

Investigation of the geochemical evolution of groundwater under agricultural land: A case study in northeastern Mexico

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Abstract

Zona Citrícola is an important area for Mexico due to its citriculture activity. Situated in a sub-humid to humid climate adjacent to the Sierra Madre Oriental, this valley hosts an aquifer system that represents sequences of shales, marls, conglomerates, and alluvial deposits. Groundwater flows from mountainous recharge areas to the basin-fill deposits and provides base flows to supply drinking water to the adjacent metropolitan area of Monterrey. Recent studies examining the groundwater quality of the study area urge the mitigation of groundwater pollution. The objective of this study was to characterize the physical and chemical properties of the groundwater and to assess the processes controlling the groundwater's chemistry. Correlation was used to identify associations among various geochemical constituents. Factor analysis was applied to identify the water's chemical characteristics that were responsible for generating most of the variability within the dataset. Hierarchical cluster analysis was employed in combination with a post-hoc analysis of variance to partition the water samples into hydrochemical water groups: recharge waters (Ca-HCO₃), transition zone waters (Ca-HCO₃-SO₄ to Ca-SO₄-HCO₃) and discharge waters (Ca-SO₄). Inverse geochemical models of these groups were developed and constrained using PHREEQC to elucidate the chemical reactions controlling the water's chemistry between an initial (recharge) and final water. The primary reactions contributing to salinity were the following: (1) water-rock interactions, including the weathering of evaporitic rocks and dedolomitization; (2) dissolution of soil gas carbon dioxide; and (3) input from animal/human wastewater and manure in combination with denitrification processes. Contributions from silicate weathering to salinity ranged from less important to insignificant. The findings suggest that it may not be cost-effective to regulate manure application to mitigate groundwater pollution. © 2014 The Authors.

SciVal Topic Prominence

Topic: [Hydrochemistry | groundwater | irrigation purposes](#)

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Reaxys Database Information

 [View Compounds](#)

Author keywords

Carbonate aquifers; Dedolomitization; Geochemical models; Mexico; Nitrate pollution; Water-rock interaction

Indexed keywords

Engineering controlled terms:	Aquifers; Calcium; Carbon dioxide; Chemical analysis; Chemical properties; Cluster analysis; Cost effectiveness; Fertilizers; Functional groups; Geochemistry; Groundwater; Groundwater flow; Groundwater pollution; Groundwater resources; Hierarchical systems; Hydrochemistry; Hydrogeology; Manures; Pollution; Potable water; Process control; Silicates; Water; Water pollution; Water quality; Weathering
Engineering uncontrolled terms	Carbonate aquifer; Dedolomitization; Geochemical models; México; Nitrate pollution; Water rock interactions
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