

ÖkoRess III

Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

El Abra

Freeport-McMoran, Chile

ID: 60

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>

El Abra

Copper

General information



Indicator or criteria	Description and values
Name of mine	El Abra
Description of mining area	The El Abra copper mine is located ca. 4,000 m a.s.l. in a desert environment with very low precipitation in northern Chile. Almost 50 km north of the city of Calama in El Loa, the El Abra granodiorite complex, lies within the West Fault of the regional Domeyko Fault System. The deposit mined in El Abra is characterized by both oxidic and sulfidic mineralization. Bornite and chalcopyrite are the predominant copper sulphides, moreover, there is a smaller amount of chalcocite. The copper bearing copper oxides in this deposit are chrysocolla and pseudomalachite as well as lesser amounts of copper-clays and tenorite (FCX 2019a; Porter GeoConsultancy 2017).
Surface extension	46.53km ² 46.53 km ² (Image date: 06.11.2014; Viewing height: 8.66 km) (Google Earth)
In operation since	1996 1996 (FCX n.d.)
Operator	Minera El Abra
Owner	Freeport-McMoran
Closest town	47 miles north of Calama (FCX n.d.)
Province	El Loa (FCX n.d.)
Country	Chile
Longitude	-68.832354°
Latitude	-21.918858°

Altitude	4100 m a.s.l. 3,900 to 4,100 m a.s.l. (Gerwe et al. 2003)
Main product and by-products	Main product: copper, by-products: none
On-site processing stages	Concentration, leaching and solvent extraction/electrowinning (FCX n.d.)
Annual production	91,300 t copper cathodes in 2018 (FCX 2019b)
Proven Reserves	488Mt, 0.44% Cu (FCX 2019a)
Probable Reserves	200Mt, 0.40% Cu (FCX 2019a)

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. At El Abra, copper is mined from sulphides and oxides (FCX n.d.).	The extraction of sulphidic minerals has a high environmental hazard potential with regard to AMD.	High	B1 = medium, can be estimated on the basis of available information
Paragenesis with heavy metals	Copper is a heavy metal itself and moreover often associated with zinc, lead, nickel and arsenic (Dehoust et al. 2017b p. 22). Moreover, olivenites occur in the deposit of El Abra, which are common oxidic secondary arsenates in hydrothermal copper deposits and, thus, indicate a paragenesis with arsenic (Porter GeoConsultancy 2017).	Copper is a heavy metal itself. The extraction of copper is consequently always evaluated with a high environmental hazard potential (EHP)	High	B2 = medium, classified according to measurement instructions

Paragenesis with radioactive components	No indication of paragenesis with thorium (Th) and uranium (U) could be found.	In accordance with the measurement instructions, copper ore deposits are evaluated with a medium EHP, if no other information is available.	Low	B2 = medium, classified according to measurement instructions
Deposit size	Total reserve: 688 Mt of ore with an average ore grade of 0.42% copper leading to a total metal content of 2.9 Mt. (FCX 2019a)	Calculating with an average annual production of ca. 339,000 t (average production between 2004 and 2018) and 23 years of production, the total size of the deposit is roughly estimated to be 10.7 Mt (Annual reports 2004-2018, own calculation). A deposit of this size is very large, leading to a high EHP.	High	B2 = medium, classified according to measurement instructions
Ore grade	0.43 % Cu (FCX 2019a)	With a copper content of 0.43 %, El Abra deposit can be assessed as low 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	Hard-rock open pit mining (FCX n.d.)	Conventional solid rock open pit mining is evaluated with a medium EHP. During open pit mining in solid rocks, the mining activities are restricted to the	Medium	A = high, can be derived directly from available data

		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.		
Use of auxiliary substances	Mining is carried out with trucks and shovel-loaders. After secondary crushing and agglomeration, the material is transported to the solvent-extraction and electrowinning plant where the copper cathodes are produced (El Abra n.d. b).	Solvent-extraction is often conducted with the help of toxic additives such as chemical solvents, leading to a high EHP in the evaluation result.	High	A = high, can be derived directly from available data
Mining waste	No information about waste rock management at El Abra could be found. It is planned to build a waste dump in the process of installing a new concentration plant a few kilometers South of the mine (El Abra n.d. a). Nevertheless, the mining of polymetallic ores such as the El Abra operation is expected to result in a high volume of tailings, which is mostly deposited in sludge ponds (Dehoust et al. 2017b p. 32).	The processing of polymetallic ores at high production quantities leads to the expectation of waste being dumped in large-volume sales basins and is therefore classified with an high EHP.	High	B2 = medium, classified according to measurement instructions
Remediation measures	Freeport-McMoran conducts programs to protect endemic vegetation and regionally wildlife at the Salar de Ascotán wetlands area (since 2010). Landscape Function Analysis (LFA) monitoring is conducted for the company's mine sites to assess the suitability of former mining areas as natural habitats (FCX 2018a). Since 2015, closure plans for the two Chilean mine sites of Freeport-McMoran are in place (FCX 2018b).	The EHP is determined as low due to the ongoing recultivation and compensation activities concomitantly to the mining process.	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 (Dehoust et al. 2017b)). Metrics are directly taken from the given risk assessment. The indicator total is determined by the highest hazard level of the sub-indicators.	The mine is located in a seismic active area (Andean Region) with a high EHP for earthquakes which determines the evaluation result. The other sub-indicators have a low EHP.	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 the evaluation result. The mine is close to a desert but not situated within.	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 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 ^{ooo}
WGI 2 -Political Stability and Absence of Violence/ Terrorism	60.95 ^{ooo}
WGI 3 - Government Effectiveness	77.88 ^{ooo}
WGI 4 -Regulatory Quality	88.94 ^{ooo}
WGI 5 - Rule of Law	81.73 ^{ooo}
WGI 6 -Control of Corruption	82.21 ^{ooo}
EPI (Environmental Performance Index)	57.49
EITI membership	n.d.
International Agreements	
ILO 176	No

<p>Others</p>	<p>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).</p>
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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>
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<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 2017)
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 information available No information available
Responsible Copper (RC): Is the mine owning company a member of RC?	No information available No information available
Responsible Copper (RC): Is the mine certified?	No information available No information available
Responsible Mining Index (RMI): Has the mine been rated?	0.67 / 6.00 0.67 / 6.00 (RMI 2018)
Responsible Mining Index Company indicator „Working conditions“	0.671 0.671 / 1.000 (RMI 2018)
Responsible Mining Index Company indicator „Environmental sustainability“	0.405 0.405 / 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 (El Abra n.d. b)
CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	No No (USA) (RMI 2018)
OECD Guidelines: Does the company have its headquarters in a signatory state?	Yes Yes (USA) (RMI 2018)
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 information obtained No information available

*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)