

ÖkoRess III

Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

Paragominas Mine

Norsk Hydro, Brazil

ID: 85

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>

Paragominas Mine

Bauxite

General information



Indicator or criteria	Description and values
Name of mine	Paragominas Mine
Description of mining area	Mine site area is 52.3 km ² . The mine is situated at the centre of the Miltonia Plateau, a structure of low elevation (50 - 150m) which extends approx. 20 km from north to south and 8 km from east to west in the eastern part of the State of Pará. Most part of the open pit site consists of two strip mining areas and tailing ponds, separated by forests. Ore processing facilities are located at the north-western rim of the site, where the ore pipeline (Mineroduto) has its starting point (The Diggins n.d.)(SEMAS 2003).
Surface extension	52.84km ² 52.84 km ² (Image date: 29.07.2011; Viewing height: 10.27 km) (Google Earth)
In operation since	2007 2007
Operator	Mineração Paragominas AS
Owner	Norsk Hydro
Closest town	Town of Paragominas, 70 km southwest
Province	Pará
Country	Brazil
Longitude	-47.72038°
Latitude	-3.258691°
Altitude	125 m a.s.l. 125 m a.s.l.
Main product and by-products	Bauxite

On-site processing stages	Strip-mining, and processing steps such as crushing and grinding, washing and sorting. The ore is then transported by a 244 km long pipeline to the AluNorte refinery in Barcarena/ Belem (MDO 2018)
Annual production	11.4 Mio t of bauxite (Hydro 2018a)
Proven Reserves	230.5 Mt Al ₂ O ₃ (MDO 2018) (reserves from 2009)
Probable Reserves	58.2 Mt Al ₂ O ₃ (MDO 2018) (reserves from 2009)

Geology 				
Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	Bauxite is a supergene enrichment of Al forming oxidic ore deposits. Aluminium (Al), which is extracted from bauxite, is a lithophilic element and primarily occurs in the form of gibbsite, which is a stable mineral under weathering conditions. It is, thus, stable under exposure to weathering in tailing ponds and waste piles. In general, AMD requires the presence of sulphide minerals.	As Al is a lithophile element and bauxite forms oxidic ore deposits, bauxite mining and beneficiation the environmental hazard potential (EHP) for AMD is low.	Low	A = high, can be derived directly from available data
Paragenesis with heavy metals	A recent publication by Instituto Evando Chagas (2018), relates potential of heavy metal release (amongst others arsenic (As), lead (Pb) and cadmium (Cd) partly to the mining activities; this potential is deduced from the fact that pisolitic Bauxite ores of Paragominas have slightly elevated As-	According to the measurement instructions, aluminium ores may be associated with zinc, copper and chrome. Based on the findings of Instituto Evando Chagas (2018) and data from Kotschoubey et al. (2005), the release of As, Pb and Cd on-site	Medium	B1 = medium, can be estimated on the basis of available information

	contents of 21 ppm (Kotschoubey et al. 2005).	cannot be ruled out and the EHP is classified as medium in consequence.		
Paragenesis with radioactive components	No indication of paragenesis with thorium or uranium could be determined.	Bauxites formed by lateritic weathering of very different silicate rocks (among others granite, gneiss, clay) are evaluated with a medium EHP, if no further information indicates otherwise. This class division is based on average thorium and uranium activity levels in Chinese bauxite deposits (Hua 2011; USGS 2015). For comparison: Carbonate bauxites would be evaluated with a low EHP. The analysed bauxites of Paragominas have Th contents between 35 -56 ppm and U contents between 3-5 ppm (Kotschoubey et al. 2005), confirming the classification as medium EHP.	Medium	B2 = medium, classified according to measurement instructions
Deposit size	288.7 Mt. (MDO 2018) (reserves from 2009)	The deposit size is estimated based on the total reserves of 288.7 Mt of bauxite, and a production since 2007 (11 years, 10 Mt bauxite /year) of about 100 Mt of bauxite. This sums up to around 380 Mt of bauxite with an average content of 49.5 % applicable Al ₂ O ₃ . Thus, the deposit size in total is about 190 Mt Al ₂ O ₃ and the Al content of the deposit is about 101 Mt. The deposit can be considered as large (>100 Mt ores) according to the measurement instructions.	High	A = high, can be derived directly from available data

Ore grade	49.5 % Al ₂ O ₃ (MDO 2018)	Considering other top bauxite deposits, Paragominas with an average grade of 49.5 % can be considered a rich bauxite deposit with reference to undisclosed data.	Low	A = high, can be derived directly from available data
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Technology 				
Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Mine type	Open-pit mining of unconsolidated deeply weathered rocks (Hydro 2018b).	The average thickness of the ore body is 1.5 m. The superficial stripping of the weathered bauxite horizon leads to a high surface consumption of the mining operation and is consequently evaluated with a high EHP.	High	A = high, can be derived directly from available data
Use of auxiliary substances	The extraction is done by strip mining without auxiliary substances (such as explosives). The processing on-site includes crushing and grinding, washing and sorting, followed by water flushing (MDO 2018).	The site-related ÖkoRes evaluation system is focused on the on-site processes. On-site no auxiliary substances are used (with the exception of water) for ore processing and flushing in pipeline. The ore processing off-site with highly aggressive caustic soda in Bayer Al-refinery process is not part of the evaluation.	Low	A = high, can be derived directly from available data
Mining waste	The used strip mining avoids the formation of an overburden stockpile. Overburden moved	Strip mining with insertion of overburden in previously mines strips	Low	A = high, can be derived directly

	for mining purpose is used to reconstruct the topography or so used for paving roads and for raising the heights of existing tailing dams. Tailing ponds retain the tailing fines from the on-site bauxite ore processing (Hydro 2018b; MDO 2018).	and reutilization of solids for building material classifies EHP as low.		from available data
Remediation measures	Overburden moved for mining purpose is used to reconstruct the topography or so used for paving roads and for raising the heights of existing tailing dams. The ponds are reforested after use. Reforestation of stripping sites ongoing since 2009 summing up to a total of around 2000 hectares. 185 hectares (ha) of previously mined land have been rehabilitated 2017 (Hydro 2018a p. 30; Google Earth).	Total reforestation is expected after end of operations. Old stripping sites already in reforestation process (process-parallel rehabilitation) or reforested.	Low	B1 = medium, can be estimated on the basis of available information

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 high and negligible for other aspects: landslides, earthquakes, tropical storms and the mine is not situated in an arctic environment	High	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.	The EHP of 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).	A medium EHP for protected areas and AZE sites was identified.	Low	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?	Yes Yes (ASI 2019)
Aluminium Stewardship Initiative (ASI): Is the mine certified?	No No (ASI 2019)
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)?	No No (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“	Not rated Not rated (RMI 2018)

Responsible Mining Index Company indicator „Environmental sustainability“	Not rated Not rated (RMI 2018)
Responsible Steel (RS): Is the mine owner a member of the RS?	Not applicable Not applicable
Responsible Steel (RS): Is the mine certified?	Not applicable Not applicable
Australian Steel Stewardship Forum (ASSF): Is the owner a member of the ASSF?	Not applicable Not applicable
Australian Steel Stewardship Forum: Is the mine certified?	Not applicable Not applicable
ISO and CSR reporting	
ISO 14001 (ISO 14004): Is the mine ISO 14001 certified?	Yes Yes (Hydro 2018b)
CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	Yes Yes (Norway) (Hydro 2019)
OECD Guidelines: Does the company have its headquarters in a signatory state?	Yes Yes (OECD 2011)
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 information obtained No information obtained
Equator Principles (EP): Is the mine financed to a major extend by a bank adherent to the EP?	Yes HSBC bank, the Bank of New York Mellon and JPMorgan Chase Bank are shareholders (EP n.d.)

*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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- Öko-Institut e.V. (Institute for Applied Ecology)