

ÖkoRess III

Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

Spence (Pampa Norte)

BHP Billiton , Chile

ID: 61

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>

Spence (Pampa Norte)

Copper

| General information  | |
|---|--|
| Indicator or criteria | Description and values |
| Name of mine | Spence (Pampa Norte) |
| Description of mining area | The Spence Mine is one of two mines in the Pampa Norte division, close to the city of Sierra Gorda and ca. 50 km south-west of Calama in northern Chile. Surrounded by the Atacama Desert, the Spence Mine is located in a dry desert ecosystem dominated by a mountainous landscape. The porphyry deposit of Pampa Norte consists of both supergene enriched and hypogene ores. Within three intrusive events, Atacamite and brochantite are the main copper bearing minerals in the oxide zones while chlorite, molybdenite, pyrites and chalcopyrite occur in the sulphide zones (Porter GeoConsultancy 2013) (Mining Technology n.d.) (Arriagada 2012) |
| Surface extension | 46.16km ² 46.16 km ² (Image date: 19.12.2019; Viewing height: 10.64 km) (Google Earth) |
| In operation since | 2006 2006 (BHP 2019a) |
| Operator | Minera Spence S.A. |
| Owner | BHP Billiton |
| Closest town | Sierra Gorda, ca. 12km south-west of the mine (Google Maps) |
| Province | Antofagasta |
| Country | Chile |
| Longitude | -69.25718° |
| Latitude | -22.79834° |

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|------------------------------|---|
| Altitude | 1700 m a.s.l. 1,700 m a.s.l. (Mining Technology n.d.) |
| Main product and by-products | Main product: copper; by-product: molybdenum |
| On-site processing stages | Crushing, leaching, solvent-extraction and electrowinning (BHP 2019a) |
| Annual production | 200,500 t copper cathodes (BHP 2018b) |
| Proven Reserves | 575 Mt, 0,45% Cu (BHP 2019a) |
| Probable Reserves | 751 Mt, 0,45% Cu (BHP 2019a) |

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 mainly obtained from Sulphides at Spence which pose a high risk for AMD (Porter GeoConsultancy 2013)(Dehoust et al. 2017b p. 13-15). There is a smaller amount of oxide but it is too less to include it in this evaluation. | The extraction of sulphidic minerals has a high environmental hazard potential with regard to AMD. | High | 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). However, no information on paragenesis with other heavy metals could be 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 |

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| 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 | 1,330 Mt with an average ore grade of 0.45% copper. This leads to a total copper content of 5.99 Mt. (Hypogene sulphides) (BHP 2019a) | Since the mine-opening in 2007, about 1.9 Mt of copper have been produced at Spence (Annual reports BHP 2007-2018). Including the current value metal reserve, the estimated deposit size amounts roughly 7.9 Mt. The deposit is classified as large and, hence, is evaluated with a high EHP. | High | B2 = medium, classified according to measurement instructions |
| Ore grade | 0.45 % (BHP 2019a) | With a copper content of 0.45 %, Spence 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 mine (BHP 2019a) | 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 |

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| | | 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 | Mining is carried out with trucks and shovel-loaders (Arriagada 2012). The site has a leaching, solvent-extraction and electrowinning (SX-EW) plant. Sulphides and Oxides are treated on two different pads: While oxide ores are chemically leached, the sulphide ores are going through a bacterial leaching process before both are processed in two parallel solvent extraction (SX) plants (Viewpoint n.d.). The copper cathodes are transported by rail to the industrial ports of Antofagasta and Mejillones (BHP 2019a). | 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 | No information about the waste management at Spence could be found. The mining of polymetallic ores such as the Spence operation is expected to result in a high volume of waste sludge, which is mostly deposited in sludge ponds (Dehoust et al. 2017b p. 32). It is planned to construct a tailings facility in the context of the "Spence Growth Option" (Minería Chilena 2018). However, no size for this planned facility is known. | The processing of polymetallic ores at high production quantities leads to the expectation of waste being dumped in large-volume basins and is therefore classified with an high EHP. | High | B2 = medium, classified according to measurement instructions |
| Remediation measures | In 2017, BHP developed a new mine closure concept for all its operations. Furthermore, a strategy to mitigate, rehabilitate and compensate environmental impacts is in place for all mine sites (BHP 2019b). No specific | 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 |

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| | information about rehabilitation measures at Spence could be found. | | | |
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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 |

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| <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 12.03.2017) (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 (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 |

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| 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)? | Yes Yes (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? | 0.50 / 6.00 0.50 / 6.00 (RMI 2018) |
| Responsible Mining Index Company indicator „Working conditions“ | 0.550 0.550 / 1.000 (RMI 2018) |
| Responsible Mining Index Company indicator „Environmental sustainability“ | 0.480 0.480 / 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 |

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| 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 (BHP 2019b) |
| CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country? | Yes Yes (UK) (RMI 2018) |
| OECD Guidelines: Does the company have its headquarters in a signatory state? | Yes Yes (UK) (RMI 2018) |
| 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.

Sources

Arriagada, I. (2012): Pampa Norte Spence site tour.

BHP (2018a): Annual Report 2018. <https://www.bhp.com/-/media/documents/investors/annual-reports/2018/bhpannualreport2018.pdf> (12.08.2019).

BHP (2018b): Operational Review for the year ended 30 June 2018. https://www.bhp.com/-/media/documents/media/reports-and-presentations/2018/180718_operationalreviewfortheyearended30june2018.pdf?la=en. (23.07.2019).

BHP (2018c): Sustainability Report 2018. <https://www.bhp.com/-/media/documents/investors/annual-reports/2018/bhpsustainabilityreport2018.pdf> (23.07.2019).

Dehoust, G.; Manhart, A.; Möck, A.; Kießling, L.; Vogt, R.; Kämper, C.; Giegrich, J.; Auberger, A.; Priester, M.; Rechlin, A.; Dolega, P. (2017a): Erörterung ökologischer Grenzen der Primärrohstoffgewinnung und Entwicklung einer Methode zur Bewertung der ökologischen Rohstoffverfügbarkeit zur Weiterentwicklung des Kritikalitätskonzeptes (ökoRess I) - Konzeptband. Umweltbundesamt, Dessau-Roßlau.

Dehoust, G.; Manhart, A.; Möck, A.; Kießling, L.; Vogt, R.; Kämper, C.; Giegrich, J.; Auberger, A.; Priester, M.; Rechlin, A.; Dolega, P. (2017b): Erörterung ökologischer Grenzen der Primärrohstoffgewinnung und Entwicklung einer Methode zur Bewertung der ökologischen Rohstoffverfügbarkeit zur Weiterentwicklung des Kritikalitätskonzeptes (ökoRess I) - Methode für einen standortbezogenen Ansatz. Umweltbundesamt, Dessau-Roßlau.

EI SourceBook (2016): Text of the Law No 19.300 General Bases for the Environment, published on the official gazette on 9th of March 1994. <http://www.eisourcebook.org/cms/February%202016/Chile%20General%20Environment%20Law%201994.pdf>. (28.12.2018).

EITI (n.d.): Countries - Implementation Status. In: Extractive Industries Transparency Initiative (EITI). <https://eiti.org/countries>. (30.09.2019).

EP (n.d.): EP Association Members & Reporting. In: Equator Principles. <https://equator-principles.com/members-reporting/>. (13.05.2019).

Eyzaguirre, N. (2018): Chile: Mining Law 2019. In: International Comparative Legal Guides International Business Reports. Text, <https://iclg.com/practice-areas/mining-laws-and-regulations/chile>. (10.09.2019).

ICMM (2017): Member reporting and performance. In: International Council on Mining and Metals (ICMM). <https://www.icmm.com/en-gb/members/member-reporting-and-performance>. (13.06.2019).

ILO (2017): Ratifications of C176 - Safety and Health in Mines Convention, 1995 (No. 176). In: International Labour Organization (ILO). http://www.ilo.org/dyn/normlex/en/f?p=1000:11300:0::NO:11300:P11300_INSTRUMENT_ID:312321. (12.04.2018).

IRMA (2014): Standard for Responsible Mining. Draft v1.0. Initiative for Responsible Mining Assurance (IRMA). https://responsiblemining.net/wp-content/uploads/2018/09/IRMA_Standard_Draft_v1.007-14.pdf.

IRMA (2018): Responsible Mining Map. In: Initiative for Responsible Mining Assurance (IRMA). <https://map.responsiblemining.net/>. (16.04.2019).

MAC (2019): Our Members. In: The Mining Association of Canada (MAC). <http://mining.ca/members-partners/our-members>. (16.04.2019).

MDNP (2018): Country Fiche Chile. In: EU - Latin America Mineral Development Network Platform (MDNP). https://www.mineralplatform.eu/system/files/CountryFiche/MDNP_country-fiche_Chile_02.pdf. (19.09.2019).

- Minehutte (2019): Chile - Mining & Environmental Law & Regulations. In: MineHutte - Regulatory Risk Ratings & Analysis of Global Mining Laws. <https://minehutte.com/jurisdiction/chile/>. (28.12.2018).
- Minería Chilena (2018): A fines de 2020 partiría la producción del proyecto Spence Growth Option (SGO). In: Minería Chilena. <http://www.mch.cl/2018/10/10/fines-2020-partiria-la-produccion-del-proyecto-spence-growth-option-sgo/>. (23.07.2019).
- Mining Technology (n.d.): Spence Copper Cathode Mine, Atacama Desert, Chile. In: Mining Technology | Mining News and Views Updated Daily.
- Pfister, S.; Koehler, A.; Hellweg, S. (2009): Assessing the Environmental Impacts of Freshwater Consumption in LCA. In: Environmental science & technology. Vol. 43, No.11, S. 4098–4104.
- Porter GeoConsultancy (2013): Spence - Chile. <http://www.portergeo.com.au/database/mineinfo.asp?mineid=mn769>. (23.07.2019).
- RMI (2018): BHP - Company report. In: Responsible Mining Index (RMI). /en/companies/7. (13.06.2019).
- UNEP (2019): Minamata Convention on Mercury: Parties and Signatories. In: UN Environment Programme (UNEP) - Minamata Convention on Mercury. <http://www.mercuryconvention.org/Countries/Parties/tabid/3428/language/en-US/Default.aspx>. (05.11.2019).
- UNFCCC (2016): Paris Agreement Signatories Rise to 187. In: United Nations Framework Convention on Climate Change (UNFCCC). <https://unfccc.int/news/malawi-armenia-zambia-and-chile-sign-paris-agreement>. (23.07.2019).
- Viewpoint (n.d.): Spence mine: From greenfield to major producer in a few short years. In: Viewpoint Mining Magazine. <http://viewpointmining.com/article/from-greenfield-to-major-producer-in-a-few-short-years>. (23.07.2019).
- Wendling, Z. A.; Emerson, J. W.; de Sherbinin, A.; Esty, D. C. (2020): 2020 Environmental Performance Index. Yale Center for Environmental Law & Policy, New Haven, CT. <https://epi.yale.edu/epi-results/2020/component/epi> (11.08.2020).
- WGI (2019): The Worldwide Governance Indicators (WGI). The World Bank. <http://info.worldbank.org/governance/WGI/#home>. (10.12.2018).

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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