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# Self-potential monitoring of a crude oil contaminated site (Trecate, Italy): first results of the modelling.

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The contamination of soils and groundwater by hydrocarbon, due to blow out, leakage from tank or pipe and oil spill, is a heavy environmental problem because infiltrated oil can persist in the ground for a long time.
The existing methods used for the remediation of these contaminated sites are invasive, time consuming and expensive. Therefore, in the last years, there was a growing interest in the use of geophysical methods for environmental monitoring (Atekwana et al., 2000; Chambers et al., 2004; Song et al., 2005; French et al., 2009).
A particular attention is given to the self-potential (SP) method because SP is sensitive to the contaminant chemistry and redox processes generated by bacteria during the biodegradation (Atekwana et al., 2004; Naudet and Revil, 2005; Revil et al., 2010).
Here we show the results of SP investigations carried out at Trecate site (Italy). This site was affected by a crude oil contamination from a well blowout in 1994. Four SP surveys (October 2009, March 2010, October 2010, and March 2011) were conducted at the site, both in the contaminated and uncontaminated regions. Significant changes are observed between SP data collected at different times. In particular, we found mostly negative electrical potential in October surveys and positive electrical potential in March surveys. The SP distributions can be interpreted as the superposition of many components, including a horizontal water-flow in the saturated shallow aquifer toward South-East, the infiltration movement of water in the unsaturated zone and, possibly, the oxidation-reduction phenomena due to bacterial activity.
As the groundwater flow usually produces SP linear trends, the data were detrended by linear regression, taking into account the measured piezometric heads in the aquifer. The detrended SP data show that the SP distribution within the contaminated zone is generally bipolar in October: the southern part of the contaminated area is characterized by negative values, whereas the northern one is characterized by positive values. In contrast, in March, positive SP values generally coincide with the contaminated area.
As described by Revil et al. (2010), the capillary fringe of the contaminated portion of the aquifer is potentially the setting of mechanism of electron transfer normal to the water table (due to a higher density of bacteria at the transition zone). This "geo-battery" generates a dipolar self-potential field. In particular, the capillary fringe is higher in October than in March because the rice fields are flooded. Therefore, the water level and the height of the capillary fringe possibly play an important role in the electrochemical mechanism. However, to clearly understand the origin of the measured SP signals, we are building a SP model using vertical dipolar electrical sources, and taking into account the electrical resistivity distribution deduced from ERT an EM measurements.
In conclusion, our results confirm that SP can play an important role in the definition of soil hydraulic characteristics and contamination distribution.
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