

Advection and redox processes as controls on minor elements in groundwater influenced by irrigation and surface-water exchange

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An understanding of the groundwater chemistry and transport of minor inorganic constituents must begin with the major processes of the hydrologic system. This research compares the influences of groundwater advection and redox chemistry on trace elements in a heavily irrigated agricultural hydrologic system.

Three times during 2004, samples were collected from both a groundwater transect that flows to the Merced River (California, USA) and from riverbed wells at the approximate point of flowpath discharge. Previous work (1, 2) has quantitatively described groundwater advection and denitrification in this groundwater system. Samples for this study were analyzed for a suite of dissolved elements by Inductively-Coupled Plasma Mass Spectrometry. Results are considered in the context of the U.S. Geological Survey National Water-Quality Assessment Program.

Concentrations of dissolved elements were statistically analyzed. Bromine, assumed to be a conservative tracer of advection, and manganese, an indicator of reducing conditions, were used as predictor variables. Strontium, barium, uranium, and phosphorus were relevant response variables. Principal component analyses and linear regression analyses indicate that advection dominates groundwater chemistry beneath the Merced River. Seasonal variation appears to influence whether groundwater composition is influenced by either hyporheic exchange from river surface water or groundwater supplied by the surrounding farmland. When the influence of advection is removed, redox chemistry becomes significant.

References

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Stable sulfur and carbon isotopes of pore-water and solid-phase compounds in sediments of the Chapopote Asphalt Volcano, southern Gulf of Mexico

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During R/V Meteor cruise M67 2a/b (March-April 2006) to the Asphalt Volcanoes of the southern Gulf of Mexico two gravity cores were retrieved from the central depression of the Chapopote Knoll which contained viscous oil/asphalt a few meters below the sediment surface. Also several push cores were taken with the remotely operated vehicle (ROV) QUEST at sites where oil/asphalt reached closely below the sediment surface. From these cores solid-phase and pore-water samples were taken for on-board and subsequent shore-based analyses. Together with a core taken from a background site which is not influenced by asphalt/oil seepage these sediment and pore water samples are currently subject to detailed analyses of (1) the stable sulfur isotopic composition of both dissolved (sulfate and sulfide) and solid-phase (iron monosulfides, pyrite) sulfur compounds, and (2) the composition and stable carbon isotopic signatures of hydrocarbon gases.

The major aims of these investigations are to identify whether and to which extent the upward migration of oil, asphalt and gas (1) stimulates biogeochemical processes and turn-over rates, and (2) influences the stable sulfur isotopic composition of both dissolved and solid phase sulfur compounds. Furthermore, we seek to determine the potential of these – possibly unusual – stable sulfur isotopic signals of solid-phase sulfides to reconstruct hydrocarbon seepage in older geological records and to elucidate how the composition and the stable carbon isotopic composition of the hydrocarbon gases are altered by the action of typical chemosynthetic communities thriving at these sites. The values of $\delta^{34}\text{S}$ of pore water and solid phase sulphide and furthermore of $\delta^{12}\text{C}$ of the pore water methane give a first indication for high bacterial activity.