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Proving natural attenuation at a petroleum hydrocarbon contaminated site by high-resolution direct push measurements as a basis for reactive transport modelling

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Abstract At a former military air-field site contaminated by kerosene as NAPL phase, comprehensive site investigations were performed in order to prove the efficacy of natural attenuation. The site investigations included high-resolution direct-push measurements to determine lithological and geo-chemical parameters, as well as contaminant data. A three-dimensional flow model based on the site data indicated that a perched aquifer extending over a portion of the site has a strong influence on the distribution of groundwater recharge to the main aquifer by intercepting and focusing it in localised areas. On the basis of the three-dimensional flow model a multi-component reactive transport model was set up to simulate transport of four major contaminants as well as of four electron acceptors along two vertical transects in the groundwater flow direction. Model predictions show that the presence of the perched aquifer has a major impact on the contaminant plume development due to strongly reduced groundwater recharge rates, and thus reduced supplies of oxygen and sulphate. Furthermore, the limited supply of Fe(III) in the mineral phase as an immobile electron acceptor eventually leads, after its depletion, to a renewed growth of the contaminant plume.

Key words natural attenuation; direct-push technology; reactive multi-component transport modelling