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Localization of pollution sources of chlorinated solvents on an alluvial aquifer: coupling hydrogeological modeling and geophysics survey

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The object of this study is to locate pollutions sources of an alluvial aquifer by chlorinated solvents. Chlorinated solvents are slightly soluble volatile organic compounds (VOCs) of the type DNAPL (dense non-acqueus phase liquids). DNAPL infiltrate into the ground and accumulate when they meet an impermeable layer.
On an active industrial site, chlorinated solvent pollution was detected at the beginning of the nineties. A historical study has indicated that this pollution was caused by a previous owner who disposed chlorinated waste in the ground at the end of the sixties. The problem is the unknown location(s) of the source(s) zone(s) of pollution. The well water of the zone of historical chlorinated waste stores is less contaminated than distant groundwater downstream of his zone.
Two geophysical studies were accomplished in the zone of waste release to find the shape of the alluvium basement, first in 1995 and second in 2010. The alluvium rests on a Miocene formation (named ”Molasse”). The permeability of Molasse is highly variable in this zone. These studies allowed us :

I) to indicate the presence of a impervious at the alluvium basement,
II) to find depressions in the alluvium basement where DNAPL could accumulate,
III) to estimate the Molasse thickness of a hundred meters.

A hydrogeological model in transient state had been implemented taking first-order decay of chlorinated solvents into account. Monitoring of chlorinated solvents concentration was reproduced at three wells between 2006 and 2009. The positions of the source zones found by modeling result correspond with the depressions in alluvium basement detected by geophysical studies.
A process of rapid degradation (volatilization or biodegradation) was also reveled by hydrogeological models.
The agreement of geophysics results and the hydrogeological modeling allowed us to locate the pollution sources and to assess that some degradation process of pollution exists.