

Variations of Major Ionic Composition and Salinity of Tigris River within Iraq

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Abstract

Major ions are widely used to identify the hydrochemical and hydrological characteristic of water to assess water quality. Major ions compositions (Ca^{+2} , Mg^{+2} , Na^{+1} , K^{+1} , Cl^{-1} , SO_4^{-2} , $[\text{HCO}_3]^{-1}$ and $[\text{CO}_3]^{-2}$), pH and salinity (TDS) of water in Tigris river were studied to explore the spatial and temporal variations. Six stations (Fishkapor, Tikrit, Baghdad, Kut, Emarah and Qurna) along river stretch within Iraq were selected to collect samples of water during the period from January 2011 to December 2012 with one month interval. The major ions in Tigris River showed significant spatial variations ($p < 0.05$), while there is no significant temporal variation. Calcium, sodium and magnesium were the most abundant cations with mean concentrations of 52-95 mg/l, 20-217 mg/l and 22-65 mg/l respectively. Sulfate, bicarbonates and chloride were the most abundant major anions, and its average ranged from 111- 432 mg/l, from 151 to 159 mg/l and from 18 to 283 mg/l respectively. Generally, the concentration values of major ions were slightly higher in wet season than those in dry season for the first three stations (Fishkapor, Tikrit and Baghdad), while the values were far higher for the last three stations (Kut, Emarah and Qurna) due to increasing surface runoff, return irrigation water flow and salinity of soil. Major ions distribution along Tigris River as showed by piper and stiff diagram exhibit different pattern of distributions. The water type changed from calcium- bicarbonate at first two stations (Fishkapor-Tikrit) into calcium- sulfate at middle two stations (Baghdad-Kut), after that changed into sodium- sulfate at the last two stations (Emarah-Qurna). Changes in water type of the Tigris river indicating the increasing effects of geologic formations downstream direction as well as human activities increasing. Generally, the salinity (TDS) of Tigris water increases downstream where average (TDS) values of the Tigris water at the Turkish Iraqi border (Fishkapor) is about 300 mg/L and it reaches (as average) more than 1300 mg/L in Basra (Qurna). The variations in salinity exhibit three river sections in terms of salt content (TDS): an upper (northern) section (Fishkapor-Tikrit), where the initial low salt content is maintained or increased slightly downstream; a middle section (Baghdad Kut),

where the dissolved salt variation is more significant; and a lower (southern) section (Emarah-Qurna), where salt content increased to high levels. The nature of these trends changes is related to the geologic formations that the river passes through, increasing in evaporation rate and increasing human activities.