Effective Remedial Decision-Making in Hydrocarbon-Impacted Sites Using Sequence Stratigraphy-Based Conceptual Site Models

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Background/Objectives. The heterogenous and complex nature of soil and groundwater systems leads to significant technical challenges in remediating hydrocarbon contamination and achieving cleanup goals within reasonable timeframes. Therefore, implementing a correlation approach that adequately addresses subsurface heterogeneity between sampling locations is critical for effective management of petroleum-contaminated sites. The sequence stratigraphic approach (supported by facies analysis) is proposed as a realistic subsurface correlation technique based on the predictable distribution of sediments in different depositional environments. The three-dimensional geologic framework derived from sequence stratigraphy can be used to map the heterogeneity of subsurface sediments across multiple scales and beyond the existing site data set. The resulting stratigraphic framework is integrated with site hydrologic and chemical data to identify sediments with high and low fluid transmissive properties. This paper provides a practical methodology of developing a sequence-stratigraphy-based conceptual site model to inform effective remedial decision-making in hydrocarbon-impacted sites.

Approach/Activities. The key factors in sequence stratigraphy are accommodation and supply of sediments. Classical sequence stratigraphy largely focuses on understanding the heterogeneity of marine and coastal environments controlled by processes relative to sea level changes. However, since hydrocarbon-contaminated sites are not limited to locations in marine and coastal environments, it is essential that a method applicable to all depositional environments including continental settings (e.g., including fluvial, alluvial fan and glacial) is established for hydrocarbon remediation. Here, a comprehensive workflow applicable to hydrocarbon impacted sites for all depositional environments is proposed and its efficacy is demonstrated with a case study of an LNAPL-impacted site.

Results/Lessons Learned. Demonstrated by a detailed case study, this investigation in fundamental methodology for developing a geological framework remediation and management of hydrocarbons in all depositional settings has gained recognition by the industry experts of hydrocarbon remediation. As a result, the proposed methodology and case study summarized here have been selected as a peer-reviewed book chapter in a book titled ‘Advances in the Characterization and Remediation of Sites Contaminated with Petroleum Hydrocarbons’ slated for publication by Springer Nature in 2023 for worldwide dissemination of the knowledge.