Deciding When to Use Environmental Sequence Stratigraphy (ESS) and Application to Perfluorinated Compounds Sites

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Background/Objectives. Conceptual site models (CSMs) typically incorporate multiple data sets to determine the spatial extent and magnitude of a given contaminant and attempt to describe their distribution, transport, and fate at a given locality. For emerging contaminants such as perfluorinated compounds, screening tools are limited, and historical data largely absent. Practitioners are reaching deep into their characterization tool bag to understand these sites with the limited data sets at their disposal.

One applicable tool is Environmental Sequence Stratigraphy (ESS). ESS reviews the depositional environments that created the site subsurface and the repeating patterns (or sequences) and variation in grain size that can act as conduits, or barriers, to groundwater and contaminant, flow. During the formative stages of an ESS investigation, the site CSM and more traditional data sets will be revisited and analyzed. However, as with any tool, the application and benefit of an ESS investigation varies in benefit and can be applied in different degrees dependent on the site characteristics. CH2M, a wholly-owned subsidiary of Jacobs, has developed a decision tree to both identify sites where ESS would be most beneficial and the degree to which it can effectively be applied based on site concerns and setting.

Approach/Activities. Several site examples were considered for the application of ESS to improve the site conceptual model. Using these candidates, the decision tree process was developed to screen the applicability of ESS to any contaminated environmental site. Of the candidate sites reviewed, one site, underlain by a subsurface deposited in a fluvial-dominated deltaic environment, and impacted with multiple potential perfluorinated sources spread over a large spatial area with discrete, traditional borings, was selected to be the highest priority based on the decision tree analysis.

Following site selection, the desktop ESS evaluation was completed using a preliminary review of a subset of borings, fluid level data, and analytical groundwater data in the context of the regional geologic setting. With this combined data set, an evergreen, interactive three-dimensional conceptual model was developed and used to update the hydrogeologic portions of the ESS CSM. This included identifying the likely presence of sand channels, lagoon, swamp, deltaic, and interbedded deposits that comprise the subsurface. Using this information, the project team identified likely preferential pathways and prioritized data gaps at the site.

Results/Lessons Learned. Understanding depositional environments provides another line of evidence to support or refine the existing CSM, explain anomalous data, or identify preferential pathways such as the presence of ancient fluvial channels. This method was effective at the candidate site impacted by perfluorinated compounds but is not as applicable to all sites due to site-specific variables. Application of ESS, particularly where emerging contaminants are a concern, can often refine existing CSMs without collecting additional site data. The refined model helped correlate existing data and reduces uncertainties. The refined CSMs are being used to support the installation of additional confirmation borings and install additional investigative monitoring wells.

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