DELINEATION OF CONTAMINANT PLUMES USING LOW-LEVEL MIHPT (LL-MIHPT)

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Plumes of dissolved contaminants may be widely distributed in the saturated zone, i.e. to great depths and over large areas. Also the concentration levels of contaminants in the plume generally are much lower than the concentrations found in the hotspot area. Characterization and delineation of contaminant plumes therefore typically require many investigation points at great depths. Often the delineation of a contaminant plume is conducted using traditional drilling techniques and installation of screened wells. However, this method is both time-consuming and resource-intensive and only a limited number of discrete depths can be screened in each well. Furhermore, screen depths are often chosen based on expected flow and contaminant distribution patterns in the saturated zone, rather than on detailed hydrogeological data and vertical contaminant distribution.

On behalf of The Capital Region of Denmark, Department of Regional Development, and in cooperation with experts from Geoprobe Systems (US), NIRAS A/S (DK) has tested a novel tool, Low-Level MIHPT (LL-MIHPT), for delineation and characterization of contaminant plumes in groundwater. LL-MIHPT is based on the existing high resolution direct push investigation tools MIP and HPT developed by Geoprobe Systems. The HPT probe (Hydraulic Profiling Tool) is used to continuously map the hydrogeological conditions (permeability), while the MIP probe is used to continuously map VOC contamination in soil and groundwater. The MIHPT system is a combination of the MIP and HPT systems and has proved to be very efficient for field investigations in hotspots and areas with high contaminant levels. However, the detection limits of the standard MIHPT system are too high for delineation of contaminant plumes where the concentration levels are significantly lower than in the source zones. The Low-Level MIHPT system is developed with the objective to detect contamination at low concentrations and thus provides a means for conducting more time efficient and cost-effective delineation of contaminant plumes in unconsolidated saturated formations.

The LL-MIHPT systems has been tested at two sites located in the towns of Farum and Slangerup in Denmark as part of ongoing field investigations at the two sites.

The purpose of this project was to test the LL-MIHPT technique for delineation of contaminant plumes in groundwater at two sites with different geological formations; sandy and clayey, respectively. The objectives have thus been to determine at which concentration level the LL-MIHPT system could detect the site specific contaminants and to investigate the correlation between observed LL-MIHPT responses and results from analysed water samples from targeted depths.

9 LL-MIHPT logs to 20-25 meters below surface have been carried out. At each log water samples were collected at specific depths with the GeoProbe for verification of the observed responses from the LL-MIHPT and for correlation of contamination levels. For further correlation of the LL-MIHPT data core samples were collected at three locations.

The results from the field tests show that it is possible with the LL-MIHPT to track relatively low concentrations of chlorinated solvents and BTEX's in the saturated zone. Hence, for chlorinated solvents a detection limit in the order of 10 μg/L can be expected. For comparison the detection limit for chlorinated solvents with the standard MIP system is in the order of 1-10 mg/L.

Based on the results and experiences obtained from the field tests the new LL-MIHPT system shows good promise for delineation of contaminant plumes in the saturated zone with simultaneous retrieval of hydrostratigraphic data from the saturated zone. Thus, LL-MIHPT logs followed by depth specific groundwater sampling with the GeoProbe system is considered to be an optimal set-up for delineation and characterization of contaminant plumes in saturated zones in unconsolidated geological formations.

The field tests were conducted and evaluated in the fall of 2013 and spring of 2014. Since then NIRAS A/S has obtained good results with the LL-MIHPT system at field investigations at several other sites.