EGU2020-948
https://doi.org/10.5194/egusphere-egu2020-948
EGU General Assembly 2020

Testing the relation between pre-sample purge extent, parameter stabilization and dissolved contaminant concentration at a DNAPL site

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Groundwater contamination resulted from anthropogenic activity often proves to be a persistent feature of the affected groundwater regime. The contaminated groundwater body is a complex and dynamic entity commonly called the “contaminant plume”, it is characterized by spatially dependent concentration pattern that exhibits temporal changes. In order to assess the actual state of the plume contemporaneous sampling of all assigned monitoring wells is necessary. These contemporaneous samplings should provide compatible results, just like subsequent sampling campaigns. Differences between consecutive concentration patterns help to understand the temporal behavior of the plume.

A monitoring well provides direct contact between the water originating from of the screened aquifer and the atmosphere. The water within the well may undergo physicochemical changes, between sampling events, mainly when aquifer water movement at the screened section of the well is slow. Among diverse alterations the stagnant water within the well may be depleted in volatile components, enriched in dissolved oxygen therefore the chemistry of the stagnant water within the well is typically not representative of the aquifer water. These alterations would not confine to the water contained inside of the well casing, they will diffuse into the aquifer at the screened section. The extent of this altered zone is hard to calculate, as it depends on a number of factors. The sampling procedure should ensure that representative formation water is sampled instead of altered water.

It is well known for long that sampling procedure can affect sample integrity. Most standardized sampling procedures consist a pre-sampling purge phase to avoid the sampling of stagnant water instead of aquifer water. Most procedures aim to define the necessary extent of the purging in well volumes (from three-five to twenty volumes). The other approach is to purge the well until all or some of certain field parameters (such as pH, specific electric conductivity, temperature, dissolved oxygen, oxidation-reduction potential, turbidity) stabilize, however definitions for parameter stabilization criteria are not uniform. Parameter stabilization approach is used mostly, when low-flow sampling technique is applied. In addition to the stabilization of field parameters low-flow technique requires water level stabilization as well.

The test site is a chlorinated hydrocarbon contaminated site, the affected subsurface consists of layered sandy aquifers and silt-clay aquicludes. Three monitoring wells were repeatedly tested quarterly on five sampling occasions. Field parameters were measured in a flow through cell and recorded regulary. Three samples were taken during purging: at the beginning of the purging; after extraction of three well volumes; and when field parameters are stabilized. The samples were analysed for organic and inorganic components.

Results indicate that at wells with lower contaminant concentrations insufficient purging may result in overestimating the proportion of contaminant degradation products over primer contaminant components.