China	26 174 300	30 444 900	38 959 500	45 417 000	50 740 600
Christmas Island (c) (d) (e)	655 474	757 013	724 278	703 719	* 700 000
India (f)	1 722 983	2 049 277	1 586 843	1 859 851	1 753 000
Iran	229 575	284 166	351 656	252 903	* 250 000
Israel	3 290 000	3 236 000	2 949 000	3 069 000	3 088 000
Jordan	6 222 775	6 374 725	5 804 991	5 552 000	6 266 000
Kazakhstan	1 706 500	1 534 100	1 059 300	1 044 900	2 470 600
Korea, Dem. P.R. of	* 100 000	* 100 000	* 100 000	* 100 000	* 100 000
Pakistan (e)	4 614	2 687	2 996	3 350	* 3 000
Philippines					
Phosphate rock	2 380	2 178	1 963	1 961	2 271
Guano	220	140	213	209	254
Sri Lanka	43 520	41 978	42 159	40 128	41 947
Syria	2 882 420	3 500 000	3 664 000	3 678 000	3 221 379
Thailand	2 580	3 020	900	3 550	3 675
Uzbekistan	482 000	468 000	573 000	599 500	700 000
Vietnam	905 000	1 024 200	1 232 400	1 522 700	2 098 900
Australia	2 015 597	1 935 630	2 083 454	2 131 045	2 156 848
Nauru (c)	* 29 000	* 18 000	* 84 000	* 200 000	497 469
World Total	145 000 000	153 000 000	151 000 000	159 000 000	166 000 000

Note(s)
(1) In addition to the countries listed, Indonesia is believed to produce phosphate rock

(a) Including lime phosphates
(b) Including beneficiated and directly shipped material
(c) Exports
(d) Including phosphate dust
(e) Years ended 30 June of that stated
(f) Years ended 31 March following that stated

PLATINUM GROUP METALS

Characteristics

Platinum is a rare, silvery greyish-white metal that is heavier than gold, corrosion resistant, and highly ductile. Platinum is one of the platinum group metals (PGM) series, consisting of platinum, palladium, rhodium, ruthenium, osmium and iridium. These metals have certain similar chemical and physical properties and are relatively inert.

Platinum sometimes occurs as the native metal but more commonly occurs in alloys with the other PGM and other metals. Platinum also forms numerous minerals in combination with sulphur, antimony, arsenic, bismuth and tellurium. Among the most common platinum-bearing minerals are sperrylite ($PtAs_2$), Pt-Fe alloys, cooperite (PtS), braggite (PtPdS) and moncheite ($PtTe_2$). Platinum deposits are rare and occur mainly in mafic and ultramafic igneous rocks in which they are concentrated by high-temperature magmatic processes. Secondary occurrences of platinum consist of placer deposits, which are produced from eroded igneous host rocks and concentrated by streams or rivers.

Many commercially exploited platinum deposits are associated with copper and/or nickel sulphides, such as chalcopyrite, pyrrhotite and pentlandite, or with chromite.

Uses

Approximately 50 per cent of both platinum and palladium produced is used in catalytic converters in vehicle exhaust systems where they help to reduce pollutants. The other significant uses for PGM are in jewellery and in a wide range of industrial applications.

Platinum is often blended with palladium, which is much cheaper, when used in catalytic converters. However, increasingly stringent environmental legislation has led to rising demand for platinum since it is more effective than palladium in removing harmful gases from the combustion process. This is especially true for diesel engines that have recently gained in popularity in some countries and require a higher proportion of platinum in their catalysts than do petrol engines.

Platinum is also used extensively in jewellery. Platinum jewellery is traditionally most popular in Japan, although the rising use of white gold, which contains platinum, has increased demand in the West. Palladium is also used in jewellery, either on its own or as a component of white gold. Demand for palladium jewellery is increasing and it is now the third most important use of the metal after autocatalysts and electronics.

Platinum is becoming increasingly important in the electronics industry where the metal is used in hard disc drives and LCD monitors. Palladium is used mainly in multi-layer ceramic capacitors (MLCC) but also in hybrid integrated circuits (HIC) and plating for connectors inside computers.

The chemical industry uses a large amount of platinum as a catalyst in the manufacture of fertilisers, explosives, polymers and in oil refining. Platinum is also used within the pharmaceutical industry in anti-cancer drugs. A growing, and potentially major use of both platinum and palladium, is in fuel cells where electricity is produced as a by-product of a chemical reaction between hydrogen and oxygen catalysed by PGM.

World production in 2008

Demand for platinum fell by five per cent in 2008 to 6.35 million troy ounces, as many sectors were affected by the economic slowdown. Despite the recession, palladium demand increased during 2008, by 15 000 troy ounces to 6.85 million troy ounces. Demand for ruthenium, iridium and rhodium fell in 2008 (Johnson Matthey, 2009a).

World production of platinum decreased in 2008 for the second consecutive year with total output of 189 000 kilograms, a nine per cent decrease from 2007 and 13 per cent lower than its peak production of 216 000 kilograms in 2006. Palladium shows the same trend with world production of 194 000 kilograms, a drop of 11 per cent from 2007 and 12 per cent lower than the 219 000 kilograms produced in 2006.

South Africa dominated the world's platinum production in 2008 with 77 per cent (146 000 kilograms) of global output provided by the Bushveld Complex. Russia followed with 13 per cent of world production (25 000 kilograms). Canada produced four per cent and Zimbabwe three per cent.

Russia was the largest palladium producer in 2008 with an output of 88 000 kilograms, 45 per cent of world production. South Africa produced 86 000 kilograms (39 per cent), followed by Canada with 13 000 kilograms (7 per cent) and the USA with 12 000 kilograms (6 per cent).

South Africa's platinum production declined in 2008 for the third consecutive year with a decrease of 20 000 kilograms, or 12 per cent, from 2007. This was due to a range of problems such as safety concerns, geological problems and labour disputes affecting the South African platinum industry.

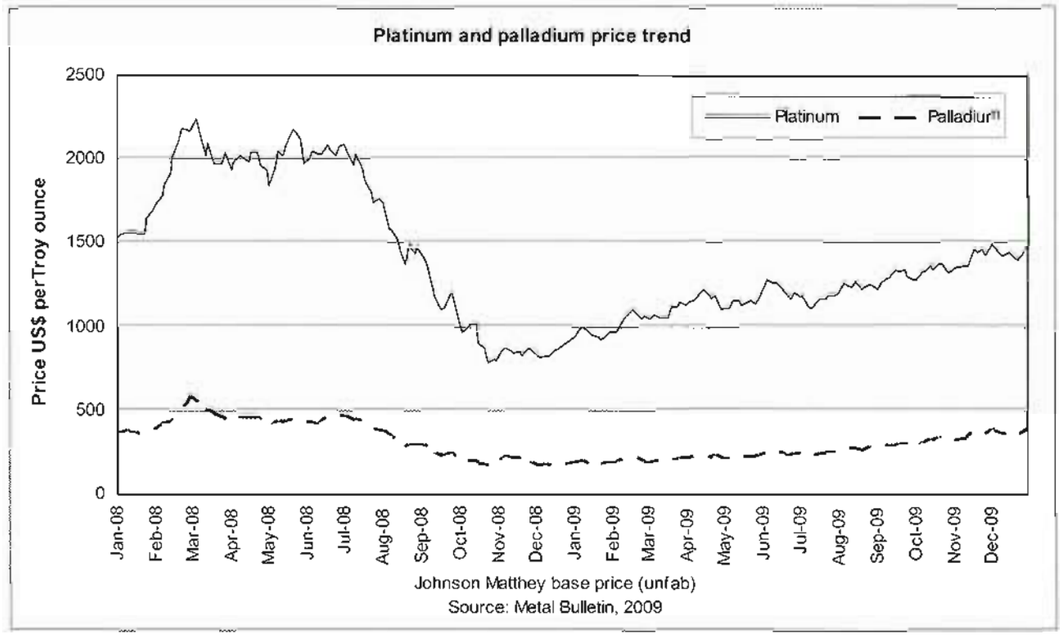
Russia's palladium output decreased by nine per cent, or 9000 kilograms from 2007, whilst platinum production increased by 2000 kilograms (nine per cent); however, this was still 14 per cent lower than its peak platinum output of 29 000 kilograms in 2006. In 2008 Zimbabwe platinum production increased by four per cent compared with 2007, reaching 5300 kilograms, and output has increased by over 150 per cent since 2002.

During 2008 United States platinum and palladium production from the Stillwater Mine in Montana decreased by ten and seven per cent respectively, and output for both metals was 17 per cent lower than peak production of 14 000 kilograms palladium and 4000 kilograms of platinum in 2006. Labour disputes at the Stillwater Mine contributed to reduced US production. Canada also showed a significant decrease in platinum and palladium production in 2008. Production decreased to 7000 kilograms of platinum (nine per cent decrease from 2007) and 13 000 kilograms of palladium (nine per cent decrease from 2007).

Prices

Unlike gold, platinum is an important and widely used metal in industry. Consequently the price of platinum is predominantly determined by normal supply and demand relationships, although movements in the gold price do have a marginal effect on the platinum price.

Platinum prices have experienced periods of volatility over the last decade. Throughout the 1990s, the price hovered around the US$400 per troy ounce mark, approximately US$250 per troy ounce lower than the highest price for platinum in the early 1980s. However, after legislation requiring automobiles to produce less pollution was introduced towards the end of the 20th century, platinum, and subsequently also palladium, was discovered to be very efficient at removing harmful products from vehicle engines in catalytic converters. This led to a dramatic increase in the price of platinum from US$420 per troy ounce in August 2001, to just over US$1500 per troy ounce by December 2007. Prices continued to increase in the first half of 2008 reaching a high of US$2276 per troy ounce in March. However, as the global financial crisis hit in the middle of the year, prices declined dramatically finishing the year at US$912 per troy ounce.



The price trend over 2009 showed a gradual but steady rise, driven by a weak US dollar, strong investor interest and a high gold price (Johnson Matthey, 2009a). The price at the beginning of the year was US$940 per troy ounce and in early January briefly rose above US$1000 per troy ounce for the first time since October 2008 (Metal Markets, 2009a). This increase was related to an announcement from the Chinese government indicating they would cut purchase taxes on new vehicles and strong demand from the Shanghai gold exchange (Johnson Matthey, 2009a). The price quickly dropped below US$1000 per troy ounce due to a strengthening US dollar reaching low of US$922 per troy ounce. Following this decline, prices began to rise as equity markets declined in both Europe and the US, making precious metals a safer investment (Metal markets, 2009b). Platinum topped US$1000 per troy ounce by mid February following concerns that new US government plans to bail out banks and rescue the economy from recession would send inflation soaring (Metal markets, 2009c). The price had dropped again by the end of February but still remained well above US$1000 per troy ounce.

Platinum and palladium both saw declines following new data that showed manufacturing activity had declined in France and the UK, as well equity market gains that caused a drop in all precious metal prices (Metal Markets, 2009d). Following this, prices rose steadily and by mid April had exceeded US$1200 per troy ounce (Metal Markets, 2009e). The rise in prices followed an announcement of plans to launch a US-based platinum Exchange Traded Fund (ETF) (Johnson Matthey, 2009a). Prices subsequently began to fall reaching US$1100 per troy ounce by the end of April.

Prices rose slightly at the beginning of May due to the weakening US dollar and hopes that demand from China would grow as data showed that manufacturing activity in China expanded in April for the first time in nine months (Metal Markets, 2009f). In May additional problems in the automotive industry caused both platinum and palladium prices to decrease with platinum falling back to around US$1100 per troy ounce (Metal Markets, 2009g). This decrease was short lived as hopes grew that demand in Asia would make up for the lack of demand in the US causing prices to rise again by the end of May (Metal Markets, 2009h). Another small dip in price occurred at the beginning of June because of worries that demand would not recover as quickly as hoped (Metal Markets, 2009i). Prices quickly began to rise again due to a combination of increased car sales in China and the possibility of a strike by a South African platinum producer (Metal Markets, 2009j).

Prices reached US$1283 per troy ounce in mid June then started to decrease due to demand worries from car manufacturers and new unemployment data from the United States reaching a low of US$1113 per troy ounce on 10th July (Metal Markets, 2009k). Hopes that the economy would recover, fed by positive home construction data caused the price to increase by the end of July (Metal Markets, 2009l). Prices rose steadily during August due to increased demand from both pollution-control device manufacturers and jewellery makers, a weakening US dollar and further strike threats in South Africa (Metal Markets, 2009m). After a small drop in price at the end of August platinum prices continued to gradually increase during September, before falling to US$1280 per troy ounce at the beginning of October. Prices continued to rise again during October due to a weak US dollar (Metal Markets, 2009n). November also saw steady increases in the platinum price. Continuing price increases

driven by a rising gold price and aided by strikes at Impala Platinum saw platinum reach a high of US$1497 per troy ounce on the 4th December (Johnson Matthey, 2009a). After a small decrease in mid December the price increased again to finish the year at US$1476 per troy ounce, a 157 per cent increase compared to the start of the year.

Palladium has performed strongly during 2009 despite a poor economic climate and showed a steady increase in price during 2009. Palladium started the year at US$190 per troy ounce and ended at US$390 per troy ounce, an increase of 205 per cent. This rise was driven by strong investment on the futures exchanges and via ETF (Johnson Matthey, 2009a). Some minor drops in price were experienced during the year but these were not as pronounced as those in platinum prices.

Industry events in 2009

Platinum was one of the metals worst hit by last year's collapse in metal prices which led to production cuts at major producers and the delay or cancellation of many new projects.

Anglo Platinum is the leading primary producer of PGMs in the world. In February the company announced a restructuring of its mining operations involving the closure of high-cost shafts and reducing output by 140 000 troy ounces of platinum per year (Johnson Matthey, 2009a). A number of projects have been delayed including the Twickenham platinum mine which has been delayed for two years and the Styldrift Merensky phase one that project has been suspended. In addition, the development of the No. 4 shaft at Amandelbult has been put on hold for four years and the construction of a base metals refinery and the No. 2 slag furnace cleaning project has been delayed by a year. However, Angloplat is continuing to develop six projects to the value of R9.8 billion (Smit, 2009).

Impala Platinum, the second largest platinum producer in the world, has faced a series of problems with its South African operations throughout 2009. These include: a severe ground fall with subsequent shaft shut-down and alterations; a two-week strike in August; and delays in ramping up production at the Marula Mine. Forecast platinum output for this financial year has fallen by 100 000 troy ounces to 850 000 troy ounces (Johnson Matthey, 2009a). Zimplat, a member of the Impala Group, increased its output during 2009. The Ngizi open pit mine closed in December 2008. The Number 1 portal reached full production in June this year and the Wedza phase of the Mimosa Mine was completed (Johnson Matthey, 2009a).

Lonmin Plc, the world's third biggest platinum producer, had problems with smelting in 2009, with their Number One furnace being shut down for a month following a matte run out in June (Johnson Matthey, 2009a). In November the company announced plans for a 25 per cent increase in production to 850 000 troy ounces from its Marikana and Pandora assets by 2013 (Mining Journal, 2009a).

South African-based Aquarius Platinum announced in November that it would be able to resume operations at its Everest Mine by September 2010. The operation has been shut since December 2008 due to a subsidence event (Mineweb, 2009a). The company acquired Ridge Mining in 2009, including the Blue Ridge Mine and Sheba's Ridge project. The Blue Ridge Mine shipped its first concentrate to the Impala Refinery Services in April 2009 (Johnson Matthey, 2009a). Emerging PGM producer Platmin announced that its flagship Pilanesberg operation in the Bushveld Complex was on track to produce 250 000 troy ounces of platinum per year from the fourth quarter of 2009. Low-cost operations due to the open pit nature of the mine have enabled the company to remain profitable (Creamer, 2009).

In the USA, Stillwater Mining lost its contract with General Motors in July but the effect of this was offset by increasing platinum prices and the company has had no problems in finding buyers for the metal displaced under that contract (Mineweb, 2009b). North American Palladium's Lac Des Iles Mine in Ontario was placed on care and maintenance in October 2008 due to declining palladium prices but, with stronger prices towards the end of 2009, the operation is set to recommence. Production of 140 000 troy ounces is the target for the next two years (Johnson Matthey, 2009b).

South Africa's Northam Platinum announced in October that construction of its new Booysendal Mine would begin in early 2010. This development could more than double Northam Platinum's output (Mineweb, 2009c). In early 2009 Platinum Australia began concentrate production from its Smokey Hills Mine in South Africa, marking the transformation of the company from explorer/developer to producer (Swanepoel, 2009).

In July Eastern Platinum decided to terminate the services of its contract mining companies at its Crocodile River Mine in South Africa and to undertake all core mining activities itself. This decision followed a sit-in by underground contract workers which involved supervisors being held hostage (Mineweb, 2009d). The company has also suspended the development of the Crocette and Kareespruit sections of Crocodile River as well as its Eastern Limb projects at Spitzkop, Kennedy's Vale and Mareesburg (Johnson Matthey, 2009a).

In October Norilsk Nickel raised its platinum and palladium production forecast for 2009 to 668 000 troy ounces and 2.85 million troy ounces respectively, more than anticipated but still a significant decrease from 2008. In December 2008, Norilsk said it would cut metals output in 2009 as demand fell due to the global economic crisis (Mineweb, 2009e).

Although many projects have been put on hold due to lower prices, many exploration projects have continued. Resource figures were released from the Duluth Complex, Minnesota, in October with an indicated resource of 3.11 million troy ounces of platinum. The complex is thought to represent one of the largest undeveloped repositories of PGMs, copper and nickel in the world (Mineweb, 2009f).

Marathon PGM Corp has received a revised feasibility study for its deposit in Ontario. Annual production for the first five years is an estimated 234 000 troy ounces of PGM and gold compared to a previous estimate of only 200 000 troy ounces. The company is currently examining a variety of financing options for the project (Mining Journal, 2009b). Australian explorer Magma Metals Ltd announced an indicated and inferred resource at Thunder Bay North in Ontario of 7.33 million tonnes grading 2.31 grams per tonne platinum and palladium. Exploration will continue to convert the inferred resources to the indicated category (Mineweb, 2009g).

Colossus Minerals has demonstrated bonanza platinum and palladium grades at its Serra Pelada gold exploration project in Brazil. Nevertheless, various issues concerning water and previous workings mean that it will be a long time before production can commence (Mineweb, 2009h).

Platinum Australia Ltd announced the initial resource estimate for its Mira deposit in South Africa, comprising an indicated and inferred resource of 6.63 million tonnes at 1.43 grams per tonne platinum, palladium and gold (combined) (Platinum Australia, 2009).

Platina Resources has received preliminary results on its study of the Skaergaard platinum and palladium project in Greenland. To date inferred resources of 106.6 million tonnes grading 0.64 grams per tonne platinum and palladium have been reported (Mineweb, 2009i).

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Mine production of platinum group metals

kilograms (metal content)

Country	2004	2005	2006	2007	2008
Russia					
Platinum	* 28 000	29 000	29 000	23 000	25 000
Palladium	97 000	97 400	98 400	96 800	87 700
Other platinum metals	* 15 000	* 15 500	* 15 600	* 14 500	* 14 500
South Africa					
Platinum	153 239	168 749	168 125	165 835	146 141
Palladium	76 403	84 908	86 265	86 461	75 537
Other platinum metals	46 759	58 218	53 138	58 623	54 089
Zimbabwe					
Platinum	4 438	4 833	4 998	5 085	5 300
Palladium	3 564	3 879	4 022	* 4 000	* 4 000
Other platinum metals	810	862	874	* 870	* 870
Canada					
Platinum	* 9 100	* 7 900	* 8 000	* 8 100	* 7 400
Palladium	* 16 000	* 13 800	* 14 000	* 14 100	* 12 900
Other platinum metals	* 1 000	* 900	* 900	* 900	* 800
USA					
Platinum	4 043	3 919	4 292	3 857	3 577
Palladium	13 654	13 312	14 401	13 312	11 944
Colombia	1 209	1 082	1 438	1 526	1 370
Australia					
Platinum	196	58	.	.	.
Palladium	846	603	(a) 959	(a) 742	(a) 710
World Total	471 000	505 000	504 000	498 000	452 000

Note(s)
(1) Wherever possible, figures relate to quantities of platinum group metals thought to be recovered from ores originating in the country stated
(2) Figures for metal production are only given for countries where recovery is thought to be based predominantly on domestic materials or on imported materials which have not been recorded as mine production elsewhere in the table
(3) In addition to the countries listed, Bulgaria, China, Ethiopia, Indonesia and Philippines are believed to produce platinum group metals

(a) Platinum group metals; all forms

Production of potash

tonnes (K_2O content)

Country	2004	2005	2006	2007	2008
Belarus	4 612 000	4 928 000	4 605 300	4 971 600	4 967 000
Germany					
Potassic salts	3 626 510	3 663 829	3 624 977	3 636 504	3 280 467
Russia	5 599 100	6 265 600	5 274 100	6 373 100	5 935 400
Spain					
Chloride	553 210	494 594	493 189	503 000	444 000
Ukraine	* 10 000	* 13 000	* 8 000	* 12 000	* 12 000
United Kingdom					
Chloride	539 500	439 200	427 000	430 000	403 800
Canada					
Chloride	10 332 000	10 140 000	8 528 000	11 426 000	10 455 000
USA					
Potassic salts	1 200 000	1 200 000	1 100 000	1 100 000	* 1 200 000
Brazil					
Chloride	403 080	404 871	403 080	471 333	383 000
Chile					
Chloride	559 000	547 000	515 000	533 000	578 000
China	1 128 200	1 450 000	1 571 900	1 822 600	1 980 000
Israel					
Chloride	2 138 400	2 224 200	2 187 000	2 146 000	2 134 000
Jordan	1 157 360	1 097 487	1 020 000	1 090 000	1 200 000
World Total	31 900 000	32 900 000	29 800 000	34 500 000	33 000 000

Production of rare earth minerals

tonnes

Country	2004	2005	2006	2007	2008
Brazil					
Monazite	731	958	958	1 173	* 1 200
China (a)	98 300	119 000	133 000	120 000	125 000
India					
Monazite (b)	149	93	45	...	..
Malaysia					
Monazite	1 683	320	894	682	233

Note(s)
(1) With the exception of the data for China, figures in this table refer to gross tonnage of concentrates
(2) In addition to the countries listed, rare earth minerals are believed to be produced in Indonesia, Kazakhstan, Democratic P R. of Korea, Republic of Korea, Kyrgyzstan, Mozambique, Nigeria, Russia and Vietnam

(a) REO content. Assumed to be 60% of concentrates produced
(b) Years ended 31 March following that stated

Production of salt

tonnes

Country	2004	2005	2006	2007	2008
Albania					
Sea salt	24 783	47 219	* 47 000	* 47 000	* 47 000
Armenia	31 625	34 682	37 000	34 800	37 334
Austria					
Rock salt	1 228	1 497	1 336	1 172	503
Salt in brine	745 670	771 455	764 103	735 724	866 674
Azerbaijan	9 234	11 202	12 000	7 126	7 527
Belarus	1 883 138	1 839 300	2 075 693	1 665 350	1 866 499
Bosnia & Herzegovina	260 456	392 940	416 305	502 487	538 357
Bulgaria	1 900 000	1 900 000	2 000 000	2 000 000	2 100 000
Croatia	32 723	36 970	29 589	32 536	3 956
Denmark	* 600 000	* 600 000	* 600 000	* 600 000	* 600 000
France					
Rock salt	406 000	494 000	..	...	.
Brine salt	1 433 000	1 468 000	.	...	.
Salt in brine	4 408 000	4 750 780	(a) 9 371 000	(a) 6 139 840	(a)* 6 000 000
Sea salt	1 365 000	1 026 000	...	..	...
Germany					
Rock salt	7 268 000	8 258 000	9 280 000	4 826 000	5 545 000
Brine salt	974 000	1 006 000	1 001 000	1 010 000	989 000
Salt in brine	7 212 000	7 449 000	7 189 000	7 558 000	7 307 000
Greece	187 522	198 024	* 200 000	212 000	220 000
Italy					
Rock salt & brine salt	3 174 313	3 475 734	2 823 960	2 214 133	2 334 315
Montenegro					
Sea salt	—	—	5 000	20 000	25 200
Netherlands	5 896 000	6 155 000	6 056 000	6 177 000	6 200 000
Poland					
Rock salt	1 099 072	1 123 219	1 129 875	591 240	618 111
Brine salt	2 940 169	2 889 941	2 899 076	2 930 726	2 783 198
Other salt	195 873	118 703	808 247	785 694	706 618
Portugal					
Rock salt	661 704	597 945	586 190	590 588	* 590 000
Sea salt	75 400	92 495	76 858	64 048	69 249
Romania	2 399 956	2 442 640	2 621 129	2 475 349	2 526 774
Russia	2 900 000	2 700 000	2 800 000	2 200 000	1 800 000
Serbia	—	—	29 847	30 023	30 115
Serbia and Montenegro					
Rock salt	10 344	...	—	—	—
Sea salt	22 239	...	—	—	—
Slovakia	121 600	105 100	122 500	117 000	109 510
Slovenia	2 852	803	1 624	3 029	535
Spain					
Rock salt	2 656 904	2 909 526	2 809 046	2 560 658	2 330 518
Sea salt	1 227 625	1 368 960	1 506 343	1 330 442	1 207 951
Other salt	108 733	121 461	115 826	102 524	100 946
Switzerland	486 000	539 000	525 000	353 000	358 000
Turkey					
Rock salt	6 100	512	.	...	.
Sea salt	582 440	529 235	* 500 000	* 500 000	* 500 000
Other salt	1 569 178	1 196 486	* 1 200 000	1 385 822	1 367 981
Ukraine	4 393 000	4 811 000	5 996 000	5 547 852	4 424 878
United Kingdom					
Rock salt	* 2 000 000	* 2 000 000	* 2 000 000	* 2 000 000	* 2 000 000
Brine salt	* 1 000 000	* 1 000 000	* 1 000 000	* 1 000 000	* 1 000 000
Salt in brine (b)	* 2 800 000	* 2 800 000	* 2 800 000	* 2 800 000	* 2 800 000
Algeria					
Brine salt & sea salt	241 800	302 700	259 596	183 189	201 603
Angola	* 30 000	* 30 000	35 000	* 35 000	* 35 000
Benin (c)	* 15 000	* 15 000	* 15 000	* 15 000	* 15 000
Botswana	208 319	243 945	151 595	165 710	170 994
Burkina Faso	* 5 000	* 5 000	* 5 000	* 5 000	* 5 000
Cape Verde	* 1 600	* 1 600	* 1 600	* 1 600	* 1 600
Djibouti	26 000	* 78 000	* 138 000	* 138 000	* 138 000
Egypt	1 010 000	* 1 000 000	* 1 000 000	* 1 000 000	* 1 000 000
Eritrea	30 754	6 300	9 737	7 448	26 071
Ethiopia (d)(e)	21 000	24 202	19 271	12 899	30 414

Production of salt

tonnes

Country	2004	2005	2006	2007	2008
Ghana	* 265 000	250 000	250 000	* 250 000	* 250 000
Guinea	* 15 000	* 15 000	* 15 000	* 15 000	* 15 000
Kenya (e)	31 139	26 595	35 024	11 596	24 345
Libya	* 40 000	* 40 000	* 40 000	* 40 000	* 40 000
Madagascar	55 000	65 000	70 000	70 000	* 70 000
Mali	* 6 000	* 6 000	* 6 000	* 6 000	* 6 000
Mauritania	* 20	* 20	310	420	570
Mauritius (c)	7 000	7 900	7 408	6 650	4 789
Morocco	277 600	351 100	319 900	215 754	219 187
Mozambique (c)	* 80 000	* 80 000	* 80 000	* 80 000	* 80 000
Namibia	750 821	573 248	603 501	810 942	* 800 000
Niger	* 2 000	1 269	* 1 300	* 1 300	* 1 300
Senegal	167 800	134 000	198 600	212 300	240 600
Somalia	* 1 000	* 1 000	* 1 000	* 1 000	* 1 000
South Africa	332 673	399 087	464 909	407 079	415 996
Sudan	* 84 000	* 84 000	11 638	22 922	20 000
Tanzania	57 062	51 166	34 798	35 224	25 896
Tunisia (c)	1 117 000	1 132 000	1 127 000	933 000	1 063 500
Uganda	* 5 000	* 1 500	* 1 500	—	—
Bahamas	1 284 294	1 470 176	1 143 000	578 000	* 420 000
Canada					
Rock salt	12 071 303	11 448 141	11 504 207	* 10 175 000	* 12 043 000
Other salt (f)	2 052 333	2 047 653	1 901 453	* 1 796 000	* 2 125 000
Costa Rica	* 20 000	* 20 000	* 20 000	* 20 000	* 20 000
Cuba	205 613	172 592	198 200	179 500	151 900
Dominican Republic					
Sea salt	* 50 000	* 50 000	* 50 000	* 50 000	* 50 000
El Salvador (c)	* 31 000	* 31 000	* 31 000	* 31 000	* 31 000
Guatemala (c)	* 60 000	* 60 000	* 60 000	* 50 000	* 50 000
Honduras	* 42 000	* 42 000	* 40 000	* 40 000	* 40 000
Mexico	8 565 520	9 507 623	8 371 353	8 032 273	8 808 714
Netherlands Antilles	* 500 000	* 500 000	* 500 000	* 500 000	* 500 000
Nicaragua (c)	* 31 000	* 30 000	* 30 000	* 30 000	* 30 000
Panama (c)	18 592	19 429	19 080	20 315	21 053
USA					
Rock salt (g)	18 300 000	17 700 000	16 500 000	16 800 000	* 15 640 000
Salt in brine (g)	20 500 000	19 900 000	19 900 000	19 700 000	* 22 080 000
Evaporated salt (g)	7 620 000	7 600 000	8 090 000	7 990 000	* 8 289 000
Argentina	1 371 792	1 845 833	1 917 656	2 357 674	* 1 900 000
Brazil					
Rock salt	1 442 000	1 559 000	1 622 000	1 621 000	* 1 600 000
Sea salt	5 205 968	5 519 618	5 122 197	5 365 091	* 5 400 000
Chile	4 938 928	6 067 583	4 580 471	4 403 743	6 431 029
Colombia					
Rock salt	232 460	215 905	248 245	266 941	245 170
Sea salt	302 101	445 562	389 630	309 557	386 461
Ecuador	* 75 000	* 75 000	* 75 000	* 75 000	...
Peru	248 898	438 375	971 710	1 185 273	1 276 274
Venezuela (c)	* 350 000	* 350 000	* 350 000	* 350 000	* 350 000
Afghanistan	* 13 000	* 12 000	* 12 000	* 12 000	* 12 000
Bangladesh (h)	620 000	650 000	* 650 000	* 650 000	* 650 000
Burma (i) (c)	* 35 000	* 35 000	* 35 000	* 35 000	* 35 000
Cambodia	86 600	90 963	59 000	76 651	* 75 000
China	40 434 400	46 610 600	56 631 300	59 755 300	59 527 800
India					
Rock salt (j)	3 800	1 900	1 600	1 200	2 100
Sea salt (j)	11 949 500	14 242 700	13 268 500	12 328 000	13 970 500
Other salt (j)	2 807 900	4 437 500	4 628 100	5 516 000	5 178 600
Indonesia	* 680 000	* 680 000	* 700 000	* 700 000	* 700 000
Iran (k)	1 791 000	2 032 445	2 617 902	2 534 871	* 2 500 000
Iraq	...	.	...	153 140	108 870
Israel (c)	570 000	570 000	* 640 000	399 904	420 809
Japan (j)	1 225 000	1 227 000	1 166 000	1 138 000	1 132 000
Jordan	21 727	29 500	28 800	17 000	25 400
Kazakhstan	347 850	178 167	416 680	227 643	504 100

Production of salt

tonnes

Country	2004	2005	2006	2007	2008
Korea, Dem. P R. of	* 500 000	* 500 000	* 500 000	* 500 000	* 500 000
Korea, Republic of	340 828	378 887	285 568	249 515	384 304
Kuwait	* 45 000	* 50 000	* 50 000	* 50 000	* 50 000
Laos	* 15 000	34 139	* 35 000	* 9 000	...
Lebanon	15 000	* 15 000	* 15 000	* 15 000	* 15 000
Mongolia	* 100 000	* 100 000	* 100 000	* 100 000	* 100 000
Oman	12 400	10 900	26 300	10 400	* 10 000
Pakistan					
Rock salt (h)	1 639 516	1 648 223	1 858 931	1 872 664	1 849 000
Sea salt (h)	11 555	14 375	15 249	10 616	* 11 000
Philippines (c)	427 615	420 950	418 210	437 689	510 059
Saudi Arabia					
Rock salt & brine salt	1 442 192	1 634 299	1 611 992	1 507 000	* 1 600 000
Sri Lanka	78 135	85 179	87 560	70 208	110 856
Syria	141 445	110 000	133 000	81 000	88 600
Taiwan	159 091	114 389	107 713	107 720	118 046
Tajikistan	59 495	65 992	51 956	47 180	* 50 000
Thailand					
Rock salt	1 031 200	1 074 214	1 008 251	1 134 931	1 211 581
Other salt	* 100 000	* 100 000	* 100 000	* 100 000	* 100 000
Turkmenistan	* 215 000	* 215 000	* 215 000	* 215 000	* 215 000
Uzbekistan	* 60 000	* 60 000	* 60 000	* 60 000	* 60 000
Vietnam	906 000	898 000	842 000	857 000	847 000
Yemen, Republic of	39 000	47 000	53 000	61 000	69 000
Australia (l)	11 221 000	12 299 000	11 364 000	10 801 000	11 160 000
New Zealand	94 010	* 90 000	83 000	102 000	67 000
World Total	234 800 000	250 100 000	259 900 000	249 700 000	256 800 000

Note(s)
(1) This table does not include production of refined salt
(2) Salt is known to be produced in many countries for which statistics are not available.

(a) Salt; all forms
(b) Used for purposes other than salt-making
(c) Sea salt
(d) Years ended 7 July of that stated
(e) Lake salt
(f) Including salt in brine
(g) Sold or used by producers
(h) Years ended 30 June of that stated
(i) Brine salt
(j) Years ended 31 March following that stated
(k) Years ended 20 March following that stated
(l) Excluding Victoria and the Northern Territory

Production of selenium metal

tonnes

Country	2004	2005	2006	2007	2008
Belgium	* 200	* 200	* 200	* 200	* 200
Finland	65	66	70	52	65
Germany	* 14	* 12	* 12	* 12	* 12
Poland	83	82	87	85	82
Russia	85	100	110	110	* 110
Sweden	131	122	135	126	130
Canada	277	107	117	144	156
Peru	76	70	75	59	60
China	* 65	* 65	* 65	* 65	* 65
India (a)	—	8	—	—	...
Japan	599	625	730	806	754
Kazakhstan	* 100	* 60	* 70	155	56
Philippines	* 48	* 68	* 65	* 65	* 65
Uzbekistan	* 20	* 20	* 20	* 20	* 20

Note(s)
(1) In addition to the countries listed, Australia, Chile, the Republic of Korea and Zimbabwe are believed to produce selenium metal

(a) Years ended 31 March following that stated

Production of sillimanite minerals

tonnes

Country	2004	2005	2006	2007	2008
France					
Andalusite	68 000	* 65 000	* 65 000	* 65 000	* 65 000
South Africa					
Andalusite	234 625	228 375	* 230 000	* 230 000	* 230 000
Zimbabwe					
Kyanite	491	—	—	—	—
USA					
Kyanite (a)	90 000	* 90 000	* 90 000	* 90 000	* 90 000
Brazil					
Kyanite (b)	* 200	* 200	* 200	* 200	* 200
India					
Kyanite (c)	8 208	8 869	8 059	4 804	4 234
Sillimanite (c)	30 711	33 119	26 366	42 586	33 399
Australia					
Sillimanite	71	38	—	—	—

Note(s)
(1) A number of other countries produce sillimanite minerals but details of output are not reported
(2) In addition to the countries listed above as producing sillimanite minerals, synthetic mullite is known to be produced in Denmark, France, Hungary and the United Kingdom

(a) Including related minerals
(b) Including beneficiated and directly shipped material
(c) Years ended 31 March following that stated

Mine production of silver

kilograms (metal content)

Country	2004	2005	2006	2007	2008
Armenia	* 4 000	* 4 000	* 4 000	* 4 000	* 4 000
Bulgaria	* 45 000	* 55 000	* 65 000	* 55 000	* 55 000
Finland	49 400	47 462	50 843	44 895	69 906
France	682	—	—	—	—
Greece	—	2 300	25 500	38 300	35 500
Ireland, Republic of	5 200	10 500	12 900	9 650	8 462
Italy	100	100	—	—	—
Macedonia	—	—	* 10 000	* 30 000	* 40 000
Poland	1 372 700	1 262 400	1 265 100	1 199 000	1 161 000
Portugal	24 400	23 786	20 078	26 514	28 825
Romania	* 18 000	* 18 000	* 18 000	* 18 000	* 18 000
Russia (a)	1 276 900	* 1 350 000	* 1 250 000	* 1 200 000	* 1 300 000
Serbia (a)	—	—	* 2 400	* 2 400	* 2 400
Serbia and Montenegro (a)	2 275	* 2 400	—	—	—
Spain	3 583	5 227	2 369	—	—
Sweden	319 563	309 933	292 255	323 171	293 068
Turkey	122 000	219 000	* 266 000	* 315 000	* 286 000
Algeria	—	800	500	500	100
Congo, Democratic Republic	69 700	53 600	67 600	76 200	34 100
Ethiopia (b)	1 133	883	902	900	1 076
Ghana	3 035	3 571	3 142	* 3 100	* 3 000
Morocco	181 000	185 700	202 300	177 712	201 195
Namibia (a)	27 153	34 102	31 307	7 902	7 700
South Africa	73 124	89 023	86 951	70 089	75 199
Sudan	2 800	* 2 600	2 437	2 405	2 400
Tanzania	13 216	12 891	14 906	12 381	10 388
Tunisia	* 2 000	* 4 000	—	—	—
Zimbabwe	3 216	3 400	* 1 000	* 1 100	500
Canada	1 337 465	1 123 837	995 024	860 449	727 710
Costa Rica	—	196	486	331	—
Guatemala	—	7 074	49 780	88 247	99 131
Honduras	48 217	53 617	55 036	53 894	58 936
Mexico	2 569 478	2 894 161	3 028 395	3 135 430	3 236 312
Nicaragua	2 950	2 936	2 929	3 420	3 720
USA	1 246 100	1 225 800	1 139 500	1 120 000	1 260 000
Argentina	172 400	263 766	245 124	255 567	255 500
Bolivia	412 550	420 300	472 210	525 000	1 110 000
Brazil	6 192	6 672	10 000	18 620	19 000
Chile	1 360 140	1 399 539	1 607 164	1 936 465	1 405 020
Colombia	8 542	7 142	8 399	9 766	9 162
Peru	3 059 829	3 193 146	3 470 661	3 493 090	3 685 931
Burma (a) (c)	* 1 100	* 2 300	* 700	* 200	—
China	2 450 000	2 500 000	* 2 600 000	* 2 700 000	* 2 800 000
India (c)	10 955	27 961	53 271	80 684	* 100 000
Indonesia	262 935	328 749	261 398	268 967	226 051
Iran	* 25 000	* 25 000	* 30 000	* 40 000	* 40 000
Japan	85 999	54 100	11 500	—	—
Kazakhstan (a)	773 300	883 200	806 083	722 927	645 627
Korea, Dem. P.R. of	* 50 000	* 50 000	* 50 000	* 50 000	* 50 000
Korea, Republic of	50 866	41 489	56 256	57 369	76 197
Laos	2 735	3 405	6 331	4 499	6 706
Malaysia	364	402	410	296	349
Mongolia	20 427	19 888	20 378	20 455	19 954
Oman	81	111	4 404	3 863	2 140
Philippines	9 315	19 150	23 502	27 754	12 694
Saudi Arabia	14 494	13 501	9 103	9 028	8 232
Uzbekistan	* 60 000	* 60 000	* 60 000	* 60 000	* 60 000

Mine production of silver

kilograms (metal content)

Country	2004	2005	2006	2007	2008
Australia	2 209 000	2 417 000	1 727 000	1 880 000	1 926 000
Fiji	1 523	1 418	494	—	265
New Zealand	* 30 100	43 003	27 221	10 568	31 017
Papua New Guinea	53 800	51 125	51 098	48 677	51 300
World Total	19 956 000	20 841 000	20 579 000	21 104 000	21 565 000

Note(s)
(1) Countries producing less than 1000 kg per year include Jamaica and Thailand

(a) Smelter and/or refinery production
(b) Years ended 7 July of that stated
(c) Years ended 31 March following that stated

Production of natural sodium carbonate

tonnes

Country	2004	2005	2006	2007	2008
Botswana	263 358	279 085	255 677	279 625	263 566
Ethiopia (a)	6 550	2 771	2 389	286	1 597
Kenya	353 835	360 161	374 210	386 578	502 846
USA	11 000 000	11 000 000	1 100 000	11 100 000	11 200 000

Note(s)
(a) Years ended 7 July of that stated

Production of strontium minerals

tonnes

Country	2004	2005	2006	2007	2008
Spain	206 001	336 630	280 195	142 512	138 590
Turkey	* 77 000	* 18 000	* 6 300	* 4 200	* 1 600
Morocco	* 2 700	* 2 700	* 2 700	* 2 700	* 2 700
Mexico	87 610	110 833	128 321	96 902	29 621
Argentina (a)	6 727	7 233	19 822	4 904	* 5 000
China	500 000	700 000	* 700 000	* 700 000	* 700 000
Iran	7 500	672	17 170	—	—
Pakistan (b)	570	1 855	1 290	1 641	1 000

Note(s)
(1) In addition to the countries listed, Germany and Poland are believed to produce strontium minerals

(a) May contain unbeneficiated material
(b) Years ended 30 June of that stated

Production of sulphur and pyrites

tonnes (sulphur content)

Country	2004	2005	2006	2007	2008
Austria					
Recovered (a)	55 322	54 377	50 097	50 501	48 024
Belarus					
Recovered (a)	32 288	48 663	38 567	41 031	44 016
Belgium					
Recovered (b) (a)	371 000	376 000	391 000	395 000	394 000
Bulgaria					
Recovered (b)	301 000	312 000	340 000	359 000	352 000
Recovered (a)	25 000	30 000	35 000	35 000	30 000
Croatia					
Recovered (a)	9 000	9 000	7 000	9 000	7 000
Czech Republic					
Recovered (a)	60 000	65 000	65 000	65 000	61 000
Denmark					
Recovered (a)	4 660	4 223	4 142	3 896	3 467
Finland					
Pyrites	283 700	184 400	199 700	194 400	237 300
Recovered (b)	325 523	304 751	325 793	* 326 000	* 320 000
Recovered (a)	65 000	70 000	70 000	125 000	150 000
France					
Recovered (a)	698 400	622 345	616 234	605 820	* 590 000
Recovered (c)	150 000	127 000	75 000	62 000	64 000
Germany					
Recovered (a)	1 526 700	1 627 900	1 706 200	1 650 100	1 578 000
Recovered (c)	40 000	42 900	42 500	35 900	39 000
Greece					
Recovered (a)	160 000	162 000	162 000	165 000	120 000
Hungary					
Recovered (a)	35 000	65 000	50 000	65 000	55 000
Italy					
Recovered (b)	113 000	92 000	87 000	84 000	82 000
Recovered (a)	575 000	650 000	680 000	650 000	645 000
Lithuania					
Recovered (a)	67 094	74 276	61 135	42 618	73 870
Netherlands					
Recovered (b)	137 000	141 000	141 000	116 000	106 000
Recovered (a)	410 000	440 000	495 000	505 000	515 000
Norway					
Recovered (b)	* 105 000	* 110 000	* 110 000	* 95 000	* 95 000
Recovered (a)	18 000	19 000	20 000	18 000	28 000
Poland					
Frasch	821 489	801 799	800 200	833 583	762 119
Recovered (b)	289 100	289 000	308 000	* 304 000	* 305 000
Recovered (a)	182 000	186 600	203 100	* 211 900	* 215 000
Portugal					
Recovered	25 000	30 000	38 000	27 000	22 000
Romania					
Recovered	53 000	79 000	60 000	64 000	61 000
Russia					
Pyrites	286 000	304 000	198 000	210 000	161 000
Recovered (a)	5 909 958	6 301 000	6 346 000	6 372 000	6 513 000
Recovered (c)	572 000	640 000	738 000	790 000	752 000
Serbia					
Recovered (b)	—	—	21 000	21 000	21 000
Serbia and Montenegro					
Recovered (b)	82 000	88 000	—	—	—
Slovakia					
Recovered (b)	5 000	5 000	5 000	5 000	5 000
Recovered (a)	65 000	65 000	65 000	78 000	75 000
Spain					
Recovered (b)	488 000	541 000	547 000	543 000	551 000
Recovered (a)	145 000	* 150 000	* 150 000	* 150 000	* 150 000

Production of sulphur and pyrites

tonnes (sulphur content)

Country	2004	2005	2006	2007	2008
Sweden					
Recovered (b)	185 800	180 000	180 000	177 000	179 000
Recovered (a)	62 238	59 839	68 391	66 569	84 456
Turkey					
Pyrites	20 000	55 000	59 000	61 000	79 000
Recovered (a) (c)	68 000	76 000	73 000	73 000	73 000
Ukraine					
Sulphur ore	136 000	139 000	133 000	131 000	134 000
United Kingdom					
Recovered (a)	120 000	124 000	115 000	130 000	135 000
Algeria					
Recovered (a)	20 000	20 000	19 000	20 000	20 000
Egypt					
Recovered (a)	78 000	78 000	80 000	80 000	80 000
Libya					
Recovered (a)	* 50 000	* 50 000	50 000	150 000	150 000
Namibia					
Pyrites	1 829	518	—	—	—
South Africa					
Pyrites	165 207	133 245	68 443	70 891	61 278
Recovered	179 776	220 254	* 231 000	* 230 000	* 230 000
Recovered	288 435	422 314	* 343 000	* 340 000	* 340 000
Zambia					
Recovered (b)	52 000	52 000	75 000	98 000	131 000
Zimbabwe					
Pyrites	26 670	19 500	13 000	6 500	* 6 500
Canada					
Recovered (b)	1 089 000	1 057 632	1 176 429	1 167 118	1 139 223
Recovered (a)	7 995 795	7 914 616	7 905 870	7 621 863	8 139 177
Cuba					
Recovered (a)	* 5 000	* 5 000	* 5 000	* 5 000	* 5 000
Mexico					
Recovered (b)	703 000	703 000	621 000	556 000	523 000
Recovered (a)	1 121 546	1 016 000	1 077 000	1 027 000	1 036 000
Netherlands Antilles					
Recovered (a)	28 000	40 000	60 000	60 000	28 000
Trinidad & Tobago					
Recovered (a)	17 000	16 000	15 000	13 000	20 000
USA					
Recovered (b)	739 000	711 000	674 000	803 000	* 800 000
Recovered (a)	9 420 000	8 790 000	8 390 000	8 280 000	* 8 400 000
Argentina					
Recovered (b)	23 000	23 000	23 000	23 000	23 000
Brazil					
Pyrites	24 174	19 618	20 954	22 336	* 25 000
Recovered (b)	279 631	266 817	297 539	321 707	366 000
Recovered (a)	91 804	112 093	117 203	135 623	157 000
Chile					
Recovered (b)	1 507 000	1 788 000	1 574 000	1 533 000	1 541 000
Colombia					
Recovered (a)	* 24 000	* 24 000	* 24 000	* 24 000	* 24 000
Sulphur ore	97 586	64 660	30 018	—	—
Ecuador					
Recovered (a)	* 20 700	* 20 700	* 21 000	* 21 000	* 21 000
Sulphur ore	* 4 000	* 4 000	* 4 000	* 4 000	* 4 000
Peru					
Recovered (b)	* 60 000	* 60 000	* 60 000	* 60 000	* 60 000
Venezuela					
Recovered (a)	730 000	950 000	950 000	850 000	800 000

Production of sulphur and pyrites

tonnes (sulphur content)

Country	2004	2005	2006	2007	2008
Abu Dhabi					
Recovered (a)	1 926 000	2 060 000	2 045 000	2 183 000	1 900 000
Bahrain					
Recovered (a)	74 850	71 518	64 565	71 771	80 000
China					
Pyrites	4 720 000	4 714 000	4 663 000	6 082 000	6 022 000
Recovered	3 070 000	3 195 000	3 588 000	4 485 000	5 268 000
Sulphur ore	827 000	950 000	1 000 000	1 200 000	1 290 000
India					
Recovered (b)	539 000	637 000	801 000	955 000	1 103 000
Recovered (a) (c)	501 000	576 000	801 000	951 000	1 101 000
Indonesia					
Recovered (b)	172 000	212 000	168 000	212 000	199 000
Recovered (a)	100 000	105 000	105 000	105 000	110 000
Iran					
Recovered (a)	1 400 000	1 440 000	1 440 000	1 456 000	1 629 000
Iraq					
Recovered (a)	100 000	100 000	100 000	100 000	100 000
Israel					
Recovered (a)	42 000	44 000	42 000	34 000	50 000
Japan					
Recovered (b) (d)	1 545 000	1 583 000	1 679 000	1 747 000	1 797 000
Recovered (a)	1 894 000	1 972 000	1 950 000	1 967 000	2 034 000
Jordan					
Recovered	..	...	.	334 000	* 310 000
Kazakhstan					
Recovered (b)	351 000	235 000	* 235 000	* 235 000	392 000
Recovered (a)	1 625 000	1 590 000	1 586 600	1 660 700	1 732 600
Korea, Dem. P R of					
Pyrites	18 000	18 000	18 000	18 000	18 000
Recovered (b)	16 000	16 000	16 000	16 000	16 000
Korea, Republic of					
Recovered (b)	796 000	861 000	899 000	912 000	990 000
Recovered (a)	660 000	660 000	660 000	* 670 000	* 660 000
Kuwait					
Recovered (a)	682 000	836 000	742 000	830 000	830 000
Oman					
Recovered (a)	* 30 000	* 30 000	* 30 000	* 30 000	* 30 000
Pakistan					
Recovered (e)	23 873	24 158	24 730	27 710	29 000
Philippines					
Recovered (b)	163 000	163 000	180 000	196 000	229 000
Recovered (a)	40 000	45 000	45 000	45 000	45 000
Qatar					
Recovered (a)	307 187	450 000	395 000	503 000	620 000
Saudi Arabia					
Recovered (a)	2 249 000	2 700 000	2 900 000	3 100 000	3 100 000
Singapore					
Recovered (a)	215 000	250 000	250 000	212 000	220 000
Syria					
Recovered (a)	34 996	36 074	43 000	40 650	40 491
Taiwan					
Recovered	222 670	267 790	245 789	249 156	211 869
Thailand					
Recovered (b)	90 000	88 000	46 000	57 000	46 000
Recovered (a)	200 000	200 000	200 000	200 000	160 000
Uzbekistan					
Recovered (b)	163 000	163 000	163 000	163 000	163 000
Recovered (a)	360 000	345 000	345 000	345 000	390 000

Production of sulphur and pyrites

tonnes (sulphur content)

Country	2004	2005	2006	2007	2008
Australia					
Recovered (b)	850 000	915 000	915 000	915 000	866 000
Recovered (a)	60 000	60 000	60 000	60 000	60 000
New Zealand					
Recovered	21 000	29 000	29 000	32 000	38 000
World Total					
Pyrites	5 500 000	5 400 000	5 200 000	6 700 000	6 600 000
Frasch	800 000	800 000	800 000	800 000	800 000
Recovered	58 600 000	60 600 000	61 100 000	63 000 000	65 100 000
Sulphur ore	1 100 000	1 200 000	1 200 000	1 300 000	1 400 000

Note(s)
(a) From petroleum refining and/or natural gas
(b) From metal sulphide processing
(c) Other
(d) Including S content of sulphur ore
(e) Years ended 30 June of that stated

Production of talc

tonnes

Country	2004	2005	2006	2007	2008
Austria	136 305	166 569	159 447	153 409	154 577
Finland	528 943	508 169	547 146	535 882	527 686
France	402 000	416 000	* 420 000	* 420 000	* 420 000
Greece	200	250	* 250	200	* 200
Italy	111 887	140 581	130 714	112 080	* 110 000
Macedonia	4 350	1 955	1 025	1 775	977
Norway	32 000	34 000	* 34 000	* 34 000	* 30 000
Portugal	6 231	5 362	5 517	12 367	* 12 500
Romania	9 725	6 760	2 967	1 513	1 843
Russia	154 138	* 150 000	* 150 000	* 150 000	* 150 000
Slovakia	3 000	200	—	—	—
Spain					
Talc	107 829	90 589	83 502	78 042	59 299
Pyrophyllite	700	700	—	—	—
Sweden	8 000	7 000	6 000	7 000	4 000
United Kingdom	3 881	6 000	4 325	2 850	2 410
Egypt (a)	54 145	38 780	* 40 000	40 572	43 990
Morocco					
Talc	* 2 200	—	1 400	944	220
Pyrophyllite	45 600	33 300	12 900	26 072	25 782
South Africa					
Talc	8 141	8 469	10 966	14 281	5 145
Pyrophyllite	28 987	60 267	74 886	123 666	80 704
Sudan	...	..	216	2 620	* 2 600
Canada	81 000	70 000	68 000	67 000	70 000
Guatemala	2 863	16 131	526	6 456	583
Mexico	101 896	64 827	40 535	32 410	16 405
USA	833 000	856 000	895 000	769 000	* 645 000
Argentina					
Talc	7 620	12 603	13 773	14 956	* 15 000
Pyrophyllite	12 594	8 470	9 340	9 880	* 10 000
Brazil (b)	409 946	413 340	389 391	401 204	* 405 000
Chile	722	886	704	764	961
Colombia (b)	* 15 000	* 15 000	* 15 000	* 15 000	* 15 000

Production of talc

tonnes

Country	2004	2005	2006	2007	2008
Peru					
Talc	8 312	14 251	14 618	23 096	17 984
Pyrophyllite	14 282	10 100	14 500	23 086	17 984
Uruguay	1 042	1 131	1 544	848	* 1 000
Bhutan	39 797	42 791	54 208	62 015	56 077
China	2 700 000	2 700 000	2 500 000	* 2 000 000	* 2 000 000
India					
Pyrophyllite (c)	271 225	182 526	147 807	204 889	226 063
Steatite (c)	684 440	681 534	739 849	825 986	820 347
Iran (d)	108 541	70 600	69 050	90 889	* 90 000
Japan					
Talc	18 253	25 491	* 25 500	* 26 000	* 25 000
Pyrophyllite	405 222	351 111	* 350 000	* 345 000	* 330 000
Korea, Dem P R of	* 50 000	* 50 000	* 50 000	* 50 000	* 50 000
Korea, Republic of					
Talc	79 313	83 471	64 118	9 557	6 438
Pyrophyllite	827 895	885 559	677 465	798 054	892 625
Nepal (e)	3 435	5 832	6 648	9 043	7 996
Pakistan (a)	52 483	20 564	21 065	27 400	38 000
Taiwan	410	—	—	—	—
Thailand					
Talc	12 592	10 270	4 373	3 508	3 264
Pyrophyllite	108 691	177 684	131 843	415 420	106 600
Vietnam					
Pyrophyllite	* 10 000	* 12 000	* 14 000	* 16 000	...
Australia (a)	123 080	150 923	* 147 000	* 121 000	* 130 000
World Total	8 600 000	8 600 000	8 200 000	8 100 000	7 600 000

Note(s)
(a) Years ended 30 June of that stated
(b) Including talc, agalmatolite and pyrophyllite
(c) Years ended 31 March following that stated
(d) Years ended 20 March following that stated
(e) Years ended 15 July of that stated

Production of tantalum and niobium minerals

tonnes

Country	2004	2005	2006	2007	2008
Burundi					
Columbite-tantalite	23	43	16	52	84
Congo, Democratic Republic					
Columbite-tantalite	74	124	120	* 120	* 120
Ethiopia					
Tantalite (a)	71	93	109	117	83
Madagascar					
Columbite	40	.	...	..	...
Mozambique					
Tantalite	712	281	95	196	396
Nigeria					
Tantalite	24	* 25	25	* 25	* 25
Rwanda					
Columbite-tantalite	220	276	188	242	298
Zimbabwe					
Columbite-tantalite	27	—	—	—	—
Canada					
Pyrochlore	* 8 200	* 6 900	* 9 200	* 9 500	* 9 700
Tantalite	209	233	204	165	* 148
Brazil					
Pyrochlore	* 79 000	* 146 000	* 175 000	* 215 000	* 250 000
Columbite-tantalite	* 6 500	* 6 600	* 5 400	* 5 000	* 5 000
China					
Columbite-tantalite	* 350	* 350	* 350	* 350	* 350
Malaysia					
Struverite	121	552	93	52	216
Australia					
Tantalite	* 2 400	* 2 500	* 1 400	* 890	* 940
World total concentrates	98 000	164 000	192 000	232 000	267 000
Nb content	27 400	42 300	52 200	71 100	82 000
Ta content	1 500	1 700	1 100	800	900

Note(s)
(1) Niobium and tantalum minerals are also believed to be produced in Namibia, Russia and South Africa.
(2) The figures in this table refer to gross tonnage of tantalum and niobium concentrates
(3) Tantalum is also recovered from tin slags and is believed to have accounted for approximately 20% of raw material supplied.

(a) Years ended 7 July of that stated

Production of tellurium metal

tonnes

Country	2004	2005	2006	2007	2008
Canada	69	11	11	14	19
USA	50	50	50	50	50
Peru	25	33	37	35	28
Japan	33	23	24	41	* 40

Note(s)
(1) In addition to the countries listed, Germany is believed to produce tellurium metal

Mine production of tin

tonnes (metal content)

Country	2004	2005	2006	2007	2008
Portugal	200	243	25	41	32
Russia (a)	3 000	2 500	2 600	2 500	1 500
Burundi	9	4	44	28	21
Congo, Democratic Republic	4 900	4 400	3 800	8 900	11 800
Niger	4	14	13	11	* 10
Nigeria	1 374	* 1 500	1 423	2 500	1 800
Rwanda	3 554	4 532	3 835	4 566	4 193
Uganda	3	—	—	24	40
Bolivia	18 115	18 639	17 669	15 972	17 320
Brazil	12 202	11 739	9 528	11 835	13 000
Peru (b)	41 613	42 145	38 470	39 019	39 037
Burma	500	700	* 900	* 500	* 500
China	118 200	121 600	126 300	147 300	* 125 000
Indonesia	73 079	78 404	80 933	66 137	53 228
Kazakhstan	14	5	—	—	—
Laos	* 400	* 600	* 600	* 700	* 700
Malaysia	2 745	2 857	2 398	2 263	2 605
Thailand	724	188	225	149	235
Vietnam	* 3 500	* 5 400	* 5 400	* 5 400	* 5 400
Australia	1 306	2 713	2 783	2 071	1 783
World Total	285 000	298 000	297 000	310 000	278 000

Note(s)
(a) Metal
(b) Recoverable

Smelter production of tin

tonnes

Country	2004	2005	2006	2007	2008
Belgium	8 900	7 700	8 000	8 400	9 200
Russia	4 200	3 700	3 700	3 300	1 700
Bolivia (a)	13 627	13 841	14 100	12 300	12 100
Brazil	11 512	8 986	8 780	9 987	11 000
Peru	40 624	36 733	40 495	36 004	38 865
China	115 300	121 800	132 100	148 800	129 100
Indonesia	60 697	67 600	65 357	64 127	69 500
Japan	707	754	854	879	956
Malaysia	33 900	37 782	22 850	25 563	31 600
Thailand	20 800	31 600	27 540	23 104	21 860
Vietnam	2 356	2 510	2 665	3 369	3 566
Australia	467	594	572	118	—
World Total	313 000	334 000	327 000	336 000	329 000

Note(s)
(1) Figures relate to both primary and secondary metal
(2) In addition to the countries listed, many countries produce small amounts of secondary metal

(a) Refined, including alloys

Production of titanium minerals

tonnes

Country	2004	2005	2006	2007	2008
Norway					
Ilmenite	866 700	806 800	850 000	882 000	915 000
Ukraine					
Ilmenite	* 600 000	* 600 000	* 600 000	* 600 000	* 600 000
Rutile	* 100 000	* 100 000	* 100 000	* 100 000	* 100 000
Egypt					
Ilmenite	120 000	* 120 000	* 120 000	108 000	88 000
Mozambique					
Ilmenite	...	..	.	140 515	328 875
Rutile	...	..	..	8 782	32 985
Sierra Leone					
Ilmenite	—	—	13 819	15 750	17 260
Rutile	—	—	73 600	82 805	78 910
South Africa					
Ilmenite (a)	1 730 000	1 904 000	* 2 070 000	* 2 248 000	* 2 176 000
Rutile	* 100 000	* 130 000	125 200	111 500	132 000
Canada					
Ilmenite (a)(b)	* 2 100 000	* 2 100 000	* 2 400 000	* 2 500 000	* 2 600 000
USA	* 500 000	* 500 000	* 500 000	* 400 000	* 400 000
Brazil					
Ilmenite	133 000	127 142	* 130 000	* 130 000	* 130 000
Rutile	* 3 000	2 782	* 3 000	3 000	* 3 000
China					
Ilmenite	* 840 000	* 1 015 000	* 1 000 000	* 1 100 000	* 1 000 000
India					
Ilmenite (c)	632 025	703 796	692 906	* 730 000	* 730 000
Rutile (c)	19 649	20 299	16 157	* 22 000	* 22 000
Kazakhstan	11 670	* 10 000	13 500	15 700	* 16 000
Korea, Republic of					
Ilmenite	150 744	157 433	179 982	193 953	226 069
Malaysia					
Ilmenite	61 471	38 195	45 649	59 310	36 779
Rutile	27 308	5 509	16 921	1 450	1 834
Sri Lanka					
Ilmenite	1 335	36 303	57 033	70 728	56 824
Rutile	2 798	8 162	2 280	4 607	3 405
Vietnam					
Ilmenite (d)	* 580 000	* 530 000	* 600 000	* 650 000	* 700 000
Rutile	* 500	* 500	* 500	* 500	* 500
Australia					
Ilmenite	1 934 000	2 034 000	2 378 000	2 339 000	2 042 000
Rutile	162 000	177 000	232 000	312 000	325 000
Leucoxene	44 000	62 000	135 000	164 000	158 000
World Total	10 700 000	11 200 000	12 400 000	13 000 000	12 900 000
Ilmenite (wt of concs)	10 300 000	10 600 000	11 900 000	12 500 000	12 100 000
Rutile (wt of concs)	415 000	434 000	570 000	647 000	700 000
All forms (TiO_2 content)	* 5 200 000	* 5 500 000	* 6 300 000	* 6 600 000	* 6 400 000

Note(s)
(1) The figures in this table refer to gross tonnage of titanium concentrates
(2) Some ilmenite is converted to synthetic rutile in Australia, India, Japan, Taiwan and USA

(a) It is believed that the majority of this is processed into slag. In 2008 South Africa produced an estimated 1 200 000 tonnes of slag (85% TiO_2) and Canada produced an estimated 1 110 000 tonnes of slag (80-95% TiO_2)
(b) Canada produces some ilmenite which is sold as such and not processed into slag, but tonnages are small
(c) Years ended 31 March following that stated
(d) BGS estimates, based on known imports into certain countries

Mine production of tungsten

tonnes (metal content)

Country	2004	2005	2006	2007	2008
Austria	1 335	1 280	1 153	1 117	1 122
Portugal (a)	746	816	780	846	* 900
Russia	* 2 800	* 2 900	* 2 900	* 3 200	* 3 200
Spain	—	—	—	—	194
Burundi	8	94	238	163	194
Congo, Democratic Republic	* 20	* 180	* 500	* 500	* 500
Rwanda	125	442	1 139	2 130	1 354
Uganda	63	36	75	86	48
Canada	—	484	2 561	2 700	2 608
Bolivia	403	530	870	1 106	1 150
Brazil (b)	293	557	525	537	* 550
Peru	—	—	50	348	...
Burma (c)	107	168	197	183	* 200
China	59 947	51 200	45 000	41 000	43 500
Kazakhstan	...	.	50	100	...
Korea, Dem. P R of	* 600	* 600	* 600	* 600	* 600
Kyrgyzstan	* 100	* 100	* 100	* 100	...
Mongolia	48	54	58	245	142
Thailand (a)	337	622	546	823	582
Uzbekistan	* 300	* 300	* 300	* 300	* 300
Australia	...	(d)(e) 44	(d)(e) 13	(d)(e) 30	(d)(e) 11
World Total	67 200	60 400	57 700	56 100	57 200

Note(s)
(a) Wolframite and scheelite
(b) Mainly scheelite
(c) Including tungsten content of tin-wolframite concentrates
(d) Scheelite
(e) Years ended 30 June of that stated

URANIUM

Characteristics

Uranium is a very dense, metallic element which is naturally radioactive. It spontaneously decays, through a long series of alpha and beta particle emissions, ultimately forming the stable element lead.

Uranium occurs in a variety of different geological environments. The largest economic deposits are in sedimentary rocks, but deposits are also found in hydrothermal, metamorphic, surficial and igneous settings. Under oxidising conditions it exists in a highly soluble form and is therefore very mobile. However, under reducing conditions, where oxygen is depleted, it converts to an insoluble form and is precipitated. This is the process that usually results in concentrations of uranium that are sufficient for economic extraction. The most common uranium mineral is uraninite (uranium oxide), known as pitchblende when in its massive form. Lesser amounts of the silicate brannerite and the uranium titanate, coffinite, also occur in economic deposits, in association with uraninite. The product shipped from all uranium mines is purified solid U_3O_8, known as 'yellowcake'. This is produced by leaching either crushed or in situ ore, followed by solvent extraction, precipitation, and calcining.

Uranium occurs as several isotopes, of which the most abundant are uranium-238 (about 99.3 per cent of natural uranium) and uranium-235 (0.7 per cent of natural uranium). In most nuclear power plants it is uranium-235 that is required and hence uranium often undergoes enrichment prior to being made into fuel.

Uses

Uranium's main use comes from the energy that is released when an atom of uranium is split by nuclear fission. This is caused by the uranium atom being struck by, and absorbing, an extra neutron. Each time an atom undergoes fission, additional neutrons are also released and these can cause a chain reaction to occur if they collide with other uranium atoms.

Over 95 per cent of uranium is used in the production of electricity in nuclear power stations. The remainder is used for the propulsion of ships, research, desalination and military ordnance.

Most nuclear power stations use the fission of uranium-235 as a heat source for converting water into steam. The steam is then used to propel turbines, which generate electricity, in the same way that fossil fuels are used in conventional power stations. The main contrast is that one kilogram of uranium-235 produces approximately three million times more energy than a similar weight of coal.

The International Energy Agency (IEA) estimates that 19 771 TWh of electricity were produced around the world in 2007. Of this, 13.8 per cent was produced by nuclear power, compared to 41.5 per cent produced by coal (IEA, 2009). However, some countries are far more reliant on nuclear power to generate their electricity than this overall figure would suggest. For example, in 2007, France produced 77.9 per cent of its electricity requirements from nuclear power, compared to 16.1 per cent in the UK. In China, the figure was just over two per cent, but significant growth in nuclear power is anticipated due to the number of new reactors under construction or planned.

In December 2009, there were a total of 435 nuclear reactors generating electricity in the world, with another 53 under construction. This includes 18 in China, nine in Russia and six each in India and South Korea. A further 136 reactors were 'on order or planned', including 35 in China, and 299 reactors were 'proposed' of which 90 were in China (World Nuclear Association, 2009a).

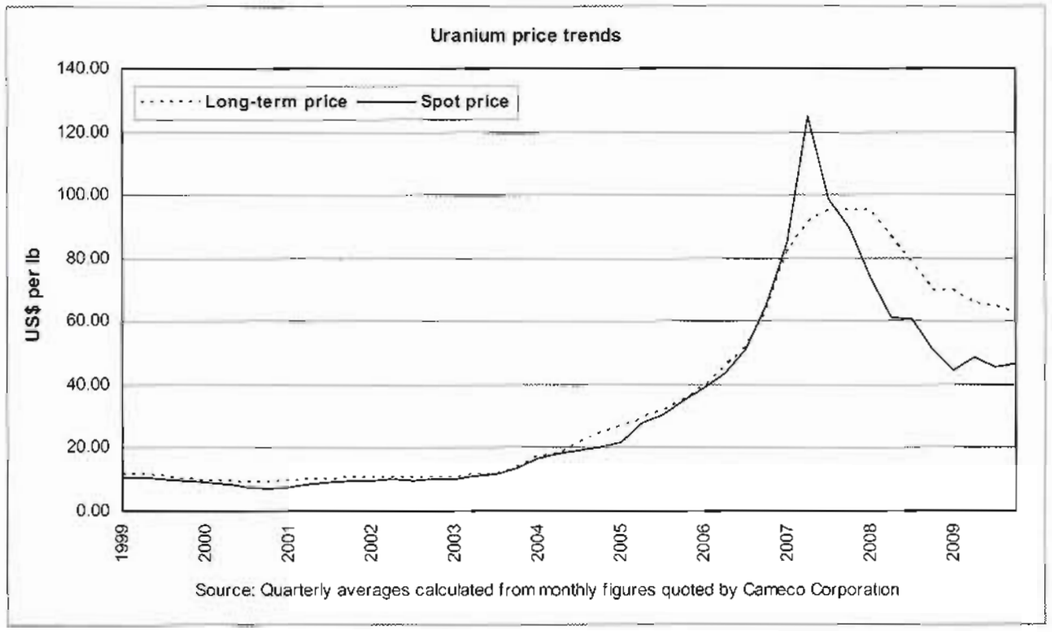
In addition to nuclear reactors for electricity production, there are currently around 250 reactors used for research purposes in 56 countries. These are used to create neutron beams suitable for studying the structure and dynamics of materials at atomic level. They are also used to produce radioisotopes for medical applications such as cancer treatment.

Nuclear reactors have been used to propel ships since the 1950s. They are particularly useful in submarines and ships operating in Arctic latitudes where they provide considerably more power than other fuels, and enable long periods at sea without the need to refuel.

Desalination is an energy intensive process and in this context nuclear power is often cost-competitive with other sources of power. In several countries desalination takes place alongside electricity generation and there is potential for this combined method to increase.

Uranium has long been a sensitive political topic because highly enriched uranium (which contains over 90 per cent of uranium-235) can be used in weapons. No uranium used in power stations is capable of use in a weapon because it contains either natural or low-enriched uranium (generally a maximum of 5 per cent of uranium-235). However, low-enriched uranium can be converted into highly enriched uranium with further enrichment.

To prevent the spread of nuclear weapons, the International Atomic Energy Authority (IAEA) has operated a series of safeguards since 1970 under the Nuclear Non-proliferation Treaty (NPT). A large number of nations have signed the Treaty, including the five countries that have officially declared that they have nuclear weapons: USA, Russia, China, UK and France. Three other countries are known to hold them: India, Pakistan and Israel, but these countries have not signed the Treaty. The work of the IAEA in attempting to enforce safeguards under the Treaty is often difficult and politically sensitive. North Korea withdrew from the Treaty in 2003 and is believed to have tested nuclear devices underground in 2006 and May 2009. Negotiations have proved to be difficult and, although their nuclear facilities were closed in 2007, they subsequently expelled IAEA inspectors and have recommenced reprocessing of spent nuclear fuel (World Nuclear Association, 2009b). Another country causing concern is Iran. It is a signatory of the Treaty and insists that its construction of facilities is for peaceful purposes; however, Iran has not been entirely transparent regarding its activities, in contravention of obligations under the NPT.



World production in 2008

The total mined production of uranium (metal content) rose again in 2008 compared to 2007 to just under 44 000 tonnes, the highest annual output since 1989. This was largely as a result of a 52 per cent increase in production from Namibia and a 28 per cent increase in output from Kazakhstan. As a result of these increases, Kazakhstan moved ahead of Australia as the second largest producing country and Namibia produced more mined uranium than Russia or Niger.

Canada remained the largest producer of mined uranium, despite its output declining again by a further five per cent. In 2008 Canada produced 20 per cent of the world's total, down from 29 per cent in 2004. In contrast, Kazakhstan's production levels have increased by 129 per cent in five years and its contribution to the world total has increased from nine per cent in 2004 to 19 per cent in 2008. Australia's output fell by two per cent in 2008 compared with 2007 and its contribution to the world total has fallen from 22 per cent in 2004 to 19 per cent in 2008, with a slightly lower tonnage than Kazakhstan.

Namibia, which contributed 10 per cent to the world total, was the fourth largest producer of mined uranium in the world in 2008, with a significant increase in output following expansion at its two uranium mines. Other significant producers in 2008 were Russia (eight per cent of the total), Niger (seven per cent), Uzbekistan (five per cent), where production levels were broadly similar to the previous year, and the USA (three per cent of the world total) where output fell by 14 per cent.

Prices

Over 80 per cent of uranium is sold under long-term contracts (three- to seven-year terms), however, a spot market has been in existence for several years and this is frequently referred to when negotiating prices for long-term contracts. From 1988 to 2004 spot market prices were very low, rising to a mere US$20 per pound by the end of 2004. However, throughout 2005 to 2007 the spot price rose sharply, reaching a high of US$138 per pound in June 2007, before falling back to around US$51 per pound by the end of 2008. During the early part of 2009 the spot price reached a three-year low of around US$42 per pound but subsequently recovered slightly to end the year at approximately US$45 per pound.

The long-term industry average price also rose significantly from a low of just over US$9 per pound in 2000 to around US$95 per pound at the end of 2007. Since then, however, it has continued to fall throughout 2008 and 2009, finishing the latter year only slightly above US$60 per pound.

Demand for uranium for electricity generation continues to be much higher than current mine production levels, with the shortfall being supplied by reprocessing, from stockpiles and by the conversion of weapons-grade uranium into fuel for power stations. Concerns remain over continuity of supply due to the significant increase in the number of nuclear reactors proposed or planned, partly as a result of current international efforts to reduce carbon dioxide emissions. However, increases in mine production and the effects of the global recession have allowed the price to fall.

Industry events in 2009

Several new uranium mines commenced production in 2009, including Daneros Mine in the USA operated by White Canyon Uranium (Batten, 2009a) and Paladin's Kayelekera Mine in Malawi (Paladin, 2009). Areva's Trekkopje Mine in Namibia recovered its first uranium from a pilot plant during the year and is expected to start full production in 2010 or 2011 (Wise uranium, 2009: Areva, 2009).

Kazakhstan has dramatically increased its number of operating mines (all using in-situ leach methods) from just one in 2004 (Inkai) to 15 by the end of 2009, with Semizbai, Budenovskoye 1 and Kharassan commencing production during the year. Although most of these mines have design capacities of less than 2000 tonnes per year, their combined output is expected to have pushed Kazakhstan into the number one spot of producing countries in 2009, overtaking even Canada (Kazatomprom, 2009).

In addition, a significant number of potential new mines are under development with production expected in the near future. Among these are: Areva's Imouraren project in Niger where commissioning is scheduled for 2010 with full production of 5000 tonnes per year expected by 2012 (Mandel, 2009); China National Uranium Corporation's Somina operation in Niger, which is scheduled to commence in 2010 (Mineweb, 2009); Alliance/Quasar Resources' Four Mile project in South Australia where commissioning is expected to start in April 2010 (Batten, 2009b) and UraniumSA's Blackbush project also in South Australia where trial mining could start later in 2010 (Mining News, 2009a). Construction has also started on Uranium One/Mitsui's Honeymoon mine, again in South Australia (Mining News, 2009b).

Progress has continued throughout 2009 in the development of uranium prospects in Western Australia, following the lifting of the long-running uranium mining ban in the state during 2008. The most recent reports suggest Mega Uranium's Lake Maitland project may be the first to commence mining, possibly as early as 2011 if it meets all the required timelines and environmental approvals. This will be quickly followed by Toro Energy's Lake Way project and BHP Billiton's Yeelirrie project resulting in three possible new mines by 2014 (Department of Mines & Petroleum, 2009).

Australia's mine production of uranium suffered a blow in October 2009 when an incident at the major Olympic Dam Mine resulted in a failure to the main shaft, used for around 75 per cent of ore haulage from the underground mine. A much lower level of production has continued using a secondary shaft and BHP Billiton is using the failure as an opportunity to bring forward other planned maintenance work. It is not clear when full production will be resumed (Batten, 2009c).

The news from Kazakhstan was not all positive during 2009 either, with an investigation into the legality of some foreign investment deals causing some concern (Saywell, 2009).

In Canada, Cameco Corporation reported that work is progressing to dewater the flooded Cigar Lake project, which was originally planned to commence production in 2007. Remediation of the main shaft is ongoing and this will enable crews to safely re-enter the development to assess its condition. An updated technical report, including a new timeline to production, is expected to be released during the first part of 2010 (Cameco, 2009b).

Exploration at the Rössing South project in Namibia continued to increase the resource estimates and investor interest in the project. A feasibility study will be completed during 2010 (Batten, 2009d). It is expected that discussions regarding co-operation on development will occur with Rössing Uranium Ltd (68.6 per cent Rio Tinto) which operates the nearby Rössing Mine, but even without ore from Rössing South the Mine is likely to have sufficient resources to extend operations to 2023 (Williams, 2009).

Exploration also continues in a number of other countries around the world, with additional mineralisation identified in Tanzania, Botswana, Namibia, at Salamanca in Spain, in Northern Territory Australia, Saskatchewan Canada and Wyoming USA.

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Mine production of uranium

tonnes (metal content)

Country	2004	2005	2006	2007	2008
Czech Republic	435	420	383	322	290
Germany	77	80	65	41	* 40
Romania	90	* 90	* 90	* 77	* 77
Russia	3 280	3 431	3 262	3 413	3 521
Ukraine	* 800	* 800	* 800	846	* 800
Namibia	3 159	2 855	2 782	2 879	4 366
Niger	3 273	3 093	3 431	3 153	2 993
South Africa	752	674	542	525	654
Canada	11 599	11 627	9 862	9 475	9 001
USA	878	1 034	1 579	1 744	1 501
Brazil	300	110	190	299	330
China	* 750	* 750	* 750	* 712	* 769
India	* 230	* 230	* 177	* 270	* 271
Kazakhstan	3 719	4 357	5 279	6 637	8 521
Pakistan	* 45	* 45	* 45	* 45	* 45
Uzbekistan	2 035	2 629	2 270	2 320	2 338
Australia	9 010	9 516	7 606	8 603	8 471
World Total	40 400	41 700	39 100	41 400	44 000
World Total (U_3O_8 equivalent)	47 700	49 200	46 100	48 800	51 900

Note(s)
(1) Excluding uranium production from decommissioning operations in France, Germany and Spain

Mine production of vanadium

tonnes (metal content)

Country	2004	2005	2006	2007	2008
Russia	24 277	* 24 000	* 24 000	* 25 000	* 27 000
South Africa	23 303	22 604	23 800	23 486	20 295
China	* 16 000	* 17 000	* 17 000	* 18 000	* 18 500
Kazakhstan	* 1 000	* 1 000	* 1 000	* 1 000	* 1 000
Australia	220	—	—	—	—
World Total	65 000	65 000	66 000	67 000	67 000

Note(s)
(1) This table includes vanadium in slag products but excludes vanadium recovered as a by product of the refining and burning of heavy oils

Production of vermiculite

tonnes

Country	2004	2005	2006	2007	2008
Russia	* 30 000	* 30 000	* 30 000	* 30 000	* 30 000
Egypt	* 400	* 6 700	* 6 700	5 770	7 560
South Africa	196 893	209 801	197 765	199 664	199 764
Uganda	2 688	2 574	3 512	3 269	—
Zimbabwe	27 150	23 045	13 421	* 13 000	* 13 000
USA (a)	* 100 000	* 100 000	* 100 000	* 100 000	* 100 000
Argentina	1 293	1 403	1 585	1 726	* 1 900
Brazil	26 000	24 191	19 279	18 952	20 000
China	* 100 000	* 100 000	* 110 000	* 110 000	* 110 000
India (b)	3 377	6 674	11 827	10 801	* 13 368
Japan	* 6 000	* 6 000	* 6 000	* 6 000	* 6 000
Australia (c)	9 676	8 769	9 392	8 900	8 319

Note(s)
(1) In addition to the countries listed Malawi is believed to produce vermiculite

(a) Sold or used by producers
(b) Years ended 31 March following that stated
(c) Years ended 30 June of that stated

Production of wollastonite

tonnes

Country	2004	2005	2006	2007	2008
Finland	16 763	15 950	16 200	16 364	15 600
Spain	..	* 30 000	* 30 000	10 918	9 500
Namibia	406	253	55	* 55	* 55
Mexico	28 224	27 132	44 280	50 809	46 844
USA	* 120 000	* 120 000	* 125 000	* 125 000	* 90 000
China	345 000	350 000	350 000	* 350 000	* 325 000
India (a)	170 292	128 582	131 572	118 666	103 837

Note(s)
(1) In addition to the countries listed, Turkey is believed to produce wollastonite

(a) Years ended 31 March following that stated

ZINC

Characteristics

Zinc is a blue-grey metal; the freshly cut surface having a typical metallic lustre, which quickly tarnishes to dull grey when exposed to air, due to oxidation. It is moderately reactive and burns with a bright bluish-green flame in air. It reacts with both acids and alkalis. It is malleable between 100°C to 210°C, above 210°C zinc becomes brittle and can be powdered. Zinc is non-magnetic.

Zinc does not occur in nature in the form of native (free) metal. The most common ore minerals are sphalerite (zinc sulphide, ZnS), also known as zinc blende, and its variety marmatite (zinc sulphide containing some iron sulphide, (Zn,Fe)S), from which over 95 per cent of the world's zinc is produced. Other economically important zinc minerals include smithsonite or zincspar ($ZnCO_3$), willemite (Zn_2SiO_4) and hemimorphite ($Zn_4Si_2O_7(OH).2H_2O$), which may occur in the near-surface weathered or oxidised zone of an ore body. Less important are metamorphic zinc oxide ores such as the spinel, franklinite (Zn, Fe, Mn)((Fe, Mn)$_2O_4$) or zincite (ZnO).

Zinc deposits are formed by deposition from hydrothermal brines and are generally polymetallic, commonly including economic levels of copper, lead, silver, cadmium, bismuth, tin and gold. Economic levels of barite and fluorite may also be present. Zinc ore deposits are widely spread throughout the world and mining is currently carried out in more than 50 countries. Australia, China, Peru, USA, Kazakhstan, Mexico and Canada have the largest zinc reserves (USGS, 2009).

Before zinc can be recovered from an ore concentrate, the sulphur content must be removed by sintering. The concentrate is brought to a temperature of more than 900°C converting the sulphide into the more active zinc oxide and sulphur is driven off as sulphur dioxide gas which subsequently is converted to sulphuric acid, an important commercial by-product. The zinc can then be extracted from the calcine either by leaching and subsequent electrolysis or by smelting in a blast furnace. Today, over 90 per cent of zinc is produced in electrolytic plants. Smelting is extremely energy intensive but has the advantage that it allows simultaneous production of lead, commonly associated with zinc in ore bodies. Electrolytic recovery produces more than 99.9 per cent pure zinc, which requires no subsequent refining (International Zinc Association, 2009).

Total world reserves of zinc are 180 million tonnes of which Australia holds 42 million tonnes, China 33 million tonnes and Peru 18 million tonnes (USGS, 2009). At present, approximately 70 per cent of the zinc produced worldwide is primary and 30 per cent is from recycled or secondary (including manufacturing scrap) sources. The level of recycling is increasing and over 80 per cent of the zinc available for recycling is recycled (International Zinc Association, 2009).

Uses

Current global uses of refined zinc are (International Lead Zinc Study Group (ILZSG), 2009):

- galvanizing (50 per cent)
- brass and bronze (17 per cent)
- zinc alloys (for die-casting industry etc.) (17 per cent)
- chemicals (6 per cent)
- semi-manufactures (6 per cent)
- miscellaneous (4 per cent)

From these first-use manufactures zinc is transformed into in a broad range of products. The main application areas are in construction (45 per cent), transport (25 per cent), consumer goods and electrical appliances (23 per cent), and general engineering (7 per cent). Zinc's ability to protect iron from corrosion in galvanising determines its most important use, and most of this product goes to supply the construction industry. Overall, about 75 per cent of zinc is used as metal. The remainder is used in zinc compounds mainly by the rubber, chemical, paint, and agricultural industries (International Zinc Association, 2009).

World production in 2008

World mine production of zinc was 12 million tonnes (metal content) in 2008, a six per cent increase on 2007. More than 40 countries mine zinc and the top three of these produce more than one million tonnes each (China, Australia and Peru). China was the top mine-producer of zinc and in 2008 mined just over three million tonnes, equivalent to 27 per cent of world mine production and a five per cent increase on 2007 figures. Peru produced 1.6 million tonnes in 2008, a notable increase of 11 per cent (on 2007), although this is a drop from the previous year's production increase (2006 to 2007), which represented a 20 per cent increase.

World slab zinc production in 2008 was 12 million tonnes. This was a two per cent increase on 2007. Production increased fairly steadily during the period 2004 to 2008, showing an overall increase of 12 per cent, although with a slight dip (two per cent) from 2004 to 2005. China remained the top-producing country with four million tonnes in 2008, equivalent to 34 per cent of world zinc slab production. This represents a five per cent increase on 2007 and a 44 per cent increase since 2004. Canada was the second-largest producer with 0.76 million tonnes and the Republic of Korea third, with production of 0.74 million tonnes in 2008.

Prices

Prices have more than doubled over the course of 2009, rising from around US$1220 per tonne in January 2009 to around US$2500 per tonne by the end of the year, slightly higher than the price at the beginning of the previous year (2008). The prices started to rise in March 2009, following a five-month period of low prices starting in October 2008, rising fairly steadily to the end of year peak (Metal Bulletin, 2009a).

The ILZSG reported the most severe drop in zinc demand since records began 50 years ago, if China is not included, due to falling industrial and construction usage in the wake of the global economic downturn (White, 2009). However, imports to China grew in the early part of the year due to the increasing gap between the lower London Metal Exchange (LME) price and the higher Shanghai price, and this helped to prevent prices falling further, although not through any increase in real demand (Metal Bulletin, 2009b).

The main reason attributed to the stabilising price was the fairly rapid response in production cuts and closures, caused by the low zinc prices in the early part of the year, which meant that the market was not swamped with over supply (O'Donovan, 2009). Continuing high levels of Chinese production contributed to the overall rise in zinc stocks throughout the year, although imports to China had all but ceased by June as the arbitrage gap between the London and Shanghai exchanges closed (Metal Bulletin, 2009c). Price rises

up until that point were mainly due to speculative interest; however European demand slowly picked up over the summer, despite the supply surplus, as much of the stocks were reported to be tied up in warehousing deals with large producers reopening their smelters on the increased prices (Metal Bulletin, 2009d).

Industry events in 2009

In the early part of the year, the low zinc price forced continuing operational cuts and closures. Among the mines suspending operations were HudBay Mineral's Chisel North Mine in Manitoba (Mining Journal, 2009a) and Minmetal's (Oz Minerals at that time) Scuddles Mine in Western Australia, (Mining Journal, 2009b) both in January. Many smelters had already closed or cut production toward the end of 2008. As the price started to pick up in March, some Chinese zinc smelters and mines were able to reopen as early as April following rising demand from car sales (Metal Bulletin, 2009e). However elsewhere in the world, demand was still very low and in April, Glencore put its Iscaycruz Mine in Peru on temporary suspension citing reduced prices (O'Donovan, 2009). In fact by the year end, Xstrata announced plans to close its Kidd Creek, Ontario, copper and zinc smelter in May 2010, citing global smelting over-capacity and low treatment and refining charges and appreciation of the Canadian versus US dollar (Thompson and Wallop, 2009).

As 2009 progressed prices rose sufficiently for some projects and smelters to re-open. The Chinese Yunnan Luoping zinc smelter and electricity plant was able to resume capacity in June after production cuts since the previous October (Metal Bulletin, 2009f). The world's largest zinc smelter company, Nystar, also returned two of its smelters to full capacity in July and reopened a third (Balen) by the end of September 2009, which had been on care and maintenance since December 2008. (Metal Bulletin, 2009g). The company also moved into mining operations this year, with the purchase of the Gordonsville mines in May and the East Tennessee zinc project purchased from Glencore in September, which it planned to restart and ramp up (Metal Bulletin, 2009h).

Griffin Mining restarted its zinc-gold Caijiaying mine in June (two months later than expected due to delays in required maintenance) after being closed in December 2008 (Metal Bulletin, 2009i). Xstrata also received final approval to reopen its McArthur River expansion in February which had been rejected towards the end of 2008 following insufficient environmental assessments. They aim to convert the underground mine to open pit which involves temporarily diverting the course of the McArthur River (Mining Journal, 2009c).

In terms of industry mergers, two that were still unresolved from 2008 did not go ahead in the end: the hostile bid of CBH to take over Perilya, was withdrawn in January (Mining Journal 2009d) and the HudBay Minerals attempted merger with Lundin Mining, was called off in February after shareholder dissent, the board resigned a month later (Mining Journal, 2009e). In October, Xstrata withdrew its proposed merger with Anglo American, which it had initiated in June (Wilshaw, 2009a). Meanwhile Chinese companies looked to buy up Anglo American's zinc assets, including the Skorpion Mine in Namibia and the Lisheen Mine in Ireland (Metal Bulletin, 2009j). The floundering Oz Minerals (formed during the Zinifex and Oxiana merger in July 2008) was taken over by the Chinese company Minmetals following shareholder approval in August 2009 (Wilshaw, 2009b). Minmetals' newly aquired Century zinc operation ran out of concentrate in November following an 11-week pipeline failure. Concentrate production was restarted just before Christmas (O'Donovan and Thompson, 2009).

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Mine production of zinc

tonnes (metal content)

Country	2004	2005	2006	2007	2008
Armenia	1 927	3 196	2 270	2 560	3 880
Bosnia & Herzegovina	1 100	2 500	902	4 799	8 595
Bulgaria	* 12 700	* 12 000	* 10 400	* 11 500	* 10 300
Finland	37 200	40 500	35 700	38 900	27 800
Greece	—	4 000	16 000	20 700	24 200
Ireland, Republic of	438 300	445 400	425 800	400 900	398 200
Macedonia	—	—	9 349	32 195	40 286
Poland	140 381	135 600	126 600	129 600	132 300
Portugal	—	—	7 505	24 163	22 567
Romania	23 599	13 784	8 052	849	14
Russia	161 700	186 000	178 000	177 000	205 000
Serbia	—	—	2 100	1 200	2 400
Serbia and Montenegro	1 300	900	—	—	—
Sweden	197 034	215 691	210 029	214 576	172 194
Turkey	39 000	56 000	59 000	71 000	73 000
Algeria	116	2 206	303	—	—
Congo, Democratic Republic	8 000	7 600	20 784	18 500	18 500
Morocco	70 600	77 300	74 400	54 353	80 747
Namibia	185 228	202 168	185 355	196 000	209 000
South Africa	32 001	32 112	34 444	31 062	29 002
Tunisia	29 011	15 713	—	—	—
Canada	791 373	666 664	637 956	630 485	716 078
Honduras	41 413	42 698	37 646	29 211	28 462
Mexico	426 360	476 307	479 400	452 012	453 588
USA	738 900	747 900	727 100	803 300	778 100
Argentina	27 220	30 227	29 808	27 025	31 000
Bolivia	147 430	159 502	172 747	214 053	383 620
Brazil	158 962	170 659	185 211	193 899	173 933
Chile	27 635	28 841	36 238	36 453	40 519
Peru	1 209 006	1 201 671	1 203 364	1 444 354	1 602 597
Burma	* 5 000	* 12 000	* 8 000	* 10 000	* 20 000
China	2 391 200	2 547 800	2 844 200	3 047 700	3 186 000
India (a)	354 600	472 241	504 863	551 992	649 581
Iran	127 000	156 000	166 000	75 000	86 000
Japan	47 800	41 500	7 200	—	—
Kazakhstan	361 400	364 300	404 600	386 000	387 400
Korea, Dem. P.R. of	* 62 000	* 65 000	* 85 000	* 95 000	* 65 000
Korea, Republic of	14	77	16	2 034	1 836
Laos	1 000	1 500	4 000	3 000	2 200
Mongolia	—	11 400	54 950	77 350	71 800
Philippines	—	2 000	3 000	7 400	1 600
Saudi Arabia	1 000	1 000	983	716	3 663
Thailand	29 922	30 572	32 103	26 406	17 811
Vietnam	40 000	48 000	45 000	45 000	45 000
Australia	1 334 000	1 367 000	1 362 000	1 514 000	1 519 000
World Total	9 700 000	10 100 000	10 400 000	11 100 000	11 700 000

Note(s)
(a) Years ended 31 March following that stated

Production of slab zinc

tonnes

Country	2004	2005	2006	2007	2008
Belgium	272 500	222 000	251 000	240 000	239 000
Bulgaria	101 500	92 500	85 900	98 100	101 700
Finland	284 525	281 904	282 238	305 543	297 722
France	260 000	209 000	120 000	129 000	118 000
Germany	382 020	334 900	342 566	294 735	292 284
Italy	118 400	121 200	109 200	102 100	107 100
Netherlands	224 000	227 500	227 500	234 000	250 000
Norway	140 901	151 285	160 670	157 027	145 469
Poland	155 500	137 300	133 900	141 900	142 500
Romania	52 746	56 795	43 705	58 342	61 978
Russia	239 000	211 000	248 000	263 000	263 000
Serbia	—	—	15 000	2 000	—
Serbia and Montenegro	3 664	18 000	—	—	—
Spain	525 000	501 400	507 300	509 000	466 000
Algeria	33 414	36 699	32 854	27 249	30 752
Namibia	120 533	132 818	129 897	150 100	145 400
South Africa	105 000	104 000	90 000	101 000	87 000
Zambia	2 000	—	—	1 000	2 000
Canada	805 438	724 035	824 465	802 103	764 312
Mexico	316 834	327 205	279 734	321 932	305 188
USA	306 000	309 000	268 900	278 000	286 000
Argentina	38 298	40 457	45 991	46 300	31 000
Brazil	273 000	274 000	279 000	265 126	260 000
Peru	195 692	163 603	175 250	162 575	190 324
China	2 719 500	2 776 100	3 162 700	3 742 600	3 913 100
India	272 000	302 000	415 000	459 000	606 000
Iran (a)	109 400	140 000	139 000	* 126 000	* 110 000
Japan	634 637	638 352	614 331	597 650	615 533
Kazakhstan	316 700	338 000	364 821	358 226	365 572
Korea, Dem. P R of	* 65 000	* 57 000	* 51 000	* 36 000	* 36 000
Korea, Republic of	669 171	646 817	667 000	691 000	739 000
Thailand	115 500	104 500	94 779	99 337	107 753
Uzbekistan	* 58 000	42 000	46 000	71 800	70 000
Vietnam	—	* 7 000	* 10 000	* 10 000	* 14 000
Australia	473 000	457 000	464 000	502 000	500 000
World Total	10 400 000	10 200 000	10 700 000	11 400 000	11 700 000

Note(s)
(a) Years ended 20 March following that stated

Production of zirconium minerals

tonnes

Country	2004	2005	2006	2007	2008
Russia (a)	* 5 500	* 6 700	* 7 500	7 136	* 7 000
Ukraine	* 35 000	* 35 000	* 35 000	* 35 000	* 35 000
Gambia	* 12 000	* 12 000	410	..	...
Mozambique	...	..	.	26 347	6 552
South Africa	379 000	314 000	414 400	388 800	404 000
USA	172 000	164 000	143 000	121 000	122 000
Brazil (a)	25 263	25 657	25 120	26 739	* 27 000
China	* 120 000	* 120 000	* 135 000	* 140 000	* 140 000
India	25 432	27 133	20 535	* 24 000	* 24 000
Indonesia	* 500	* 2 600	* 65 000	* 111 000	* 65 000
Malaysia	6 686	4 954	1 690	7 393	984
Sri Lanka	12 826	23 587	8 321	381	1 447
Thailand	—	—	—	1 023	—
Vietnam (b)	* 40 000	* 35 000	* 27 000	* 22 000	* 24 000
Australia	441 000	426 000	491 000	600 000	550 000
World Total	1 275 000	1 197 000	1 374 000	1 511 000	1 407 000

Note(s)
(1) In this table the term 'zirconium minerals' is understood to mean zircon, unless otherwise stated

(a) Including caldasite rock containing zircon and baddeleyite
(b) Conservative BGS estimates, based on exports