$\delta^{13}C$ and $\delta^{37}Cl$ Isotope Fractionation for Distinguishing Between Aerobic and Anaerobic Degradation of TCE

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Background/Objectives. Trichloroethylene (TCE) is a carcinogenic volatile organic chemical used primarily in the textile and metal industries, and threatens the quality of water resources worldwide. Two main processes for TCE degradation are known, anaerobic reductive dechlorination and aerobic co-metabolism. Combining carbon and chlorine isotope analysis may be powerful for distinguishing between both processes. However, so far, dual element isotope fractionation in TCE transformation has been investigated for reductive dechlorination only. The other side of the picture – aerobic biodegradation – is missing. Our main objective was to evaluate to what extent dual carbon-chlorine isotope data can be used for distinguishing between anaerobic and aerobic biodegradation of TCE in the field.

Approach/Activities. In the present study we aimed to explore dual ^{37}Cl and ^{13}C isotopic effects associated with degradation of TCE by the methanotroph OB3b and the toluene degrader *Pseudomonas putida* F1 in the laboratory scale. The compound specific isotope analysis (CSIA) approach is based on the fact that bonds with lighter isotopes are normally cleaved slightly faster than bonds with heavy isotopes. Consequently, a direct indication of degradation is obtained, and its extent may be assessed even without the need for concentration-based mass balances. Multi-element isotope analysis may point to specific bonds involved in the rate-limiting step of the reaction and different degradation mechanisms can be further distinguished. Recent analytical developments in Cl-CSIA have facilitated the measurement of chlorine isotope ratios in TCE.

Results/Lessons Learned. Although both strains F1 and OB3b are thought to oxidize TCE via similar mechanism, they do not present similar dual-isotope trends. At first sight, the dual element isotope trend observed with OB3b seems to interfere with pathway distinction. However, since the isotope enrichment is rather small for strain OB3b, and it should be questioned whether it would indeed lead to large misinterpretations at field sites. Further research is currently conducted to determine whether the OB3b results reflect other monooxygenase enzymes, or is rather specific for this strain. Additionally, we aim to investigate whether this strain is of highly relevance for polluted sites.