

ÖkoRess III

Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

Vale Northern System Carajas Iron Ore Mines

Vale S.A. , Brazil

ID: 2

Note

The qualitative assessment of Environmental Hazard Potentials (EHPs) in this factsheet was conducted according to the method developed in the precursor project ÖkoRess I “Discussion of the environmental limits of primary raw material extraction and development of a method for assessing the environmental availability of raw materials to further develop the criticality concept”¹ (Dehoust et al. 2017a). The measurement instructions applied here are described in Dehoust et al. 2017b. The method is tested and further developed within this project (ÖkoRess III).

The information in this factsheet refers exclusively to publicly available, designated sources that have been classified as serious by the authors. It is specifically pointed out that no statement is made about the implementation and quality of agreements or standards that are applied. The implementation of agreements through memberships, certifications, etc. is the responsibility of the companies.


The surface extension of each mine area has been estimated based on publically accessible satellite images as official land-use plans from the public authorities or mine operators are not consistently available. It therefore only corresponds to the apparent area where mining, processing facilities, heaps, etc. and related infrastructure are clearly identifiable.

The fact sheets make no claim to completeness of all relevant voluntary standards. Mentioning a membership in one of the listed voluntary standards does not imply an assessment of the suitability of the standard in itself, nor does it make any statement about the member's success in implementation.

¹TEXTE 87/2017 <https://www.umweltbundesamt.de/publikationen/discussion-of-the-environmental-limits-of-primary>

Vale Northern System Carajas Iron Ore Mines

Iron ore

General information 	
Indicator or criteria	Description and values
Name of mine	Vale Northern System Carajas Iron Ore Mines
Description of mining area	<p>The VNSC are situated in a sparsely populated and well-forested part of the state of Pará, in northern Brazil. VNS Carajas is divided into Serra Norte (39.6 km²), Serra Sul (18.8 km²) and Serra Leste (2.5 km²) mines which are 40 - 50 km apart from each other. The total extension of the three mines is about 60 km². Since 1984 mining operations take place in Serra Norte. In 2014, a new mine beneficiation plant started its operations in Serra Leste. In 2016, operation started in the Serra Sul S11D Project.</p> <p>Geology: Jaspilite represents the proto-ore of the Carajas region deposits, typically with 15 to 45 % iron (Fe) and 35 - 65 % silica (SiO₂). Jaspilite leaching resulted in progressive silica depletion forming hard hematite at depth but soft hematite (laterites) as weathering product near the surface. Both, hard and soft hematites have iron contents ranging from 60 to 68 % (MDO 2019; Vale 2009, 2017a).</p>
Surface extension	59.46km ² 59.46 km ² (Image date: 01.06.2018; Viewing height: 10.21 km) (Google Earth)
In operation since	1984 1984 (MDO 2019). In 1970 a joint venture company was formed to exploit the deposit with the Vale mining company owning 51% and U.S. Steel owning 49%. In 1977 Vale acquired full ownership (Mining Technology 2019).
Operator	Vale S.A.
Owner	Vale S.A.
Closest town	Serra Norte Mine: 30 km west of Parauapebas; Serra Sul Mine: 52 km west of Canaã de Carajas; Serra Leste Mine: 15 km north of Curionópolis (MDO 2019).
Province	State of Pará
Country	Brazil

Longitude	-50.169581°
Latitude	-60.62483°
Altitude	750 m a.s.l. Varying: 250-750 m a.s.l. (Google Earth)
Main product and by-products	Main product: iron ore; by-products: none (MDO 2019; Mining Technology 2019)
On-site processing stages	Extraction and processing steps up to ore concentration (crushing, grinding and screening) (Vale 2018)
Annual production	Total Northern System 169.2 Mt: <ul style="list-style-type: none"> • Serra Norte (2017): 142.7 Mt • Serra Leste (2017): 4.3 Mt • Serra Sul: 22.2 Mt (Vale 2018)
Proven Reserves	1795.6Mt with 65.95 % of Fe (Vale 2018)
Probable Reserves	4827 Mt with 65.5% ore grade (Vale 2018)

Geology



Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	The VNS Carajas mines comprises oxidic iron ore of haematitic composition and goethitic weathering products of the lateritic/canga type. No sulphides are reported.	Iron is a siderophilic element. Siderophilic elements often are sulfidic but also mined in oxidic ores as in the present case. As the ore is oxidic and no sulphides are present, preconditions for acid mine drainage have a low environmental hazard potential (EPH).	Low	B1 = medium, can be estimated on the basis of available information

Paragenesis with heavy metals	No indication for paragenesis with heavy metals could be determined.	As there is no direct information on the paragenesis with heavy metals available, the measurement instructions are referred to. These indicate that oxidic iron ores can be associated with heavy metals such as lead, zinc, copper, chrome, and arsenic. According to Wellmer and Hageluecken (2015) heavy metals and arsenic may have a limited relevance in the extraction of oxidic iron ores, leading to a medium EHP.	Medium	B1 = medium, can be estimated on the basis of available information
Paragenesis with radioactive components	No indication of paragenesis with thorium or uranium	In accordance with the measurement instructions, iron ore deposits are evaluated with a medium EHP, if no other information is available.	Medium	B2 = medium, classified according to measurement instructions
Deposit size	In 2017 the total reserves of the three mine sites amounted to 6623 Mt with 65.6 % ore grade (Vale 2018)	Considering total reserves of about 6622.6 Mt with an ore grade of 65.5 %, the complex has a total iron (Fe) content of 4344 Mt Fe. Adding 33 years of production with an average of 100 Mt of ore or 60 Mt of Fe, the deposit can be classified as very large to gigantic.	High	A = high, can be derived directly from available data
Ore grade	65.6 % iron grade (reference year 2017) (Vale 2018)	65.6 % is a high grade iron ore in Brazilian and international context, which leads to a high EHP.	Low	B1 = medium, can be estimated on the basis of available information

Technology



Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Mine type	Hard-rock open pit mining (Vale 2018)	Conventional solid rock open pit mining is evaluated with a medium EHP. Mining is restricted to the horizontal and vertical extension of the ore body/mineralized zone, leading to a medium EHP in the evaluation result. The impact is higher than in underground mining but less pronounced than in mining of alluvial or unconsolidated sediments.	Medium	B1 = medium, can be estimated on the basis of available information
Use of auxiliary substances	Mining is carried out without trucks but conveyor belts and shovel-loaders after drilling and blasting of hard rock sequences. No concentration plant operates at Carajas. Beneficiation process steps at the mine site include: sizing, screening, hydrocycloning, crushing and filtration (Vale 2009, 2017a, 2018).	Ore processing is restricted to sorting and gravimetric methods, thus allowing classification to low EPH.	Low	B1 = medium, can be estimated on the basis of available information
Mining waste	Natural moisture beneficiation processing results in the reduction of water use and tailing ponds (S 11 D Project Serra Sul). In Serra Norte Carajas, tailing ponds are constructed in safe pits (lower than the edge of the terrain) so that no dams are necessary.	Reduced generation of fines and slurries due to modified beneficiation process and safe conditions of few tailing pond justify a low EHP. There is no information available regarding waste pile stability.	Low	B1 = medium, can be estimated on the basis of available information

	There are no tailing ponds in Serra Leste (Vale 2017b; d).			
Remediation measures	Compensation measures include: 1. Rehabilitation of pasture degraded area near to S11D, equivalent to 70 soccer fields by 170,000 native plants of the Amazon; 2. buffer zone management by shared governance through Vale Institute of Technology (ITV) www.itv.org/en/ , stabilization and 3. renaturation of waste piles. In Serra Norte: mainly prevention measures and reforestation implemented by Comissões Internas do Meio Ambiente (CIMAs). No further information is available regarding mine-closure plan and financial provisions (Vale 2017b; d).	In S11 D Serra Sul compensation measures and remediation take place concomitantly to operation, which justifies a classification to a low EHP.	Low	B2 = medium, classified according to measurement instructions

Framework conditions natural environment



Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Accident hazard due to floods, earthquake, storms, landslides	The rating system for the 4 sub-indicators uses georeferenced data from publicly available risk maps (see measurement instructions). Metrics are directly taken from the given risk assessment. The indicator total is determined by the highest hazard level of the sub-indicators.	The environmental hazard potential (EHP) for landslides is medium and is negligible for all other aspects (earthquakes, tropical storms and floods or situation in arctic environment).	Medium	B2 = medium, classified according to measurement instructions

Water Stress Index (WSI) und desert areas	The WSI by Pfister et al. (2009) provides characterization factors on the relative water availability at watershed level. Absolute water shortages in dry areas is supplemented by desert areas. The highest hazard level of the sub-indicators determines the total result.	EHP for the WSI is low and the mine is not situated in a desert area.	Low	B2 = medium, classified according to measurement instructions
Protected areas and AZE sites	Georeferenced data for designated protected areas are used to assess hazards posed by mining extraction. The metric to evaluate EHPs corresponds to the method first described in the draft standard of the Initiative for Responsible Mining Assurance (IRMA 2014).	The mine is not close to protected areas as defined in the ÖkoRes evaluation method.	Medium	B2 = medium, classified according to measurement instructions

State Governance

Indicators	
WGI 1 -Voice and Accountability	61.58 ^{ooo}
WGI 2 -Political Stability and Absence of Violence/ Terrorism	31.43 ^{ooo}
WGI 3 - Government Effectiveness	41.83 ^{ooo}
WGI 4 -Regulatory Quality	51.44 ^{ooo}
WGI 5 - Rule of Law	43.75 ^{ooo}

WGI 6 -Control of Corruption	36.06 °°°
EPI (Environmental Performance Index)	60.7
EITI membership	No
International Agreements	
ILO 176	Brazil is part of ILO 176
Others	Reaffirmation of commitment with the 2030 Agenda for Sustainable Development in 2017 (Mercosur countries). Signature of the Paris Agreement on Climate Change and participation at COP 22. (MDNP 2018)
Legal framework	

<p>Areas of Law: Environment</p>	<p>Comprehensive legal framework on federal level with norms regarding licensing (compulsory for mining and industry), environmental impact assessment including the need for public consultations during the primary licence process and Environmental management and mine closure plan in the course the installation licence (MineHutte 2019), environmental crimes, waste management, water and groundwater protection, contaminated land exist (Leonhardt / Stump 2018). Federal states have legislation and regulation autonomy, however (with exception of some states in the industrialized southeast) limited enforcement capacity (ibid.). "Polluter pays" and joint liability are basic principles regarding recovery/mitigation of impacts. The public prosecutor being represented by the independent public ministry (Ministerio Publico) on federal and state level has controlling function also over environmental authorities (ibid.). Environmental and mining authorities still need to align licensing procedures. Sector Plans for Mitigation and Adaptation to Climate Change in Mining aims at the reduction of CO2 in the mining sector (MDNP 2018).</p>
<p>Areas of Law: Occupational Health and Safety (OHS)</p>	<p>Brazil implements the National Norm NR-22 since 1999 through its Ministry of Labour. The norm specifies the conditions for safe working and health conditions in mining, in accordance to ILO 176 criteria and is also responsible for the inspections of compliance with occupational health and safety (OHS) regulations (Cattabriga / Castro 2014). Companies inform all accidents to the INSS, an agency of the Ministry of Social Welfare (MPAS), which administers a compulsory employer-funded compensation insurance system (Elgstrand et al. 2013). The National Department for Mineral Production – DNPM published the Mining Regulatory Standard in 2001, which supports the establishment of specific sectorial and state standards of OHS in Mining (DNPM 2001) .</p>

Corporate Social Responsibility (CSR)

Voluntary Standards	
Aluminium Stewardship Initiative (ASI): Is the mine owning company a member?	Not applicable Not applicable
Aluminium Stewardship Initiative (ASI): Is the mine certified?	Not applicable Not applicable
International Council of Mining & Metals (ICMM): Is the mine owning company a member?	Yes Yes (ICMM 2019)
Towards Sustainable Mining (TSM) Is the mine owning company a member of the Mining Association of Canada (MAC)?	Yes Yes (MAC 2019)
Towards Sustainable Mining (TSM) outside Canada: Are TSM standards implemented*?	No information available No information obtained
Initiative for Responsible Mining Assurance (IRMA): Is the mine owning company a member?	No No (IRMA 2018)
Initiative for Responsible Mining Assurance (IRMA): Is the mine certified?	No No (IRMA 2018)
Responsible Copper (RC): Is the mine owning company a member of RC?	Not applicable Not applicable
Responsible Copper (RC): Is the mine certified?	Not applicable Not applicable
Responsible Mining Index (RMI): Has the mine been rated?	No No (RMI 2018)
Responsible Mining Index Company indicator „Working conditions“	0.575 0.575 / 1.000 (RMI 2018)

Responsible Mining Index Company indicator „Environmental sustainability“	0.391 0.391 / 1.000 (RMI 2018)
Responsible Steel (RS): Is the mine owner a member of the RS?	No information obtained No information obtained
Responsible Steel (RS): Is the mine certified?	No information obtained No information obtained
Australian Steel Stewardship Forum (ASSF): Is the owner a member of the ASSF?	No No (ASSF 2019)
Australian Steel Stewardship Forum: Is the mine certified?	No No (ASSF 2019)
ISO and CSR reporting	
ISO 14001 (ISO 14004): Is the mine ISO 14001 certified?	Yes Yes (Vale 2017c)
CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	No No (RMI 2018)
OECD Guidelines: Does the company have its headquarters in a signatory state?	Yes Yes (Brazil) (OECD 2019)
ISO 26000: Does the mine implement ISO 26000?*	No No
Banking Standards	
WB Standards / IFC Performance Standards: Is the mine financed to a major extend by the world bank?	No No (Vale 2018)
Equator Principles (EP): Is the mine financed to a major extend by a bank adherent to the EP?	Yes Shareholder Mitsui Agglomerate (Vale 2018)

*by companies own account.

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A Glossary

Table 1 Legend

Environmental hazard potential



low



medium



high

Data quality



low



medium



high

- No concrete information, no general specifications of the measurement instructions, expert estimation.
- Assessment not possible due to lack of data at the site, as there is also no evidence for an assessment and there are no generalized assessment rules.

- Assessable on the basis of available information.
- Generalized classification according to measurement instructions.

- Can be derived directly from available data.

B Abbreviations

EHP	Environmental hazard potential
FY	Financial year
kt	Kilo tonnes
m a.s.l.	Meters above sea level
Mt	Million tonnes
OHS	Occupational Health and Safety
t	tonnes
TSF	Tailing Storage Facility
WGI	World Governance Indicators
WHS	Work Health and Safety

C Imprint

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