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Groundwater-surfacewater interactions and inorganic carbon cycling in Eastern United Arab Emirates (UAE)

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Increasing groundwater salinity and aquifer depletion are a major concern in the UAE. Isotopes of oxygen, hydrogen, and carbon, and chloride concentrations in groundwater were used to study surface water-groundwater interactions and inorganic carbon cycling in two main aquifers in the United Arab Emirates. These are the coastal Eastern Gravel Plain aquifer and the inland Ophioliteaquifer.
The δD- $\delta^{18}$of groundwater samples plot on a line given by:

$$\delta D = 4\ \delta^{18}O + 4.4\ (r^2 = 0.4)$$

In comparison, the Local Meteoric Water Line (LMWL) has been defined by the line: $\delta D = 8\ \delta 18O + 15$. In order to better understand the system investigated, samples were separated into two groups based on the δD- $\delta_{18}O$ relationship. These are (1) samples that plot above the LMWL ($\delta D = 6.1\ \delta_{18}O + 12.4$, r_2=0.8) and which are located predominantly in the north of the study area, and (2) samples that plot below the LMWL ($\delta D = 5.6\ \delta_{18}O + 6.2$, r_2=0.8) and which are mostly distributed in the south. Slopes for both the groups are similar and lower than that for LMWL indicating potential evaporation of recharging water. However, the y-intercept differs between the two groups suggesting evaporation of return flow and evapotranspiration in the unsaturated zone to be more significant in the south. This is attributed to intense agriculture activities in the region. Seawater intrusion is absent or minimal based on isotopes and chloride concentrations.
Samples from the Eastern Gravel Plain aquifer have $\delta_{13}C$ and DIC values in the range of –10 to -17‰ and 12 to 100 mg C/l respectively while the range for those from the Ophiolite aquifer is –11 to –16.4‰ and 16 to 114 mg C/l respectively. This suggests the control of C-3 and C-4 plants on DIC formation, an observation supported by the range $\delta_{13}C$ of soil organic matter(–18.5 to –22.1 ‰.).

Keywords: United Arab Emirates, salinity, DIC and carbon isotopes, oxygen and hydrogen isotopes, Eastern Gravel Plain aquifer, Ophiolite aquifer.