

## CHAPTER VI CONCLUSION AND RECOMMENDATION



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Investigation for the development of the Ribeira area was made with emphasis on the following four points: (1) Drafting the development plan for mining and dressing of the new deposit discovered in the Perau area, (2) Organization of infrastructure associated with the development, (3) Evaluation of mine development in relation to the development of the new deposit, and (4) Redevelopment of the mines under operation in the Ribeira area.

### (1) Conclusion

#### 1) Mine Development

Mining of the new deposit was planned for operation based on assumptions such as a mine life of 10 years, an annual production of crude ore of 90,000 tons (7,500 tons/month) and a vertical shaft transportation system.

Dressing was planned for differential flotation of lead, zinc and barite. All the tailings will be deposited in the tailings pond for the purpose of prevention of environmental pollution.

#### 2) Organization of Infrastructure

Investigation and design were made into details of the plan for transportation, water, electric power, manpower and mine camp site.

#### 3) Overall Evaluation

The economical analysis showed that the development of the new deposit is advantageous for the economy of Brazil even if the international metal price in concentrate produced goes down by 10 % from current levels. This leads to the conclusion that the development plan should proceed. However, as shown by the financial analysis, it cannot be said that the private sector will invest in the development of the mine, unless the metallic price of concentrates goes up by 20 % of current prices.

#### 4) Promotion of Five Mines under Operation

The investigation showed, all the mines to be behind in exploration. Few mines are operating a systematic method of mining, leading to low efficiency.

### (2) Recommendation

#### 1) Mine Development

Because of many uncertainties in respect to the ore reserve of the new deposit at Perau, it is necessary to plan fill-in drilling between the existing holes at intervals of 30 to 50 m in order to accurately estimate the ore reserve.

Since the new deposit is emplaced at a depth of 150 to 300 m below the surface, a vertical shaft is planned for the exploitation. This seems to be the most suitable method for development of the strata-bound deposit in the deeper part, although it is a little expensive.

Mechanization in exploration, mining and haulage is confined to the least amount because of a relatively cheap labor to mining cost.

Although gravity dressing would be applicable to the ore of the new deposit, the differential flotation method was adopted to recover the concentrates of lead, zinc and barite because of the low recovery rate of the former. It will be necessary to make an additional dressing test, using the drill cores, when drilling for confirmation of ore reserves is carried out.

Because the new deposit is emplaced in limestone terrain, the pH of underground water is about seven and the heavy metals content is low. It will be the same as the waste water from the dressing plant. However, a tailings pond must be provided because the waste water contains some cyanide which is used as a flotation depressor.

## 2) Organization of Infrastructure

Roads in the Ribeira area are mostly unpaved, and many areas are behind in development of electric power and communication. Therefore, organization of the infrastructure will serve to further other industries and will greatly profit local residents.

Mining and dressing operations of the new deposit will require a manpower of 150 to 200, which will benefit nearly 1,000 people if families are included.

The rate of unemployment is increasing in the area because of declining mining operations. The income of municipalities in the area largely depends on the mine product tax. Therefore, development of the new deposit will greatly contribute to the improvement of life of local residents.

## 3) Evaluation of Mine Development

It is regrettable that the financial analysis for mine development is not so satisfactory. nonferrous metals, the Government should encourage the private sectors to tender for development by taking measures such as refund of indirect tax assessed on the materials, mitigation of IUM (mine production tax) tax, reduction of interest rate of governmental financing and expansion of the finance limit.

by taking measures such as refund of indirect tax assessed on the materials, mitigation of IUM (mine production tax) tax, reduction of interest rate of governmental financing and expansion of the finance limit.

Since the new deposit has the largest ore reserve in the area, its development will put new

life into the mining industry of the area where mineral production is currently being reduced, and greatly contribute to employment.

#### 4) Redevelopment of Existing Five Mines

With regard to the existing five Furnas, Penelas, Barrinha, Rocha and Perau, mines it is not practical to establish an overall development plan because they are operated by different companies and because there is a great difference in the ore reserves, as well as in mining and dressing technologies, between the mines.

It is necessary for the companies to stabilize the mining operation by promoting exploration to establish the ore reserves and by introduction of effective technology.

The following proposals are recommended to the mines.

##### a) Perau Mine

Prospecting: Development of the G-4 level and underground drilling are recommended for exploration of the northern extension of the Perau deposit operating at present.

Mining : The pillars should be recovered by the waste filling method because the wall rock is strong enough. For developing the lower part, below the G-2 level, it is preferable to sink an inclined shaft along the ore body and to adopt a skip winding haulage method.

Dressing : The feeding of ore to the new dressing plant to be built at the time of development of the new deposit should be investigated.

##### b) Furnas Mine

Prospecting: The fissure pattern of veins should be investigated to make clear the ore shoot and to apply it to the exploration of the downward extension of the deposit. A geochemical prospect and geophysical survey along the ore bearing horizon is desirable.

Mining: The mining method using waste filling, used at present, appears to be appropriate. It is recommended to enlarge the diameter of the air pipe to raise the efficiency of the compressed air. It is also recommended to use pick hammers in narrow working faces.

Dressing: Experiment and research on dressing of lead and zinc oxide ores is needed.

##### c) Penelas Mine

Prospecting: Since exploration within the mine has almost been completed, it is necessary to carry out exploration for new areas including contact, metasomatic type deposits. A detailed survey of the showings of strata-bound deposits of lead, zinc and barite in the Canoas areas is desirable.

Mining: The mining system is well organized when compared with other mines.

Dressing and Refining: There are no particular comments on the equipment and techniques of these operations but pollution control by proper treatment of the tailing dressings and the stack gas refining is necessary.

d) Barrinha Mine

Prospecting: It is necessary to confirm the down-chute of the deposit by continuing exploration. A drill survey for the geophysical anomaly (SIP) detected to the southwest of the deposit is recommended.

Mining: While mining is operated by sublevel stoping, the working environment is dangerous because of the irregular setting of the working face. The diameter of the pipe from the compressor should be enlarged.

Dressing: New installation of mechanical dressing facilities will not be required if the mine continues high-grade ore production.

e) Rocha Mine

Prospecting: It is recommended that the underground mapping be continued to follow the distribution of dolomite and that effective exploration be continued for the lower extension of the deposit.

Mining: It is recommended that introduction of the shrinkage method, in addition to present sublevel stoping, is investigated.

It is necessary to consider safety measures for the workers by preparing a manway in the raise. Electric detonators for blasting in the raise should be used.

Dressing: It will be necessary to consider a pollution control system for treatment of tailings.

5) Summary of the Ribeira Area Development

The development of the Ribeira area has been discussed, centering on the development of the new deposit, taking the organization of infrastructure and redevelopment of the existing five mines into consideration. The start of the project will have various effects on the area.

Technically, adoption of systematic exploration and mining methods as well as the development of the technology for separating minerals by differential flotation will give impetus to the technique of mine development of the area and lead to the transfer of various new technologies.

Economically, an exchange, including promotion of employment and purchase of materials, will be activated, leading to increased welfare resulting from increase of tax revenues to municipal bodies.

Although development of the deposit on a private basis seems to be difficult in the present market climate a time will come when the development will be possible considering factors such as supporting measures to be taken by the Government, rise of metal prices and increased ore reserve estimates.

It is sincerely hoped that a detailed survey of the new deposit will be promoted so as to grasp future opportunities.

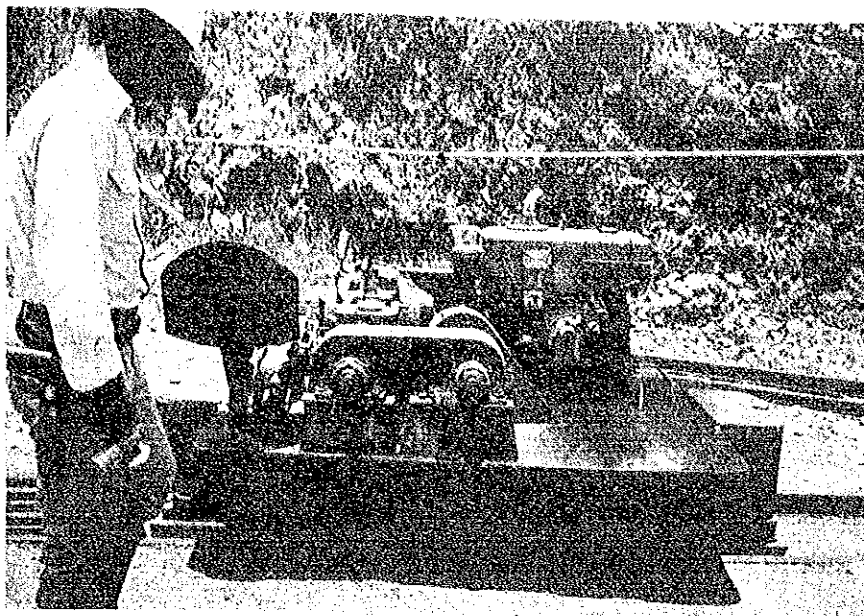


## **Appendix**

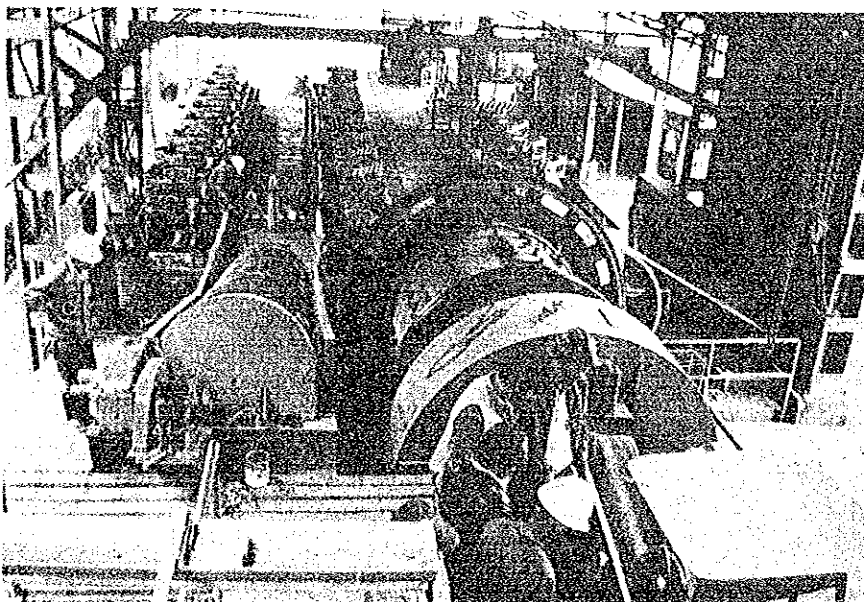
- 1) Photograph of Investigation in Brazil
- 2) References
- 3) Production of Lead Ore in Ribeira Area



1) Photograph of Investigation in Brazil



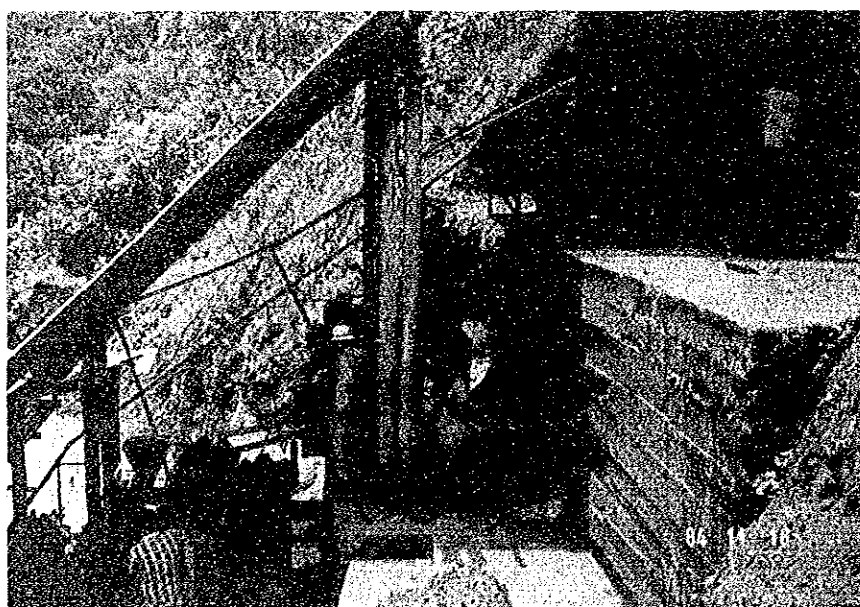
Panelas mine  
Locomotive (Home made)



Panelas mine  
Dressing plant



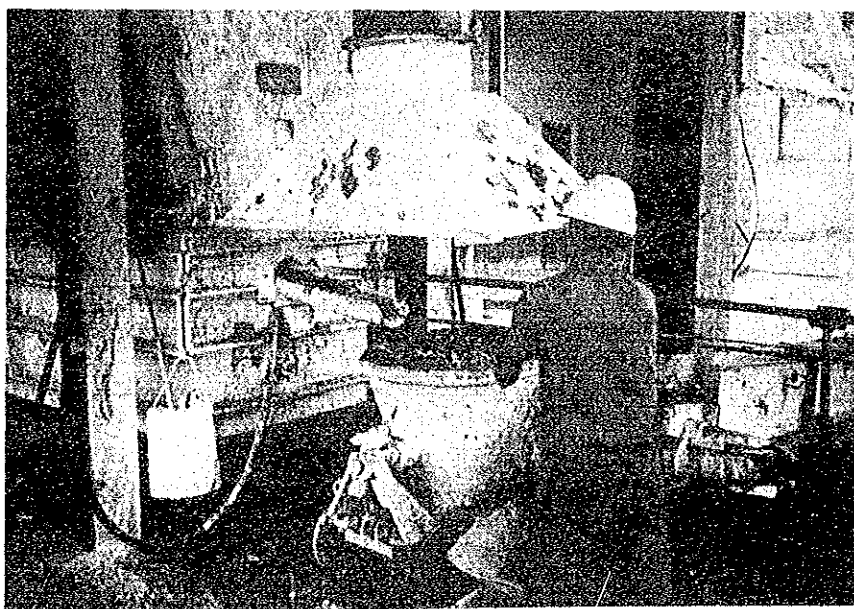
Frunas mine  
Adit Mouth



Barrinha mine  
Test plant of ore dressing



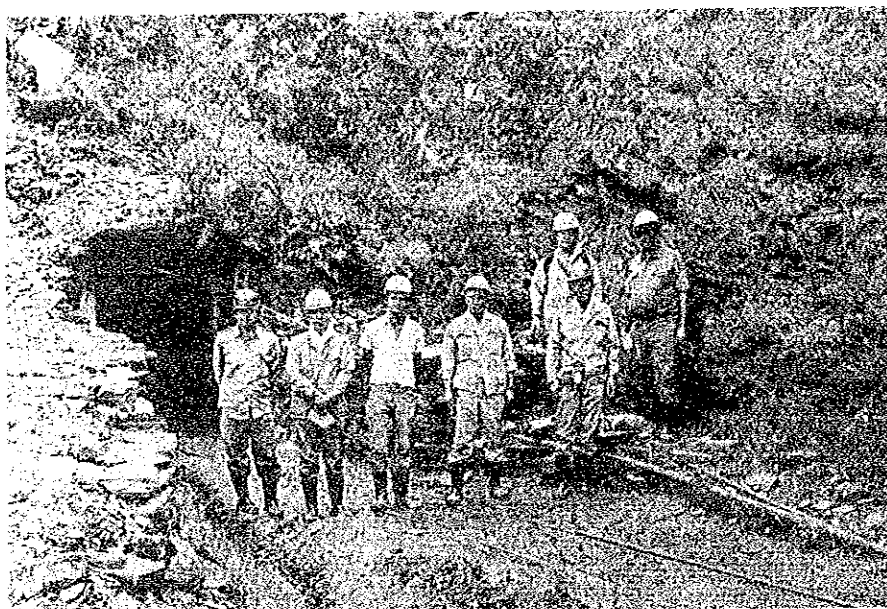
Panelas mine  
Calcination



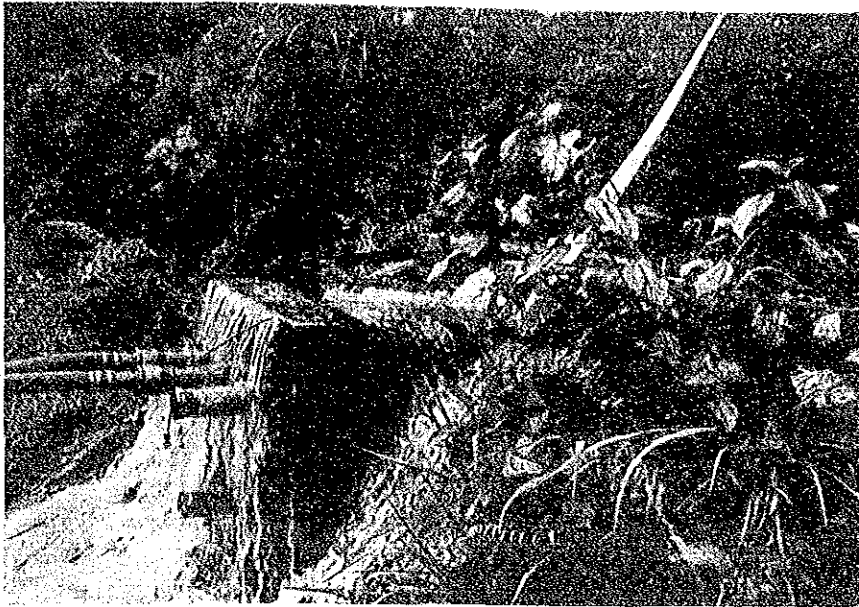
Panelas mine  
Refining of Lead



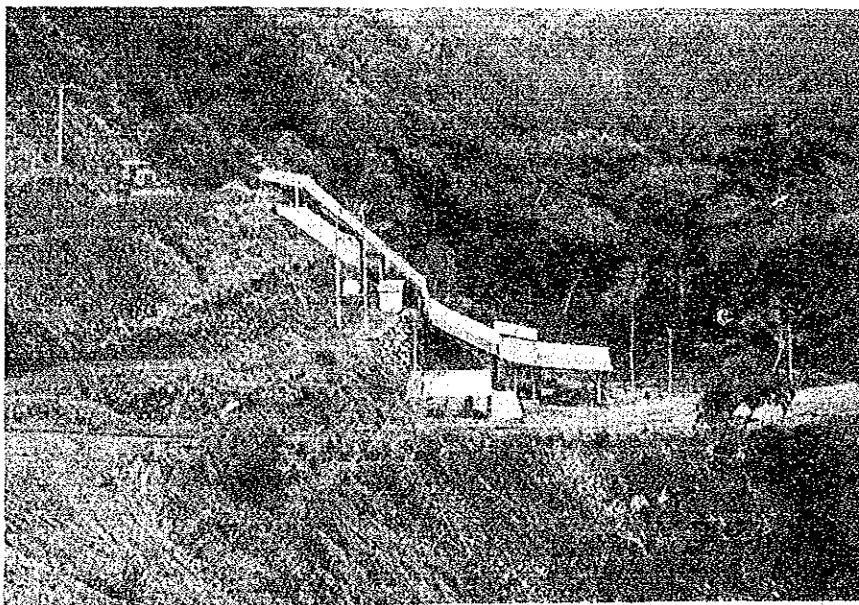
Panelas mine  
Chimney  
of Stackgas



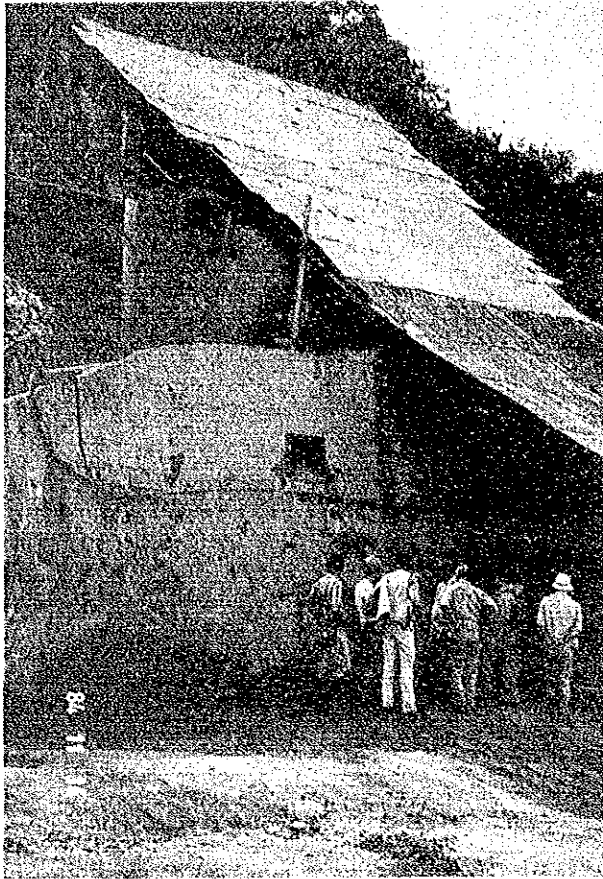
Perau mine  
Adit mouth



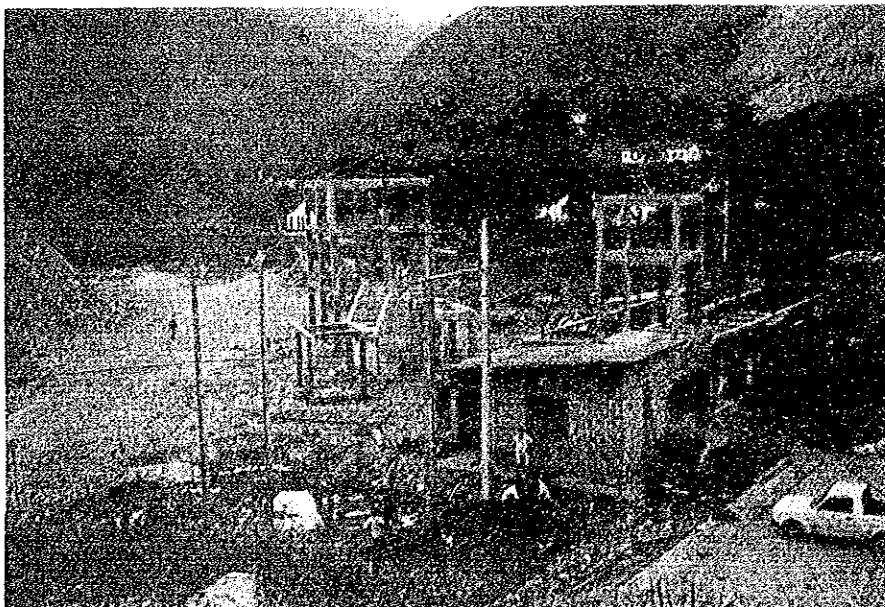
Perau mine  
Water Supply  
from river water



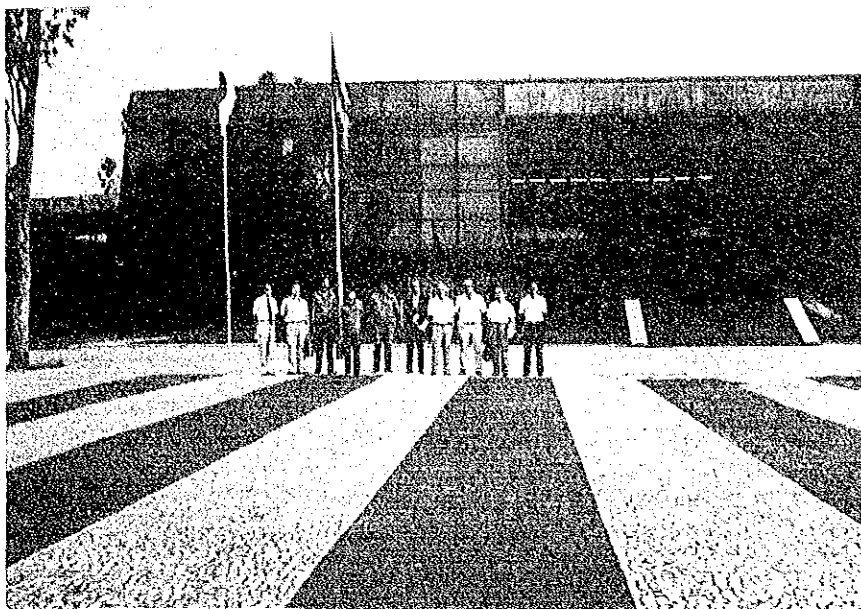
Perau mine  
Test plant  
of Dressing



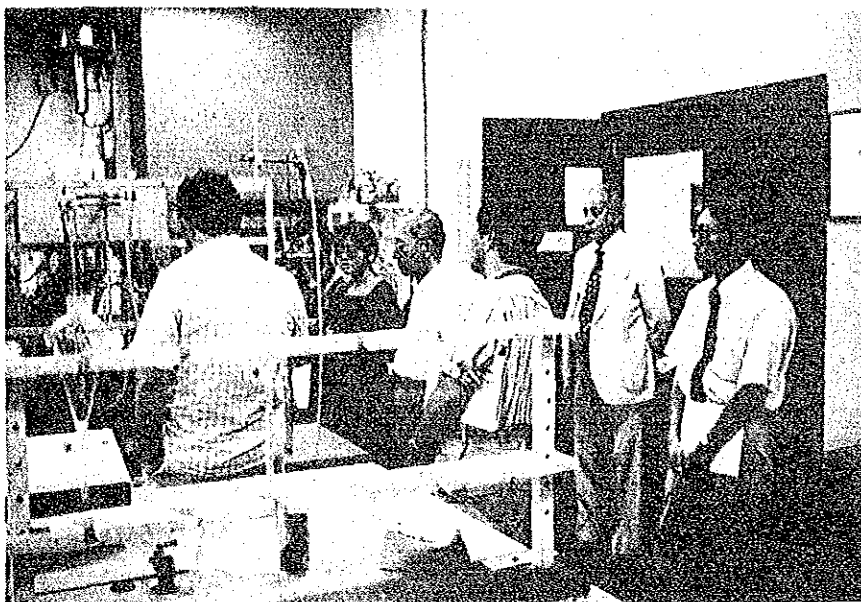
Rocha mine  
Dressing plant



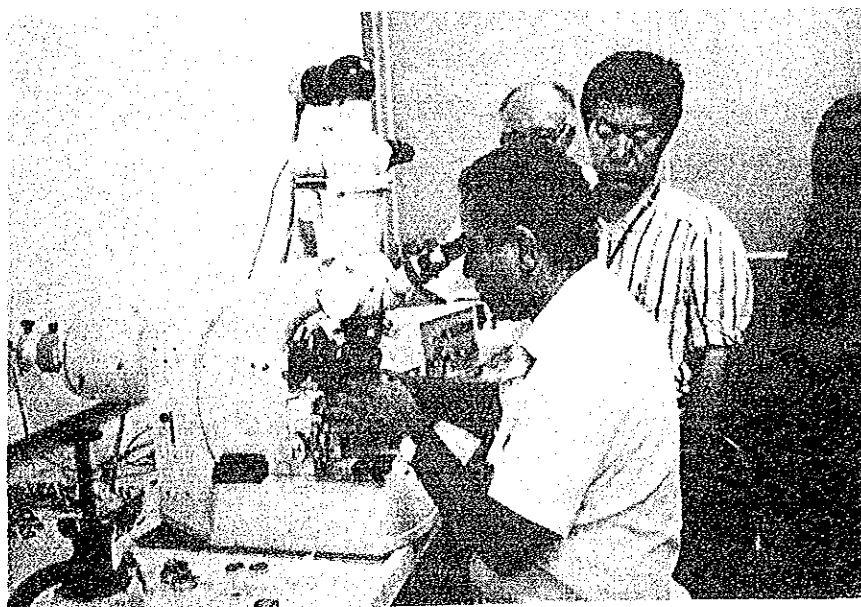
Rocha mine  
New Dressing plant  
(under construction)



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## 2) References

### ○ Introduction

- Present State of Economical Community in Brazil: International Cooperation Promotion Agency of Japan 1983
- Sadao Maruyama: Present state of nonferrous mining in Brazil, Bishimetal exploration co. limit. No. 147, '81-2
- Hiroshi Saito: New Brazil, The Simul Press. 1983
- Samario Mineral: 1982-1984, Ministério das Minas e Energia
- Annual Report DNPM: 1983

### ○ Mining

- A Construção São Paulo ano XXXVII: 1984 n. 1915-1919
- International statistical yearbook: 1983, Japanese Government;

### ○ Geology

- De Almeida, F.F.M., Hasui, Y., De Brito Neves, B.B. and Fuck, R.A., Brazilian structural provinces: an introduction, Earth-Sci. Rev., 17: 1-29. 1981
- AMARAL, G.; CORDANI, U.G.; KAWASHITA, K & Reynolds, J.H., Potassium-argon dates of basaltic rocks from Southern Brazil, Geoch. Cosmoch. Acta, v. 30, pp. 159-189. 1966
- AMARAL, G. et al, Potassium Argon Ages of Alkaline rocks from Southern Brazil. Geoch. Cosmoch. Acta, v. 31, n.2., pp. 117-142. 1967
- BATOLLA Jr., F., SILVA, A.T.S.F. da and ALGARTE, J.P., o Pre-Cambriano da região sul-sudeste do Estado de São Paulo e este-nordeste do Estado do Paraná Atas 3º-Simpósio Regional de Geologia, Curitiba, pp. 94-108. 1981
- CORDANI, U.G. and BITTENCOURT, I., Determinações de idade potássio-argônio em rochas do Grupo Açungui. Anais 21º Congresso Brasileiro de Geologia, Curitiba, pp. 218-233. 1967
- D.N.P.M., Carta Geologica do Brazil ao Milionésimo Folha Curitiba - SG22. 1974
- DNPM/CPRM, Projeto Leste do Paraná. São Paulo, 14v, inédito. 1977
- DNPM/CPRM, Projeto Geoquimica no Vale do Ribeira. São Paulo, 8v., inédito. 1978
- DNPM/CPRM, Projeto Integração e Detalhe Geológico no Vale do Ribeira. São Paulo, 15v. inédito. 1981
- JICA/MMAJ, On Geological Survey of Anta Gorda Brazil, Phase I. 1981
- JICA/MMAJ, On Geological Survey of Anta Gorda Brazil, Phase II. 1982

- JICA/MMAJ, On Geological Survey of Anta Gorda Brazil, Phase III. 1983
- MELCHER, G.C., Contribuição ao conhecimento do distrito mineral do Ribeira do Iguape, Estados de São Paulo e Paraná. Tese Livre Doc. Geol., ESE. Politécnica USP, São Paulo, 122p, (inédito). 1968
- Ore dressing
  - Taggart (Arthur E. Taggart): Handbook of Mineral Dressing Ores and Industrial Minerals New York, John Wiley & Sons Inc., London, Chapman & Hall, Limited., Third Print; January 1948
  - Fukunosuke Yamada: Mine Management and Design of Ore Dressing Plant, Asakura Bookstore, published in December 26th 1951
  - Faço: Allis-chalmers, Crushing Handbook
  - A Construção São Paulo revista semanal 12/11/84 & 19/11/84
  - Hosokura Mining Co. Ltd.: The Outline of Hosokura Mill, October 1979
  - Dōwa Mining Co. Ltd.: The Outline of Matsumine Mill, April 1982
  - Nordberg: Catalog of Ball Mill
  - T. ALAN O'HARA: Quickguides to the evaluation of ore bodies, CIM Bulletin, February 1980
  - Other, Makers' Catalog
- Infrastructure
  - Secretaria dos Transportes, "Porto de Paranaguá, Dossiê de Informações, Assessoria de Controle de Resultados," Março 1984
  - Administração dos Portos De Paranaguá e Antonina, "Porto de Paranaguá, Estatística 1984"
  - Edidra Abrio, "Guia Rodoviário do Brasil 1984," Geomapas, "Paraná, Rodoviário e Político 1984"
  - Associação Nacional das Empresas de Transportes Rodoviários de Carga, "Transporte Rodoviário de Cargas, Tabela de Tarifas 25," 18/07/84
  - DNAEE, "Código de Águas, Legislação Subseqüente e Correlata," 1974
  - DNAEE, "Código de Águas, Volume II," 1980
  - DNAEE, DCRH, "Norma para Apresentação de Projetos Relativos à Exploração dos Recursos Hídricos," Junho, 1979
  - Ministério do Interior, Secretaria Especial do Meio Ambiente, "Legislação Básica."
  - COPEL, "Sistema Elétrico do Paraná 1984"
  - Departamento Estadual de Estatística, "Anuário Estatístico 1983"

○ Evaluation

- United Nations, "Guidelines for Project Evaluation," New York, 1972
- OECD, "Manual of Industrial Projects Analysis," Paris, 1968
- E.J. Michan, "Elements of Cost-Benefit Analysis," London, 1972
- DNPM, "Balanço Mineral Brasileiro, Brasília," 1984
- E & MJ, Various issues
- DNPM, "Boletim de Preços 50, Brasília," 1984
- DNPM, "Sumário Mineral 1984, Brasília," 1984
- ABRANFE, "Informativo Mercado, São Paulo," 1984
- ICZ, "Relatório Estatístico De Pb, Ni e Zn, São Paulo," 1981
- JETRO, "System of Export Incentives and its Practice (In Japanese)," São Paulo, 1984

### 3) Production of Lead Ore in Ribeira Area (1)

ANOS	PANELAS <sup>1)</sup>		ROCHA		LAGEADO		FURNAS		PAQUEIRO		DIOGO LOPES		BUENO	
	MINERIO <sup>2)</sup>	Pb%	CONDITO <sup>3)</sup>	Pb%	MINERIO	Pb%	CONDITO	Pb%	MINERIO	Pb%	CONDITO	Pb%	MINERIO	Pb%
1943														
1944	4.000	40,0	1.600											
1945														
1946														
1947	4.380	20,8	910											
1948	8.122	20,8	1.692											
1949	10.000	24,0	2.400											
1950	14.762	23,7	3.506											
1951	14.086	22,8	3.206											
1952	12.921	23,0	2.973											
1953	13.260	23,9	3.169											
1954	35.840	8,05	2.886											
1955	49.730	7,04	3.500											
1956	33.865	6,38	3.436											
1957	59.112	5,74	3.392											
1958	50.183	5,74	2.881											
1959	53.730	5,98	3.213											
1960	53.429	5,36	2.866											
1961	49.900	6,84	3.412											
1962	48.857	6,31	3.083											
1963	42.742	6,78	2.897											
1964	41.735	5,71	2.382											
1965	33.289	5,06	1.684											
1966	37.323	5,93	2.215											
1967	45.618	5,16	2.356											
1968	53.744	4,56	2.449											
1969	53.411	4,62	2.467											
1970	56.443	4,55	2.569											
1971	54.283	4,89	2.656											
1972	52.797	5,04	2.659											
1973	43.588	5,78	2.521											
1974	38.641	6,19	2.393											
1975	31.190	6,82	2.127											
1976	33.315	6,24	2.078											
1977	32.947	5,95	1.959											
1978	26.059	6,24	1.627											
1979	29.294	5,79	1.697											
1980	24.716	5,63	1.393											
1981	23.203	5,28	1.224											
1982	15.137	5,13	776											
1983	12.245	5,40	662											
TOTAL	1.317.897*	6,90*	90.916	6,18	7.483	9,80	733	9,80	17.999	9,00	1.612	9,72	66	10,6

Note: 1) Mine name

2) MINERIO : Amount of Production (t/Year)

3) CONDITO: Pb Content

### 3) Production of Lead Ore in Ribeira Area (2)

ANOS	LARANJAL			PESCARIA			BARRINHA			PERAU			ABERTA DO LEAO			TOTAL GERAL		
	MINERIO	Pb%	CONDITO	MINERIO	Pb%	CONDITO	MINERIO	Pb%	CONDITO	MINERIO	Pb%	CONDITO	MINERIO	Pb%	CONDITO	MINERIO	Pb%	CONDITO
1943																		
1944																		
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1960																		
1961																		
1962																		
1963			1	492	4,88	24												
1964				881	4,65	41												
1965																		
1966																		
1967																		
1968																		
1969																		
1970																		
1971																		
1972																		
1973																		
1974																		
1975																		
1976																		
1977			2															
1978			3															
1979																		
1980																		
1981																		
1982																		
1983																		
TOTAL	107	5,60	6	1.313	4,73	65	41.903	19,53	8.185	152.850	6,85	10.464	167	18,6	31			





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