Best Practice for Characterization and Remediation of Sediments and Aquifers: Environmental Sequence Stratigraphy

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Background/Objectives. Historically, an assumption of relatively homogeneous, isotropic permeability in contaminated groundwater aquifers was used to design and implement containment and remediation systems. However, subsurface heterogeneity leads to great departures from that simplification, and has limited remedy effectiveness. This heterogeneity in clastic sedimentary (sand, gravel, silt, and clay) aquifers is a result of the geologic processes which laid down the sediment originally (depositional environments). A great body of research and knowledge has evolved over the past decades to address permeability heterogeneity in clastic oil and gas reservoirs to maximize production, and this work employs the concepts known as “Sequence Stratigraphy” and “Facies Models”. Despite widespread implementation in the petroleum industry, these concepts have not been widely employed to predict groundwater flow and contaminant fate and transport in aquifers. Application of both sequence stratigraphic principles and facies models to groundwater aquifers is herein referred to as “Environmental Sequence Stratigraphy”, or “ESS”.

Approach/Activities. To encourage implementation of these concepts to groundwater remediation projects, a Technical Issue Paper (TIP) was prepared at the request of the USEPA. This talk provides an overview of the TIP titled “Best Practices for Environmental Site Management: A Practical Guide for Applying Environmental Sequence Stratigraphy to Improve Conceptual Site Models”.

Results/Lessons Learned. We present techniques to elucidate vertical and lateral grain size trends in existing groundwater remediation site data and, and describe how these patterns can be interpreted in the context of sequence stratigraphy and facies models to make realistic predictions about lateral continuity of aquifer and aquitard units. We present stratigraphic “rules of thumb” to apply to correlation of aquifer materials between wells. We show examples of geologically realistic interpretations of aquifer architecture based on ESS rules of thumb.