Hydrogeologic Insight in Identification and Characterization of Saltwater Contamination and Associated Environmental Impacts in Kansas and Oklahoma

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Geological and hydrological properties of saltwater contamination sites have proved to be valuable, along with geochemical methods, for source identification and historical characterization of contamination in Kansas and Oklahoma. The observations are based on over 100 different studies of varying extent during the last 25 years. The geochemical methods are based primarily on mixing curves of bromide/chloride and sulfate/chloride ratios versus chloride concentration. The ratios range widely for saltwaters from subsurface formations and evaporite dissolution, or generated by evapotranspiration and industrial or other anthropogenic processes. Permian strata contain soluble evaporite minerals and natural saltwater in many locations. Permian saltwater has naturally intruded into overlying lower Cretaceous rock and Cenozoic sediments. Changes in land and water use, including geomorphic alteration of the land surface, can generate saline water by evapotranspiration concentration of natural dissolved constituents. Heterogeneity in the permeability of aquifer sediments and rocks can lead to stratification of saltwater contamination, both from sources at an aquifer base and the land surface. Sloping surfaces of low-permeability bedrock can affect the movement of dense saltwater pollution at the base of permeable aquifer sediments. Higher hydraulic head in confined, saltwater-containing bedrock than in an overlying aquifer can lead to upward saltwater flow in unplugged boreholes. Lateral and vertical changes in aquifer hydraulic heads caused by human activities can shift the movement of saltwater contamination. Changes in cation ratios caused by exchange on aquifer clays can be used to evaluate whether a saltwater plume is advancing or has been substantially flushed.