Source Zone and Plume Characterization Using Smart Characterization and Real-Time Techniques in Brazil

Júlio Vilar, César Petroni, Guilherme Martinelli, Alexandre Joly, and ***Marcelo Sousa***
(Arcadis Brazil)
Kimberley Haymond and Nicklaus Welty (Arcadis US)
Jesse Overgord and Jay Smith (Philips North America LLC)
Carlos Umilta (Philips do Brasil)

Background/Objectives. Until recently, investigative methods for contaminated sites in Brazil relied mainly on conventional monitoring wells and soil sampling techniques. However, high-resolution and real-time site investigations are becoming more feasible in Brazil due to increasing equipment availability, reduced costs and a growing awareness that the results obtained may result in more effective and efficient remediation measures and in lower overall site management costs. The use of high-resolution techniques has being included in recent guidelines published by the São Paulo State Environmental Agency, which tends to be a reference for other agencies in Brazil and Latin America.

In this work, the application of Smart Characterization approaches in a site impacted by chlorinated compounds is discussed with a focus on how the obtained results can support site management measures and on demonstrating how such techniques can be applied in remote areas in Latin America. The study site is located in the State of Pernambuco (northeast region of Brazil) and the objective of its investigation is to fully characterize the source area and the distribution of constituents in groundwater in order to guide accelerated remediation. As part of the characterization efforts, both transport and contaminant storage zones were delineated in the site subsurface.

Approach/Activities. This project relied on a combination of different smart characterization tools, such hydrogeological mapping (via 42 hydraulic profiling tool [HPT] surveys), high-density soil sampling in both the vadose and saturated zone (via 30 whole core soil samples [WCSS]) and discrete groundwater sampling (via 21 vertical aquifer profiling [VAP]). In total, 472 soil and groundwater samples were analyzed in the field using a mobile lab with short turnaround time (real-time approach) and appropriate quality assurance and quality control measures. The locations of sampling points were adapted in the field based on the obtained results. This resulting data was integrated and interpreted in 3-dimensions using the software Earth Volumetric Studio (EVS).

Results/Lessons Learned. The site hydrogeology is comprised of fluvial deposits with discontinuous sandy and clayey layers. Despite the usual spatial heterogeneity in such deposits, the results from the investigation significantly improved the existing conceptual site model (CSM), delineated the contaminant source zone vertically and horizontally, and identified the main flow and storage areas. These results were used to design multiple remediation efforts to address both the source zone and plume migration. The investigation identified important features such as local occurrence of small sandy areas within a larger clayey layer, through which vertical groundwater flow and contaminant flux were taking place near the source zone. Site characterizations performed only using monitoring wells would normally miss such features.

The current case study also demonstrates the feasibility of high-resolution and real-time investigations in more remote areas in Latin America. The equipment used in this study was

mobilized from São Paulo, located approximately 2700 km from the site. With proper coordination and adequate field personnel to support real-time site investigation decisions, the application of such site assessment techniques can be utilized to reduce overall costs and therefore are expected to become more common in Latin America.