

US MINERAL DEPENDENCE ON SOUTH AFRICA: EXPLODING THE MYTHS

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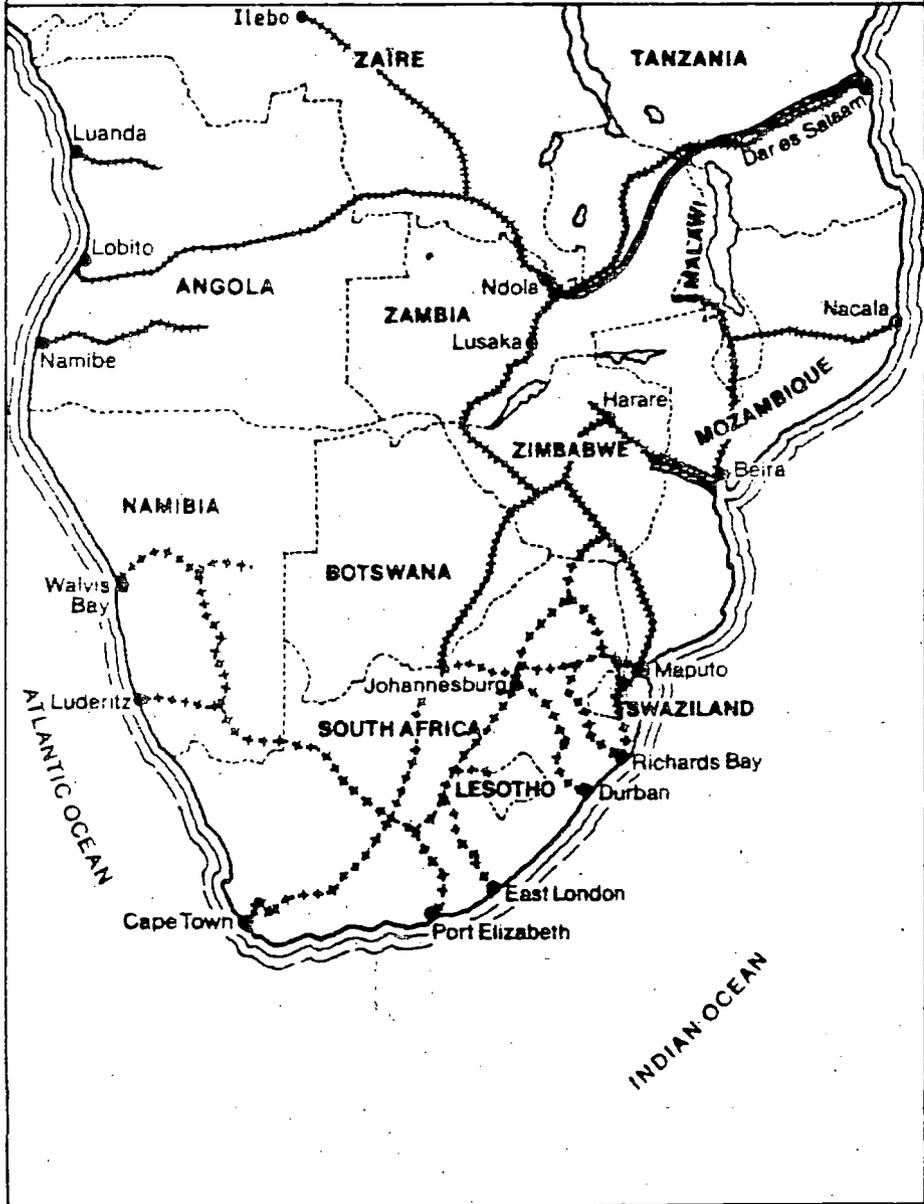
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Figure 1

Rail and Pipeline Routes

- SADCC railways
- South African railways
- Pipeline
- International boundaries



1 Introduction

1.1 Background

In 1986 the US Congress passed a comprehensive Anti-Apartheid Act (Public Law 99-440, 22 USC 5001 et seq.) which included a ban of all imports from South Africa of agricultural products, coal, iron and steel, and textiles and exports of oil, nuclear materials, and computers to "apartheid enforcing" agencies. In addition, Section 303 of the Act prohibits imports from South African concerns which are owned, controlled or subsidised by the government except for strategic minerals essential for the economy or defence of the USA which are unavailable from elsewhere.

In February 1987 the US Department of State "certified" ten such strategic minerals. These "certified minerals" are:

- 1) andalusite
- 2) antimony
- 3) chrysotile asbestos
- 4) chromium and ferrochromium
- 5) cobalt
- 6) natural industrial diamonds
- 7) manganese and manganese alloys
- 8) platinum group minerals (PGM's)
- 9) rutile
- 10) vanadium

These minerals were deemed to be strategic using the following criteria:

- a) that the lack of the mineral concerned would adversely affect the peacetime economy of the USA, the USA's competitiveness or defence,
- b) that the mineral concerned was not available from in sufficient quantities from alternative reliable sources. In this regard the USSR and other European Eastern bloc states were excluded from consideration,
- c) minerals for which other Southern African states were the main source, but which were deemed to be shipped via South Africa were also considered to be strategic.

1.2 Approach

The approach of this paper is first to review the validity for inclusion of the ten "certified minerals" using the State Department's criteria. Second to make a case for the development of these minerals in the other states of southern Africa.

In the debate surrounding the sanctions issue an aspect often overlooked is aid to the neighbours of South Africa. We call this "positive sanctions" whereby sanctions against the South African apartheid regime are linked to positive action to develop alternative supplies of these strategic minerals from other countries in the region, particularly the Frontline States.

The concept of positive sanctions would mean that the reduced supply of minerals brought about by sanctions against the RSA would be compensated for by the development of these minerals in the other states of the region. As the geology of these states is similar, several minerals for which the RSA is a major producer also occur in the surrounding countries. This strategy not only guarantees the US supplies of minerals embargoed from South Africa, but also would go some way to regaining the US's credibility in the region after a decade of the Reagan doctrine of collaboration and support for South Africa ("constructive engagement"), even to the extent of joining the Apartheid regime in the destabilisation of neighbouring states.

In 1986 the loss to the southern African mining industries due to South African destabilisation was estimated at 4.5 GUS\$ and mining in some of the countries had all but ceased due to South African sponsored banditry (Jourdan: 1986a). A policy of positive sanctions would therefore not only aid the South African people in their struggle against the Apartheid regime, but would also help the Frontline states to bolster their economies against future South African onslaughts.

The reasons for the US to diversify its mineral supply sources away from South Africa, should not only be seen in terms of sanctions, but also that it makes good business sense not to be too dependent on any one source, particularly if that source is likely to experience escalating internal civil strife in the near to medium future.

In arguing the case for alternative sources and the development of other southern African deposits, this paper is in fact arguing for the inclusion of these minerals under the total ban as with steel and coal, not just if the South African producer is owned, controlled or subsidised by the Apartheid regime.

Alternative sources are considered at two levels: actual, where the exploitation of mineral deposits is already underway and potential, where alternative deposits still need to be developed, particularly suitable southern African deposits. In this regard the validity of the third criteria will be assessed.

This paper does not investigate the first criteria, that the certified minerals are vital to the peacetime US economy and defence. Rather we only consider alternative sources of supply.

Finally, this paper is to some extent in response to the paper compiled by the US General Accounting Office entitled "Strategic Minerals: Extent of US Reliance on South Africa" of June 1988 requested by Senators Messrs. Kennedy and Weiker (GAO: 1988).

2 The "Certified Minerals"

2.1 Overview

The inclusion of several of the ten minerals using the stated criteria is blatantly ludicrous and leads one to believe that the Apartheid Regime has significant support in the State Department, as their inclusion makes very little sense when one explores the alternative sources of supply and the level of US imports.

For this reason the certified minerals have been divided into two groups. The first group includes those minerals for which there are reasonable and secure alternative sources of supply and include natural industrial diamonds, antimony, cobalt, manganese, rutile, vanadium, chrysotile asbestos and alumino-silicates (andalusite, sillimanite and kyanite).

The second group includes those minerals for which there would be difficulty in securing alternative operating sources, but some occur in the southern African region outside South Africa and need to be developed. These include chromite and ferrochrome and the platinum group minerals (PGM's).

2.2 Minerals with Actual Alternative Sources

2.2.1 Industrial Diamonds

The most obvious non-strategic mineral for the USA in terms of South African supply are natural industrial diamonds. According to the US Bureau of Mines, in 1987 the US imported 48.6 million carats of industrial diamonds (natural and synthetic) for consumption of which less than 0.5% came directly from South Africa (GAO: 1988), though some South African production could have been imported via intermediate countries such as Ireland. The main diamond producers in 1986 were Australia, Zaire, Botswana, the USSR and South Africa, in that order (Table 1). In addition almost all of Australia's, Zaire's and the USSR's output is industrial grade while Botswana and South Africa have a significant proportion of gem grade stones.

Table 1

World Diamond Production: 1986		
Country	Mcarats	% World
Australia	29.23	32%
Zaire	23.30	25%
Botswana	13.14	14%
USSR	10.80	12%
South Africa	10.23	11%
Others	4.80	5%

TOTAL: 91.50 100%

Source: BGS: 1988

The British Geological Survey (BGS) estimated that the US imported a total of 25.6 Mcarats in 1986 of natural diamonds of all types of which only 9 Mcarats were of industrial grade (Table 2).

Table 2

US Diamond Imports 1986	
Type	Mcarats
-----	-----
Rough	1.29
Cut	7.88
Industrial	8.95
Bort	.25
Dust	7.26
-----	-----
TOTAL:	25.63
-----	-----
Source: BGS: 1988	
-----	-----

What is clear is that South Africa does not constitute the only secure source of industrial diamonds outside the centrally planned economies. The main producer, Australia, is not only a secure source of supply, but also has almost half the world reserve base. The second largest producer, Zaire, is widely considered to be a client state of the US and should therefore be considered a secure source for that country.

It should also be borne in mind in this regard that, in case of a shortage, there are several US firms that produce synthetic industrial diamonds which could expand output to cater for at least part of the USA's natural diamond imports. Also, in 1986 the US National Defence Stockpile of industrial diamonds stood at 22 Mcarats of crushing bort (USBM: 1988).

The only other possible objective reason that the State Department might have had for including industrial diamonds in the list of certified minerals is the fact that a South African company, De Beers Consolidated Diamond Mines, has a virtual international diamond marketing monopoly via its subsidiary the Central Selling Organisation (CSO) in London. Given this situation, it is still highly improbable that the CSO would refuse to sell production from countries other than South Africa to the US if the US banned production from South Africa. Even if this highly unlikely event came to pass, other countries would most probably bypass the CSO and sell direct to US customers.

The GAO report mentions a specific type of industrial diamond (Type IIB) for which there is reportedly only one source from one mine, naturally in South Africa. It is further claimed that it "has a unique defence communication application" (GAO: 1988, p28). As no further details are given it is difficult to confirm whether or not there is a substitute for this application. Assuming that there is not, there appears to be no reason why the State Department did not exempt (certify) this specific type only, rather than their blanket exemption for all industrial diamonds.

2.2.2 Cobalt

In the case of cobalt, inclusion on the certified list clearly does not come from South Africa's dominant position a producer. On the contrary the RSA contributed an insignificant proportion of world mine production of cobalt in 1986 (Table 3). The main producers in that year were Zaire, Zambia, Australia, the USSR and New Caledonia (France). In the same year South Africa imported 157 tonnes of cobalt metal and made no exports (BGS: 1988).

Table 3

Country	ktonnes	%	%*
Zaire	14.26	45%	--
Zambia	4.34	14%	--
Australia	2.91	9%	23%
USSR	2.80	9%	22%
New Caledonia	1.92	6%	15%
Others	5.27	17%	41%
TOTAL:	31.50	100%	100%

* % excluding Zaire and Zambia
Source: BGS: 1988

In terms of reserves, in 1983 the IMM estimated that Zaire had 30% of the world's cobalt resource base, New Caledonia 18%, the USSR 14% and did not consider South Africa's resources worth mentioning (IMM: 1983).

Inclusion of this mineral on the certified mineral list must clearly come from the third criteria: that a significant proportion of world output is shipped via South Africa. Only Zaire's and Zambia's production, 61% of world output in 1986, could possibly be shipped via South Africa. US imports of cobalt in 1986 were estimated at 5.5 ktonnes by the BGS and 5.3 ktonnes by the USBM (BGS: 1988 & USBM: 1988). These estimates would constitute around 17% of world production in 1986 and in terms of world output excluding Zaire and Zambia the percentage would be 43%.

Although the majority of world production comes from Zaire and Zambia, it does not therefore follow that all exports from these two countries must necessarily go via South Africa. Figure 1 gives the main transport routes in the southern African region. There are five principle routes for copper and cobalt exports from the Zaire-Zambia Copperbelt:

- 1) Via Ilebo to the port of Matadi (Zaire)
- 2) Via the Benguela line to Lobito (Angola)
- 3) Via the Tazara line to Dar es Salaam (Tanzania)
- 4) Via Zimbabwe to Beira and Maputo (Mozambique)
- 5) Via Zimbabwe and Botswana to the South African ports

Historically the principal routes were primarily the Benguela line to Lobito Bay in Angola and secondly via Zimbabwe to the Mozambican port of Beira and later, Maputo. Since the independence of Angola in 1975 the Benguela route has been out of action due to the destabilisation policies of South Africa in collusion with the US.

Under normal circumstances the Benguela line would be the cheapest and quickest route to the coast (see Jourdan: 1986a). The US State Department's Assistant Secretary of State for African Affairs, Chester Crocker, recently (August, 1988) reaffirmed his government's commitment to the destabilisation of Angola despite the withdrawal of South African troops from Angola and South Africa's agreement to finally comply with UN resolution 435 of 1975 to withdraw its occupying forces from Namibia and allow democratic elections under UN supervision.

It would appear somewhat strange that the US State Department itself is keeping an important cobalt export route closed then turning around and saying that cobalt should be on the list of certified minerals because of its own actions. But, even without the Benguela line operational, it would be ridiculous to assume that less than 20 ktonnes/annum of cobalt could not be exported via the Tazara line to Dar es Salaam, via Zimbabwe to the port of Beira, or via Ilebo to Matadi. In 1986 the port of Dar es Salaam handled 84% of Zambia's total metal exports of half a million tonnes of copper, zinc, lead and cobalt, and Beira accounted for 9% (Memaco: 1987).

2.2.3 Andalusite

Andalusite is an alumino-silicate together with kyanite and sillimanite. Their main use is in the manufacture of refractory (heat resistant) bricks for metallurgical furnaces. Why the State Department specifically listed andalusite is unclear as all three alumino-silicates are converted to mullite, the form used in refractories. Both andalusite and sillimanite are imported by the US from South Africa. The US is the world's largest producer of kyanite and also has substantial production of synthetic mullite made from alumina and silica. Production of synthetic mullite in the US was about 25 ktonnes in 1985 (USBM: 1988).

World production figures for the alumino-silicates are difficult to come by. South Africa, France, the US, India and Sweden are producers. The South African Chamber of Mines claims that in 1986 South Africa had 47% of the "Western Worlds" alumino-silicate reserve base (SACM: 1987). The US itself has an adequate reserve base of kyanite estimated at 30 Mtonnes and has sufficient capacity for the production of synthetic mullite for the end-uses where kyanite is unsuitable (USBM: 1986). Thus it is unclear why South African alumino-silicates are included on the prescribed minerals list.

There are several deposits of alumino-silicates in the other states of southern Africa. If the US considers that its import exposure to South Africa is unacceptably high, then these deposits should be considered as potential alternative supply sources. The Zimbabwean Mining Development Corporation (ZMDC) is currently developing its kyanite property, Ky Mine, and would certainly be interested in sales to the US.

2.2.4 Chrysotile Asbestos

Of all the minerals on the certified list, the logic behind the inclusion of chrysotile asbestos is the most baffling as the US's neighbour and ally, Canada, is far and away the western world's largest producer. In 1986 Canada produced 69% of western world output of 955 ktonnes and South Africa produced 10% (Table 4). In the same year the US imported 102 ktonnes of chrysotile asbestos of which less than one ktonne came from South Africa and 99% came from Canada (USBM: 1988).

Table 4
Western World
Chrysotile Output: 1986

Country	Ktonnes	%
Canada	662	69%
Zimbabwe	164	17%
South Africa	91	10%
Swaziland	21	2%
Cyprus	13	1%
Japan	4	-

TOTAL:	955	100%

Source: BGS: 1988		

Appendix III of the 1988 GAO Report claims that "a particular strategic grade of chrysotile", used in missile and submarine construction, is mined in Zimbabwe and shipped through South Africa (GAO: 1988, p28). If in fact all of 600,000 tonnes of Canadian production is unsuitable for these uses and only the Zimbabwean product is appropriate it must be an extremely small amount as, from 1985 to 1987, neither the US Bureau of Mines nor the Minerals Marketing Corporation of Zimbabwe (MMCZ), which markets all of the Zimbabwean product, registered US imports of asbestos from Zimbabwe (USBM: 1988 & MMCZ: 1988). In addition the MMCZ exports about 50 ktonnes/annum in containers via Beira and any US demand could easily be met using this export route (MMCZ: 1988). There would therefore appear to be no objective reason for including chrysotile asbestos on the certified minerals list.

2.2.5 Antimony

US imports for consumption of antimony in 1986 were 23 Ktonnes most of which came from China and in the same year GSA stocks stood at 34 ktonnes (USBM: 1988). Imports of this amount could clearly be supplied by non-Comecon countries, excluding South Africa, which produced 41.6 ktonnes of antimony in 1986 (Table 5). As the South African product is not of a special grade or quality the reasoning behind this metal's inclusion on the prescribed list remains illusive.

Table 5
World Antimony Production: 1986

Country	ktonnes	%	%*
China	14.00	25%	29%
Bolivia	10.24	19%	21%
South Africa	6.82	12%	14%
USSR	6.00	11%	---
Canada	3.81	7%	8%
Mexico	3.34	6%	7%
Guatamala	2.02	4%	4%
Turkey	1.99	4%	4%
Thailand	1.26	2%	3%
Australia	1.13	2%	2%
Others	4.59	8%	8%

TOTAL:	55.20	100%	100%
=====			

* excluding COMECON countries.

Source: BGS: 1988

There are several potential antimony sources in the rest of the southern African region and two mines are in operation in Zimbabwe (Indarama and Belingwe Star). If the US seriously wanted to develop new alternative sources, an appraisal of other southern African deposits could be a fruitful starting point.

2.2.6 Manganese

In 1986 South Africa produced 26% of the world's non-Comecon manganese ore (Table 6) and its exports to the US amounted to 13 kt, manganese content (USBM: 1988). The bulk of US ore imports came from Gabon 53%, Brazil 17% and Australia 16% (USBM: 1988). US imports from South Africa of ferromanganese and silicomanganese together were 156 ktonnes of contained manganese representing 39% of total imports of these two alloys. In addition, in 1986, the US also imported from the RSA small quantities of manganese metal (9 kt) and manganese dioxide (3 kt) (USBM: 1988).

US dependence on South African supplies is minor for all types of manganese except for ferromanganese for which it represented 36% of imports in 1986, but as many of the smelters in the OECD countries are running at under capacity (particularly in the USA), this quantity could fairly easily be made up by them if the

US were to ban imports of South African manganese. The main South African producer Samancor was privitised in 1986 when it was bought from the Apartheid state by the Afrikaner mining house Gencor.

Table 6

Manganese Ore Output: 1986			
Country	kt	%	%*
USSR	9300	39%	---
RSA	3719	15%	26%
Brazil	2700	11%	19%
Gabon	2513	10%	17%
Australia	1649	7%	11%
China	1600	7%	11%
India	1275	5%	9%
Others	1244	5%	7%

TOTAL:	24000	100%	100%

* excluding Comecon states			
Source: BGS: 1988			

There are several manganese deposits in the rest of southern Africa, but the only one in operation is in southern Zaire just off the Benguela railway line (Kisenga), but it is having problems exporting its ore to Lobito Bay due to Apartheid and US sponsored sabotage of the line in Angola. Therefore one positive way of eliminating South African ore imports would be for the US to cease aiding the Unita rebels in Angola. In addition both Zambia (Mwanza) and Angola (Kiaponte and Kitota) have in the past produced manganese and these deposits could be reassessed in this regard (see Jourdan: 1986c).

2.2.7 Rutile (and Ti slag)

Rutile is one of the main titanium ore minerals, the others being illmenite and leucoxene. Why specifically rutile was included on the certified list and not the other titanium minerals, remains a mystery. The world's main sources of titanium are Canada (slag) and Australia (Ti minerals). South Africa is a relatively small producer and in 1986 the titanium content of its mineral and slag production was but 11% of the world total (BGS: 1988). In that year US imports from South Africa were only significant for slag (Table 7), but these could easily be substituted for by other countries. Not only does but one-fifth of US rutile imports come from South Africa, but this mineral is also produced synthetically in several countries, including the US (Table 7).

Table 7

US Titanium Imports: 1986		
Source	kt	% RSA
Ilmenite	426	0%
Ti Slag	328	46%
Rutile	159	21%
TiO ₂ pigments	184	<1%
Ti sponge	1.5	0%
Ti metal	0.1	0%
Ti scrap	2.2	0%
Ti wrought	1.1	0%
Source: USBM: 1988		

Several other states in southern Africa have significant reserves of titanium minerals in beach sand deposits on the coasts of both Mozambique and Tanzania and along the lake shore of Lake Malawi-Niassa/Nyasa. A recent UN Revolving Fund for Natural Resources Exploration study of the region isolated these deposits as warranting further investigation for commercial exploitation (UNRF: 1988). Resources of heavy mineral sands in Mozambique have been estimated at 118 Mt containing 3.5 to 5% heavy minerals (Jourdan: 1986b). Estimates put Tanzanian resources of heavy mineral sands at around 50 Mt (UNRF: 1988).

2.2.8 Vanadium

Vanadium is mainly used in special steels and alloys. A tiny amount is used by the chemical and ceramic industries. It is generally traded as vanadium pentoxide the main feed for ferrovanadium production.

Vanadium is seldom mined as such, it is usually a byproduct or coproduct of iron/steel making, uranium processing or phosphorous production. In addition it is also recovered from petroleum residues, clays and spent catalysts. Thus actual primary mine production of vanadium is low compared to the amount generated by other processes.

In 1986 the US imported for its own consumption a mere 1.3 ktonnes of ferrovanadium containing about one thousand tonnes of vanadium, mainly from Canada (36%) and Austria (21%), South Africa (20%) and West Germany (17%) (USBM: 1988). In the same year the US's imports of vanadium pentoxide for its own consumption was 374 tons of contained vanadium of which two-thirds came from South Africa (USBM: 1988). Thus total imports of contained vanadium were 1,452 tonnes constituting 37% of consumption (3.9 ktons). South African imports therefore constituted only 9% of US consumption.

Table 9
Production of Vanadium: 1986

Country	ktonnes	%
South Africa	15.6	45%
USSR	9.6	27%
China	4.5	13%
US	4.5*	13%
Japan	0.8*	2%
TOTAL:	35.0	100%

* includes secondary recovery
Source: USBM: 1988

Although South Africa is the main world producer of vanadium (Table 9), the US is also a significant producer, both from mine production and from secondary recovery from petroleum residues, ashes and spent catalysts. The US's dependence on imports in general and South African imports in particular is thus low and there is therefore ^{no} strong argument as to why South African supplies of this commodity should be included on the list of certified minerals.

2.3 Minerals with Potential Alternative Sources

2.3.1 Chromite & Ferrochrome

In this section we deal with the second group of minerals where the case for exemption is arguable, in other words where South Africa's share of non-Comecon output and trade is considerable. The best known case is that of chromite and ferrochrome where in 1986 the RSA mined 52% of non-socialist output of the former and smelted 41% of the latter (Table 8).

Table 8
NSW* Chromite and Ferrochrome Production: 1986

Chromite			Ferrochrome		
Country	kt	%	Country	kt	%
South Africa	3453	52%	South Africa	915	41%
India	630	9%	Japan	310	14%
Turkey	600	9%	Zimbabwe	190	8%
Finland	590	9%	Finland	134	6%
Zimbabwe	553	8%	Brazil	120	5%
Brazil	270	4%	Sweden	105	5%
Philippines	180	3%	India	95	4%
Madagascar	110	2%	Yugoslavia	75	3%
Others	249	4%	Others	296	13%
TOTAL:	6635	100%	TOTAL:	2240	100%

*NSW Non-socialist world.

Source: SLH: 1988

In 1986 the US imported 443 kt of chromite of which 145 kt (34%) came from South Africa. In the same year 352 kt of ferrochrome were imported of which 209 kt (59%) came from South Africa (USBM: 1988). This level of dependence would admittedly be difficult to drop without any cost to the US consumers. The US could at a pinch be supplied by other producers, but this would push the price of their product up as there would be a reduced supply base. Conversely though, it would push the price of the South African product down as it would then have a reduced market. As the South African chrome is not of a high grade, US consumers should have no major problems regarding quality when switching to alternative suppliers.

Although the RSA has the bulk of the World's high iron chromite reserves (90%), most of the high chromium reserves are next door in Zimbabwe (84%) which are estimated at 560 Mt but could be well over 1 Gt and its resource base is put at three to ten billion tons (Slatter: 1981). The lower figure represents 80 years of world supply at current consumption rates, longer than even the most pessimistic predictions of the time left for the Apartheid regime in South Africa.

This mineral therefore could provide the US with an ideal opportunity for applying positive sanctions whereby the embargo of supplies from the Apartheid regime is compensated for by developing alternative capacity in the Frontline States who are already experiencing various forms of South African destabilisation and aggression (see Hanlon: 1986, Martin: 1986 and Jourdan: 1986b).

American consumption of South African ferrochrome could easily be substituted for by doubling Zimbabwean smelter capacity. A USBM report estimated Zimbabwean chromite mining capacity to be around 1 Mt/ann which would be enough to maintain present ferrochrome output and take on the US's current supplies from South Africa (USBM: 1981). In addition Zimbabwe's neighbours (Zambia and Mozambique) have a huge excess capacity of extremely cheap hydro power available for the ferrochrome smelting process and one (Mozambique) has the necessary grade of coking coal for the reductant. Thus this sanctions/expansion project would end up benefiting several of the Apartheid regime's regional victims.

The US's chromite imports from South Africa could fairly easily be met by suppliers round the world marginally increasing output (less than 10%) or by the US importing more ferrochrome rather than chromite.

2.3.2 The Platinum Group Metals

The principal economic platinum group metals are platinum, palladium and rhodium and the minor ones are iridium, osmium and ruthenium. South African mines dominate the production of platinum and in 1986 they produced 83% of Western world supply (Table 9). Their production of palladium is second only to that of the Soviet Union (Table 9) and they produce most of the world's rhodium (JM: 1988).

Table 9
 PLATINUM AND PALLADIUM SUPPLY: 1986

<u>Platinum</u>			<u>Palladium</u>		
Country	kg	%	Country	kg	%
South Africa	73094	83%	USSR sales	49766	55%
USSR sales	9020	10%	South Africa	32348	36%
Canada	4666	5%	Canada	5910	7%
Japan	663	1%	Japan	1453	2%
Others	588	1%	Others	1348	1%
-----			-----		
TOTAL:	88031	100%	TOTAL:	90825	100%
-----			-----		
Sources: JM: 1988, USBM: 1988, BGS 1988					

In 1986 the US imported 53.6 tonnes of platinum of which 68% came from South Africa, 43.1 tonnes of palladium of which 38% came from South Africa and 5.6 tonnes of rhodium of which 55% came from South Africa (USBM: 1988). With regard to domestic US production, the new Stillwater operation which came into operation in 1987 is producing about 780 kg of platinum per annum and about 2.3 tonnes of palladium (USBM: 1988 & JM: 1988).

As with chromium, it would be extremely difficult for the US to replace South African supplies of the PGM's from the rest of the world excluding the USSR without adverse economic affects to the US consumers. But, like chromium, there are substantial resources of PGM's in the Great Dyke of Zimbabwe and a major PGM deposit has recently been discovered in Botswana.

The Zimbabwean resources have been put at 1.7 billion tonnes containing 5.45 g/t PGM's and gold plus 0.2% nickel and 0.15% copper (Bohmke: 1981). Of the 5.45 g/t PGM's plus gold, 45% is platinum, 32% is palladium, 14% is gold, 4% is rhodium and 5% are the other PGM's (Bohmke: 1981).

This resource base is clearly adequate for Zimbabwe to become a medium-sized producer, which, together with US output (Stillwater) and production from the rest of the world excluding the USSR, could replace US imports from the RSA. The Zimbabwean deposits are lower grade than the South African ones and at current prices are marginal, but if a progressive embargo was imposed of, for instance, a 10% reduction of South African imports per year, as the Zimbabwean deposits were being developed, then there would be an increase in the world market prices for non-RSA or "clean" PGM's which would guarantee the profitability of the Zimbabwean operations.

As the PGM's would be airfreighted to the customers, any problems raised by the State Department regarding transportation through South Africa would not apply.

The PGM deposit in Botswana is located in the south of the country near the Molopo River on the South African border. The formation is geologically similar to the Bushveld Igneous Complex in the RSA which contains the majority of world PGM reserves. Detailed assessment of the deposit has still to be done.

This strategy of positive sanctions, might in the case of the PGM's, entail a certain cost to the USA, in that the development of the alternative deposits would most probably require cheap initial finance with a low interest rate, which could be in the form of a loan from the US state. It would be foolhardy to contemplate that the eradication of Apartheid will not cost the US anything.

3 Conclusion

This paper has reviewed the ten minerals on the State Department's list of "certified minerals". The review has attempted to assess whether or not the US does indeed need to get these minerals from or through South Africa and also considered alternative source in the southern African region excluding South Africa. The following conclusions were reached:

a) For most of the ten minerals there are currently sources of supply other than the RSA. There are six of these:

- 1) andalusite (alumino-silicates)
- 2) antimony
- 3) industrial diamonds
- 4) manganese
- 5) rutile (titanium minerals)
- 6) vanadium

b) Even though there are alternative, operating, sources of supply for these six minerals, if the US still wanted to reduce there import exposure to the RSA, the southern African region had alternative resources which could be developed (or expanded) of the following minerals:

- 1) alumino-silicates (Zimbabwe)
- 2) antimony (Zimbabwe)
- 3) industrial diamonds (Angola and Zaire)
- 4) manganese (Zaire, Zambia and Angola)
- 5) titanium minerals (Mozambique, Tanzania, Malawi)

c) For minerals not produced in South Africa, but which were included as it was claimed that US imports were routed through South Africa, it was concluded that there were several other operating routes other than via South Africa that could be used. There were two such minerals:

- 1) cobalt (from Zaire and/or Zambia)
- 2) chrysotile asbestos (from Zimbabwe)

d) For two minerals it was concluded that currently alternative suppliers could not meet US demand but there existed potential alternative sources within the southern African region. The minerals were:

- 1) chromite and ferrochrome (Zimbabwe)
- 2) the platinum group metals (Zimbabwe and Botswana)

e) With regard to chromite and the PGM's it was concluded that "positive sanctions" should be applied by the US whereby alternative sources in the Frontline States should be developed to compensate for South African supplies. It was suggested that the US should progressively reduce its South African imports of chromite, ferrochrome and the PGM's while developing these deposits in Zimbabwe and, in the case of PGM's, Botswana.

f) Finally, if the US were to embargo all of the certified minerals except for chromite, ferrochrome and the PGM's the extra cost to the US of switching suppliers would be negligible. If a progressive embargo was applied for chromite, ferrochrome and the PGM's while alternative sources were being developed, it was concluded that the extra cost to the US would also be extremely low.

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