Geophysical Research Abstracts
Vol. 18, EGU2016-9651-3, 2016
EGU General Assembly 2016

Conceptualization of groundwater flow of a coastal arid aquifer using isotopic and chemical tools: La Paz, Baja California Sur, Mexico

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Groundwater from the La Paz coastal aquifer in Baja California Sur, Mexico, is the main source of drinking water for the local population. Due to its proximity to the coast, sea water intrusion is the main factor of salinization of groundwater. Other geochemical processes also affect the quality of the aquifer threating its vulnerability. Forty-seven samples were analyzed for ion chemistry and isotopes. A hierarchical cluster analysis was performed for a better interpretation resulting in three main groups and proved for geographical correspondence. Deuterium and d18O ranged from -82 to -52.1 and from -11.6 to -7 permil, respectively, showing that the main recharge originates in the Sierra el Novillo, flowing toward SE-NW direction and in accordance to deuterium excess (d) high evaporation effects (d>10‰ are mostly in the middle portion of the study area and in El Centenario due to high kinetic isotope fractioning related to elevated temperatures. Hydrogeochemistry analyses demonstrated salinization mainly due to sea water intrusion and in second instance due water-rock interaction, where enrichment of Na+ (ranges from 35.7 to 1089 mg/L-1) was present in some samples probably due to weathering of silicates and/or cation exchange in soils with Ca2+ (27.7 to 658 mg/L-1) at clay-surfaces. High concentrations of NO_3-2 (ranges from 1.4 to 48.8 mg/L-1), Cl- (ranges from 54.4 to 2960 mg/L-1) and Na+ show that anthropogenic input is mainly coming from an agricultural area (El Centenario-Chametla) where heavy groundwater extractions are made for irrigational purposes, lowering the groundwater table up to 10 m and consequently promoting upconing and salinity concentrations (NaCl). Carbon-13 and radiocarbon ranged from -12.3 to -9.1‰ and from 29.5 to 100.4 pmC, respectively. Distribution of ages (up to ∼5000 years) indicates two flow trends (E-W and SE-NW).