

# ÖkoRess III

## Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

**Alumbrera**

**Glencore, Argentina**

ID: 76

## 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>

# Alumbreira

## Copper

General information	
Indicator or criteria	Description and values
Name of mine	Alumbreira
Description of mining area	<p>The Bajo de la Alumbreira porphyry copper/gold deposit lies in the eastern Andes of Argentina 1200 km north-west of Buenos Aires in a sparsely populated region of Catamarca Province, at an elevation of 2550 m above sea level. The deposit is centered on a closely spaced cluster of small felsic porphyry stocks emplaced into andesites and dacites during several intrusion phases. Zones of secondary K-feldspar are characteristic of significant copper/gold mineralization which consists of copper sulphide minerals bornite and chalcopyrite associated with magnetite. (Researchgate 2003)</p> <p>In March 2019, the Alumbreira copper/gold mining complex was integrated with the Agua Rica copper/gold deposit hosting a large scale, long life copper mineral resource with associated gold, silver, and molybdenum. The feasibility study for the integrated project with updated mineral reserve, production and project cost estimates will be completed by 2020. (Glencore news release, March 7, 2019)</p> <p>The mining complex includes associated infrastructure such as power supply, roads, railway systems and port facilities. (WBCSD 2014)</p>
Surface extension	27.99km <sup>2</sup> 27.99 km <sup>2</sup> (Image date: 20.07.2019; Viewing height: 8.57 km) (Google Earth)
In operation since	1998 Start of commercial production in February 1998 (Mining Frontier Dec 29, 2014)
Operator	Minera Alumbreira
Owner	Glencore
Closest town	Andalgalá 40km direct, by road 70km (GoogleEarth 2019)
Province	Catamarca Province, 1,100km north west of Buenos Aires (GoogleEarth 2019)


Country	Argentina
Longitude	-66.60858°
Latitude	-27.33062°
Altitude	2500 m a.s.l. Average altitude of 2,500 m a.s.l. (GoogleEarth 2019)
Main product and by-products	Main products: Copper (Cu) and gold (Au); by-products: Molybdenum (Mo) and silver (Ag) (Glencore Annual Report 2018)
On-site processing stages	Crushing, SAG and ball milling, gravity separation, flotation, thickener, resulting slurry is pumped 216 kilometres via pipeline to Tucumán city where the slurry undergoes a drying process, excess water is dumped into a nearby canal, and dry concentrate is transported by train to a port near Rosario to be shipped overseas for smelting (Mining Data Online n.y.).
Annual production	<p>Alubrera: Copper in conc. 17.4 kt, Gold in conc./doré 120 koz, Silver in conc./doré 156 koz, Molybdenum no data. (Glencore Annual Report 2018)</p> <p>Forecast from Agua Rica: Mine life of 25 years at average production of about 236 000 t/y of copper-equivalent metal, including the contributions of gold, molybdenum and silver for the first ten years of operation. This is based on the Agua Rica mineral reserve being estimated to contain proven &amp; probable reserves of about 4.5 Mt of copper and 6.5 Moz of gold contained in 910 Mt of ore. (Wood Mackenzie, June 2018)</p> <p>Agua Rica is a copper-gold-molybdenum porphyry deposit. The base case scenario calls for an open pit operation with the ore treated in a 110 kt/d concentrator. For the first five years the mine will produce a clean concentrate. After five years the plant will be converted to dual lines, one line producing a clean concentrate (80 % of output). The other 20 % will have a high arsenic content and will be further treated on site via leaching and pressure oxidation to produce a gold doré. It is assumed that the mine will use the existing facilities at Alubrera which is due to be depleted by 2019. (Wood Mackenzie, June 2018)</p>
Proven Reserves	ooo
Probable Reserves	ooo

## Geology



Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	Presence of copper sulphide and pyrite mineralization: Alteration zones feature a central copper-iron sulphide and gold-mineralized core with pyrite overprinted the potassic alteration zone. (Harris, AC et al., Econ. Geol. Vol. 100)	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 instructions, the Environmental Hazard Potential (EHP) resulting from AMD potential is high.	High	A = high, can be derived directly from available data
Paragenesis with heavy metals	Mineralisation in Alubrera: consists predominantly of copper sulphides, as such it is associated with heavy metal Cu. (Porter Geo 2006) In the Agua Rica deposit. Mineralization is associated with heavy metals copper and arsenic (Cu, As). (Porter Geo 2006)	Since copper itself is considered to be a harmful metal to the ecosystem and human health, the measure instructions suggests 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.	Medium	B2 = medium, classified according to measurement instructions
Deposit size	Measured & Indicated Alubrera Sulphides: 123 Mt @ 0.37 % Cu	The integrated deposit size of 4.02 Mt Cu is classified as large (3-10 Mt Cu) even without calculating the amount of	High	A = high, can be derived directly from available data

	(Glencore Resources & Reserves Report 2018) = 0.480 Mt Cu (own calculation) Agua Rica Sulphides: 909 Mt @ 0.39 % Cu (Wood Mackenzie, June 2018) = 3.545 Mt Cu (own calculation)	ore already extracted. According to the measurement instructions based on Petrow et al. (2008), this results in a high EHP as large deposits potentially have a higher expected total impact on the natural environment.		
Ore grade	Alumbreira: 0.37 % Cu (Glencore Resources & Reserves Report 2018) Agua Rica: 0.39 % Cu (Wood Mackenzie, June 2018)	The low grade (Cu 0.5-3.0 %) deposit of predominantly sulphide ore indicates a high EHP according to the measurement instructions based on Priester et al. (2019).	Medium	A = high, can be derived directly from available data

Technology 				
Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Mine type	Conventional hard rock open pit mining (Alumbreira Sustainability Report 2017).	Conventional hard 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

<p>Use of auxiliary substances</p>	<p>Mining: Drilling &amp; blasting, loading with electric shovels and truck haulage to crusher. (Mining Technology n.y.)                  Processing: Crushing, SAG and primary ball mill grinding circuits, rougher flotation, ball mill regrinding, gravity recovery and cleaner flotation. (Mining Technology n.y.)                  Concentrates are pipelined 316 km after thickening to 63 % solids to the Cruz del Norte [Tucuman] plant. After de-watering, it is railed to Puerta Alumbrrera on the Parana River (Mining Technology n.y.).                  “No cyanide, mercury, chromium, arsenic or lead is used for or involved in ore processing at our operations.” (Alumbrrera Sustainability Report 2017).</p>	<p>The measurement instructions would suggest a low EHP for the gravity separation process, however, a high EHP is indicated, since the copper concentration process includes flotation, which is commonly associated with toxic chemicals.                  Future processing of Agua Rica ore, which contains arsenic, will include site leaching recovery methods, which also indicate a high EHP.</p>	<p>High</p>	<p>A = high, can be derived directly from available data</p>
<p>Mining waste</p>	<p>“The nation will be watching Minera Alumbrrera’s methodology while it begins to comply with its mine closure plan, as the environmental and socioeconomic impacts will set a major precedent for what is acceptable” (Global Business Reports, Feb 2017).</p>	<p>No others references to mining waste or waste management found. In absence of any published mining waste documentation, the indicated EHP is rated medium.</p>	<p>Medium</p>	<p>B2 = medium, classified according to measurement instructions</p>
<p>Remediation measures</p>	<p>The waste rock is assessed for its net acid-generating potential and segregated as necessary (CM Journal Feb 2000).                  MAA created a seed bank and is actively testing revegetation methods (Alumbrrera Sustainability Report 2017).</p>	<p>To date, there is no published mine closure plan, which is “19 years in the making” (Glencore – Our work in land rehabilitation 2018).                  In absence of any published mining waste documentation, the indicated EHP is rated medium.</p>	<p>Medium</p>	<p>B2 = medium, classified according to measurement instructions</p>

## 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. 2017)). Metrics are directly taken from the given risk assessment. The indicator total is determined by the highest hazard level of the sub-indicators.	The Baja Alubrera mine has a medium EHP for earthquake and landslide. which indicates the general 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 medium and the mine is not situated in a desert area. Accordingly, the general result is a medium EHP.	Medium	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	65.52 <sup>ooo</sup>
WGI 2 -Political Stability and Absence of Violence/ Terrorism	53.33 <sup>ooo</sup>
WGI 3 - Government Effectiveness	59.62 <sup>ooo</sup>
WGI 4 -Regulatory Quality	41.35 <sup>ooo</sup>
WGI 5 - Rule of Law	46.15 <sup>ooo</sup>
WGI 6 -Control of Corruption	47.6 <sup>ooo</sup>
EPI (Environmental Performance Index)	59.3
EITI membership	Argentina joined EITI in 2019. The country has yet to be assessed against the 2016 Standard
International Agreements	
ILO 176	No

Others	<ul style="list-style-type: none"> <li>• Signatory to the Minamata Convention 2013, ratified in 2017 (UNEP n.y.)</li> <li>• Signatory to the Paris Agreement 2016, signed 22 April 2016 and ratified 21 September 2016 (United Nations Treaty Collection n.y.)</li> </ul>
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**Legal framework**

Areas of Law: Environment	<p>“Argentina has a widely varied climate, encompassing all types of conditions, from tropical to sub-polar. As with many countries in South America, deforestation is a key environmental issue, as is pollution, with air and water pollution common.” (Minehutte n.y.)</p> <p><b>PRINCIPAL LEGISLATION AND REGULATOR</b></p> <p>“Article 41 of the Argentinian Constitution guarantees the right to a healthy environment, one that is suitable for human development and present human needs without affecting future generations. The General Environmental Law No. 25675 (2002) (Ley General del Ambiente) and Law No. 24585 (which amended the Mining Code) are particularly relevant in relation to the regulation of environmental impacts arising from mining operations. The latter law introduced environmental impact assessments (EIAs) in relation to prospecting and mining activities and assigned responsibility for its enforcement to the Provincial Authorities. The so-called Federal Environmental Pact (1993) promotes the development of environmental policies within the national territory, providing framework agreements between the Provinces and the Nation in order to improve environmental preservation. The Environmental Federal Council (Consejo Federal de Medio Ambiente in Spanish, or COFEMA) facilitates cooperation between the Nation and the Provinces.” (Minehutte n.y.)</p> <p><b>EIA PROCESS</b></p> <p>“The General Environmental Law states that any activity that adversely affects the environment or the quality of life of a given population must be made the subject of an</p>
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	<p>EIA prior to the relevant activity being undertaken (Art. 11). An environmental impact study (EIS) must be completed, which must contain a detailed description of the project or activity, the anticipated environmental consequences of the activity and a mitigation plan. According to the Mining Code, operators are obliged to submit an EIS prior to the commencement of prospecting or mining activities. Each Province has its own environmental authority, which is required to issue a decision on an EIS within 60 days from the filing date. The EIS (or Declaración de Impacto Ambiental (DIA) in Spanish) must be updated every two years according to the activities conducted and results and observations made.” (Minehutte n.y.)</p>
<p>Areas of Law: Occupational Health and Safety (OHS)</p>	<p>“The OHS law creates the Superintendence of Occupational Risks (SRT) as an autonomous body under the Ministry of Labour and Social Security (Ley núm. 24557, de riesgos del trabajo. (35).</p> <p>The overriding principle for labour law is set out in Article 14bis of the Constitution of Argentina which aims to provide for dignified and equitable working conditions. There are two leading OSH laws. The first is Law. No. 24557 of 13 September 1995 on Occupational Risks, reformed in 2012, requiring employers to contact the occupational risk insurance provided by Occupational Risk Insurers (ART) which are undertakings governed by private law (private insurance companies) approved by the Superintendence of Occupational Risks (SRT). The Superintendence on Occupational Risks is an autonomous body under the Ministry of Labour and Social Security which supervises the Occupational Risk Insurers. The other leading OSH law is the Law No.</p>

	<p>19587 of 21 April 1972 on Occupational Hygiene and Safety and its implementing Regulation- Decree No. 351 of 22 May 1979. Another key piece of legislation containing OSH provisions is the Law No. 20744 on the Work Contract, reformed in 2012.</p> <p>With regard to OSH inspection, The Law No. 25212 of 24 November 1999 ratifying the Federal Labour Pact and the Law No. 25877 on the Labour Regime provide some general rules about the powers of labour inspectors. Argentina is organized as a federation, composed of twenty-three provinces and the city of Buenos Aires. Therefore, powers of labour inspectors depend on this administrative division, as each province has different procedural labour laws.</p> <p>Finally, OSH rules can be observed in the resolutions of the Ministry of Labour concerning particular issues in the field of OSH such as work in confined spaces, work with asbestos and regulations regarding ergonomic techniques." (ILO.org/dyn/legosh Argentina 2013)</p>
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## Corporate Social Responsibility (CSR)

<b>Voluntary Standards</b>	
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, Glencore plc joined ICMM in 2014.

Towards Sustainable Mining (TSM) Is the mine owning company a member of the Mining Association of Canada (MAC)?	Yes Yes (MAC n.y)
Towards Sustainable Mining (TSM) outside Canada: Are TSM standards implemented*?	No information available The Argentine Chamber of Mining Entrepreneurs (CAEM) announced the implementation of the "Towards Sustainable Mining" initiative, which seeks to improve the social and environmental practices of the mining industry. This is the second time that the TSM program has been adopted by a mining association outside of Canada, and the first time in Latin America. No mentioning of TSM standards in connection with the Alumbreira mining operation (Glencore Sustainability Report 2017 – Final).
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?	4.33 / 6.00 4.33 / 6.00 (RMI n.y.)
Responsible Mining Index Company indicator „Working conditions“	0.601 Glencore 0.601 / 1.000 (RMI n.y.)
Responsible Mining Index Company indicator „Environmental sustainability“	0.497 Glencore 0.497 / 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 Minera Alumbreira recertified the Environmental Management System in accordance with the international standards ISO14001 and ISO9001 under the new version of the integrated ISO14001 standards of the Argentine Institute for Standardization and Certification (IRAM). Valid since 2005, the authorization was extended by the agency until the year 2021 (infoalumbreira.com.ar n.y.).
CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	No No, Glencore plc has its headquarters in Baar, Switzerland (Glencore 2019)
OECD Guidelines: Does the company have its headquarters in a signatory state?	Yes Yes, Switzerland is an OECD member state since 1961 (OECD n.y.)
ISO 26000: Does the mine implement ISO 26000?*	No information obtained No information available
<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)