Bioremediation and Sustainable Environmental Technologies—2017. Fourth International Symposium on Bioremediation and Sustainable Environmental Technologies (Miami, FL; May 2017). ©2017 Battelle Memorial Institute, Columbus, OH, www.battelle.org/biosymp. A. Barton and S. Rosansky (Chairs)

Bioremediation of Deep Contamination: Deeper Is Not Always More Difficult

Ryan A. Wymore, P.E. (wymorera@cdmsmith.com) (CDM Smith, Denver, CO, USA)

Background/Objectives. In situ bioremediation(ISB) has been used extensively over the past three decades for remediation of many types of contaminants. It has become more commonly considered as a treatment option for sites contaminated with dense non-aqueous-phase liquids (DNAPLs), particularly those associated with chlorinated ethenes. Because these contaminants are denser than water, they can readily migrate downward through the subsurface, leading to sites with soil and groundwater contamination at depth. Deep contamination is not limited to DNAPL-related constituents, as metals (such as chromium) and even petroleum based contaminants can migrate through the subsurface to depths of hundreds of feet below ground surface (bgs).

Approach/Activities. Implementing ISB at sites with deep contamination is not inherently more difficult compared to shallow sites. All types of enhanced ISB involve addition of some type of amendment to the subsurface, which of course requires infrastructure and equipment. The obvious difference at deep sites compared to shallow sites is that this infrastructure (e.g. injection wells) can be significantly more expensive, and options for installing it are more limited. For example, direct push technology (DPT) based tools, which can be extremely valuable for site characterization, direct injection of amendment, and even injection well installation, may not be usable at deeper sites. However, some aspects of ISB can actually be easier at deeper sites. For example, amendment injections can be performed at higher pressures without risks of surfacing or unintentionally creating fractures.

Results/Lessons Learned. This presentation is intended to serve as an overview to the session “Bioremediation of Deep Contamination” and will provide several examples of ISB implementation at deep sites, including:

- ISB for chlorinated solvents, including a site where DPT was used to install injection wells to treat contamination down to 80 ft bgs, as well as a site where biobarriers were used to treat contamination nearly 150 ft bgs
- ISB of chromium contaminated water at depths greater than 100 ft through lactate injection
- A site where application of high resolution site characterization principles prevented the over-design of an ISB system that was originally intended to inject amendment to nearly 100 ft bgs

Overall, ISB can be successful at sites of any depth when it is designed properly. From a technical standpoint, depth in and of itself does not preclude or limit ISB. Difficulties related to low permeability lithologies that can limit effectiveness of amendment injection are a much more significant factor, and these effects can be observed at sites where contamination is present at tens of feet bgs.