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A hydrochemical and isotopic analysis of spatial and temporal variations of the perched aquifers; an example from the Cuvelai-Etosha Basin, Namibia

Josefina Hamutoko (1), Heike Wanke (1), Matthias Beyer (2), Paul Koeniger (2), Marcel Gaj (2,3)

(1) University of Namibia, Geology, Windhoek, Namibia (jhamutoko@gmail.com), (2) Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany , (3) Global Institute for Water Security, School of Environment and Sustainability, University of Saskatchewan, Saskatoon, Canada

The rural communities in the Cuvelai-Etosha Basin (CEB) located in northern Namibia depend on groundwater as the main source of drinking water as well as for watering of livestock. The groundwater is hosted within a multi-layered aquifer system of which the shallowest are perched. Due to a shallow depth to the water table of the perched aquifers, they are highly vulnerable to both climatic and human-induced changes. As part of the Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL) project, the aim of the present study is to investigate the quality and the origin of the groundwater and associated recharge processes of perched aquifers to improve the groundwater management. Hydrochemical and water stable isotopes (18O and 2H) data were collected during 6 field campaigns over a period of three years (2014 to 2016). The samples were collected from two core sites within the basin (Ohangwena and Omusati regions). According to the World Health Organisation (WHO) recommendations and Namibian guideline values, the water quality in most wells is not acceptable for drinking and domestic purposes, mainly because of high turbidity, total dissolved solids, fluoride and nitrate values. Both the hydrochemical and isotopic signatures of water samples indicate spatial differences between the Omusati and Ohangwena region. In the Ohangwena region bicarbonate is the dominant anion whereas in the Omusati region the groundwater is dominated by sulphate. The cation dominance changes from calcium and magnesium (Ca-Mg) to sodium and potassium (Na-K). Samples from Omusati region cover a wide range of isotopic signatures from highly depleted to highly enriched δ-values. In contrast, water samples of the Ohangwena region split into two distinct groups. One group represents samples from deep wells that are depleted in 18O and 2H. The second group consists of samples from shallow wells which are enriched in 18O and 2H. Temporal variations in the Omusati are shown by changes in total dissolved solids and isotopic composition while in the Ohangwena region both isotopic and hydrochemical composition does not show strong seasonality. The isotopic signatures imply that perched aquifers in both regions were recharged under recent climatic conditions. Though these perched aquifers are both in one basin, they are chemically and isotopically different as a result of rock-water interactions and thus groundwater management practices should be designed to take into account these differences.