

THE BRAZILIAN MINING INDUSTRY: CURRENT ISSUES AND PROSPECTS

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Abstract

The Brazilian economy was sluggish in the 80's and in the early 90's, but it recently started to show some signs of recovery. High inflation rates have been one of Brazil's major economic problems in that period. Four successive economic stabilization plans failed in an effort to reverse the situation that plagued other Latin American economies. The last attempt started in July 1994 - "Real Plan" - based upon exchange reserves (anchor) and the reduction of the global stock of local currency held by the Central Bank. Amendments to the Constitution of 1988 are also considered to be critical to the reactivation of the Brazilian economy and for increasing the flow of foreign investments. These changes in the macroeconomic level will certainly be beneficial to boost the mineral sector in the coming years.

Historically, Brazil has shown its technical capability to operate in the mining industry under competitive international standards. Its size (GDP share is approximately 2% - US\$12.2 billion) and diversity are not well perceived by some analysts, although it ranks 1st. to 6th. world producer for niobium, iron ore, tin, asbestos, aluminium, fluorspar, manganese, magnesite, dimension stones, and talc.

This paper also examines three different scenarios used by the government agency *Departamento Nacional da Produção Mineral-DNPM* for promoting the mineral sector until the year 2000: *Scenario A (optimistic)* - economic development becomes one of the priorities, provided that inflation is kept under control; this implies a higher consumption of aggregate minerals, and also metallic and non-metallics for the expansion of the infrastructure in general, housing programmes, basic sanitation, new industrial complexes, and so on; *Scenario B (conservative)* - this would mean that mineral production would follow the GDP evolution as in the past ten years (low growth rates); and *Scenario C (pessimistic)* - the government would be able to sustain the present growth rates, as a consequence of multiple problems that could reduce the internal investment and hinder the inflow of foreign capital.

1) The Brazilian Economy

The performance of Brazilian economy from the mid-1960s until the mid-1970s was impressive with GDP growing at an average annual rate of about 8%. The industrial and manufacturing industries grew at rates of 13.2% and 13.9%, respectively (IBGE 1980). These years are frequently referred to as the period of "The Brazilian Miracle". Another important factor in the Brazilian boom during this period is the favorable international scenario, which included significant expansion of international trade by the developed countries and a high level of capital movement.

A significant change in the macroeconomic setting occurred in the second half of the 1970s. Although individual industries were affected differently, overall the rise in world petroleum prices had strong repercussions on the metal consuming sectors. The completion of large public investment programs conducted to modify the balance of payments contributed to internal economic disruptions. Brazil's external debt increased from \$62.8 billion in 1980 to \$121.2 billion in 1991, which in addition to the austerity program and economic slowdown, and reduced foreign private investment triggered by the 1988 Constitution, which confined foreign investment to a minority position in any new mining project have been recent constraints on mineral and other industrial development.

During the period of 1980-1984 the economy experienced a brief period recession, with low GDP growth rates (Table 1). Following this period, the economy again showed growth at historical rates. However, as inflation worsened, a new recessive crisis developed in 1987 and continue until today. The GDP, according to Central Bank estimates, reached US\$ 500 billion in 1993 is now in the 10th in the world ranking, and represents about one third of the Latin American economy.

Table 1- Growth rates by sector based upon annual average variation in the period (%).

Sector	1980-1984	1985-1989
GDP	1.4	4.5
Agricultural	4.0	4.1
Mineral Industry	12.6	3.8
Manufacturing	-0.2	4.0
Construction	-2.4	5.2
Trade	0.5	3.6
Transportation	2.0	6.1
Communications	14.7	15.3
Financial	6.0	1.1
Service and public utilities	8.0	5.8

Source: Anuário Estatístico do Brasil - (IBGE, 1991).

High inflation rates have been one of Brazil's major economic problems in the last twenty years. Four successive economic stabilization plans(1986, 1987, 1989, and 1990) failed in an effort to reverse the situation. A chronic imbalance of the public sector budgets combined with an overall indexation of prices and wages, prevented any measure of inflation control. Recently, the government established the "Real Plan" based upon exchange rates reserves(anchor) and by reducing the global stock of local currency held by the Central Bank. This program also based on a rigid control of public deficit, registered a significant drop in the inflation rates at the end of semester of 1994(average of 2.5% a month).

However, a significant achievement of the results obtained will depend on the new measures such as reforming the taxation system, simplifying the role of the government in the economy, and removing the restrictions of mining activities by foreign firms. These measures should be taken gradually and will involve a long agenda until the next century.

Recent political events in 1994 indicated that in the next presidential term (1995/1998) it will be possible to adopt delicate actions and necessary reforms that will generate a positive impact in the economy as well as in the mineral sector.

The events of the impeachment of the former President Collor de Mello, the Congress Inquiry Committee(CPI) to investigate the Congress Budget Committee together with the political clima of normality that prevailed during the presidential elections indicated that the democratic institutions are mature and consolidate enough to guarantee the necessary changes.

Thus, these actions executed in an agenda that combines favorable external conditions, internal political opportunities and conventional wisdom will have the following aims:

- a) adoption of necessary measures to keep the monetary stability, including a growing autonomy of the Central Bank;
- b) a tight discipline in the budget for reducing the public deficit and severe changes in the budget execution and operation aiming at more efficiency in its use;
- c) reducing the internal disequilibrium between regions and social groups.

These actions demand a progressive economic integration with the world market creating a flow of goods, services, and capital without tariff barriers. This can be achieved by a progressive involvement with the neighboring countries (MERCOSUL-Southern Common Market) after 1995, followed by other countries of South America (ALCSA) and including all the American Continent in the next decade (2005), besides a privileged flow with the European Community. The ^{surplus}surplus balance will not be a necessary condition; the goal now is greater volumes of exchanges and trade.

This integration will necessarily lead to facing some old unsolved problems:

i) increase in efficiency of the productive system including not only the modernization of the private firms which achieved a relatively good success in ISO 9000 certifications, as well as in the modernization of the State through the simplification of overburden procedures and rules (reducing the so called "**Brazil factor**" or "**Brazil cost**"), the modernization of the infrastructure (transportation, energy, telecommunications), and improved labor qualifications.

ii) reduction or even suppressing the role of the government as a producer and replacing it by a less regulatory agent to improve their market efficiency increasing the level of exchange economy and an active agent in the grant economy and the execution of public services.

iii) tax reform to increase the public revenue through the expansion of the tax base (i.e. increasing the number of tax payers) simplifying tax collection and reducing tax avoidance without increasing the real levies. Equitable distribution of responsibilities between the Federal Administration and the States and Counties by decentralizing functions is also necessary.

iv) eliminate barriers to entry and abolish the restrictions for foreign capital and adoption of flexible forms of State monopolies.

These changes will provoke specific effects in the mineral sector that will be examine forthwith. *em seguida*

2) The Mining Industry

A new operational environment has an adjustment period, when some negative aspects may occur. The reduction of import tariffs in 1990 generated some of these impacts and forced the Brazilian mining companies a restructuring process to remain competitive. These process pushed the companies to improve their operational conditions and make them well prepared for the years to come.

The mining industry in Brazil is big and diversified and its share of GDP has been historically around 2.5% (Table 2).

The official data does not include an underground economy of 30-40% generated not only by tax ^{outflow} avoidance, but by the lack of tax mechanisms to reach certain productive activities. For example, considering the mineral sector, the consumption of underground water for irrigation or domestic consumption is not taxed or even included in the statistics. The same situation happens to other minerals used in the housing construction. It is possible that with a better-structured system of national accounting the mineral production would reach a value of US\$18-20 billion.

Table 2 - Mining sector share of GDP in Brazil (US\$ billion)

year	mining production(1)	production of mineral sector(2)(*)	GDP(3)	1/3	2/3	(1+2)/3(%)
1980	5.0	57.0	237.0	2.1	24.0	26.1
1981	6.5	62.0	285.0	2.2	21.7	24.0
1982	6.8	69.0	296.0	2.3	23.3	25.6
1983	7.2	49.0	210.0	3.4	23.3	26.7
1984	9.8	53.0	211.0	4.6	25.1	29.7
1985	9.3	57.0	220.0	4.2	25.9	30.1
1986	7.3	65.9	263.0	2.7	25.0	27.8
1987	8.9	83.5	326.0	2.7	25.6	28.3
1988	8.4	100.0	380.0	2.2	26.3	28.5
1989	9.0	130.0	483.0	1.8	26.9	28.7
1990	9.5	140.0	478.0	1.9	29.3	31.2
1991	11.5	110.0	412.0	2.8	26.7	29.5
1992	12.2	124.0	425.0	2.9	29.2	32.1

(*) including metallurgy plants, ironworks, fertilizers, cement and petrochemical industry in the statistics.

Brazil has been a leading producer of iron ore, ferroalloys, aluminum, bauxite, tin, manganese, niobium, asbestos, fluorspar, magnesite, kaolin, talc, and dimension stones in the last decades. Brazilian exports of non-fuel minerals and related semifinished products are in the range of US\$10 billion annually; the destination is Western Europe, North America, Japan, the Pacific Rim, and also Latin America. For the domestic market, Brazil has an impressive output of crushed stone, sand, and gravel, clays, and limestone. Yet, the Amazon region continues to be one of the least known tracts of the world, mainly because of the tropical rain forest cover.

The comparison of the Brazilian mineral production with the selected world mineral production (table 3) permits us to evaluate the size and importance of mining industry.

Table 3-Ranking of the Brazilian mining production in 1993 in selected minerals (values expressed in 10⁶ tonnes).

	world	Brazil	rank	%	trend
oil ¹	3169.7	33.0	18	1.0	=
coal	4500.0	4.5	-	0.1	↓
natural gas ²	1838.7	-	-	-	
steel	725.3	25.2	9	3.4	↑
iron ore	938.0	155.0	3	16.5	↑
aluminum	19.6	1.1	6	5.6	↑
bauxite	113.0	11	4	9.7	↑
cement	1396.0	31	9	2.2	↑
lime	141.0	5.8	6	4.1	↑
kaolin ¹	26.5	0.91	4	3.4	↑
phosphate	117.0	3.5	8	3.0	=
manganese	19.5	1.5	5	7.7	↑
gold ³	2281	75.7	7	3.3	↑
magnesite	14.7	0.9	6	6.1	↑
chromite	9.9	0.3	7	3.0	=
talc	8.8	0.48	6	5.4	↑
tin	0.116	0.027	2	23.2	=
niobium	0.014	0.011	1	80.1	=

(1) 1992 (2) tonnes of oil equivalent(tonne) (3)tonnes including "garimpo" output

↑ = upward trend = stable ↓=downward trend

data source = Mineral Commodity Summary(several), Sumário Mineral-DNPM(several), Metals & Minerals Annual Review (1994).

Alôá disse
Beyond the productive base indicated previously (Tables 2 and 3) it is worth mentioning some relevant aspects that provide a sustainable support and increase the potential of mineral industry:

- the Brazilian trade balance of minerals and manufactured products based upon minerals

reaches a volume and a diversification of products and countries that represent a complete experience in all stages and routines related to international trading. The exports in 1992 reached a volume of US\$ 5 billion including 38 items, mainly from iron ore US\$ 2.3 billion and aluminum US\$ 1.2 billion. The imports reached US\$ 4.6 billion with 37 items, mainly from oil US\$ 2.6 billion, coal US\$ 685 million, copper US\$ 422 million, potash US\$ 264 million and aluminum US\$232 million ;

- the control of technological skills of mining and ore treatment reached a good level of maturity and a wide range of applications, so that the country can easily deal with the adjustments for exploitation of any size class and kind of mine. New processing technologies can be easily absorbed. The industry has the technical capabilities and material conditions to produce internally all kinds of equipment required by the mining industry as well as great managerial entrepreneurship. The same framework can be extended to the labor training and education to meet all the demands of the mineral sector;

- on the consumption side, there is an enormous political interest to better reach the most vulnerable groups in society. A large contingent with a small rising level in their income has prompt psychological and cultural conditions to incorporate industrial and sophisticated products and services thus enlarging the domestic market. There is a significant deficit of housing and infrastructure which means a great demand for products of mineral origin.

Based upon this framework it is possible that the commodities described below show the following general trend:

Oil: The adoption of flexible forms of State monopoly will permit Petrobras to intensify the joint ventures and contracts with the private sector multiplying its enormous investment capacity. We estimate that approximately US\$ 10 billion in projects are now being examined for investments in the refining, transportation, oil tankers, pipelines and storage of oil and gas.

Coal: Although Brazilian reserves are large, the quality of coal cannot compete with foreign sources for metallurgical use. The coal for electricity generation could be improved with the privatization of the utilities sector and integration with the Mercosul.

Uranium: Brazil possesses a good level of uranium reserves. The use of these resources under the government monopoly will not show great perspectives for a change in the near future, even bearing in mind the presence of good deposits as yet underdeveloped. The possibilities of the completion of Angra 2 nuclear plant by the year 2000 are very small, considering the need for investments of US\$ 1 billion and the unfavorable historical events of former nuclear plant (Angra 1) and also the public mistrust in nuclear power generation in the international context.

Steel: This is a fully privatized sector that has been used as a strong argument to encourage other state-owned companies to follow suit. The steel production in 1994 was of 25.8 million tonnes representing a growth of 2.3 over the previous year. The new privatized companies showed a good performance and good profit margins. The majority of firms adopted expansion plans indicating that by the year 2000, Brazil will be ranked as a world leading producer (8th position).

Iron Ore: The Iron Ore Quadrangle, located in Minas Gerais State, is still increasing its

output, possibly reaching 200 million tonnes of iron ore by the end of this century. However, the successful newcomer indeed is Carajás, jumping to an output of 55 million tonnes of iron ore from zero in 1985. The reserves of high grade ore are about 18 billion tonnes. In addition, Carajás metallogenetic province is proving to be rich in manganese, nickel, tin, and tungsten. The state-owned CVRD is responsible for expressive share of production which include not only iron ore deposits, but also railroad, ports, and ships (1994 sales of iron ore reached 100 million of tonnes). There is a strong trend to include the CVRD in the privatization plan of the new government. Privatization and increased access by the private sector can restore efficiency by increasing competition. Freed from mineral production and the administrative drain caused by public-enterprise problems, the government can concentrate on those actions that are best suited to the public sector in mining: the provision of infrastructure for mineral investments and to help develop human-capital resources.

Aluminum: Bauxite is being produced mainly in Trombetas district, also in the Amazon region, and will reach 12 million tonnes in year 2000. The reserves are abundant, estimated at 1.5 billion tonnes, and located in sparsely populated lands, well endowed with cheap hydroelectric power in the neighborhood. Brazilian exports of aluminum are presently in the range of US\$ 1.1 billion per year; bauxite exports are valued at US\$ 120 million, and alumina exports one fourth of that. In 1995 a new alumina refinery (Alunorte) is due to beginning operation that will reach in 1997, 1.1 million of tonnes. This new plant is a subsidiary of CVRD like the MRN. This sector could also be privatized and the new partners can give a new dimension in the programming expansions.

Cement: The cement industry as well as the aggregate sector will be solicited in the new government to provide low costs to gradually reduce the housing deficit. The reduction of government intervention in the real state business (mainly in the home lease policy), the deregulation of market and reduction of imports duties of cement to balance the Brazilian private oligopoly could create the conditions for a significant growth in the cement industry.

Kaolin: Another good surprise in the Amazon region is high grade kaolin, found in Jari district (once the El Dorado of Mr. Daniel Ludwig, the famous billionaire who died a couple of years ago), and also in Capim river banks, south of Belém, capital of Pará State. Anchored in quite abundant reserves, Brazil is rapidly boosting its exports of processed kaolin, mainly for the consumption of the paper industry all over the world, and may reach 2.5 million tonnes in year 2000. This is really an accomplishment, especially in view of the fact that some decades ago only England and the US had a place in the sun in this exclusive market (Machado et al. 1994).

Tin: The best tin district is Pitinga, in Amazonas State, discovered less than 20 years ago and responsible for the tremendous success of Brazil in the international market, thus putting some pressure on traditional suppliers. To make things worse for the competitors, another rich deposit was discovered some years ago in Rondonia state (Bom Futuro) close to Bolivian border, and mostly exploited by diggers and subject to smuggling. As Brazil is not a member of ITC, there has been a lot of pressure aimed at reducing Brazilian output of low cost concentrates and consequent flooding in the international market.

Niobium: Niobium has a very peculiar position in the Brazilian mineral sector. This country is endowed with 85.8% of the world niobium reserves and 80% of world production; the other countries with significant reserves are Canada, Nigeria, and Zaire. The huge reserves found in Araxá-Tapira district (Minas Gerais state) support an yearly export of Fe-Nb alloys

that surpass US\$ 100 million in value; there are also exports of high purity Fe-Nb alloys, Ni-Nb alloys, niobium oxide and niobium(metal). In spite of the efforts spent by the major producer-CBMM(a company jointly owned by Moreira Sales group and Molycorp)-in increasing the consumption of niobium, there are some fears in industrialized countries that CBMM could exert a monopolist control over this market. It seems possible that the future development of new Russian projects could bring some benefit to Brazilian producers, a rather unique case of positive competition in favor of a solitary supplier.

Gold: Monetary stability and economic growth will lead to the production of "garimpos" being restricted to high grade deposits. In 1994, for the first time the industrial production is higher than the "garimpo" output. The actual exchange rate(1R\$ =0.86 US\$), the levels of gold price and the new job creation helps the reduction of "garimpo" share production. The potential of gold is far from being fully known and good prospecting campaigns can generate good results.

3) Prospects for the Future

During the year 1994 the Departamento Nacional da Produção Mineral-DNPM, the federal agency in charge of formulating the Brazilian mineral policy, devised a comprehensive plan for promoting the development of the mineral sector ("Plano Plurianual para o Desenvolvimento da Mineração Brasileira"); this task was accomplished with the active participation of 25 working groups, including experts from industry, academia and government.(DNPM 1994)

As a new government approaches three different scenarios were envisaged:

Scenario A (optimistic): provided that economic development becomes one of the priorities, this would obviously imply a higher consumption of aggregate minerals needed for the expansion of the infrastructure in general (power plants, road networks, railways, waterways, ports, communication networks, etc.), housing programmes, basic sanitation (water treatment, sewage treatment, waste management), new industrial complexes, and so on. The consumption of metallic and non-metallic minerals would substantially grow as well.

Scenario B (conservative): a conservative scenario would mean that mineral production would follow the GDP evolution in a more or less linear fashion. The study revealed that aggregate minerals output should grow at the mean rate of 4% per year in the period 1993-2000. For export minerals (iron ore, aluminum, manganese, ferro-niobium) the mean rate should be lower, more likely 2% per year.

Scenario C (pessimistic): The worst scenario would be one that the government could not sustain the present growth rates, as a consequence of multiple problems in the federal budget, increase of tax avoidance, fast growth of the invisible economy, lack of harmony between the Executive power and the Congress, disarray in the government administration and bureaucracy, return to high and uncivilized inflation rates, and scarcity of foreign investment flows. In this case, the growth rates of mineral production would be lower

than in scenario B, or even negative.

A recent study accomplished by these authors to DNPM about the future scenarios for the Brazilian mineral sector took into account that:

Economic Climate

The international climate is becoming more and more competitive among companies and among nations, in pace with the trends of the global economy at the end of this century.

Countries like the US and Canada are ^{struggling} struggling to keep their position in the international mining industry through improvements in productivity, cost reduction, technological innovations, and their ability to comply with the increasing demands of both severe and costly environmental legislation and procedures.

This burden is pushing North American and European companies to LDCs, where the legislation is less severe, incentives to foreign investment are being offered, and, last but not least, the widespread occurrence of virgin reserves (higher grades and other physical features) brings a clear competitive advantage *vis-à-vis* mature reserves found in industrialized countries.

Even though regional blocs will play an important role in the design of international trade, it is quite acceptable that world-class deposits will ignore the geographical boundaries of such regional blocs, as they represent the best opportunities for export even for long distance markets.

While more than 70 countries, many of them in Latin America, are making their mineral legislation and policies more flexible with an aim to attracting foreign investment, Brazil is still lagging behind due to "political imbroglios" and small politics which hinder the governance of the country from taking the right path.

Mineral Legislation

There is a strong pressure for Brazil to change its legislation in a direction which would allow foreign companies to be wholly-owned either for exploration or for mining activities, if they want to. The amendment to the Constitution of 1988 should come out in favor of foreign capital without much discussion, at least this is our present perception.

Similarly, it is expected that mineral taxation will follow international standards, so that Brazilian exports will not be penalized by the unfair rules that are prevailing today. This is the only way that Brazil might assure its place in a competitive and dynamic market. Some studies have been conducted and point into this direction.

Environmental Control

The Brazilian environmental legislation is improving as time goes by, but there is some criticism from the industry that federal and state jurisdictions are conflicting in many examples. In addition, the lead time of a project is often stretched too much because of slow

procedures or lack of good will from government officials.

It must be recognized, however, that Brazilian legislation is still very friendly to the investor, lacking the hard constraints presently adopted in the US and Canada against the mining companies, regarding reclamation and closure plans, just to mention one example. There is a strong tolerance for water and air quality in the mine site. There is nothing similar to the Superfund programme, for instance. Enforcement is rather an exception, not the rule, for cultural reasons. It will take some years before the government authorities will impose strict rules and procedures upon the mining industry regarding the environment.

An outlook of the major mining districts until the year 2000 is shown as an exhibit of this paper.

4) Final remarks

A recent survey made by Mining Journal(1994) ranking Brazil in the 13th position behind countries like Venezuela, Bolivia, Cuba, Mexico, Ghana, Guyana, Argentina, Indonesia and Surinam. This kind of classification seems to be very biased around some financial and quantitative indicators that do not reflect many important aspects that could be considered in a mining investment. Some of them are mentioned below:

- The resource base is one of these aspects. Brazil has enormous mineral wealth that still largely unexploited. The size of 8.5 million km² (3.3 million of square miles) and difficulties for geological survey in some areas does not make it an easy task, but with adequate financial resources there is plenty of technical and scientific capacity to execute this job. The government branches related to the mineral sector are in the re-engineering process to offer better basic information to stimulate the discovery of new mineral deposits.
- The Brazilian economy is one of ten leading economies of the world acting in the major industrial sectors and great level of competitiveness. The stiff economic reforms(cutting public spending) and the replacement of state protectionism with import liberalization and privatization of several sectors will conduct the Brazilian economy to be more open and interact in the world scenario.
- Brazilian society has western cultural characteristics and high degree of multi-racial absorption. The populational growth rate is moderate and is in equilibrium with economic growth and the sustainable development projections.

These aspects mentioned above and the mature stage achieved by the mineral industry in Brazil show in this paper together with the expectations of reducing the inflation and the disequilibrium in the income distribution, Brazil will be considered one of the best emerging markets for investments in the mining sector, remaining behind only when its geological wealth is not adequate for selected minerals.

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References

DNPM. 1994. **Plano Plurianual para o Desenvolvimento do Setor Mineral**. Brasília(DF), 102p.

Mining Journal. 1994. Emerging Markets, special supplement n.8295, vol.323, sept.30,1994, London,UK

Machado,I.F.; Bordonalli,S.P. and Hegenberg,F.E.N.1994. Virgin versus mature reserves: A dilemma for new investment, **Raw Materials Report**, n.10, vol.1, p.8-16.

OUTLOOK OF MAJOR MINING DISTRICTS IN BRAZIL

DISTRICT	MINERALS PRODUCED	PRESENT PRODUCTION (per year)	PROJECTION TO YEAR 2000	NOTES
Iron Ore Quadrangle	Fe, Au, Al, Mn	150 million tonnes of iron ore ca. 10 tonnes of gold	250 million tonnes of iron ore 12-14 tonnes of gold	Reserves of high grade Mn ore already exhausted; there are more than 5 million tonnes averaging 25-30% Mn
Carajás	Fe, Mn, Au	36 million tonnes of iron ore 350,000 tonnes of Mn ore 5 tonnes of gold	45 million tonnes of iron ore 800,000 tonnes of Mn ore 20 tonnes of gold	In Salobo copper project there will be 7 tonnes of gold/year as by-product; there is also potential for nickel, tin and tungsten
Trombetas	Bauxite	8 million tonnes	12 million tonnes	Reserves of 1.5 billion tonnes
Pitinga	Cassiterite, tantalite	7,000 tonnes of Sn	Over 50,000 tonnes of Sn (including Rondonia district)	Production will continue for decades as a world-class deposit
Rondonia	Cassiterite, Au, diamonds, tantalite	14,000 tonnes of Sn 60 tonnes of tantalite	(See Pitinga district)	It is likely to exist 2 kimberlite districts with good potential for diamonds (Machado and Pimenta Bueno districts)
Jari	Kaolin, bauxite	476,000 tonnes of kaolin 92,300 tonnes of refractory bauxite	750,000 tonnes of kaolin 140,000 tonnes of refractory bauxite	Reserves are estimated to be 250 million tonnes of kaolin, but of lower quality than those of Capim district
Araxá-Tapira	Phosphate rock, Nb, Ti	2 million tonnes of phosphate rock, 27,000 tonnes of Fe-Nb	Probably stable Ditto	The joint venture CVRD-DuPont (60,000 tpy of TiO2) did not go ahead due to technological problems
Araci	Au	6 tonnes of gold	7 tonnes of gold	The reserves are estimated to be 100 tonnes and are controlled by CVRD and CBPM (Bahia state)
Corumbá (Urucum)	Fe, Mn	200,000 tonnes of iron ore 250,000 tonnes of Mn ore	1 million tonnes of iron ore 300,000 tonnes of Mn ore	Growth potential limited due to its geographical position, except by future expansion of Mercosur market

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DISTRICT	MINERALS PRODUCED	PRESENT PRODUCTION (per year)	PROJECTION TO YEAR 2000	NOTES
Coal Basins (Southern states)	Coal, pyrites	4 million tonnes of coal	?	Growth potential hindered by high ash content and serious environmental degradation
Tapajós	Au	10 tonnes of gold (estimate)	?	This is the largest gold province of Brazil, exploited solely by diggers; there are some mineralized pre-cambrian granites in this region; however, no detailed exploration so far
Roraima	Au, diamonds	5 tonnes of gold (estimate) 20,000-30,000 ct	? ?	The future of this district will depend on policies to be adopted in relation to aboriginal lands and "garimpeiros"
Capim River*	Kaolin	Development stage	2 million tonnes of processed kaolin	The deposits are world-class; its potential is far superior to those of either Georgia or Cornwall
Sels Lagos*	Nb, Ti	Preliminary exploration	?	The production of niobium in Brazil has been hindered because of surplus reserves found in just one country, raising fears of monopolistic control

* Potential mining district

This chart was set up by J.H. Grossi Sad, I.F. Machado, S.B. Suslick, and S.P. Bordonalli