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1.0 INTRODUCTION

At the request of Companhia Vale do Rio Doce (Vale), the consulting engineering firm of Pincock, Allen & Holt - Brasil (Pincock), a division of Runge Serviços de Consultoria do Brasil Ltda., completed a review and audit of the statement of reserves and the supporting resource estimation for certain of the iron ore mines and projects in Brazil. This report presents the results and findings for the following properties that are within the Southern System:

- Fábrica Complex with the João Pereira and Segredo Mines
- Vargem Grande Complex with the Abóboras, Capitão do Mato and Tamanduá Mines
- Apolo Project

As part of the current auditing project, Pincock also reviewed the reserves for the operation N4E and N4W mines and the Serra Sul Project of the Carajas Northern System. The findings from this work are addressed in a separate appendix.

This audit was based on the current life of mine plans prepared by Vale as well as review of previous audits and other work by Pincock and other consultants as discussed subsequently. The life-of-mine plans are based on topographic surfaces as of the end of December 2007, with resource models that have been updated since the last reserve audits. As such, the reserves stated herein are as of December 31, 2007. This report is prepared in support of Vale's 20F Annual Report filing with the United States Securities and Exchange Commission (SEC). As part of this project, Pincock conducted site visits, observed mining operations, and reviewed the methodology used by Vale's geologists and mining engineers in calculating reserves.

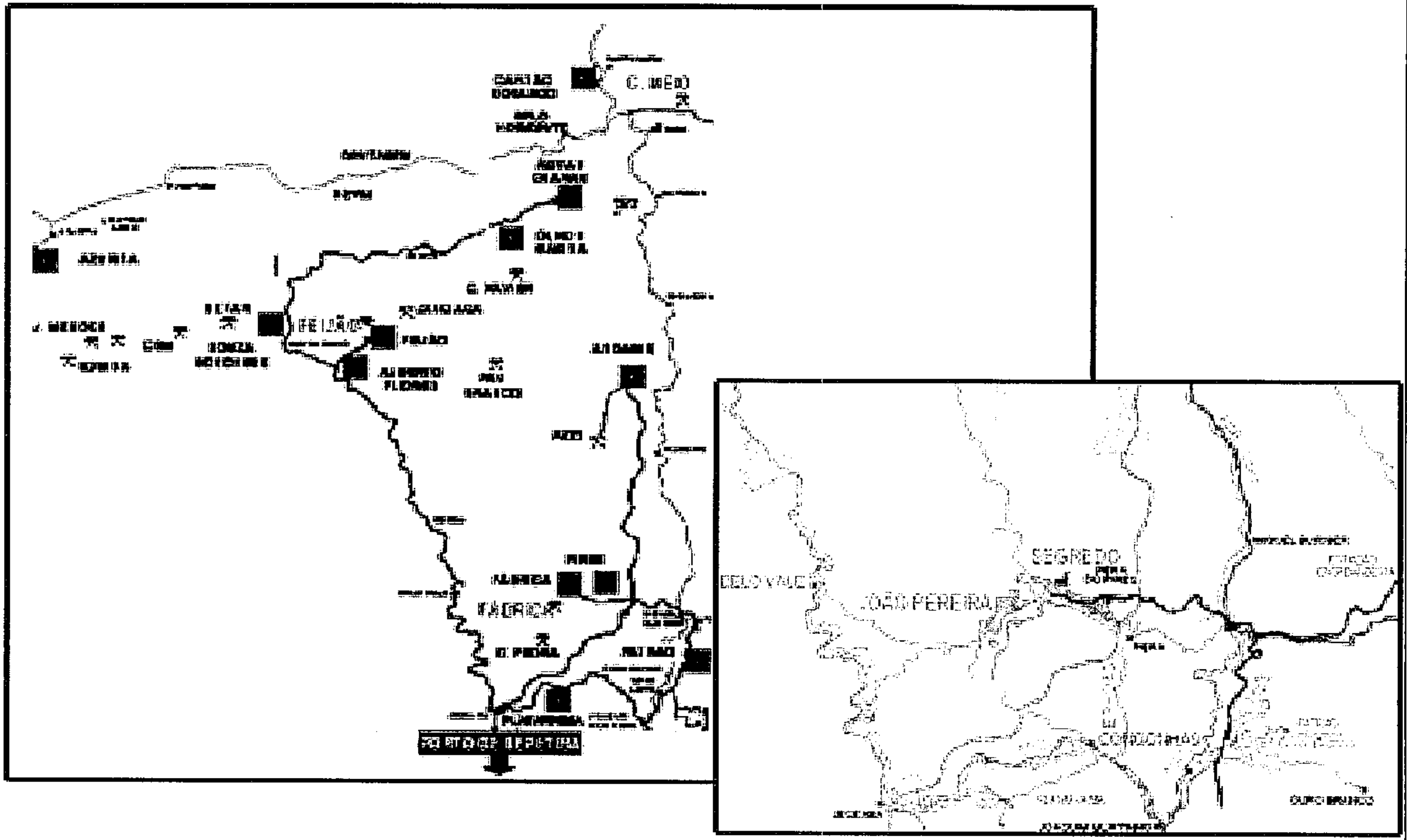
1.1 *Project Descriptions*

The following provides a description of the three properties in the Southern System which are addressed in this report. The Fábrica Complex and Vargem Grande Complex are located in the southwest and western portions, respectively, of the Iron Quadrangle (Quadrilàtero Ferrìfero) of Minas Gerais State, while the Apolo Project is located near the center.

1.1.1 Fábrica Complex

Mining at the Fábrica Mining complex began in 1923 by the Companhia Brasileira de Mineração e Metalurgia. Fábrica mining operations consist of two open pit mines, the João Pereira Mine and the Segredo Mine and the Fábrica processing plant complex. Figure 1-1 presents the general location of the Fábrica operations.

Approximately 18.2 million tonnes of iron ore was schedule for production in 2008 from the Fábrica operations. The current mine production is primarily hematite from the Segredo Mine and primarily higher grade itabirite from the João Pereira Mine. Run of mine ore from the two mines are blended and



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pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	VALE	FIGURE 1-1 FABRICA SITE LOCATION	Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.1-1.dwg

processed through the Fábrica process plant to produce lump ore, hematitinha (a product sold to locally), sinter feed and pellet feed. A portion of the pellet feed is processed through the Fábrica pelletizing plant while the rest is shipped. The hematite resources at the two mines feeding the Fábrica process plant will be depleted after 2020, under the current mining plan.

Vale is planning to increase production from the Fábrica operations by construction of two new plants to process only itabirite ores for pellet feed production. The first 10 million tonne per year (mtpy) plant is to be constructed in 2014 and the second 10 mtpy plant is to be constructed in 2016. This reserve review evaluates the planned itabirite production through these plants. A Feasibility Study for the Fábrica itabirite project is in process but is not available for this reserve review. Vale has provided Pincock with various engineering studies and reports, as well as capital and operating cost estimates to demonstrate the technical and economic viability of mining and processing the itabirite ores.

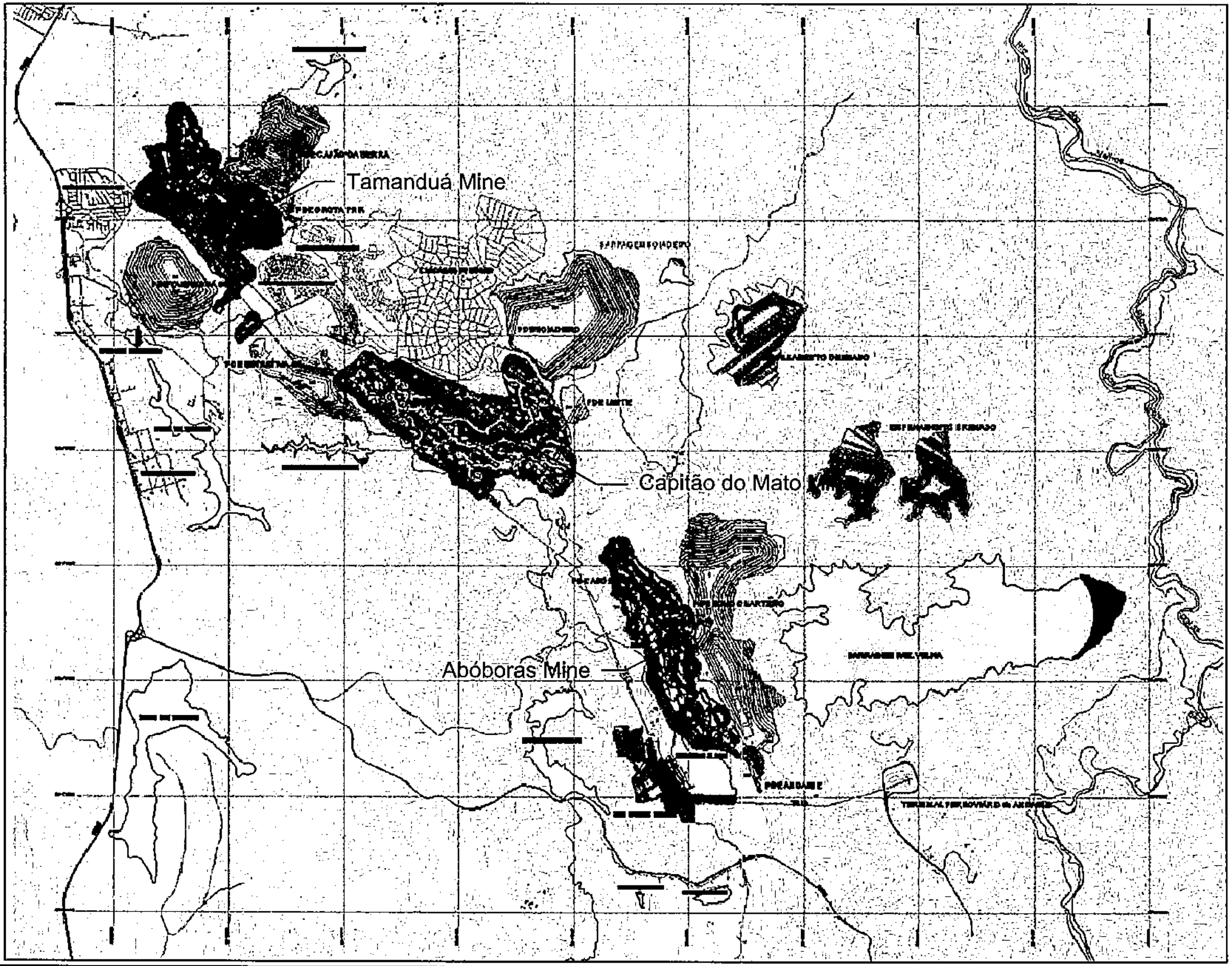
Product from the Fábrica operation can be shipped to either the Tubarão Port near Vitoria in Espirito Santo state or to the Sepetiba Port near Itaguai, in Rio de Janeiro state. Iron ore product is shipped by rail to one of three port facilities. The port of Tubarão is served by the Ferro Vale rail line and the ports of Volta Redonda and Sepetiba/Guaiba are served by the Ferro MRS rail line. Ferro Vale is wholly owned by Vale, and the company is a partner in Ferro MRS. Costs for the rail operation are carried in an operating division outside of the Southern System, and an annual shipping rate is established that is back charged to the Southern System mines.

1.1.2 Vargem Grande Complex

The Vargem Grande mining operations are part of Vale's Southern System of mines and is located in the Iron Quadrangle (Quadrilàtero Ferrìfero), which is located in the south-central part of the State of Minas Gerais. The operations are within the municipality of Nova Lima. Vargem Grande mining operations consist of three open pit mines, the Capitão do Mato Mine, the Tamanduá Mine and the Abóboras Mine which feed ore to the Vargem Grande processing plant. The three mines are located between 20 and 40 km from Belo Horizonte. Figure 1-2 presents the general location of the Vargem Grande operations and Figure 1-3 presents an aerial photography of the three mines and processing plant.

Approximately 55.4 million tonnes of Run-of-Mine (ROM) iron ore with 65 percent Fe was schedule for production in 2008 from the Vargem Grande operations. The current mine production is hematite and higher grade, friable itabirite. ROM ore from the three mines are dry crushed and screened at each mine, then transported and processed through the Vargem Grande process plant to produce lump ore, hematitinha (a product sold to locally), sinter feed and pellet feed.

Vale is planning to increase production from the Vargem Grande operations by construction of new processing plant to process only itabirite ores for pellet feed production. The first 10-mtpy plant is to be constructed by 2011 and the second 10-mtpy plant is to be constructed in 2015. The new plants will be located in the vicinity of the existing process plant. The current reserve review evaluates the planned itabirite production through these plants. A Feasibility Study for the Vargem Grande itabirite project is in process but is not available for this reserve review. Vale has provided Pincock with various engineering



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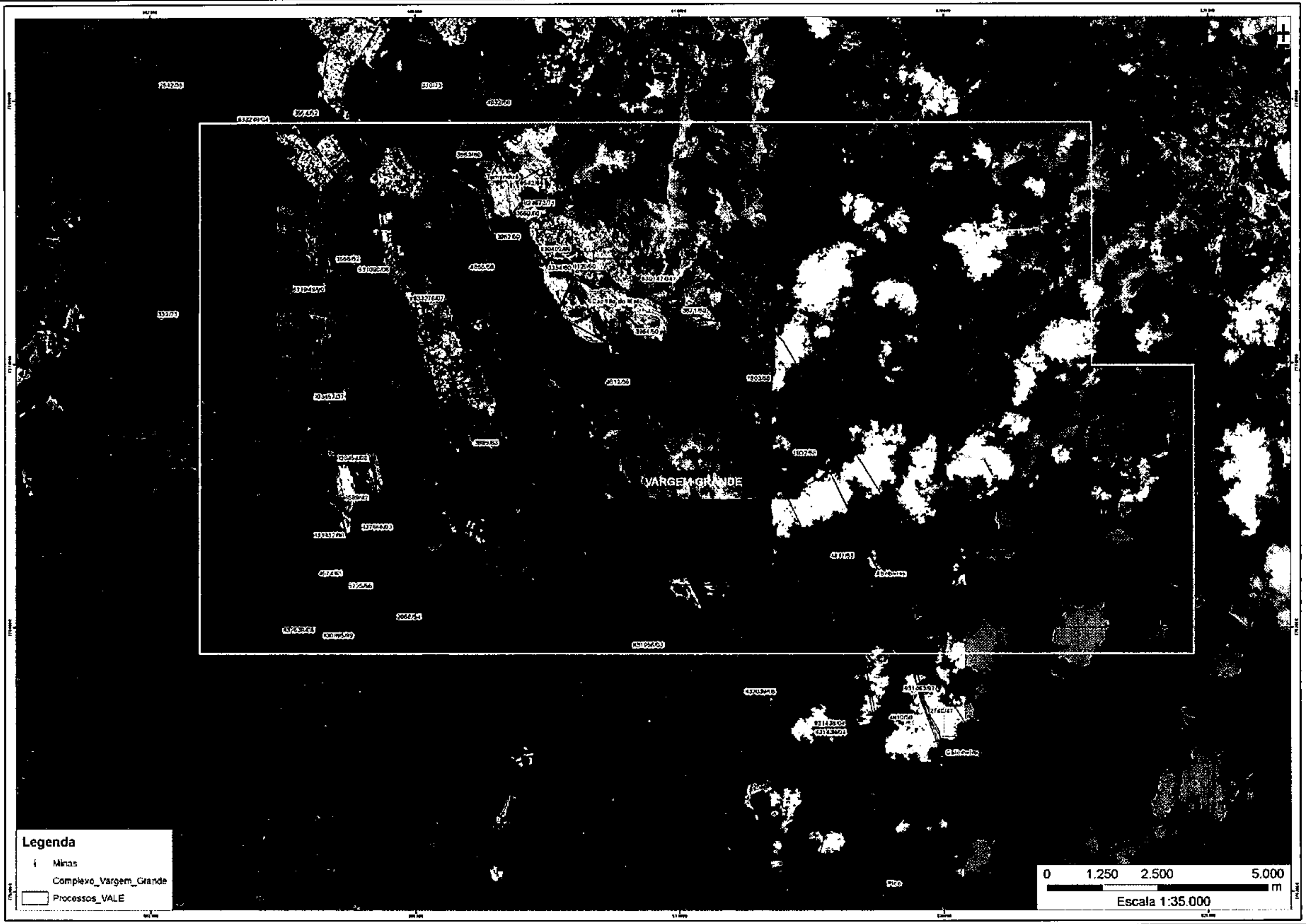
pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	VALE	FIGURE 1-2 VARGEM GRANDE COMPLEX MINE LAYOUT	Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.1-2.dwg



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pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	VALE	FIGURE 1-3 VARGEM GRANDE AERIAL CONCESSION MAP	Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.1-3.dwg

studies and reports including a FEL 2 Pre-Feasibility Study, as well as capital and operating cost estimates to demonstrate the technical and economic viability of mining and processing the itabirite ores.

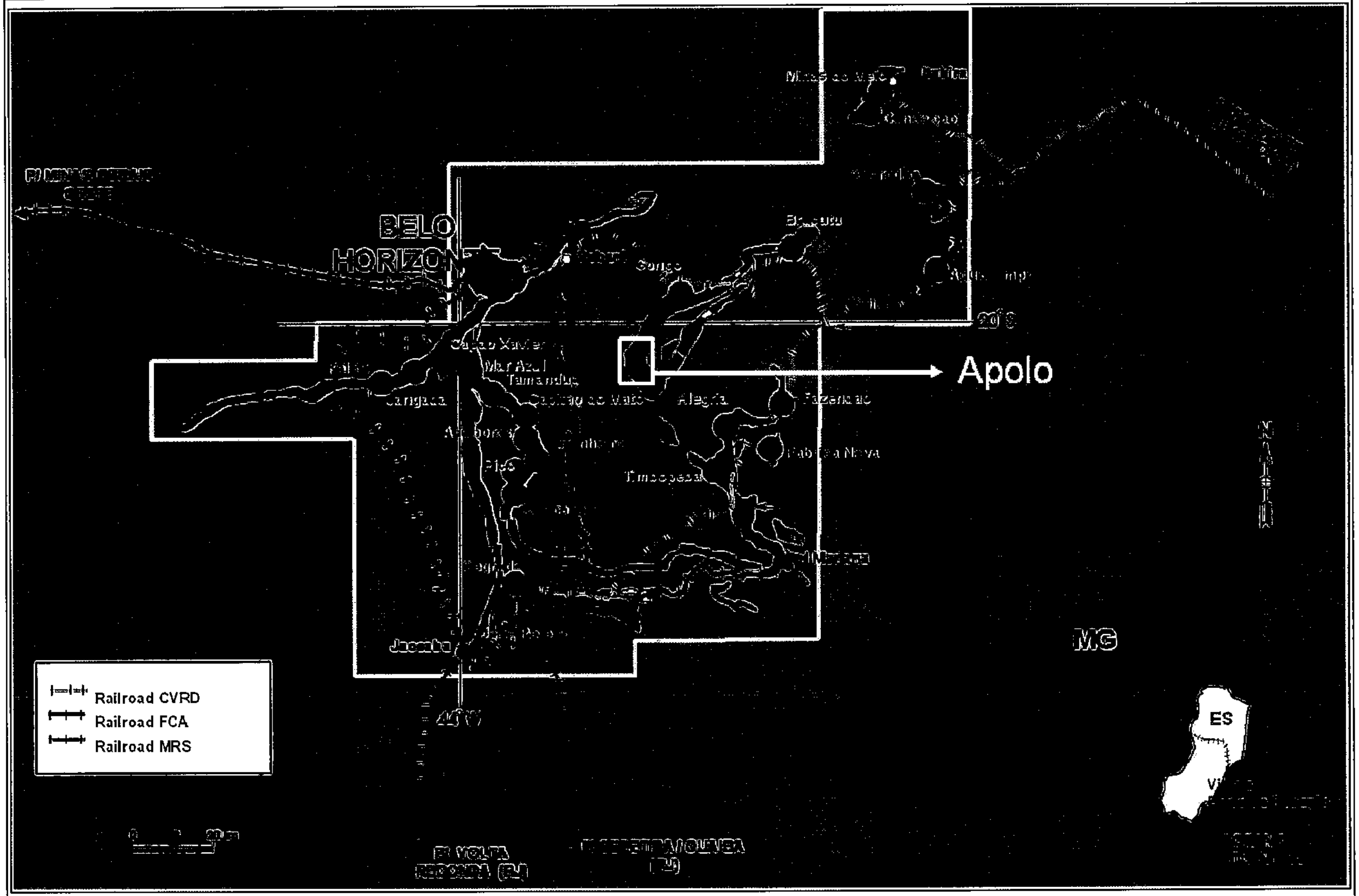
Product from the Vargem Grande operation is shipped to the Guaíba Maritime Terminal Complex located near Itaguai in the state of Rio de Janeiro via the Ferro MRS rail line. Ferro Vale is wholly owned by Vale, and the company is a partner in Ferro MRS. Costs for the rail operation are carried in an operating division outside of the Southern System, and an annual shipping rate is established that is back charged to the Southern System mines.

1.1.3 Apolo Project

The Apolo Project (previously referred to as the Maquiné Project or Apolo-Maquiné Project) is an undeveloped mineral resource located in the central portion of the Iron Quadrangle within the municipal districts of Rio Acima, Raposos, Caeté and Santa Bárbara, approximately 40 km southeast of Belo Horizonte, the capital of the state of Minas Gerais. Figure 1-4 presents the general location of the project. Three mining concessions cover the project, Mato Grosso, Extramil and Apolo. The Apolo concession was acquired by Vale in 2004 and exploration significantly increased the resource defined for the project.

The Apolo Project is one of the new expansion projects that Vale plans, which along with projects to expand itabirite mining for pellet feed production at the Vargem Grande and Fábrica Complexes, will augment production from the Southern System as the hematite and rich itabirite reserves are depleted at other operating mines. The Apolo Project is to be developed as a large scale open pit mine, with production scheduled to begin in 2013. There will be an initial production of 13.6 million tonnes per year (mtpy) of Run of Mine (ROM) high grade ore (hematite and rich, friable itabirite), ramping up to 33 mtpy after year 2. A first phase beneficiation plant is to produce about 18.1 mtpy of sinter feed and 7.9 mtpy of pellet feed from the high grade ore. In year 4, a second processing plant will be commissioned which will treat approximately 20 mtpy of lower grade itabirite for approximately 9 mtpy pellet feed production. Total production will be maintained at about 52 mtpy of ROM until year 14 when the richer ore is depleted and production will drop to 33 mtpy of lower grade material.

The Apolo Project will require over 21 km of rail line extension and about 24 km of new electric power transmission line. A 53-hectare water storage reservoir will be constructed and a 464 hectare tailings pond will have to be built. These are all in addition to developing a new mine and constructing the ore processing and ancillary facilities. Product from the operation is to initially be shipped to the Tubarão Port near Vitoria in Espirito Santo state. Eventually, ore can be shipped from the Sepetiba Port near Itaguai, in Rio de Janeiro state. The port of Tubarão is served by the Ferro Vale rail line and the ports of Volta Redonda and Sepetiba/Guaiba are served by the Ferro MRS rail line. Ferro Vale is wholly owned by Vale, and the company is a partner in Ferro MRS. Costs for the rail operation are carried in an operating division outside of the Southern System, and an annual shipping rate is established that is back charged to the Southern System mines.



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pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	VALE	FIGURE 1-4 APOLO PROJECT GENERAL LOCATION	Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.1-4.dwg

This reserve review evaluates the planned itabirite production through these plants. A FEL 3 (Feasibility Study) for the Apolo Project is in process but was not available for this reserve review. A FEL 2 (Pre-Feasibility) study was provided; however, the project had been expanded in scope to include the second phase process plant construction to all processing itabirite ore as a result of the FEL 2 study conclusions. Vale provided Pincock with various engineering studies and reports, as well as capital and operating cost estimates to demonstrate the technical and economic viability of mining and processing for the Apolo project.

1.1.4 Setting of Sites and Climate

The area of Vale's Southern System of mines is characterized by moderately steep terrain, with total topographic relief ranging from around 600 meters to 1,500 meters along the crests of the mountain chains. The region was originally covered with tropical forests that have largely been cut in the past, with large plantations of eucalyptus trees being planted as well as maintaining pasture land for livestock grazing. Brazil has a focus on restoration of natural species and Vale has incorporated this in the mine site reclamation work by using only native species for permanent revegetation. The average annual temperature is about 18° C. Average low temperatures are 8° C during June through August and average high temperatures are 24° C in January through February. Annual precipitation is about 1,500 mm and occurs primarily during a rainy season that lasts from October to March with June to August being relatively dry. Annual evaporation is on the order of 1,000 mm.

1.2 *Audit History*

Auditing of the reported resources of the Vale properties began in 1997 in support of the filing of an F-3 Form with the United States Securities and Exchange Commission (SEC) as a requirement of the initial listing and public offering of Vale shares on the New York Stock Exchange. From the initial audit in 1997 through the audit completed of the 1999 reserves, the external auditor was the U.S. based company Mineral Resources Development, Inc. (MRDI). MRDI was acquired by AMEC in May 2000 and subsequent audits through the end of 2002 were done as AMEC but involved essentially the same personnel as the prior MRDI work. Vale changed auditors for 2003 and 2004. The audit of reserves stated as of the end of 2003 was completed by Golder Associates in early 2004.

Pincock completed the audit of year-end 2004 reserves in early 2005. This work included a thorough review of the metallurgy, processing plants and environmental management, as these areas had not been completely addressed in previous audits. The primary focus of metallurgical and environmental assessments was to confirm there were not material issues that would present impairments to production of the mineable reserves being stated.

The Fábrica Complex had been previously audited by MRDI following acquisition by Vale and continued with the audit by Pincock of the year-end 2004 reserves. Apolo Project (previously referred to as Maquiné Project) and Vargem Grande complex were first audited under the Vale program by Pincock in early 2005. For the Apolo project, the year-end 2004 audit was the first time that a resource estimate was available for review as the project had advanced from exploration to early development. Controlling interest in the Vargem Grande Complex, previously owned by Minerações Brasileiras Reunides (MBR), was acquired in 2003 by Vale with the purchase of 60 percent of Caemi, which in turn owned 85 percent of MBR. MBR's mines, including Vargem Grande Complex were brought into Vale's reserve auditing program at the time of the year-end 2004 audit completed by Pincock. In 2007, Vale entered into an agreement with the other partners in MBR to increase the equity position and obtain 100 percent control of MBR to allow integration with Vale's other South System mining operations to achieve operational synergies.

AMEC again audited the reserves in 2005. For 2006, a third-party audit was not conducted, but reserves were reconciled by Vale's technical personnel. In February 2008, Pincock completed a reserve reconciliation review of Vale stated reserves as of December 31, 2007.

Pincock would note that the audit reports for year-end 2004 and year-end 2005 and the 2008 reserve reconciliation report were reviewed as background for this current audit were considered to be professionally prepared relative to the auditing and review of drilling, sampling and assay practices; development of the geologic model; interpretation of grade variations, validation of resource and reserve calculations, mining and processing costs, regulatory permits and approvals.

1.3 *Scope of Work*

The work completed for this audit included:

- Review of the 2004 and 2005 audit reports and the 2007 reserve reconciliation report
- Completing site visits to the operating mines by the full Pincock audit team, with the greenfields Apolo Project having previously been visited in March 2005 by three of the current project team members.
- Review and independent analysis of data provided by Vale's staff
- Preparation of an interim report of the findings of the resource review
- Preparation of this report of the findings of the audit.

Vale presented both verbal and written reports to Pincock during the site visit to provide for our understanding of the data, geologic model, mineral processing, and mine designs in sufficient detail to confirm that the reported resources and reserves were estimated in accordance with generally accepted principles and practices of the mining industry.

Pincock reviewed the inputs to the reserve estimates to confirm that appropriate steps have been taken to properly classify the resources as reserves. This includes information regarding the ability to technically, economically and legally extract the reserves. Our team included a geologist to review the geology and geologic model, a geostatistician to examine the analytical approaches used in estimating resources, a mining engineer to assess mining methods and costs and the mine planning that supports definition of mineable reserves, a metallurgist to review processing operations and costs, and a geotechnical/environmental engineer to review environmental management and the existence of a satisfactory reclamation and rehabilitation program.

The following areas are included in this audit:

- Auditing the Geologic and Resource Models

  - Review of the current status of the exploration methods, sampling and assaying procedures, and the geologic interpretations with the Vale geologists familiar with the projects.

  - Review of the statistical and geostatistical parameters used in the estimation of the in situ resources.

  - Review of the reconciliation of past production to the predicted model resources. This involves reconciliation of modeling based on bench face, trench and drill hole sampling during mining with the long-term resource model.

- Auditing of Reserves

  - Review of the direct operating costs, recoveries, and other economic data used to determine the mineable reserves in the ultimate pits.

  - Review of current mine progress, planned progress, and ultimate pit configuration.

  - Comparison of predicted direct operating costs to the costs currently being reported at the mines.

  - Review of metallurgical test work and process facilities for each mining operation.

  - Review of mine geotechnics including approaches to design and monitoring of pit slopes, mine waste disposal areas, tailings impoundment dams and sediment or other impounding structures.

  - Review of the status of the surface and mineral rights, mine permits, closure plans, and environmental management.

The audit work was focused on the mining operations and did not include a review of the railroad systems or port facilities. The railroads are operated and the costs accounted for as stand-alone operations with transport costs assigned to the Southern System on a per-tonne of material moved basis. The port facilities are within the cost structure of the Southern System and include the final product blending systems as well as material handling and ship loadout facilities.

1.4 *Work Plan*

Site visits conducted by Pincock's project team were made in two stages. Visits by the Geologist and Geostatistician were made during the period of September 13 to October 5, 2008. Site visits by the Mining Engineer, Process Engineer and Environmental Engineer were made during the period of

December 3 to December 19, 2008. Visits were also made to other Vale operations which are the subject of this audit during these same periods.

Project reviews started with meetings in Belo Horizonte where an overall review of the Vale operations and each specific mine operation unit was provided. Site visits were then made to the operations and a tour was made of the mines and processing plant facilities. During the site visit, presentations were provided of background information and data specific to each mining operation within the complex.

Vale's staff provided all requested information in a professional and timely manner and Pincock considers the scope of work completed and the data received sufficient for the scope of this audit in accordance with the SEC Guide 7, "Description of Property by Issuers Engaged or to Be Engaged in Significant Mining Operations," as well as generally accepted industry standards.

1.5 *Personnel*

The senior level, multi-disciplinary project team was comprised of professionals who are familiar with large, high tonnage open-pit operations and iron ore processing facilities. The team included Darrel Buffington, P.E., Director, Pincock Allen & Holt - Brasil as Project Manager; Doug Jones, Vice President – Mining and Geology, Leonel Lopez, C.P.G., Principal Geologist; Bipin Bhatt, Principal Geostatistician; and Ron Harma, Principal Metallurgical Engineer.

1.6 *Limitations of Audit*

PAH has independently reviewed information and data supplied by Vale and its affiliates and consultants. Although, PAH's opinions expressed in this report rely on the accuracy of the supplied data, PAH has no reason to believe that any material facts have been withheld. Vale's technical staff was open and forthcoming with information. PAH does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from investment or other financial decisions or actions resulting from them.

All disclosure about properties in this report conforms to the standards of United States Securities and Exchange Commission Industry Guide 7, Description of Property by Issuers Engaged or to be Engaged in Significant Mining Operations, other than disclosure of "Mineral Resources," "Measured Mineral Resources," "Indicated Mineral Resources," and "Inferred Mineral Resources," which are Canadian geological and mining terms as defined in accordance with Canadian National Instrument 43-101 under the guidelines set out in the CIM Standards.

In this report, references to "Canadian National Instrument 43-101" are references to National Instrument 43-101, Standards of Disclosure for Mineral Projects, of the Canadian Securities Administrators and references to "CIM Standards" are references to Canadian Institute of Mining, Metallurgy and Petroleum (the "CIM") Standards on Mineral Resources and Mineral Reserves, adopted by the CIM Council on August 20, 2000, and amended by the Standards for Disclosure for Mineral Projects, Form 43-101F1 and Companion Policy 43-101CP dated December 23, 2005.

Mineral resource estimates are inherently forward-looking statements and may be subject to change. Although PAH exercises due diligence in reviewing the supplied information, uncontrollable factors or unforeseen events can have significant positive or negative impacts on mineral resource statements. Uncontrollable factors or unforeseen events consist of risks related to the business such as, the cyclical nature of the mineral industry, the internationally competitiveness of the industry, price fluctuations based on varying levels of demand and international or local monetary or political policy changes. Any one or combination of factors could significantly influence mineral resource statements.

This report uses the terms "Measured Mineral Resource" and "Indicated Mineral Resource." We advise U.S. investors that while such terms are recognized and permitted under Canadian regulations, the U.S. Securities and Exchange Commission does not recognize them. U.S. investors are cautioned not to assume that any part or all of the Mineral Resources in these categories will ever be converted into Mineral Reserves.

This report uses the term "Inferred Mineral Resource." We advise U.S. investors that while such terms are recognized and permitted under Canadian regulations, the U.S. Securities and Exchange Commission does not recognize resources. "Inferred Mineral Resources" have a great amount of uncertainty as to their existence, and great uncertainty as to their economic and legal feasibility. It cannot be assumed that all or any part of an Inferred Mineral Resource will ever be upgraded to a higher category. Under Canadian rules, estimates of Inferred Mineral Resources may not form the basis of feasibility or other economic studies. U.S. investors are cautioned not to assume that any part or all of an Inferred Mineral Resource exists, or is economically or legally mineable.

The results and opinions expressed in this report are based on PAH's observations and the technical data provided by Vale and are conditional upon the technical data being current, accurate, and complete as of the date of this report, and the understanding that no information has been withheld that would affect the conclusions made herein. PAH reserves the right, but will not be obligated, to revise this report and the conclusions contained within if additional information becomes known to PAH subsequent to the date of this report. PAH does not assume responsibility for Vale's actions in distributing this report.

1.7 *Units and Abbreviations*

Pincock has based all measurements in the metric system, and has identified exceptions to this, notably when listing both English and Metric standards. Currencies are generally based on 2008 US dollar, converting to the Brazilian Real at 1.8 Real per US dollar.

Unless otherwise stated, Dollars are United States Dollars, and weights are in metric tonnes of 1,000 kilograms (2,204.62 pounds). The following abbreviations are used in this report:

Abbreviation	Unit or Term
AA	Atomic Adsorption
BIF	Banded iron formation
DCF	Discounted Cash Flow

G&A	General and Administrative
FEL	Front End Loaded Project Evaluation Study
ft	feet
ft^3	cubic feet
IDS	Inverse Distance Squared
ICP	Inductively Coupled Plasma
In	inch
ISO	International Standards Organization
JORC	Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves
k	Thousands
kg	kilogram
km	Kilometer
LI	Installation License
LMC	Linear co-regionalization model
LO	Operating License
LP	Preliminary License
LOI	Loss On Ignition
M	Millions
Mt or mt	Million tonnes
mm	millimeters
m^3	cubic meter
mtpy	Million tonnes per year
NI 43-101	Canadian National Instrument 43-101
NPO	Natural Pellet Ore
NPV	Net Present Value
OCK	Ordinary Co-Kriging
OK	Ordinary Kriging
PAH	Pincock Allen & Holt
oz	ounces
ROM	run-of-mine
T or t	Metric Tonne (1,000 kg or 2,204.6 lbs)
TDA	Total De-clustered Average
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
Tpa or tpy	Tonnes per annum
tpd	Tonnes per day
tph	Tonnes per hour
UTM	Universal Transverse Mercator coordinate system
VGR	Vargem Grande Complex
yd^3	cubic yards
$	United States Dollars
R$	Brazilian Reals

XRF	X-Ray Fluorescence
%	Percent by weight

<u>Common Chemical Symbols</u>

Aluminum	Al
Calcium	Ca
Chlorine	Cl
Cobalt	Co
Copper	Cu
Gold	Au
Iron	Fe
Lead	Pb
Magnesium	Mg
Manganese	Mn
Molybdenum	Mo
Nickel	Ni
Oxygen	O_2
Potassium	K
Silver	Ag
Sulfur	S
Titanium	Ti

2.0 GEOLOGY

Vale's Southern System consists of iron deposits located in the Quadrilátero Ferrífero (Iron Quadrangle), in the south central part of the State of Minas Gerais. These deposits are hosted by the Iron Formation of the meta-sedimentary Super Group Minas Formation of Precambrian age. The following provides a discussion of the regional geology that is common to the Fábrica Complex, Vargem Grande Complex and the Apolo Project and the exploration activities conducted to develop the information used in resource estimation.

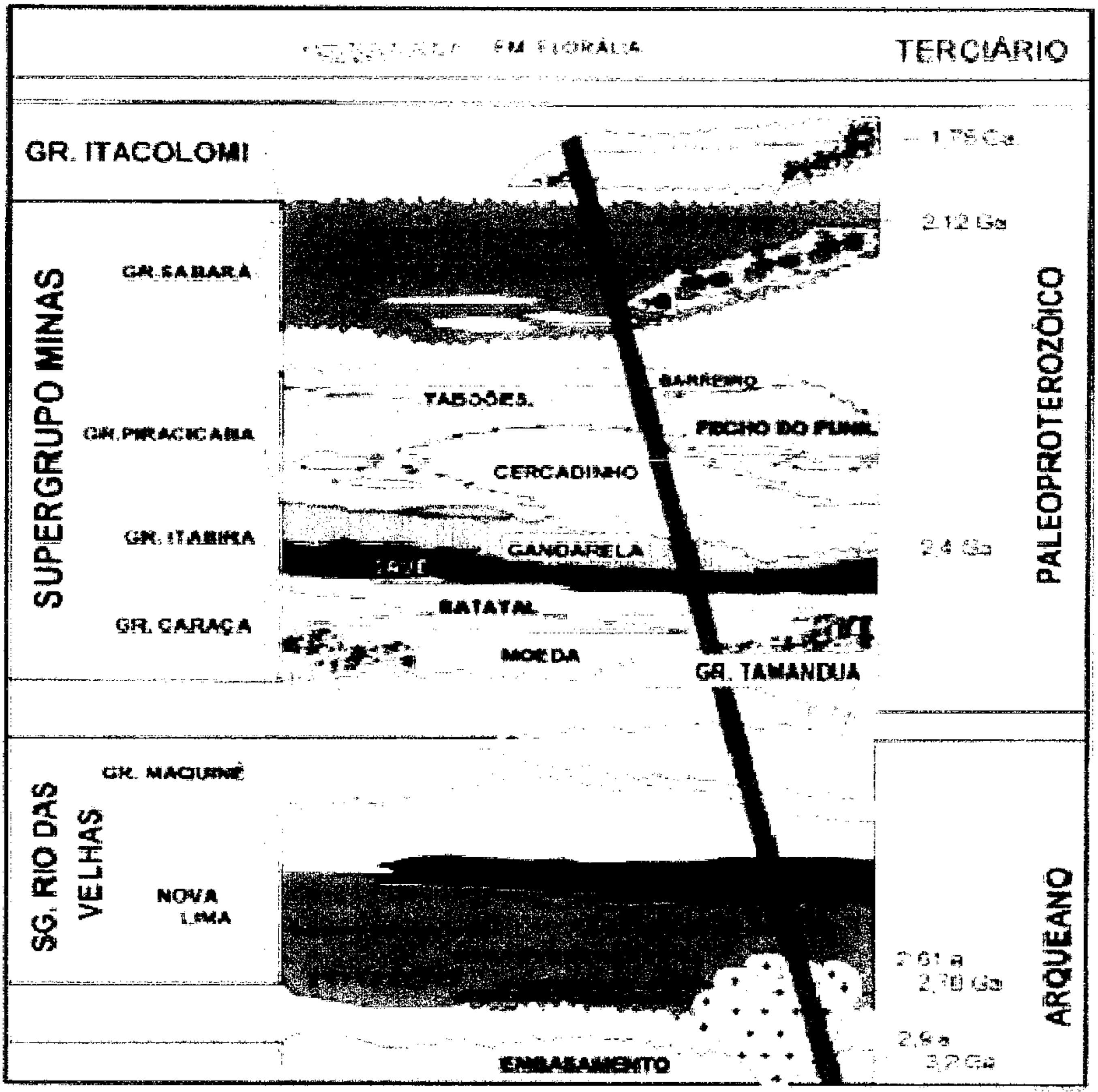
2.1 *Regional Geology*

The Iron Quadrangle contains stratiform iron-deposits of Proterozoic age which are hosted in the southern portion of the Sao Francisco Craton. The Craton is characterized by the Precambrian granite complexes, and the Achaean and Proterozoic volcano–sedimentary sequences. The iron deposits occur within the Iron Formation (Cauê Formation) of the Itabira Group, which together with the Caraça and Piracicaba Groups constitute the Minas Supergroup of Paleoproterozoic age in the Brazilian Shield.

The Minas Supergroup overlies the Achaean Greenstones of the Rio das Velhas Supergroup, which consists of a sequence of meta-volcanic sedimentary rocks of Achaean age. It underlies metamorphic rocks of the Itacolomi Group. The Mafic dikes intrude the stratigraphic column. Figure 2-1 represents a simplified stratigraphic column of the Iron Quadrangle. The Minas Supergroup has been subjected to a long history of geologic events, including uplifting, overturning, intrusions, and compressive and tensile deformations. These geological events created the appropriate structural conditions for the formation of iron deposits.

Three groups make up the Minas Supergroup. The lowest unit, the Caraça Group, is primarily a clastic unit. It consists of quartzite with intercalated phyllite and conglomerate. An erosional unconformity marks the contact between the Caraça Group and the overlying Itabira Group.

The Itabira Group comprises the lower Cauê Itabirite (which contains the main iron deposits of the Quadrilátero Ferrífero), a mix of itabirite (oxide facies of the iron formation) and dolomitic itabirite, with minor phyllite and dolomite. It is overlain by the upper member of the formation, the Gandarela Unit. It consists of dolomite and minor limestone, dolomitic itabirite, itabirite and dolomitic phyllite. The uppermost unit, the Piracicaba Group is characterized by clastic sediments which include quartzite, phyllite, and dolomite. The final member of the Supergroup is the Sabará Formation that comprises chlorite schist, phyllite, greywacke, tuff, conglomerate, quartzite, and rare itabirite. The age of deposition of this sequence is estimated to be from 2.6 to 2.12 Ga, while an age of 2.42 Ga has been obtained from a dolomite of the Itabira Group.



Prepared by pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	Drawing Provided by/Prepared for VALE	FIGURE 2-1 SIMPLIFIED STRATIGRAPHIC COLUMN of the IRON QUADRANGLE	Date of Issue Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.2-1.dwg

2.2 *Structural Geology*

The structure of the Iron Quadrangle district is characterized by domal granitoids, with thrust faulting and associated isoclinal folds, while the Rio das Velhas and Minas Supergroups are interpreted to have been thrust stacked to the west and northwest.

The Minas Supergroup has been subjected to a long history of geologic events, including uplifting, overturning, intrusions, and compressive and distensive deformations that created the appropriate structural conditions for deposition, migration and posterior alteration processes to concentrate the mineralization that has originated the iron deposits.

2.3 *Mineralization*

The main iron ore types in the Iron Quadrangle are:

Hematite: Hematite represents the high-grade ore type within the iron deposit. The iron content varies from 65 to 67 percent. It is either massive or foliated in nature. The hematite is classified according to its physical and chemical characteristics as Compact Hematite, Friable Hematite, and Goethitic / Argilitic Hematite. Its origin is related to hydrothermal or metasomatic processes.

Itabirite: Itabirite is a term widely used in Brazil to denote a metamorphosed iron formation composed of iron oxides (hematite, magnetite, and martite), abundant quartz, very rarely mica, and other accessory minerals. It may be foliated or compact. The un-enriched (poor) itabirites from the Quadrilátero Ferrífero tend to have little magnetite, and composed principally of quartz–hematite, quartz–hematite–carbonate and hematite–carbonate. Itabirite represents the majority of reserves and resources of the Iron Quadrangle deposits. According to Vale, it was originated by silica leaching and residual iron-oxide enrichment process during post-metamorphic weathering cycles. The iron content averages about 45 percent, and occasionally it may reach up to 60 percent. The Itabirite ore is classified according to its physical and chemical characteristics as Compact Itabirite, Friable Itabirite, Goethitic / Argilitic Itabirite or Ochre.

Canga: Canga ore consists of unconsolidated talus material formed by the weathering of the iron formation. The iron content ranges significantly, with generally high concentration of phosphorous and alumina.

Rolados: A second detrital mineralization type. Consists of a ferruginous or lateritic matrix with fragments and blocks of different materials such as hematite, itabirite, quartz; high Fe grade, with high contaminant levels, such as P and Al_2O_3.

2.4 *Exploration*

Vale's exploration programs are designed by two exploration divisions, the Long Term and the Short Term Planning. Long Term Planning is focused on exploration of new deposits and resource development by mapping and drilling with respect to geologic modeling. The Short Term Planning is based on detailed mapping and channel sampling at the mining operations and some close-spaced drilling. The following discusses the overall approach to drilling, sampling and logging applied at the Vale's Southern System.

2.4.1 Drilling

Vale bases resource estimates on diamond core drilling as the primary source of information. Geologic models for the projects in the Iron Quadrangle have been defined by data generated from drilling carried out by Vale as well as previous owners of these three properties that have been recently acquired. All core drilling is performed by independent contractors. Vale has well established procedures for drilling, including penalties.

In general, it is the Southern System policy for resource estimates to be based on a pattern of drilling at 100 by 100 meter centers, with closer spacing at 50 by 50 meters where geologic characteristics require additional detailing. The depth of drilling is more dependent on the mining programs. Drill holes are made both vertically and inclined to vertical. Down hole surveys are frequently made of inclined drill holes to measure deviation. In drilling programs Vale uses the services of technical independent contractors to review core recovery, which is estimated at over 90 percent by Vale. The contractor and the Vale technician each independently measure the recovered versus drilled intervals to calculate the core recovery. The core recovery data is entered into the Vale database (SMQP and BDP) and becomes a part of the database. Pincock observed numerous core boxes, at different mine sites, and was able to confirm a high rate of core recovery.

Core is placed into wooden core boxes at the drill site, and drill hole number and drilled intervals are marked on aluminum tags at the end of each box. The cores are transported to central storage facilities, where they are logged, sampled and stored.

Table 2-1 presents a summary of the drilling that has been completed at the three projects addressed in this audit. In general, the drilling is presented in two phases, that completed by previous owners before Vale acquired the property and the drilling completed by Vale. The date of acquisition was generally between 2002 and 2004.

2.4.2 Logging

The cores are transported to central storage facilities, where they are logged and stored. Core is stored on racks that are inventoried by deposit area and drill hole number. Core is retained until the area represented by the drilled interval is mined out. Core is logged on metal racks using natural light or flood lamps according to Vale's standard procedures. For the older Vale mines, this is according to standard procedure TP-DEGL-02 "Descrição Geológica dos Testemunhos de Sondagem" and standard procedure PRO-2004 "Procedimento para Gerenciamento e Aquisição de Dados de Sondagem em Ocorrências de Minério de Ferro" for the former MBR mines. All logging is based on lithological codes that indicate geologic descriptions and geotechnical characteristics of the core. Table 2-2 presents typical rock codes used in logging for the Southern System mines. Intervals from which analytical samples are to be taken

TABLE 2-1
Vale
Southern System Reserve Audit
Summary of Exploration Data

	No. of Drill Holes	Meters Drilled
Fábrica Complex		
João Pereira		
1974 to 2004	594	43,406
2004 to 2007	106	22,987
Total	700	66,393
Segredo		
1970 to 2004	432	29,366
2004 to 2007	126	26,324
Total	558	55,690
Vargem Grande Complex		
Abóboras		
1992 to 2004	40	2,925
2004 to 2006	135	20,189
Total	175	23,114
Tamanduá		
pre 1990 to 2001	129	35,158
2001 to 2006	307	37,261
Total	436	72,419
Capitão do Mato		
pre 1990 to 2001	96	13,170
2001 to 2006	436	59,131
Total	532	72,301
Apolo Project		
1970 to 1998	132	12,307
2001 to 2007	65	10,898
Total	197	23,205

TABLE 2-2
Vale
Southern System Reserve Audit
Lithological Rock Codes used for Logging Core Samples, Fábrica Complex

Hard Hematite	HC
Soft Hematite	HF
Argilitic Hematite	HAR
Manganiferous Hematite	HMN
Rich Soft Itabirite	IFR
Soft Itabirite	IF
Manganiferous Itabirite	IMN
Hard Itabirite	IC
Argilitic Itabirite	IAR
Aluminous Itabirite	IAL
Dolomitic Itabirite	IDO
Canga	CG
Laterite	LT
Intrusive Rocks	IN
Schist	XI
Dolomite	DOL
Ferruginous Quartzite	QF

are defined during the logging process. The log is recorded in a formal log form, which is later entered in the SMQP or BDP databases.

When the core is placed into wooden core boxes at the drill site, the drill hole number and drilled intervals are marked on aluminum tags at the end of each box. Figure 2-2 shows an example of the core box labeling and storage of the box at Vargem Grande Complex which is typical of the Vale operations.

Pincock examined the core storage facilities and found them to be in good shape. Pincock randomly picked a few drill holes to examine and log the core to check the database. The database was acceptable and in good order.

2.4.3 Sampling

Sampling of drill core for the Southern System Mines is carried out by Vale and/or contract geologists under a standard procedure that has been developed by Vale. Sampling norms have been established for the drill core according to the Operational Procedure (PRO). Some of the guidelines include:

- Standard length of sample: 10 m
- Maximum length: 15 m
- Minimum length: 5 m
- Sample weight: 25 kg
- All ferriferous formations shall be sampled
- Geological domains must be respected for sampling intervals

All samples are identified and recorded by contractor geologists and/or Vale prior to shipping them to the laboratory.

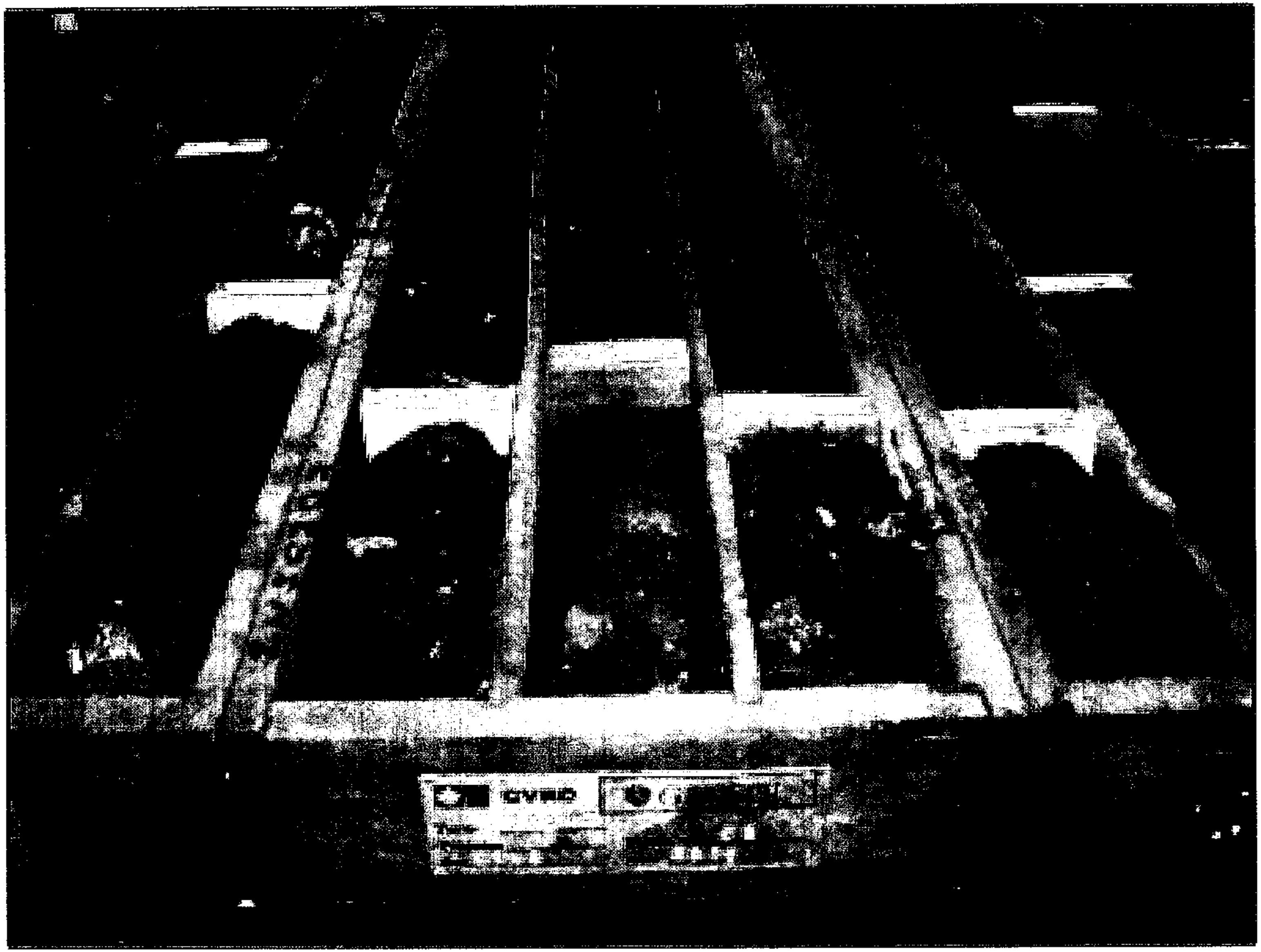
The criteria for sampling of drill core are defined in the Vale standard procedures. For the older Vale mines, this is standard procedure TP-DEGL-02 "Descrição Geológica dos Testemunhos de Sondagem" and PRO-2004 "Procedimento para Gerenciamento e Aquisição de Dados de Sondagem em Ocorrências de Minério de Ferro" for the former MBR mines. The general sampling criteria include:

- Standard length = 8 to 10 m. Defined as a function of the historical average of the sampling length and the standard height of mine benches that is used by Vale.

- Minimum length = 4.0 m. The calculation to define the minimum length is based on a minimum representative mass of 30 kg considering an average density of 3 g/cm^3.

- Maximum length = 12 m.

- All ferriferous formations (high and low grade ore) are sampled.



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pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	VALE	FIGURE 2-2 CORE SAMPLES at the VARGEM GRANDE CORE STORAGE FACILITY	Mar/2009
Project No. 9508 B	Project Name: Southern System		Drawing Name: Fig.2-2.dwg

Exception: in the case of monotonous sequences of hard itabirites (HIB), only the contact intervals are sampled.

- Dilution is avoided by observing the geological contacts and trying to distribute the intervals close to a standard length (8 m). The sampling of compact/ hard ferriferous formation (hematite/ itabirite) intervals together with samples of soft ferriferous formations is avoided.

- Ferriferous Formations: intercalations smaller than the minimum length (4m) is redistributed in equal parts in adjacent samples whenever possible, or sampled separately for bulk assaying purpose (Crude), without the whole grain size – chemical analysis.

- The core sampling procedures must respect the geological/ lithological contacts.

The sampling intervals are defined by the field geologist who also decides the lab routine for chemical and granulometric fraction analyses (whole rock and the granulometric fraction).

In addition to the drill core sampling, Vale carries out the channel sampling of the benches at active mine sites. Two types of sampling of mining faces are performed: punctual channels (CAP) and continuous channels (CAN). Both channels are excavated by a backhoe, which extracts the excavated material and piles it up laterally. The CAN type is usually performed through continuous trenches opened up parallel to the direction of the geological sections at 25 meter intervals. An example of channel sampling is illustrated in Figure 2-3.

FIGURE 2-3: Channel Sampling Method

A sample of approximately 60 kg of material of homogeneous lithology is collected from the pile(s) of excavated material. The sample is sent to the laboratory for the standardized grain size-chemical analysis. Recovery of the channel sample is considered as 100 percent. The length of the CAP type is standardized at 3 meters but the CAN length is variable according to the lithologic homogeneity of the excavated material.

2.5 *Sample Analysis*

Sample preparation and analytical procedures established by Vale are based on metallurgical properties of the orebody, and include determination of saleable products such as Lump Ore (LO), Sinter Feed (SF), Pellet Feed (PF) and tailings (<0.15 mm). The procedures are constantly revised and upgraded to incorporate new analytical techniques, laboratory structures, and new metallurgical requirements. These procedures are well documented in their reports. Figure 2-4 presents an example of one of the procedures which is applied at the Fábrica Complex. The general procedure is followed for samples for the Apolo and Vargem Grande projects, but the specific screen sizes for the granulometric analysis vary slightly.

The collected samples from the Fábric Complex are shipped to the laboratory. The laboratory performs the crushing, screening and chemical assaying, for evaluation of grain size partition corresponding to the products: Lump Ore, Sinter Feed and Pellet Feed, Fines plus tailings. The treatment of the drillhole samples includes the following steps:

- Reduction of grain size by crushing to -50 mm.
- Screening and classification of grains in four fractions: +6.3 mm; -6.3 mm +1.0 mm; -1.0 mm +0.15 mm; -0.15 mm.
- Chemical assays of all fractions and of the bulk sample.

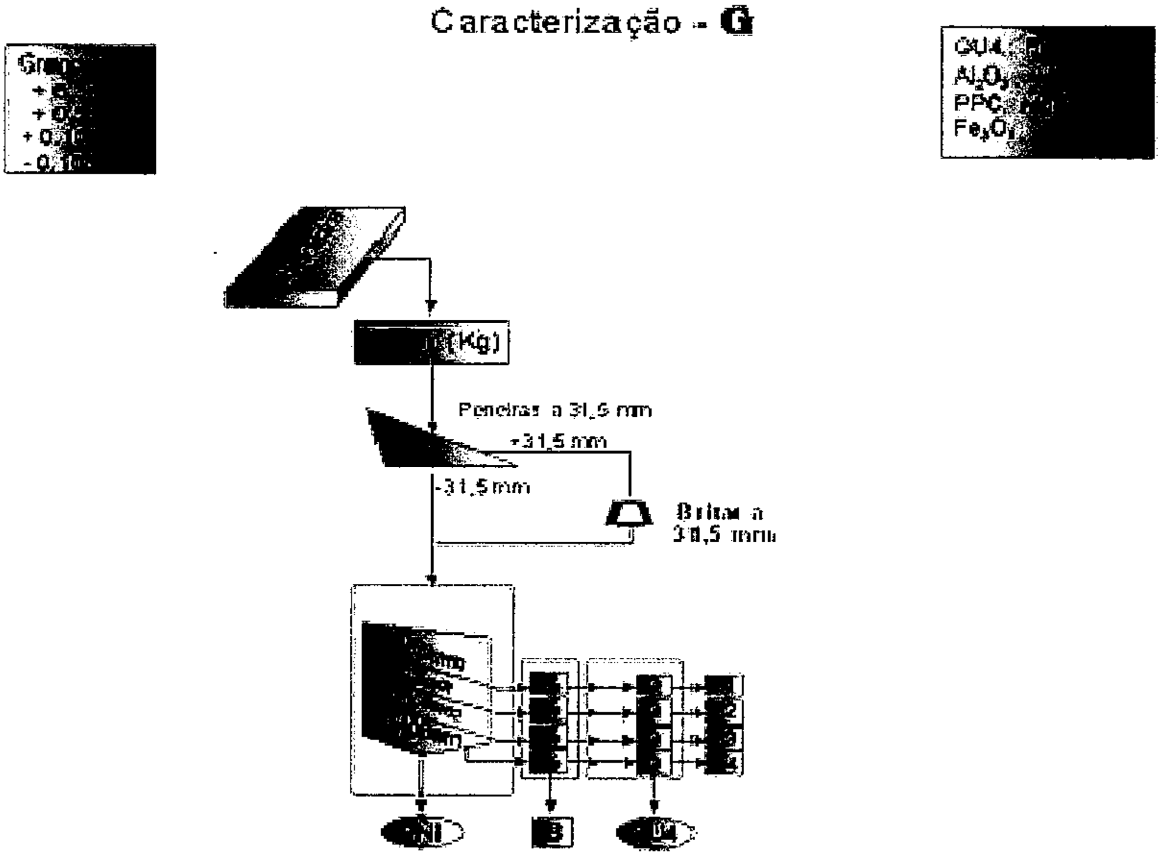
The Laboratory Department (GEQPR) is responsible for the physical and chemical analyses of all samples and for providing information on those tests to the Vale database (GIM – SMQP and the Nautilus) system. Vale has documented all the procedures used in sampling. Pincock examined the procedures and found them to be acceptable.

The Control used for drill hole samples is the evaluation of the Global Grade (Crude) of the samples against the weighted grades of granulometric fractions. The pulps containing the powdered samples are identified and filed for storage.

The determination of Fe, P, SiO_2, Al_2O_3, Mn, LOI, CaO, MgO, and TiO_2 content is performed through wet analysis, X-R fluorescence and ICP.

Plano de Análise - FBF

Caracterização - G



- Peneiramento a úmido
- Fe: análise via úmida
- SiO_2, Al_2O_3, P, Mn, TiO_2, CaO, MgO: até 2004 análise via plasma e após esta data, análise via RX pastilha fundida
- Fe_3O_4 medido via Satmagan
- PPC: análise gravimétrico
- Global: Apresentar apenas o calculado

LEGENDA

% Análise Granulométrica
Quim: Análise Química

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pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	VALE Project Name: Southern System	FIGURE 2-4 SAMPLE PREPARATION and ANALYSIS PROCEDURE FLOW CHART	Mar/2009
Project No. 9508 B			Drawing Name: Fig.2-4.dwg

2.6 *Sample QA/QC Procedures*

Vale has established strict controls on the lab equipments and in procedures to assure the best possible analytical results. Quality control of sample preparation is assured through the calibration of scales, screens, timers and thermometers. The analytical procedures include regular checks and proper calibration of the equipments and the use of certified reference material (CRM) or internal standard after each batch. The analytical results are also counterchecked by the stoichiometric balance of oxides. The results are also reproduced for the global grades and for granulometric fractions for quality checks. Duplicate samples and blanks are sent to the commercial laboratories for checks. The statistical analysis is carried out for comparison.

Figure 2-5 presents an example of correlation of original and duplicate samples. Overall the results show good reproducibility. Pincock examined the laboratory procedures and the results presented by Vale Laboratory staff, and accept the overall laboratory QA/QC procedures.

2.7 *Density Determination*

Density determinations for the Southern System Mines are carried out by either Vale technical staff or Contractors. The methodology used was:

- Calibrated Sand-filled Pit (FA)
- Volume displacement of solid rock core in water (DV) also referred to as the water immersion method
- Ratio of material removed from a drill hole to the volume of the drill hole (BH)

Table 2-3 summarizes the results of Vale's density studies. Pincock examined the procedures and results, and found them to be acceptable. Pincock believes that the number of samples (particularly the waste rocks) used for density determination should be increased in the future and values determined for each individual deposit. The information on density should be updated.

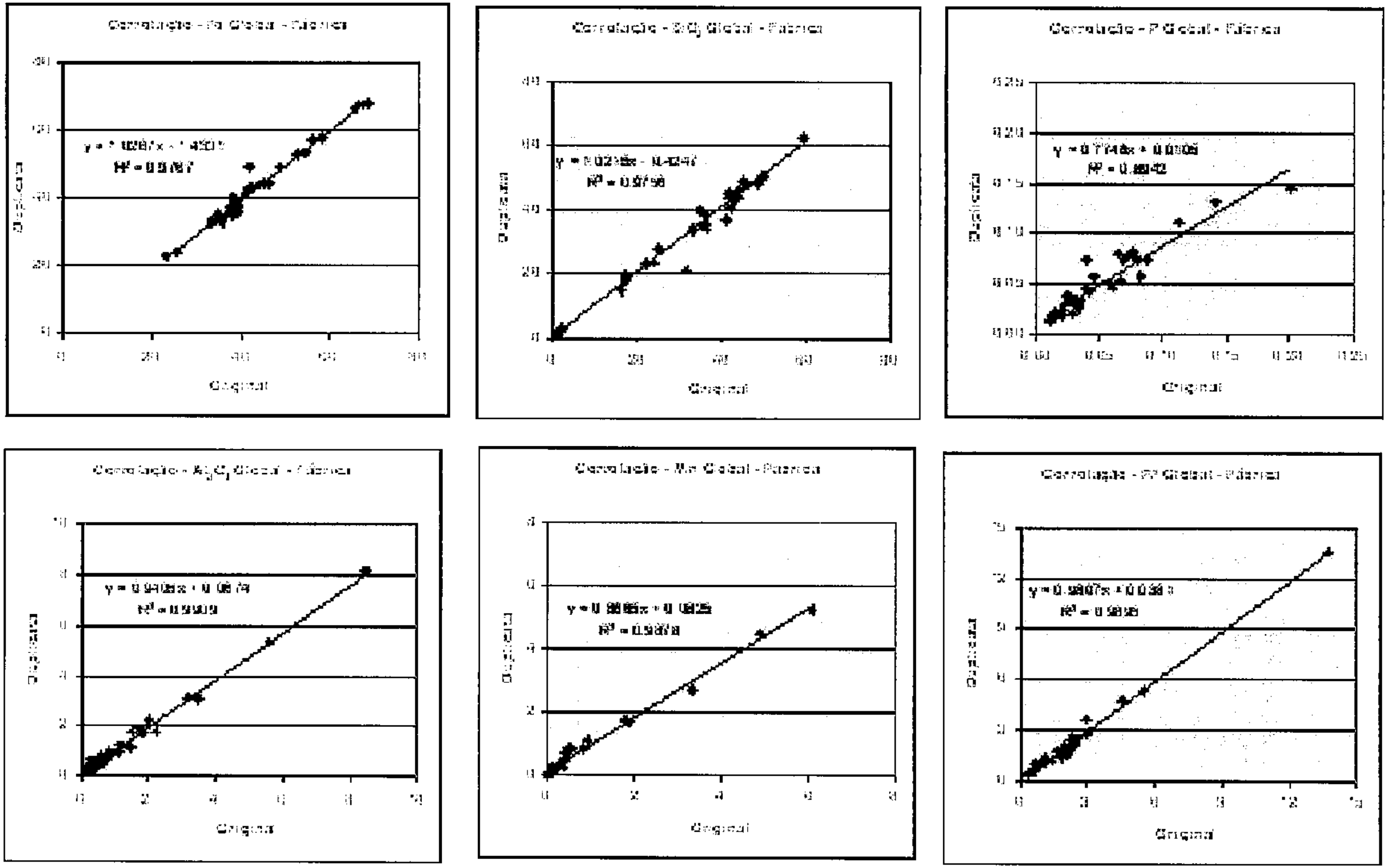

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FIGURE 2-5
GRAPHICAL CORRELATION BETWEEN ORIGINAL and DUPLICATE SAMPLES

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Mar/2009

Drawing Name
Fig.2-5.dwg

TABLE 2-3
Vale
Southern System Reserve Audit
Density Measurements of Various Lithological Units

Rock Code	Number of Samples	Natural Density	Dry Density	Moisture (%)	Analytical Method*
Hard Hematite – HC	91	4,45	4,43	0,35	DV / BH
Soft Hematite – HF	83	3,37	3,15	6,84	FA
Clay Hematite – HAR	21	2,91	2,71	7,06	FA
Manganiferous Hematite – HMN	9	3,15	2,90	8,20	FA
Rich Soft Itabirite – IFR	68	2,89	2,71	6,27	FA
Soft Itabirite – IF	137	2,67	2,55	4,69	FA / BH
Manganiferous Itabirite – IMN	13	2,85	2,52	11,81	FA
Hard Itabirite – IC	35	3,14	3,13	0,43	DV / BH
Argilitic Itabirite – IAR	91	2,64	2,40	11,48	FA
Aluminous Itabirite - IAL	6	2,73	2,44	11,00	FA
Dolomitic Itabirite – IDO	9	2,32	2,21	5,37	FA / DV
Canga – CG	15	3,18	2,83	10,76	DV
Laterite – LT	12	2,09	1,82	12,88	FA
Intrusive Rocks – IN	8	1,86	1,38	25,99	FA
Schist – XI	60	1,98	1,55	21,48	FA
Dolomite – DOL	15	2,74	2,73	0,10	DV
Ferruginous Quartzite - QF	22	2,38	2,25	6,41	FA

*DV – Volume Displacement or Water Immersion method; FA – Calibrated sand filled pit; BH – Ratio of material removed from a drill hole to the volume of the drill hole

3.0 RESOURCE MODELING AND GEOSTATISTICS

The approach to geostatistical analysis and resource modeling is basically standardized within the Vale Resource Modeling Group for both the Southern System and Northern System. The following sections discuss the approaches that are standardized. Discussions of the specific resource estimation that has been completed for each of the three areas of the Southern System that are addressed in this report are presented in Section 8 of this report.

3.1 *Approach to Modeling*

The geologic modeling and resource estimation procedures developed by Vale Resource Modeling Group are considered to be quite adequate for the purpose of supporting the development of Vale's reported statement of resources and reserves.

Vale's Resource Modeling Group for long-term planning is centrally located in Belo Horizonte. This group is responsible for generating geologic models, resource block models, and long-term mine plans for reserve estimation for all the Vale's iron ore mining operations. With this centralization of the geologic work, the basic procedures employed for all the iron ore mines are essentially identical. Estimates are generally made of the global analyses for Fe, SiO_2, Al_2O_3, P, Mn, and LOI (loss on ignition), and for granulometric fractions, but these vary from mine to mine, depending on the mineral characteristics. Vale's approach to geological modeling and resource estimation includes all the basic steps accepted by the international mining industry, as summarized in Table 3-1 for the Vargem Grande Complex and Apolo Project. Pincock performed a review of Vale's procedures during the audit process.

3.2 *Data Organization*

The initial step in the resource estimation process includes the storage of all data into the primary database computer (PDB), then ultimately exporting the data into VULCAN® for resource modeling. The geostatistical work is performed in Geovariance's ISATIS® Software. Some intermediate work is done in GEMS®. Datamine® software is also in some applications.

3.3 *Rock Codes*

The lithological units in the database are identified from field core logging. Vale is using a validation procedure to perform some additional checks on lithologic classification after the results of grain-size and chemical analysis are received. In this procedure, if the lithology from the drill core is described as soft itabirite, for example and the validation process (classification by grain-size and chemical analysis) identifies the rock as hard hematite, then the responsible geologist will make that correction in lithologic assignment at his discretion, to finalize the rock code. A typical example from the N4W and N4E deposits of the Carajás complex of the chemical and grain size criteria used to redefine lithological units is presented in Table 3-2.

TABLE 3-1
Vale
Southern System Reserve Audit
Vale's General Approach to Resource Modeling

Data Organization	Main data storage in either the BDP/SMQP database system at Vale's corporate office
	Original data gathering in Excel® and/or Access® files.
	Modeling data stored in Vulcan® and ISATIS® files.
Data Management	Drill hole data, sampling data, survey data, core logging sheets, etc.
	Channel sampling data from benches, Bench mapping, etc.
Consistency Checks	Re-surveying of old drill hole collars
	Visual checks on Drill hole location with topography
	Checks on assays and digital data entry
	Visual checks on digital data entry
	Automatic assay data entry by Laboratory (to avoid room for error)
	Re-assaying of old drill hole core samples
Statistics	Basic - Univariate and Multivariate Stats for global values and granulometric fractions
	Generation of Histograms, Probability plots, Scatter plots, Box-plots, Contact analysis ,etc
	All statistical studies done using ISATIS® software
Density Measurements	Calibrated Sand filled method on ore exposures
	Water Immersion method for intact rock core
	Open wells method
	Box Core method
Chemical Assay Data Handling	Grain-size analysis
	Comparative study of Global analyzed values with calculated values
	Comparative study of duplicate samples
	Inter-laboratory cross-checks and comparison study
	QA/QC checks
	Drill recovery and grain-size chemical bias and recalculation
Geological Modeling	Vale uses either On-screen method or Cell Model method or combination of these methods
	Generation of cross-sections and plan-views
	On-screen interpretation and generation of solids by extrusion of plan-view polygons, Wire frames, etc
	Also used is Indicator Kriging of lithological units with sample data
	Re-evaluation and identification of lithology using chemical data for modeling.
Variography	ISATIS ® is used for modeling
	Vale uses Linear Model of Coregionalization (LMC) for all the chemical variables.
	Correlograms plots separated by elements or in combination
	Averaged correlogram models for all granulometric fractions
	Nugget constants from downhole correlograms
Grade Interpolation (Kriging)	Block estimation by Ordinary Cokriging (OCK) using geological domains
	Peripheral and empty blocks are filled by ISD and Declustering Averages Methods
	Octant based search ellipsoids (maximum two by octant)
	Estimation done to a parent cell size
	Kriging process weighted by composite length
	Search ranges are based on LMC variography
	Vale used "Dilation and Erosion" method for Segredo and Joao Pereira deposits
Resource Classification	Based on "Risk Index" analysis proposed by Ribeiro and Amorim (Vale Geostatistician)
Resource Model Validation	**Statistical Comparison Checks include:**
	Global Bias
	Grade Interpolation ranges compared to composite ranges
	Averages and distribution
	Nearest Neighbor method includes:
	Global Bias
	Local Bias by Bench
	Local Bias by section
	Trends
On-screen Inspection	Sections are randomly chosen
	Composites and Kriged grades visually compared

Table 3-2 presents the classification criteria whereby Fe is the iron content and G1 is the percentage of material larger than 6.3 mm after crushing the sample to a maximum 50 mm particle size in the laboratory. This final rock code assignment is made after the validation performed using tests for stoichiometric balance of oxides for each litho-unit in addition to the validation procedure based on grain-size chemical analysis and geological interpretation.

TABLE 3-2
Vale
Southern System Reserve Audit
Typical Criteria for Validating Lithological Codes

Lithology	Final Code	Criteria Used
Friable Hematite	HF	Fe ≥ 60% e G1 < 50%
Compact Hematite	HC	Fe ≥ 60% e G1 ≥ 50%
Manganiferous Hematite	HMN	Fe ≥ 55% e Mn ≥ 2%
Structural Canga	CE	Fe ≥ 55%
Chemical Canga	CQ	Fe < 55%
Ferro- manganese	FM	Fe < 55% e Mn ≥ 2%

Vale believes that these checks are necessary to confirm field classification of lithology. The ore-bearing rock codes currently used by Vale for modeling are summarized in Table 3-3.

During the audit process Pincock found the resulting dataset contained numerous rock codes with what appears as only minor mineralogical differences. Vale considers it necessary to have a more detailed estimation of the mining blocks, since most of the geological contacts are well identified and should be taken as "hard contacts" during the geostatistical estimation. However, Pincock suggests a review be made to further simplify the number of rock codes used in the geologic models for resource estimations.

3.4 *Data Consistency Check*

Vale uses four different steps to check the consistency of data in the geologic modeling process as follows:

1. Re-surveying of old drill hole collars
2. Conducting checks on drill hole location with topography
3. Re-assaying of old drill hole core samples
4. Performing visual checks on assays and digital database entries

Pincock performed some visual checks on assay, digital database, and drill hole location with topography, and found the values to be free of error. The dataset presented by Vale was considered to be in excellent condition.

TABLE 3-3
Vale
Southern System Reserve Audit
Rock Codes Used in Geologic Classification

		Vargem Grande Complex			Fabrica Complex			Carajas Complex		
Rock Type	Code	Tamanduã	Aboboras	Capitão do Mato	Segredo	João Pereira	Apolo	N4E	N4W	Serra Sul
Compact Hematite	HC	HC	HC	HC	HC	HC	HC	HC	HC	HC
Friable Hematite	HF	HF	HF	HF	HF	HF	HF	HF	HF	HF
Medium Hematite	HM			HM						
Friable Contaminated Hematite	HFC			HFC						
Contaminated Hematite	HMC	HMC	HMC	HMC						
Iron Clay Hematite	HAR				HAR	HAR				
Siliceous Hematite	HCS	HCS	HCS							
Manganiferous Hematite	HMN				HMN			HMN	HMN	HMN
Friable Siliceous Itabirite	IFS	IFS	IFS	IFS						
Contaminated Itabirite	IFC	IFC	IFC	IFC						
Manganiferous Itabirite	IMN	IMN	IMN		IMN	IMN				
Compact Itabirite	IC	IC	IC		IC	IC	IC			
Compact Siliceous Itabirite	ICS			ICS						
Medium Siliceous Itabirite	IMS	IMS	IMS	IMS						
Rich Soft Itabirite	IFR				IFR	IFR				
Dolomitic Itabirite	IDO				IDO	IDO				
Soft Itabirite	IF				IF	IF	IF			
Goethitic Itabirite	IGO						IGO			
Iron Clay Itabirite	IAR				IAR	IAR				
Ochre	OC						OC			
Canga – Chemical	CQ							CQ	CQ	CQ
Canga – Structural	CE							CE	CE	CE
Canga	CG	CG	CG	CG	CG	CG	CG			
Detrital Ore	RO				RO	RO				
Jaspilite	JP							JP	JP	JP
Rich Jaspilite	JR									JR
Ferro Manganese	FM							FM	FM	

3.5 *Basic Statistics*

Vale has performed extensive statistical studies on all of the mines reviewed by Pincock for this audit. The study includes univariate statistics for all of the chemical variables used in the modeling of lithological domains and related granulometric fractions. The comparison of basic statistics of the original samples (raw data), the composites, and the block model estimates have been summarized by Vale for Pincock's review. Within the scope of the resource and reserve audit, Pincock performed limited checks of comparison studies, and found the data to be within acceptable limits. No major differences were identified.

Vale also generated numerous histograms and box-plots graphics for the raw data, composites, and block estimates. Pincock reviewed the data and duplicated the graphics on histograms and box plots for Segredo, Apollo, and Serra Sul mines, and found them acceptable. An example of statistical study performed by Vale on composites on Apollo deposit is included in Table 3-4.

Examples of histograms of variable Fe (hematite) from the Abóboras deposit of the Vargem Grande Complex and box-plot of variable Fe_gl (hematite) from the N4W deposit of the Carajás Complex are presented in Figures 3-1 and 3-2.

3.6 *Compositing*

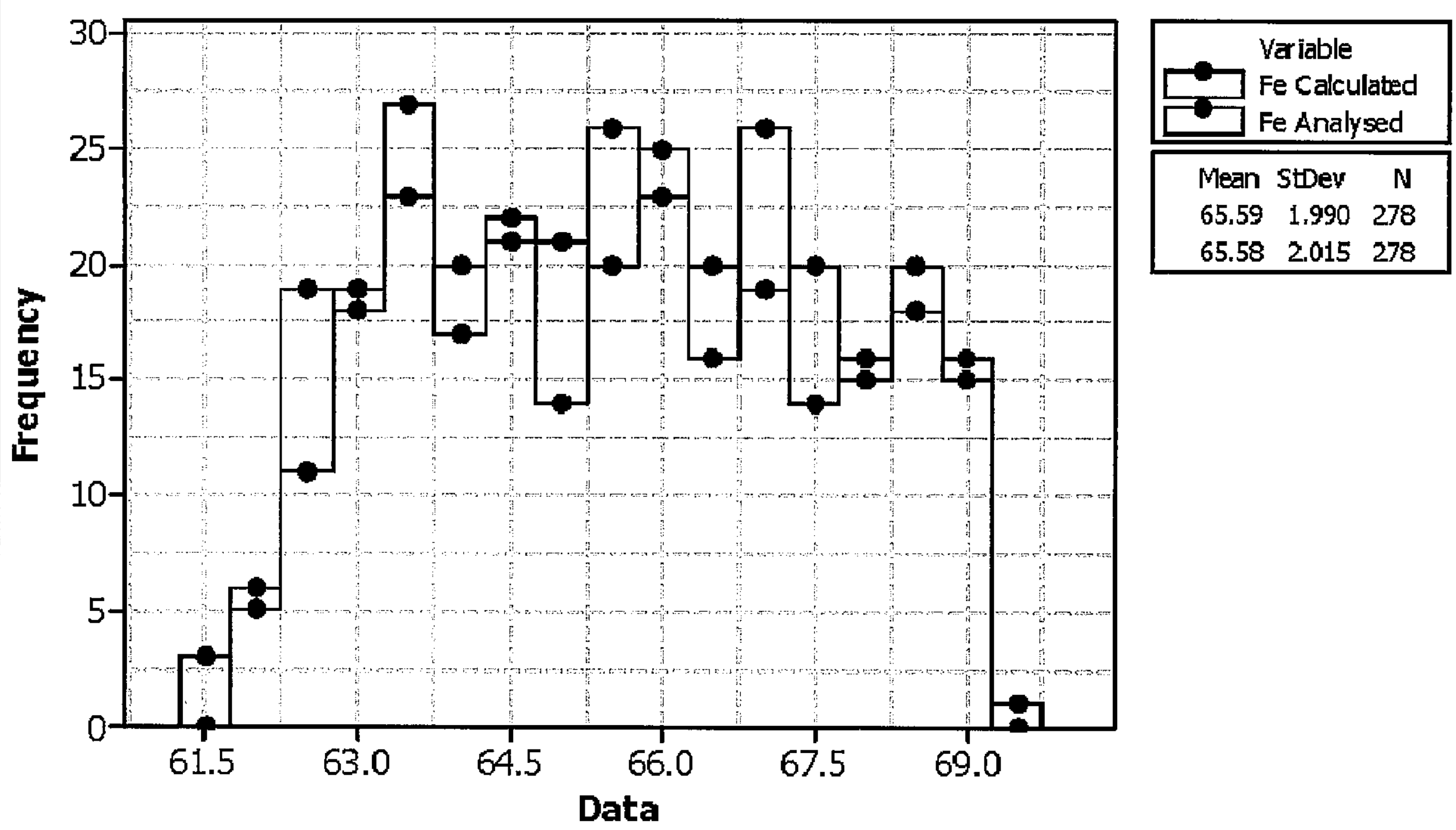
Drill hole composites are produced using variable downhole lengths. Based on the drill hole log information for each deposit, the composites are broken at geological boundaries. Though the length of the drill core samples analyzed varies from 0.5 m to more than 15 m, in a geostatistical sense the support samples' lengths are standardized in composites to match the actual mining bench height and the block model vertical cell height.

For the deposits reviewed in this audit, except the N4E and N4W deposits, the length of the composites remain uniform. In the case of the N4E and N4W deposits, this was not done by Vale because of the thickness variability and the nature of the contacts of the lithological units. Vale performed statistical analysis to determine which composite interval is acceptable (in this case) for grade estimation procedure. Its study revealed that variable lengths of 3 to 15 meter composites can be used for grade accumulation for the N4E and N4W deposits because the sample weights of less than 15 meter composites are too low to influence the outcome. Vale assumed that all the composites above 3 meters have the same representation.

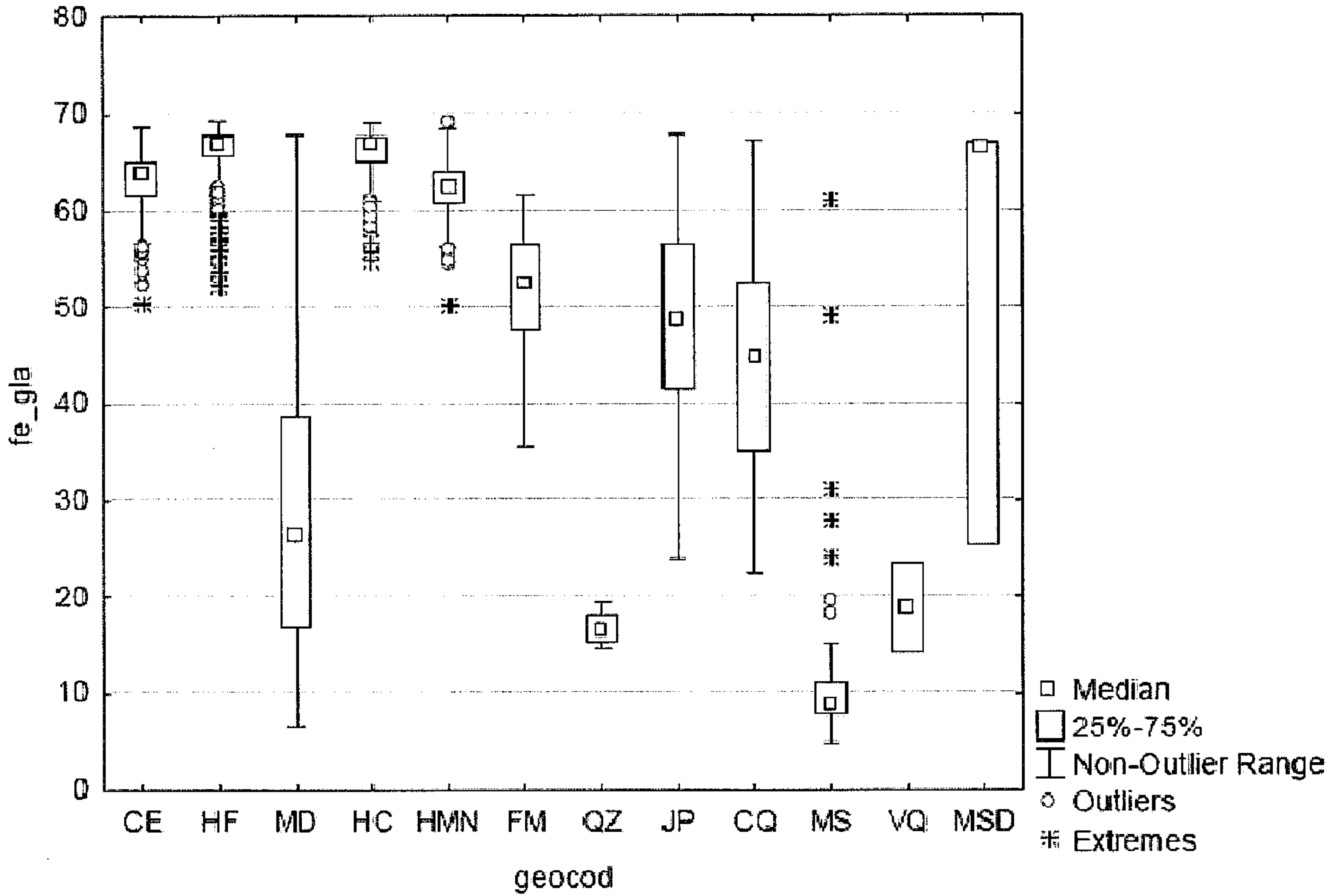
Pincock performed checks on a number of composites during the audit and found that the composites were calculated correctly.

TABLE 3-4
VALE
Southern System Reserve Audit
Composite Univariate Statistics for Apolo Deposit

Lithology	Lithological Code	Variable	No. of Samples	Minimum	Maximum	Mean	Median	Std. Dev	Variance	Coeff. Variation	Q1	Q3
Canga	CG	FEGL	158	42.576	67.438	58.201	58.830	5.033	25.336	0.086	54.943	62.084
Compact Hematite	HC	FEGL	31	61.225	68.180	64.562	65.135	1.624	2.638	0.025	63.552	65.513
Soft (Friable) Hematite	HF	FEGL	631	59.493	68.054	63.598	63.732	1.915	3.666	0.030	62.033	65.049
Compact Itabirite	IC	FEGL	254	27.434	53.951	39.836	39.712	4.160	17.308	0.104	37.319	42.506
Friable Itabirite	IF	FEGL	339	12.913	60.235	48.181	48.565	7.673	58.882	0.159	42.364	54.827
Goethitic Itabirite	IGO	FEGL	313	10.900	62.158	51.812	54.304	8.331	69.402	0.161	48.743	57.585
Ochre	OC	FEGL	304	18.459	63.751	53.774	56.330	7.996	63.931	0.149	52.078	58.819
Canga	CG	SIGL	158	0.580	10.475	2.430	1.717	2.028	4.111	0.834	1.261	2.561
Compact Hematite	HC	SIGL	31	0.646	5.644	1.739	0.972	1.321	1.746	0.760	0.802	2.612
Soft (Friable) Hematite	HF	SIGL	631	0.460	12.042	2.849	2.188	2.002	4.006	0.703	1.418	3.664
Compact Itabirite	IC	SIGL	254	16.292	55.390	39.281	39.960	5.940	35.279	0.151	36.630	42.681
Friable Itabirite	IF	SIGL	339	1.239	78.117	26.422	26.571	11.703	136.955	0.443	16.508	35.057
Goethitic Itabirite	IGO	SIGL	313	0.897	73.122	15.815	12.447	13.474	181.537	0.852	5.135	22.491
Ochre	OC	SIGL	304	0.799	68.621	9.254	3.570	12.656	160.170	1.368	2.359	9.759
Canga	CG	PGL	158	0.025	0.340	0.109	0.095	0.058	0.003	0.532	0.067	0.140
Compact Hematite	HC	PGL	31	0.031	0.249	0.116	0.098	0.061	0.004	0.529	0.079	0.158
Soft (Friable) Hematite	HF	PGL	631	0.007	0.266	0.073	0.065	0.038	0.001	0.515	0.044	0.094
Compact Itabirite	IC	PGL	254	0.010	0.339	0.052	0.049	0.023	0.001	0.437	0.036	0.063
Friable Itabirite	IF	PGL	339	0.013	0.154	0.046	0.045	0.016	0.000	0.355	0.034	0.059
Goethitic Itabirite	IGO	PGL	313	0.020	0.343	0.115	0.103	0.057	0.003	0.501	0.079	0.138
Ochre	OC	PGL	304	0.009	0.357	0.103	0.090	0.064	0.004	0.617	0.060	0.120
Canga	CG	ALGL	158	0.896	16.205	5.583	5.101	3.483	12.128	0.624	2.491	7.563
Compact Hematite	HC	ALGL	31	0.242	3.332	1.415	1.050	0.934	0.872	0.660	0.709	2.002
Soft (Friable) Hematite	HF	ALGL	631	0.010	6.302	2.006	1.768	1.066	1.137	0.531	1.194	2.611
Compact Itabirite	IC	ALGL	254	0.053	22.553	0.577	0.380	1.275	1.626	2.210	0.261	0.631
Friable Itabirite	IF	ALGL	339	0.200	8.634	1.301	1.121	0.918	0.843	0.706	0.676	1.590
Goethitic Itabirite	IGO	ALGL	313	0.294	7.681	2.213	1.654	1.648	2.716	0.745	1.019	3.012
Ochre	OC	ALGL	304	0.315	14.896	2.893	2.378	2.152	4.631	0.744	1.514	3.704
Canga	CG	MNGL	158	0.010	4.260	0.167	0.073	0.425	0.181	2.546	0.055	0.112
Compact Hematite	HC	MNGL	31	0.019	2.973	0.351	0.161	0.550	0.303	1.568	0.100	0.368
Soft (Friable) Hematite	HF	MNGL	631	0.009	7.640	0.280	0.134	0.427	0.182	1.523	0.068	0.337
Compact Itabirite	IC	MNGL	254	0.001	2.029	0.096	0.048	0.182	0.033	1.900	0.019	0.103
Friable Itabirite	IF	MNGL	339	0.001	2.707	0.152	0.066	0.284	0.081	1.870	0.025	0.149
Goethitic Itabirite	IGO	MNGL	313	0.011	11.733	0.515	0.157	1.152	1.326	2.236	0.081	0.505
Ochre	OC	MNGL	304	0.003	3.540	0.303	0.172	0.413	0.171	1.362	0.098	0.368
Canga	CG	PFGL	158	1.448	14.236	7.571	7.078	3.178	10.097	0.420	4.908	9.617
Compact Hematite	HC	PFGL	31	1.381	6.409	3.774	4.006	1.137	1.292	0.301	2.907	4.471
Soft (Friable) Hematite	HF	PFGL	631	0.716	9.862	3.433	3.071	1.726	2.978	0.503	2.228	4.251
Compact Itabirite	IC	PFGL	254	0.317	10.227	2.826	2.751	1.599	2.557	0.566	1.487	3.775
Friable Itabirite	IF	PFGL	339	0.131	10.188	2.507	2.064	1.512	2.285	0.603	1.512	3.155
Goethitic Itabirite	IGO	PFGL	313	1.348	13.556	6.358	5.895	2.804	7.861	0.441	4.158	8.311
Ochre	OC	PFGL	304	3.092	16.062	9.784	9.804	2.368	5.608	0.242	8.113	11.695
Canga	CG	G1	158	7.085	100.000	39.455	38.178	15.948	254.346	0.404	28.073	48.953
Compact Hematite	HC	G1	31	51.323	100.000	81.801	83.543	12.701	161.303	0.155	69.512	90.330
Soft (Friable) Hematite	HF	G1	631	4.516	93.232	33.232	31.124	15.094	227.821	0.454	23.200	40.864
Compact Itabirite	IC	G1	254	37.640	100.000	81.754	83.914	13.619	185.483	0.167	69.834	93.783
Friable Itabirite	IF	G1	339	5.945	70.382	31.967	31.596	14.056	197.580	0.440	19.630	43.182
Goethitic Itabirite	IGO	G1	313	6.377	94.419	40.909	39.293	17.438	304.072	0.426	27.643	50.150
Ochre	OC	G1	304	1.169	93.003	31.422	28.669	16.036	257.147	0.510	21.722	37.869
Canga	CG	G2	158	0.000	56.310	21.574	20.161	8.591	73.803	0.398	16.664	24.557
Compact Hematite	HC	G2	31	0.000	23.102	9.385	7.987	6.567	43.127	0.700	4.720	13.493
Soft (Friable) Hematite	HF	G2	631	3.093	50.167	22.868	21.494	7.142	51.007	0.312	17.744	27.285
Compact Itabirite	IC	G2	254	0.000	25.751	8.217	7.210	6.085	37.023	0.741	3.092	13.061
Friable Itabirite	IF	G2	339	5.988	42.773	19.367	18.674	5.799	33.634	0.299	15.553	21.820
Goethitic Itabirite	IGO	G2	313	3.602	46.299	22.993	21.734	8.439	71.210	0.367	17.413	28.100
Ochre	OC	G2	304	3.825	65.818	27.953	28.516	11.557	133.575	0.413	17.579	37.339
Canga	CG	G3	158	0.000	29.415	11.542	11.379	3.943	15.543	0.342	9.287	13.833
Compact Hematite	HC	G3	31	0.000	9.614	3.698	3.976	2.614	6.835	0.707	1.348	5.489
Soft (Friable) Hematite	HF	G3	631	1.752	31.479	13.626	12.493	4.902	24.032	0.360	10.191	16.266
Compact Itabirite	IC	G3	254	0.000	13.069	3.545	2.249	3.194	10.205	0.901	0.961	6.222
Friable Itabirite	IF	G3	339	3.392	24.346	11.638	10.783	4.075	16.604	0.350	8.846	13.829
Goethitic Itabirite	IGO	G3	313	0.796	32.918	12.603	11.948	5.236	27.413	0.415	9.287	15.658
Ochre	OC	G3	304	1.530	34.384	14.720	13.758	6.526	42.586	0.443	9.320	20.166
Canga	CG	G4	158	0.000	71.542	27.429	26.085	15.069	227.082	0.549	17.345	37.193
Compact Hematite	HC	G4	31	0.000	26.319	5.116	4.514	4.830	23.328	0.944	2.160	7.296
Soft (Friable) Hematite	HF	G4	631	1.229	62.577	30.272	29.855	11.840	140.180	0.391	22.368	38.686
Compact Itabirite	IC	G4	254	0.000	26.706	6.483	5.320	5.768	33.265	0.890	1.705	9.626
Friable Itabirite	IF	G4	339	9.857	71.173	37.028	37.145	12.840	164.854	0.347	27.303	46.426
Goethitic Itabirite	IGO	G4	313	0.498	63.441	23.495	21.934	12.527	156.917	0.533	13.896	30.984
Ochre	OC	G4	304	1.000	80.106	25.904	18.764	19.196	368.492	0.741	10.957	39.731



Prepared by pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	Drawing Provided by/Prepared for VALE	FIGURE 3-1 HISTOGRAM of Fe Calculated and Fe Analyzed ABOBORAS DEPOSIT, VARGEM GRANDE COMPLEX	Date of Issue Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.3-1.dwg



Prepared by pincock, allen & holt, 165 S. Union Boulevard, Suite 950, Lakewood, Colorado 80228, Phone (303) 986-6950	Drawing Provided by/Prepared for VALE	FIGURE 3-2 BOX PLOT of GLOBAL IRON (Fe_gla) N4W DEPOSIT	Date of Issue Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.3-2.dwg

3.7 *Geological Modeling*

Vale is using two separate methods to build a geological model:

- On-screen Method for preliminary interpretation
- Cell Model Method for final interpretation

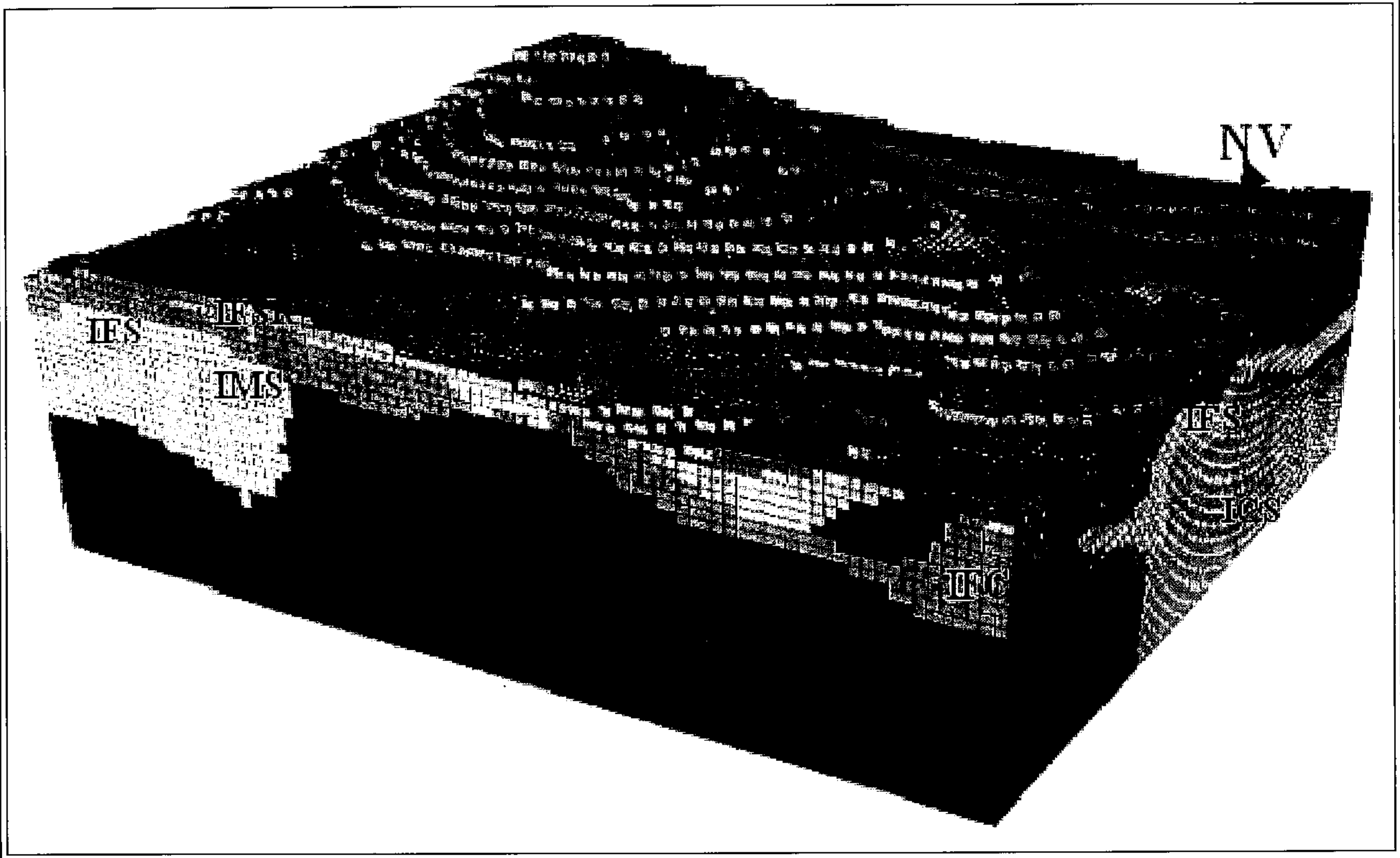
On-screen method is a two-step approach used by Vale personnel, which involves an on-screen generation of cross sections and plan views followed by on-screen geological data interpretation. The geologic model is based primarily on the interpretation of geological contacts between several drill holes in cross sections. The interpreted lithological contacts from the cross sections are then transferred to the plan views. After the interpretation of the geology, solids are generated on-screen by extrusion of plan-view polygons for each lithological unit to define their domains.

The revised new method known as Cell Model is now being used widely to update the old models. In this method the cross-sections are generated on a predefined uniform grid and revised lithological codes. The cross-sections are filled with blocks that create model cells. 3-D solids are then created using wireframes. This is done separately for both waste and ore rock codes. The interpolation of the block model is then performed by indicator krigging (IK) using the sample data. The indicators are the center point of the uniform blocks. These points are generated by splitting the polygons from both plan-views and cross-sections. This procedure is carried out in all cross-sections and plan-views using the lithological and sampling data files. The variography (Indicator variograms) is performed using predefined lithological indicators (combination of litho-types). Each indicator is individually krigged using the same search parameters. The axes of ellipsoid may or may not be rotated. The major search is always carried out in the strike direction to respect the geologic continuity of the banded iron ore formation.

The cell model is the combination of three separate models: ore plan-view, ore cross-section, and waste rock models. Figure 3-3 shows the lithological Block Model of Capitão Do Mato deposit, Vargem Grande Complex as a typical example.

Pincock believes that this cell model method developed by Vale is complex, and may not be necessary for this type of deposit. Pincock examined several interpreted cross-sections of different deposits. While Pincock usually concurred with the geologic interpretations, in some cross-sections shallow drill holes did not fully support the geologic interpretation of ore body continuity. Pincock did not find any longitudinal sections. It is our opinion that generation of longitudinal sections will facilitate on-screen interpretation

For geostatistical studies, Vale has treated each lithological unit as a separate domain. The reason for this separation is that the granulometric size fractions have different characteristics in different geological environments. This difference has a direct impact on their ore processing characteristics, including total mass recovery and type and grade of final product. Hence, the contact analysis is an integral part of the modeling process. It requires pairing of composites according to separation distance and plotting average value by separation distance. The plots are then used to determine the composite selection depending on whether the lithological contact should be treated as a hard contact or a soft contact.



Prepared by pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	Drawing Provided by/Prepared for VALE	FIGURE 3-3 LITHOLOGICAL BLOCK MODEL, CAPITAO DO MATO DEPOSIT SW EXTENSION, VARGEM GRANDE COMPLEX	Date of Issue Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.3-3.dwg

The contacts are defined as a hard contact where the difference is sharp and as a soft contact where the difference is gradational. Pincock examined these characteristics, reviewed Vale's contact analyses data and plots, and found no significant difference in the value of the mean grade as the soft contact is approached from either side. In that case the composites from either side of the contact may be used for kriging these domains regardless of their distance. In the case of a hard contact, Pincock found significant change in the mean grade values as the contact is approached from either side. In this case, the lithology dictates the use of composites for kriging these domains. The composites used are limited and depend on the lithology.

Figure 3-4 presents both types of contact examples from Serra Sul deposit, Carajás Complex.

Pincock concludes that a sharp change in the granulometric size fractions does exist on either side of the different geological domains, and concurs with Vale's treatment of individual geological domains as spatial domains.

3.8 *Variography*

Vale personnel have conducted detailed and extensive variography for each deposit. Vale used Linear Model of Co-regionalization (LMC) for all the chemical variables (Fe, Al, Si, P, Mn, and LOI) in each granulometric fraction. LMC is a technique that ensures that estimates derived from co-kriging have a positive or zero variance. To ensure this, the sill matrices for each basic structure must be positive definite. Pincock believes that this method is more logical and acceptable on the grounds that it is effective for modeling the spatial correlations of multivariate data at each scale, and it could extract the hidden spatial correlation at the regional scale.

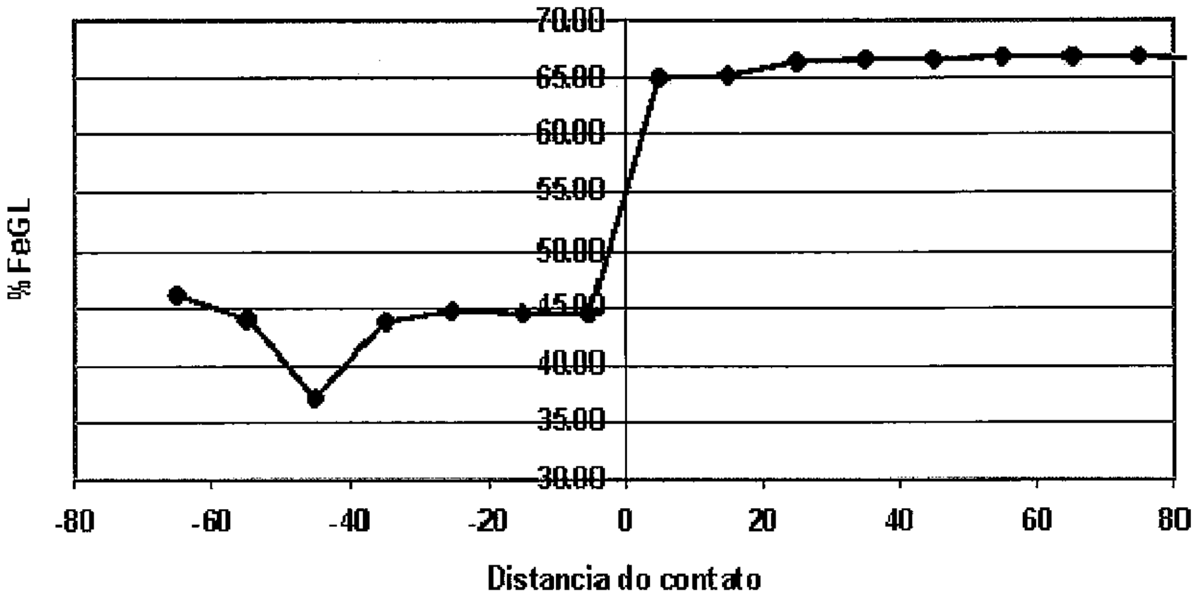
The LMC is based on the global grade variogram models or cross variogram models, using the automatic sill fitting option in Isatis®. LMC is performed in two steps:

1. Both direct semi-variograms are first modeled as linear combination of selected basic structures, and

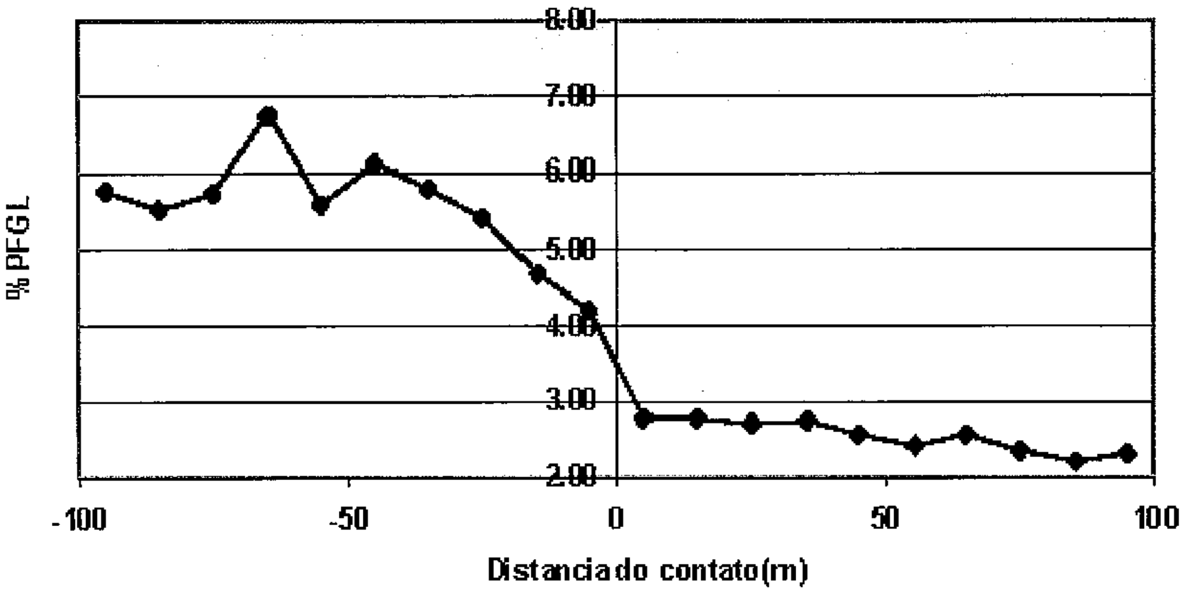
2. The same basic structures are then fitted to the cross semi-variogram under the constraint that the sill matrices are positive definite.

The semi-variograms or cross variograms are calculated in sets of two or four chemical variables for the granulometric fractions to define correlation between each variable. The experimental as well as the model semi-Variograms and/or cross variograms are generated in the down hole as well as in the various horizontal directions.

Figure 3-5 shows typical experimental and modeled variograms which in this case were developed for the N4E North and N4E South deposits of the Carajás Complex and are representative of variography procedures used for the Southern System deposits.

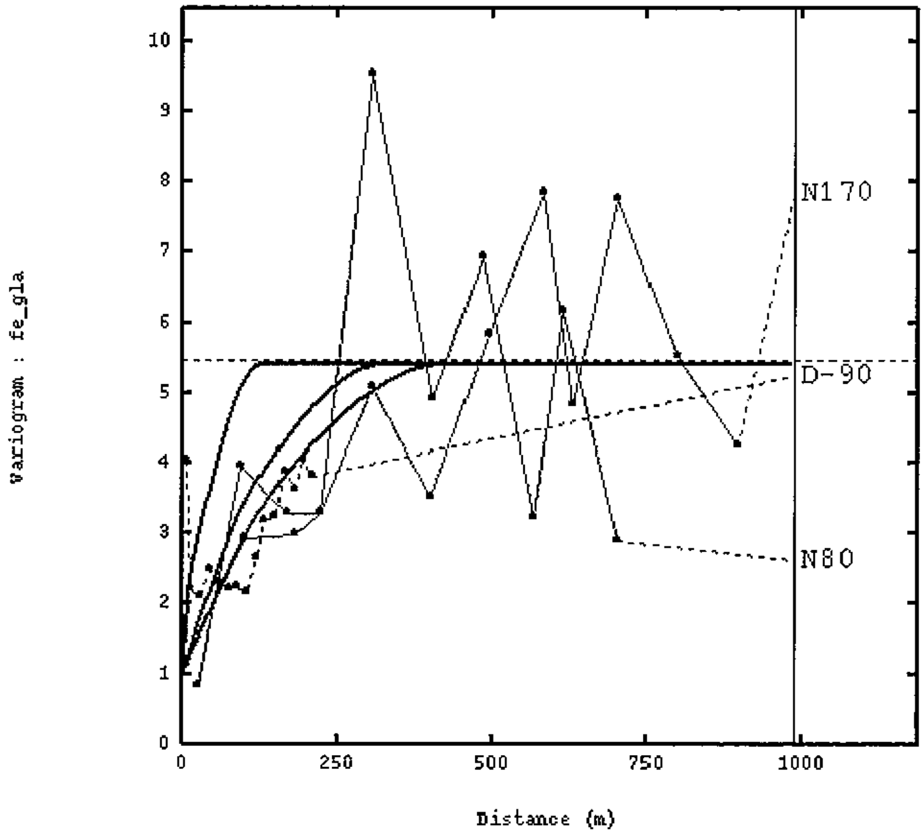


Hard Contact

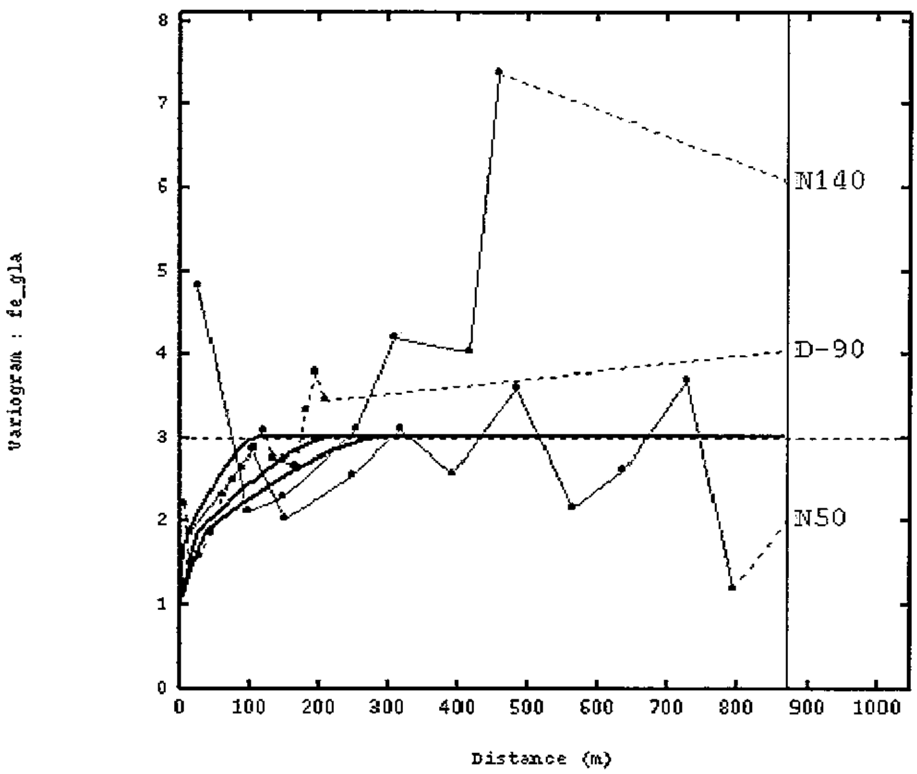


Soft Contact

Prepared by pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	Drawing Provided by/Prepared for VALE	FIGURE 3-4 CONTACTS SERRA SUL DEPOSIT CARAJAS COMPLEX	Date of Issue Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.3-4.dwg



(A) N4E North



(B) N4E South

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pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	VALE	FIGURE 3-5 EXPERIMENTAL and MODELED SEMI-VARIOGRAMS GLOBAL Fe of HEMATITE	Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.3-5.dwg

Pincock observed anisotropies (grade variation) in many of the Vale's variogram models, and believes that it is linked directly to the subsurface geological environment (supergene enrichment). Pincock performed checks on a few correlograms for compliance of 3D model with the experimental data for several variables. Both models generally showed very good integrity.

3.9 *Grade Accumulation*

Before sample compositing, Vale uses a grade accumulation procedure known as "Special Variability Analysis" for the grade estimation. This procedure requires the size fraction proportions (as percentage of the total sample after crushing and screening to a minus 31 mm size) and the accumulated assay value for each size fraction. The grade accumulation assay value for a given size fraction is calculated by multiplying percentage of a given size fraction by the assay of that same size fraction. For example, AFeG1 = G1 (% of +6.3mm fraction) x FeG1 (% of Fe in the +6.3mm fraction). This procedure is carried out to make sure all the composites are appropriately (weighted) in the block estimation. This procedure is standard for all the iron ore mines based on the fact that the individual assay of each size fraction can only represent the volume of that size fraction. Hence, it is required that the samples be weighted using their relevant size fraction.

In addition to the above procedure, Vale also used a mobile cell declustering method to define overall weighted mean grades. In this method, each sample is assigned a weight inversely proportional to the quantity of samples contained in a cell (or a block) of predefined dimension. This procedure smoothes the effects caused by the preferential sample clustering.

3.10 *Grade Estimation and Kriging Plan*

Vale's approach to grade estimation is based on the following steps:

1. Blocks are estimated by the Ordinary Co-kriging (**OCK**) method using all the geological domains. In some areas where the data was scarce particularly in the peripheral zones of the block model area, the alternate **IDS** (Inverse Distance Squared) and/or **TDA** (total declustered average) methods were used to estimate the block value. Some block grade estimation required correction. This was accomplished by employing linear regression analysis. The stoichiometric checking was performed by standard mathematical procedure.

2. An octant based search ellipsoid (maximum two by octant) is generated

3. Estimation is done to a parent cell size

4. Kriging process is performed

An ellipsoid is used in the sample search, oriented according to the main variography direction. The search is carried out using either one pass search or multiple pass searches along the major axis, the semi-major axis, and the minor (vertical) axis. The search ranges are based on the modeled variograms (correlograms) or cross variograms (defined by **LMC**) for each deposit.

The kriging parameters defined by Vale are adequate and reasonable.

3.11 *Resource Model Validation*

The resource model validation conducted by Vale is performed by:

1. Statistical comparison checks of:

- Global Bias
- Grade interpolation ranges compared to composite ranges
- Averages and Distributions

2. Nearest Neighbor Model:

- Global Bias
- Local bias by bench
- Local bias by section
- Trends

3. On-screen inspection

- Some sections are randomly chosen;
- Composites and Krigged grades are visually compared

Vale provided a series of block model cross-sections and bench plots of krigged estimates for all the deposits under review for this audit. Pincock performed visual inspection of these bench plots and cross-sections. Nearest Neighbor model statistics for composites were compared with the krigged model estimates grouped by various domains. The block model averages generally showed a very good conformance with the estimates. Pincock also observed that the global mean values were very close and the local grade variations were well represented by the estimation process. Pincock confirms the conformity of the volume and grades of most elements to the target grade-volume relationship. Pincock also noticed some overestimation and or underestimation of contaminants and global iron content in certain areas. Pincock attributes this unconformity to either the wide spaced drilling, the lack of drilling, or the shallow drilling in these areas.

3.12 *Resource Classification*

In order to define "Measured," "Indicated," and "Inferred" categories to satisfy the requirements for resource classification, Vale has adopted a procedure proposed by Vale's Geostatisticians called "Risk Analysis." This procedure meets the requirements referred to in the **"Brazilian Standard for**

Classification of Resources and Reserves" issued by DNPM in September 2002. Vale has developed "Risk Index" (IR (u)) to define the resource categories and to eliminate any errors (e.g., sample spacing, geological complexity, erratic grade distribution, etc) introduced during the kriging process. The Risk Index approach to resource classification is considered to be acceptable by Pincock, but may be result in a slightly conservative approach to the final determination of Measured and Inferred material.

Classical geostatistical techniques applied to chemical variables do not take into account the geometry of the ore bodies. In this case, the resource classification criteria based on kriging variance do not consider the risk of any geological and geochemical variability in an iron deposit. In order to eliminate any "risk" in the estimation process, Vale is using indicator kriging to develop "Risk Index" based on the sample distribution as well as on the geometrical characteristics of the deposit.

According the established methodology, the indicators are created assigning the value 1 (one) to mineral, and the value 0 (zero) to the waste samples. The directional indicator variograms are generated and the indicator kriging is carried out. The result of the indicator kriging for each block will be a weighted average of sample that, by definition, assumes only the values 0 (zero) or 1 (one). So, 1 will be the maximum possible result and 0 (zero) will be the minimum, except a few negative kriging weights. Blocks with kriging value 1 have high probability of ore occurrence while the blocks showing the value zero have high probability of waste occurrence. The intermediate values between zero and one, indicate some probability for both ore and waste lithologies. If the kriging result indicates the most likely lithology, the kriging variance will indicate the degree of confidence of this assumption. So, both the parameters must be considered in the final analysis. In this case, each block will fall in certain category, and the respective values are recognized as "Risk Index." The explanation is provided in Table 3-5 which presents the Risk Index by resource confidence category.

The next step involves the plotting of kriged value [1-kriging result] vs. kriging variance/sill in the Cartesian bi-dimensional space.

TABLE 3-5
Vale
Fábrica Complex Reserve Audit
Vale Resource Classification

Resource Classification	Risk Index Range (RI)
Measured	< 0.6
Indicated	Between 0.6 - 0.9
Inferred	> 0.9

The final risk will be proportional to the "distance" from the origin and so, the number referred to as "risk index" can be obtained by the expression:

$$IR(u)_{simplificado} = \sqrt{[1 - I^{*}_{K}(u)]^2 + [\sigma^{2}_{IK}(u)]^2}$$

Where,

$I^{*}_{K}(u)$ = is the estimate, by indicator kriging, associated with the block at location u;

$\sigma^{2}_{IK}(u)$ = is the indicator kriging variance, associated with the block at location u.

Figure 3-6 represents the curves for RI = 0.6 and RI = 0.9 defining the boundaries between Measured, Indicated and Inferred resource categories, respectively. In Pincock's opinion, this method of classification developed by Vale is acceptable and meets the requirements of NI-43-101.

Vale is still using an older method called "Dilation and Erosion" to classify kriged blocks for resource reporting purpose in the Fábrica Complex for the Segredo and João Pereira deposits. This method is discussed in detail by Pincock in its May 2005 Resource and Reserve Audit report of the Vale Southern System. Pincock has reviewed Vale's new and old methodologies and considers the approach to develop resource classification as acceptable.

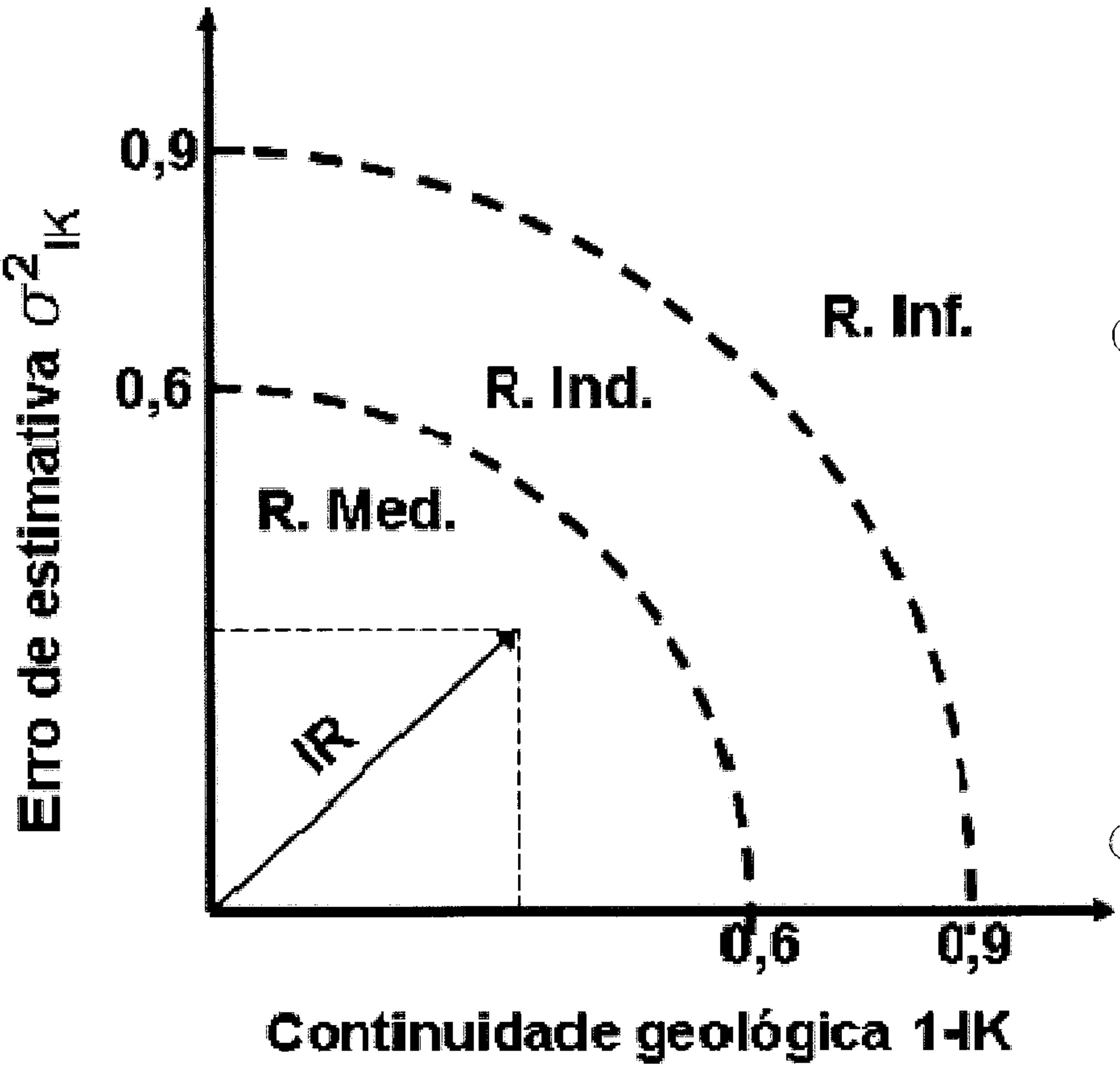
3.13 *Resource Statement*

The total resource estimate for the Fábrica and Vargem Grande Complexes and the Apolo Project is presented Table 3-6. The resources represent the estimated material, without regard to the currently planned pit limits, and are as of the end of December 2007. All tonnes have been reported on a wet basis.

TABLE 3-6
Vale
Southern System Reserve Audit
Estimated Measured and Indicated Resources (3) (6) (7), as of December 31, 2007

Mineral Property (1)	Tonnage x1000 (2)(3) Iron	Grade Fe (%)	Tonnage x1000 (2)(3) Iron	Grade Fe (%)
	Hematite		Itabirite	
Southern System				
Fabrica Complex				
João Pereira	44,901	64.32	944,316	38.78
Segredo	123,467	65.64	645,254	40.30
Vargem Grande Complex				
Abóboras	61,064	64.54	544,254	43.49
Capitão Do Mato	306,386	65.54	713,701	46.63
Tamandúa	363,353	66.23	588,871	47.30
Minas Centrais Complex				
Apolo (Maquiné)	284,568	63.47	625,718	49.10
Subtotal Southern System	**1,183,739**	**65.17**	**4,062,114**	**43.86**

Notes:
1) Vale's equity interest in mines is 100% unless otherwise noted.
2) Tonnage is stated in wet metric run-of-mine (ROM) tonnes.
3) Resource estimates are inclusive of reserves.
4) Resource estimates as of December 31, 2007.
6) Resource estimates as of December 31, 2005.
7) Resource estimates by Vale, compiled by Pincock



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pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	VALE Project Name	FIGURE 3-6 RISE INDEX (RI) PLOT SHOWING RESOURCE CLASSIFICATION CATEGORIES	Mar/2009 Drawing Name
Project No. 9508 B	Southern System		Fig.3-6.dwg

4.0 MINING REVIEW

4.1 *General Discussion*

Pincock engineers visited the operating mines and process facilities within Vale's Fábrica Complex and the Vargem Grande Complex during December 2008. Apolo project was not visited as it is an undeveloped project which was visited by Pincock project team in March 2005 and no mining activities have taken place at the project. The two mines within the Fábrica Complex and the three mines of the Vargem Grande Complex are large open pit operations. This section provides a discussion of the aspects of the mining operations that are common to these Complexes and as are proposed for the Apolo Project. Specific discussions of each of the operations are presented in Section 8 of this report.

The geological setting of the iron ore deposits influences the approach to mining, with entry to the deposit afforded by extracting the exposed iron ore formation where it outcrops. The mine pits then expand and deepen following the dipping banded iron formation units as time progresses. Over time the pits progress to the stage where the pit floor is below the general topographic level, thereby requiring uphill loaded truck hauls.

Material is moved at these operations with large-scale mining equipment. In the larger scale waste stripping and mining of some of the itabirite benches the shovels and trucks are used, while excavators and smaller profile trucks are utilized in some of the tighter hematite ore benches. Vale provided Pincock with an extensive equipment lists for each property which are presented for each operation subsequently in this report. Exact equipment numbers available for the mining operations may fluctuate with varying needs in the pit and surrounding infrastructure. Pincock believes the equipment fleet, maintenance of the fleet, and Vale's ability to replace and expand the fleet are sufficient for the ROM production profiles planned.

Because of the friability of the ore, only occasional drilling and blasting are required. Just the compact hematite, and compact itabirite where it occurs within the pit boundary, require blasting to facilitate excavation and for ROM size preparation prior to transport from the pit. Compact itabirite is not now considered to be ore, but is being stockpiled and recognition is given to a change in classification as process plants designed for beneficiation of itabirite ores are commissioned for the Vargem Grande and Fábrica Complexes over the next few years. The current reserve statement prepared by Vale recognizes the itabirite ore.

Ore is hauled either to the processing plants or in the case of the Vargem Grande Complex to near pit primary crusher locations by haul trucks. Haulage distances vary but presently few significant uphill haul profiles exist, outside of the pit limits. Pincock reviewed the haulage profile methodology utilized by Vale planning engineers for all of the Southern System mines that were audited. The profiles are generated on yearly pit plans and the operating and haulage times are calculated from a database of present performances and production record of equipment. Pincock believes this is well done and is accurate for developing equipment fleet schedules. Equipment replacement in the mine is scheduled to occur at reasonable intervals, as measured by the operating hours for a particular machine or fleet. At some pits, replacement has not been timely although it is believed that this situation will improve in the near future. Capital projections for replacement appear to be adequate. Operating costs for mining seem reasonable for the mining conditions, labor rates, and unit material prices confronting Vale.

4.2 *Mine Planning*

Pincock reviewed and assessed the methodology in use at Vale for developing pits and for assigning economic values to the blocks of material contained within the geologic and mining block models, and found that the approach follows accepted engineering/economic practice. Pit optimization and cutoff grade analysis begins with the resource model, which has previously been developed for the deposit. Identified ore types currently include:

1. Hematite, typically grading above 64 percent Fe;

2. Soft itabirite, with an iron content above 48 percent and upper limits on both phosphorous and manganese;

3. Rich Canga, with an iron content above 55 percent.

The Fábrica and Vargem Grande Complex pits are designed to mine beyond hematite limits through the competent itabirites at the ultimate pit limits. Competent itabirites are presently stockpiled or wasted, depending on the time until the itabirite processing plants are commissioned and capable of receiving itabirites.

Based on lithologies (lithotype), in situ iron content, and other quality factors, the expected saleable products are projected for each block in the resource model. Natural Pellet Ores (NPO) requires simple crushing and screening, whereas finer product sizing for the sinter feed product (SF) is performed with separation by simple gravimetric or magnetic methods. Pellet Feed (PF) is generally obtained from the finest-sized material by flotation methods. Thus, depending on the preparation plant to which the ore will be sent and the saleable end product, there will be different costs associated with processing. Product recovery is projected at this point in the mine planning process, as is iron content of each product type.

This assignment of blocks influences mining costs as well, most notably haulage costs to deliver run-of-mine ore to its respective dumping point. The engineering department estimates haul distances, truck payload, truck cycles times, and so forth to arrive at an operating cost estimate for both ore and waste hauling, and estimates other related mining costs including drilling and blasting, loading, road maintenance, general and administrative charges, etc. Additionally, all downstream charges are incorporated into the cost model for the block; these include loading rail cars with product, rail transportation to the port, port handling and ship loading costs, and a component for corporate general and administrative charges.

Operating costs for the current model have been taken from actual cost data for 2008. To these direct operational costs are added replacement capital estimates for the mining function and for other expenditures expected in the future that are required to maintain (but not expand) the present level of operation. Table 4-1 provides the downstream charges and capital allocations by property for 2008. Both costs and product prices have increased from 2007, typically more than the change in exchange rate alone would suggest.

TABLE 4-1
Vale
Southern System Mines Reserve Audit
2008 Unit Costs (US$/t product)

Fábrica	
João Periera and Segredo	
Mine	$3.77
Plants ITM HM	$2.01
Plants ITM ITAB.	$7.20
Administrative	$2.02
Railway Transport MRS	$9.00
Railway Transport EFVM	$2.54
Port CBPS	$7.41
Port Tubarão	$0.88
Vargem Grande	
Abóboras Mine	
Mine	$1.19
Plants ITM HM	$0.76
Plants ITM ITAB.	$7.23
Administrative	$1.07
Railway transport (MRS)	$9.00
Port (TIG)	$1.04
Capitão do Mato Mine	
Mine	$2.82
Plants ITM HM	$2.19
Plants ITM ITAB.	$7.23
Administrative	$1.11
Railway transport (MRS)	$9.00
Port (TIG)	$1.04
Tamanduá Mine	
Mine	$4.29
Plants ITM HM	$2.24
Plants ITM ITAB.	$7.23
Administrative	$1.11
Railway transport (MRS)	$9.00
Port (TIG)	$1.04
Gama Mine	
Mine	$1.19
Plants ITM HM	$0.76
Plants ITM ITAB.	$7.23
Administrative	$1.07
Railway transport (MRS)	$9.00
Port (TIG)	$1.04
3 year Average Realized Prices (US$/t)	
Lump - External Market	$86.42
Sinter Feed - External Market	$53.60
Pellet Feed - External Market	$49.85

A typical cutoff grade calculation and application is not performed by Vale for the company's Southern System iron mines. In certain of the active mines there does appear to be a gradational tenor of iron in portions of the deposit, but in other operations the material grade is dependent upon geologic material type and may exhibit large step-wise differences. Thus, the company makes a primary distinction between hematite and itabirite ore types. Further, there is a competency ranking as well, such that some hard materials will not be mined and processed at the present time even though a strict cutoff grade analysis would likely show that these could be extracted, processed and sold at a profit.

A benefit calculation is performed for each block in the resource model which incorporates the tonnage of the block, expected revenues for the contained iron (by each product), the amount of NPO, SF, or PF to be recovered, and prices in US$/iron unit for the different products obtained. From the revenue are subtracted all the costs noted above to arrive at a net value per block of ore. Optimization of the final pit is performed with a Lerchs-Grossman algorithm using nested pits, and checks are made to determine if there is a high percentage of inferred resources within the pit boundaries, whether the incremental stripping ratio is excessive, and if physical boundary limits such as encroachment on the limits of the DNPM concessions or other existing infrastructure are honored. A pit optimizing routine is employed which incorporates the net present value concept when blocks are mined, so that a sequence of extraction is identified that will maximize operational cash flows.

An ultimate designed pit is developed, and mine scheduling is performed which details all material movement by year and provides the forecast for total product deliveries. Prices and associated costs are assigned on a constant-dollar basis, with income taxes applied at a 34 percent rate. Standard discounting of net after-tax cash flows is performed using Vale's weighted average cost of capital of 12 percent. An internal rate of return is also calculated at this time, and thus the economic parameters of each operation within the Southern System can be readily reviewed and compared.

Once the ultimate pit has been decided, operational pits are developed for nearer term years, usually 8 to 10 years, and a ROM production schedule of all lithology types is produced. These schedules are then reviewed by the appropriate process engineers and iterations are made where necessary.

4.3 *Geotechnical Engineering for Pits, Waste Dumps, and Tailings*

In the December 2008 audit, Pincock reviewed the procedure for geotechnical assessment and slope design used in all of the Southern System mines.

Since 2001, Vale has had an internal geotechnical staff of geotechnical engineers, engineering geologists, and hydrologists responsible for the investigation, design and monitoring of all mine slopes, mine waste dumps, tailings impoundments and water and sediment impoundments. Each of the four mining complexes has geotechnical staff assigned with responsibility for day-to-day monitoring and evaluation of the specific aspects of that complex. In addition, Vale uses outside consultants both to complete projects as well as for an annual third-party technical review of all dams, waste dumps, and pit slopes.

The geotechnical engineering program for pit slopes is integrated with the exploration geology work. All drill core that is recovered is logged for geotechnical characterization following procedures established by the International Society for Rock Mechanics (ISRM) and the Brazilian Association for Environmental and Engineering Geology (ABGE). The logging and classification systems have been modified to add one more class that represents the prevalent low-strength rock that is common in the iron ore formations. Design analyses are primarily focused on rotational and planar slope failure modes. Pit slope design is done in a phased manner, with input from the long-term mining staff to develop an optimal pit design from both the standpoint of geotechnical stability and practicality in mining.

Groundwater is a key factor in pit slope stability. Dewatering measures that have been implemented include horizontal drains, deep dewatering wells and in-pit sumps. Monitoring systems in the pits include piezometers and survey prism monuments to measure slope movement. Inclinometers are installed in critical areas or areas exhibiting higher rates of movement.

Design of new waste dumps focuses on providing foundation drainage to control development of water in the dumps, on assuring adequate stability of the dump material and foundation soils and control of surface water to control erosion and infiltration of surface water. A geotechnical characterization program is completed for each new dump area and specific designs are developed.

Design of new tailings and sediment impoundments, is by Vale's staff, in conjunction with external consultants. Vale constructs performs raises to existing impoundments as required. Procedures that are implemented follow accepted engineering practices for retaining structures.

4.4 *Life of Mine Plans*

Yearly mine production plans to achieve the ultimate pits are typically based on designed pits through about 10 years of operation, then on "mathematical" pits through life of mine. Pincock believes Vale is taking a reasonable approach in the design for pits whose operating life extends very far out in the future, as do these. All these production figures are subject to change, of course, depending on future markets, additional property drilling, and availability of corporate capital.

4.5 *Reserves*

Table 4-2 is summary of reserves stated for the three properties in the Southern System that have been audited. These reserves as shown are as of December 31, 2007 and are not net of 2008 production. The December 2007 reserves will be depleted for 2008 production when year-end surveys are completed.

Table 4-3 summarizes the change in stated reserves between the reconciliation conducted by Pincock in January 2008 and the current stated reserves. The majority of the increase in reserve comes from Vale's plans to build itabirite processing plants and process itabirite material which had previously largely been considered waste. Pincock would note that Vale has not considered the itabirite materials that are in existing waste dumps that potentially could be technically and economically processed after the new itabirite plants come on line.

TABLE 4-2
Vale
Southern System Mines Reserve Audit
Stated Reserves as of December 31, 2007

Fabrica Reserve Summary	Proven		Probable		Total	
	Mt	Fe%	Mt	Fe%	Mt	Fe%
João Pereira						
Hematite [a]	18.1	63.8%	18.3	62.0%	36.3	62.9%
Itabirite	253.7	41.7%	294.8	40.4%	548.5	41.0%
Total Ore	**271.8**	**43.1%**	**313.0**	**41.6%**	**584.8**	**42.3%**
Segredo						
Hematite [a]	58.5	63.4%	49.8	57.8%	108.3	60.8%
Itabirite	89.8	44.9%	113.5	44.0%	203.3	44.4%
Total Ore	**148.3**	**52.2%**	**163.3**	**48.2%**	**311.6**	**50.1%**
Fábrica Mine Total						
Hematite	76.6	63.5%	68.1	58.9%	144.7	61.4%
Itabirite	343.5	42.5%	408.3	41.4%	751.7	41.9%
Total Ore	**420.0**	**46.3%**	**476.4**	**43.9%**	**896.4**	**45.0%**

Vargem Grande Reserve Summary	Proven		Probable		Total	
	Mt	Fe%	Mt	Fe%	Mt	Fe%
Aboboras						
Hematite [a]	38.5	65.3%	17.0	63.3%	55.4	64.7%
Itabirite	208.2	43.0%	205.7	42.2%	413.9	42.6%
Total Ore	**246.7**	**46.5%**	**222.7**	**43.8%**	**469.3**	**45.2%**
Capitao do Mato						
Hematite	118.1	65.9%	144.7	65.0%	262.8	65.4%
Itabirite	116.7	47.1%	459.6	45.9%	576.3	46.2%
Total Ore	**234.8**	**56.6%**	**604.3**	**50.4%**	**839.1**	**52.2%**
Tamandua						
Hematite	124.9	66.1%	53.4	65.0%	178.3	65.8%
Itabirite	167.1	47.4%	200.5	47.2%	367.7	47.2%
Total Ore	**292.1**	**55.4%**	**254.0**	**50.9%**	**546.0**	**53.3%**
VARGEM GRANDE COMPLEX						
Hematite	281.5	65.9%	215.1	64.9%	496.5	65.4%
Itabirite	492.0	45.5%	865.9	45.3%	1,357.9	45.4%
Total Ore	**773.5**	**52.9%**	**1,081.0**	**49.2%**	**1,854.5**	**50.7%**

Apolo Reserve Summary [b]	Proven		Probable		Total	
	Mt	Fe%	Mt	Fe%	Mt	Fe%
Hematite	157.4	63.6%	131.3	63.3%	288.7	63.4%
Itabirite	142.2	50.5%	222.0	50.1%	364.2	50.3%
Total Ore	**299.6**	**57.4%**	**353.3**	**55.0%**	**652.9**	**56.1%**

(a) Hematite reserves include hematite plus hematitic covering material referred to as canaga and rolado. In some cases, the hematitic and rolado material were reported as "Itabirite" in the resource estimate. Subsequent analysis determined these materials would best be processed with the hematite and are now accounted for as hematite reserves.

(b) Apolo Project's audited reserve includes mineralized material within two DNPM mining concessions not currently controlled by VALE. The legal right to mine the full reserve as stated herein will require obtaining the right to mine within these concessions.

TABLE 4-3
Vale
Southern System Reserve Audit
Change in Reserves Between 2007 and 2008

	2008[a]		2007[b]		Change	
	Tonnage (mt)	Fe Grade	Tonnage (mt)	Fe Grade	Tonnage (mt)	Fe Grade
Fabrica Complex	896.4	45.0%	466.0	50.2%	430.4	-5.2%
Vargem Grande Complex						
Abóboras	469.3	45.2%	26.5	66.1%	442.8	-20.9%
Capitão do Mato	839.1	52.2%	121.4	66.2%	717.7	-14.0%
Tamanduá	546.0	53.3%	75.1	66.5%	470.9	-13.2%
Apolo Project	652.9	56.1%	278.7	58.3%	374.2	-2.2%

(a) 2008 refers to current audit of stated reserves as of December 31, 2007, considering updated resource models.

(b) 2007 refers to reconcilliation of 2005 reserves by depletion for production in 2006 and 2007 to arrive at a reserve number as of December 31, 2007 but that is based on resource models and reserve calcuations audited in 2005.

5.0 PROCESSING

Iron ore processing within the Southern System mines has primarily focused on hematite and high grade itabirite which require relatively straightforward process flowsheets for beneficiation. As a response to strategic plans for increased production and declining reserves of the currently produced high grade ore, Vale plans to commission new processing plants to treat the lower grade, and typically harder itabirite ore. The following sections provide a general discussion of the current beneficiation plants for the Fábrica and Vargem Grande Complexes and the planned plants for treatment of the itabirite ores. The processing plant of the Apolo Project will include both treatment systems. A more detailed discussion of the processing operations and costs for each property is included in Section 8 of this report.

5.1 *High Grade Ore Processing*

The typical processing for higher grade ores in the Southern System Mines consists first of multi-stage dry crushing and screening to produce lump ore, hematitinha, and sinter feed products. The fines or undersize from the above dry processing steps are subsequently treated by wet processing using further screening, classification, high intensity magnetic separation and gravity concentration to produce additional sinter feed and pellet feed. The pellet feed is dewatered in a thickener and filtered. The reground filter cake is then transported to pelletizing plants or sold as pellet feed.

The hematite ROM ore averages about 55 percent Fe for Fábrica Complex and 65 percent at the Vargem Grande Complex. Hematite ROM for the Apolo Project is projected to be about 61 percent Fe. Metallurgical recoveries range from about 75 percent for the Fábrica and Apolo projects to 83 percent (for 2008) at the Vargem Grande Complex. Tailings are disposed of in impoundments formed by embankment dams. Tailings grades range from around 50 to 60 percent Fe. Table 5-1 presents a summary of the budgeted 2008 production from each of the hematite processing plants, as well as projected production from the Apolo Project.

TABLE 5-1
Vale
Southern System Mines Reserve Audit
2008 Budgeted Production

	Fábrica Complex		Vargem Grande Complex		Apolo Project[a]	
Product	Proportion	Mt	Proportion	Mt	Proportion	Mt
Lump ore	5%	0.931	14%	4.878		
Hematitinha	4%	0.651	8%	2.84		
Sinter feed	32%	5.766	53%	18.605	50%	16.1
Pellet feed	27%	4.924	12%	4.176	25%	7.9
Tailings	33%		13%		26%	

(a) planned production

Vale estimates the processing cost per tonne of product for the Fábrica operations for 2008 was R$ 4.02 (US$ 2.23) and R$4.63 (US$ 2.58) for the Vargem Grande Complex processing operations. Processing costs for the Apolo Project hematite plant are projected to be R$5.5 (US$ 3.06).

A discussion of the processing plant design and operation is presented in Section 8. Overall, Pincock considers the ore processing facilities to have well designed flowsheets for the ore that is being treated. The plants and equipment appeared to be well maintained and housekeeping was generally good.

5.2 *Proposed Itabirite Processing Plants*

In order to both increase production of pellet feed during the remaining period of hematite production and to allow continued mining of the lower grade itabirite from the Southern System mines, Vale plans to construct and startup new itabirite processing plants at the Fábrica and Vargem Grande Complexes and to include an itabirite plant as part of the Apolo project. The itabirite plants will be expanded in phases at each operation. Table 5-2 summarizes the projected development and capacity of the plants.

TABLE 5-2
Vale
Southern System Mines Reserve Audit
Itabirite Plant Schedule and Production Capacity

	Fábrica Complex		Vargem Grande Complex		Apolo Project	
	Year	Production [a]	Year	Production [a]	Year	Production [a]
Phase 1	2014	10	2011	10	2015	8.2
Phase 2	2016	10				
Total		20		10		8.2

(a) Production is final pellet feed produced

As noted in Table 5-2, the Vargem Grande Itabirite Plant will be the first to come on line, followed by the first phase of the Fábrica itabirite Project and then the Apolo Project. The overall mineral processing technology that will be utilized for processing itabirite ores is proven and well developed at other Vale Mines nearby in Brazil and does not represent a pioneering experiment. The flowsheets for the three projects are not identical to other plants because of the unique mineralogical characteristics of each iron deposit. However, the individual unit operations processing steps and equipment have been used in other plants and Vale has carefully selected and successfully evaluated these in pilot plant scale testing to design the process, validate the flowsheet and to size the process equipment. Vale also has the benefit of using the actual data and operating costs from some of their other operating processing plants to use in establishing realistic and reliable performance and cost predictions for the itabirite ore processing. Also, because Vale has recently been building other new plants and expanding older plants they have recent and reliable information for making the capital cost estimates for the new plants. All of the above combined provides for a good confidence level in the planned itabirite ore processing projects.

In general terms, the itabirite processing will consist of three stages. The first stage consists of crushing, screening and stockpiling of the ore in homogenization piles. In the second stage of the process the crushed ore is reclaimed from the homogenization stockpile and fed to the dry tertiary and quaternary screening and crushing. The third stage of the process is all wet processing and that is where the separation of iron minerals from waste minerals takes place. The crushed ore is to be ground in large ball mills in a closed circuit with a hydrocyclone classifying system. Underflow from the hydrocyclones will return to the ball mills for additional grinding and the overflow will report to a desliming circuit to produce flotation feed and slimes tailings. The flotation feed will pass through a series of flotation cells to concentrate the iron product which is then dewatered by thickening followed by vacuum filtration. Tailings produced in the flotation process are discharged to tailings impoundment dams.

Capital and operating costs for the itabirite projects are summarized in Table 5-3. As noted previously, the level of engineering that has been completed is variable due to the time until the projects will be brought on line. The Vargem Grande plant is most advanced, with a feasibility study level (FEL3) cost estimate having been recently completed. The recent experience gained by Vale in constructing projects such as the Brucutu project provides a basis for reliable cost estimation and analysis for purposes of demonstrating economic viability in reserve definition. Economic sensitivity analyses are discussed for each project subsequently in Section 8 and show the projects to be financially viable.

TABLE 5-3
Vale
Southern System Mines Reserve Audit
Itabrite Plant Capital and Operating Costs

	Estimated Capital Cost (US$ millions)	Estimated Operating Costs (US$/tonne product)
Fábrica Complex	849.00	7.62
Vargem Grande Complex	1.18	8.05
Apolo Project	1.03	8.02

6.0 INFRASTRUCTURE

The Fábrica Complex, the Vargem Grande Complex and the Apolo Project are all located within 75 km of Belo Horizonte. Services and suppliers are readily available from Belo Horizonte. The amount of mining activity in the state of Minas Gerais provides a strong basis for logistical support to the Vale Southern System mines. The following summarizes the general infrastructure conditions in the area. Specific issues with infrastructure needs for the Apolo Project are discussed in Section 8.

6.1 *Transportation*

The area is well served by railroads and highways that connect the towns and cities. Regularly scheduled air service is available into Belo Horizonte. Most international flights connect through either São Paulo or Rio de Janeiro.

The operation is located immediately off a paved public highway. Product from the Southern System Mines is shipped by rail to either the Port of Tubarão or Sepetiba, with Vargem Grande Complex only capable of accessing the Sepetiba Port. The port facilities include final product blending facilities as well as the train unloading and ship loading facilities. The port facilities were not visited by Pincock during this audit.

6.2 *Employee Housing and Services*

Local housing is available for employees within the communities surrounding the mines of the Fábrica operation, therefore the Vale does not provide employee housing. There are adequate schools, medical services and businesses to support the work force. The mine sites do have medical facilities to handle emergencies; however, medical facilities are available in Belo Horizonte and other local communities such as Congonhas for the Fábrica Complex, to support the mine's needs.

6.3 *Communications*

Telephone communications are available over landlines, and via cellular towers. Internet communications are available at the mine sites.

6.4 *Water and Sewage*

Process water is provided primarily from surface water, with a substantial contribution from recycled water from the tailings pond or surface water impoundments.

6.5 *Power*

All mine sites are served by power from the national grid. It is understood the power supply is quite reliable and does not impact operations.

6.6 *Fuel*

Diesel fuel is delivered by truck into the mines. Onsite bulk storage facilities are available at all mines.

6.7 *Mine Site Infrastructure*

The facilities at the mines include the following:

- Maintenance Shops
  - Welding Shop
  - Heavy and Light Vehicle Maintenance
  - Tire Shop
  - Truck Wash
- Warehouse
  - Offices
  - Personnel
  - Administration
- Access Gate
  - Medical Clinic
  - Central Restaurant
  - General Services
  - Vehicles and Buses
- Safety
  - Fire Station with fire truck
  - Substation and Power Distribution
  - Product Transportation Systems

7.0 ENVIRONMENTAL, HEALTH, AND SAFETY

A comprehensive review of Vale's Environmental, Health and Safety (EHS) aspects was completed during Pincock's resource and reserve audit made during March 2005, for the audit of reserves as of December 2004. The objective of that review was to identify environmental or health and safety issues that could affect Vale's ability to mine the declared reserves, or EHS issues which represent a significant liability and risk to the continued viability of the mining operations of the Southern System. In this context, the EHS component of the reserve audit did not involved a detailed audit of all procedures, activities and records related to the EHS management, but rather focused on ensuring that appropriate measures were in place to identify, monitor and address EHS risks and impacts. During the current audit, site visits were made and discussions were held with the objective of confirming the programs and conditions reported in the May 2005 report are still applicable. The following presents the combined findings of the 2005 site visit and confirmed during the 2008 site visit.

Pincock's approach to EHS auditing involved a focus on the following three items:

- Regarding permits: Have all major legal and environmental permits been obtained that will allow Vale to mine their declared reserve?

- Regarding management: Is there an EHS management system and is it functioning?

- Regarding monitoring and compliance: Are the environmental parameters required by their permits being monitored, and are the operations subject to regulatory action for non-compliance?

In conducting this audit Pincock relied on information and data supplied by Vale, which was supplemented by our observations during site visits to the mines and associated facilities. The scope of work did not include a detailed environmental audit or confirmation of compliance with regulatory agencies.

7.1 *Legal and Permitting*

There is concurrent regulatory authority by the Federal, State and Local governments over nature conservation, soil and natural resources protection, environmental preservation and pollution control. For the Southern System operations, which are located entirely within the State of Minas Gerais, environmental licensing is through the State Secretary for Environment and Sustainable Development (SEMAD) in addition to Federal level regulation through the National Department of Mineral Production (DNPM).

7.1.1 Regulatory Structure

Within the 1988 Brazilian Federal Constitution, mineral resources are defined as assets of the Federal Government. The legal right to mine is decreed to the mining company by the Federal Government of

Brazil in the form of a Mining Decree in accordance with the Mining Code that was originally established under Decree Law No. 227, dated February 28, 1967. There is a separation of the surface rights from the mineral rights, therefore, a business entity may hold valid mining rights from the Federal Government but must still negotiate legal access with the surface rights holder.

The Mining Code, which has been amended several times since passage, addresses both issuance of prospecting permits as well as a Mining Concession permit (Mining Decree), which is issued after the project proponent has demonstrated the technical and economic viability of the project. The Mining Decree, along with the appropriate environmental permitting forms the basis of the right to mine a mineral deposit. The mining decree is granted for a specific area and for the exploitation of a specific mineral. The federal department responsible for issuing the mining rights is the National Department of Mineral Production (DNPM). Mining rights given by the Mining Decree are transferable with approval of the DNPM. With the acquisition of Fábrica complex by Vale in 2003, the Mining Decrees were transferred for these properties.

Beyond the Mining Decree, additional regulatory approvals must be obtained to address environmental and social impacts of a mining project. There is concurrent regulatory authority by the Federal, State and Local governments over nature conservation, soil and natural resources protection, environmental preservation and pollution control. For the Fábrica, Vargem Grande and Apolo operations, which are located entirely within the State of Minas Gerais, environmental licensing is through the State Secretary for Environment and Sustainable Development (SEMAD). The State Council for Environmental Policies (COPAM) is responsible for formulating the technical norms and guidelines for environmental quality. The State Foundation for the Environment (FEAM) is the lead agency within SEMAD and under COPAM for permitting mining operations. FEAM is responsible for review and evaluation of mining projects to confirm the proposed mineral development will comply with the environmental policies formulated by COPAM. As part of the regulatory review process, the State Institute for Forestry (IEF) and the Water Management Institute (IGAM) are responsible for review and comment on issues related to agriculture and forestry and water resources, respectively.

Environmental licenses for mining operations are typically provided in three stages:

- A Preliminary License (LP) is provided at the time the basic information on the proposed project has been submitted and is considered to provide adequate assurances the project will comply with COPAM's technical norms and guidelines.
- An Installation License is provided at the time detailed design of the facility is completed and determined to comply with the project objectives defined in the LP.
- An Operation License (LO) is provided at the time the project is constructed and commissioned and it has been determined that the facility complies with the required norms and standards. The minimum term of the LO is four years, with projects identified as having a lesser potential for environmental impacts given terms of eight years. Revalidation or renewal of the LO requires

submittal of effectiveness of environmental controls and a plan for proposed modifications if the operation is not in compliance with requirements at the time of the renewal.

Since the environmental regulations and requirements developed in the late 1980s through the 1990s, there was a need to normalize the licensing of mines that were operating prior to that time. In 1994, mining companies were required to legalize their operations through the issuance of Corrective Operating Licenses (LOC). As part of this process, mining operations were required to submit plans to address any deficiencies in environmental compliance and were given a four-year period to complete the projects identified in this plan. If projects were not completed at the end of four years, the mining companies were required to defend why projects were not completed and provide documentation of projects that had been completed.

An Environmental Assessment Performance Report (RADA) is submitted for renewal of the LO or LOC, which provides and analysis of the environmental controls and if applicable, proposes modifications to the environmental management and controls system.

As part of the licensing process, an environmental impact analysis is required. The level of detail of the analysis is determined by the significance of potential impacts. For significant projects such as the Apolo Project, a full environmental impact assessment is required which includes inter-agency review and consultation, public announcements of availability of documents for review and certain taxes or fees to be paid. The results of the environmental impact analysis are submitted in two documents, an Estudo do Impacto Ambiental (EIA) or Environmental Impact Analysis report and a Relatório de Impacto Ambiental (RIMA) or Report of the Environmental Impact. The EIA presents the evaluation and characterization of the baseline of the physical environment, the hydrologic conditions, the biological environment and the socio-economic conditions within the project area. The RIMA provides the purpose and need of the project, presents an analysis of the project's impacts on the environment, provides the alternatives considered to reduce the impacts, presents the mitigation measures to reduce the impact of unavoidable impacts and provides the monitoring program to be implemented for assessment of the effectiveness of the mitigation measures.

Water use and extraction of water is regulated by IGAM. The party proposing to develop or extract water must prove that there is no significant impact to the base flow of the watershed. There are currently water basin committees being formed that will regulate water use in each hydrologic basin. Vale expects that water users will be charged a fee based on amount of water used and the quality of the water returned to the basin. Fees raised from this program will support construction and operation of water and sewer treatment plants.

7.1.2 Permitting of New Projects

The new itabirite processing projects for Fábrica Complex and Vargem Grande Complex will require regulatory approval and modification of the existing Operating Licenses. In that these will be expansion projects to the existing operation, an Installation License will needed to allow construction of the plants, then an Operating License will be issued by FEAM. This is primarily an administrative process with technical review to confirm the expansion project will meet the environmental performance standards of the original Operating License.

Permitting of the Apolo Project will be a more intensive effort in that it is a greenfields project. In accordance with the regulatory requirements, Vale is preparing the EIA and RIMA with the assistance of third party consultants. Public meetings have been held to identify concerns of the local population as part of the scoping of the EIA/RIMA document preparation. The EIA/RIMA is scheduled to be submitted in early 2009 and approximately two years is scheduled to obtain the Installation License (LI) for the Apolo Project.

From Pincock's review of the provided schedule and scope of EIA/RIMA, it is our opinion that Vale's schedule for permitting is reasonable, considering the overall project implementation schedule. As in the permitting of any major, greenfields mining project involving the regulatory process and public review and comment, the exact schedule and the need for additional studies or evaluation are uncertainties. Comments received during the public meetings during the EIA/RIMA scoping process indicate a significant public concern for impacts to water resources due to the water demands for the project and the environmental risks associated with the tailings disposal and sediment containment dams, which are common public concerns. Impacts due to the inflow of workers during construction and operation were also identified. The changing land use in the area resulting from development of gated communities referred to as "Condominium developments" are changing focus from the historic agricultural land use. This brings additional public concerns with noise, dust and visual impacts. Vale's success in expanding the operations of the portions of the Southern System that were previously operated as MBR which are adjacent to commuter communities around Belo Horizonte would indicate Vale has the ability to successfully operate within this environment. However, the lack of the environmental license presents a risk to the development of these risks, although a reasonable risk, typical of projects at this phase of development.

7.1.3 Legal Right to Mine

The company must have the legal right to mine the material being reported as mineable reserves as granted by the DNPM. Vale's mine plans were reviewed to confirm that the ultimate pits that define the limits of reserves are within the concession defined by the Mining Decrees. Based on Pincock's review, Vale has been diligent in limiting the calculation of reserves to that portion of the orebody that can be extracted with operations maintained within the limits defined by the Mining Decrees. Other surface disturbances such as tailings disposal or mine waste disposal can extend into areas in which Vale controls the surface rights; however, all mining operations for mineral extractions are contained within the area defined by the Mining Decrees.

From Vale's representations, the current DNPM Mining Decree's provide the legal right to mine all areas within the ultimate pit limits of the mines of the Fábrica and Vargem Grande Complexes. Pincock completed a review of the documentation and found it to be thorough but our review does not constitute a legal review to confirm all aspects of the legal right to mine.

Relative to the Apolo Project, a portion of the ultimate pit that has been designed for the Apolo Project for the reserve estimation includes an area for which Vale does not currently hold the National Department of Mineral Production (DNPM) mining concessions. There are two concessions for this area that are not currently controlled by Vale. Pincock understands negotiations are well under way with one of the companies holding the concessions and are beginning with the second company. Pincock would note that the ability to mine these other concessions by the current concession holders is also limited by Vale's land position. Therefore to effectively develop this mineral resource, cooperation of the parties will be required. It is Pincock's opinion that Vale is likely to reach a resolution on the ability to mine the Apolo reserves through negotiation with the DNPM concession holders. We understand that if the negotiations are not successful, there is legal recourse for Vale to pursue the legal right to mine. Therefore, considering the schedule to develop this greenfield deposit, it is Pincock's opinion that it is reasonable to expect Vale will obtain the legal right to mine the reserve as currently estimated.

7.2 *Environmental Management*

7.2.1 Policy and Structure

Vale has an established environmental policy that is specific to the Southern System of mines, which subscribes to the principles of sustainable development and respecting the health and safety of the employees. The policy includes the following key commitments:

- To operate through practices and measures aimed at control of quality of products and services and prevention of pollution, accidents and occupational diseases and impacts.
- To prioritize occupational health and safety before profit and production.
- To optimize use of materials and energy to contribute to the preservation of natural resources and insure competitiveness.
- To comply with legislative norms and other commitments that the company has signed or committed to.
- To maintain communication channels with clients, communities, employees, and other interested parties.
- To strive for continuing improvements to operations based on periodic evaluation of client's needs, of the environmental aspects, and the health and safety aspects.
- To train and elevate awareness of employees and encourage suppliers and service suppliers to act in accordance with these policies.

Pincock considers this policy to comply with environmental polices subscribed to by international mining companies. We would note that it is typical that the environmental policy is signed by the unit general manager to convey the level of personal commitment from the most senior level down to the rank and file.

The Southern System environmental management system is ISO 14001 compliant and subject to periodic external review and auditing for compliance with ISO operating standards and practices. ISO 14001 management systems were implemented at the various operations between June 2000 and November 2002. Under the ISO 14001 management system the operations are subject to regular auditing to confirm compliance with the environmental management plan.

Vale's Southern System operates under a centralized environmental management staff. Each mining complex within the Southern System has specific environmental management staff permanently assigned to that complex. From Pincock's review of the overall structure of the environmental management system and the implementation observed at the Fábrica and Vargem Grande Complexes, it is our opinion that the environmental issues are being effectively and efficiently managed. The Vale environmental management program is considered to be representative of best management practices in the mining industry.

7.2.2 Environmental Management Plans

During the site visits and data review completed in 2005, Vale provided either copies of key environmental management plans or detailed discussions regarding the implementation of key management programs including:

- Solid and hazardous waste management
- Spill prevention and response
- Emergency response
- Site environmental monitoring including surface water quality, blast ground vibration and air overpressure, and air quality
- Community relations and communication

From Pincock's review, we consider the environmental management plans and the actual implementation of the environmental systems to be well within accepted practices for major mining companies. During the site visits, the implementation of the environmental management practices were observed and found to also meet industry best management practices. There were three areas, however, that Pincock believes deserve comment relative to regulatory compliance or mining best management practices.

The first relates to water quality monitoring. Currently, groundwater quality is not routinely monitored. Typical best management practice would be to monitor groundwater quality up gradient and down gradient of the mining operations to have documentation of any impacts of the mining operations. It is understood the regulatory agencies do not require groundwater quality monitoring as a matter of courses in iron ore mining operations. Considering the inert nature of the mine waste and tailings as well as the relatively benign reagents used in mineral processing, it would appear the lack of groundwater monitoring is a reflection of the limited potential for significant groundwater quality impacts.

The second area relates to surface water quality monitoring results. Pincock understands the discharge water quality standards that the Southern System operates under are Federal standards that apply to all of Brazil and do not consider the specific background water quality of the receiving waters or regional waters. Vale routinely exceeds these standards relative to parameters such as soluble iron, phenols, oil and grease, and in some areas, total and fecal coliform. Exceedances occur in the background monitoring locations as well as monitoring locations downstream of the mining operations. Vale reports and explains these exceedances to FEAM along with an analysis of the water quality upstream and downstream of the mining operations. From Pincock's review Vale makes a well documented case that these exceedances do not indicate a water quality impact due to mining operations as the background and downstream water quality is similar. Rather the exceedances of the uniform standards are a function of the standards not reflecting the baseline water quality of the region.

The third area relates to topsoil recovery and stockpiling practices. Currently, Vale recovers limited amounts of available topsoil for use in reclamation work. This would not be in keeping with generally accepted mine reclamation practices as most other types of mining require placement of topsoil over mine waste and tailings to facilitate sustainable revegetation. The nature of the mine waste and tailings at the Southern System mines, however, is very amenable to direct revegetation. Vale has demonstrated success in direct revegetation of mine waste and tailings with sustainable, native vegetation. Accordingly, while Vale's lack of topsoil recovery is not in keeping with accepted practices, it is not impacting the ability to reclaim disturbed mine lands.

7.3 *Closure and Reclamation Planning*

Vale's Southern System mines present a very favorable condition relative to reclamation and closure. The mine wastes (tailings and non-economic mineralized waste) are relatively benign from a geochemistry standpoint and do not exhibit typical hard rock mining issues such as acid rock drainage generation potential or toxic metal mobility. Direct revegetation of the mine waste and tailings is routinely and successfully done. A standardized approach to mine waste reclamation has been established that consists of constructing mine waste dumps at 2 to 1 (horizontal to vertical) slopes with intermediate benches at 10-meter vertical intervals to provide an overall slope of 2.75 to 1.

Surface water collection ditches are constructed on the benches which are graded to drain to down-drop structures at either certain points on the dump face or at the outer edges of the dumps. The down-drop structures are typically reinforced concrete channels that lead to natural drainages.

Reclamation of the dump faces and top surfaces is done in two steps, with the first step consisting of planting grasses for surface stabilization and erosion protection as well as nitrogen fixation in the soils. The second phase consists of planting native grasses, shrubs and trees as the permanent revegetation. Topsoil is placed in 0.5-meter layers when available; however, Vale's experience is that permanent reclamation objectives can be achieved using direct revegetation of the mine wastes.

Waste dumps are constructed from the bottom upward such that the lower slopes are built out to the ultimate configuration. This allows concurrent reclamation of the lower portion of the slopes as the dump is constructed, thereby reducing the amount of reclamation required at the end of mine life or at the time the dump is filled to capacity.

Current reclamation planning calls for a number of the existing tailings and sediment containment ponds to remain as permanent lakes after the end of mine life. This is an accepted mine closure practice, providing the lakes are ecologically viable, in conformance with acceptable post-closure land use and have adequate safety margins for both the dams and the spillways to be permanent lakes. Pincock did observe that voluntary revegetation occurs on the tailings with little effort providing the free water is removed. It appears that if revegetation of the tailings surface is required, it can be readily achieved in the same manner as the waste dumps are reclaimed.

The annual budget for each mining operation includes operating costs for annual reclamation work. The annual reclamation plan is prepared by the mine planning staff and submitted to FEAM for review and approval and then implemented as part of the routine mining work. These costs are carried as mine operating costs.

Vale carries final reclamation and closure costs as a corporate financial liability. Therefore, these would be considered "sunk costs" and would not impact the mine economics that define mineable reserves for ongoing mining operations.

7.4 *Health and Safety*

Vale has an established health and safety program that was significantly revised and refocused in the last few years. The safety program follows typical protocol of:

- Employee safety orientation through the Safety Department with job specific safety training as part of the overall job training.
- Risk identification and classification
- Analysis of activities, risks and preventative measures
- Emphasis on prevention of accidents through risk awareness
- Providing at least 10 minutes of safety review every day
- Auditing of implementation of safety programs with focus of auditing being on managers being responsible for the safety of the workers reporting to them.

From Pincock's review and site observations, the basics of the program are in place relative to worker training, job site risks and hazards awareness and utilization of personal protective equipment. However, there is additional work to be accomplished in uniform implementation across all the complexes of the Southern System.

7.5 *Summary*

The purpose of the EHS component of the reserve audit was to identify environmental or health and safety issues that could affect the ability to mine the declared reserves for the Fábrica Complex, or EHS issues which represent a significant liability and risk to the continued viability of the operation. Having completed a review of Vale's EHS permits, management plans, and compliance and monitoring data, which included a review of documents and field observations during the site visits during the audit completed in March 2005 and reviewed in the current audit, it is Pincock's opinion that there are no major EHS issues that would prevent the Southern System of Vale from mining its stated reserves.

As with most other areas of the world, ongoing mining will involve a changing regulatory framework. Permitting of the Itabirite Projects will require modification of the existing Operating License and obtaining approval for installation of the new process plants and related tailings disposal dams and for the entire new Apolo Project. Pincock considers it highly likely that Vale will be able to permit the proposed expansion project based on the historic mining in this area, the surrounding landuse and the established regulatory structure under which mining operates in Minas Gerais State. The proximity of other mining operations does present future competition for surface rights in the areas outside of Vale's DNPM mining concessions that might be necessary for waste rock and tailings disposal.

8.0 FÁBRICA MINING COMPLEX

The following presents a discussion of the specific aspects of the Fábrica Complex. The Fábrica Complex, consisting of the João Pereira and Segredo Mines were acquired by Vale in 2003 from Ferteco Mineração, S.A. The João Pereira mine operations date to 1956 and the Segredo Mine began production in 1984.

8.1 *Geology*

The Fábrica mining complex is situated along a south-trending limb of the Iron Formation in the southern portion of the Iron Quadrangle. João Pereira and Alto Bandeira mines are situated within a 40 km long east-west trending limb of the Dom Bosco syncline of the Iron Formation (see Figure 8-1). The Segredo Mine consists of the Ponto 2, Ponto 3, Area 10 and Segredo deposits. The mine area is surrounded by the western portion of the Dom Bosco syncline, near the Moeda syncline.

The stratigraphic sequence of the region consists of five geological units:

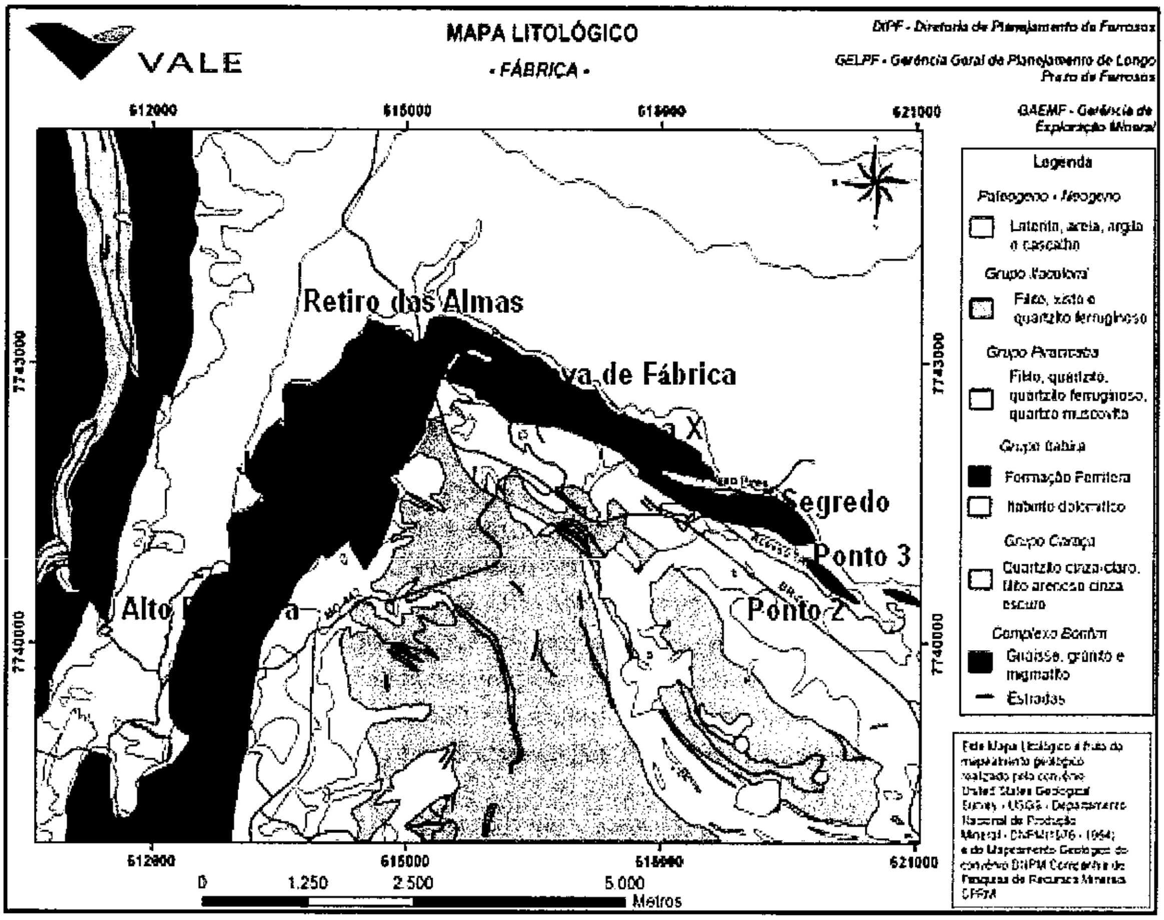
- Gneisses of the Achaean crystalline basement;
- Phyllites and quartzites of the Rio das Velhas Supergroup;
- The Iron Formation, metasediments and orthoquartzites of the Minas Supergroup;
- Quartzites and meta-conglomerates of the Itacolomi Group;
- Recent cover, including "Canga," laterite and "Rolados."

The crystalline basement rocks are banded gneisses, migmatites, and granites of various compositions, and the metamorphic complexes of Bonfim and Belo Horizonte. The Rio das Velhas Supergroup (from the base to the top) is composed of the Nova Lima group and the Maquiné group. The Nova Lima group consists of phyllites, graphitic phyllites, sericite schists, metagreywackes, mafic and ultramafics, Algoma type iron formations, metacherts and dolomites. The bottom of the Maquiné group is defined by an erosional unconformity. Basal conglomerates are overlain in turn by massive quartzites, schists, sericite–quartz schist, and phyllites.

The Minas Supergroup consists of the Caraça, Itabira, Piracicaba, and Sabará Groups. The Caraça group is made up of the Moeda and Batatal Formations and occurs in a continuous belt in the western portion of the area in the Serra da Moeda. The Moeda Formation is composed of metaconglomerates, phyllites, and fine grained quartzites with sericite and muscovite. The Batatal Formation is composed of sericitic phyllite, and lesser metachert, iron formation and graphitic phyllite.

The Itabira Group is represented by the Cauê and Gandarela Formations. From the base, the Cauê Formation is composed of itabirites, dolomitic itabirites, and amphibolitic itabirites, and is approximately 200 m to 400 m thick. The Gandarela Formation forms a gradational contact with the Cauê Formation and is composed of dolomitic phyllites, dolomites and phyllites.

FIGURE 8-1
Regional Geology of the Segredo and João Pereira Deposits



The Piracicaba Group of rocks crop out along the entire length of the Serra do Curral, and are represented from the bottom to the top by the Cercadinho, Fecho do Funil, Taboões, and Barreiro Formations. The Cercadinho Formation is composed of quartzites, ferruginous quartzites, phyllites, and dolomites. The Fecho do Funil Formation is composed of dolomitic phyllites, phyllites, and impure dolomites. The Taboões Formation consists of fine-grained, equigranular orthoquartzites, whereas the Barreiro Formation is composed of predominantly phyllites and graphitic phyllites.

The Sabará Group crops out to the north of Serra do Curral, and is composed of sericitic phyllites, chlorite and biotite schists, metagreywackes, quartzites, felsic quartzites, iron formations, itabirites and metaconglomerates with intercalations of dolomites. The Itacolomi Group is composed of phyllites, silicic phyllites, and quartzites. Mafic intrusives are found in granite–gneiss complexes. The intrusive rocks are in the form of dikes, plugs, and small stocks, and may reach up to 500 m in length. The Itacolomi Group is composed of phyllites, quartzitic phyllites, metaconglomerates, quartzites, and ferruginous quartzites, which are very similar to itabirites.

The structural history of the area is a result of five tectonic events, divided into principal deformation phases. The first three phases are related to the Trans-Amazonian or Minas Orogeny (Endo et al., 2004) and denoted as E1. These phases are responsible for the penetrative deformation fabric of the Minas Supergroup. E1 is characterized primarily by a schistosity S1, parallel to bedding, and a second schistosity, oblique to the first, representing the axial plane of folds generated in two successive deformation events, D1 and D2. Phase D1 was responsible for generating recumbent folds (F1) at the regional scale, transported on a basal decollement surface (the Curral Nappe). Phase D1 was also responsible for overturned stratigraphy, with the Cauê Formation on top of the Sabará Group.

The Phase D2 is characterized by a coaxial refolding event (F2) of the F1 folds. A third phase of deformation, superimposed on the Minas Supergroup, is represented by kink banding with an east–west orientation.

Subsequent to the first three deformation phases, structures related to orogenic collapse formed with successive nucleation of high-angle normal faults with a north-south orientation (E2). Following orogenic collapse, intrusion of mafic bodies occurred (E3). The Brazilian event (E4) is attributed to banding and crenulation cleavages with north-south orientation and merging to the west (D4). Phase D5 is related to event E5, generating a system of east–west and north–south trending grabens, with later deposition of Tertiary sediments into the grabens.

8.2 *Resource Models*

The João Pereira and Segredo resource models were previously audited by Pincock in 2005. The new drilling campaign added an additional 126 and 106 holes in Segredo and João Pereira models, respectively. Vale updated the models by incorporating the new data (4236 samples from Segredo and 6593 samples from Joao Pereira) obtained from the drilling campaign launched during 2004-2007 period. The Segredo model includes the existing Segredo mine area along with adjacent Area 10 which will be incorporated into the ultimate Segredo pit.

Vale's modeling procedures for both the deposits are discussed in Section 3 of this report and summarized below.

- Generation of univariate statistics of raw data and composites, Histograms, Box-plots, and Geological Contact Analysis. Pincock performed some cross-checks of the data files and univariate statistics, and did not find any significant errors. The data presented to Pincock are acceptable.

- Density Determination (using calibrated sand filled pit, water immersion for compact materials, and opening well methods). Vale has done a good job on the density model for these deposits.

- Assay compositing (10 m composites for Segredo and 13 m composites for João Pereira). The composites of 10 and 13 meters were chosen based on the actual mining bench height. The compositing is carried out to provide a set of samples that are equally valid so that the subsequent quantitative procedures are not biased. Vale generated a series of composite statistics and plots for all the variables and also for the granulometric size fractions for both deposits. Pincock performed checks on composites for both deposits using the raw data. The data produced by Pincock were in agreement with Vale composites. The differences were very minor. Not all the composites were for 10 or 13 meter lengths, as about 30 percent of the composites were less than 10 or 13 meters length. Some composites were not more than 2 m length. The reason for the short composites is Vale's approach of compositing the raw data as discussed earlier.

- Variography (generation of correlograms for all chemical variables and granulometric fractions). Vale geologists conducted extensive variography of each element (Fe, Si, Al, P, and Mn) and of all four granulometric size fractions (G1= +6.3 mm, G2 = -6.3+0.5 mm, G3 = -0.5+0.106 mm, and G4 = -0.106 mm) using the Correlogram Method. The variography was carried out on all available composites from all domains because of the lack of sufficient sample pairs in each domain. The correlograms were generated in various horizontal and in the down hole directions. Vale geologists generally model a single 3D variogram to represent the global values for the elements and all the granulometric size fractions. The reason for this procedure is that the experimental variogram of the same element in different granulometric size fractions show striking similarities. The nugget was determined from the down-hole (vertical) correlogram. Pincock performed checks on a few correlograms for compliance of 3D model with the experimental data for several variables. Both models generally show very good integrity.

- Generation of Lithological Block Model (130 cross-sections and 14 Plan-views for Segredo and 60 cross-sections and 37 Plan-views for João Pereira). Pincock performed random checks on many cross-sections and plan-views. Some areas did not have enough deep drill holes for subsurface interpretation. Vale needs to put more emphasis on structural aspects of the subsurface geological interpretation. The lithological domains used to generate block models for both deposits are summarized in Table 8-1.

TABLE 8-1
Vale
Southern System Mines Reserve Audit
Lithological Domains - Segredo and João Pereira Deposits, Fábrica Complex

Domain	Code
Hard Hematite	HC
Soft Hematite	HF
Manganiferous Hematite	HMN
Iron Clay Hematite	HAR
Rich Soft Itabirite	IFR
Dolomitic Itabirite	IDO
Soft Itabirite	IF
Hard Itabirite	IC
Manganiferous Itabirite	IMN
Iron Clay Itabirite	IAR
Detrital Ore	RO
Canga	CG

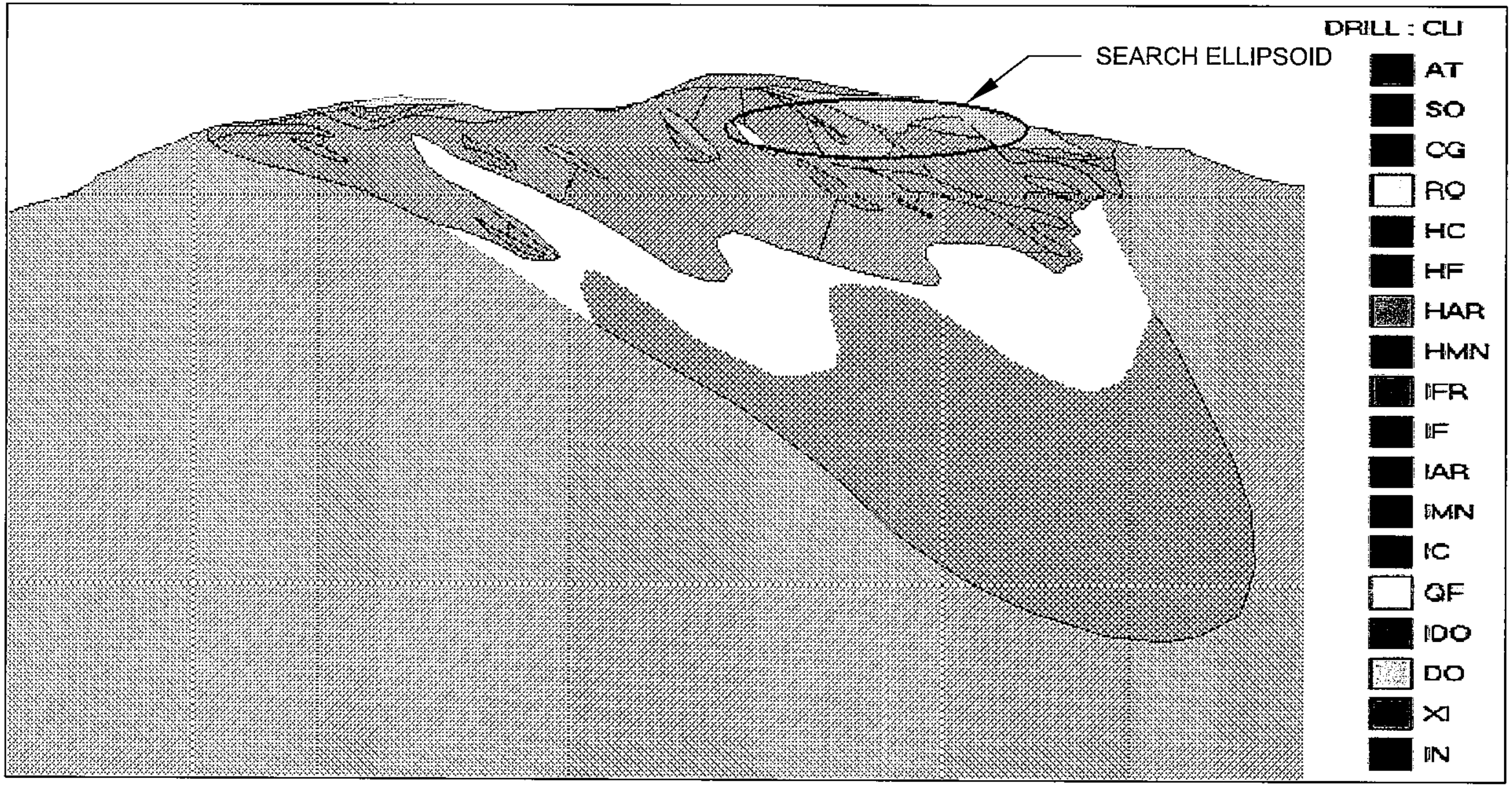
- Block Model procedures include wire frames and generation of solids by extrusion of polygons from plan-views for waste rocks, and estimation of variables for lithological interpretation of ore-bearing rocks using Indicator Kriging Method (as described in detail in Section 3 of this report). Pincock conducted the checks to identify any unassigned blocks within the block model, but did not find any serious mistakes. This is an important step which has a direct impact on the final ore resource estimates.

- Grade Interpolation - Blocks were estimated by ordinary kriging method using geological domains. João Pereira and Segredo both used a pass search of 300 to 350 meters along the Major axis, 200 to 250 meters along the Semi-major axis, and 30 to 40 meters along the Minor axis for all the variables. The major orientation was aligned to azimuth 45° and 110° for the João Pereira and Segredo models, respectively. The minimum number of octants was set to 1 with a maximum two samples per octant. Figure 8-2 shows the orientation of search ellipsoid for João Pereira deposit.

- Block Model Validation was performed by comparing geological codes with block codes, solid volumes with block volumes, composites with block statistics, and estimated block model averages with declustered composite statistics using Nearest Neighbor approach.

Resources are classified using Vale's "Dilation and Erosion" method. Pincock has accepted this method during 2005 resource and reserve audit.

Pincock performed checks on statistical comparison between block model composites and declustered composites using nearest neighbor (NN) approach for both models. Pincock also validated the data by performing graphical analysis, checks on the smoothing in the kriged blocks, and checks on the grade-



Prepared by pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	Drawing Provided by/Prepared for VALE	FIGURE 8-2 ORIENTATION of SEARCH ELLIPSOID JOÃO PEREIRA, FABRICA COMPLEX	Date of Issue Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.8-2.dwg

tonnage curves. Pincock also performed limited basic statistical comparison checks between block model estimates and assay composites. Most of the global mean values show an excellent conformance except silica, which shows higher block model estimates. Pincock considers the high values for contaminants very conservative.

Vale provided bench plots of the kriged estimates vs. the NN declustered composite averages. These plots provide an indication of conformance of the block averages to the declustered 10 and 13 meter composite data. Pincock finds this comparison of data acceptable. The block model averages generally showed good conformance. The deviation was in the range of 3 percent. Both models did not show any overestimation and underestimation of contaminants and global iron in any areas. Pincock also observed that the global mean values were very close and the local grade variations were well represented by the estimation process. Pincock confirms the overall conformity of the volume and grades of most elements to the target grade-volume relationship.

8.3 *Resource Statement*

The total resource for the João Pereira and Segredo deposits reviewed is reported in Table 8-2. The resource represents the estimated hematite and itabirite ores, for which processing of the itabirite ores will require development of the new beneficiation plants that Vale is planning. Pincock considers Vale's Resource estimates as acceptable for public disclosure and as a basis for estimation of reserves under US Securities Exchange Commission criteria.

TABLE 8-2
Vale
Southern System Mines Reserve Review
Fábrica Complex Estimated Measured and Indicated Resources [3] [4] [5]
As of December 2007

Mineral Property [1]	Tonnage x1000 [2][3] Iron	Grade Fe (%)	Tonnage x1000 [2][3] Iron	Grade Fe (%)
	Hematite		Itabirite	
Fabrica Complex				
João Pereira				
Measured Resources	16,777	63.94	319,385	40.41
Indicated Resources	28,124	64.54	624,931	37.95
Subtotal	**44,901**	**64.32**	**944,316**	**38.78**
Segredo				
Measured Resources	60,690	65.46	155,072	42.18
Indicated Resources	62,777	65.82	490,182	39.70
Subtotal	**123,467**	**65.64**	**645,254**	**40.30**
Total Measured and Indicated Resources	**168,368**	**65.29**	**1,589,570**	**39.40**
Inferred Resources				
João Pereira	15,726	65.30	919,319	36.26
Segredo	22,089	65.66	982,811	38.39
Total Inferred Resources	**37,815**	**65.51**	**1,902,130**	**37.36**

Notes:
1) Vale's equity interest in mines is 100% unless otherwise noted.
2) Tonnage is stated in wet metric run-of-mine (ROM) tonnes.
3) Resource estimates are inclusive of reserves.
4) Resource estimates as of December 31, 2007.
5) Resource estimates by Vale, compiled by Pincock Allen & Holt - Brasil.

8.4 *Mining Review*

8.4.1 General Discussion

Pincock engineers visited the mines and process facilities within Vale's Fábrica Complex during December 2008. The location and layout of the mines are shown in Figures 8-3 to 8-5. The 2008 Run of Mine (ROM) production figures in millions of tonnes are given below.

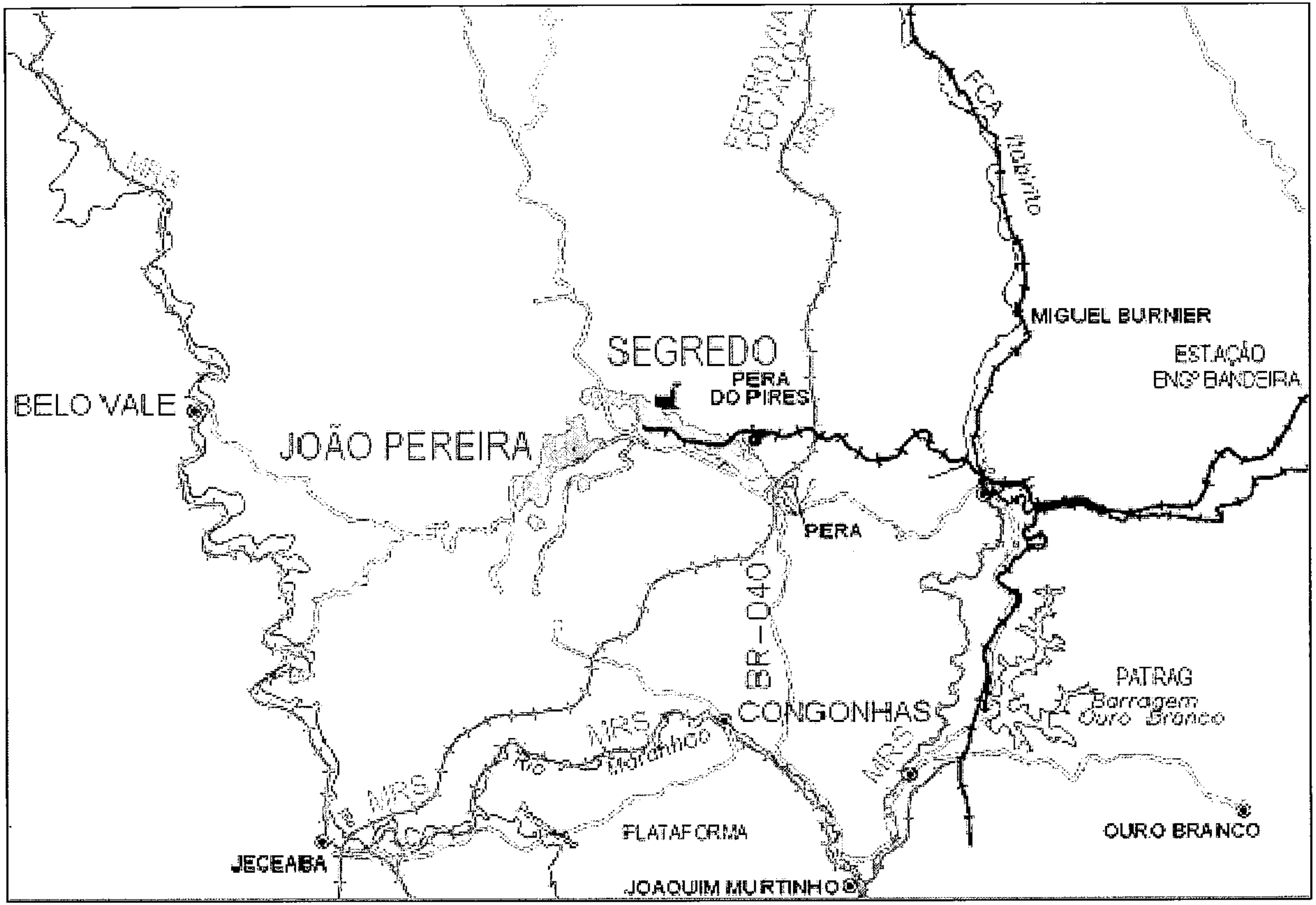
Mine	2008 Ore Production ROM (million tonnes)
Segredo	5.8
João Periera	21.7
Fábrica Total	**27.5**

The mines within the Fábrica Complex are large open pit operations. The geological setting of the iron ore deposits influences the approach to mining, with entry to the deposit afforded by extracting the exposed iron ore formation where it outcrops. In the case of the Fábrica Complex mines, the mining is spread out along the relatively narrow, long strike of the banded iron formation, the mines are presently relatively shallow, and will progress deeper along the strike in several separate flat and smaller pit areas.

Fábrica moves its material with large-scale mining equipment as summarized in the mining fleet overview listed in Table 8-3. In the larger scale waste stripping and mining of some of the itabirite benches the shovels and trucks are used, while excavators and smaller profile trucks are utilized in the tighter hematite ore benches. Vale provided Pincock with an extensive equipment list which is broadly summarized in Table 8-3. Exact equipment counts available for the mining operation may fluctuate with varying needs in the pit and surrounding infrastructure. Pincock believes the equipment fleet, maintenance of the fleet, and Vale's ability to replace and expand the fleet are sufficient for the ROM production profiles planned.

TABLE 8-3
Vale
Southern System Mines Reserve Audit
Fábrica Mine Equipment Overview

Equipment	Capacity/size	Number
Blasthole Drills	$4^{5/16"}$ to $6^{1/2"}$	1
Electric Shovels	17 - 24 yd^3	4
Wheel Loaders	15 - 22 yd^3	5
Excavators	5 - 6 yd^3	5
Wheel Loaders	5 - 8 yd^3	18
Haul Trucks	140 - 150 t	18
Haul Trucks	40 t	55
Dozers		12
Graders		5



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pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	VALE	FIGURE 8-3 MAP AREA	Mar/2009
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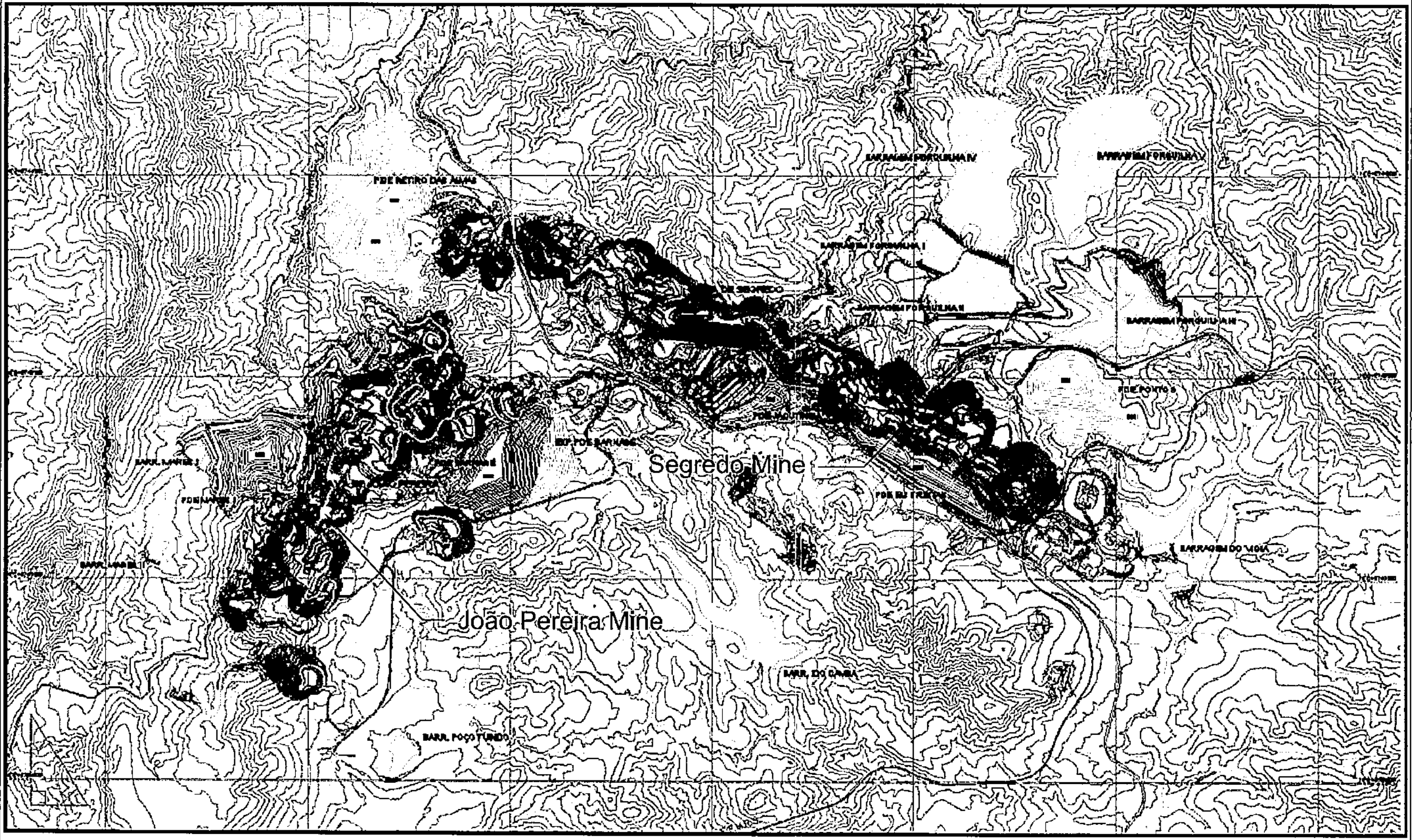

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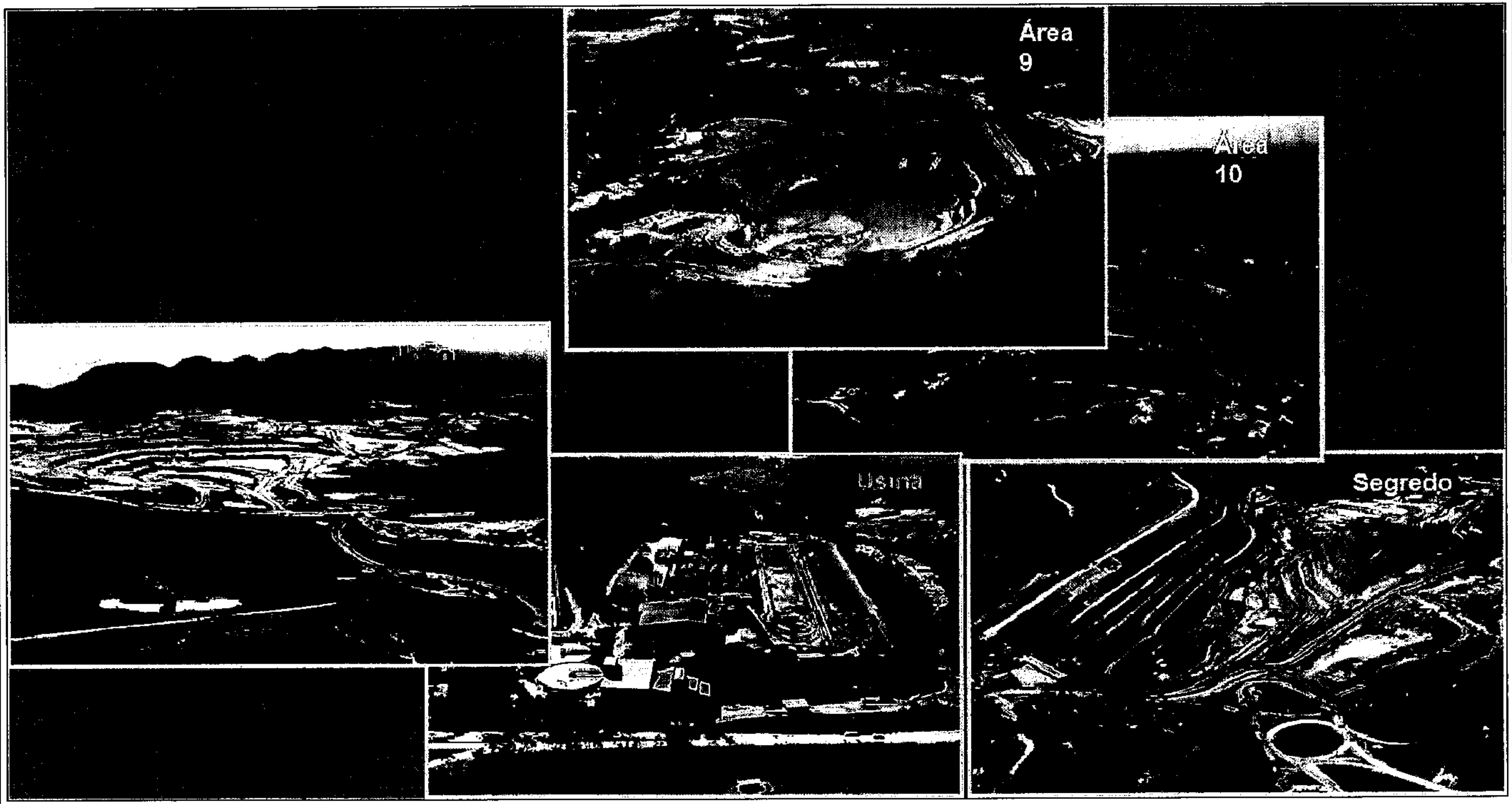
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.8-4.dwg



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pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	VALE	FIGURE 8-5 AERIAL PHOTOS	Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.8-5.dwg

Because of the friability of the ore, only occasional drilling and blasting are required. Just the compact hematite, and compact itabirite where it occurs within the pit boundary, require size preparation prior to transport from the pit. Compact itabirite is not now considered to be ore, but is being stockpiled and recognition is given to a change in classification in 2013 when the first 10 mtpy itabirite processing plant for the Fábrica Complex is to be commissioned. An expansion in itabirite ore processing capacity is planned in 2016 with the installation of an additional 10 mtpy capacity. The current reserve statement prepared by Vale recognizes the itabirite ore.

Ore is hauled to the current 16 mtpy treatment plants central to Fábrica, which is processing hematite, soft itabirite, and rich canga. Haulage is distant but presently few significant uphill haul profiles exist.

Pincock reviewed the haulage profile methodology utilized by Vale planning engineers for all of the Southern System mines that were audited, including the two mines at the Fábrica Complex. The profiles are generated on yearly pit plans and the operating and haulage times are calculated from a database of present performances and production record of equipment. Pincock believes this is done well and is accurate for developing equipment fleet schedules. Equipment replacement in the mine is scheduled to occur at reasonable intervals, as measured by the operating hours for a particular machine or fleet. At some pits, replacement has not been timely although it is believed that this situation will improve in the near future. Capital projections for replacement appear to be adequate. Operating costs for mining seem reasonable for the mining conditions, labor rates, and unit material prices confronting Vale.

8.4.2 Mine Planning

Pincock reviewed and assessed the methodology in use at Vale for developing pits and for assigning economic values to the blocks of material contained within the geologic and mining block models, and found that the approach follows accepted engineering/economic practice. Pit optimization and cutoff grade analysis begins with the resource model, which has previously been developed for the deposit. Identified ore types currently include:

1. Hematite, typically grading above 64 percent Fe;

2. Soft itabirite, with an iron content above 48 percent and upper limits on both phosphorous and manganese;

3. Rich Canga, with an iron content above 55 percent.

The Fábrica pits are designed to mine beyond hematite limits through the competent itabirites at the ultimate pit limits. Competent itabirites are presently stockpiled to be processed beginning in 2014 when the Itabirite expansion project (Plant 2) is commissioned to process itabirites only. At that time Plant 1 (the existing plant) will treat hematite ores only, with grades increasing from the present 55 percent and 63 percent recovery to 63 percent Fe and 75 percent recovery.

Based on lithologies (lithotype), in situ iron content, and other quality factors, the expected saleable products are projected for each block in the resource model. Natural Pellet Ores (NPO) requires simple crushing and screening, whereas finer product sizing for the sinter feed product (SF) is performed with separation by simple gravimetric or magnetic methods. Pellet Feed (PF) is generally obtained from the finest-sized material by flotation methods. Thus, depending on the preparation plant to which the ore will be sent and the saleable end product, there will be different costs associated with processing. Product recovery is projected at this point in the mine planning process, as is iron content of each product type.

This assignment of blocks influences mining costs as well, most notably haulage costs to deliver run-of-mine ore to its respective dumping point. The engineering department estimates haul distances, truck payload, truck cycles times, and so forth to arrive at an operating cost estimate for both ore and waste hauling, and estimates other related mining costs including drilling and blasting, loading, road maintenance, general and administrative charges, etc. Additionally, all downstream charges are incorporated into the cost model for the block; these include loading rail cars with product, rail transportation to the port, port handling and ship loading costs, and a component for corporate general and administrative charges.

Operating costs for the current model have been taken from actual cost data for 2008. To these direct operational costs are added replacement capital estimates for the mining function and for other expenditures expected in the future that are required to maintain (but not expand) the present level of operation. Table 8-4 provides the downstream charges and capital allocations by property for 2008. Both costs and product prices have increased from 2007, typically more than the change in exchange rate alone would suggest.

TABLE 8-4
Vale
Southern System Mines Reserve Audit
2008 Unit Operating Costs and Product Prices

Operating Cost Area	US$/t of Product
Mine	$3.77
Plant 1 (itabirite and hematite)	$2.01
Plant 2 (itabirite)	$7.20
General & Administrative	$2.02
Railway Transport MRS	$9.00
Railway Transport EFVM	$2.54
Port of Sepetiba	$7.41
Port of Tubarão	$0.88
3-Year Average Product Prices	**US$/t of Product**
Granulado - External Market	$86.42
Sinter Feed - External Market	$53.60
Pellet Feed - External Market	$49.85

A typical cutoff grade calculation and application is not performed by Vale for the company's Southern System iron mines. In certain of the active mines there does appear to be a gradational tenor of iron in portions of the deposit, but in other operations the material grade is dependent upon geologic material type and may exhibit large step-wise differences. Thus the company makes a primary distinction between hematite and itabirite ore types. Further, there is a competency ranking as well, such that some hard materials will not be mined and processed at the present time even though a strict cutoff grade analysis would likely show that these could be extracted, processed and sold at a profit.

A benefit calculation is performed for each block in the resource model which incorporates the tonnage of the block, expected revenues for the contained iron (by each product), the amount of NPO, SF, or PF to be recovered, and prices in US$/iron unit for the different products obtained. From the revenue are subtracted all the costs noted above to arrive at a net value per block of ore. Optimization of the final pit is performed with a Lerchs-Grossman algorithm using nested pits, and checks are made to determine if there is a high percentage of inferred resources within the pit boundaries, whether the incremental stripping ratio is excessive, and if physical boundary limits such as encroachment on the limits of the DNPM concessions or other existing infrastructure are honored. A pit optimizing routine is employed which incorporates the net present value concept when blocks are mined, so that a sequence of extraction is identified that will maximize operational cash flows.

An ultimate designed pit is developed, and mine scheduling is performed which details all material movement by year and provides the forecast for total product deliveries. Prices and associated costs are assigned on a constant-dollar basis, with income taxes applied at a 34 percent rate. Standard discounting of net after-tax cash flows is performed using Vale's weighted average cost of capital of 12 percent. An internal rate of return is also calculated at this time, and thus the economic parameters of each operation within the Southern System can be readily reviewed and compared.

Once the ultimate pit has been decided, operational pits are developed for nearer term years, usually 8 to 10 years, and a ROM production schedule of all lithology types is produced. These schedules are then reviewed by the appropriate process engineers and iterations are made where necessary.

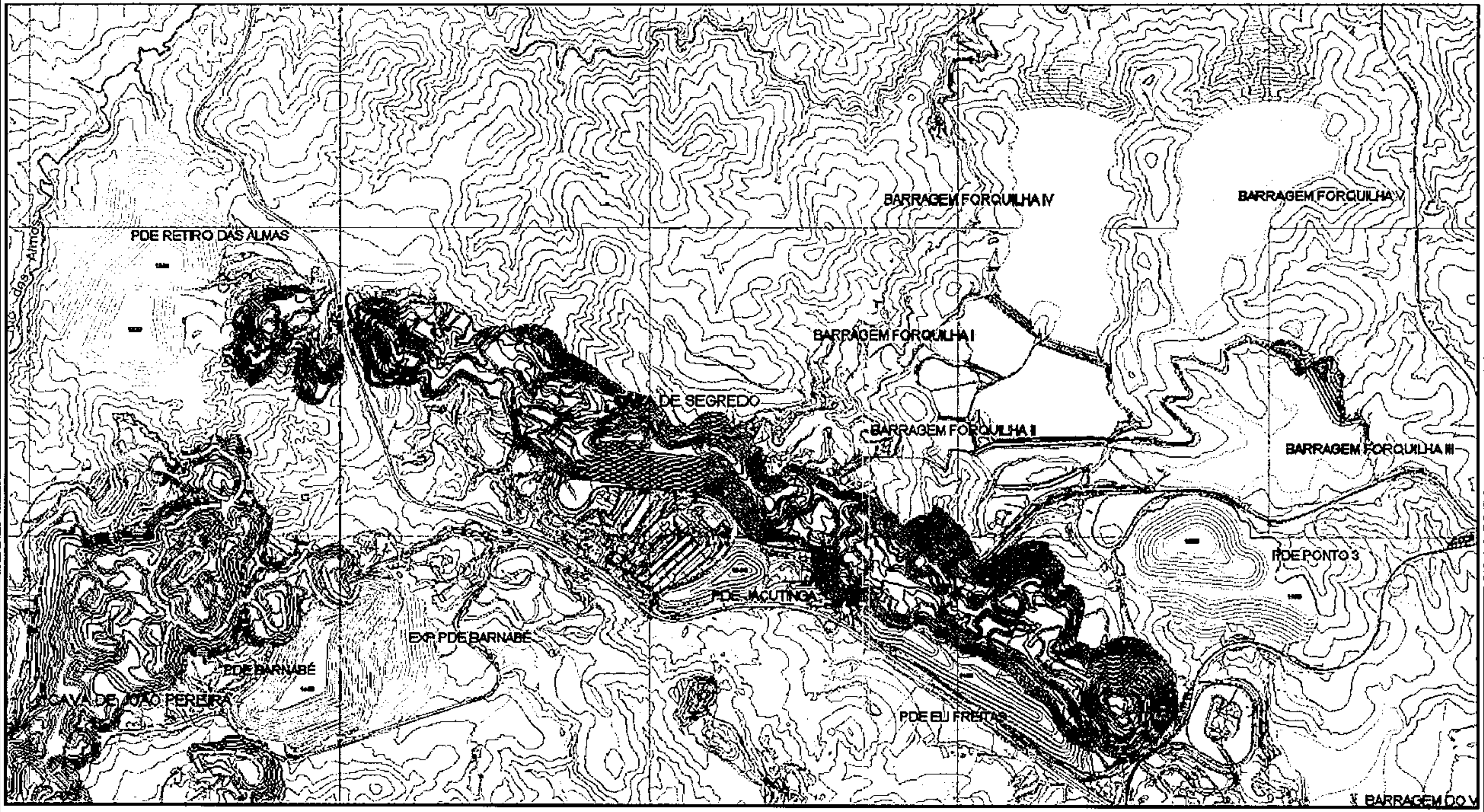
8.4.3 Life of Mine Plans

Table 8-5 provides a summary of Run-of Mine (ROM) and production data summary for Fábrica used for reserve economic confirmation. The yearly plans to achieve the ultimate pits are based on designed pits through 2015, then on "mathematical" pits through life of mine. Figures 8-6 and 8-7 show the ultimate pits for Segredo and João Pereira, respectively. Pincock believes Vale is taking a reasonable approach in the design for pits whose operating life extends very far out in the future, as do these. All these production figures are subject to change, of course, depending on future markets, additional property drilling, and availability of corporate capital.

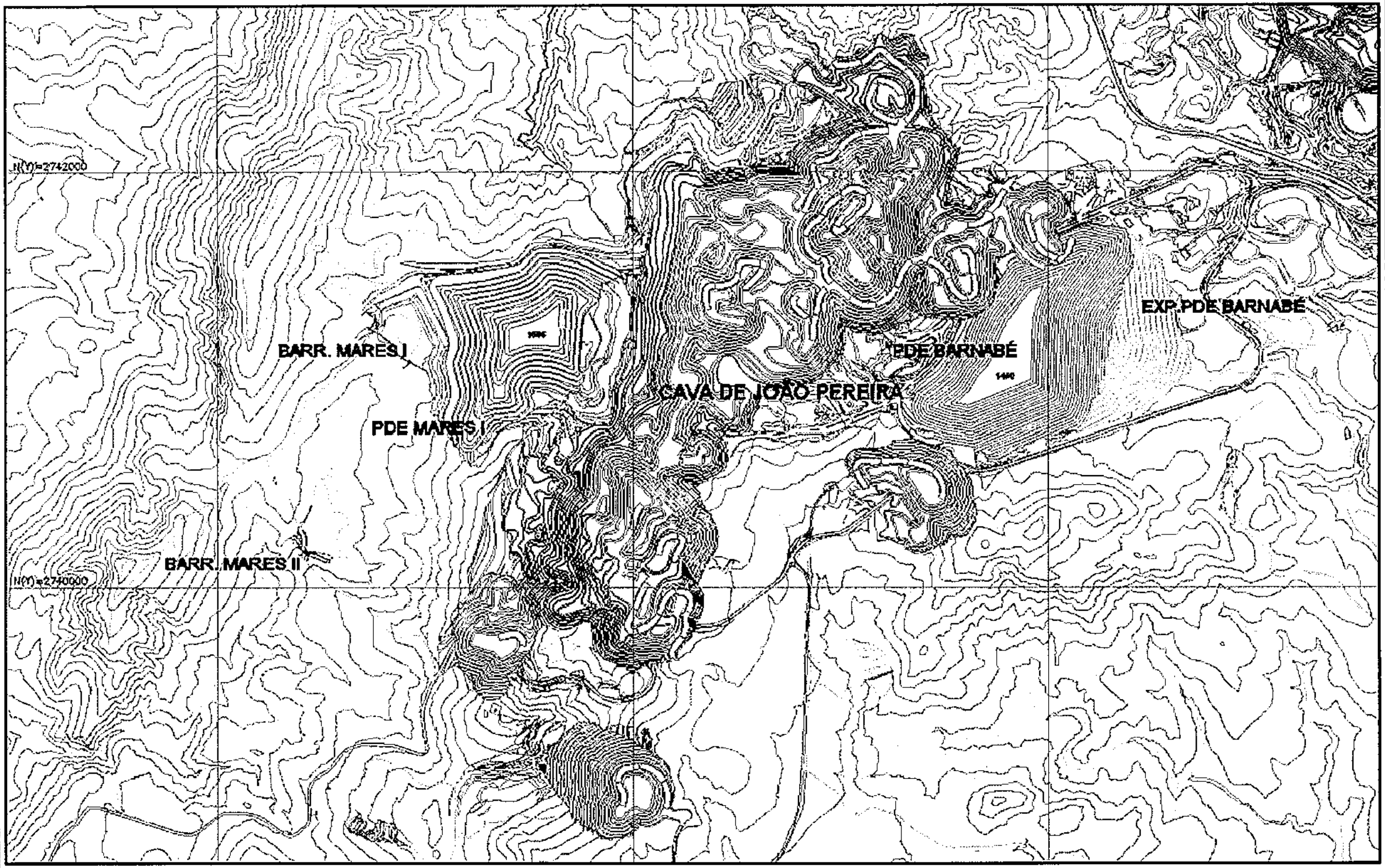
Additionally, some waste replacement is necessary and planned for both pits for short haul benefits and lack of necessary waste dumping areas over the life of the mines. Notable strategies and critical paths in the Fábrica Complex life of mine plans are:

TABLE 8-5
Vale
Southern System Mines Reserve Audit
Fábrica Schedule Plan and Products, Life of Mine Production Schedule

		Production (million tonnes)											
		Total	2008	2009	2010	2011	2012	2013	2014	2015	to 2020	to 2030	to 2040
Segredo													
ROM -> Plant - Actual		104.3	5.8	5.1	6.6	6.7	14.1	8.2	8.3	7.8	39.2	1.0	1.4
ROM -> Plant 2 - Itabirite Processing Plant		170.4	0.0	0.0	0.0	0.0	0.0	7.0	8.8	3.9	19.5	57.6	73.6
Itabirite -> Stockpile		22.5	0.0	2.8	2.1	2.0	4.0	1.8	1.7	1.4	6.8	0.0	0.0
Waste		258.7	6.6	5.4	2.1	4.1	24.0	13.8	13.1	10.6	52.8	55.0	71.0
Total Mine Movement		555.9	12.5	13.3	10.7	12.9	42.1	30.9	31.9	23.7	118.4	113.7	146.0
Other Movement @5%		27.8	0.6	0.7	0.5	0.6	2.1	1.5	1.6	1.2	5.9	5.7	7.3
Total Mine and Other Movement		583.7	13.1	14.0	11.3	13.5	44.2	32.4	33.5	24.9	124.3	119.4	153.3
João Periera													
ROM -> Plant 1 - Actual		61.9	10.0	10.6	9.3	10.0	4.6	3.1	1.7	1.5	7.7	2.8	0.5
ROM -> Plant 2 - Itabirite Processing Plant		477.6	0.0	0.0	0.0	0.0	0.0	18.1	18.8	22.1	110.3	186.4	121.9
Itabirites -> Stockpile		45.2	11.7	8.1	11.6	7.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0
Waste		210.1	6.8	5.3	3.7	4.4	3.3	10.6	11.4	11.5	57.3	43.8	52.1
Total Mine Movement		794.8	28.5	23.9	24.5	21.4	14.8	31.8	31.9	35.1	175.4	233.0	174.5
Other Movement @5%		39.7	1.4	1.2	1.2	1.1	0.7	1.6	1.6	1.8	8.8	11.7	8.7
Total Mine and Other Movement		834.5	29.9	25.1	25.7	22.5	15.5	33.4	33.5	36.8	184.1	244.7	183.2
TOTAL FABRICA													
ROM -> Plant 1 - Actual		166.2	15.8	15.6	15.9	16.8	18.7	11.4	10.0	9.4	46.9	3.8	1.9
ROM -> Plant 2 - Itabirite Processing Plant		648.0	0.0	0.0	0.0	0.0	0.0	25.1	27.6	26.0	129.8	244.1	195.5
Itabirites -> Stockpile		67.7	11.7	10.9	13.6	9.0	10.8	1.8	1.7	1.4	6.8	0.0	0.0
Waste		468.8	13.4	10.7	5.7	8.6	27.3	24.4	24.5	22.0	110.2	98.8	123.1
Total Mine Movement		1350.7	41.0	37.2	35.2	34.3	56.9	62.7	63.7	58.7	293.7	346.7	320.5
Other Movement @5%		67.5	2.0	1.9	1.8	1.7	2.8	3.1	3.2	2.9	14.7	17.3	16.0
Total Mine and Other Movement		1418.2	43.0	39.1	37.0	36.0	59.7	65.8	66.9	61.7	308.4	364.0	336.5
Stockpile -> VGR Itabirite Plant		67.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.2	50.5
Total Mine, Other, and Stock -> Plant		1485.9	43.0	39.1	37.0	36.0	59.7	65.8	66.9	61.7	308.4	381.2	387.0
Total Mine and Other Movement		1418.2	43.0	39.1	37.0	36.0	59.7	65.8	66.9	61.7	308.4	364.0	336.5
FÁBRICA Plant 1 Production (Hematite)	Fe Grade												
LO	14%	12.2	1.5	1.5	1.5	1.6	1.8	0.5	0.5	0.6	2.8	0.0	0.0
HM	4%	5.3	0.4	0.4	0.4	0.5	0.5	0.3	0.3	0.4	1.9	0.0	0.0
CSF		0.0									0.0	0.0	0.0
SF	52%	64.5	5.7	5.6	5.7	6.0	6.7	3.9	3.6	3.6	18.0	3.8	1.9
PFF	30%	39.1	3.3	3.3	3.3	3.5	3.9	3.5	2.9	2.6	12.8	0.0	0.0
TOTAL		121.1	10.9	10.8	10.9	11.6	12.9	8.3	7.4	7.1	35.5	3.8	1.9
FÁBRICA Plant 2 Production (Itabirites)													
PFF		288.3						10.9	11.4	11.5	57.4	102.0	95.2
		0.0											
TOTAL		288.3	0.0	0.0	0.0	0.0	0.0	10.9	11.4	11.5	57.4	102.0	95.2
Summary of Products													
GRANULAR		17.5	1.9	1.9	1.9	2.0	2.3	0.8	0.8	0.9	4.7	0.0	0.0
SINTER FEED		64.5	5.7	5.6	5.7	6.0	6.7	3.9	3.6	3.6	18.0	3.8	1.9
PELLET FEED		327.4	3.3	3.3	3.3	3.5	3.9	14.4	14.3	14.0	70.2	102.0	95.2
TOTAL		409.4	10.9	10.8	10.9	11.6	12.9	19.2	18.8	18.6	92.9	105.8	97.1



Prepared by pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	Drawing Provided by/Prepared for VALE	FIGURE 8-6 SEGREDO ULTIMATE PIT	Date of Issue Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.8-6.dwg



Prepared by pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	Drawing Provided by/Prepared for VALE	FIGURE 8-7 JOAO PEREIRA ULTIMATE PIT	Date of Issue Mar/2009
Project No. 9508 B	Project Name Southern System		Drawing Name Fig.8-7.dwg

- Moving the existing rail system which is atop hematite reserve at Segredo mine. Plans have been made and an alternative rail spur and loadout location will be completed in time for this mining. However is it critical to mine near the railroad to keep the quality blend of ROM feed to the existing process plant.

- As soon as the rail spur is moved, plans call for a large increase in production at Segredo to maintain grade as higher grade ore (hematite) is depleted from the João Pereira mine.

- Plant 2 (Itabirite Processing Plant) starts operation in 2014, at which time Plant 1 runs only hematite and all itabirite (friable and compact) goes to Plant 2.

- Hematite is exhausted at João Pereira in 2020

- Segredo has the larger water management problem in the system and the water management in the pit is needed to keep ore grade up. Water inflows have been modeled, the aquifers are known, and predicted inflows are manageable.

- The main focus is on Segredo being able to make the planned ore production to maintain grade.

8.5 *Reconciliation of Model to Actual Production*

Pincock was provided preliminary data for reconciliation of the 2007 long term model. This is an important factor in determining the integrity of the model as well as mine performance. The 2007 data provided is a part of a work in progress. Conclusions have not been made and thus not presented here. Pincock previously reviewed Vale model reconciliation against the 2004 model and found acceptable results.

In December 2008, Pincock completed a review of Vale's reconciliation of 2007 production to deplete the stated reserves as of 2006 and arrive at a reserve statement as of December 2007, considering the resource models being used at that time.

For the Fábrica Complex mines, Pincock found an acceptable agreement between estimated and actual production for ore tonnes. Waste reconciliation had a greater variance with the mine plan projecting a greater tonnage of waste than production records document.

Vale's 2008 reconciliation of mine plans to production is in progress and will compare long term block model to short term mine plans to run-of mine as reported by modular dispatch. Pincock recommends carrying reconciliation to production as verification of produced grades, lithologic types and quality. These factors become increasingly important as the itabirite plants are commissioned and the different ore types are processed.

8.6 *Reserves*

Table 8-6 is a summary of reserves estimated by Vale for the Fábrica complex. These reserves as shown are as of December 2007 and are not net of 2008 production. The December 2007 reserves will be depleted for 2008 production when year-end surveys are completed.

As shown in Table 8-7, there is an increase of 430 million tonnes on Fábrica ore reserves from 2007 to 2008. The majority of this increase comes from Vale's plans to build itabirite processing plants and process this material which had previously largely been considered waste. Pincock would note that Vale has not considered the itabirite materials that are in existing waste dumps that potentially could be technically and economically processed after 2014, when Plant 2 comes on line.

TABLE 8-7
Vale
Southern System Mines Reserve Audit
Fábrica Reserve Change from 2007 to 2008

	2007		2008		Change between 2008 and 2007	
	Mt	Fe%	Mt	Fe%	Mt	Fe%
João Pereira						
Hematite	27.0	65.9%	36.3	62.9%	+ 9.3	-3.0%
Itabirite	331.0	46.7%	548.5	41.0%	+ 217.5	-5.7%
Total Ore	**358.0**	**48.1%**	**584.8**	**42.3%**	**+ 226.8**	**-5.8%**
Waste	293.0		210.2		-82.8	
Total João Pereira Movement	651.0		795.0		+ 144.0	
Segredo						
Hematite	39.0	65.4%	108.3	60.8%	+ 69.3	-4.6%
Itabirite	69.0	52.1%	203.3	45.1%	+ 134.3	-7.0%
Total Ore	**108.0**	**56.9%**	**311.6**	**50.6%**	**+ 203.6**	**-6.3%**
Waste	156.0		240.0		+ 84.0	
Total Segredo Movement	264.0		551.6		+ 287.6	
FABRICA MINE						
Hematite	66.0	65.6%	144.7	61.4%	+ 78.7	-4.2%
Itabirite	400.0	47.6%	751.7	41.9%	+ 351.7	-5.7%
TOTAL FABRICA ORE	**466.0**	**50.2%**	**896.4**	**45.0%**	**+ 430.4**	**-5.1%**
Waste	449.0		450.2		+ 1.2	
Total Fábrica Complex Movement	915.0		1,346.6		+ 431.6	

Notes:

"2008 Reserves" are reserves as estimated as of December 2007, considering additions from the new resource models and mine plans audited by Pincock in this project but do not consider depletion for 2008 production. "2007 Reserves" are reserves as of December 2006 with depletion for actual 2007 production which was reviewed by Pincock in early 2008 and are based on the previous resource models and mine plans that were audited by AMEC in 2007.

TABLE 8-6
Vale
Southern System Mines Reserve Audit
Fábrica Reserve Summary

	Proven		Probable		Total		ROM Quality				
João Pereira	Mt	Fe%	Mt	Fe%	Mt	Fe%	Si%	Al%	P%	Mn%	LOI%
Hematite[a]	18.1	63.8%	18.3	62.0%	36.3	62.9%	4.13%	2.31%	0.08%	0.11%	3.23%
Itabirite	253.7	41.7%	294.8	40.4%	548.5	41.0%	38.6%	0.80%	0.04%	0.13%	1.54%
Total Ore	**271.8**	**43.1%**	**313.0**	**41.6%**	**584.8**	**42.3%**					
Waste					210.2						
Total João Periera Movement					795.0						
Segredo											
Hematite[a]	58.5	63.4%	49.8	57.8%	108.3	60.8%	4.83%	3.69%	0.06%	0.84%	2.81%
Itabirite	89.8	44.9%	113.5	44.0%	203.3	45.1%	29.0%	1.57%	1.90%	1.22%	2.30%
Total Ore	**148.3**	**52.2%**	**163.3**	**48.2%**	**311.6**	**50.6%**					
Waste					832.8						
Total Segredo Movement					1,456.0						
Fábrica Complex											
Hematite[a]	76.6	63.5%	68.1	58.9%	144.7	61.4%	4.62%	3.32%	0.06%	0.66%	2.90%
Itabirite	343.5	42.5%	408.3	41.4%	751.7	41.9%	36.3%	1.13%	0.05%	0.46%	1.75%
Total Fábrica Ore	**420.0**	**46.3%**	**476.4**	**43.9%**	**896.4**	**45.0%**					
Waste					1,043.0						
Total Fábrica Movement					2,251.0						

(a) The Hematite reserve includes hematite material plus canga and rolado material

8.7 *Processing*

8.7.1 General Discussion

The Fábrica ore processing plant presently treats hematite or and some high grade itabirites from the João Pereira and Segredo Mines. The current plant produces lump ore, hematitinha, sinter feed and pellet feed. Some of the pellet feed is used on to feed the on-site Fábrica pellet plant. It was reported by Vale that there is enough hematite available to blend with higher grade itabirites for the current plant production until 2020. In 2008, it was expected that 18.2 million tonnes of ore would be treated to produce 12.3 million tonnes of products for a mass recovery of 67.5 percent. The production rate is expected to increase to 12.5 mtpy in 2009 and to 14.5 mtpy in 2010. The additional 2.0 mtpy will be from a small dry processing plant that will be added as a capital project. In 2014 the production is expected to reach 24.5 mtpy with the start up of the first 10 mtpy low grade itabirite plan (1a ITM I Fábrica). Another 10 mtpy itabirite plant (2a ITM I Fábrica) expansion scheduled for startup in 2016 is in Vale's long range plans.

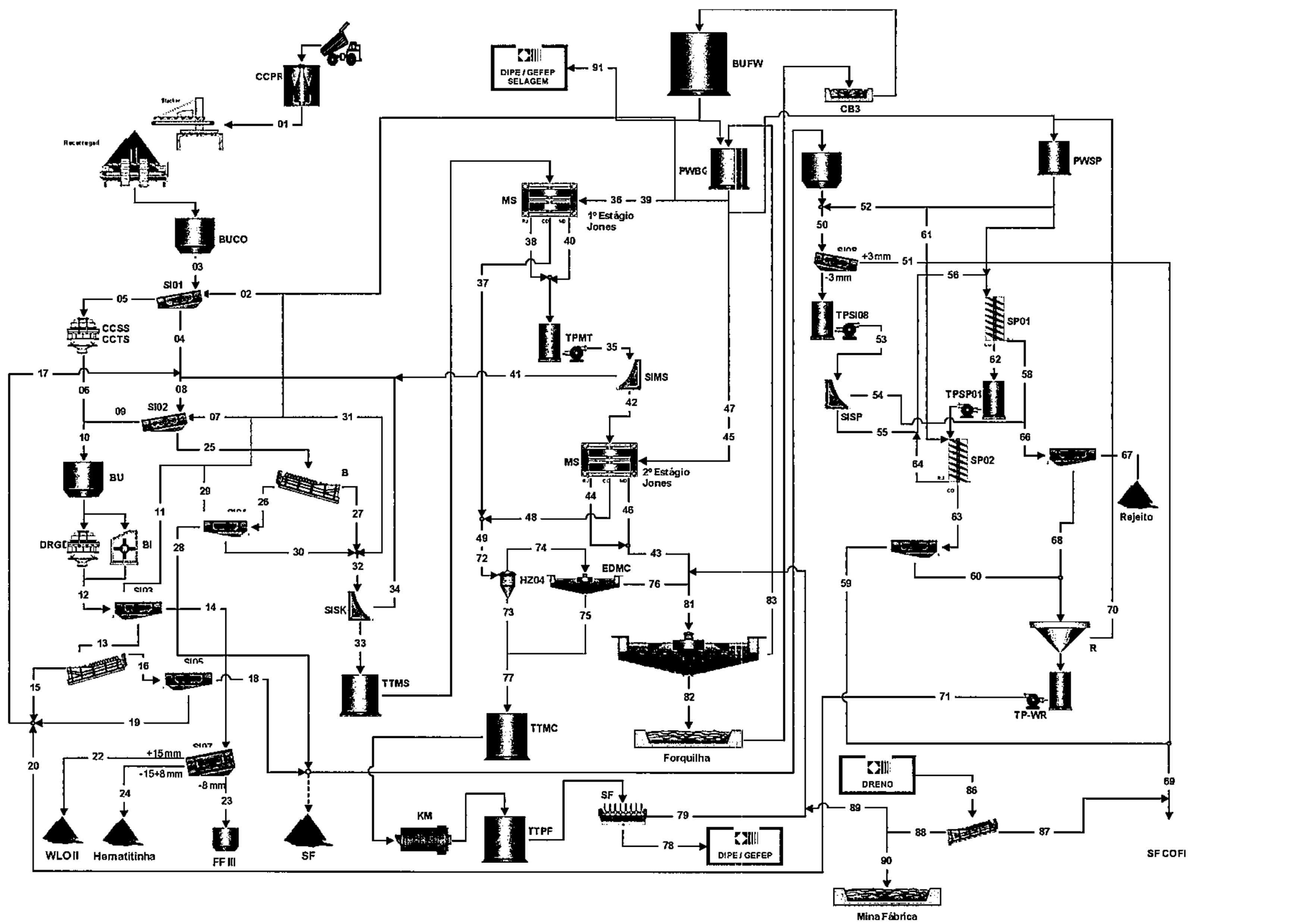
The following sections present a review of the existing process plant and the proposed itabirite projects.

8.7.2 Existing Fábrica Plant Flowsheet and Costs

The process is typical of other Southern System Mines. There are three stages of dry primary, secondary and tertiary crushing and screening that produce lump ore, hematitinha and sinter feed products. The first two stages are open circuit and the third is closed-circuit. The fines or undersize from the above dry processing steps are treated by wet processing in further screening, classification, high intensity magnetic separation and gravity concentration to produce additional sinter feed and pellet feed. The pellet feed is dewatered in a thickener, reground in a ball mill and filtered. These concentrates are reground not for liberation but to create a finer particle size for pelletizing. The reground filter cake is conveyed to the pelletizing plant where it is converted into pellets. The processing flowsheet is shown in Figure 8-8.

The ROM ore averages about 55.2 percent Fe. Typical product splits as a percent of ROM and product quality are shown in Table 8-8, but can vary a little from year to year.

The ROM ore grade for Fábrica is lower in iron content than other hematite plants and the ore mineralogy is a little more difficult to treat. The flowsheet is a somewhat more complex as a result. ROM blending from the two mines is very important for a stable and efficient operation in the processing plant. The metallurgical recovery of iron is reported to be about 76 percent, which is lower than some of the other hematite plants and may be due to the ore mineralogy.



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Project No. 9508 B

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Project Name: Southern System

FIGURE 8-8
FABRICA COMPLEX
PROCESS PLANT FLOWSHEET

Date of Issue: Mar/2009

Drawing Name: Fig.8-8.dwg

TABLE 8-8
Vale
Southern System Mines Reserve Audit
Fábrica Complex Current Process Plant Production

Product	Proportion	Average Grade
ROM	100%	55.2% Fe
Lump ore	3%	66.1% Fe
Hematitinha	2%	66.9% Fe
Sinter feed	28%	65.5% Fe
Pellet feed	32%	68.2% Fe
Tailings	35%	38.4% Fe

Vale estimates the processing cost per tonne of product for the Fábrica operations for 2008 was $R 4.02 (US$ 2.01) and the total production costs was reported at $R 15.60 (US$ 7.80). For 2007 the actual processing cost per tonne of product was $R 4.94 (US$ 4.94) and $R 17.52 (US$ 8.76) for the total production cost.

The Fábrica processing facility has a well designed flowsheet for the ore that it treats from the two mines. The plant and equipment appeared to be well maintained and housekeeping was good. The difficult ore and complex flowsheet probably make this one of the most difficult plants to operate because of the close coordination required between the mining and processing staff to maintain a consistent ROM feed blend for the plant.

8.7.3 Proposed Itabirite Processing Plants

General

In order to both increase production of pellet feed during the remaining period of hematite production and to allow continued mining of the lower grade itabirites, Vale plans to construct and startup a new 10 mtpy process plant in 2014 with a second 10 mtpy expansion in 2016. This plant and the associated flowsheet will be somewhat different than the existing plant and will only process low grade itabirites to produce a single pellet feed product. No high grade hematite will be processed in the new plant.

The plant will be located near the existing ore processing and pelletizing facilities. The project is in the early stages of design development so many of the details are not as well developed and refined as for the new Vargem Grande Itabirite Plant which is scheduled to start up three years earlier in 2011. However, it is Pincock's opinion that sufficient research and development work has been done and a preliminary plant site has been selected and designed so the project costs and economics can be considered to be reliable and reasonably accurate.

Vale's senior management has decided that the Northern System Mines at Carajas will produce more sinter feed and less pellet feed. This decision means that Vale will have to produce more pellet feed from the Southern System Mines to replace the loss from Carajas and to be able to maintain market share. The Fabrica itabirite project is the second of the new projects to produce pellet feed with the Vargem Grande itabirite being the first of the new plants. The design philosophy is based on the unique mineralogical characteristics of itabirite and is somewhat similar to the process that will be used for the new Vargem Grande itabirite plant. Both plants will have some features that utilize new technology but will also have standard equipment and practices used in other itabirite plants.

The processing plant is designed to process 25 mtpy ROM to produce the 10 mtpy of pellet feed. The ROM ore grade is 41.1 percent Fe and the final pellet feed product is 66.5 percent Fe. The mass recovery is 39.8 percent and the iron recovery is 64.3 percent, which is quite low for a processing plant of this type. The majority of the iron losses (approximately 60 percent) are in the slime tailings which assay about 43.5 percent Fe which is higher in iron content than the incoming ROM ore.

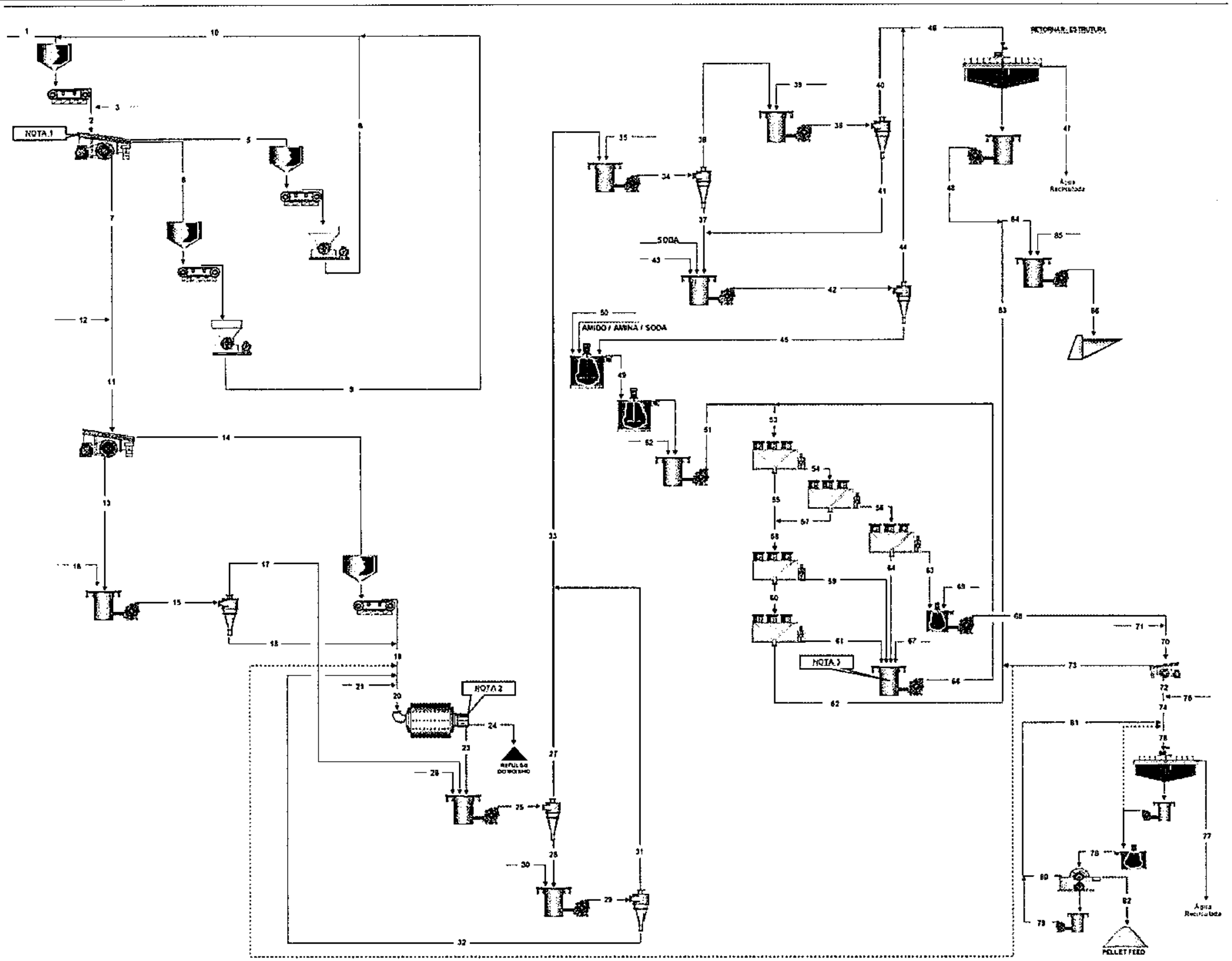
Process Plant and Equipment

The process within the new plant will consist of three stages. The first stage consists of a single vibrating grizzly and primary crusher operating dry in an open circuit. The product passes directly to the second step of the first stage which is secondary screening and crushing. There are four vibrating screens and two cone crushers operating dry in open circuit to produce a 50 mm product which is put into a homogenizing stockpile. The system is designed to handle 4206 tph.

In the second stage of the process the crushed ore is reclaimed from the homogenization stockpile and fed to the dry tertiary and quaternary screening and crushing. There is tertiary cone crusher operating in closed circuit with six vibrating screens. The product goes to the last stage of dry processing where it is screened and crushed with ten vibrating screens and five cone crushers operating in closed circuit. It is assumed the ore is crushed to 12 mm in size (0.5 inches) for the next stage of wet processing starting with ball mill grinding. The flowsheet for the third stage of wet processing is shown in Figure 8-9.

The third stage of the process is all wet processing and that is where the separation of iron minerals from waste minerals takes place. Details of all the wet processing equipment were not available. Information available includes four large ball mills (18 ft x 29 ft). The ball mills grind the finely crushed product in closed circuit in a double hydrocyclone classifying system with the underflow returning to the ball mill for more grinding. The overflow goes into a three stage hydrocyclone desliming circuit for preparing flotation feed. The ball mill circuits generate a ground ore product with a size consist of about 0.105 mm (105 microns or 150 mesh).

The hydrocyclone desliming circuit produces two products; flotation feed and slime tailings. The flotation feed from the desliming passes through two conditioning tanks where the flotation reagents are added. The flotation takes place in four steps of rougher, scavenger, cleaner and recleaner flotation machines with recycling of the intermediate products. The recleaner concentrate is the final concentrate product and the second scavenger froth (overflow) is the final tailing. The flotation concentrate is fine screened



NOTA 1: Fluxo 4 - refere-se ao US do 1º deck, sendo este auxiliar
NOTA 2: Fluxo 22 - refere-se a Descarga da Moagem
NOTA 3: Fluxo 65 - refere-se a junção dos fluxos 59, 61 e 64.

Prepared by	Drawing Provided by/Prepared for		Date of Issue
pincock, allen & holt 165 S. Union Boulevard, Suite 950 Lakewood, Colorado 80228 Phone (303) 986-6950	VALE	FIGURE 8-9 PROPOSED ITABIRITE PROCESS PLANT FLOWSHEET	Mar/2009
Project No. 9508 B	Project Name: Southern System		Drawing Name: Fig.8-9.dwg

before thickening in a conventional thickener. The thickener underflow is further dewatered in vacuum disc filters and the thickener overflow is recycled back to the plant as process water. The flotation tailing joins the slime tailings that have been thickened and both are pumped together to the tailings pond.

Some chemicals are used for flotation and are added into the conditioners which are directly ahead of flotation. Caustic soda (NaOH) is added to control pH, solubilized starch is added to depress the iron minerals and amine is added to float or remove the silicious waste. The process is known as reverse flotation where the non-valuable minerals are floated and removed leaving behind a clean, high grade iron ore concentrate.

Process Plant Capital and Operating Costs

The project is expected to be completed and producing at full capacity in 2014 at an estimated capital cost of US$ 849 million. This is one of the highest capital costs per tonne of annual production at US$ 85/ tonne compared to all of the other planned Vale projects but is lower than some of the other itabirite projects. The Vargem Grande itabirite project is US$ 118/tonne, Apolo is US$ 96/tonne and the non-itabirite projects such as Serra Sul and Carajas North are US$ 55/tonne and US$ 42/tonne, respectively. PAH believes the estimated capital cost is realistic for the purposes of this reserve audit.

The operating cost per tonne of pellet feed at the Fábrica itabirite plant is estimated at $US 7.62/tonne for only the processing. This is fairly close to the cost of $US 8.05/tonne that Vale estimates for the more advanced Vargem Grande project. The Fábrica operating cost estimate is more at a Prefeasibility Study level while the Vargem Grande is a Feasibility level cost estimate. However, PAH feels that this cost estimate has been carefully prepared and is in line with quoted costs from other similar Vale plants such as Feijão at US$ 9.01/tonne. For the Fábrica itabirite plant, PAH estimates that the grinding, flotation and vacuum filtration will be +/- US$ 5.25/tonne or about 65 to 70 percent of the processing cost. In summary, although this project has not been developed to a full Feasibility Study level PAH believes the projected operating cost has been carefully estimated and prepared and is reasonably accurate for purposes of establishing the economic viability of the future processing of itabirites.

8.7.4 Discussion

It is the opinion of PAH that the planning for the processing plant proposed at the Fábrica operation for treating the low grade itabirite ore is realistic and is based upon sound and reliable technology and equipment. Vale has much recent experience with estimated capital costs because of all the recent expansion and construction. The operating costs are considered realistic and are largely based and comparable to other similar Vale plants. Projections of the product quality indicate the pellet feed should be of very high quality and should compete strongly in the pellet feed market.

The operating costs are much higher than the hematite plants where very little grinding and beneficiation must be done. Therefore, the mass recoveries at the hematite plants are double the itabirite plants so the greater volume of product reduces the unit production cost. However, although the processing costs may be high compared to some of Vale's hematite plants they are low compared to other iron ore processing plants worldwide.

PAH feels there is one aspect of the project that Vale should not be satisfied with and that is the projected, very low iron recovery at about 64 percent. PAH feels the desliming losses are too high and that Vale should be investigating other desliming methods such as desliming thickeners and controlling the pulp chemistry instead of hydrocyclones. Hydrocyclone desliming is done with brute force and cannot be as selective or sophisticated as a process in a thickener. Desliming losses account for about 60 percent of the tailings loss which represents over 20 percent of the ROM ore. It would seem that there should be strong incentives to explore, develop and utilize some of the other potential technologies for more efficient desliming.

8.8 *Economic Viability*

Pincock has reviewed Vale's projected economic viability of Vale's Fábrica Complex from 2008 to the end of reserve life as an economic test of reserves. The two mines of the Fábrica Complex run as one operation, with costs tracked and reported as one and are combined as one for the economic analysis.

For the 2008 reserve audit, full economics were projected to the life of the reserve. In the past, reserves for this complex were based on previous year's operating costs and revenues. For the 2008 reserve, which includes a sizeable increase in itabirite reserve dependent on capital construction and investments, it is appropriate to project life of reserve economics.

The Fábrica Complex economics were performed by Vale engineers and analysts and reviewed by Pincock while on site for the property visits. Economic analysis for the 2008 reserve was initially approached with the Itabirite projects as stand- alone projects, with no consideration of the present hematite production, and both plants show positive cash flows. The second analysis, contained herein, was expanded to include all material from 2009 forward as an economic test. Predictably the second approach works to the economic advantage of the reserve by offsetting capital investment with present operating revenue.

All costs are expressed in US$ at the following exchange rates:

2008:	1.80
2009:	1.75
2010 and after:	1.72

Cash operating costs and specific allocated charges have been compiled for each complex and are presented in Table 8-9. The Vale accounting department tracks direct cash costs for each property within a complex, and also supplies the direct cash costs for downstream activities including rail transport and port handling.

TABLE 8-9
Vale
Southern System Reserve Audit
Operational Unit Costs

	US$/tonne product
Mine	$3.77
Plants ITM HM	$2.01
Plants ITM ITAB.	$7.20
Administrative	$2.02
Railway transport (MRS)	$9.00
Railway transport (EFVM)	$9.00
Port CBPS	$1.04
Port Tubarão	$1.04

Additionally, administrative allocations for the site management and for the general corporate charges are proportioned back to the operations as well, and a capital replacement charge is included which accounts for expected future expenditures that will be required to maintain the operation at its present level of production.

The 2008 operational unit costs for the Fábrica Complex are used in the cash flow analysis and are listed in Table 8-9 on the cost per tonne of product.

Rail and port charges represent just the direct cash operating costs for these activities, and not the transaction price that would be charged to an outside customer. Pincock has experience with large open pit operations elsewhere with respect to the mine capital cost component and believes this charge to be within the range normally expected. Other investment charges are covered in the capital section of the cash flow analysis.

Unit prices for product sold are based on a price per iron unit, defined as the iron content of a metric ton of product measured in percent. For the ore reserve economic test provided to Pincock, average three year unit prices per tonne of product were used. While this simplifies the cash flow, inaccuracies could exist due to varying grades using this pricing assumption. If the economics were marginal this assumption would require further analysis. While Pincock recommends that economic analyses be performed on actual contract price structure (price per iron unit) using predicted grades of mined ore, the economics for Fábrica are robust enough that the per-tonne pricing method is considered to be adequate for an economic viability test. Average prices realized for Fábrica products sold for export during 2006, 2007, and 2008 were (US$):

Lump Ore	$86.40/tonne
Sinter Feed	$53.60/tonne
Pellet Feed	$49.90/tonne

PAH independently has reviewed published data for 2008 showing monthly prices received by Vale at the company's Tubarão port; these correspond with the unit prices presented by the company for the year. Vale also sells a portion of its products within the country at significantly reduced prices; in these cases the rail and port charges to the customer do not apply, and the company maintains much of its profit margin. Pertinent life of mine information for the Fábrica complex is summarized in Table 8-10 per tonne of product.

TABLE 8-10
Vale
Southern System Reserve Audit
Mine Life of Reserve Economic Summary

	US$ million
Gross Income	21,289
Operating Costs	6,905
EBIT	14,384
Capital Investment	1,922
Net Revenue	10.717
Net Present Value @12% - Fábrica	2,188

The review of the Fábrica cash flow indicates a substantial Net Present Value (NPV) (discounted at Vale's weighted average cost of capital of 12 percent). The Internal Rate of Return (IRR) is not applicable due to existing operation with positive cash flow from year one. Sensitivity to cost, operating and capital expenditures is analyzed up to doubling (+100%) each variable. A positive NPV in each case illustrates the sound economics of the Fábrica reserve, as shown in Table 8-11.

TABLE 8-11
Vale
Southern System Reserve Audit
Sensitivity to Cost

Op Cost	NPV U$ million	Cap Ex	NPV U$ million
0%	2,188	0%	2,188
10%	2,039	10%	2.097
20%	1,890	20%	2,006
50%	1,444	50%	1,732
100%	700	100%	1,277

Note: OP cost and Capital Expenditure are varied separately

Additionally, Vale imposes another economic hurdle that serves as an indicator of risk; i.e., a ratio of NPV for the project versus the NPV of the capital investment. If the ratio is greater than one, the project risk is considered to be modest.

Based on this review of life of mine economics using three year rolling average realized prices, PAH believes that the viability of Vale's Fábrica's 2008 reserve is readily demonstrated.

The production profile and annual costs and revenues on which the cash flow economics is based, follow in Tables 8-12 and 8-13. Table 8-14 presents the annual cash flow resulting from the production profile, costs and revenues.

TABLE 8-12
Vale
Southern System Reserve Audit
Fábrica Complex Production Profile

Production Summary	Total	2008 actual	2009	2010	2011	2012	2013	2014	2015	to 2020	to 2030	to 2040
Movement (Million tons)	-											
WASTE	469	13.4	10.7	5.7	8.6	27.3	24.4	24.5	22.0	110.2	98.8	123.1
ROM - Plant 1 (Hematite)	166	15.8	15.6	15.9	16.8	18.7	11.4	10.0	9.4	46.9	3.8	1.9
ROM - Plant 2 (Itabirite)	648	-	-	-	-	-	25.1	27.6	26.0	129.8	244.1	195.5
OTHER MOVEMENTS	68	2.0	1.9	1.8	1.7	2.8	3.1	3.2	2.9	14.7	17.3	16.0
TOTAL	1,351	31.3	28.2	23.3	27.0	48.9	64.0	65.3	60.3	301.6	364.0	336.5
PRODUCTION												
Current Plant	121	10.9	10.8	10.9	11.6	12.9	8.3	7.4	7.1	35.5	3.8	1.9
Itabirite Plant	288	-	-	-	-	-	10.9	11.4	11.5	57.4	102.0	95.2
Total	409	10.9	10.8	10.9	11.6	12.9	19.2	18.8	18.6	92.9	105.8	97.1
PRODUCTION DISTRIBUTION RAILWAY												
Proportion of Railway and Port Costs												
MRS	52%											
EFVM	48%											
Plant 1												
MRS/CPBS	63	5.7	5.6	5.7	6.0	6.7	4.3	3.9	3.7	18.5	2.0	1.0
EFVM/Tubarão	58	5.2	5.2	5.2	5.5	6.2	4.0	3.6	3.4	17.0	1.8	0.9
Plant 2	-											
EFVM/Tubarão	288	-	-	-	-	-	10.9	11.4	11.5	57.4	102.0	95.2
Total	409	10.9	10.8	10.9	11.6	12.9	19.2	18.8	18.6	92.9	105.8	97.1