

## Geosciences for the sustainability of Brazilian mining

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### Summary

Since the arrival of Europeans in Brazil 500 years ago mining has left a mixed legacy: positive, in its importance to the national economy, and negative, in its environmental impacts. Scars from early impacts can be seen in areas of intensive mining, merging with new ones. The present main impacts are: deforestation, pollution of surface and groundwaters, acid drainage, landscape degradation, air pollution, conflicts with other land uses, social impacts. Brazilian mining is divided between organized and unorganized mining (small sand pits and quarries and "garimpos"), with an extensive but confuse legislation and a deficient licensing and enforcing system. Proposals are presented to make mining sustainable, being the main ones: rationalization of the legislation and of its enforcement; establishment of fiscal incentives for mining; establishment of real warranties for rehabilitation of degraded areas; support to recycling; research and diffusion of environmentally sound technologies; better communication with society; insertion of mining as a legitimate land use in municipal planning and participation of the University in research and training for sustainability.

### Introduction

Since the arrival of Europeans in Brazil 500 years ago mining has left a mixed legacy: positive, in its importance to the national economy, and negative, in its environmental impacts. Scars from early impacts can be seen in areas of intensive mining, merging with new ones.

From the point of view of mining technology, and particularly of the study and control of the environmental impacts caused by it, the history of mining in Brazil can be understood as superimposed models, with the predominance of one or the other in some historical periods, without however the most primitive models being annulled by the more developed ones. As in many other cases, such as of the land tenure policy, the history of mining in Brazil tends to repeat itself, with more complex models substituting the simpler ones in some points of the territory, while in others the cycle is just beginning.

These are the models of mining in Brazil:

- a: small mines, with inadequate technology;
- b: large mines, with inadequate technology;
- c: mines with adequate extraction technology, but without environmental control;
- d: mines with environmental control.

What is here considered adequate extraction technology includes, at least, ore deposit evaluation and mining project using geological and mining engineering principles, followed by the execution of the project with professional supervision. Until the eighties, environmental control of mining was almost nonexistent, and still is little and

inefficiently applied, even when there exists an Environmental Impact Study.

### Environmental impacts of mining in Brazil

The environmental control of mining and the reclamation of degraded areas are not priorities in Brazil. Even the CVRD, pioneer and leader in the application of environmental control and reclamation, when controlled by the Federal government, destined only US\$ 20.744.500,00 to these activities in 1989. Compare this with the US\$ 2,344 billion export revenue of the company and the US\$ 734,5 million net profit in the same year. Neither mining nor, consequently, its environmental control are priority for the Brazilian government, in none of its levels. The consequences of this disregard are:

- 1) the division of mining into two segments: that of **organized mining**, that pays taxes, builds up an infrastructure used for the development of the area where it settles, pays wages, provides reasonably safe working conditions and assistance to workers, and is progressively adopting environmental control and reclamation of degraded areas and that of the *garimpagem*, with its pitiful working conditions, exploitation of workers, destruction of mineral reserves, environmental degradation and, frequently, association with crime.
- 2) the persistence of rudimentary technological models of mining, leading to predatory extraction and environmental degradation, even in mines operated by organized and properly legalized companies.
- 3) the impacts of mining affect the entire country. Although they degrade smaller areas than agriculture and construction, mining can produce in Brazil:
  - deforestation, contributing to the reduction of plant and animal biodiversity and loss of the fertile layer of the soil;
  - mining scars, sometimes of great extension and depth, causing more serious problems when they affect urban areas, as in the *garimpo* in Poconé and in some areas mined for construction materials;
  - pollution of surface waters by sediments or by toxic effluents, mainly mercury used for gold recovery;
  - the tailings of all ores extracted prior to the mandatory environmental control, and of many not controlled after it, continue to pollute waters, soils and air, notably the acid drainage of tailing dumps of coal mines of southern Brazil and the pollution by lead sulfides, such as in the Ribeira River valley.
  - alteration of the amount and quality of groundwater, whose control and reclamation are much more expensive and complex than that of surface waters;
  - destruction of dunes for construction sand in the

Northeast and industrial sand in the Southeast

- air pollution by dust or gases from processing plants;
- social impacts, larger when they reach peoples of cultures very different from the contacting one, as has happened with the lanomami indians of Roraima.

The degradation by mining can be important in urban areas, where each degraded square meter would be precious for residential or industrial use or for urban infrastructure. The obligation of reclamation of degraded areas is recent and still not totally applied. The absence of a performance bond allows the miner to escape his obligations by abandoning the area or by bankruptcy of the company.

On the other hand, the lack of municipal planning of land use eliminates the feasibility of mining areas that could first be mined and later used for urbanization. Thus construction minerals, mainly sand and clay, must be transported from distant areas, elevating freight costs, which account for the largest portion of their price.

The environmental and mining laws in Brazil are part of the problem, and not the solution. First, legislation is very complicated. At the same time, some fundamental legislative initiatives have not been implemented, such as:

- regulation of Article 23 of the Federal Constitution, that specifies the common competence of all levels of government for the protection of the environment and for registration, enforcement and fiscalization of the concessions for exploration and exploitation of mineral and hydraulic resources in their territories.
- establishment of real warranties, like performance bonds, which are the only efficient way to guarantee the execution of projects of environmental control and reclamation of degraded areas.
- mandatory inclusion of mining in Municipal Development Plans
- regulation of mining in native reserves, where at present mining is both prohibited as legalized activity and tolerated as *garimpo*;

Second, law enforcement is deficient. The National Department of Mineral Production remains without material and human resources and without political support to perform with minimal efficiency. A great part of its personnel struggles to do whatever is possible with what little is available. The computerization should be commended, which allows access to the mining law and statistics through the Internet (address <http://www.dnpm.gov>).

Other government functions relative to mining are in a worse state. The fiscalization of the mineral patrimony and of the environmental and working conditions of mining, also attribution of the DNPM, is extremely deficient. The geologic surveys are executed very slowly by CPRM, which is also affected by the scarcity and irregularity of funding.

In the environmental area, the fiscalization of mining is also an attribution of the environmental control agencies of the Ministry of the Environment and of the state governments.

There are a few effective efforts of fiscalization, control, research and support to miners. The governments change, or the pressures of the polluters increase and the activities are discontinued.

Even in the rare occasions in which the several agents execute their functions, it lacks coordination among their actions. The number of institutions that have or judge to have attributions over mining is frightening. In a study made by the Regional Council of Engineering - CREA-SP on sand mining, 18 different institutions were identified as related to mining in riverbeds in the São Paulo Metropolitan Area.

In this insecure environment, part of the fiscalization actions are done by the State Attorneys and by NGOs, using the Law of Public Civil Action. In some cases, at least, this action seems to have larger effects of intimidating and increasing the costs for law abiding miners than in increasing the enforcement of the environmental law. The determination of the law of placing the informer NGO as a party in the lawsuit is not enforced. This favors the groundless accusation, which is aided by not being mandatory a technical inspection before the proposition of the lawsuit, even in cases in which a preliminary sentence is asked. This can be granted and a mine be paralyzed without crime. Until the situation is cleared, which can take much time in Brazil, the mine will remain shut. The contrary also happens. In cases of obvious ecological crime it is possible to a guilty and well advised company to drag a process for years, without any punishment.

In most cases the municipal governments, that have the attribution to administrate the mineral patrimony in relation to construction materials, are not equipped nor give importance to mining. Except for some state capitals and a few municipal governments, mining is neither regulated nor included in plans as a legitimate land use. Municipal action only happens to prohibit mining, in cases when the conflicts on land use become insoluble.

Therefore it occurs in Brazil a contradictory situation. It is easy to do criminal mining, either of the point of view of the mineral patrimony that is appropriated without due concession, or of the environmental one. At the same time, for an operator mining according the regulations, everything is difficult, beginning by knowing which regulations to follow. He needs to obtain authorizations and licenses of federal, state and municipal organs, whose applications can wait years to be appreciated. Even a concession does not assure him safety. His claim can be invaded by *garimpeiros*, without the State guaranteeing his rights or even his life. He can suffer fines or closing, to incur in costs and to have difficulties for his defense, even operating conformable to law. His costs will consequently be larger than those of his unlawful competitors.

It is not surprising that the expected "investment boom" did not happen here, even having Brazil great potential for large size and high grade deposits. The main reasons are insecurity in the ownership of the mines, restrictive

legislation, bureaucratic difficulties and absence of reliable basic data in scales adequate for prospecting and exploration. For the national investors it is difficult to decide for a long term investment, especially with the current interest rates, that turn negative the liquid present values of almost all the investment analyses.

### Proposals

Mining is necessary to Brazil. More than this, it is important that mining works correctly, to meet the needs of a large and growing population, in an area lacking infrastructure and at the same time it continues to produce export surplus revenues. However, it is not desirable a disordered increase of production, without environmental control or reclamation.

Sustainable development should be sought in mining, even if it is difficult to apply this concept to nonrenewable resources. If it is applied the classic Brundtland definition the sustainability in mining is impossible, because any use of a mineral commodity reduces its resource base (totality of the existent mineral substance), because the mineral substances are not renewable. The sustainability of the nonrenewable substances is reached when its consumption is the same or smaller than the generation of substitutes and, at the same time, the problem of the residues produced by its production and use is controlled.

The international guidelines do not help much. Mining is almost unknown in the Agenda 21. It is rarely mentioned, and almost always as a polluting agent. Almost nothing is told about its role in supplying raw materials to assure human life on Earth. It is repeated here, in the international level, and among environmentalists, the mixture of ignorance and disdain for mining that appears in the Brazilian politics. The Agenda specifies numerous institutional measures for sustainable development. It appears here the basic incoherence of the Agenda: while in many points the local initiative is praised, many detailed measures are proposed, turning it impossible to execute those details and to have some local initiative.

The Brazilian Ministry of the Environment developed a work program for application of the Agenda 21 principles to mining in Brazil, whose results are presented in the "Environmental Guidelines for the Mineral Sector". These guidelines seem well done and applicable, since support is given to the technicians and companies disposed to follow them. In summary, these are the guidelines:

- 1 - Maintenance of agile, integrated and efficient legal, normative and institutional mechanisms for licensing, monitoring, and environmental fiscalization in the Mineral Sector.
- 2 - Internalization of modern concepts of Environmental Administration and of environmentally compatible technologies in the processes of extraction, processing and use of Mineral Resources.
- 3 - Maintenance of the knowledge base, formation and conscientization of human resources who make

possible environmental planning and administration in the mineral Sector.

With the guidelines come a large number of programs, actions and recommendations. Some of them should be emphasized:

- Definition of competencies, unification and organization of the process of environmental licensing in the mineral sector
- establishment of real warranties for the rehabilitation of degraded areas;
- implementation of appropriate economic instruments to modern systems of environmental administration;
- to implement ways to support recycling;
- to encourage, to diffuse and to induce the use of new technologies for the environmental control and reclamation in mining;
- implementation of joint actions for the reduction of clandestineness;
- demonstrative projects for the regulation of the activities of *garimpo* and of extraction of sand;
- implementation of fiscalization campaigns in areas closed to mineral extraction.

These guidelines, are well elaborated and realistic, and their proposals contain much of what it is consent among those who work seriously in the mineral sector in Brazil. However, it should be noted:

- their execution will demand a nonexistent coordination among the several government levels and between them and the private sector.
- the sources of the necessary resources are not declared for their implementation.
- it is worrying the treatment, in the same program, of *garimpo* and sand extraction. It reveals a disposition to deregulate the extraction of sand, which would be disastrous for the urban areas where it happens.

- there is an almost total absence of the academic community, both in the elaboration of the guidelines and in the forecast for participation in the implementation. Is the Brazilian University so remote from the mineral sector?

The sustainable development in mining does not depend exclusively on the mineral sector. The more efficient measures for the reduction of the exhaustion of resources and of the environmental impact of mining are those destined to decrease the use of mineral commodities. The production of more durable consumer goods, the reuse and the recycling, the rationalization of use, as well as the substitution by renewable resources, have larger effect than the actions taken inside the mineral sector for the sustainability. These internal actions are also important. The rational working of the deposits, that includes their correct evaluation, the control of environmental impacts and the reclamation of the disturbed areas, is fundamental for the best use of the resources and the integration of mining with other land uses and with the other sectors of economic activity in the search of sustainability.

How to arrive there?

It is necessary to exist a political will, in the highest level, to appropriate resources for the survey of the conditions of Brazilian mining and for the concrete planning of its development, followed by measures to implement it. This will does not exist now.

It is necessary an effort of all components of this sector to show the importance of mining and of its associated areas, as those of geologic and environmental survey. This demonstration will only be achieved if the isolation between the mineral sector and the society be broken. The chronicle of communication of the mineral sector is extremely negative. Mining is considered by the environmental agencies, NGOs and the general public as highly polluting, without its role being recognized as one of the most important bases of the economy, depending on mineral inputs the activities responsible for nearly a third of the Gross Domestic Product - GDP. This fraction used to be presented in the Mineral Yearbooks and Summaries of the DNPM. Not even there it is presented now. The dominant public perception is that mining is an activity of little importance and highly polluting, a perfect target for legal restrictions and budget cuts.

When a political will exists the results are immediate, as shown by the recent history of the Brazilian mineral sector. Even without a total reorganization of the sector, some concrete measures are necessary and possible:

- rationalization of the legislation and of its enforcement, allowing to the miner to know what should he do in relation to the mineral patrimony and to the environment, and facilitating his legalization, under the orientation of trained professionals of the control agencies, that also should have political support for efficient enforcement actions.
- enforcement and orientation activities to assure that environmental documents (EIS, Environmental Control Plans) contain reliable data, that can be used for regional-scale studies, and that the plans propose feasible activities. Particularly it would be necessary to enforce the need for a professionally conducted deposit evaluation, without which all mining and reclamation plans are fiction exercises.
- the establishment of fiscal incentives for the mining activity, compensating its disadvantages in relation to other investments, as the long term maturation and the risk, that is high for the low grade minerals.
- to establish real warranties of reclamation of the disturbed areas, as part of the licensing documents. The value foreseen for such costs should be object of a performance bond, a real warranty, like a bank letter, an insurance policy, a caution in money or a real state collateral. Part of the resources immobilized as warranty would be returned to the miner after each phase of reclamation be completed; the remaining would be returned only after final reclamation.. This is the only way to really assure reclamation; without a real warranty the door remains open for abandonment of the area, bankruptcy of the company and a rich and free owner.
- the insertion of mining as a legitimate land use, in the municipal managing plans, after a study of the mineral

potentiality of the territory. Without this planning, at the same time mining destroys areas necessary for other activities, and areas with high mineral potential are made unfeasible for mining by permanent uses.

The University has important functions to fulfill for the development of the mineral sector and some of them are its prerogatives. It should develop research, together with public and private institutions or by its own initiative, in this case the most valuable for its independence. The University personnel can consult for the mineral sector, provided it does not become their main activity, and not allowing that the dependence of contracts turns the University an uncritical appendix of the government or of the companies. Nevertheless, it is education the main and untransferable attribution of the University.

The author identified three attitudes in the activities of the environmental professionals: the knowledge of nature: search for the basic data on the Earth and of their relationships, without immediate economic objectives; the domain of nature: application of knowledge for the use of Earth resources; the integration with nature: with knowledge supporting the efforts for maintenance of humanity on Earth in sustainable bases.

According to the historical moment, each of these attitudes is privileged. The Greeks valued the knowledge, the industrial revolution demanded the domain; its consequences urge the integration with nature, under pain of destruction of humanity. It is not enough now to educate a scientist or a technician. Although these parts should be developed in the professional of the environment, it is fundamental to develop in him an attitude of respect to the human beings and to the other beings, animate and inanimate. The best way to develop this planetary conscience (ecologic? holistic? integrated?) is the involvement of the student, as early as possible, in actions for the defense, the rational use and the recovery of the environment.

The mining professional (geologist, mining engineer) cannot be just a technician. He must be a professional of the environment, being an obligation of the University to help him to develop his planetary conscience. At the same time, it should contribute to develop his political conscience, enabling him to defend his ideas. When there is a need to a political will to take measures for the development of mining in sustainable bases we cannot just hope that it develops spontaneously in government. The conscious professionals should act to disseminate the understanding of the importance of rational mining. It is necessary to break the isolation that mining and Geology have been keeping from the whole of the population. The concerned population will have conditions to demand a mineral production that meets its needs without destroying the environment. This is the fundamental, although not enough condition, for a change in the attitudes of the administration and of the productive sector in relation to mining.