

ÖkoRess III

Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

Andina Copper Mine

Codelco, Chile

ID: 43

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>

Andina Copper Mine

Copper

General information 	
Indicator or criteria	Description and values
Name of mine	Andina Copper Mine
Description of mining area	División Andina began its operation with underground mining and additionally started open pit mining in the 1980s through the exploitation of the Sur-Sur mine (until 2000) and later the La Unión and Don Luis pits (currently Rajo Don Luis). The mine is situated in the semi-arid Andes in the high mountains region. The landscape is sparsely vegetated and has been mined extensively since 1970. Due to its semi aridity, precipitation is low and an important source for the water catchments are the glaciers in the region. División Andina operates the Rio Blanco deposit (Codelco 2019b) which consists out of the main ore bodies Río Blanco, Don Luis and Sur Sur. The Rio Blanco porphyry copper-molybdenum deposit belongs to the Neogene metallogenic strip, which is the easternmost in Chile and extends through the high mountain range between 18°S and approximately 35°S (Maksaev 2001). The main copper sulfides are chalcopyrite and bornite (Gómez et al. 2017 p. 63). The Los Bronces mine exploits the same ore body and is located right next to División Andina.
Surface extension	61.53km ² 61.53 km ² (Image date: 06.08.2019; Viewing height: 16.61 km) (Google Earth)
In operation since	1970 1970 (Codelco 2019a p. 21)
Operator	Codelco
Owner	Codelco
Closest town	80 km northeast of Santiago de Chile
Province	The Andes, Región de Valparaíso
Country	Chile

Longitude	-70.27162°
Latitude	-33.14653°
Altitude	4200 m a.s.l. Between 3,700 and 4,200 m a.s.l. (Codelco 2019b)
Main product and by-products	Main product: copper; by-products: molybdenum, silver (Codelco 2019a p. 28)
On-site processing stages	Block caving (underground operations), truck and shovel (open pit). Further processing of both operations takes place underground due to harsh high mountain conditions. The ore is crushed, milled and undergoes flotation. The concentrates are mostly transported to Ventanas refinery. Tailings are transported via channels (80 km) to the TSF Tranque Ovejería (Arcadis 2018).
Annual production	2018: 196 kt of copper in concentrates, 3.5 kt of molybdenum, 49 t of silver (Codelco 2019a p. 28)
Proven Reserves	219 Mt copper ore (Codelco 2019a p. 101)
Probable Reserves	943 Mt copper ore (Codelco 2019a p. 101)

Geology



Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	At División Andina, the copper is obtained from sulphides (Gómez et al. 2017), which are particularly prone to AMD. Studies indicate an elevated risk of AMD in deposits of the mine (Lapuente Fuentes 2009) and Codelco itself lists investments of acid drainage measures at the mine site (Codelco 2019a p. 244).	The extraction of sulphidic minerals has a high environmental hazard potential with regard to AMD. Furthermore, studies and investments by Codelco indicate an elevated risk of AMD.	High	A = high, can be derived directly from available data

Paragenesis with heavy metals	Soil samples of the mine site show elevated levels of mercury and antimony (Gómez et al. 2017 p. 63).	Academic research of soil conditions in the mining area indicate that there are elevated heavy metal concentrations. Moreover copper is a heavy metal itself. Accordingly, the mine poses a high EHP for the contamination with heavy metals.	High	A = high, can be derived directly from available data
Paragenesis with radioactive components	No indication of paragenesis with thorium (Th) and uranium (U) could be determined.	In accordance with the measurement instructions, copper 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 2018 the total reserves amounted to 1,162 Mt ore by an copper grade of 0.69 %. This equivalent to 8 Mt refined copper (Codelco 2019a p. 101).	By considering historic statistical data, a total production of 7.1 Mt copper between 1970 and 2018 was estimated (own calculation based on (COCHILCO 2016)). Adding the current reserves of 2018 to the cumulated mined copper, it results in a total deposit size of 16 Mt copper. 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	In 2018: 0.69 % total copper grade (Codelco 2019a p. 101)	With a copper ore grade of 0.69 %, the deposit of División Andina is classified 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	The mine has underground and open pit site operations (Codelco 2019b), both extracting the ore from hard rock. The most recent extension plans of the mine focus on open pit mining (Arcadis 2018). According to national press, Codelco anticipates a (partly) closure of the underground mine (Diario El Andino 2018; Minería Pan-Americana 2018). According to González (2017) underground mining accounts for 40 % of total ore extraction at the site.	The overall evaluation is determined by open pit mining on hard rock, since open pit activities have a higher importance at the site. Open-pit mines are usually limited to an area that is only slightly larger than the projection of the deposit body to the surface. Accordingly, the EHP resulting from the mining method is medium.	Medium	B1 = medium, can be estimated on the basis of available information
Use of auxiliary substances	The ore is extracted by block caving (underground) and truck and shovel method (open pit). The extracted ore is first crushed and milled in a number of steps and then processed on site in a conventional flotation procedure to produce copper concentrates (González 2018). The concentrates are shipped to off-site refineries (Arcadis 2018).	The processing of the ore at División Andina involves a flotation process where possibly toxic reagents are added. Accordingly the environmental hazard potential of this indicator is high.	High	A = high, can be derived directly from available data
Mining waste	Since 1999 the active TSF of División Andina is Tranque Ovejería which is located 45 km West of the mine site. The tailings flow in a concrete channel downhill (Codelco 2011a). Ovejería has the permission for operation until 2064. It's maximum capacity is 1,930 Mt covering an	The maximum height of the dam with 130 m results according to the definition of ICOLD (2018) into the large dam category (> 16 m height). Large TSF's are evaluated with a high EHP. The inactive embalse Los Leones also falls	High	A = high, can be derived directly from available data

	area of 1,900 ha. The maximum height of the dam wall will be 130 m (Consejo Minero 2019). The old TSF was embalse Los Leones which is now inactive and hosts 43 km ³ of tailings (ICOLD Chile 2019).	into the large dam category due to its capacity.		
Remediation measures	Codelco states it is in compliance with the transitional provisions of national law and has eight current closure plans duly approved by the authority, corresponding to each of its eight operating divisions. The plans were updated in 2018 with the objective of bringing them from the transitional rules of the law to full regularization for 2020. Additionally Codelco has bank guarantees constituted for 27,058,918 Unidades de Fomento (UF) in favor of the Chilean state, to ensure full compliance of with facility closures when this occurs (Codelco 2019a p. 62).	Closure plans are under approval by authorities and funds have been provisioned. Nevertheless, accompanying renaturation or recultivation have not been observed and change in landscape might be irreparable in high mountain region without vegetation. Accordingly, a medium EHP is assigned. Even though, this has no impact on the indicator, it should be noted that rock glaciers were severely damaged in the past (Brenning 2008).	Medium	A = high, can be derived directly from available data

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	The Andina mine has a high EHP for earthquakes and landslides which determine the evaluation result. The other sub-indicators have a low EHP.	High	A = high, can be derived directly from available data

	assessment. The indicator total is determined by the highest hazard level of the sub-indicators.			
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 but the mine is not situated in a desert area. The result for the water stress 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 mining area 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	79.31 ^{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 °°°
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</p>

	<p>(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 The BMW Group and the Chilean copper mining company Codelco have signed an agreement to cooperate on a sustainable and transparent supply of copper (BMW Group 2018)
Responsible Copper (RC): Is the mine certified?	No information available No information
Responsible Mining Index (RMI): Has the mine been rated?	No No (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 2011b)

CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	No No (Codelco 2019a)
OECD Guidelines: Does the company have its headquarters in a signatory state?	Yes Yes (Codelco 2019a)
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 indication of current investment (The World Bank 2019).
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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