European Geosciences Union
General Assembly 2014

EGU-2014-12327
Vienna / Austria

Stable isotope and hydro chemical variability along the Calueque-Oshakati Canal in the Cuvelai-Etosha Basin, Namibia

Paul Koeniger[1], Matthias Beyer[1], Marcel Gaj[1], Josefina Hamutoko[2], Shoopala Uugulu[2], Heike Wanke[2], Markus Huber[3], Christoph Lohe[1], Martin Quinger[1], Thomas Himmelsbach[1]

Introduction

Since 1973 Kunene River water (currently between 47 and 63 Million m^3 per year [1]) is carried from the Calueque Dam in Angola along a 150 km concrete canal to Oshakati in the Cuvelai-Etosha Basin which supplies the most densely populated area of Namibia with drinking water. Backup storage is held in the Olushandja Dam and in water towers at Ogongo, Oshakati and Ondangwa and about 4,000 km of pipelines radiate out from purification schemes and supply most of the people and the livestock [2, 3]. The canal is open along most of its course to Oshakati, allowing livestock and people living nearby to make free use of the water. During the rainy season, flood water from the vast Oshana drainage system swashes into the canal bearing a potential health risk when consumed untreated.

Objective

Within the SASSCAL project (Southern African Science Service Centre for Climate Change and Adaptive Land Management - www.sasscal.org) water samples were collected during a field campaign from 18th to 20th November 2013 right before the onset of the rainy season 2013/14, to gain information on water evolution, evaporation and mixing influences as well as to characterize input concentrations for indirect recharge in this area.

Study site and methods

Water samples were collected at 17 sites along the canal (about every 10 km) and the Kunene River for stable water isotopes (deuterium and oxygen-18) and hydro chemical analyzes. Coordinates and altitude, temperature, conductivity, pH-value, and oxygen content were measured in the field. Hydro chemical and stable isotope analyzes were conducted later on in the laboratory. Stable isotopes were analyzed using a Thermo Finnigan Delta XP IRMS connected to a GasBench and H/Device with accuracies of 0.2 ‰ and 0.8 ‰ for $\delta^{18}O$ and $\delta^{2}H$, respectively. Further campaigns within and after the rainy season are planned.

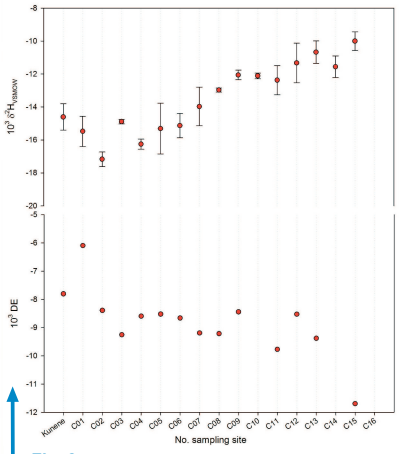

Fig. 2: Stable isotopes results: upper part, deuterium values and lower part, deuterium excess values of 17 sites along the Calueque-Oshakati Canal, indicates successive evaporative influence.

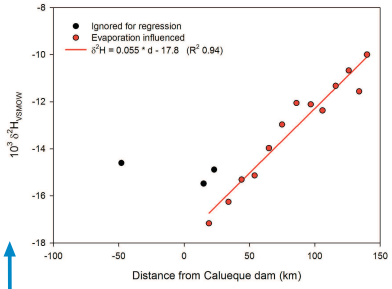

Fig. 3: Deuterium values of 17 sites along the Calueque-Oshakati Canal in relation to travel distance indicate a trend of evaporative enrichment with distance from the Calueque dam in Angola with a factor of about 6 ‰ per 100 km.

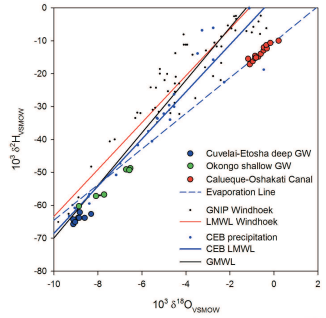

Fig. 4: $\delta^{18}O$ vs. $\delta^{2}H$ plot of water samples collected from the Calueque-Oshakati Canal (red dots), from deep groundwater (Ohangwena-II) of the Cuvelei-Etosha basin (blue dots), and from shallow groundwater in the Okongo region, for comparison. Stable isotopes from local precipitation are available from Windhoek (GNIP) about 600 km in the South and from Cuvelai-Etosha basin (CEB LMWL).

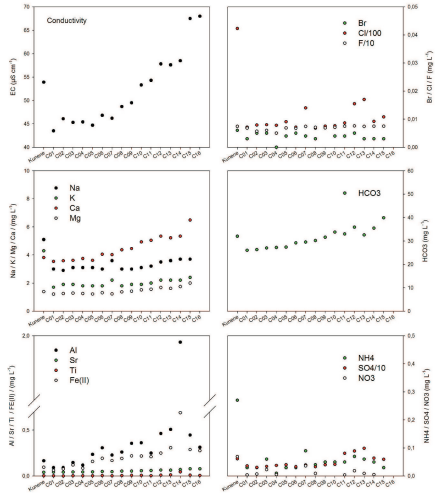

Fig. 5: Selected field- and hydro chemical parameters of the samples collected from the Kunene River and the Calueque-Oshakati Canal.

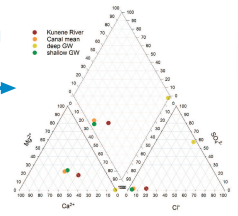

Fig. 6: Piper plot of Kunene River sample, mean of the Calueque-Oshakati Canal samples, CEB deep groundwater (WW 201636 and WW 201637) and Okongo shallow groundwater samples.

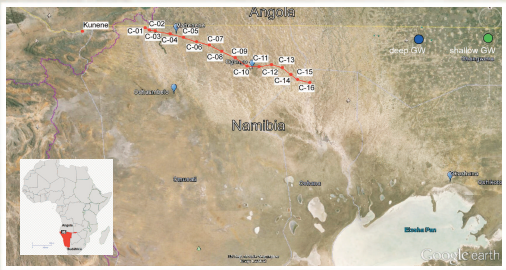

Fig. 1: Location of the Calueque-Oshakati Canal from the Angolan border to the city of Oshakati in Northern Namibia. Red dots and labels indicate the location of the sampling sites, where field parameters were measured and water samples for isotope and hydro-chemical parameters were collected. Deep groundwater was collected from six wells in November 2012. Shallow groundwater was collected in the Okongo region during March 2012.

Results and Discussion

- Clear evaporative enrichment of surface water collected along the Calueque-Oshakati Canal
- Small fluctuations indicate enhanced evaporation (Kunene river, Olushandja dam C03, C11 and C15) or influence of mixing with surface- or groundwater with a different isotope signature (C01, C09, C12)
- Precipitation data from Windhoek (LMWL) and from Cuvelai-Etosha basin (CEB LMWL, collected over 2-years) provide a first approximation of isotope input
- Pronounced differences in shallow / deep groundwater
- Hydro chemical pattern for the canal samples indicate a general Ca-HCO_3-type of water

References

[1] Directorate of Rural Water Supply (2004): Directorate of Rural Water Supply 1993-2003. Ministry of Agriculture, Water and Rural Development, Windhoek, Namibia, 64 pp.

[2] Mendelson J., Jarvis A., Robertson T. (2013): A profile and Atlas of the Cuvelai-Etosha basin. Ministry of Agriculture, Water and Rural Development, Windhoek, Namibia, 170 pp.

[3] Christelis G., Struckmeier W. (Eds) (2001): Groundwater in Namibia - an explanation to the Hydrogeological Map. Department of Water Affairs, Ministry of Agriculture, Water and Rural Development, Windhoek, Namibia, 128 pp.

Dr. Paul Koeniger
paul.koeniger@bgr.de
Tel 0-49-511-643-3072
Fax 0-49-511-643-2304

[1]Federal Institute for Geosciences and Natural Resources

[2]University of Namibia (UNAM), Windhoek
[3]Geo-Tools-Consult, Munich, Germany