

ÖkoRess III

Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

Gabriela Mistral

Codelco, Chile

ID: 67

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>

Gabriela Mistral

Copper

General information 	
Indicator or criteria	Description and values
Name of mine	Gabriela Mistral
Description of mining area	Gabriela Mistral is situated in a mining district south of Calama in northern Chile. The environment in this desert region is characterized by extremely low precipitation and a mountainous and rough landscape. The ore extracted at Gabriela Mistral belongs to the Gaby Sur porphyry deposit, which consist of a volcano-sedimentary sequence, the Elvira Pampa intrusive complex and the Gaby intrusive Complex. Gaby Sur comprises an up to 180 m thick copper oxide zone, underlain by hypogene sulphides. The main copper bearing oxides are chrysocolla, neotocite, atacamite and malachite while the main sulphides are chalcopyrite, bornite and pyrite (Codelco 2019; Porter GeoConsultancy 2003).
Surface extension	72.04km ² 72.04 km ² (Image date: 28.11.2016; Viewing height: 14.87 km) (Google Earth)
In operation since	2008 2008 (Codelco 2018a p. 28)
Operator	Minera Gaby
Owner	Codelco
Closest town	120 km southwest of Calama (Codelco 2019)
Province	Antofagasta
Country	Chile
Longitude	-68.820344°
Latitude	-23.407582°

Altitude	2660 m a.s.l. 2,660 m a.s.l. (Codelco 2019)
Main product and by-products	Main product: copper; by-product: none
On-site processing stages	Crushing, leaching, solvent-extraction and electrowinning (Codelco 2019).
Annual production	122,737 t of fine copper (2017) (Codelco 2018a p. 28).
Proven Reserves	281 Mt with an average ore grade of 0.36% copper (Codelco 2018a p. 115).
Probable Reserves	71 Mt with an average ore grade of 0.30% copper (Codelco 2018a p. 115).

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 (Dehoust et al. 2017b p. 13). At Gabriela Mistral, copper is mainly mined from oxides (Codelco 2019) which are not known to be vulnerable for AMD.	The extraction of oxidic minerals has a low environmental hazard potential with regard to AMD.	Low	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 arsen (Dehoust et al. 2017b p. 22). No information about paragenesis with other heavy metals could be found.	Since copper itself is considered to be a harmful metal to the ecosystem and human health, the measurement instructions suggest a high 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	351 Mt ore reserve with an average ore grade of 0.34% copper (2017) leads to a current deposit size of 1.2 Mt copper (Codelco 2018a p. 115).	From 2008 (mine opening) to 2017, 1.2 Mt of copper were produced in Gabriela Mistral. Together with the current metal content of the reserve, the deposit size is approximately 2.4 Mt. The deposit is classified as medium sized and, hence, is evaluated with a medium EHP.	Medium	B2 = medium, classified according to measurement instructions
Ore grade	0.34 % Cu (Codelco 2018a p. 115)	With a copper content of 0.34 %, Gabriela Mistral 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	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 horizontal and vertical extension of the	Medium	A = high, can be derived directly from available data

		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	Trucks and Shovel/Loaders extract the ore in Gabriela Mistral (Miningdata 2019). The on-site processing includes primary, secondary and tertiary crushing stages; curing in acidifying drums, leaching as well as solvent extraction (SX) and electrowinning (EW) (Codelco 2019).	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	In 2017, roughly 21Mt of waste-rock were produced at the mine site. It is officially planned to build a tailings facility until 2020 (Codelco 2018a p. 130).	Satellite images indicate a large landfill in the southwest of the mine. Due to the lack of information, this indicator is evaluated with a high EHP.	High	B2 = medium, classified according to measurement instructions
Remediation measures	Codelco has closure plans in force for all of its operations. According to the company, environmental objectives are to [...]“encourage, engage/collaborate protection and/ or conservation initiatives at local and national level, towards the strengthening of biodiversity” (Codelco 2018b p. 37). No specific information about reclamation measures at Gabriela Mistral could be obtained.	If there is a lack of information, according to the measurement guide, a low EHP is given to mines of major companies. These have to meet environmental standards and are controlled regularly.	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 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 Gabriela Mistral mine has a high EHP for earthquakes which determines the evaluation result. The other sub-indicators have a low EHP.	High	A = high, can be derived directly from available data
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 not high but the mine is situated in a desert area. This result alone already determines the high EHP result.	High	A = high, can be derived directly from available data
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	A = high, can be derived directly from available data

State Governance

Indicators	
WGI 1 -Voice and Accountability	79.3 ^{ooo}
WGI 2 -Political Stability and Absence of Violence/ Terrorism	61 ^{ooo}
WGI 3 - Government Effectiveness	77.9 ^{ooo}
WGI 4 -Regulatory Quality	88.9 ^{ooo}
WGI 5 - Rule of Law	81.7 ^{ooo}
WGI 6 -Control of Corruption	82.2 ^{ooo}
EPI (Environmental Performance Index)	57.49
EITI membership	Not a member
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 Mar 2017) (UNFCCC 2016).</p>
<p>Legal framework</p>	
<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 (ibid.).</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 (ibid.). 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 (ibid.). 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	
<p>Aluminium Stewardship Initiative (ASI): Is the mine owning company a member?</p>	<p>Not applicable Not applicable</p>
<p>Aluminium Stewardship Initiative (ASI): Is the mine certified?</p>	<p>Not applicable Not applicable</p>
<p>International Council of Mining & Metals (ICMM): Is the mine owning company a member?</p>	<p>Yes Yes (ICMM 2019)</p>

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“	0.664 0.664/ 1.000 (RMI 2018)
Responsible Mining Index Company indicator „Environmental sustainability“	0.326 0.326/ 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 (Codelco 2018a p. 268)
CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	No No (Chile) (RMI 2018)
OECD Guidelines: Does the company have its headquarters in a signatory state?	Yes Yes (Chile) (OECD 2019)
ISO 26000: Does the mine implement ISO 26000?*	No information obtained No information obtained
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?	No information obtained No information obtained

*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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