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# Who Says Chlorinated Solvents Can't Biodegrade in the Presence of High Sulfate in Marine Sediments?

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**Background/Objectives.** Past practices at Naval Air Station North Island Installation Restoration (IR) Site 9 have resulted in a chlorinated volatile organic compound (CVOC) groundwater plume that extends offshore toward San Diego Bay. CVOCs have been detected in sediment porewater adjacent to the IR Site 9 shoreline. Offshore sampling results indicate that CVOC concentrations in the Bay sediment pore water decreased significantly between 2000 and 2015 and natural destruction of CVOCs is occurring in the Bay sediments. NAVFAC initiated a project to delineate the zone where CVOC-impacted groundwater reaches the Bay sediments and investigate the role of biotic and abiotic degradation on CVOC fate in Bay sediments, which contain porewater sulfate concentrations close to that of typical seawater (2.7 g/L).

**Approach/Activities.** A Trident Probe rig was used to sample sediment pore water in a zone that extends ~ 1000 ft along shore by ~ 350 ft offshore from IR Site 9. One hundred thirty three (133) borings were advanced, and porewater CVOC samples were collected in 47 locations at depths of 1- and 5-feet into the sediment. Three locations within the identified groundwater discharge zone were selected for laboratory microcosm assays to measure the capacity for Bay sediments to degrade IR Site 9 CVOCs biotically and/or abiotically. Sediment core and porewater samples were collected at depths of 1, 5, and 8 feet into the sediments, sealed and shipped at 4$^{o}$C to SiREM, and sediment slurry microcosms were constructed in 250 mL glass bottles. Sterile control and active (unamended) microcosms were prepared and incubated in an anaerobic chamber for 39 weeks, and sampled periodically for CVOCs and other chemical and molecular analytes. Initial total CVOC concentrations in most microcosms were about 2 mg/L.

**Results/Lessons Learned.** Complete, anaerobic, intrinsic dechlorination of chloroethenes (CEs) was observed at each depth at all three locations. Dechlorination in all locations occurred in the presence of sulfate concentrations exceeding 2.5 g/L, demonstrating that degradation of CEs can occur naturally in the presence of high sulfate. Of the eight depth-locations studied, CEs degraded completely in < 7 weeks in two depth-locations, < 9 weeks in two depth-locations, and < 39 weeks in the remaining depth locations. CE degradation half lives ranged from 4 to 10 days in the four most active depth-locations. CEs did not degrade in sterile controls, with the exception of one location where partial dechlorination of cDCE observed. Acetylene was not detected. *Dehalococcoides* and/or *Dehalococcoides-vcrA* were detected in all study locations; however, sequential dechlorination of TCE to ethene was observed in one location only. In all other locations accumulation of dechlorination daughter products was not observed. The reductant driving dechlorination has not been determined yet; however, amphibole, biotite, and natural organic carbon have been detected in the sediment at potentially significant concentrations. Magnetite content in the sediment is relatively low (0.004 to 0.03%). Additional analyses are ongoing now and the results will be presented at the Biosymposium.