

# ÖkoRess III

## Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

**Cerro Verde**

**Freeport-McMoRan , Peru**

ID: 46

## 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”<sup>1</sup> (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.

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<sup>1</sup>TEXTE 87/2017 <https://www.umweltbundesamt.de/publikationen/discussion-of-the-environmental-limits-of-primary>

# Cerro Verde

## Copper

General information 	
Indicator or criteria	Description and values
Name of mine	Cerro Verde
Description of mining area	<p>Cerro Verde is an open-pit copper and molybdenum mine complex located in an arid, sparsely populated region in the foothills of the Peruvian Andes close to the city of Arequipa. The complex includes the Santa Rosa, Cerro Verde and Cerro Negro deposits (FCX 2019). Mineralization includes primary sulphide minerals (chalcopyrite, molybdenite), secondary copper sulphides (chalcocite, covellite) and oxide copper minerals (brochantite, chrysocolla, and malachite) (R. Stegen et al. 2018).</p> <p>Cerro Verde's associated infrastructure includes a 220 kV transmission line, tailing storage facility, and ancillary buildings and facilities. The copper cathodes and concentrate are transported to the Pacific Port of Matarani for shipment to overseas (Mining Technology n.y.).</p>
Surface extension	44.77km <sup>2</sup> 44.77 km <sup>2</sup> (Image date: 25.11.2019; Viewing height: 12.99 km) (Google Earth)
In operation since	1916 1916 (Responsible Mining Index 2019)
Operator	Sociedad Minera Cerro Verde S.A.A.
Owner	Freeport-McMoRan
Closest town	Cerro Verde is located 32 km southwest of Arequipa in southwestern Peru (FCX 2019). Suburban town limits are about 6 km from CV footprint (GoogleEarth 2018).
Province	Arequipa Region
Country	Peru
Longitude	-71.59769°

Latitude	-16.53772°
Altitude	2800 m a.s.l. 2,300 m - 2,800 m a.s.l. (GoogleEarth 2018)
Main product and by-products	Main product: copper (Cu); by-products: molybdenum (Mo), silver (Ag) (FCX Annual Report 2018)
On-site processing stages	Cerro Verde's operation consists of an open-pit copper mine, a 409,500 t/d concentrator, and SX/ EW leaching facilities. Leach copper production is derived from a 39,000 t/d crushed leach facility and a 100,000 t/d ROM leach system (FCX 10k-statement 2018). Large-scale expansion completed in September 2015 expanding the concentrator facilities to 409,500 t/d (2019) and providing incremental annual production of approximately 600 million pounds of copper (272,150 t/a) and 15 million pounds of molybdenum (or 6,800 t/a) (Mining Technology 2019). SX/EW leaching facilities: Leach copper production is derived from a 39,000 t/d crushed ore leach facility and a 100,000 t/d ROM leach system. This SX/EW leaching operation has a capacity of approximately 200 million pounds of copper (90,720 t) per year (FCX 2019).
Annual production	Approx. 600 million pounds of copper (272,150 t/a) and 15 million pounds of molybdenum (6,800 t/a), (FCX 2019). Mill throughput rates reported for 2018 averaged 387,600 t/d (FCX Annual Report 2018) or 141.5 Mt per annum for FY2018 (own calculation).
Proven Reserves	As at December 31, 2018: 4,324 Mt @ 0.35 % Cu and 0.01 % Mo (FCX 2018 Form 10-k)
Probable Reserves	As at December 31, 2018: 4,324 Mt @ 0.35 % Cu and 0.01 % Mo (FCX 2018 Form 10-k)

## Geology



Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	Primary sulphide minerals (chalcopyrite, molybdenite), secondary copper sulphides (chalcocite, covellite), major oxide copper minerals (brochantite, chrysocolla, malachite)	The mined ore is mainly sulphidic, moreover copper is a chalcophile element. Overall preconditions for generating acid mine drainage are given. According to the measurement	High	A = high, can be derived directly from available data

	and copper pitch) (R. Stegen et al. 2018).	instructions, the Environmental Hazard Potential (EHP) resulting from AMD potential is high.		
Paragenesis with heavy metals	Mineralization is associated with heavy metals: Cu and Mo (R. Stegen et al. 2018)	Since copper itself is considered to be a harmful metal to the ecosystem and human health, the measurement instructions suggest a high EHP.	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 (USGS 2015).	Low	B2 = medium, classified according to measurement instructions
Deposit size	29.6 billion lbs (or 13.426 Mt) of contained Cu (FCX 2018 Form 10-k)	The deposit size sums up to 13.426 Mt of Cu. The deposit size (> 10 Mt) is classified as very large (gigantic), even without calculating the extracted ore to date. According to measurement instructions based on Petrow et al. (2008), this results in a high EHP as very large deposits potentially have a higher expected total impact on the natural environment.	High	A = high, can be derived directly from available data
Ore grade	0.35 % Cu (FCX 2018 Form 10-k)	The low grade (Cu 0.5-3.0 %) deposit of predominantly sulphide ore indicates a high EHP according to measurement instructions based on Priester et al. (2019).	Medium	A = high, can be derived directly from available data

<b>Technology</b>				
Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Mine type	Conventional open pit hard rock mining (FCX 2018)	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 ore body/mineralized zone. The impact is higher than in underground mining but less pronounced than in mining of alluvial or unconsolidated sediments.	Medium	A = high, can be derived directly from available data
Use of auxiliary substances	Mining process: drill & blast, loading and truck hauling to mill (FCX 2019) Processing steps: • Flotation • Heap leach • ROM/dump leach • SX-EW (FCX 2019)	All four processing methods involve the use of toxic chemicals. Therefore, the EHP is rated as high.	High	A = high, can be derived directly from available data
Mining waste	Environmental and Social Impact Assessment (ESIA) – Cerro Verde Production Unit Expansion Project, prepared by Knight Piésold. November 2011 (Project Review 2014).	Export Development Canada (EDC) reviewed the Cerro Verde project in accordance with its Environmental and Social Review Directive and the Equator Principles, and concluded that the project is designed to meet or exceed internationally recognized good	Low	B2 = medium, classified according to measurement instructions

		practices, guidelines or standards. To reach this conclusion, EDC reviewed a project Environmental Impact Assessment [Knight Piésold 2011], which was benchmarked against relevant international environmental and social standards (EDC 2014). Based on EDC's assessment, the indicated EHP is rated as low.		
Remediation measures	<p>Cerro Verde is subject to regulation under the Mine Closure Law administered by the Peruvian Ministry of Energy and Mines. The latest closure plan and cost estimate for the Cerro Verde mine expansion were submitted in November 2013 and approved in August 2014. At December 31, 2017, Cerro Verde had accrued reclamation and closure costs of \$108 million (2015: \$106 million). (FCX Annual Report 2015/2017)</p> <p>As part of a \$5 billion expansion, Cerro Verde spent \$500 million building the first wastewater treatment plant for [Arequipa]. For years, the city had dumped its raw sewage into the Chili River. The plant helps farmers downstream, as they are no longer using polluted water to irrigate their crops. (ShareAmerica, 2016)</p>	Approved closure plan and financial bond in place for remediation and rehabilitation along with ongoing water conservation and recycling measures.	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 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	55.17 <sup>ooo</sup>
WGI 2 -Political Stability and Absence of Violence/ Terrorism	36.19 <sup>ooo</sup>
WGI 3 - Government Effectiveness	48.56 <sup>ooo</sup>
WGI 4 -Regulatory Quality	67.31 <sup>ooo</sup>
WGI 5 - Rule of Law	33.17 <sup>ooo</sup>
WGI 6 -Control of Corruption	38.94 <sup>ooo</sup>
EPI (Environmental Performance Index)	61.92
EITI membership	Meaningful progress (EITI 2019)
International Agreements	
ILO 176	Yes

<p>Others</p>	<p>Part of the UN Framework Convention on Climate Change (UNFCCC). Signature of the Paris Agreement on Climate Change and participation at COP 22. COP 20 held in Lima in 2014.</p> <p>Ratification of the Minamata Convention of Mercury in November 2015.</p> <p>Reaffirmation of commitment with the 2030 Agenda for Sustainable Development. (MDNP 2018)</p>
<p><b>Legal framework</b></p>	
<p>Areas of Law: Environment</p>	<p>Peru has a detailed and elaborate environmental legislation in the resource sector. Significant laws are the General Environmental Law (GEL), the Environmental Impact Assessment (EIA) Law and the Environmental Regulation for mining and exploration activities, among others (see MineHutte n.d.) for more information).</p> <p>An EIA needs to be carried out for all activities that may lead to significant impact on the environment. Activities are categorized, according to their foreseen impact. For activities with a middle to high environmental impact, detailed planning is required, including but not limited to management, abandonment, citizen participation and monitoring. Each stage of exploration and exploitation requires a specific type of consent, including environmental consent and public hearings (ibid.).</p> <p>The Ministry of Energy and Mines (MINEM) is the main competent authority for mining and mineral exploration – also for environmental matters. Nonetheless, several more state bodies play a role. Depending on the level of environmental impact, the competent authorities for the approval of an EIA may also be the National Environmental Certification Service for Sustainable Investments (SENACE), or the regional government, for instance (ibid.).</p>

Areas of Law: Occupational Health and Safety (OHS)	Peru has ratified the ILO Convention 176 on Safety in Health on Mines in June 2008 and subsequently adopted the Supreme Decree No. 024-2016-MS for the Regulation of Occupational Safety and Health in Mining. The Decree applies to mining as much as activities related to the mining sector, such as civil constructions, machinery, equipment and mechanical maintenance (MDNP 2018). The legislation on occupational health and safety (OHS) concerns minimum wages, medical tests and occupational safety for miners (Elias 2018). The Ministerio de Energía y Minas (MINEM) is the competent authority for OHS matters (MDNP 2018). ICGL additionally names the Organismo Supervisor de la Inversión en Energía y Minería (Osinerghmin), the superintendencia nacional de fiscalización laboral (SUNAFIL) and the ministry of labour and employment.
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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, Freeport-McMoRan is a founding member of ICMM (ICMM n.y.)
Towards Sustainable Mining (TSM) Is the mine owning company a member of the Mining Association of Canada (MAC)?	No No (MAC n.y.)

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 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?	1.17 / 6.00 1.17 / 6.00 (RMI n.y.)
Responsible Mining Index Company indicator „Working conditions“	0.617 Freeport-McMoRan 0.617 / 1.000 (RMI n.y.)
Responsible Mining Index Company indicator „Environmental sustainability“	0.405 Freeport-McMoRan 0.405 / 1.000 (RMI n.y.)
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
<b>ISO and CSR reporting</b>	
ISO 14001 (ISO 14004): Is the mine ISO 14001 certified?	Yes “These lines of action are carried out within the framework of the international and local certifications that our operating units have in the three countries where

	we operate. In 2017 we maintained 4 units certified in ISO 14001: 2004.” (Grupo Mexico, Informe Annual 2017 SCC, p.11).
CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	No No (Phoenix AZ, USA)
OECD Guidelines: Does the company have its headquarters in a signatory state?	No USA, member country since 1961 (OECD)
ISO 26000: Does the mine implement ISO 26000?*	No No (Cerro Verde/certificaciones/ n.y.)
<b>Banking Standards</b>	
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.

## Sources

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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)