

Risk assessment of abandoned mine sites in Namibia

Kaarina Ndalulilwa, Alina Haidula & Rosina Leonard

Geological Survey of Namibia (GSN), Ministry of Mines & Energy (MME), kndalulilwa@mme.gov.na

Rainer Ellmies

The Federal Institute of Geosciences and Natural Resources (BGR), Hanover, Germany

Abstract. Early mining activities in Namibia, and subsequent beneficiation processes have been conducted with little to no regards for the environment, thus leaving the land with un-rehabilitated abandoned mines. The abandoned mine sites pose environmental problems such as collapse of structures, contamination of groundwater and soil and subsequently effects to livestock and human health.

An inventory with 157 abandoned mines has been compiled through the BGR-GSN project of technical cooperation. Of the 157 mines, detailed environmental monitoring has only been carried out at few of these abandoned mines by soil, stream sediment, water sampling and partly radiation.

In 2010, a "Risk Assessment Manual" developed for the Chilean government was adapted and customized into the Namibian situation, taking into account specifics of the minerals mined in the past in Namibia, beneficiation processes, as well as the environmental and the legal situation. The manual prioritizes the risk potentials. Accordingly, the Namibian government can start with mitigation of the most severe hazardous risks.

The manual includes guidelines for assessing safety and contamination risks, with further detail of classifying the risk according to the geological and physical situation on the ground.

Keywords. abandoned mine sites, risk assessment, Namibia,

1 Introduction

Mining in Namibia dates as far back as more than 400 years ago, as evidenced from archeological work of copper smelting at the Matchless mine, located about 40 km west of Windhoek. Even long before mining technology was introduced, Namibians have been smelting copper in anthills, with aid of charcoal, in the Otavi Mountainland (Schneider, 1998). Following the publication titled "Travels in Tropical Africa", in 1852 by Sir Francis Galton, in which he mentions encounters with various Bushmen and Owambo who were transporting copper ore in the Otavi Mountainland; a port was soon after established at Walvis Bay and exploration and mining activities commenced in Namibia (Cairncross, 1997). Since then widespread deposits have been mined all over Namibia. These were mainly for base metals, precious metals, precious stones (mainly diamonds) and industrial minerals (mainly salt).

Early exploration and mining activities were conducted with little regard for the environment. Once an economic deposit was discovered, ore extraction was mainly aimed at mining out as much of the ore as technologically possible at as many sites as possible without any remedial measures undertaken. Extraction methods used then, were not always efficient in the

recovery of commodities and therefore large quantities of ore were at times discarded in tailings or with slag creating further sources of contamination. This is a problem that has been left for the shoulders of the current generation of Namibians and its government. Rehabilitation is an expensive task, and makes rehabilitation only possible in extremely limited numbers. Therefore, a prioritization of risks is a prerequisite for decision makers to eventually go ahead with site-specific rehabilitation.

The legacy of this long mining history is an inventory of 157 abandoned mine sites countrywide, on which no remedial measures have been undertaken (Fig. 1). This is a problem that now lies on the shoulders of the Namibian government. The current costs of mine site rehabilitation, coupled with inadequate funds and limited knowledge, makes rehabilitation in many cases impossible.

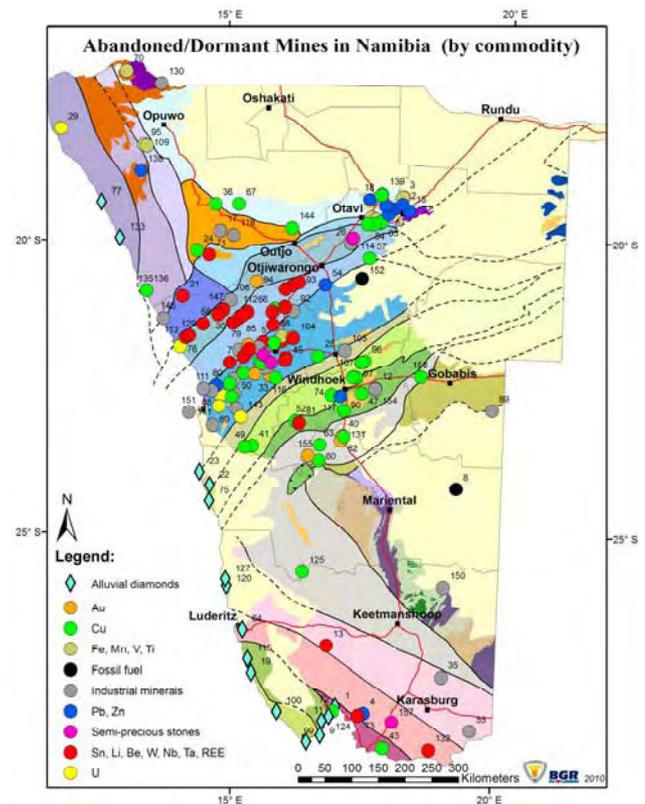


Figure 1. Location of known Abandoned Mines Sites in Namibia.

2 Environmental Monitoring of Abandoned Mine Sites

The government of Namibia has become aware of the dangers posed by uncontained mining related activities, and has put in place facilities to deal with both past and active mining environments in Namibia. For instance the Mining Directorate in the Ministry of Mine Energy has the task to oversee that mineral resources are exploited in a safe, responsible and sustainable manner. To achieve this task the directorate undertakes to proactively develop and implement environmental policies to minimise the impact of the exploitation of Namibia's mineral resources, and to promote, monitor and ensure safe and healthy conditions for mining industry employees and the public.

3 Risk Assessment Manual of Abandoned Mine Sites in Namibia

Risk assessment of abandoned mines must be undertaken in a systematic way, such that the data may always be used as a baseline for further monitoring. To this effect a "Risk Assessment Manual" developed for the Chilean government was adapted and customized into the Namibian situation, taking into account specifics of the minerals mined in the past in Namibia, beneficiation processes, as well as the environmental and the legal situation. The risk assessment manual was produced by highly recognized specialists in the various fields of environmental aspects and supported by the BGR-GSN Technical Cooperation Project.

The manual prioritizes the risk potentials and accordingly triggers mitigation of the most severe hazardous risks. It includes guidelines for assessing safety and contamination risks, with further detail of classifying the risk according to the geological and physical situation on the ground. Evaluating the risk of abandoned mine site starts by carrying out a desktop study, which is followed by a simplified risk assessment for safety and contamination at the site, and if necessary, a detailed risk assessment. This will lead to classification and prioritization of abandoned mine site according to the identified risks.

The manual also includes sample forms in which different components of the mine (generally all works, installations, support services and infrastructure necessary for mining operations) are listed so that appropriate evaluation is always carried out in a systematic way according to guidelines, which further make it easier to incorporate the collected data into a database. The manual classifies risks of contamination and risk to safety from past mining sites that are evaluated in terms of sources, exposure pathways and receptors (eg. humans and the environment).

A simplified practical training exercise on the manual has been carried out at three mine sites in Namibia with subsequent re-customization.

4 Conclusion

Of the 157 abandoned mine sites in Namibia in the inventory, only a handful has been monitored to determine their contamination and safety risks. These monitoring activities have been carried out in a detailed risk assessment. The Ministry of Mines and Energy continues to monitor the abandoned mines of Namibia in a systematic way according to guidelines in the Risk Assessment Manual. As the government is not able to rehabilitate all mine sites cheaper alternatives for rehabilitation are sought.

The "Risk Assessment Manual for Abandoned Mine Sites" represents a scientific and practical basis for the evaluation of risks at abandoned mine sites. The manual which has been customized for the Namibian context can be further developed and customized with little to moderate effort for any other country.

Acknowledgements

Bryony Walmsley of the Southern African Institute of Environmental Assessment (SAIEA), Dr. Willie van Niekerk of Infotox (Pty) Ltd, and Peter Terbrugge of SRK Consulting, are thanked for the excellent work done during the customization of the "Risk Assessment Manual of Abandoned Mine Sites in Namibia".

References

- BGR/GSN/SERNAGEOMIN, 2010, The Risk Assessment Manual of Abandoned Mine Sites in Namibia, Ministry of Mines and Energy, Namibia.
- Cairncross, B., 1997, The Otavi Mountain Land Cu-Pb-Zn-V deposits: Namibia, Mineralogical Record, Volume 28, pg 109-130.
- Schneider, GIC, 1998, The History of Mining in Namibia, Namibia Brief, No. 21, pg 19-31.