

Sample Submitted

Master Science Thesis_Hydrogeology

Gibbs (1970) identified the three major mechanisms controlling 'surface water' chemistry; defined as atmospheric precipitation, rock-water interactions and evaporation-crystallization process. The author identified that the major cations characterizing the end members of the world's surface waters are Ca for freshwater and Na for highly saline water bodies. In the Gibbs Plot (Figure...) the weight ratio of the cations $\text{Na}/(\text{Na}+\text{Ca})$ (Gibbs ratio I) is plotted on the x-axis and TDS on the y-axis. A similar plot for the anions $\text{Cl}/(\text{Cl}+\text{HCO}_3)$ (Gibbs ratio II) are plotted on the axis and TDS on the y-axis. The Gibbs Plot has since been used in groundwater hydrogeochemistry, to determine the processes that control the composition/addition of dissolved salts to groundwater.

Marandi and Shand (2018) assessed the correctness in applying the Gibbs Plot to 'groundwater' studies and remarked that it is not incorrect to do so. In fact, plotting ion ratios and salinity of groundwater can lead to a better understanding of key hydrochemical processes. Furthermore, two thirds of stream flow around the world is groundwater that has been discharged into streams (Alley et al., 1998 as cited in Marandi and Shand, 2018). The authors' further state that the incorrect use of the Gibbs Plot occurs when groundwater studies analyse process based models that have been developed for surface waters and link these to the Gibbs Plot to assess groundwater processes. In doing these kinds of analyses, interpretations of data is slowed down. Additionally, the Gibbs Plot used on its own oversimplifies and leaves out many other important processes that affect the chemistry of groundwater.

Applying the Gibbs Plot to this study, values for groundwater samples in the study area range from 0 to 1.0 meq/l on the Gibbs ratio I plot, with an average of 0.7 meq/l. Gibbs ratio II values for the same samples also ranges from 0 to 1.0 meq/l, with an average of 0.1 meq/l. All the groundwater samples plot in the middle section of the Gibbs Plots, suggestive of rock dominance as the main control of the groundwater chemistry in the area of study.