Investigation of irrigation return flows in a coastal karstic aquifer in the Jaffna Region (northern Sri Lanka)- evidence from solutes and water stable isotopes

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Groundwater in Miocene karstic aquifers in the Jaffna Peninsula of Sri Lanka is an important resource for mainly agriculture. The subsurface in this area is characterized by highly productive limestone aquifers that are used for drinking water and agriculture. A comprehensive hydrogeochemical study was carried out to determine processes that may affect water quality in this region. For this purpose major and trace element composition and environmental isotope ratios of oxygen and hydrogen (δ18O and δ2H) were determined in 35 groundwater samples. The ion abundance of groundwater in the region was characterized by an anion sequence with the following order of abundance- HCO3>Cl>SO4>NO3. For cations, average Na+ + K+ contents in groundwater exceeded those of Ca2+ + Mg2+ in most cases. Ionic relationships of major solutes indicated open system calcite dissolution while seawater intrusions are also evident, however only in close to shore locations. The solute contents were also enriched by agricultural irrigation returns and associated evaporation. This was confirmed by the environmental isotope composition of groundwater that deviated from the local meteoric water line (LMWL) and formed its own regression line denoted as the local evaporation line (LEL). The latter can be described by δ2H=5.8 x δ18O - 2.9 (r²=0.98). Increased contents of nitrates (up to 5.8 mg/L), sulfate (up to 430 mg/L) and fluorides (up to 1.5 mg/L) provided evidence of anthropogenic inputs of solutes from agriculture. Fluoride contents that are problematic in some parts of the metamorphic terrain of Sri Lanka were low and varied from 0.08 to 1.54 mg/L.