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# Isotopic composition and elemental concentration of water bodies in the Kuiseb and Cuvelai-Etosha Basin, Namibia

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Water scarcity is one of the key limiting factors to sustainable economic, industrial, social, and environmental development. With variable climate, Namibia is becoming more dependent on groundwater especially during droughts.
Water trajectories and chemical equivalence are reliant on environmental tracers such as isotope ratios, mineralogy and trace elements. The environmental tracers could especially be beneficial in the study of groundwater systems in arid/semi arid environments, where mixing and pumping from such sources is of importance, and could help with the understanding of water flows and geochemical dynamics of such systems.
In this study, water samples were analyzed for stable isotope ratios with the Cavity Ring-Down Spectrometry using the Picarro L2120 – i analyser, and trace elements using Inductively Coupled Plasma Mass Spectroscopy (ICP-MS model NexION 300D/350D), based on EPA Method 200.8. Isotope ratios were then compared to the global meteoric water line (GMWL) and available secondary data, also taking into consideration the variations over time.
A descriptive analytical study aimed at generating baseline data in an attempt to address the high evaporation and low recharge in Namibia was conducted in the Kuiseb Basin, which is a predominantly dry area, and the Cuvelai-Etosha Basin, which is prone to alternating floods and droughts.
Open water bodies of the Cuvelai-Etosha Basin were enriched in heavy isotopes and plotted below the GMWL towards the evaporation trend, reflecting the high evaporation of the basin. The boreholes in the Kuiseb Basin were depleted of heavy isotopes and plotted along the Meteoric Water Lines, indicating direct recharge from rainfall and minimal, if any evaporation effects. Comparison of the available isotope data from different studies showed an increase in heavy isotope ratios of open water bodies, groundwater and precipitation.
The presence of dissolved salts (salinity) decreases the chemical potential and spontaneous transformation of liquid into vapour state, thus, reducing the evaporation rate, which is significantly linked to variations in isotopic composition. The study also detected high salinity (63 0/00) concentrations (linked to high Total Dissolved Solids of 25.46g/L) in the Cuvelai waters compared to the 37 0/00 salinity (with low TDS of 3.8g/L) in the Kuiseb. The high salinity is linked to the geological and meteorological make-up of the Cuvelai i.e. Kalahari sedimentary rocks, runoff sediments, high temperature and evaporation rates, as well as alternating floods and drought (rainfall variations). The elements observed include Ba, K, Sb, As, Cd, Cr, Cu, Mo, Ni, V, Zn and Bi in the Kuiseb, and Ca, Cl, Mg, Na, Al, Be, Br, Ce, Cs, Fe, Pb, Mn, Se, Ti in the Cuvelai-Etosha Basin. The Cuvelai-Etosha Basin was also found to host more anthropogenic activities (including burning of vegetation) influencing the elemental composition, and causing deterioration of the water quality.

Keywords: Isotope Ratios, Trace metals, ICP-MS, Cuvelai-Etosha Basin, Kuiseb Basin