

Hydrochemistry and Stable Isotopes ($\delta^{18}\text{O}$ and $\delta^2\text{H}$) Tools Applied to the Study of Karst Aquifers in Wonderfonteinspruit Valley: North West, South Africa

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Abstract : In South Africa, Karst aquifers are receiving greater attention since they provide large supplies of water which is used for domestic and agricultural purposes as well as for industry. Accordingly, a better insight into the origin of water mineralization and the geochemical processes controlling the recharge of the aquifer is crucial. Analyses of geochemical and environmental isotopes could lead to relevant information regarding karstification and infiltration processes, groundwater chemistry and isotopy. A study was conducted in a typical karst landscape of Wonderfonteinspruit catchment, also known as Wonderfonteinspruit Valley in North-western -South Africa. Furthermore, fifty-two samples were collected from (35 boreholes, 5 surface waters, 4 Dams, 4 springs, 1 canal, 2 pipelines, 1 cave) within the study area for hydrochemistry and ^2H and ^{18}O analysis. The determination of the anions (Cl^- , SO_4^{2-} , NO_2^- , NO_3^-) were performed using Metrohm ion chromatography, model: 761 compact IC, with a precision of ± 0.001 mg/l. While, the cations (Na^+ , Mg^{2+} , K^+ , Ca^{2+}) were determined using Metrohm ion chromatography, Model: ICP-MS 7500 series. The alkalinity (Alk) was determined by pH meter with volumetric titration using HCL to pH 4.5; 4.2; and 8.2. In addition, $\delta^{18}\text{O}$ and $\delta^2\text{H}$ relative to the Vienna-Standard Mean Ocean Water (RVSMOW), were determined by picarro L2130-I Isotopic H_2O (Cavity Ringdown laser spectrometer, Picarro Ltd). The hydrochemical analysis of Wonderfonteinspruit groundwater showed a dominance of the cations Ca-Mg and the anion HCO_3^- . Piper diagram shows that the groundwater sample of study area is characterized by four hydrochemical facies: Two main groups: (1) Ca-Mg-Cl- SO_4 ; (2) Ca-Mg- HCO_3^- and two minor groups: (3) Ca-Mg-Cl; (4) Na-K- HCO_3^- . The majority of boreholes of Malmani (Transvaal Supergroup) aquifer are plotted in Ca-Mg- HCO_3^- . Oxygen-18 ($\delta^{18}\text{O}\text{‰SMOW}$) and deuterium ($\delta^2\text{H}\text{‰SMOW}$) isotopic data indicate that the aquifer's recharge is influenced by two phenomena; precipitation rates for most of the samples and river flow (Wonderfonteinspruit, Middelvieinspruit, Renfonteinspruit) for some samples.

Keywords : South Africa, Wonderfonteinspruit Valley, isotopic, hydrochemical, carbonate aquifers

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