ÖkoRess III

Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

Norilsk-1 Deposit and Talnakh Ore Field

Nornickel, Russia

ID: 52

German Environment Agency

Umwelt Bundesamt

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.

[1]TEXTE 87/2017 https://www.umweltbundesamt.de/publikationen/discussion-of-the-environmental-limits-of-primary

Norilsk-1 Deposit and Talnakh Ore Field

Copper

General information

Indicator or criteria	Description and values
Name of mine	Norilsk-1 Deposit and Talnakh Ore Field
Description of mining area	Near the cities of Norilsk and Talnakh, beyond the Arctic Circle on the Taimyr Peninsula in the north of the Krasnoyarsk Territory, Nornickel own two world-class copper, nickel, PGE ore clusters – the Norilsk-1 Deposit and the Talnakh Ore Field (Nornickel, 2019). Three different grades of copper-nickel sulphide ores (rich, cupriferous and disseminated ore) are extracted in six underground mines. Only the Norilsk-1 deposit is also mined as open pit. The landscape is characterized by tundra, wetlands with rivers, lakes and bogs, and coastal arctic desert. The climate in the region is sub-polar. The Norilsk areas is known for its pervasive environmental pollution that has been caused by long-term mining and processing of predominantly sulphidic ore since the early 1940s (Derome / Lukina 2011; Kirdyanov et al. 2014; Yakovlev et al. 2008; Zubareva et al. 2003).
Surface extension	232.47km^2 232.47 km^2 (Image date: 19.7.2019; Viewing height: 21.56 km) (Google Earth)
In operation since	1935 1935 (Nornickel n.d. a)
Operator	Polar Division and Medvezhy Ruchey
Owner	Nornickel
Closest town	Norilsk (Google Maps)
Province	Krasnoyarsk Krai
Country	Russia
Longitude	88.17546°

Latitude	69.28118°
Altitude	92 m a.s.l. 92 m a.s.l. (Google Earth)
Main product and by-products	Main product: Copper and nickel; by-products: PGM - palladium, platinum, rhodium, ruthenium and iridium; and selenium (Nornickel, 2019).
On-site processing stages	On-site the metals production cycle embraces operations ranging from primary ore mining, predominantly underground, concentration, and smelting. Underground mining is carried out through sublevel caving. The basic processing stages performed at the ore concentrators located at Norilsk and Talnakh comprise crushing, milling, gravitation, flotation, and thickening. Thickened concentrates are then transported via a pipeline from the concentrators to the Nadezhda metallurgical plant (Ni) and the copper plant (Cu + PGE). The copper plant processes all of the copper concentrate from the company's concentrators, as well as third-party feedstock, to obtain copper cathodes, elemental sulphur, and sulphuric acid. The PGM concentrator is part of copper plant and recycles slime from the tank house to produce concentrates of precious metals and technical selenium (Nornickel, 2019).
Annual production	17.3 Mt of ore, containing Cu ~ 2.2% (353,131 t), Ni ~ 1.3%, PGM ~ 6.7 ppm (Nornickel, 2019)
Proven Reserves	350.20 Mt (Nornickel, 2019)
Probable Reserves	333.43 Mt (Nornickel, 2019)

Geology

Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	Copper-nickel sulphide ores are extracted (Nornickel, 2019). The mineral assemblage consists of Cu-Fe-Ni sulphide minerals such as bornite, pyrrhotite, cubanite, chalcopyrite, pentlandite, and chalcocite (Krivolutskaya et al. 2018).	The extraction of sulphidic minerals has a high environmental hazard potential with regard to AMD.	High	A = high, can be derived directly from available data

Paragenesis with heavy metals	Copper and nickel are heavy metals themselves. According to Krivolutskaya et al. (2018), the geochemical composition of the sulphide ores also contains selenium, zinc, tungsten, arsenic, and lead.	The extraction of primary copper and nickel ores and associated other heavy minerals, which occur in trace, is consequently always evaluated with a high environmental hazard potential (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 found.	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	Proven and probable reserves are 350.20 Mt and 333.43 Mt, respectively, as per the Nornickel (2019).	The total reserve thus amounts to 683 Mt copper-nickel ore. The deposits are classified as very large and, hence, is evaluated with a high EHP even without back-calculation of already mined material since the mine opened in 1936.	High	A = high, can be derived directly from available data
Ore grade	The average copper and nickel grades are 2.2% and 1.3%, respectively, as per Nornickel (2019)	Based on the grade classes for selected commodities in the updated measurement instructions (Dehoust et al. 2017b) based on Priester et al. (2019), the deposits' ore grade correspond to an 'average' ore grade. The EHP is therefore evaluated as 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	All mines in the mining complex are underground. They are extracted by sublevel caving. In this process, the ore is mined by blasting or by collapsing sub levels. The voids formed after extraction get filled with fractured rock. Additionally, there is one mine at Norilsk-1 deposit that is also operated as open pit (Nornickel, 2019).	Most of the mining activities takes place underground. The EHP is therefore evaluated as low.	Low	A = high, can be derived directly from available data
Use of auxiliary substances	Explosive substances are used for the extraction of primary ore-bearing material. The ore is concentrated by flotation. Copper cathodes are by electro-winning. Concentrate is leached with agents that dissolve metal-containing minerals or the entire material, so that the metal is deposited on the cathode.. The end product is high purity metal cathode. (Nornickel, 2019).	Flotation and the dissolving of metal-containing minerals as a prerequisite for electro-winning require toxic auxiliary substances, leading to a high EHP in the evaluation result. In general, the use of explosive substances do not lead to a higher EHP.	High	A = high, can be derived directly from available data
Mining waste	Nornickel currently operates three tailings pits: Lebyazhye, tailings pits of Nadezhda Metallurgical Plant, Talnakh Concentrator. The company conducts regular monitoring of the environmental conditions at tailings pits and within the area of their environmental impact for the purpose of observation, assessment and forecast of environmental changes as well	The disposal of fluid waste in obviously leaking tailing dams and the disposal of unconsolidated mining waste on steep and high heaps lead to a high EHP evaluation result. Norilsk smelting plants are considered to be the main polluters in the global boreal region and the area around the	High	A = high, can be derived directly from available data

	as for the prevention and mitigation of adverse environmental impact (Nornickel, 2019). Based on the evaluation of the Google Earth satellite images, the structural dam height is not higher than 15 m above the ground surface. A tailing pond which covers an area of ~ 3 km^2 and the corresponding pipeline appear to leak slurry into the environment. Solid mining residues are stored on heaps that are up to 200m above the ground surface. Starting from the hill slopes, the unconsolidated material is unloaded in a fan shape so that the valleys gradually fill up.	city is one of the most polluted in the world (e.g. Derome & Lukina, 2011). The sulfur content in the precipitation of the Polar Division of Norilsk (MMC) remains the highest not only in Siberia, but all of Russia, while less than 10 percent of the wastewater from all sources go through purification (Bronder et al. 2010). The Norilsk areas is known for its pervasive completely degraded forest ecosystem that has been caused by long-term mining and processing of predominantly sulphidic ore since the early 1940s (Kirdyanov et al., 2014). The main components of emissions are sulfur dioxide, nitrogen oxide, and heavy metals. Currently, the zone of damaged forests extends for more than 200 km (Zubareva et al., 2003). The territory within 4 km from Norilsk is characterized by high concentrations of heavy metals, the absence of trees, and the disturbance of the organic matter mineralization (Yakovlev et al., 2008).		
Remediation measures	Waste generated from the extraction of ore mineral resources is used in backfilling of mined-out areas and pits, road filling, and strengthening of tailings pits according to the Nornickel, 2019.	No detailed information are available on remediation measures, rehabilitation, recultivation, renaturation, or mine-closure planning. According to general rules of the measurment instructions, the EHP is evaluated as high in this case, because the mining company is operating in a country with low	High	B2 = medium, classified according to measurement instructions

		governance performance and is fully or partly state dependend.		

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). Metrics are directly taken from the given risk assessment. The indicator total is determined by the highest hazard level of the sub-indicators.	The Nornickel mining complex is located in an area with a medium EHP for landslides (rated 1) which determines the evaluation result. The other sub-indicators have a low EHP.	Medium	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 availablility 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 water stress in the mining area 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 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	19.21 °°°
WGI 2 -Political Stability and Absence of Violence/ Terrorism	29.05 °°°
WGI 3 - Government Effectiveness	50.96 °°°
WGI 4 -Regulatory Quality	31.73 °°°
WGI 5 - Rule of Law	20.67 °°°
WGI 6 -Control of Corruption	21.15 °°°
EPI (Environmental Performance Index)	63.79
EITI membership	No
International Agreements	
ILO 176	ratified

Others	none
Legal framework	
Areas of Law: Environment	Federal Law on Environment Protection N 7-ФЗ dated 10.01.2002 The state body "Rosprirodnadzor" (The Federal Supervisory Service for Nature Management) exercises control and supervision to the mining operations plan, following the Environmental legislation (Josefson / Rotar 2018). Further approvals concerning deterioration of environmental media (e.g. air quality) are obtained by other legal offices. Public consultation is not mentioned. The mining operations plan has to consider all measures identified by the environmental impact assessment that is carried out at the Federal level. This addresses in particular storage of tailings, waste products, sanitary and epidemiological welfare. In case of closure of the mine site openings and drilled holes should be brought back into a condition guaranteeing life, health and safety of the environment and manmade infrastructure. The plan of mining operations must consider obligations and provisions of the zoning legislation (Posashkov / Mazurov 2018). However, deposits and occurrences of minerals are referred to as industrial zones.

Areas of Law: Occupational Health and Safety (OHS)	Federal Law on Occupational Health and Safety 181-ФЗ dated 17.07.1999 The main requirements for compliance with health and safety regulations applicable to mining operations are the same as those generally applicable for operating hazardous industrial facilities. Virtually all major aspects of mining operations are considered by Russian law to be hazardous industrial operations and are, therefore, regulated by Federal Law "On Industrial Safety at Hazardous Industrial Facilities" (Josefson / Rotar 2018). The law stipulates obligations in relation to occupational safety for both employers and employees. Violations to occupational safety requirements entail administrative and criminal sanctions according to the Criminal Code of the Russian Federation and the Administrative Offences Code (Posashkov / Mazurov 2018).

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
Towards Sustainable Mining (TSM) Is the mine owning company a member of the Mining Association of Canada (MAC)?	No No

Towards Sustainable Mining (TSM) outside Canada: Are TSM standards implemented*?	No No
Initiative for Responsible Mining Assurance (IRMA): Is the mine owning company a member?	No No
Initiative for Responsible Mining Assurance (IRMA): Is the mine certified?	No No
Responsible Copper (RC): Is the mine owning company a member of RC?	No No
Responsible Copper (RC): Is the mine certified?	No No
Responsible Mining Index (RMI): Has the mine been rated?	No No
Responsible Mining Index Company indicator „Working conditions“	Not applicable Not applicable
Responsible Mining Index Company indicator „Environmental sustainability“	Not applicable Not applicable
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 ISO 14001:2015 (and in addition ISO 9001:2015 and ISO/IEC 27001:2013) (Nornickel 2019)

CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	No No (Nornickel n.d. b)
OECD Guidelines: Does the company have its headquarters in a signatory state?	No No (OECD 2019)
ISO 26000: Does the mine implement ISO 26000?*	No No (Nornickel 2019)
Banking Standards	
WB Standards / IFC Performance Standards: Is the mine financed to a major extend by the world bank?	No No
Equator Principles (EP): Is the mine financed to a major extend by a bank adherent to the EP?	No No

*by companies own account.

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A Glossary

Table 1 Legend

Environmental hazard potential

low

medium

high

Data quality

low

- 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.

medium

- Assessable on the basis of available information.
- Generalized classification according to measurement instructions.

high

- 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).

Project Partners:

- ifeu – Institut für Energie-und Umweltforschung Heidelberg gGmbH (Institute for Energy and Environmental Research)
- Öko-Institut e.V. (Institute for Applied Ecology)