REPORT R88/ 2011

OVERVIEW OF THE COBALT INDUSTRY IN SOUTH AFRICA, 2000 - 2009

DIRECTORATE: MINERAL ECONOMICS

A base metal crusher unit in Mpumalanga

mineral resources
Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

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1. Introduction

Cobalt, one of the world's abundant elements, has many strategic and irreplaceable industrial uses. It is mostly used in superalloys (e.g. heat-resistant cobalt-chromium –tungsten-molybdenum alloys used for jet engines), in a variety of permanent magnet alloys, in high-speed and high-temperature cutting tools, many other special alloys, in rechargeable batteries, cemented carbides and advanced ceramics. In oxide form, cobalt is used in ceramic glazes and colourants whereas the medicinal uses include cobalt-salt supplements in animal feeds to counteract certain deficiency diseases, surgical implants and the radio-isotope cobalt 60, is used in the treatment of cancer.

In this report, the major developments in the South African cobalt industry in the past decade (2000 – 2009), including production, consumption and exports are discussed. The current global overview is also briefly discussed.

2. World Cobalt Industry overview

2.1 Occurrence

Cobalt is found in four characteristic geological settings, namely:

- The primary basic-ultrabasic magmatic nickel sulphide deposits, such as Sadbury in Canada, Norilsk in Siberia, and the komatiitic nickel deposits in Canada, Australia, Zimbabwe, South Africa and Selebi-Phikwe in Botswana.
- Hydrothermal copper-nickel sulphide and arsenide deposits, the arsenic association being very characteristic, such as in the Erzgebirge in Germany, the cobalt district in Canada, Bou Azzer in Morocco, Kilembe in Uganda and Kabanga in Tanzania. South Africa's cobalt also occurs in the form the copper-nickel sulphide.
- Cobalt is found in lateritic nickel deposits such as in Cuba, New Caledonia, the Phillipines, the Buhinda deposit in Burundi and the Biankouma and Sipilou deposits in Cote D'Ivore.

- Sediment-hosted diagenetically enriched copper-cobalt deposits of the Shaba Province of DRC and, to a lesser extent, in Zambia. Together these two constitute the world's largest resource of cobalt.

2.2 Reserves

According to the United States Geological Survey (USGS), world identified land-based cobalt resources are estimated at 15 million tonnes (Mt), representing nearly 500 years of cobalt supply at the current rates of production. Global reserves are estimated at 6.6 Mt (Table 1).

TABLE 1 – WORLD COBALT RESERVES, 2009

	RESERVES		
COUNTRY	kt	Percent	Rank
Australia	1 500	22.7	2
Brazil	29	0.4	9
Canada	120	1.8	7
China	72	1.1	8
Cuba	500	7.6	3
DR Congo	3 400	51.5	1
Morocco	20	0.3	10
New Caledonia	230	3.5	6
Russia	250	3.8	5
South Africa[±]	15	0.2	11
Zambia	270	4.1	4
Other	194	2.9	
TOTAL	6 600	100.0	

Sources: USGS, January 2010, p47
[±]Mineral Economics Directorate

Over half of known global reserves are in the DRC (50.5 percent), followed by Australia's 22.7 percent and Cuba's 7.6 percent. In addition there are also metalliferous nodules on the ocean floor containing up to 0.36 percent (2.5 – 10 million tons) of cobalt.

2.3. Supply and demand

During the review period global mine production grew by an annual average of 7.5 percent, with DRC, Zambia, Australia and Canada respectively dominating

production. In 2009, the DRC, accounting for 40.3 percent of global cobalt mine production, dominated global mine production (Table 2). Australia (10.2 percent), China (10 percent) and Russia (10 percent) follow at a distant second, third and fourth respectively.

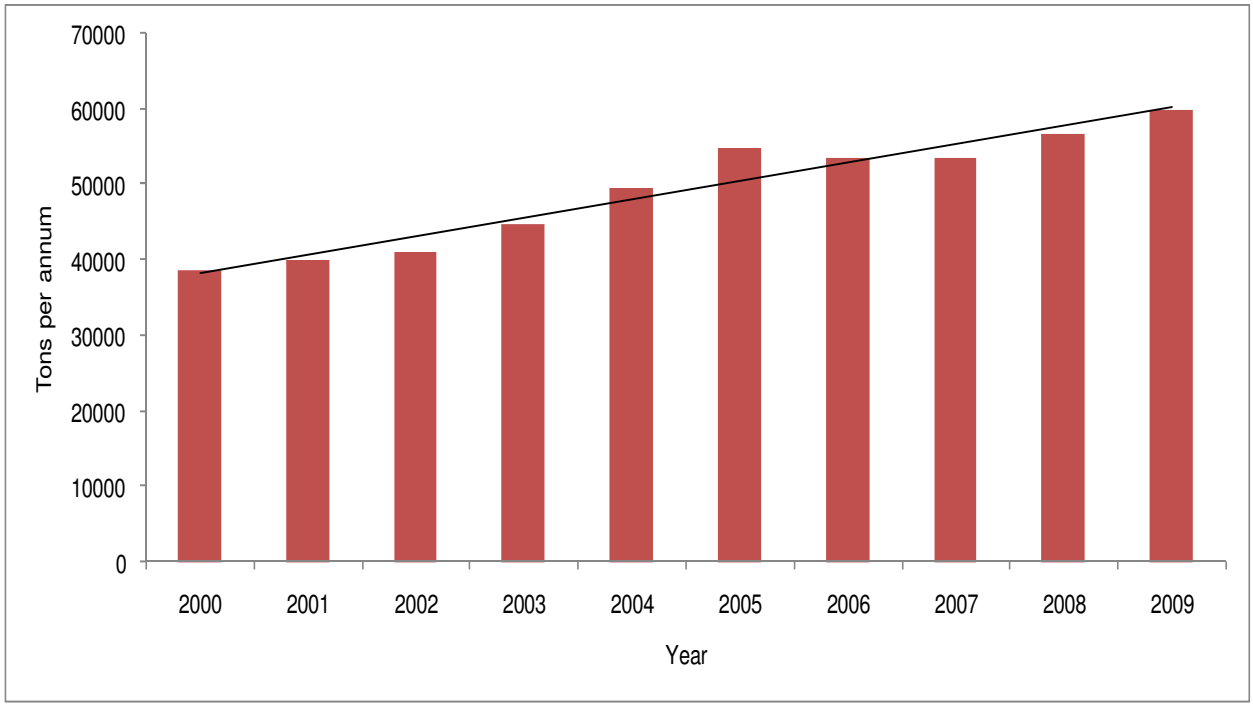
TABLE 2 – WORLD COBALT MINE PRODUCTION, 2009

	MINE PRODUCTION[e]		
COUNTRY	t	Percent	Rank
Australia	6 300	10.2	2
Brazil	1 000	1.6	10
Canada	5 000	8.1	5
China	6 200	10.0	3
Cuba	3 500	5.6	6
DR Congo	25 000	40.3	1
Morocco	1 600	2.6	8
New	1 300	2.1	9
Russia	6 200	10.0	3
South Africa[±]	238	0.4	11
Zambia	2 500	4.0	7
Other	3 162	5.1	
TOTAL	62 000	100,0	

Sources: USGS, January 2010, p47 (for Reserves and Mine Production)
[±]Mineral Economics Directorate
[e]Estimate

Worldwide, refined cobalt production has grown at an annual average of 5 percent from 38.7 kt in 2000 to 59.8 kt in 2009 (Fig. 1). Global refined cobalt production is dominated by countries such as Canada, Russia, China, Finland and Australia (Table 3).

FIGURE 1: GLOBAL REFINED COBALT PRODUCTION, 2000 - 2009



Source: The CDI, Cobalt News October 2004 and Cobalt News April 2010

The top global cobalt producing companies include OMG (Finland), ICCI (Canada), Xstrata (Norway), Katanga Mining (DRC), Minara (Australia) and Norilsk (Russia). Together these companies accounted for about 40 percent of global production in 2009.

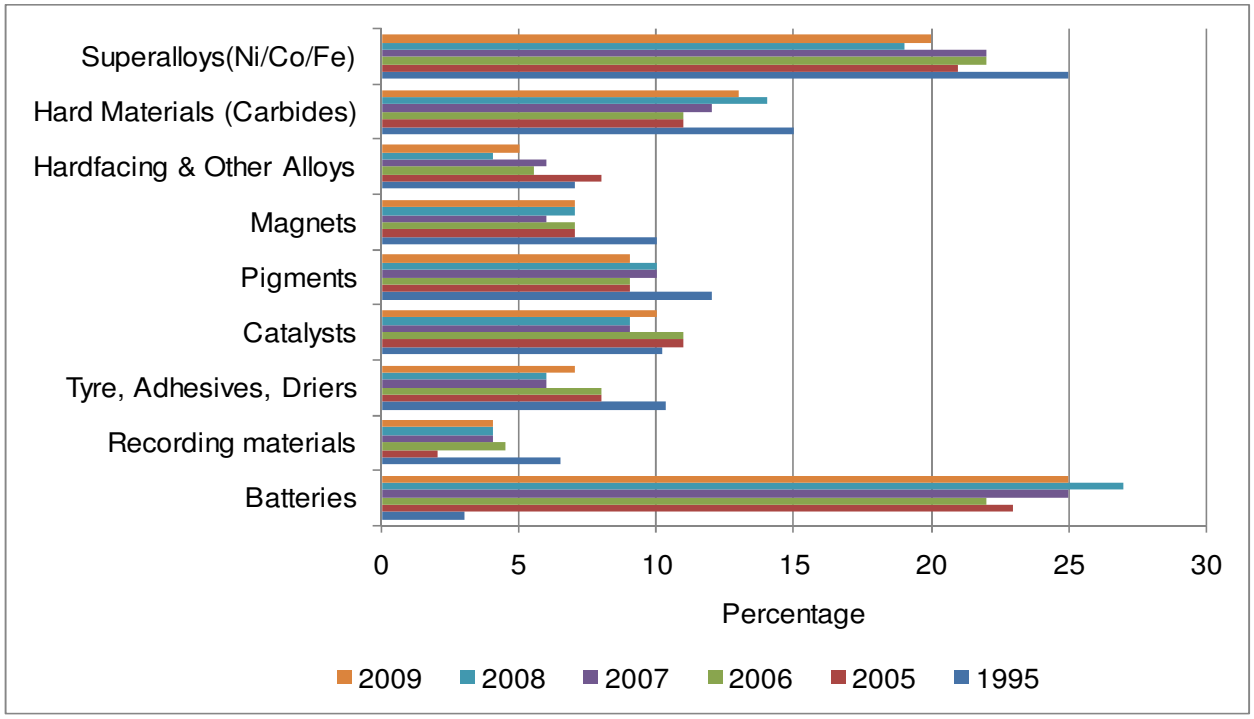
TABLE 3 - REFINED COBALT PRODUCTION BY COUNTRY, 2008 AND 2009

COUNTRY	2008	2009	RANK
	t	t	
Australia	3 618	4050	4
Belgium	3 020	2150	8
Brazil	994	1012	12
Canada	5 628	4914	3
China	18 239	23138	1
DRC	300	2950	6
Finland	8 950	8850	2
France	311	368	15
India	858	1001	13
Japan	1 071	1332	11
Morocco	1 711	1600	9
Norway	3 719	3510	5
Russia	2 502	2352	7
South Africa*	244	238	16
Uganda	663	673	14
Zambia	3 841	1535	10
TOTAL	55 675	59 673	

Source: *Cobalt News, April, 2010, p 3*
Cobalt Facts, 2010. Cobalt Supply & Demand 2009
* *DMR, Mineral Economics Directorate*

End user demand patterns have significantly changed over the period under review. Until 1995, demand came predominantly from metallurgical uses and magnetic alloys, representing 58 percent of the demand, whereas in 2005, chemical applications (pigments, catalysts, adhesives and driers, recording materials and batteries) became major end users of cobalt accounting for 53 percent of the total demand (Kapusta, 2007). From 2005 until now, chemical applications remain dominant, mainly driven by sustained growth in the production of rechargeable batteries, which for the past five years averaged 24.4 percent of the total cobalt demand, compared with approximately three percent in 1995 (Fig. 2).

FIGURE 2: COBALT CONSUMPTION BY END-USER, 2005 - 2009



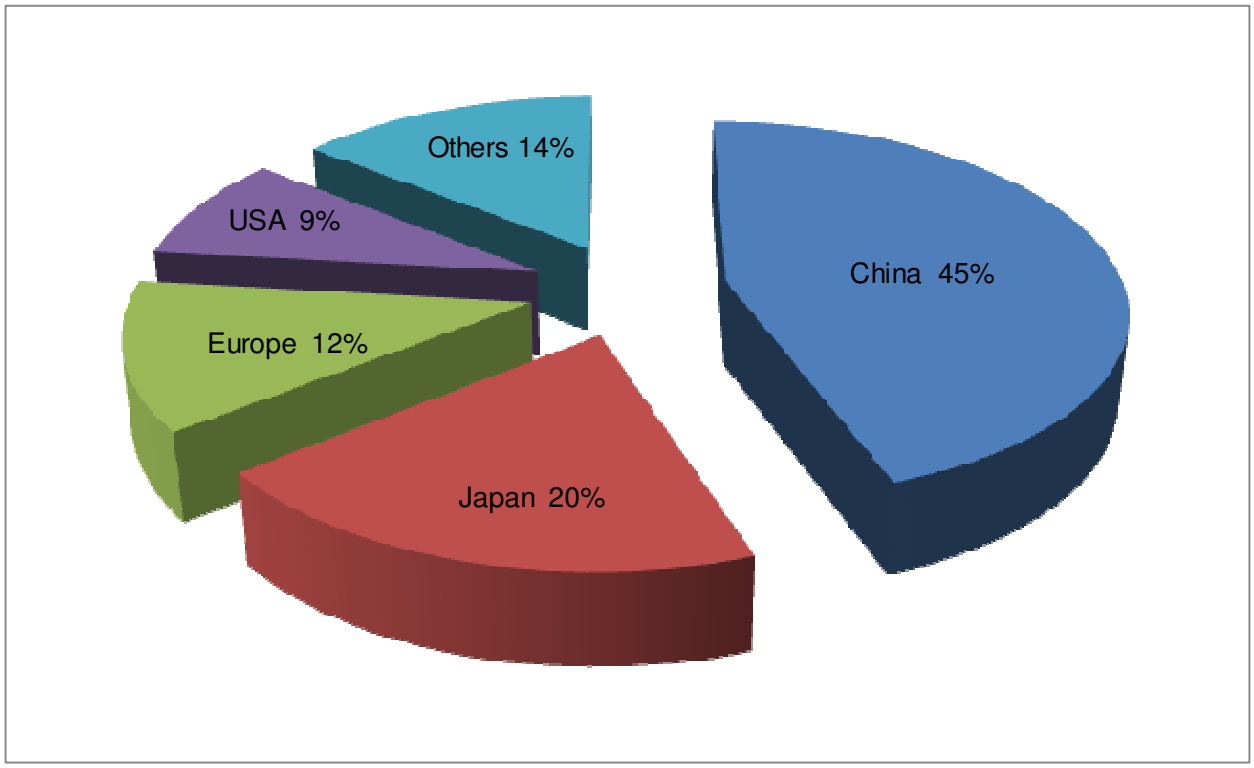
Source: The CDI, Cobalt News January 2007

Rechargeable batteries will continue to be the dominant end user because of growth in technological devices such as mobile phones, laptops and recently the hybrid cars. Sectors such as superalloys (aerospace), catalysts (plastics and textile industries), gas-to-liquid technology (synthetic fuels from coal gas and natural gas), and hybrid electric vehicles (lithium-ion batteries) will continue to drive the growth in demand for cobalt worldwide.

According to Roskill Information Services, cobalt consumption was split between the Americas (North and South), Europe and Japan in 2001. Europe dominated consumption, accounting for around 30 percent, followed by the Americas' 29 percent and Japan's 21 percent, while the rest of the world accounted for less than 20 percent of demand. By 2006, the breakdown of world cobalt consumption had changed significantly, mainly due to rapid growth in demand in China and the emerging Asian economies. China's share of world consumption of cobalt increased from 3 percent in 1997 to 20 percent in 2006, while the rest of Asia (excluding Japan) doubled its share of demand from 5 percent to 10 percent over the same

period. China's increase in market share has come at the expense of Europe and the USA. In 2006, the Americas accounted for 23 percent of world consumption and Europe represented 24 percent, a decline of 6 percent in both cases from 2001. In 2009, China was a global leader in cobalt consumption accounting for 45 percent of global consumption, followed distantly by; Japan's 20 percent, Europe's 12 percent and the USA's 9 percent (Fig. 3). Other countries collectively accounted for 14 percent of the global consumption.

FIGURE 3: COBALT CONSUMPTION BY COUNTRY, 2009

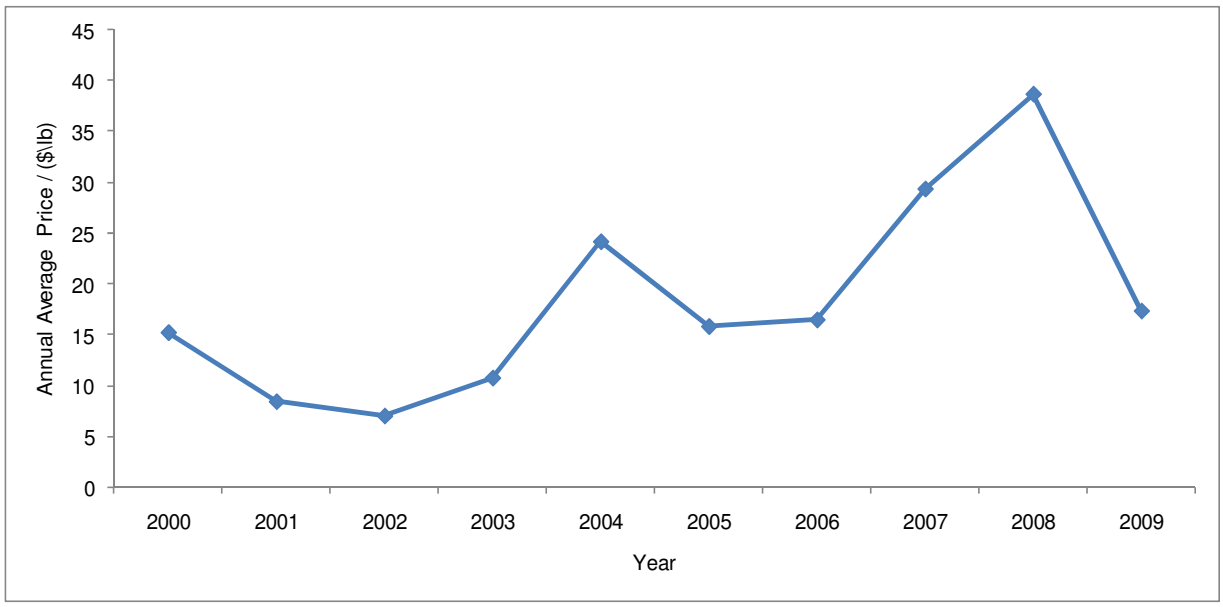


Source: Darton Commodities (email communication), 2010

2.4. Prices

Cobalt prices have been very unstable during the ten year period. The slower economic growth in the developed world, especially in the USA and Japan, resulted in an oversupply of the cobalt metal leading to a downward pressure on cobalt prices. The annual average price decreased by 44.5 percent to $8.45 /lb in 2001 compared with 2000 (Fig. 4). In 2002 the falling trend continued as prices decreased by 16.7 percent to $7.04 /lb compared with 2001.

FIGURE 4: COBALT ANNUAL AVERAGE PRICES, 2000 - 2009



Source: Metal Bulletin

In 2003, the average cobalt price increased by 52.9 percent $10.77 /lb compared with 2002 and surged by a further 124.2 percent to $24.15 /lb in 2004, owing to higher demand from China and Japan.

In 2005, prices plunged by 34.5 percent to $15.83 compared with 2004 as consumers, particularly in the battery sector, liquidated inventories in the first half of the year. Massive increase in cobalt demand in China was largely met from increases in domestic production from imported ores and concentrates as opposed to imports of refined metal. The volatility of the prices continued in 2006 when prices slightly increased by 4.1 percent to $16.48 /lb mainly due to the constrained supply of raw material from the DRC. Prices increased by 78 percent to $29.33 /lb in 2007 and 31.7 percent to $38.64 /lb in 2008 encouraged by surging demand from China resulting from that country's rapid economic growth. In 2009 cobalt prices plunged by 55.1 percent to $17.35 due to the global economic recession.

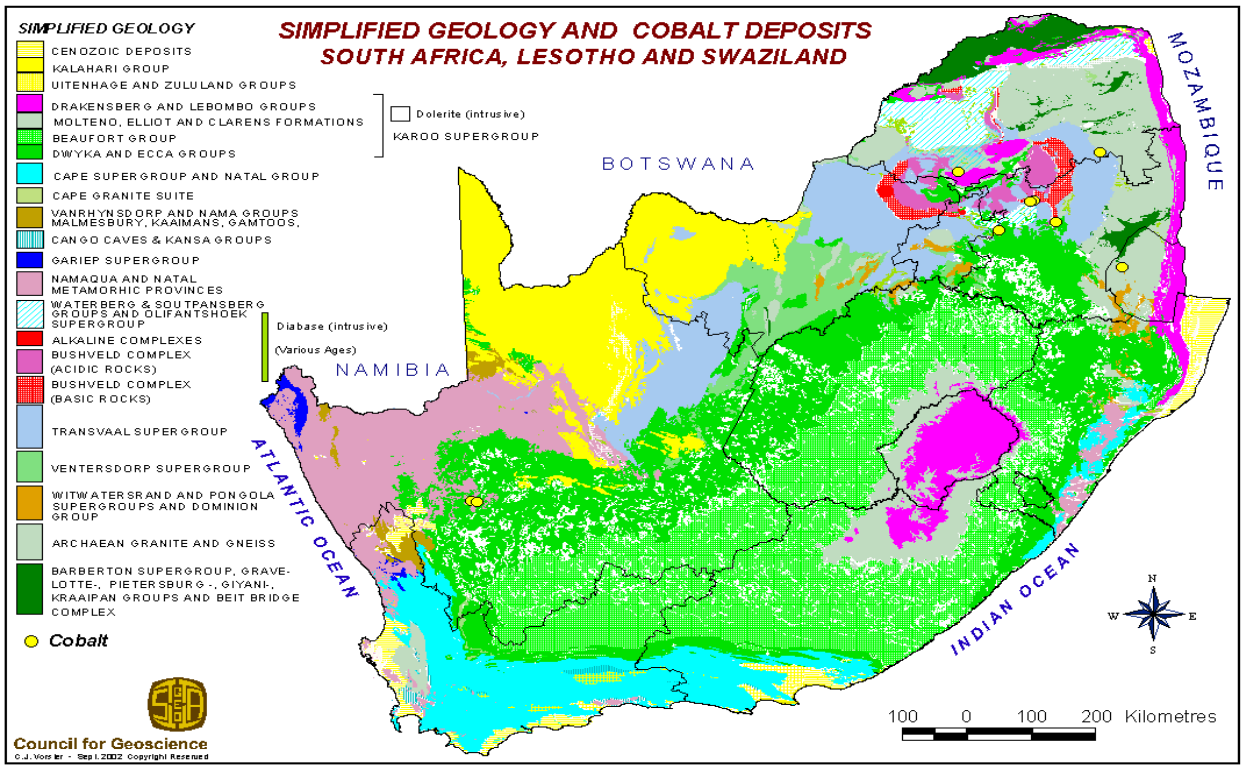
3. South Africa

South Africa's cobalt industry contributed an average 0.01 percent to the Gross Domestic Product (GDP) during the past decade.

3.1 Occurrence

South Africa's cobalt occurs in the form of nickel sulphide and nickel-copper sulphide. The USGS estimates South Africa's cobalt reserves at 15 kt. The vast majority of these reserves occur in the Merensky Reef, the Plat Reef and UG2 chromitite layer. These three layers are in the Bushveld Complex geological formation which extends into Limpopo, North West and Gauteng provinces (Fig. 5). South Africa's cobalt is produced as by a by-product of the mining and refining of platinum-group metals (PGMs) operations as well as a by-product of a single nickel mine operation, the Nkomati mine.

FIGURE 5: SOUTH AFRICA'S COBALT DEPOSITS



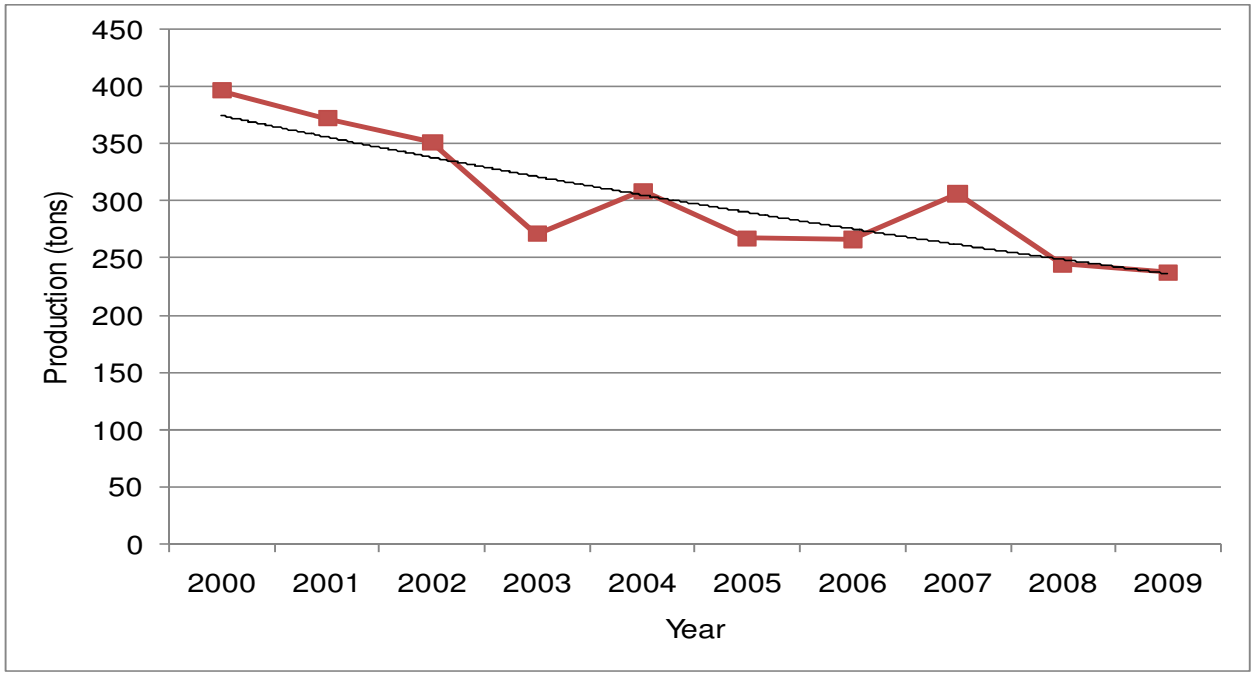
Source: Council for Geoscience, South Africa

3.2 Production

In South Africa, cobalt production is mainly from PGM mining activities and it is dominated by Anglo Platinum Ltd with 11 operating mines. Other PGM producers that contribute to cobalt production are Impala Platinum Holdings (1 mine), Xstrata (Pty) Ltd (1 mine), Aquarium Platinum South Africa (2 mines), Northam Platinum (1 mine) and Anooraq Resources Corporation (1 mine). Nkomati mine, owned by African Rainbow Minerals and Norilsk Nickel, the only nickel mine in the country, produces cobalt as a by-product.

South Africa's cobalt production decreased at an annual average rate of 5.5 percent during the period 2000 to 2009 (Fig. 6). The biggest drop was in 2003 when production plunged by 23 percent to 271 t compared with 2002. The possible reason of the drop in production could be that most of the base metal matte was stockpiled because output of the main product of mining operations, platinum-group metals increased by 10.6 percent compared with 2002. In 2004, cobalt production increased by 14 percent to 309 t compared with 2003 consistent with the 7.4 percent PGMs production increase and the rise in cobalt prices.

FIGURE 6: SOUTH AFRICA'S COBALT PRODUCTION, 2000 - 2009



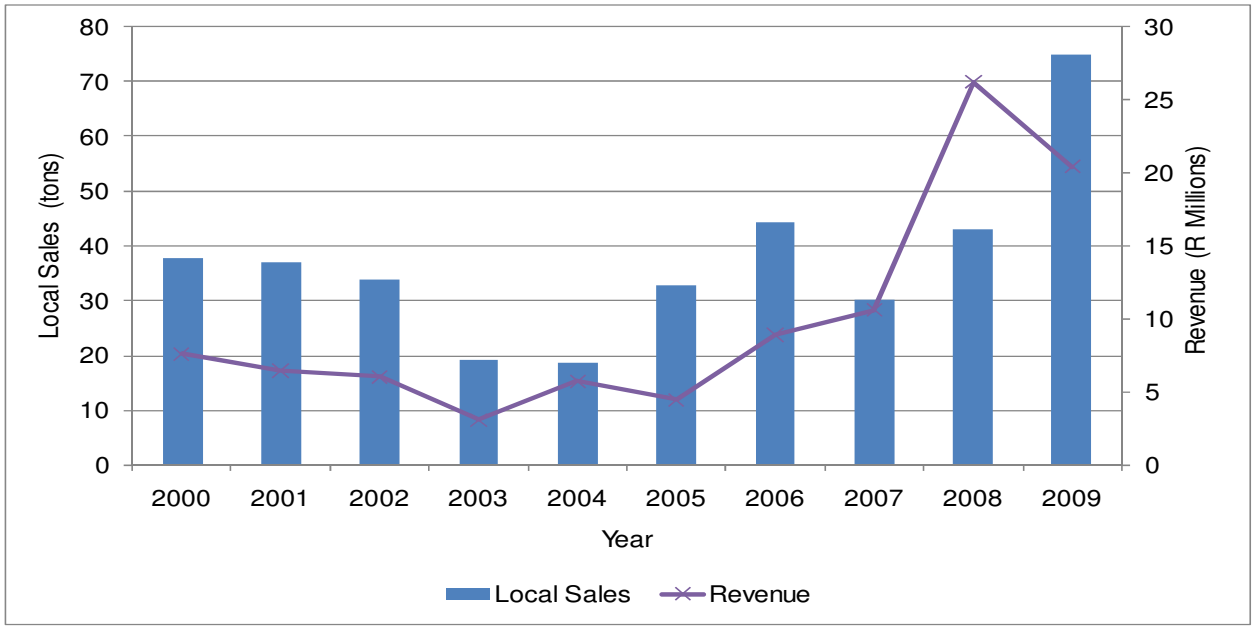
Source: DMR, Mineral Economics Directorate

In the following two years the downward trend continued, with output decreasing by 13 percent and 0.4 percent in 2005 and 2006 respectively. In 2007, production increased by 14 percent to 307 t before it plunged by 20 percent to 244 t in 2008 owing to a decline in PGMs production.

3.3 Local sales

Over the period 2000 to 2009, local cobalt sales have grown at an average of 7.9 percent per year (Fig. 7). However, during the period 2000 to 2004, local sales had a negative average growth rate with 2003 representing the biggest slump of 43 percent compared with 2002, corresponding with the biggest drop in domestic production during 2003.

FIGURE 7: LOCAL SALES VOLUMES AND REVENUES GENERATED, 2000 TO 2009



Source: DMR, Mineral Economics Directorate

Lower cobalt prices and an increase in PGMs production led to an increase in local sales volume by 76.6 percent to 32.7 t in 2005 compared with 2004. In 2006, local sales volumes increased by 35.5 percent. Local sales volumes decreased by 31.7 percent due to high cobalt prices in 2007.

Revenue from local sales grew at the rate of 11.7 percent per year during the period under review. From 2000 to 2003, revenue decreased from R7.6 million to R3 million mainly due to lower sales volumes and cobalt prices. In 2004, revenue increased by 86 percent to R5.7 million compared with 2003 mainly due to high cobalt prices. In 2005, it decreased by 22 percent to R4.4 million corresponding to the 13 percent drop in production.

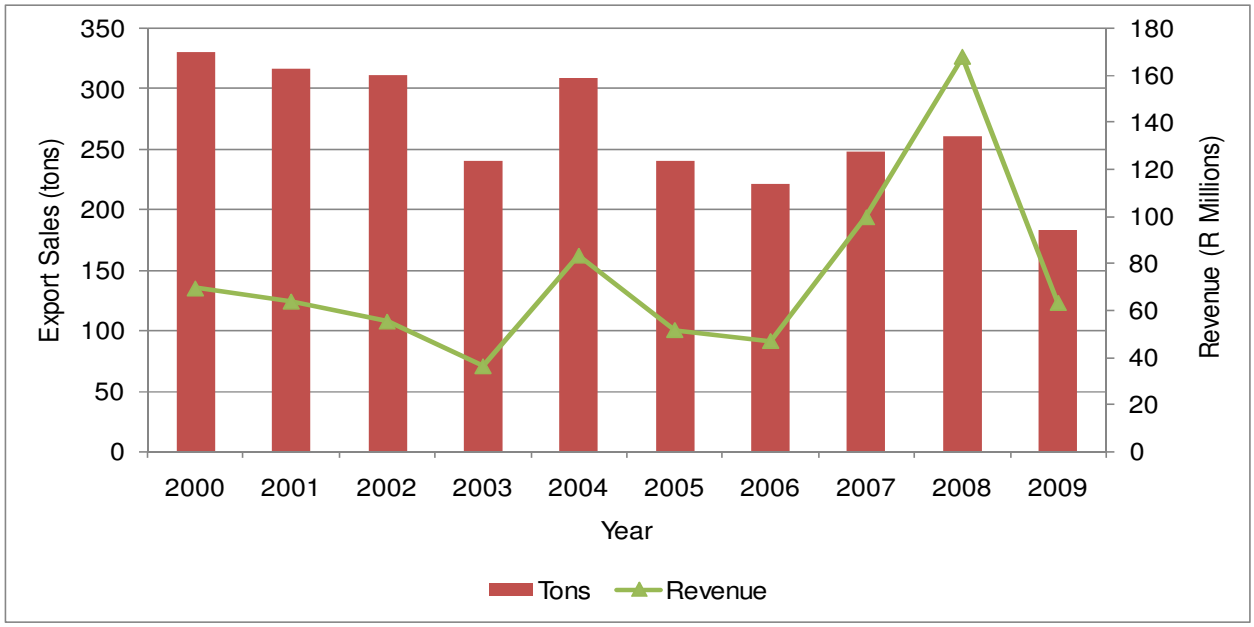
In 2006, local revenue increased by 100 percent to R8.8 million as the sales mass increased by 36 percent. The rising trend continued with revenue increasing by 19 percent to R10.6 million in 2007 and a further 148 percent to R26 million in 2008. In 2009, revenue decreased by 22 percent to R20.4 million due to the stronger

rand/dollar exchange rates and the global financial crisis that kept most consumers out of the market.

3.4 Export sales

On average, South Africa exported above 85 percent of its annual cobalt production during the period under review. The volumes exported have been decreasing at a rate of 6.4 percent per annum (Fig. 8). The amount of cobalt exported decreased by 4.1 percent to 317 t in 2001 compared with 2000. This was followed by 1 percent decrease to 311 t in 2002. In 2003, the export volumes plunged 22.6 percent to 241 t compared with 2002. The export market recovered briefly in 2004, increasing by 28.5 percent to 309 t before it reverted to its downward trend, decreasing by a further 22.2 percent and 8.3 percent in 2005 and 2006 respectively.

FIGURE 8: EXPORT SALES VOLUMES AND REVENUES GENERATED, 2000 - 2009



Source: DMR, Mineral Economics Directorate

The second growth in export volumes was recorded in 2007 (12.5 percent) and 2008 (5.2 percent). In 2009, the amount of cobalt exported decreased by 30.1 percent to 182 t compared with 2008.

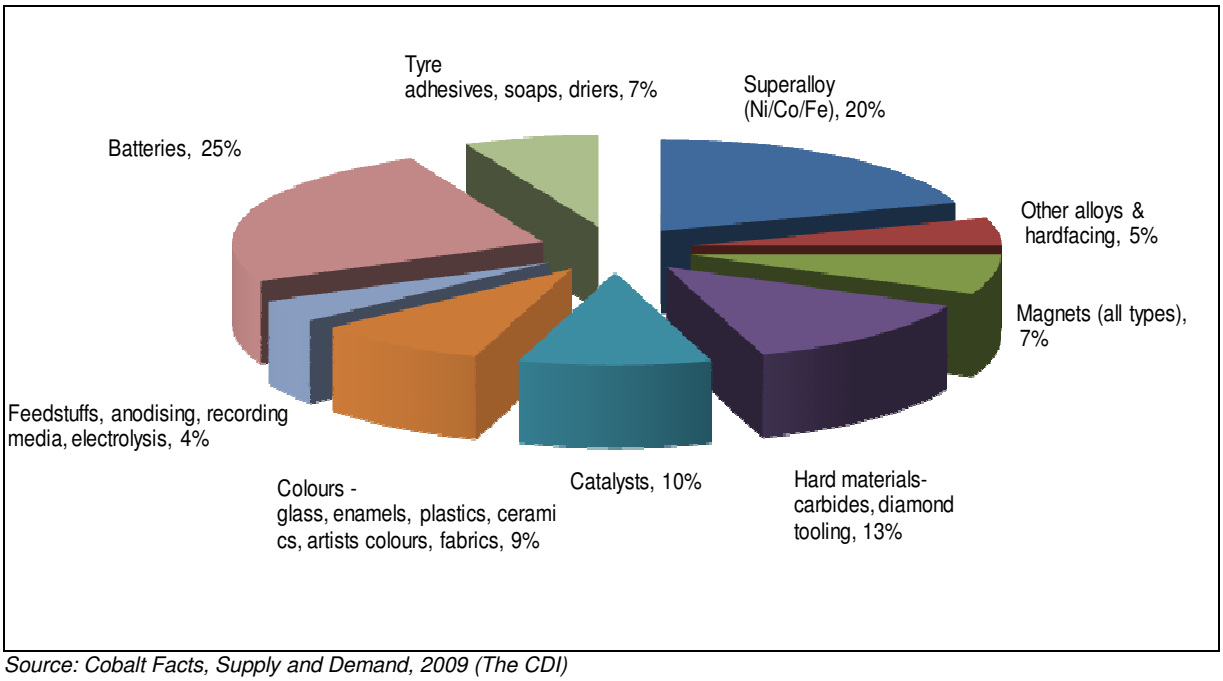
Revenue from export sales followed a similar trend to that of export volumes. During the period 2000 to 2003 revenue declined at a rate of 19.4 percent per annum to R36 million in line with the decreasing sales volumes. In 2004, revenue increased by 130 percent to R83 million compared with 2003. Decreases of 38 percent and 9 percent were recorded in 2005 and 2006 respectively. In 2007, the revenue increased by 111 percent to R99 million compared with 2006. It further increased by 69 percent to R167 million in 2008 compared with 2007 before it drastically plunged by 62 percent to R63 million in 2009.

South Africa exported cobalt to various countries. During the period under study the number of countries varied from 7 to 18 in a year. China had been the number one importer of South Africa's cobalt, second only to Belgium in 2008 and 2009. Other countries that import a significant amount of South Africa's cobalt include India, Switzerland, Finland, Japan and Hong Kong among others.

3.5 Beneficiation

The Department of Mineral Resources has developed a Beneficiation Strategy that is aimed at providing a strategic focus for South Africa's minerals industry in terms of developing pilot mineral value chains and facilitating the expansion of beneficiation initiatives in the country, up to the last stages of the value chain. Although not included in the initial study of ten mineral commodities, cobalt beneficiation can also play a vital role in the creation of new jobs, skills development and economic growth. Figure 9 shows the global picture as far as the cobalt end user is concerned.

FIGURE 9: GLOBAL COBALT BENEFICIATION BY SECTOR, 2009

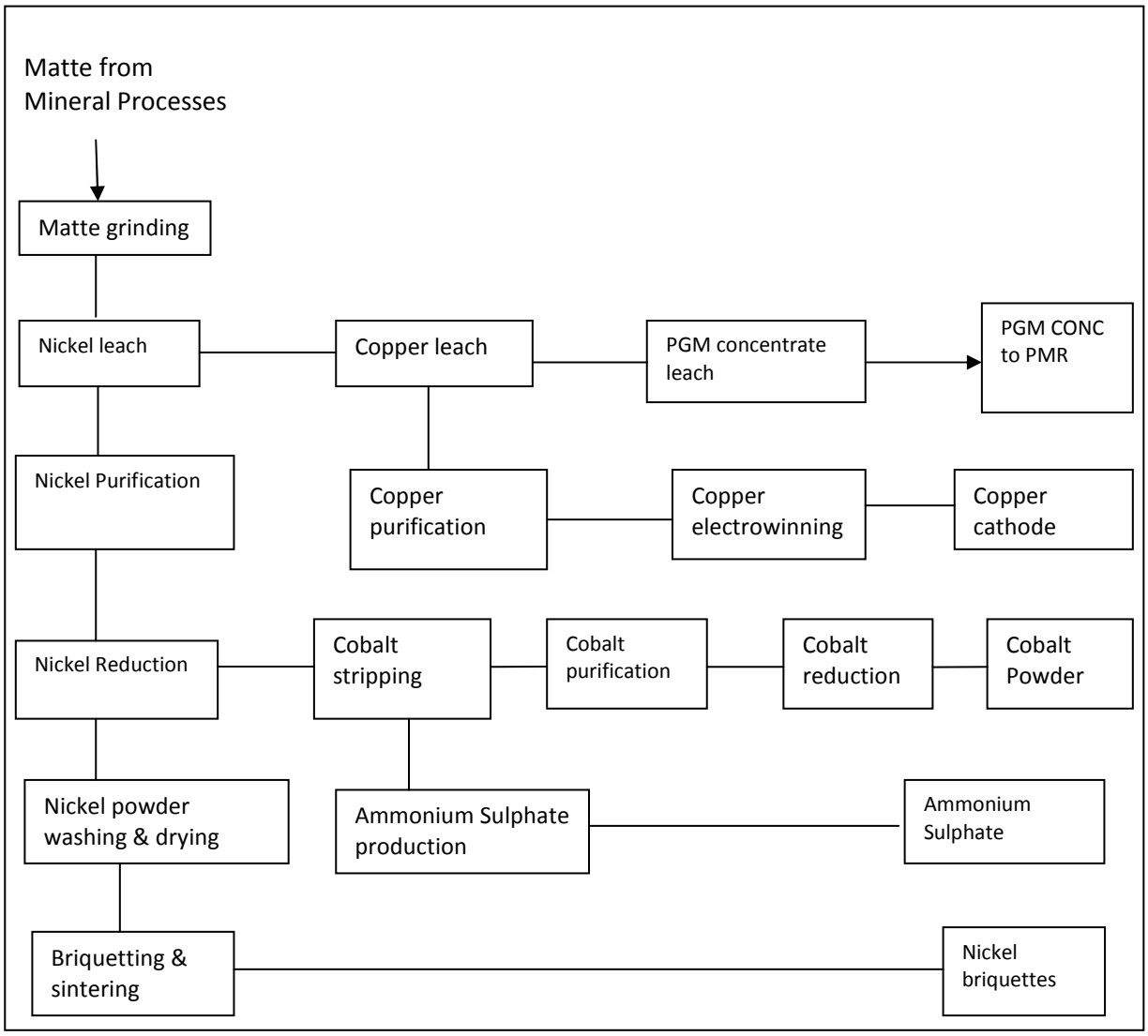


Source: Cobalt Facts, Supply and Demand, 2009 (The CDI)

The major challenge with the South African cobalt market is that local consumption data like the one presented in figure 8 is not available since the DMR does not collect this information. Looking at figure 8, it is evident that cobalt downstream beneficiation can contribute immensely in the South African economy. Currently the country exports about 85 percent of its cobalt production.

In South Africa cobalt is obtained as a by-product of base metal refineries (Fig. 10). Cobalt is produced in powder form in this process and subsequently used for the manufacture of alloys in the aircraft industry and in batteries. Sasol also uses cobalt as a catalyst for its gas-to-liquid process.

FIGURE 10: A FLOW DIAGRAM OF THE BASE METAL REFINERY PROCESS



Source: Impala Platinum Limited Refineries

3.6 REACH legislation

The South African Cobalt market is likely to be affected by the REACH (Registration Evaluation Authorization and restriction of Chemicals) legislation which is the European Union's (EU) New Chemical Policy. The objective of REACH is to improve the protection of human health and the environment and to enhance the competitiveness and innovation of the EU chemical industry. The regulation also

seeks to improve the development of alternative methods for the assessment of hazards of substances. The legislation came into effect on 1st June 2007. The requirements of this legislation is that all manufacturers and importers of chemical substances in the EU, including metals and metal components, in quantities exceeding one ton per year will be required to submit a registration to the new European Chemicals Agency. It was designed using the principle of 'no data, no market', to shift onto industry the responsibility of assessing any risks relating to the substance it places on the EU market.

In South Africa all inputs (concerning REACH) from the mining industry are co-ordinated by the South African Chamber of Mines (SACoM). According to the mining industry, the impact of REACH on South African exports including beneficiated mineral products will not be overwhelming as the cost of complying with REACH will only be a fraction of one percent of sales. To date, there is no comprehensive data analysis that evaluates the impact of REACH on the South African cobalt industry.

4. Conclusion

On average, the cobalt industry contributed 0.01 percent to South Africa's GDP during the period under review. Even though it is mined as a by-product, it is evident that cobalt contributes to the economy of the country.

South Africa exports above 80 percent of its mined cobalt. Although this generates the much needed foreign currency, foreign earnings could be improved if local beneficiation of this commodity is increased and this will also enhance the human capital development of the local people.

The DMR must use section 28 of the MPRDA to persuade companies to submit end user statistics for cobalt. This information will be crucial especially when planning for the downstream beneficiation of cobalt and checking the local cobalt market against the global market.

Even though the cobalt market is not big in South Africa, REACH may derail the market since the registration of an item takes at least 18 months and this also has a cost burden associated with it. On the positive side, REACH will promote innovation and development of safer substitutes. The legislation will also encourage downstream value addition in the South African cobalt industry. An in-depth impact assessment study by government and industry on the impact of REACH on the South African mining industry must be undertaken.

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