Hydrochemistry

Precipitation and land-use controls on the groundwater chemistry

At a local scale, groundwater chemistry is influenced by natural mineralogical transformations taking place in the soil matrix and also by anthropogenic activities such as land-use changes. On the basin scale, the chemistry changes with climatic inputs such as rainwater. A study is carried out to analyse the hydrogeochemical behavior under the influence of lithologic, precipitation and anthropogenic controls in the upper Cauvery basin, which stretches along three climatic zones – humid, sub-humid and semi-arid. This is followed by the analysis of contributions made by the components of the hydrogeochemical cycle. A geochemical model is developed, which is used to study the spatiotemporal variations in groundwater chemistry in a small experimental watershed. Analysis of the groundwater chemistry in the basin is observed to show a gradient along the climatic gradient with sub-humid zone bridging between the semi-arid and humid zones. Wells in the relatively higher pumping regions, which receive sufficient annual recharge exhibit dilution chemistry though groundwater level fluctuations are higher. However, wells in regions of high pumping with insufficient recharge show 'anti - dilution' chemistry.

Rainfall and its chemistry is analyzed using data from various monitoring stations in India. A model is developed to quantify the variation in concentration of Cl and Na (marine elements) under the influence of inland distance and annual rainfall. The model is used to predict the concentrations of Cl and Na in rain of different station points in the upper Cauvery basin. Na concentration is further used to estimate the recharge to groundwater using an alternative approach – Sodium Mass Balance approach. SMB recharge estimates are observed to offer a better alternative than the chlorine mass balance estimates in the semi-arid and sub-humid zones, which are affected by agricultural inputs. Water – rock reactions evolve towards equilibrium with the primary minerals while a series of secondary minerals precipitate. Mass balance approach is adopted to quantify the rates of mineral interactions at an experimental watershed, Mule Hole. These weathering rates are tested for the sensitivity to carbonates. A hydrogeochemical model is developed based on a mixing cell approach, which considers the spatio-temporal variations in the recharge and the weathering inputs in the 'mixing zone'. The model developed is able to simulate the temporal variations in the groundwater chemistry. In summary, the study analyses the effects of lithological, climatic and anthropogenic factors on groundwater chemistry.