

The strategic environmental management plan for the central Namib uranium province

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Abstract. The Ministry of Mines and Energy in Namibia and its cooperation partner BGR have taken the lead to conduct the worldwide first Strategic Environmental Assessment (SEA) for a mining area.

Uranium exploration has become increasingly active leading to a “uranium rush” in the central Namib desert. Besides the general positive regional and national economic impacts, there are a number of potentially conflicting social, environmental and economic aspects. The main practical issues of the SEA include water and power supply, physical and social infrastructure, health and safety, competing land uses, biodiversity and mine closure.

The SEA investigated four uranium mining scenarios with a minimum of 2 and a maximum of 12 uranium mines operational by 2020. It provides a big picture overview and sound advice on how to avoid antagonistic and negative cumulative impacts as well as how to enhance synergies or positive impacts.

To complement this process, a Strategic Environmental Management Plan (SEMP) provides an overall monitoring and management frame and practical tools for achieving best practice. The SEMP proposes ways that the operators in the industry can collaborate to achieve a common approach towards long term management and monitoring, e.g. aquifer and air quality monitoring, tailings maintenance, etc.

Keywords: uranium, environment, SEA, SEMP, Namibia

1 Economic geology of the central Namib uranium province

Due to the rising global demand for primary supplies of uranium, exploration and mining have become increasingly active in Namibia leading to a “uranium rush”. In total, the Ministry of Mines and Energy lists 78 exclusive prospecting licenses (EPLs) of which 66 have been granted and 12 are pending. Two uranium mines are currently in operation, Rio Tinto’s Rössing Mine and Paladin Resources’ Langer Heinrich Mine (Fig. 1). AREVA and Forsys Metals have been awarded mining licenses for Trekkopje and Valencia, respectively. Bannerman Resources at Etango and Extract Resources at Husab/Rössing South have commenced with environmental impact assessments and feasibility studies. Other companies have active exploration programs on the go.

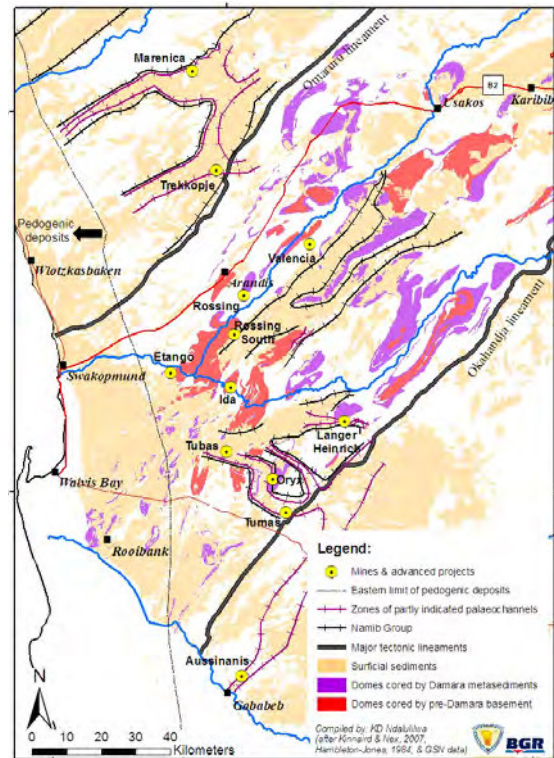


Figure 1. Uranium deposits in the central Namib uranium province and potentially uranium bearing structures.

Namibian uranium deposits are mainly confined to the high-temperature low-pressure Central Zone of the Neoproterozoic to early Paleozoic Pan-African mobile belt of the Damara Orogen, the Damara Belt. In the Central Zone of the Damara Belt, more than 300 granitic intrusions and northeast-trending dome and basin structures are known (Kinnaird and Nex, 2007). The metamorphic grade in the Central Zone increases from east to west, reaching high-grade conditions with local partial melting (Hartman et al., 1983; Jung et al., 2007). The Southern Central Zone is characterised by lithofacies differences, the presence of basement inliers and the occurrence of uraniumiferous granites (Miller, 1983).

Rocks of the Central Zone of the Damara Belt represent a sequence of events, starting with rifting around 850 Ma; followed by deposition of deep marine sediments; and collision of the Kalahari and the Congo Cratons marked by poly-deformation and intrusion of plutonic rocks (Miller, 2008). The Damaran intrusive rocks consist of syn- to post-tectonic granites varying in size from veins to huge plutons; emplacement of these

granites happened over a period of 150 Ma, between 650 and 500 Ma (Tack & Bowden, 1999). These granites include red, medium- to fine-grained granites; coarsely porphyritic biotite monzogranites and associated dioritic rock types together called the Salem Granitic Suite; and late, fine- to coarse-grained uranium-rich pegmatitic leucogranites (Fig. 2; Smith, 1965).



Figure 2. Uranium-bearing sheeted leuco-granites intruding Khan Formation metasediments.

Uranium occurrences found in, and those coupled with, plutonic rocks offer potential for economic deposits as well as source rocks for uranium in pedogenic and sedimentary sequences (Roesner and Schreuder, 1992). The two main types of uranium deposits found in the Southern Central Zone of the Damara Belt are the sheeted leucogranite/alaskite-hosted primary uranium deposits, and the surficial calcrete-hosted secondary uranium deposits. The known primary uranium deposits include Rössing, Husab/Rössing South, Valencia, Ida-Dome, Goanikontes, and Hildenhof, whereas calcrete-hosted secondary uranium deposits include amongst others the Langer Heinrich, Trekkopje, Aussinanis and Tubas deposits. The Rössing Uranium Mine, operated by a subsidiary of Rio Tinto PLC, is one of the largest uranium mines in the world, mining a high-tonnage, but low-grade primary ore. The deposit has been mined since 1976, and produces approximately 4000 t of uranium oxide annually (Chamber of Mines, 2008).

2 The Strategic Environmental Assessment (SEA)

2.1 Background of the Uranium SEA

A Strategic Environmental Assessment (SEA) determines the negative and positive cumulative effects of impacts on the environment, the social and economic development, and investigates and recommends ways to avoid or minimise negative or enhance positive impacts. A SEA is a tool to understand likely scenarios.

The SEA “Central Namib Uranium Rush” has been commissioned by the Ministry of Mines and Energy to investigate the impact of the uranium exploration and mining in the Erongo Region. The idea was conceived

by the Ministry in collaboration with the Chamber of Mines, and the German-Namibian Technical Cooperation Project of the Geological Surveys of Germany (BGR) and Namibia (GSN).

A Steering Committee consisting of 30 members from government, NGOs, mining industry and civil society representatives guided the SEA process and the SEA working team by integrating and streamlining the SEA with existing policies, the selection of an external reviewer, ensuring public participation and examining progress of the SEA. The SEA report was completed by the end of 2010.

2.2 The SEA “Uranium Rush” scenarios

As no one can predict the future of commodity prices as well as supply and demand, the SEA had to investigate likely development scenarios:

Scenario 1 “Below expectations”: Up to four uranium mines will be operational by 2020: (i) Rössing, (ii) Langer Heinrich, (iii) Trekkopje (AREVA) and (iv) Valencia;

Scenario 2 “Within expectations”: Four to six uranium mines will be operational by 2020; in addition to scenario (1) (v) Rössing South Husab Mine/Extract Resources and (vi) Etango Mine/ Bannerman;

Scenario 3 “Above expectation”: Up to 12 uranium mines will be operational in the region by 2020;

Scenario 4 “Boom and Bust”: All the mines close suddenly and in an unplanned way.

Key statistics for Scenario 2

- **U₃O₈ production 47 Mlbs/a (2015)**
- **Export value of uranium by 2015 = N\$23bn**
- **Revenue (2020) = N\$2.4bn**
- **Employment peaks at 8,500 additional jobs**
This requires:
 - plus 10,000 serviced plots in nearby towns
 - schools for additional 20,000 learners by 2015
- **Water demand of the mines 35 Mm³/a**
- **Power demand of the mines 300 MW**
- **Increase in traffic 47-72%**

Figure 3. Key statistics for the “expected” uranium rush scenario (10N\$=1 Euro).

2.3 The main “issues” of the Uranium SEA

Besides the generally positive regional and national economic impact, there are a number of potentially conflicting social, environmental and economic aspects which need to be considered. Those impacts can result in strains and conflicts or opportunities and synergisms.

The main issues of the Strategic Environmental Assessment for the Central Namib Uranium Rush include:

1. **Water:** The operation of the 7 uranium mines (in the expected scenario) in the arid Central Namib will require approximately 35-50 million cubic meter of fresh water annually. This amount can't be extracted from the regional groundwater resources. Fresh water has to be produced by sea water desalination which is an energy intensive process. In addition, the scarce groundwater resources of the Swakop, Khan, Omaruru and Kuiseb Rivers have to be protected for any contamination from those mining operations. Therefore, the SEA established a groundwater data base for the region as well as a water balance and groundwater model (Kuells et al., 2011).
2. **Power:** The uranium mines will require an additional 150 to 300 megawatts of installed capacity which is currently not available.
3. **Infrastructure:** Pipelines, electricity lines, roads and railways have to be constructed in an optimized balance between logistics, efficiency and minimised impact to the environment. Development corridors were defined.
4. **Social infrastructure:** Under the expected scenario, an additional influx of approximately 50,000 people will double the number of residents in the towns of Swakopmund and Walvis Bay within a very short time. The SEA advises on regional and local town planning including housing, health facilities, recreation facilities, schools etc.
5. **Health and safety:** Residents in the coastal area are highly concerned about increasing radiation and its negative health effects. The SEA conducted a specialist study on air quality and radiation as baseline information and developed a regional air quality monitoring program.
6. **Land use and regional economy:** Mining, tourism and agriculture are Namibia's economic pillars which are in most cases antagonistically related.
7. **Environment:** The landscape integrity and endemic species are part of Namibia's unique natural assets. Therefore, millions of tourists visit the Namib Naukluft National Park every year and significantly contribute to the country's economy. Environmental Impact Assessments (EIA) of the mines focus on the actual mining area. However, the cumulative impacts on the environment extend these boundaries.
8. **Mine closure:** Mineral resources are finite resources. Therefore, mine closure and rehabilitation have to be an integral part of any feasibility study for mining operations. Although we are talking about a "rush-like" opening phase of many new mines, it is essential to develop a post-mining land use plan by now.

3 The implementation process

The Strategic Environmental Management Plan (SEMP) for the central Namib uranium province is currently being rolled out as a direct outcome of the Strategic Environmental Assessment for the Uranium Rush (SEA).

The SEMP mainstreams the sustainability principle throughout the life cycle of uranium mining related projects. It addresses the cumulative impacts of developments according to the "major issues" identified in the SEA.

The SEMP consists of 12 Environmental Quality Objectives (EQO) (Fig. 4) with 43 targets and 118 indicators. It sets targets and limits of environmental quality and acts as a score card for annual monitoring reports. Monitoring and reporting will be managed by a young and dynamic group of scientists at the Geological Survey of Namibia, the so called SEMP Office.

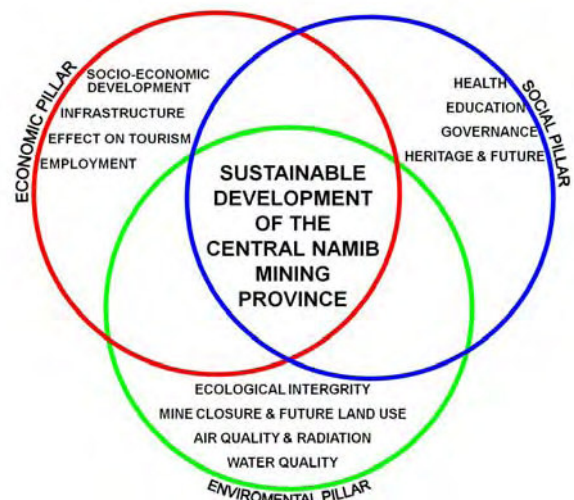


Figure 4. The 12 Environmental Quality Objectives mainstreaming the sustainable development of the central Namib mining province.

In concert with a larger skills shortage, Namibia is experiencing a critical lack of capacity in the broad environmental and biodiversity management fields, which needs to be filled through dedicated training programmes.

The Namib Ecological Restoration and Monitoring Unit (NERMU), a functional unit to be housed within the Gobabeb Training and Research Centre will be tasked with specific monitoring, research and training activities in the SEMP.

The SEA has identified a broad field of necessary additional studies and monitoring which have to be conducted within the SEMP process:

- Monitoring of radiation levels in the wider uranium province as well as at possible receptor sites, especially the major settlements (Fig. 5),

- Close monitoring of groundwater quality based on baseline data, a geohydrological model and geochemical “fingerprints” of possible effluents from the mining operations (Fig. 5),
- Developing a better understanding of the biodiversity in the Namib;
- Adopting a landscape approach to development and management of the area;
- Planning for and implementing restoration of ecosystems impacted by exploration and mining.

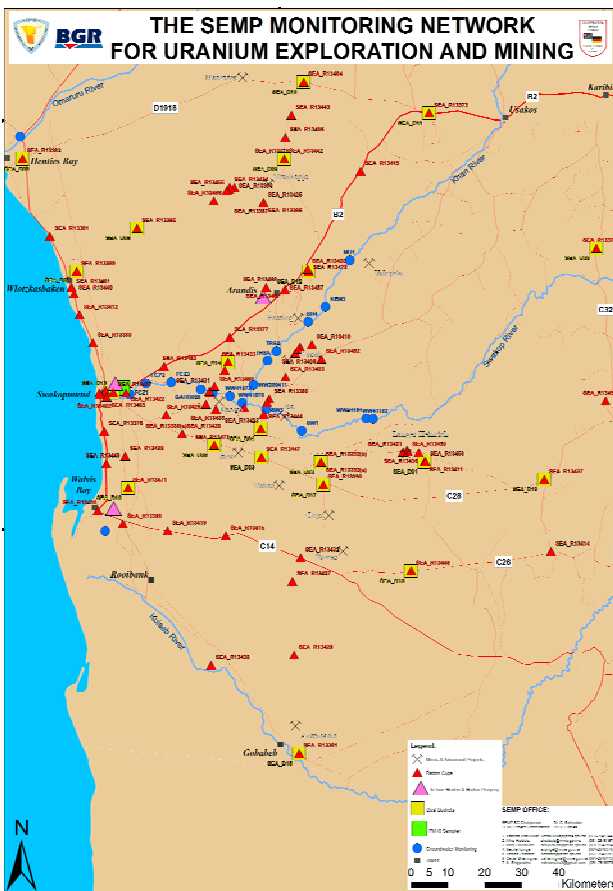


Figure 5. The SEMP network for air and water quality monitoring in the central Namib desert

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