

ÖkoRess III

Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

Sentinel

First Quantum , Zambia

ID: 51

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>

Sentinel

Copper

General information



Indicator or criteria	Description and values
Name of mine	Sentinel
Description of mining area	The deposit is located on the flanks of the Kabompo structural dome, 55 km west of the Lumwana mine, and 140 km west of the town of Solwezi (First Quantum 2018a). Main ore minerals are chalcopyrite, pyrite, and pyrrhotite other rarer minerals bornite and chalcocite (Hitzman et al. 2012).
Surface extension	21.23km ² 21.23 km ² (Image date: 29.06.2017; Viewing height: 7.73 km) (Google Earth)
In operation since	2015 2015 (Gray et al. 2015)
Operator	Kalumbila Minerals Ltd (KML)
Owner	First Quantum
Closest town	Approximately 150 km west of the town of Solwezi
Province	North Western Province
Country	Zambia
Longitude	25.299353°
Latitude	-12.279165°
Altitude	1230 m a.s.l. 1230 a.s.l. (Google Earth)
Main product and by-products	Copper concentrate
On-site processing stages	The ore is crushed in the mine and transported by conveyor belts to the processing plant. The concept of the processing plant is based on a conventional sulphide ore flotation circuit (First Quantum 2018a).

Annual production	223,656 tons of copper (First Quantum 2018b)
Proven Reserves	717.7 Mt (First Quantum 2018c)
Probable Reserves	152.0 Mt (First Quantum 2018c)

Geology



Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	The mineralisation of the sentinel deposit is predominantly primary sulphide copper only very small amounts of oxide ore are present (Gray et al. 2015).	Geochemical conditions for AMD are given – the vast majority of the mined ore is sulphidic. Accordingly, the EHP due to preconditions for AMD is high.	High	A = high, can be derived directly from available data
Paragenesis with heavy metals	Copper itself is a heavy metal. Plus, a complete elemental analysis was provided for concentrate samples. These analyses showed levels of up to 900 ppm for zinc and cobalt as well as up to 170 ppm for lead and 500 ppm for nickel (Gray et al. 2015)...	Since copper itself is a heavy metal and a variety of other heavy metals are present in the concentrate the paragenesis with heavy metals shows a high EHP.	High	A = high, can be derived directly from available data
Paragenesis with radioactive components	A complete elemental analysis was provided for concentrate samples. These analyses showed a low level of uranium (6 - 20 ppm) and thorium (5 - 15 ppm). (Gray et al. 2015).	According to the measuring instructions, the Th- and U-levels are to be classified as low since the substrate is suitable for the use as building material. Accordingly, the EHP for paragenesis with radioactive materials is low.	Low	C = low, no concrete information, no general specifications in the measuring instructions, (expert) estimate

Deposit size	First Quantum estimates that a total of 985 Mt ore will be mined during the entire mining period at grade of 0.51 % Cu (2015-2033) resulting in a copper content of ca. 5 Mt (Gray et al. 2015).	The deposit size can be evaluated as large according to the measurement instructions, resulting in a high environmental hazard potential. Larger deposits potentially have a greater expected total impact on the natural environment.	High	A = high, can be derived directly from available data
Ore grade	0.5% in ore reserve (First Quantum 2018b; c)	Priester et al. (2019) analysed ore grades of different metals and indicate that copper grades between 0.5 and 3 % Cu can be characterized as average. Accordingly, the environmental hazard potential caused by the ore grade is medium.	Medium	A = high, can be derived directly from available data

Technology



Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Mine type	Open-pit mining (First Quantum 2018a)	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 mining method poses a medium EHP.	Medium	A = high, can be derived directly from available data
Use of auxiliary substances	The ore is crushed in-pit and conveyed overland, and onto a crushed ore stockpile ahead of two milling trains, each comprising a SAG mill and a single ball mill. Each train consists of two parallel banks of flotation cells,	Flotation includes the application of (potentially) toxic reagents. Accordingly, the extraction and processing method poses a high EHP.	High	C = low, no concrete information, no general specifications in

	each comprising seven cells operating in series. Collector, other and gangue depressant are added to the flotation circuit as required via dedicated systems (Gray et al. 2015).			the measuring instructions, (expert) estimate
Mining waste	Flotation tailings are stored in a tailings storage facility. The TSF has a circular design with a dam length of 5.5 km and maximum heights of 40 m (Gray et al. 2015).	The TSF has a significant size. Moreover the highest structures reach heights of 40 m qualifying them as Large Dams according to ICOLD (2011). Accordingly, the minewaste management poses a high EHP.	High	A = high, can be derived directly from available data
Remediation measures	Mine closure provisions are in place. The main environmental liabilities at the mine will arise at closure and are related to the dismantling and rehabilitation of the process plants, pipelines, roads, tailings dam, open pits and waste rock dumps. Financial provision for the closure are in place (Gray et al. 2015).	Financial provisions are taken for the closure of the mine. A mine closure plan is in place. Accordingly, the remediation measures pose a medium EHP.	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	All other sub-indicators show a low EHP for the mine, which results in a low EHP.	Low	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 low and the mine is not situated in a desert area, which results in a low EHP.	Low	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	35.96 ^{ooo}
WGI 2 -Political Stability and Absence of Violence/ Terrorism	50.48 ^{ooo}
WGI 3 - Government Effectiveness	28.85 ^{ooo}

WGI 4 -Regulatory Quality	33.65 °°°
WGI 5 - Rule of Law	41.35 °°°
WGI 6 -Control of Corruption	35.58 °°°
EPI (Environmental Performance Index)	50.97
EITI membership	Yes, with meaningful progress
International Agreements	
ILO 176	Ratified and in force since 04 Jan 1999
Others	No information obtained
Legal framework	

<p>Areas of Law: Environment</p>	<p>Mining rights holders require an approved environmental authorization issued by The Zambian Environmental Management Agency (ZEMA). Moreover a waste management license is required to handle hazardous wastes. Mines are only to be closed once a certificate of abandonment is granted. This requires identification of insurance and indemnities. However, liability remains with the holder of the mining license (Silwamba / Jalasi 2018).</p> <p>Environmental Impact Assessments of mines are a requirement and are managed by the Zambian Environment Management Agency (ZEMA). The process involves mandatory public consultations with government agencies, local authorities, NGO s, CSOs and interested parties (Environmental Council of Zambia n.d.; MineHutte 2019).</p> <p>The Environmental Management Act is fundamental to environmental standards in the mining sector (Rüttinger et al. 2014).</p>
<p>Areas of Law: Occupational Health and Safety (OHS)</p>	<p>Health and safety are governed by the Mining Regulation 1971 and 1973 and are complemented by the Guide to the Mining Regulations booklet. Owners, employers, managers and employees are imposed with obligations regarding health and safety (Silwamba / Jalasi 2018). The Mines Safety Department within The Ministry of Mines and Minerals Development is responsible for health and safety matters of all employees in the mining sector (MineHutte 2019).</p>

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?	No No (ICMM 2019)
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 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?	No No (RMI 2018)
Responsible Mining Index Company indicator „Working conditions“	Not applicable Not applicable (RMI 2018)

Responsible Mining Index Company indicator „Environmental sustainability“	Not applicable Not applicable (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?	No information obtained No information available
CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	No No (Canada) (First Quantum 2019)
OECD Guidelines: Does the company have its headquarters in a signatory state?	Yes Yes (Canada) (OECD 2019)
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 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

Publisher:

German Environment Agency
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Project period: 03/2018 –02/2021

The research project has been commissioned by the German Environment Agency as part of the Environmental Research Plan of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and funded by the Federal Government (FKZ: 3717 35 306 0).

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- Öko-Institut e.V. (Institute for Applied Ecology)