World Mineral Statistics – 100 years old and still counting

With the recent publication of data for 2012 the British Geological Survey (BGS) has 100 years of continuous mineral production data, but what do they tell us about worldwide industrial mineral production? Teresa Brown has been analysing some of the trends.

Long term trends

It is probably no surprise that the production of industrial minerals has increased dramatically between 1913 and 2012, but when you closely examine the data the scale of the increase is staggering. For example, production of graphite in 1913 was slightly more than 143 thousand tonnes, whereas in 2012 global output was more than 2.1 million tonnes, an increase of 1370 per cent. Production of magnesite in 1913 was 354 thousand tonnes compared with nearly 24.5 million tonnes in 2012; an increase of more than 6800 percent. These are equivalent to increases of 14 per cent per year and 68 per cent per year, respectively, in each of the 100 years. 100-year production trends for five industrial minerals are shown in Figure 1.

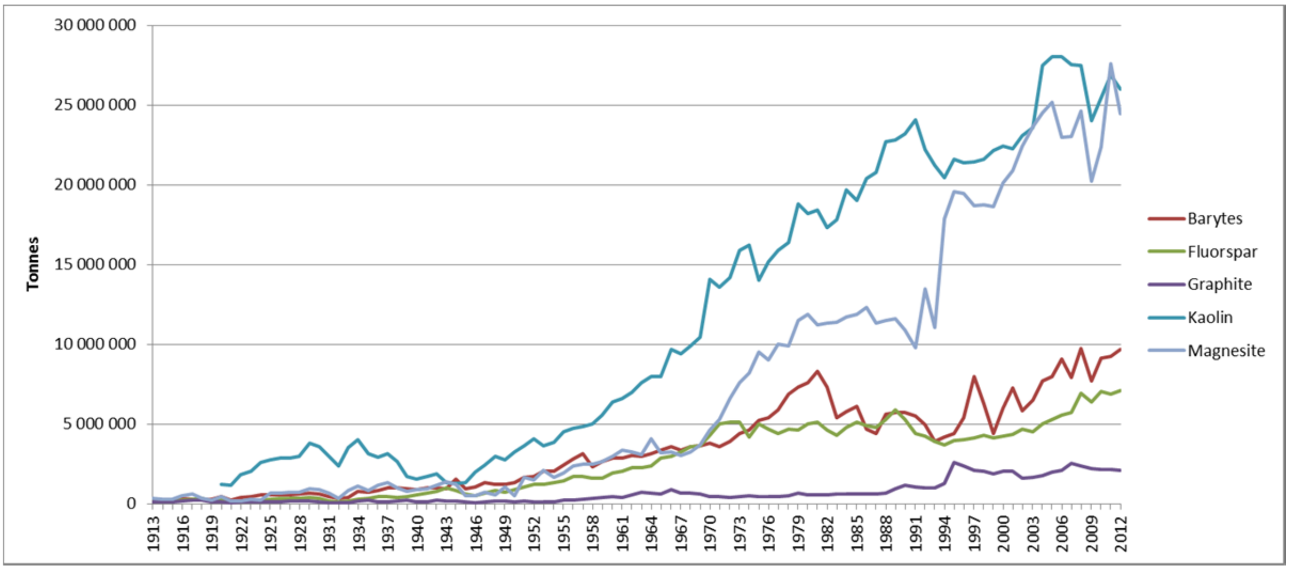

Figure 1: Total world production of selected industrial minerals 1913 to 2012 (Source: British Geological Survey © NERC)

If you interrogate the figures in more detail some interesting patterns emerge. Although it might be considered likely that the biggest percentage increases have occurred in recent times, on a decade by decade scale this is not true for many industrial minerals. Barytes, fluorspar, lithium and magnesite underwent the largest percentage increase in the period 1932 to 1942. For kaolin and phosphate rock it occurred between 1942 to 1952, and for graphite from 1952 to 1962, although for the latter the period between 1932 to 1942 also experienced high production growth (see Table 1).

	Year the data first available	Percentage change per decade									
		1913-1922	**1922-1932**	**1932-1942**	**1942-1952**	**1952-1962**	**1962-1972**	**1972-1982**	**1982-1992**	**1992-2002**	**2002-2012**
Barytes	1913	133%	-16%	193%	70%	78%	28%	87%	-32%	19%	65%
Fluorspar	1913	24%	-45%	641%	53%	82%	128%	-10%	-8%	10%	52%
Graphite	1913	-26%	-39%	281%	-45%	298%	-29%	44%	82%	62%	30%
Kaolin	1920		31%	-20%	117%	71%	103%	22%	28%	4%	13%
Lithium	1925			621%	240%	382%	6%	-13%	81%	74%	116%
Magnesite	1913	-54%	92%	276%	29%	116%	103%	71%	19%	66%	9%
Phosphate rock	1913	-21%	14%	45%	169%	86%	95%	36%	11%	-1%	55%

Table 1: Percentage change in world total production per decade for selected industrial minerals (Source: British Geological Survey © NERC)

To understand why these mineral production increases occurred when they did it is necessary to consider a number of different factors. Increasing global population, improvements in societies' living standards and the development of new technologies have all had an impact on the consumption of minerals, resulting in increased production of many commodities. Global events also have a noticeable impact. Many of the production increases described above correlate with the Second World War (1939–1945) and this is also reflected in production data for many metallic minerals. Spikes in production of certain minerals also occurred around the time of the First World War and during other conflicts. Therefore it would be straightforward to conclude that one effect of conflict is to increase mineral consumption, however, it is more complicated than that. The 1940s and 1950s was a period of human history that experienced significant change in the consumption of a wide range of consumer products as the social structure of many countries altered following the Second World War and this obscures the picture.

Evolution of the data series

It was the impact of the First World War that created the impetus for BGS's predecessors to begin the process of collecting worldwide mineral production and trade data. The collection of mineral statistics for the UK began in the 1850s and although the necessity of extending this to include other countries had previously been identified, early attempts to do so prior to 1913 were sporadic and not fully comprehensive. Conflict inevitably restricts supplies from opposing countries, and the disruption to transport infrastructure causes problems with deliveries between other nations. As a result supplies of certain key minerals from overseas, including phosphates, were interrupted during the First World War.

Thus, in 1918 an 'Imperial War Conference' recommended the formation of an Imperial Mineral Resources Bureau in the UK specifically to "… collect, co-ordinate and disseminate information in regard to the resources, production, treatment, consumption and requirements of every mineral and metal of economic value …" and to "… advise on the development of the mineral resources … in order that such resources may be made available for the purposes of imperial defence or industry …". This led directly to the publication in 1921 of the first edition of *The Mineral Industry of the British Empire and Foreign Countries, Statistical Summary (Production, Imports and Exports)* covering the last pre-War year of 1913 through to post-War

1919 and 1920. This book and its successors have been published more or less annually ever since. The release of the latest volume covering 2008 to 2012 completes the 100th year of the underlying dataset and is therefore known as the 'Centenary Edition'.

There have been many changes since the first edition – not least the dropping of references to the 'British Empire' and the somewhat derogatory sounding reference to 'foreign' countries, which happened in 1950. Political changes are also reflected in the changing of country names: early editions refer to Persia, Siam and Ceylon, for example, today Iran, Thailand and Sri Lanka respectively. The dissolution and unification of countries, is also reflected by their appearance or disappearance in the volumes. For example the Soviet Union dissolved in 1991 and was replaced by 15 'new' countries, whereas the former states known as the 'Federal Republic of Germany' (West) and 'German Democratic Republic' (East) are replaced simply with 'Germany' following reunification in 1990. A meander through the series of books quickly becomes a lesson in 20th century geographical history.

There has been an increase in the number of commodities covered by the series too, from 39 in the first volume to 73 commodities in the Centenary Edition. It might be expected that as mankind has developed the modern technology which is considered essential today, this has required a wider range of commodities for its manufacture and therefore the increase in the number of minerals in each book would have risen more sharply in recent times. However, as Figure 2 demonstrates, this is not actually the case. Conversely, it is surprising how early in the series some commodities first appear, despite being particularly newsworthy in recent times. Graphite, for example, appears in the very earliest edition with data from 1913 and data for lithium begins in 1925. Although mankind has developed new uses for these commodities, they also have more traditional end-use sectors that still require considerable quantities of the mineral. For example, lithium demand for batteries has only very recently overtaken the quantity required for ceramics and glass.

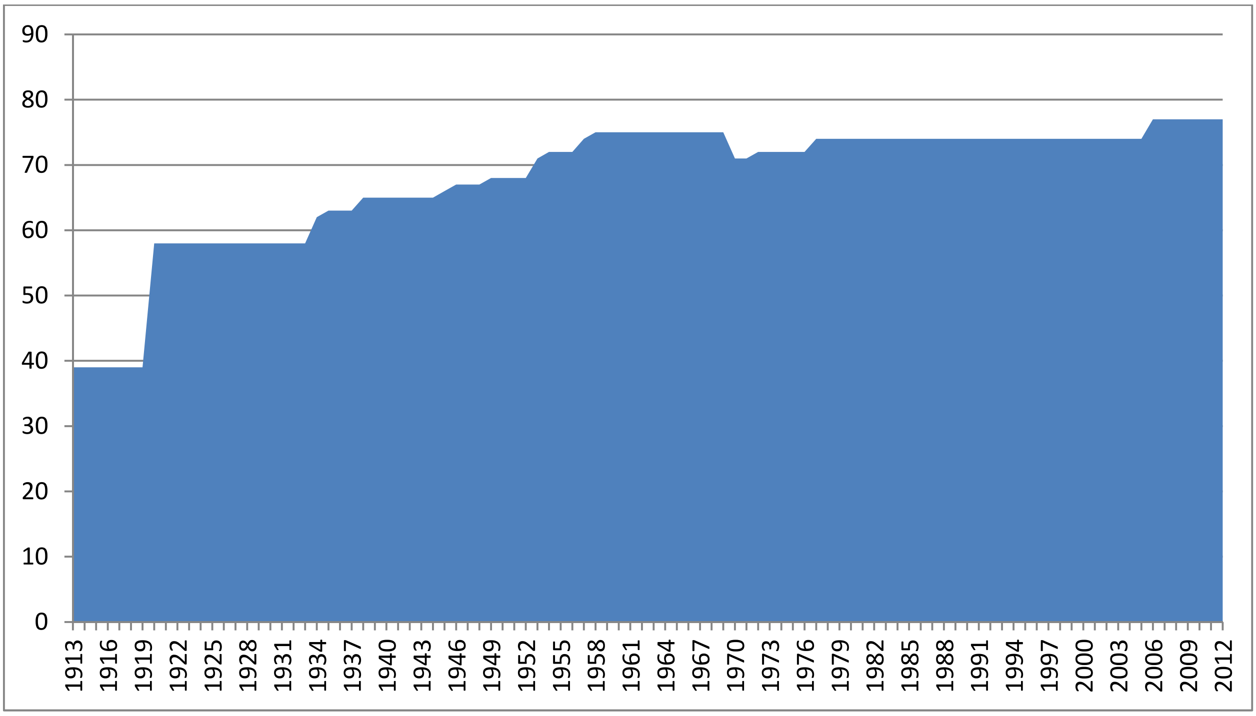

Figure 2: The number of commodities that appear in the World Mineral Statistics series, BGS © NERC

Changes in consumption

The rapidly growing global population has been a significant factor in the increased levels of consumption of all minerals. But concerns over food security to feed the Earth's expanding population have driven the production of agricultural minerals, such as phosphate rock and potash, in particular. Production of the former has grown from 7.3 million tonnes in 1913 to 215 million tonnes in 2012, while the latter has increased from 1.2 million tonnes in 1920 to 31.5 million tonnes in 2012.

The continually changing and expanding uses for many industrial minerals have driven very large production volume increases in recent years. For example, fluorspar production in the decade 2002 to 2012 has increased by 52 per cent, its largest decadal increase for 40 years. This is likely to result from the development of new chemicals requiring fluorine, and follows many years of relatively flat or declining production of fluorspar, as the world phased out its use of chlorofluorocarbons (CFCs) following evidence of the damage caused to the ozone layer by the chlorine. Global production of lithium in the decade 2001 to 2012 increased by 116 per cent, the largest decadal increase for 50 years and almost certainly the effect of the demand for batteries mentioned earlier.

For other industrial minerals, the end uses have not significantly changed over long periods and consequently production levels are more closely aligned with demand in their leading end-use sectors. For example, barytes is predominantly used for drilling muds (approximately 80 per cent of the total production) and therefore a decrease in output of 32 per cent in the period 1982 to 1992 suggests a significant drop in oil and gas exploration drilling during that time period. This observation fits with reality; increasing oil production in the early 1980s caused a significant fall in the oil price, which resulted in a significant drop in drilling activity. This fall in drilling activity is reflected in the number of drilling rigs in operation, which reached a peak in the early 1980s at approximately 6000 but fell sharply to approximately 2000 rigs by 1990 (Conerly, 2013). It is notable that worldwide production of barytes increased by 65 per cent in the period 2002 to 2012, partly as a result of the increased activity in the shale gas and oil industry, particularly in the USA.

Diversity or concentration of supply

Another development that can be observed in the statistics relates to changes in the countries supplying minerals to the world market. Fluorspar is a good example because 50 years ago none of the 23 producing countries produced more than 22 per cent of the world's total, whereas in 2012 China alone accounted for 62 per cent of global output. Of the remaining 21 fluorspar producing countries in 2012 only three produced more than two percent of total world production (See Figure 3a).

By contrast, in 1962 there were 37 countries producing kaolin but the USA and United Kingdom together accounted for 64 per cent of global production, whereas in 2012 this had expanded to 56 producing countries, with the USA producing just 23 per cent of the world's total. The UK, with four per cent of global production in 2012, has been overtaken by kaolin production levels in Germany, China, Brazil, Iran and Turkey (see Figure 3b).

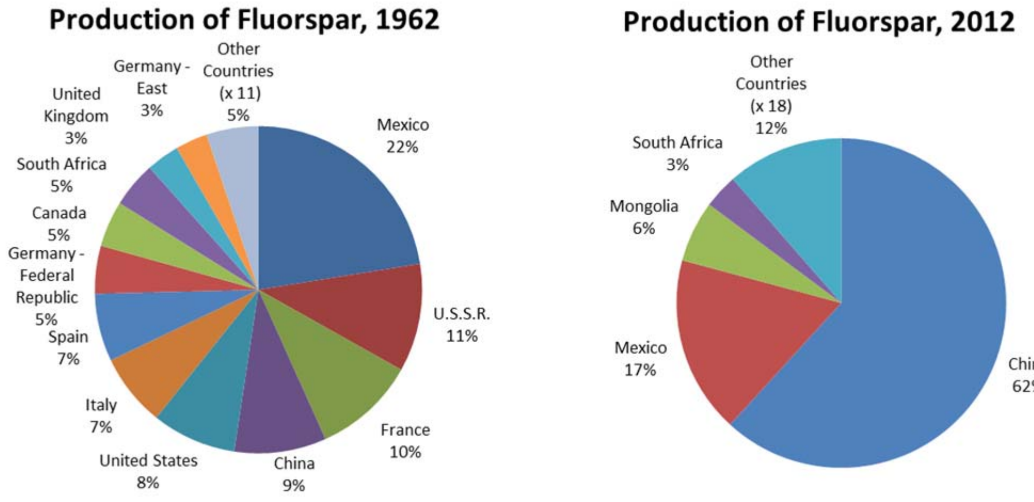

Figure 3a: Distribution of world production of fluorspar in 1962 compared with 2012.

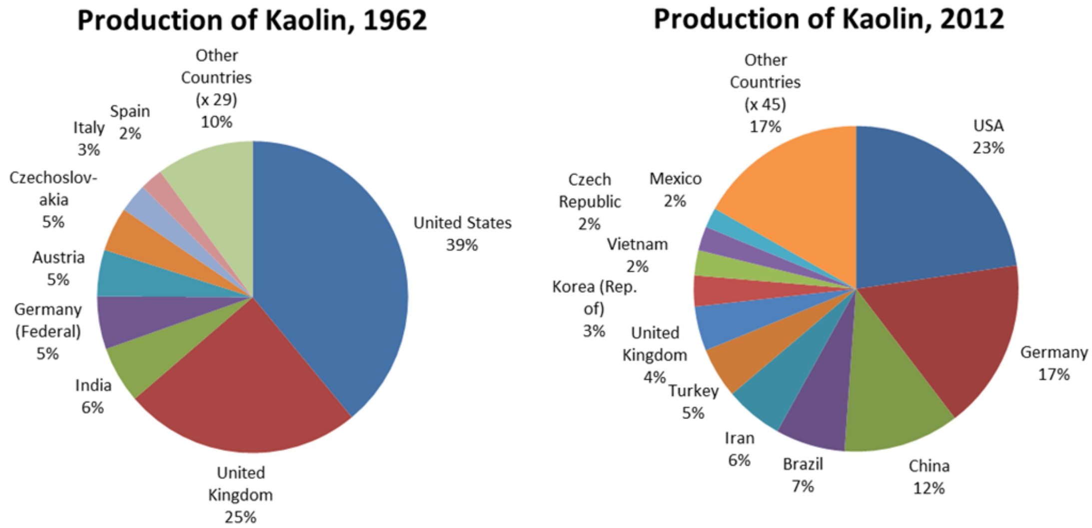

Figure 3b: Distribution of world production of kaolin in 1962 compared with 2012.

The emergence of China as a leading producer of many industrial minerals, as it is for many metals, is clear in the data. In 1962 China produced three per cent of the world's barytes, nine per cent of the world's fluorspar, eight per cent of the world's graphite and virtually none of the world's magnesite. In contrast, in 2012 China produced 45 per cent of the world's barytes, 62 per cent of fluorspar, 86 per cent of graphite and 65 per cent of magnesite. Of the 28 industrial minerals covered by World Mineral Production and listed in Table 2, China is the leading producer of 12 in 2012, whereas in 1962 it was not the leading producer of any.

It is interesting to consider whether any other nation has previously held such a dominant position in terms of global mineral production as China currently does. In 1962, it was the USA that dominated global production of many minerals. BGS data indicates that the USA was the leading producer of 17 of that same list of 28 industrial minerals (Table 2), albeit for a few of these minerals the data may not be absolutely complete. In 1962 the USA accounted for 70 per cent of the world's production of mica, 31 per cent of feldspar and 41 percent of phosphate rock. However, by 2012 production had declined to 14 per cent, three per cent and 14 per cent, respectively for each of these minerals. However, the USA remains the leading producer of six of these industrial minerals in 2012; more than any other country with the exception of China (Table 2).

	Leading producing country	
	1962	**2012**
Arsenic (white)	Mexico	China
Asbestos	Canada	Russia
Barytes	USA	China
Bentonite	USA	USA
Borates	USA	Turkey
Bromine	USA	USA
Diatomite	USA	USA
Feldspar	USA	Turkey
Fluorspar	Mexico	China
Fuller's earth	USA	USA
Graphite	South Korea	China
Gypsum	USA	China
Iodine	Chile	Chile
Kaolin	USA	USA
Lithium (Li contnet)	Rhodesia	Chile
Magnesite	Austria	China
Mica	USA	China
Natural sodium carbonate	USA	USA
Nepheline syenite	Canada	Russia
Perlite	USA	China
Phosphate rock	USA	China
Potash	Germany, Federal Republic	Canada
Salt	USA	China
Sillimanite minerals	South Africa	South Africa
Talc	USA	China
Vermiculite	USA	South Africa
Wollastonite	USA	China
Zirconium minerals	Australia	Australia

Table 2: The leading global producer of many industrial minerals in 1962 compared with 2012.

If production concentration is not a new phenomenon, then it raises the question of whether it actually represents a major supply risk. The security of supply of minerals is currently very topical and concerns have been raised by governments and industry globally about the availability of raw materials to support the manufacturing sector. Production concentration alone is not necessarily the critical factor; it only becomes a problem if there are geopolitical constraints on supply, for example if a major producer decides to erect trade barriers or is afflicted by poor governance. Conversely, if the leading producing country is strongly in favour of international free trade, influenced only by levels of demand, then the risk associated with having a single major producer is lessened. Therefore, it is not just the presence of a dominant producing country that matters but the policies and actions of that country.

A continuing dataset

Whatever ones view on mineral supply risk, data such as that presented in World Mineral Production and its predecessors remains fundamental to informing the policy- and decision-making processes on many different levels: from nations, or groups of nations, to investors and private companies. The collection and analysis of data that are as accurate and precise as possible remains as important today as it has always been. The BGS is constantly seeking to improve the quality and coverage of the data it publishes in this long-running series and remains open to suggestions and feedback as it moves into the next century of data compilation.

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