

ÖkoRess III

Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

Radomiro Tomic

Codelco, Chile

ID: 40

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>

Radomiro Tomic

Copper

General information



Indicator or criteria	Description and values
Name of mine	Radomiro Tomic
Description of mining area	The Radomiro Tomic mine is located in a sparsely populated part of the Atacama desert, ca. 40 km north of Calama in the province of El Loa. It is part of a deposit cluster within the west fault of the Domeyko Fault Zone. The deposit is mainly hosted by the Chuqui Porphyry orebody which is a medium/coarse grained granodiorite and monzogranite. Concentric bornite-chalcopyrite, chalcopyrite-pyrite and pyrite-chalcopyrite are characteristic for the hypogene mineralisation in this region (PorterGeoconsultancy 1998).
Surface extension	57.21km ² 57.21 km ² (Image date: 20.12.2019; Viewing height: 14.19 km) (Google Earth)
In operation since	1997 1997 (CODELCO 2018a)
Operator	Codelco
Owner	Codelco
Closest town	Calama, 40 km south of the mine (CODELCO n.d.)
Province	El Loa (CODELCO n.d.)
Country	Chile
Longitude	-68.8825°
Latitude	-22.23265°
Altitude	3000 m a.s.l. 3,000 m a.s.l.
Main product and by-products	Main product: copper; by-product: molybdenum (Codelco n.d.)

On-site processing stages	Acid leaching, heap leach, solvent extraction & electrowinning (Thomaz 2006)
Annual production	318,878 t of fine copper, 1,738 t of molybdenum (2017) (Codelco n.d.)
Proven Reserves	738 Mt, 0.50% copper (CODELCO 2018a)
Probable Reserves	1,305 Mt, 0.47% copper (CODELCO 2018a)

Geology



Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	Copper is a chalcophilic element. It is obtained from both oxides and sulphides at Radomiro Tomic. No information could be found on the shares of sulfides or oxides of the total extraction. Since sulphide exploitation has started a few years ago, the sulphide share of the overall production is estimated to be low. (CODELCO n.d. see measurement instructions).	The extraction of oxidic minerals has a low environmental hazard potential with regard to AMD. However, information on the precise quantities of sulphides and oxides extracted may modify this assessment.	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 arsenic. Direct information on association of copper with further heavy metals at the Radomiro Tomic deposit was not found.	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	Codelco operates a pilot plant for the uranium processing to test the recovery rates. The mining of Uranium at Radomiro Tomic is to be continued when proves to be a profitable activity at Radomiro Tomic (BNamericas 2011).	The exact uranium grades in the Radomiro Tomic deposit are unknown to the authors. Nonetheless, Uranium is present and to an unknown and potentially varying concentration in the ore body. Hence, the evaluation results in a medium EHP.	Medium	B2 = medium, classified according to measurement instructions
Deposit size	2,043 Mt ore reserve with an ore grade of 0.48 % in 2017 (CODELCO 2018a).	Calculating with an average annual production of ca. 320,000 t of fine copper and 22 years of production, the total size of the deposit is roughly estimated to be 16,85 Mt of copper (CODELCO 2018 and own calculation). A deposit of this size is very large, leading to a high EHP.	High	n.d.
Ore grade	0.48 %	With a copper content of 0.48 %, the Radomiro Tomic deposit can be assessed as an lowgrade deposit, leading to a high EHP.	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 mine (Thomaz 2006)	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	The ore is extracted with the help of drills, shovels and loaders. After primary crushing next to the pit, the ore is conveyed to the 56 km distant processing facility. The following processing steps are heap leaching and separation by four-stage solvent extraction and electrowinning (Thomaz 2006).	Solvent extraction and leaching is often performed with toxic additives that may pose a potential hazard to the environment. Therefore, this indicator is evaluated with a high EHP.	High	B1 = medium, can be estimated on the basis of available information
Mining waste	133,559 t of overburden rock were generated at Radomiro Tomic in 2017. The overburden rock is conveyed to locations such as: “recycling or reuse plants, energy recovery, storage deposits / landfills or sent to waste treatment companies”. No information about a specific waste dump could be obtained (CODELCO 2018b).	The disposal of waste in in stable stockpiles or smaller tailing ponds such as those at Radomiro Tomic are evaluated with a medium EHP.	Medium	B2 = medium, classified according to measurement instructions
Remediation measures	According to Codelco, a biodiversity action plan for all operations is in place. Additionally, there is a mine closure plan for Radomiro Tomic which was approved in 2015 (CODELCO 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 and the mine is situated in a desert area. Both results alone already determine the high EHP result.	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

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).
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Legal framework

Areas of Law: Environment	<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 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?	0.50 / 6.00 0.50 / 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 2003)
CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	No No (Chile)
OECD Guidelines: Does the company have its headquarters in a signatory state?	Yes Yes (Chile)
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

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