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Deep Groundwater Systems in Southern Africa
- from occasional findings towards an exploration strategy -

Himmelsbach, T.[1], Bäumle, R.[1], Meyer, U.1, Noell, U.[1], Lohe, Ch., Wallner, M.[1] and Lindenmaier, F.[1]

[1]Federal Institute for Geosciences and Natural Resources, BGR Hannover, GERMANY

The Federal Institute for Geosciences and Natural Resources (Bundesanstalt für Geowissenschaften und Rohstoffe - BGR) actively promotes and develops new technologies and methods for hydrogeological exploration for deep lying fossil and semi-fossil aquifers within a number of technical cooperation and scientific research projects. One of the major aims of BGR is to combine different technologies and methods in an innovative way by combining the technical infrastructures, methodologies and expertise inside BGR with the scientific expertise of hydrogeologists in Southern Africa.

BGR and partners found a deep lying fresh water aquifer in the Cuvelai Basin of Northern Namibia which is completely separated by a confining hydraulic layer from overlying salty groundwater horizons. First geophysical soundings in the late 1990s and later exploration drillings showed that the lateral extent of this newly found aquifer is extremely large, indicating that a sedimentary structure such as a palaeo-delta might serve as a huge groundwater reservoir. In the meanwhile a complete core comprising nearly the entire the Kalahari succession has been drilled and evaluated with regard to sedimentary structures and genetic aspects (Miller, et al. 2016). A separate but comparable and presumably tectonically controlled deep Kalahari aquifer system has been identified in the Eastern Zambezi Region, northeastern Namibia (Margane et al. 2005).

The newly obtained results lead to the conclusion that exploration for new aquifers should be aligned to a strategy which is comparable to that being used in hydrocarbon exploration. Hence, first of all the question has to be answered, whether there exists an appropriate reservoir structure to store large volumes of groundwater. A next logical step must therefore include the search for bounding tectonic features, e.g. horst and graben structures, and/or sedimentary

structures which may act as confining layers. Last but not least, the hypothesis of a plausible recharge area has to be proved which either contributed to the fossil groundwater reservoir in the past or still replenishes it today, slowly but continuously, creating a semi-fossil groundwater body. Although this approach seems to be plausible and logical it requires however the combination of various interdisciplinary investigations such as remote sensing, tectonics and structural geology, aero-geophysical and ground based geophysical soundings, hydrogeological and palaeo-hydrological investigations and intense isotope and hydro-geochemical investigations.

This approach has been tested to new promising aquifer structures especially in the Eastern Zambezi Region of Namibia where groundwater exploration ended up relatively often by detection of deep fresh water resources in the vicinity of more or less salt water bearing formations. First results are promising and are giving hope that new large aquifers might be found along a very old tectonic axis which is linked to neo-tectonic and very likely still active horst and graben structures which form part of an abandoned rift system.

References:

[1] Margane et al. (2005), unpublished internal Report BGR, 148pp.
[2] Miller et al. (2016): 303-322
[3] Smith R and Jones P (2010) Econ Geol 105:443-798
[4] Smith R et al. (2012) In: *The Art of Writing an Abstract*: XYZ Publishers, 12-24