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Extending the in situ microcosm approach (BACTRAP®) to field sites without groundwater wells – a new Direct-Push probe

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Due to the large number of contaminated field sites in Europe, monitored natural attenuation is in most cases the only financially feasible site remediation option. However, only few methods are accepted by authorities as real proofs of natural attenuation. One of those methods is the recently developed in situ microcosm approach (BACTRAP®). These in situ microcosms consist of a perforated Teflon tube filled with an activated carbon matrix and closed by glass wool stoppers. Afterwards, ^{13}C labelled contaminants are loaded on the activated carbon and the microcosms are then exposed in groundwater wells. Based on this approach, natural attenuation was accepted by authorities as a site remediation option for the BTEX polluted megasite Zeitz in Germany.

Until now, the in situ microcosms are adapted to conditions in a groundwater well at the level of the aquifer. Due to that, the system is only applicable on field sites with a network of monitoring wells and only microbial activity inside the aquifer can be assessed. To overcome these limitations, a new Direct-Push BACTRAP-probe was developed on basis of the Geoprobe® infrastructure. With help of this new probe, the approach can be extended to field sites without monitoring wells and microbial activity can also be measured in the vadose zone above the aquifer.

Classical and Direct-Push BACTRAPs have been applied in the BTEX contaminated aquifer at the ModelPROBE reference site Zeitz(Germany). Both types of BACTRAPs were incubated in the centre and at the fringe of the BTEX plume. During microbial degradation of the ^{13}C labelled substrate, the ^{13}C label was incorporated into bacterial biomass, which was determined by phospholipid fatty acid (PLFA) analysis, and provided the proof of in situ natural attenuation. In addition, the bacterial communities on classical and Direct-Push microcosms were compared by analysing PLFA patterns.

Concluding, Direct-Push based BACTRAPs offer a promising and cost efficient way for monitoring natural attenuation or remediation success at field sites currently inaccessible by the technique.