



Use of FFEC Logging for Long-term Monitoring of Regional Flow in Multi-layer Aquifer System

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The flowing fluid electrical conductivity (FFEC) logging method has been successfully used in deep boreholes to estimate the transmissivity, salinity of formation water, hydraulic head, and regional flow rate of hydraulically conducting layers as a function of depth, and to do so in much less time than conventional well logging methods. In this method, the wellbore fluid electrical conductivity (FEC) is measured over depth for a series of time periods under pumping condition, after replacement of wellbore water with deionized water or water of salinity distinctly different from that of the formation. These FEC profiles are analyzed by fitting to an one-dimensional advection-dispersion equation. In this presentation, we modified the FFEC procedure to monitor the temporal changes in regional flows in a deep formation with multiple conductive layers for periods of months and years. Regional flows in the layers can vary, for instance, due to changes in subsurface flow recharge or discharge rates. In the event of CO₂ injection in the deep subsurface for geological storage of supercritical CO₂, the regional flow pattern of the storage formation will be disturbed and may change with time as the low density and low viscosity CO₂ enters more and more into the conductive layers. The present study explores the possibility of using the FFEC method for such a long-term monitoring of the flow velocity of formation water in an observation well. We assume the conductive layers in the storage formation to have different values of transmissivity. Results indicate that potential long-term temporal changes in regional flow in the layers can be estimated at a monitoring well by the FFEC method. Conditions for the applicability of this method are discussed.