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Shaly-Sand Log Analysis in an Environmental Application: Abstract

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ABSTRACT

A procedure to determine ground-water quality from analysis of electromagnetic induction logs was developed to detect and assess the distribution of saltwater intrusion into the alluvial Great Bend Prairie aquifer. The cross correlation between the induction and natural gamma-ray logs from a freshwater well was optimized (based on empirical statistics) to reduce shaly-sand effects — the variations on the induction log due primarily to the presence of clay minerals. The correction method obviates determination of variations of aquifer porosity or cation-exchange capacity for detailed log analysis of porewater conductance.

The method was applied to sets of logs collected from a network of monitoring wells in the aquifer. The corrected induction logs (units of mS/m) were calibrated to chloride concentration (mg/L) based on a highly significant linear-regression relationship (R=0.99) between the chlorinity of well-water samples and the median values of the corrected log for the screened intervals of the wells sampled.

The derived freshwater-saltwater transition zone profiles were processed by curve-fitting techniques to develop objective, quantitative estimates of key characteristics such as the saturated thicknesses of the usably fresh and unusable salt water (at the 500 mg/L chloride interface) and the determination of aquifer dispersivity. The curve-fit method also allowed incomplete transition zone profiles to be completed to the base of the aquifer by extrapolation. The transition zone characteristics provide a database for regionalization of saltwater distribution and for monitoring changes of the distribution at both local and regional scales.

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