Recharge in the High Plains Aquifer: Physical and Chemical Data

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The semi-arid High Plains aquifer (HPA) is critical for agriculture production in the United States. After years of extensive groundwater mining in western Kansas, water-level declines exceed 30 m in some areas, with depth to water between 60 and 90 m. There is a poor spatial understanding of recharge rates, and it is increasingly evident that local differences in aquifer architecture play an important role in recharge. Efforts are currently underway to improve understanding of these critical issues at two sites through a combination of pore water analysis from coring, increased water-level monitoring frequency and groundwater age sampling.

The first site, located in south-western Kansas, USA, consists of unconfined and confined aquifer intervals separated by a thick (>34 m) aquitard. Hydrograph analysis indicates most of the pumped water from the lower interval appears to be originating as downward vertical leakage induced by the large drawdown (>35m) resulting from interference between irrigation wells in the lower interval. Stable isotope data (δ^2H, $\delta^{18}O$), collected from core samples, a monitoring well, and nearby irrigation wells, indicate distinct water masses in the upper and lower aquifers.

A second site, located in northwestern Kansas, has a HPA sequence that consists of a single, relatively thick, unconfined aquifer. Previously unrecognized vertical inflow can be discerned in higher-frequency water level measurements despite indications of a laterally closed system. Groundwater has been sampled for chemistry, and environmental tracers (δ^2H, $\delta^{18}O$, ^3H, and ^{14}C). Tritium detected in one of five wells sampled in the area, combined with younger ^{14}C age (~ 4,200 BP), indicate that modern recharge is mixing with older water. Coring beneath an irrigated field, through the 60 m unsaturated zone, was completed, providing detailed Cl^-, NO_3^-, water content, and sediment size profiles. This information will be used to calculate diffuse recharge rates and investigate the potential for recharge from (1) irrigation return water or (2) perched aquifers.