REPORT R48/2005

SOUTH AFRICAN FERROUS MINERALS

PRODUCTION TRENDS

1994-2003

DIRECTORATE: MINERAL ECONOMICS

Courtesy of Higveldsteel and Vanadium

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

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THIS IS THE SECOND EDITION (SEPTEMBER 2005)

ISBN: 1-919927-17-0

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ABSTRACT

This report presents an analysis of growth trends in the production of South Africa's ferrous ores for the 10 year period (1994 – 2003). Only the main ferrous minerals are included in this study, namely, the ores of chrome, iron and manganese.

The data used in this report are extracted from the official regulatory monthly returns of operating ferrous mines submitted to the Mineral Economics Directorate, of the Department of Minerals and Energy.

This analysis is graphical accompanied by short explanations on each of the commodities. Growth trends are cumulative for a period of 10 years and are calculated exponentially.

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1. CHROME

1.1 INTRODUCTION

Chromium (Cr) has a wide range of uses in metals, chemicals and industries. Chromium metal is seldom used alone, but as a metallurgical alloying element it imparts outstanding corrosion resistance and allows a bright attractive finish to stainless steel and alloys. In lesser amounts it provides the valuable property of thorough-hardenability to steels, offering toughness with strength. In the nonferrous metals industry it is alloyed with other metals (e.g. copper, aluminium, nickel, cobalt, titanium) for specialised purposes, but in most instances is added as chromium metal derived from chemicals production routes.

The main ore of chromium is chromite. About 85 per cent of chromite ore is converted into ferrochrome is submerged-arc furnaces by reduction with carbon or silicon for the metallurgical industries. The stainless steel industry that has developed since 1920 accounts for more than 90 per cent of the total chromite consumption. Chromium chemicals production uses about 5 per cent of total chromite; and the remaining 5 per cent is used for refractories and foundry sands.

Downstream chromium chemicals are produced from the bulk chemicals, sodium dichromate, which is made by roasting the oxide ore with soda ash and leaching the product in an aqueous solution. They are used as mordants in textile dyeing, colourants for inks, dyes and paints, in timber preservatives and varnishes, for leather tanning, and in chromium plating.

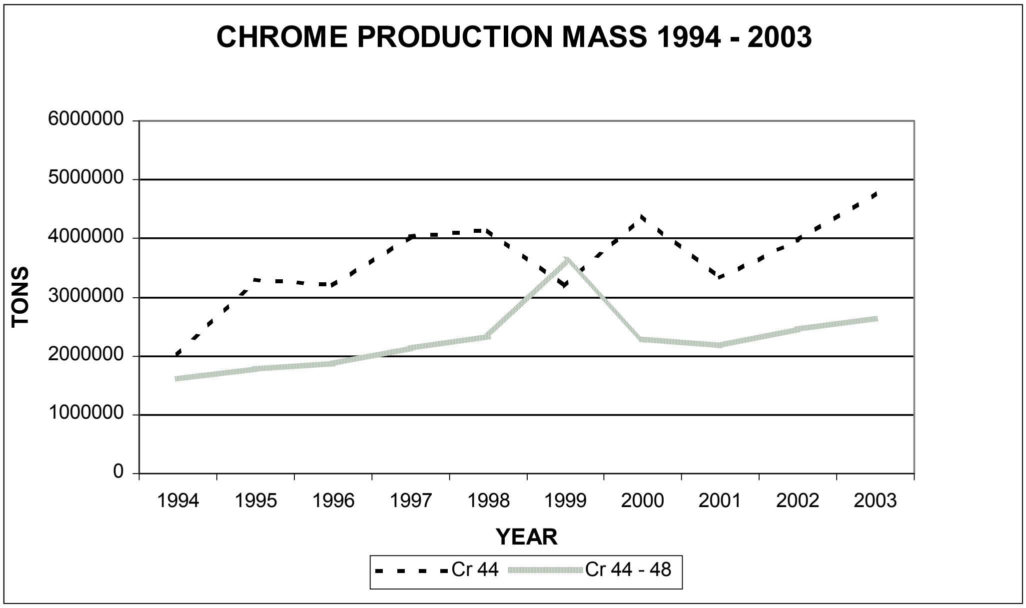
Refractory chromite bricks for furnace linings are reported to have been first used in 1880. Tonnage applications were developed in the 1930s, in combination with magnesia, for open-hearth steel making furnaces. Bricks and castables of magnesite-chrome and chrome-magnesite are now used in AOD vessels, arc-furnaces, copper converters, re-verberatory furnaces, and cement kilns. Chromite foundry sand is a specialised, well-graded product used in the production of steel castings, and utilising the property of chilling during solidification due to its relatively enhanced thermal conductivity.

In South Africa, the presence of chromite ore was first noted in Rusternburg district of the North West Province by the famous explorer and geologist, Carl Mauch, in 1865. Mining started in about 1916 and volume ferrochrome production commenced in about 1960.

1.2 OCCURRENCE

Chrome ore deposits invariably occur in association with mafic and ultramafic rocks. In South Africa, they are present in layers within the mafic phase of the Bushveld Complex, where they formed as a result of differential crystallisation during the solidification of the parent magma. A remarkable aspect of the chrome seams in these deposits is their consistency of grade and thickness over distances of up to 200km, and to vertical depths in excess of 1 000 meters.

Figure 1



1.3 CHROMITE ORE PRODUCTION TRENDS

Two subtypes of chromite ore are mined in the Bushveld complex namely: ore containing less than 44 percent chromium, and ore with a chromium content between 44 and 48 percent.

Production of chromite ore with a chromium content of less than 44 percent has more than doubled over the ten year period, from two million tons in 1994 to an output of 4,7 million tons in 2003 (Figure 1). The largest annual increase occurred between 1994 and 1995 when output jumped by more than 1 million tons from 2 million to 3,2 million tons. It should be noted that it took a further two years to reach the four million tons mark in 1997.

This subtype registered a 5,5 percent per annum growth over the full 10 year period from 1994 to 2003, while a 7 percent growth was recorded over the five years from 1999 to 2003. Despite rapid growth occurring from 1995 and 1997, output slowed considerably and became far more volatile in the succeeding years with the 5 million ton production level yet to be attained. This may signal the absence of reserve capacity or a lack of investment in the development of chromite mining projects in the chrome sector over the period

Over the 10 year period chromite ore with a chromium content of between 44 and 48 percent rose by only one million tons from 1,6 million tons in 1994 to 2,6 million tons in 2003. However, there was one deviation from this slow output growth trend. In 1999 production of 44 to 48 percent subtype spiked to 3,6 million tons, but output fell back to 2,2 million tons in 2000.

Ironically, 1999 was also the year when the less than 44 percent chromium subtype experienced a slump in production. This was also the only time that production of the lower than 44 percent subtype was less than that of the 44 to 48 percent chromium content subtype during the period under review. The unavailability of less than 44 percent subtype ore led to an unusual demand for the 44 to 48 percent material as both types are interchangeable in ferrochrome production process. The shortage in the market, however, subsided once supplies of the less than 44 percent subtype returned to normal in 2000.

Although output of chromite ore with a 44 to 48 percent content increased by 4,9 percent per annum over the full period from 1994 to 2003, a negative growth rate of 5 percent was recorded during the last five years of the period in question (1999 – 2003). This was due to the significant slump in production from 3,6 million tons in 1999 to 2.2 million tons in 2000, which had a distortive effect on the growth rate recorded during last five years of the period reviewed.

Overall chromite production (both subtypes included) has increased robustly during the ten-year period. This upward trend was fuelled by increasing demand for ferrochrome in stainless steel production, which has climbed some six percent per annum during the last three years.

2. IRON ORE

2.1 INTRODUCTION

Iron is the fourth most abundant rock-forming element and composes about 5% of the Earth's crust. The principal ore minerals of iron are hematite, magnetite, siderite and goethite. An estimated 98% of the ore shipped in the world is consumed in the manufacture of iron and steel. The remaining 2% is used in the manufacture of cement, heavy-medium materials, pigments, ballast, agricultural products, or especially chemicals. As a result, demand for iron ore is tied directly to the production of raw steel and the availability of high-quality ferrous scrap. Iron ore is exceeded in bulk tonnage handled only by coal, limestone and crude oil.

In South Africa, the origins of iron ore mining and processing can be traced back for many centuries. However, the first formal steel smelting took place in 1913, when the Union Steel Works Corporation erected a plant at Vereeniging, using scrap metal as a feed material. Dunswart Iron and Steel Works established a similar plant at Benoni a few years later, and the construction of a blast furnace at Pretoria by the Pretoria Iron Steel Works, for the production of pig iron, followed in 1918. Another plant was erected at Newcastle in 1926, and the source was supplied from the Prestwick Mine in the Dundee-Utrecht area of KwaZulu-Natal. In 1928, the two steelworks were amalgamated to form the Iron and Steel Corporation, subsequently renamed Iscor Ltd. This company later commissioned another steelworks at Vanderbijlpark, developed an entirely new complex at Newcastle and extended the existing Pretoria plant. Ore from Thabazimbi Mine was the main source of supply. Iscor continued to expand, especially after 1953, when the Sishen Mine in the Northern Cape Province first came on stream as a major supplier of ore. The global steel giant, Mittal Steel acquired a majority stake in Iscor in 2000 and the Corporation was renamed Mittal Steel South Africa in 2004.

In 1968, Highveld Steel and Vanadium Corporation, a subsidiary of the Anglo American Corporation, started producing pig iron and steel at its works near Witbank. Ore is supplied from the Mapochs Mine, and over the years production facilities have been expanded to increase output and widen the range of products.

2.2 OCCURRENCE

South Africa is well endowed with iron ore, the principal deposits being located at Sishen, where large, irregular bodies containing hematite occur adjacent to the manganese occurrences, and near Postmasburg, some 60 km to the south.

Other high-grade hematite deposits are associated with the iron formation of the Chuniespoort Group at Thabazimbi, on the northern rim of the Bushveld Complex.

The Bushveld Complex contains vast reserves of titaniferous magnetite carrying 55 to 57 per cent iron, 8 to 15 per cent titanium dioxide and up to 2,2 per cent vanadium pentoxide. Various parallel seams occur over a distance totalling nearly 300 km in both the western and eastern limbs of the Complex. At the Marpochs Mine, owned by the Highveld Steel and Vanadium Corporation, the proven ore reserves are estimated at more than 100 millions tons.

Figure 2

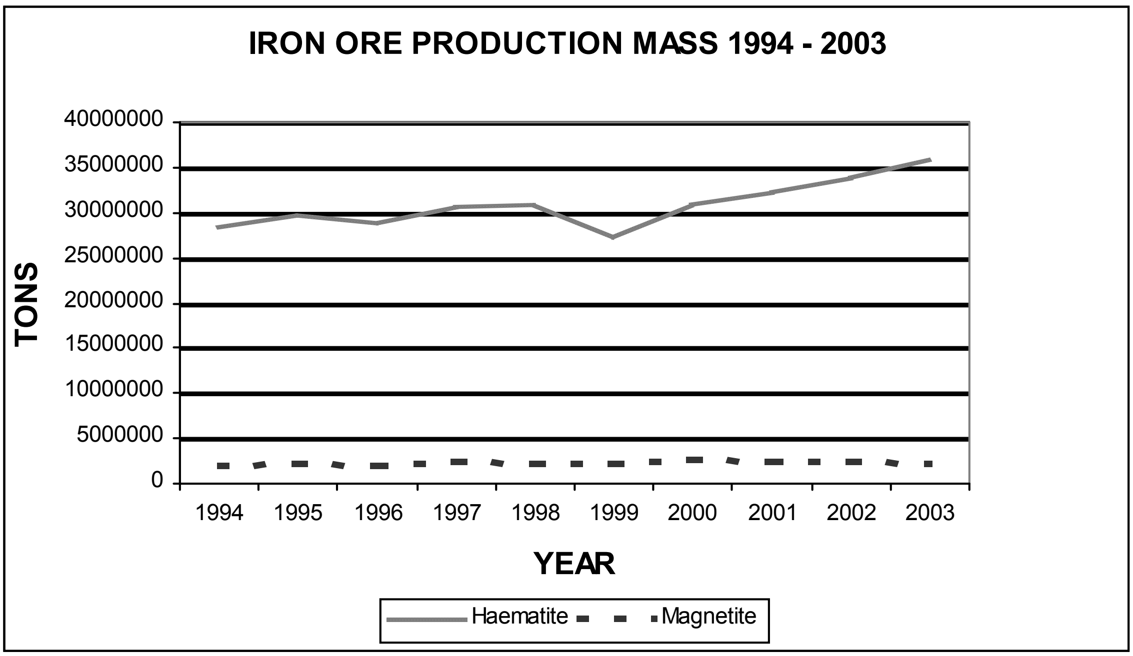
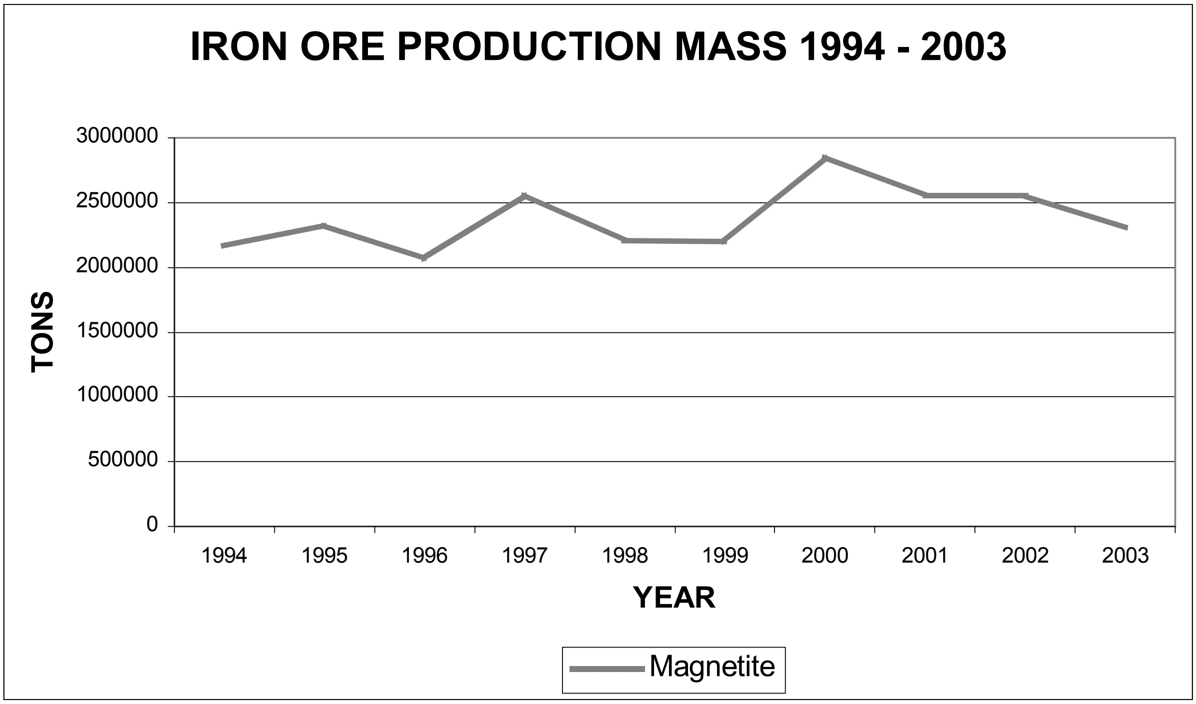


Figure 3



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2.3 IRON ORE PRODUCTION TRENDS

Annual South African hematite production has risen from 28,3 million tons in 1994 reaching 35,7 million tons in 2003 (Figure 2). A growth of 2,1 percent per annum was achieved during the ten-year period of study. The lowest output occurred in 1999 when 2,73 million tons were produced. Thereafter, a steady increase in production volume was evident, with a growth rate of 6,3 percent per annum being realized in the last five years of the period of the study (1999 – 2003). This strong growth is consistent with the successive record levels of world steel output that was achieved during the same period.

There has been no significant growth in the production of magnetite (Figure 3). A growth rate of 1,5 percent per annum was recorded for magnetite between 1994 and 2003. This positive trend was accentuated by an anomalous tonnage of 2,8 million tons of magnetite recorded in 2000. Output growth during the last five years of the study was insignificant.

Hematite however, has shown a strong increase in output. Given the strong steel demand from Asia especially China large increases in hematite iron ore production can be expected to continue in the future. Production for magnetite is expected to be static considering its inability to respond to high levels of demand prevailing in the steel industry.

3 MANGANESE

3.1 INTRODUCTION

Manganese was the second most consumed element after iron, until the last quarter of the twentieth century. It has recently been displaced to third position by aluminium.

Manganese plays an important dual role in the production and performance of most steels. With a high affinity for sulphur and other deleterious elements, it has the ability transfer them from the molten metal to the slag, and disperse those remaining in a harmless form. It also has valuable alloying characteristics.

Just as manganese is important to steel production, steel output is crucial to the demand for manganese, consuming some 95 per cent of total production. The manganese content of many cast irons and steel is around 0,5 per cent, but in certain alloy irons and steel it can be much more.

The advent of continuous casting of steel, to replace traditional ingot casting since about 1960, has had a serious effect on the need for, and consumption of, manganese. Specific consumption in steel was originally about 15 kg/t of steel, but today it appears to have stabilised at approximately 7 kg of manganese per ton of steel.

In nonferrous metallurgy, manganese is used as an alloying element with aluminium, where it acts as a strengthening agent, and with copper to produce a wide range of manganese bronzes.

Manganese dioxide is a powerful oxidising agent used in a variety of chemical applications, the most important being in dry-cell batteries and for the acid leaching of certain ores, notably those of uranium and zinc. Manganese chemicals, predominantly the sulphate, are largely consumed in the production of fungicides for agricultural use.

3.2 OCCURRENCE

The deposits of the Northern Cape occur in a zone extending northwards over a distance of 150 km, from just south of Postmasburg to as far as Wessels and Black Rock Mines north of Hotazel. The northern (or Kalahari) field is the most extensive and contains South Africa's major deposits of metallurgical-grade ore. The southern (or Postmasburg) field contains predominantly ferruginous manganese ore.

The economically mineable ore in the Kalahari filed is largely overlain by younger sediments. Surface exposures occur in the north of Black Rock mine, on the eastern perimeter, and at Mamatwan mine in the south where the depth of overburden is minimal. In the west, the ore body extends down dip to a vertical depth of 1 200m in some localities. In the northern part of the field the manganese content is higher, ranging to up to more than 60 per cent.

Deposits in the North West province, which formed through the weathering of dolomites of the Malmani Subgroup (Transvaal Sequence), are found scattered across an area extending from west of Krugersdorp to the Botswana border.

More than 80 per cent of the World's manganese ore resources are located in South Africa.

Figure 4

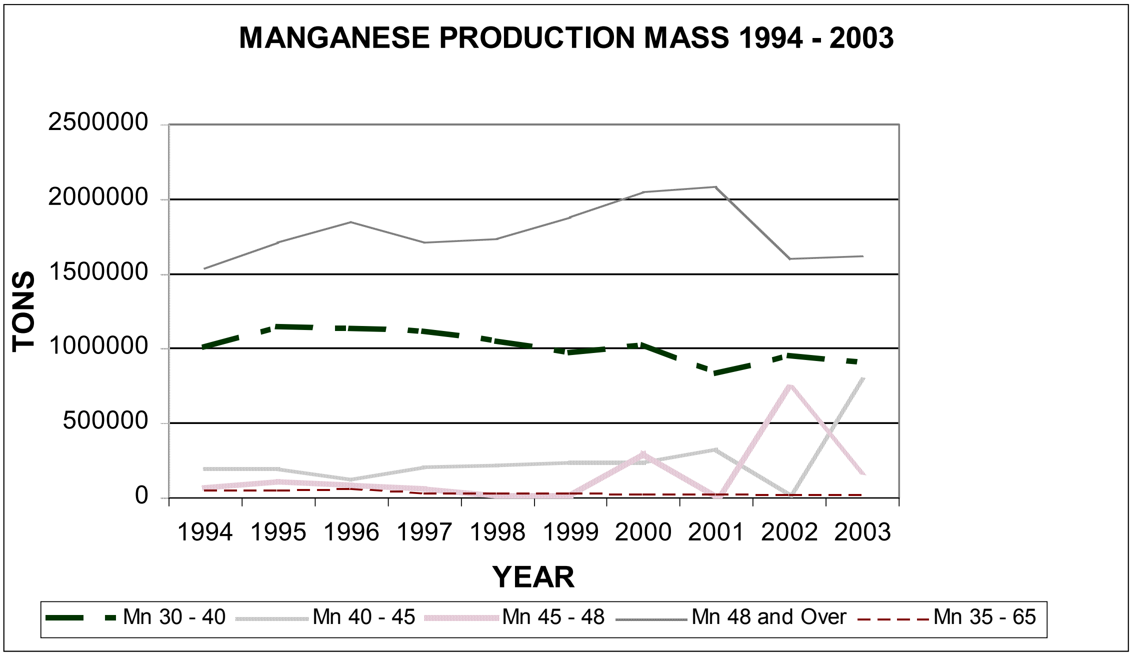
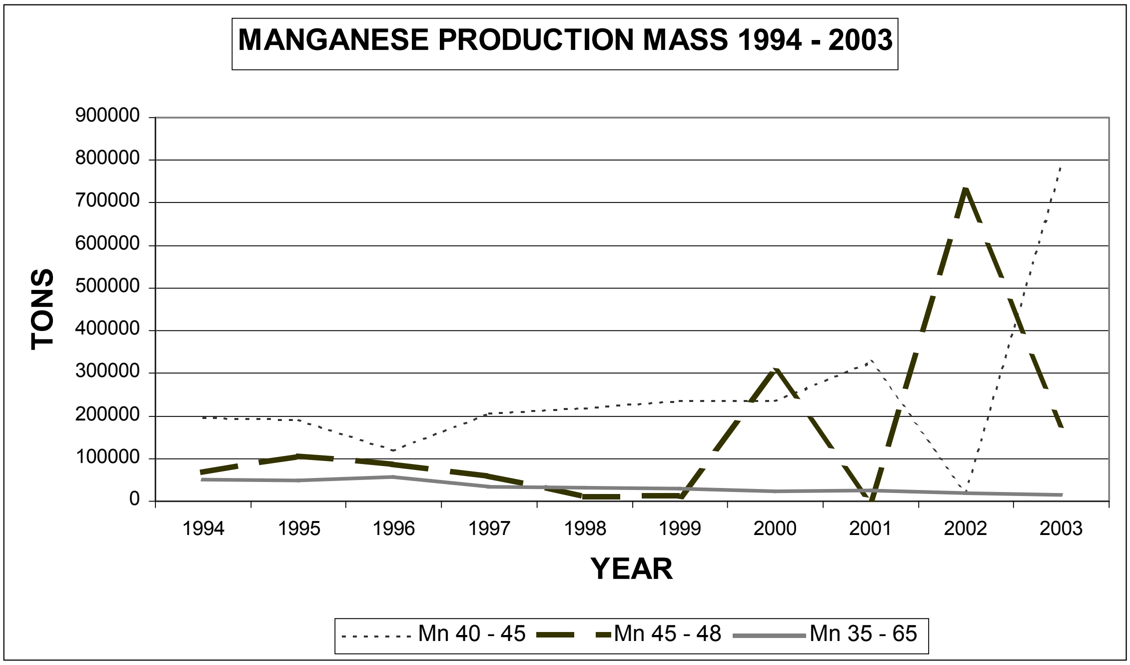


Figure 5



3.3 MANGANESE ORE PRODUCTION TRENDS

Five separate grades of manganese ore are mined in South Africa, namely: 30 – 40 percent grade; 40 – 45 percent grade; 45 – 48 percent grade; 48 percent and over grade and 35 to 65 percent grade.

Manganese ore subtype with manganese content of 48 percent and over recorded a substantial annual production of above 1,5 million tons per annum during the ten years (Figure 4). This subtype peaked in 2001 exceeding 2 million tons, but output decreased rapidly after 2001. Over the period between 1994 to 2003 production of 48 percent content and over has grown by 0,7 percent per annum but during the last 5 years from 1999 to 2003 output has decreased by 5 percent per annum. However, tonnage of the subtype has since stabilised and the declining trend is likely to be reversed due to current strong demand from the steel industry.

Production of 30 to 40 percent manganese content subtype has averaged one million tons in the last ten years, exceeding the one million mark up until 1998 but dipping below that figure during the rest of the 10 year period (Figure 4). The output growth rate for the whole decade was negative with a 2,5 percent per annum recorded during the period. A negative growth rate of 2 percent has been also been recorded in the last 5 years of the period under consideration (1999 – 2003).

Output of 40 to 45 percent manganese content subtype has ranged around two to three hundred thousand tons, for most of the period in question, but in 2003 this tonnage was exceeded considerably (Figure 5). A growth rate of 1,1 percent per annum was recorded over the ten year period. Despite a record level production of 0,7 million tons in 2003, a growth rate of –1 percent per annum was recorded for the last five years of the period under consideration. The unusually high production level in 2003 reflected an increased level of demand for the subtype in metallurgical and non metallurgical applications.

Production of 45 to 48 percent manganese content subtype rose from 50 thousand tons in 1994 to around 0,3 million tons in 2000 (Figure 5). Volatile output of this subtype which saw nil production recorded in 2001 has distorted the growth profiles. Volatility continued with 0,7 million tons being produced in 2002. A growth rate of 6,3 percent per annum was recorded over the last 5 years of the review period.

Manganese subtype with a manganese content of between 35 to 65 percent content has recorded insignificant tonnages when compared with other subtypes (Figure 5). In 1994 about 50 thousand tons were produced, and in 2003 an output of only 15 thousand tons was recorded. Demand for this subtype appears to be decreasing as it has failed to improve on its output level during 2002 and 2003 when most of the other sub types have recorded increased production.

4. CONCLUSION

Output growth of ferrous ores has been slow in the first half of the ten year period under study; this coincided with the period of the Asian crisis in 1997 which induced high levels of volatility in the minerals market. Chromite ore production has shown strong growth in the last ten years, especially the less than 44 percent subtype, while iron ore output recorded positive but modest growth.

The positive performance of chrome and iron ore in the last ten years can be contrasted with that of manganese, which has remained static with its most highly traded subtype (48 percent and over) adopting a negative growth path from year 2001.

Since 2000 consumption levels in general have risen positively, and the ferrous minerals market has been characterized by strong demand for ferrous ores. The weak dollar has effectively reduced commodity prices for consumers thereby fuelling strong demand for raw materials.

There is evidence of capacity constrains as output milestones are becoming harder to achieve. In South Africa, the logistic hurdle with regard to the railway line from Sishen to Sahldana for iron ore is one such constraint. For the chrome mining industry green and brownfields projects are only expected to come on stream towards the end of 2006, and only then can production be expected to increase significantly, thereby adjusting to strong demand for its products on ferrous markets.