

Mining expansion

Vale celebrates its 70th anniversary by investing in long-term projects with a focus on mining and sustainable development

Dinorah Ereno

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In seventy years, Vale has grown from a small mining company in the town of Itabira, in the State of Minas Gerais, to the world's leading global iron ore producer and the world's second largest producer of nickel. With business operations in 38 countries on five continents, the company is also involved in the logistics business, including railways, port terminals, cabotage, energy, and fertilizers. The company's outstanding success is based on enormous investments in state-of-the-art technology and in research and innovation. The immediate needs of clients are supported by three research and development centers, including two centers in Brazil and one center in Canada. Other long-term research projects in several areas are conducted at the Vale Technological Institute (ITV), which was founded in 2009.

The initial conversations about the creation of a non-profit institute began in 2007. However, the project only gained momentum at the end of 2008, when neurophysiologist Luiz Eugênio Mello was hired as the executive director of ITV. At that time, Mello was the dean of undergradu-

ate studies at the Federal University of São Paulo (Unifesp). "Last year, Vale invested US\$ 1.7 billion in R&D. Of this amount, nearly R\$ 23 million went to ITV," states Mello, who is also a former assistant coordinator of FAPESP's Scientific Director's Office. In 2011, at US\$ 22.8 billion, the mining company's net profit was 32% higher than it had been in 2010.

Since it was founded, ITV has entered into 97 R&D agreements and has established partnerships with 36 national and international institutions, including Embrapa, the Massachusetts Institute of Technology (MIT) and Switzerland's Federal Polytechnic School of Lausanne. The institute also has partnerships with FAPESP and with the research foundations of the states of Minas Gerais and Pará. These entities have provided ITV with funds of R\$ 120 million, which have been allocated to research projects in the fields of mining, energy, and ecoefficiency.

Two research units with different research objectives – sustainable development in Belem, in the State of Pará, and mining in Ouro Preto, in the State of Minas Gerais – conduct research





From left to right, Regina Bronstein, Sandoval Carneiro, Roberto Dal'Agnol, Cláudia Diniz, Luiz Eugênio Mello, José Oswaldo Siqueira and Hugo Resende, all of whom are affiliated with the Vale Technological Institute

studies in the fields of climate change, water management, sustainability in the mining industry, biodiversity, energy, and environmental monitoring technology. These fields were defined as priorities at workshops that were organized by Vale in 2010 and attended by researchers from several institutions who are experts in their respective fields of study.

The ITV Sustainable Development unit is headed by Luiz Carlos de Lima Silveira, a physician and neuroscientist who assumed the position of scientific director of the unit in 2010. Currently, 33 researchers from a variety of fields are conducting research on six different topics: biodiversity, including soil microbiology and plant biotechnology; climate change; water management; bioenergy and photosynthesis; sustainable mining; and environmental monitoring. Two other fields – sustainable architecture and urban planning in the Amazon region and sustainomics, which is defined as the science of sustainable development – are also being researched.

Silveira, who created the postgraduate program in neuroscience and cell biology at the Federal Uni-



Taquari Mine in the State of Sergipe: exploiting potassium

iversity of Pará (Ufpa), defines his current work as a continuation of his academic experience: “I gained administrative experience during my career as a researcher and implemented two research groups: one focusing on the basic sciences and the other, on the neuroscience of tropical medicine.” Silveira explains. “These credentials enabled me to take on my current job.” Silveira has a medical degree from Ufpa, as well as a master’s degree and a doctorate in biophysics from the University of Rio do Janeiro (UFRJ). He did his postdoctoral work in neuroscience at Oxford University, England.

AN URBAN PHENOMENON

In Silveira’s opinion, the creation of a research group in Brazil requires a number of skills, especially when the focus is the Amazon region, which has many regional disparities and must be integrated with the other regions in the country. At ITV in Belém, more than 10 research projects are being conducted in collaboration with local institutions, such as Ufpa and Embrapa Amazônia Oriental, and international institutions, such as Belgium’s Flanders Biotechnology Institute and Israel’s Weizmann Institute of Science.

The choice of Belém as one of the physical locations of the research network was strategic; the city is the capital of the State of Pará, where Vale has a large iron ore mining operation in the Carajás mountain range. Belém has two million inhabitants. The mines in Carajás alone account for 36% of the iron ore that is currently produced by Vale. In 2011, Vale’s iron ore production totaled 322.6 million tons. According to Silveira, “Belém is a big city that lies geographically and temporally on the frontier between the Amazon Region and the Atlantic Ocean; the region’s

enormous biodiversity has to be studied.” Two research projects are at an advanced stage. One is the Urbis project, which focuses on urban planning and is dedicated to the urban development in the western part of the Amazon region. The other project focuses on the climate-related effects of Vale’s mining operations.

The Urbis project is coordinated by Ana Cláudia Cardoso and space engineer Antonio Miguel Monteiro, who is employed by the National Institute for Space Research (Inpe). “Our plan is to work on a multidisciplinary vision of the urban phenomenon of Pará,” states Cardoso, who has a degree in architecture and urban planning from Ufpa, a master’s degree in urban planning from the University of Brasília (UnB) and a doctorate in architecture from Oxford Brookes University in England. The researchers want to understand how major economic activities such as mining, animal husbandry, and timber exploitation are influencing not only the capital city but also the medium-sized and small towns in forest conversion areas and the villages along highways and river banks. The project participants include economists, urban planners and ecologists from institutions such as the Federal University of Minas Gerais (UFMG), the State University of Campinas (Unicamp), and the Getúlio Vargas Foundation. The participants will use specific tools to analyze occupation levels in the state. According to Cardoso, “Migration rates in some municipal regions of Pará are four times higher than in other regions of Brazil because of the investment dynamics of Vale and the influence of farming and cattle ranching.”

The research team working on climate change is comprised of a physicist and two meteorolo-

36%

of the iron ore produced by Vale is in Carajás in the State of Pará

gists. It is coordinated by Luiz Gylvan Meira Filho, the former president of the Brazilian Space Agency. Luís Antônio Lacerda Aímola has been a member of the team since he left Israel to move to Belém. In Israel, Luís Antônio worked as a researcher in the field of climate change and modeling. He has a degree in physics from Unicamp and a doctorate in environmental sciences from the University of São Paulo (USP); he did his postdoctoral work at the Weizmann Institute. “I was attracted by the company’s innovative vision, which led it to create a center of excellence in research focused on the field of sustainable development, and by the possibility of conducting long-term research projects,” explains Aímola.

CLIMATE EVENTS

Since May of 2011, he has been working on a project that seeks to connect the possible physical changes in the tropical region’s rainfall regime due to global warming with the economic elements of climate models. “If significant changes occur, they can change the dynamics of the Amazon Forest,” he states. Because mining depends on rainfall regimes, mining operations can be jeopardized by extreme climate events. “I am working on the physical as-

pects of climate, as well as on possible future climatic effects on the economies of tropical regions,” Aímola explains. One of the meteorologists on the team is studying the effects of climate change on Vale’s operations in the eastern Amazon region. The other meteorologist is constructing a climate model for the Amazon region.

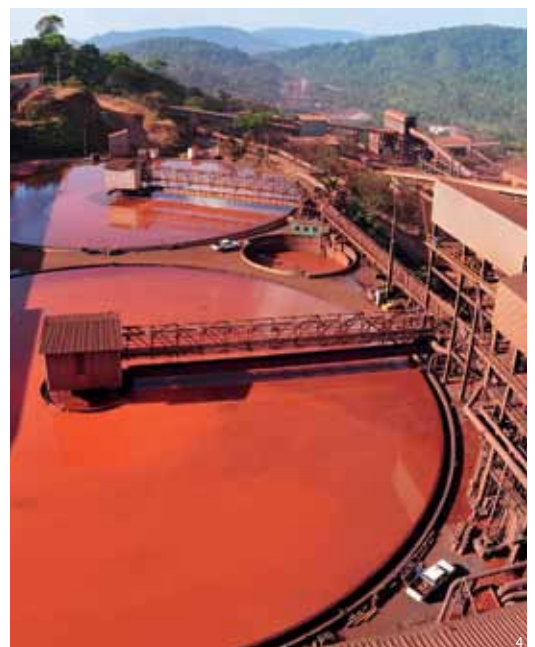
ITV Mineração is in the process of being established in the city of Ouro Preto in Minas Gerais. The priority fields are infrastructure, metallurgy, mineral processing and exploitation, prospecting and geology, and water resources. One of the projects is coordinated by agronomic engineer José Oswaldo Siqueira, who is also a retired professor from the Federal University of Lavras (Ufla). He was hired by ITV one year ago to work on technology for manufacturing fertilizers.

Agriculture begins with mining. The raw materials that are extracted from rocks are used to produce fertilizers

“Agriculture starts with mining,” Siqueira explains. The raw materials extracted from the rocks are used to produce fertilizers. “Our biggest challenge,” he says, “is to bring the requirements of agriculture and food production to a mining company.” Siqueira has a degree from the School of Agriculture of Lavras (which is currently known as Ufla) as well as a master’s degree and a doctorate from the University of Florida. He did his postdoctoral work at the University of Michigan. Siqueira argues that because of this connection between agriculture and mining, it is



On the side and below, computer images show the new iron ore processing projects in Carajás. On the right, the same mine’s current processing area is displayed



necessary to seek new technological processes that can increase the efficiency of the extraction of raw materials and thus make it possible to obtain high-quality, environmentally friendly products.

“Most of the technology used to make fertilizers nowadays was developed between 1950 and 1970,” Siqueira explains. This stagnation has been caused by a lack of interest on the part of developed nations, by farm policies and by the historically low price of fertilizer. However, the situation has changed in the last five years. Brazil must now increase the technological competence of the entire production chain.

THE MINING FRONTIER

“This is a strategic issue, because the country imports approximately two-thirds of the fertilizers it consumes,” states Siqueira. Phosphate, for example, is essential for agricultural production, but the worldwide reserves of this mineral are extremely limited. Vale produces fertilizers such as phosphate and potassium, but its aim is to become a major producer of raw materials for fertilizers on a global scale. Toward this end, the company has invested heavily in Brazil and in Africa, Peru, Argentina and Canada, acquiring mines and companies. In addition to developing fertilizer production technology, ITV Mineração is working on eleven other research areas, one of which is the mining frontier of the ocean floor. This research is being conducted in partnership with Ufla, USP, and universities such as Australia’s Queensland University of Technology.

After working for 25 years at Embraer, aeronautics engineer Hugo Resende accepted the



Iron ore storage area at Carajás

invitation extended to him in October of 2011, when he was asked to organize a department that would focus on an incubator for technology start-ups linked to the ITV. “The challenge is to identify new, technology-based business start-up opportunities based on research studies conducted not only at ITV but also at Vale’s other research centers,” explains. Resende, who has a degree from the Aeronautics Technology Institute (ITA) as well as a master’s degree and a doctorate from Stanford University. At Embraer, Resende worked on aircraft development and aeronautical software. Prior to becoming the chief scientist responsible for the company’s partnerships with universities and for identifying projects of interest to the company, he worked as a technological development manager.

Resende accepted Vale’s invitation because he envisioned it as a new challenge. “Identifying

INSTITUTIONS AT WHICH THE COMPANY’S RESEARCHERS STUDIED

LUIZ EUGÊNIO MELLO

Physician, executive director of ITV

Unifesp Undergraduate degree, master’s degree and doctorate
University of California postdoctoral work

LUIZ CARLOS DE LIMA SILVEIRA

Physician, scientific director of ITV Sustainable Development

Ufpa Undergraduate degree
UFRJ Master’s degree and doctorate
University of Oxford Postdoctoral work

LUÍS ANTÔNIO LACERDA AÍMOLA

Physicist, researcher at ITV Sustainable Development

Unicamp Undergraduate degree
USP Doctorate
Weizmann Institute of Science, Israel Postdoctoral work

JOSÉ OSWALDO SIQUEIRA

Agronomy engineer, researcher at ITV Mining

Ufla Undergraduate degree
University of Florida Master’s degree and doctorate
University of Michigan Postdoctoral work

ANA CLÁUDIA CARDOSO

Architect, researcher at ITV Sustainable Development

Ufpa Undergraduate degree
UnB Master’s degree
Oxford Brookes University Doctorate

STEPHEN POTTER

Mine engineer, director of Integrated Planning and Technological Development

Royal School of Mines, London Undergraduate degree and master’s degree

HUGO RESENDE

Aeronautical engineer, manager of business start-up incubator

ITA Undergraduate degree
Stanford University Master’s degree and doctorate

ROGÉRIO CARNEIRO

Metallurgical engineer, general manager of the CTF

UFMG Undergraduate degree and master’s degree

opportunities and transforming them into business was a missing element in my professional experience,” says Resende, who also held several positions on the executive board of the National Association of R&D at Innovative Companies (Anpei) and was the president of this association in 2006. The start-up incubator is expected to become operational in 2013. This activity is being integrated into the MIT model, which was chosen as a point of reference for the process that created ITV. According to Mello, “MIT’s focus is to transfer technology to companies and to train entrepreneurs.”

IMMEDIATE RESPONSE

Three large laboratories are responsible for addressing technological needs that require immediate responses. The Mineral Development Center (CDM) and the Ferrous Technology Center (CTF) are located in Minas Gerais. The third laboratory, which is dedicated to nickel and base metal technology, is located in Canada. Founded in 1965, the CDM is considered to have made the company’s first technological advancement by developing its own technology for processing minerals with low iron ore content. The company developed this technology in the 1960s, which enabled Vale to extend the life of its mines. The CTF, which was created in 2007, conducts research on the entire iron ore chain from mining to steel. “Our work focuses on the steel industry,” explains metallurgical engineer Rogério Carneiro, who is the general manager of the CTF and has an undergraduate degree and a master’s degree from UFMG. “Several laboratories and mathematical models that simulate steel manufacturing processes enable us to develop solutions for our clients,” states Carneiro, who has worked for Vale since 2001. Before joining Vale, he worked for 17 years at a Brazilian steel company, coordinating research on iron ore, sintering, and blast furnaces. Of the CTF lab’s 120 employees and contractors, 30 are researchers with master’s or doctoral degrees, including metallurgical engineers, mining engineers, and geologists. Using these labs and models, one can test items ranging from different processing routes to the behavior of the iron ore in steel mills. According to Carneiro, “CTF has equipment that simulates a steel mill.”

The innovative technologies that are used to produce iron ore distinguish Vale from other companies and have helped to secure the company’s outstanding position within the international community. One example of such innovative technologies is the transportation of iron ore using bulldozers and mobile stone crushers rather than trucks. This mode of transportation is being used as part of a project for Carajás known as S11D. The bulldozers and stone crushers will



Experiments at the Mineral Development Center in Minas Gerais

extract the iron ore and transport it to the processing unit. “The processing of iron ore, based on its own natural humidity, with no added water, is another technology that will minimize environmental impact,” explains mining engineer Stephen Potter, director of Integrated Planning and Technological Development at Vale. Potter has an undergraduate degree and a master’s degree from London’s Royal School of Mines. “Besides reducing water consumption, this technology will allow us to recover the mined ore at the mine,” states Potter, an Englishman who has worked in the mining industry for 20 years and has been with Vale since 2009. The finer particles that are eliminated in the conventional process will be mixed into the end product. In addition, it will no longer be necessary to discard the waste from the process into a dam specifically built for this objective. “The fact that no loaded trucks will be moving around the mine will lower the impact on the environment,” explains Potter. Vale has recently been granted the preliminary environmental license necessary to implement the project. ■