Cumulative Groundwater Impact of Mining in the Kalahari Manganese Field and the Need for a Strategic Environmental Assessment Approach

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Extended Abstract

During the last few years the mining sector in the Kalahari Manganese Field in the Northern Cape Province of South Africa has increased significantly. Groundwater in the semi-arid Kalahari is a scarce commodity. Therefore water supply for mines, impacts due to mine dewatering and river diversion plans have increased pressure on limited water resources. Groundwater quality and quantity impacts of existing and developing mining projects are investigated individually. This paper presents predictions and results from individual hydrogeological investigations and elaborates how a strategic regional environmental assessment approach can summarise the cumulative impacts to fundamentally understand the regional footprint of mining in the area.

The Kalahari Manganese Field (KMF) is estimated to contain approximately 1,000 Mt of potentially exploitable manganese resources, while its geological simplicity makes the KMF one of the most important manganese resources in the world. The manganese deposits represent structurally preserved erosional relics of the Paleoproterozoic Hotazel Formation of the Voelwater Subgroup (Transvaal Supergroup). It consists of a Superior type iron-formation interbedded with manganese ore in three sedimentary cycles of which the lowermost unit is the most economically viable. Several abandoned mines and a number of active mining operations are located in an area of approximately 550 km^2. Besides, a number of emerging manganese prospects are in the process of obtaining mining licenses.

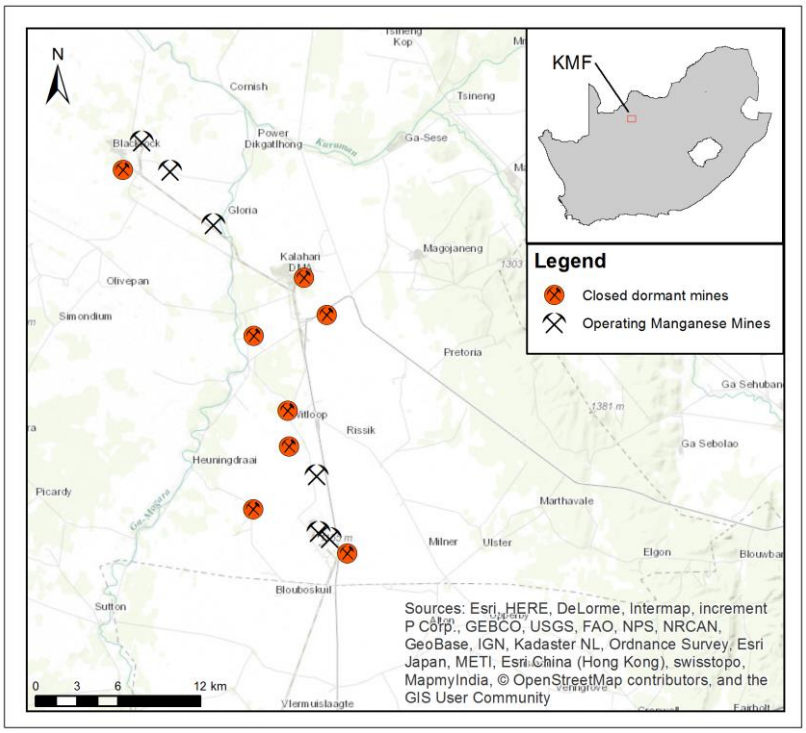

***Figure 1**: Overview of Mining Activities in the Kalahari Manganese Field (KMF)*

Hydrogeological investigations including numerical groundwater models have been implemented to predict the impacts of the proposed individual mining sites on groundwater quantity and quality in the closer proximity of the development. The groundwater models were developed to predict mine dewatering, contamination plumes, river diversions but also mine water supply. All of them are focused on the closer mining area or relevant concession areas only. Neither regional flow patterns in porous media and fractured aquifers nor cumulative groundwater impacts have been investigated so far. Hydrochemical and water level monitoring results as well as results from groundwater flow models have been taken as basis for risk assessments. Taking these results into consideration it has becomes clear that a broader look at cumulative impacts from numerous smaller mine concessions is needed.

Two different aquifer systems dominate the hydrogeology of the KMF. First the unconsolidated Kalahari sediments as primary, porous aquifer and the secondly the underlying fractured bedrock (secondary aquifer). Ephemeral rivers, mainly the Gamogara River and its tributaries, contribute to the groundwater resources and act as important indirect groundwater recharge sources. However, mine dewatering or more important the artificial diversion of smaller river sections might have significant impacts on the aquifer systems or downstream water users and mine sites. Additional impacts may result from different operational life of mines. With the existing monitoring tools and model predictions at small scales, a reasonable and reliable assessment is impossible.

Environmental Impact Assessments and model predictions will become more significant and reliable when cumulative effects on a regional scale are considered. In order to achieve the above goals the following objectives are proposed:

- Development of a decision support system,
- Collaboration between mining industries, government agencies, experts and specialists to improve data sharing and knowledge etc.,
- Development of a strategic environmental (and socio-economic) management plan to guide mining and third party interests and ensure long-term monitoring,
- Implementation of a regional ground- and surface water monitoring network.

Like other water management plans for mining areas in Namibia and Canada have shown (see [1] and [2]), monitoring networks and regional numerical modelling can be reliable tools for both estimating cumulative impacts and mitigating requirements for mining concessions, avoiding duplication of work and conflict of interests

Key words: Mine Water, Numerical Modeling, Strategic Assessment, Kalahari Manganese Field

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