New Geochemical and Geographic Information System Methodologies to Assess Element Mobility in Groundwater and Surface Water

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A new geochemical and geographic information system (GIS) methodology was developed to aid assessing potential groundwater and surface water vulnerability to future mining of Quaternary to Pliocene sandstone hosted uranium resources in the Texas Coastal Plain sedimentary strata. Maps indicating the potential for element mobility were constructed using a stepwise approach by evaluating historical geochemical data from the National Uranium Resource Evaluation (NURE) and USGS National Water Information System (NWIS) databases. These data were analyzed in GIS for geochemical mobility criteria which include, in groundwater, oxidation-reduction potential (pE), pH, and sulfide species. In addition, the presence or absence of iron substrates in aquifers was assessed. Quantified values of these criteria were selected and applied in GIS to create four environmental condition (EC) categories which relate to the mobility of specific metals. Simulations of empirical data in PHREEQC and Geochemist's Workbench were used to constrain chemical indicators of iron saturation and phase equilibria at varying pE to establish values to identify the existence of iron substrates. Twelve-digit hydrologic unit code (HUC) boundaries were used in GIS as analysis areas to determine the most commonly occurring EC (statistical mode) in each HUC. Resulting maps identify areas having varying potential element mobility. Statistical distributions of empirical element concentrations were created for each EC to identify the mobility of elements. This methodology provides a systematic approach for identifying areas where groundwater and surface water near mining may be susceptible to element mobility near mining.