NOVEL MECHANISMS OF CHLORINATED ETHENE BIODEGRADATION AT GROUND WATER-SURFACE WATER INTERFACES. F. H. Chapelle and P.M. Bradley, U.S. Geological Survey, 720 Gracern Road, Suite 129, Columbia, SC, 29210 Chapelle@usgs.gov

ABSTRACT It is often observed that chlorinated ethene-contaminated ground water discharges to surface-water bodies. These ground water-surface water interfaces are characterized by more active microbial processes than typically observed in ground-water systems. Thus, these interfaces can contribute substantially to the natural biodegradation of chlorinated ethenes. Because of their relatively high microbial activity, ground water-surface water interfaces also provide an opportunity to investigate the biochemistry of ongoing biodegradation processes. At one site in Florida known as NAS Cecil Field, the behavior of chlorinated ethene-contaminated ground water discharging to a small stream was observed using closely spaced monitoring wells and sediment diffusion samplers. The results of this field study showed that while substantial concentrations of chlorinated ethenes were transported toward the stream by flowing ground water, these contaminants were completely attenuated prior to discharging to surface water. Subsequent experimental studies demonstrated that a number of previously unknown microbial processes contribute to the observed biodegradation. These processes include oxidation of vinyl chloride coupled to the reduction of oxygen, Fe(III), and sulfate (Fig. 1). Mechanisms of anaerobic oxidation include the acetogenic degradation of vinyl chloride to acetate (Fig. 2), followed by followed by acetotrophic Fe(III) reduction, sulfate reduction, and methanogenesis. This indicates that anaerobic oxidation of chlorinated ethenes can be a significant component of overall biodegradation (Fig. 3).

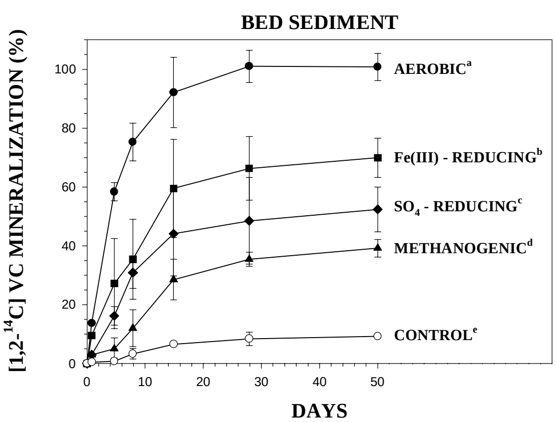

Fig. 1–Anaerobic oxidation of vinyl chloride.

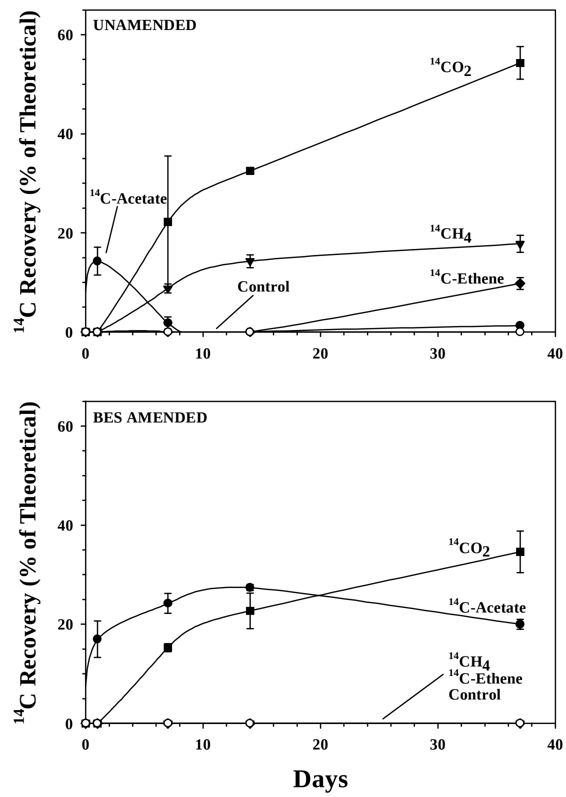

Fig. 2–Acetate production from vinyl chloride.

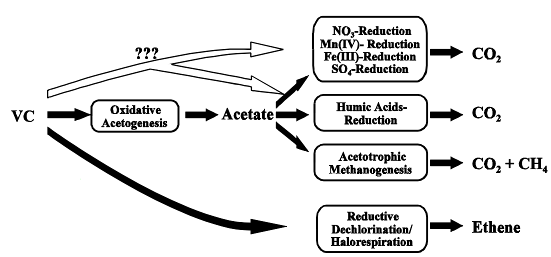

Fig. 3–Model for anaerobic degradation of vinyl chloride to carbon dioxide.

References:

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