

ÖkoRess III

Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

Los Pelambres

Antofagasta, Chile

ID: 39

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>

Los Pelambres

Copper

General information 	
Indicator or criteria	Description and values
Name of mine	Los Pelambres
Description of mining area	Los Pelambres is a large open-pit mine and part of a porphyry copper deposit in Chile's Coquimbo region approximately 200 km from Santiago. It is located in a high mountainous region of the Andean cordillera. The deposit forms the northern-most part of three giant Miocene to Pliocene deposits (the other two are El Teniente and Los Bronces-Rio Blanco) that are close to the boundary of two major Andean segments (Porter GeoConsultancy 2012). The main minerals at Los Pelambres are chalcopyrite, chalcocite, bornite, covellite and molybdenite (ibid.)
Surface extension	36.2km ² 36.20 km ² (Image date: 03.03.2017; Viewing height: 12.14 km) (Google Earth)
In operation since	2000 2000
Operator	Minera Los Pelambres S.A
Owner	Antofagasta
Closest town	Salamanca, situated 45 km west of the mine
Province	Choapa Province
Country	Chile
Longitude	-70.48889°
Latitude	-31.71389°
Altitude	3200 m a.s.l. 3,200 m a.s.l. (Mining Technology n.d.)

Main product and by-products	Main product: copper; by-products: molybdenum, gold, silver (Antofagasta PLC n.d. a).
On-site processing stages	Milling and flotation (Antofagasta PLC n.d. b).
Annual production	Production in 2017: copper 343,800 t, molybdenum: 10,500 t of, gold: 55,400 ounces (Antofagasta PLC n.d. a).
Proven Reserves	719.6 copper ore, 0.021 % Mo and 0.05 g/t Au in 2017 (Antofagasta PLC 2018)
Probable Reserves	473.8 copper ore with an average ore content of 0.58 % Cu, 0.017% Mo and 0.05 g/t Au in 2017 (Antofagasta PLC 2018)

Geology



Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	Copper is a chalcophilic element. Chalcophilic elements are often obtained from sulphidic deposits, which are particularly prone to AMD. Copper is obtained from sulphides in Los Pelambres (Antofagasta PLC n.d. a).	The extraction of sulphidic minerals has a high environmental hazard potential with regard to AMD and is therefore classified as high.	High	A = high, can be derived directly from available data
Paragenesis with heavy metals	Copper is a heavy metal itself and often associated with other heavy metals such as zinc, lead or arsenic. Nonetheless, no information on a paragenesis of copper with further heavy metals at Los Pelambres was obtained. A study on heavy metals in the Choapa River near Los Pelambres showed increased concentrations of Pb, Zn and Ni in the sediments due to mining activities (Copaja et al. 2014).	Copper is a heavy metal itself. The extraction of heavy metals is assessed with a high environmental hazard potential (EHP).	High	B1 = medium, can be estimated on the basis of available information

Paragenesis with radioactive components	No indication of a paragenesis with thorium and uranium could be determined.	In accordance with the measurement instructions, copper ore deposits are evaluated with a medium EHP, if no other information is available.	Low	n.d.
Deposit size	Total reserve in 2017: 1,193 Mt copper ore, leads to a copper content of: 7.16 Mt (0.6%) (Antofagasta PLC 2018).	Production started in 2000. Thus, an estimated annual production of 340,000 t over 18 years is added to the current deposit size of 1,193 Mt copper ore. The estimated total reserve at Los Pelambres, thus, amounts roughly to 13 Mt (own calculation, annual reports 2001-2018). The deposit is classified as very large and, hence, is evaluated with a high EHP.	High	B1 = medium, can be estimated on the basis of available information
Ore grade	0.6 % copper ore grade in 2017 (Antofagasta PLC 2018)	With a copper grade of 0.6 %, the Los Pelambres deposit is evaluated as an average grade deposit.	Medium	A = high, can be derived directly from available data

Technology 				
Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Mine type	Los Pelambres is an open pit mine (Antofagasta PLC n.d. a).	Conventional solid rock open pit mining is evaluated with a medium EHP. During open pit mining in solid rocks, the	Medium	A = high, can be derived directly

		mining activities are restricted to the horizontal and vertical extension of the ore body/mineralized zone. The impact is higher than in underground mining but less pronounced than in mining of alluvial or unconsolidated sediments.		from available data
Use of auxiliary substances	In a first step, the ore is extracted with the help of shovels and loaders. After crushing and grinding, the ore is going through a flotation process and is separated from the molybdenum ore (Nicholls 2016).	Flotation is often conducted with the help of toxic additives such as organic hydrocarbons, leading to a high EHP.	High	B1 = medium, can be estimated on the basis of available information
Mining waste	Tailings are stored in the largest mining dam in South America, called El Mauro. It has a height of 237 m and a total capacity of 1,700 Mio tons (Consejo Minero 2019; London Mining network 2017).	The disposal of waste in large-volume and large-scale tailing dams is evaluated with a high EHP.	High	B1 = medium, can be estimated on the basis of available information
Remediation measures	According to Antofagasta Holdings, all of its operations have mine closure plans, approved by the Chilean government. Since 2000 the company is engaged in protecting biodiversity in the Choapa valley (Antofagasta Minerals 2014). Since that year, wetlands have been recovered and forest areas preserved (Antofagasta Minerals 2015). No information about the size of the recovered area could be obtained.	The EHP is evaluated as low due to the recultivation and compensation activities during mining.	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 earthquakes is high, medium for landslides and low for floods and tropical storms. With at least one sub-indicator with a high EHP, the EHP evaluation result is high as well.	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 for water stress is high which determines a high EHP evaluation result although the mine is not situated in a desert area.	High	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 site is not situated in or near designated protected areas and AZE sites, which results in a low EHP.	Low	B2 = medium, classified according to measurement instructions

State Governance

Indicators	
WGI 1 -Voice and Accountability	79.31 °°°
WGI 2 -Political Stability and Absence of Violence/ Terrorism	60.95 °°°
WGI 3 - Government Effectiveness	77.88 °°°
WGI 4 -Regulatory Quality	88.94 °°°
WGI 5 - Rule of Law	81.73 °°°
WGI 6 -Control of Corruption	82.21 °°°
EPI (Environmental Performance Index)	57.49
EITI membership	n.d.
International Agreements	
ILO 176	No
Others	Ratification of the Minamata Convention on Mercury 27.08.2018 (UNEP 2019) Signature of the Paris Agreement on Climate Change (which entered into force on 12.03.2017) (UNFCCC 2016).

Legal framework	
<p>Areas of Law: Environment</p>	<p>The Chilean state is obliged to guarantee a pollution-free environment through environmental legislation. The Environmental Law 19.300 includes the statutory environmental framework and defines that Environmental Impact Assessments (EIA) are mandatory to obtain an environmental license for projects in the mining sector. To these belong, e.g., projects for minerals, oil, gas and coal at different stages of the mine life cycle (exploration to mine closure), (EI SourceBook 2016).</p> <p>The design of the EIAs differ, depending on the potential hazards to a number of social or environmental circumstances. Previous consent of indigenous communities need to be obtained, if these communities are directly affected by a mining project (Minehutte 2019).</p> <p>Three main institutions -with different and defined roles- enforce the environmental regulations: The Ministry of Environment, the Environmental Assessment Service and the Environmental Superintendence. Moreover, according to Law No. 20.600, Environmental Courts have the power to resolve environmental disputes. EIS are presented to the responsible Regional Commission on the Environment or the Executive Directorate of the National Commission on the environment if several regions are affected (Minehutte 2019).</p>

<p>Areas of Law: Occupational Health and Safety (OHS)</p>	<p>Chile ratified the ILO Convention N° 161 Occupational Health Services Convention since 1999 (MDNP 2018). The Supreme Decree No. 132/2004 of the Ministry of Mining regulates occupational health and safety (OHS) measures in the mining sector with the objective to protect the life and physical integrity of all humans that work in or are related to the mining industry. It, furthermore, aims to protect facilities and infrastructure that allow mining operations and their continuance (MDNP 2018)(National Library of Congress 2017). In this framework, companies with more than 100 workers are required to have a Risk Prevention Department in place. This department is headed by an expert qualified by the National Geology and Mining Service (SERNAGEOMIN). The development of plans and programs for the prevention of accidents and occupational diseases is mandatory (MDNP 2018). In general, employers are obliged to ensure the safety of employees, machines and buildings (through training, protective clothing, maintenance of machines). At the same time, employees must ensure that occupational safety and safety rules are observed and controlled (ICLG 2018).</p>
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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)?	No No (MAC 2019)
Towards Sustainable Mining (TSM) outside Canada: Are TSM standards implemented*?	No information available No information available
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?	No No
Responsible Copper (RC): Is the mine certified?	No information available No information available
Responsible Mining Index (RMI): Has the mine been rated?	2.5 / 6.00 2.5 / 6.00 (RMI 2018)
Responsible Mining Index Company indicator „Working conditions“	0.553 0.553 / 1.000 (RMI 2018)
Responsible Mining Index Company indicator „Environmental sustainability“	0.469 0.469 / 1.000 (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 (Antofagasta Minerals 2014)
CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	Yes Yes UK (Antofagasta PLC n.d. b)
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 information obtained No information available
Banking Standards	
WB Standards / IFC Performance Standards: Is the mine financed to a major extend by the world bank?	No information obtained No information available
Equator Principles (EP): Is the mine financed to a major extend by a bank adherent to the EP?	No No (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

Publisher:

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Project period: 03/2018 –02/2021

The research project has been commissioned by the German Environment Agency as part of the Environmental Research Plan of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and funded by the Federal Government (FKZ: 3717 35 306 0).

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