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Expanded Application of Microbial Genomics and Ecology Tools into Soil-Groundwater Bioremediation

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ABSTRACT

Characterizing and quantifying microbial functional and ecological behaviors in nature as well as in engineered system is one of the major challenges in environmental sciences and technologies. Microbial genome sequencing and modern biotechnology development have led to the development of high-throughput detection technologies such as DNA microarrays. Such high-throughput genomic tools are believed to have a lot of potential in the future direction of our environmental studies. In this context, the first part of this presentation illustrates the examples of use of genome-wide microarray gene expression analysis in providing useful information for PCB (polychlorinated biphenyl) bioremediation. To improve the understanding of microbial degradation behaviors in PCB bioremediation, the genome-wide gene expressions in a PCB-degrading bacterial strain (*Burkholderia xenovorans* LB400) were analyzed under more environmentally relevant conditions such as carbon limitation, biofilm-forming conditions, and PCB-mediated stresses. The results suggested that this type of genomic screening is able to list candidate genes for further genetic engineering to improve PCB degradation in soil environments. As the second part, the potential applications and limitations of DNA microarray and environmental meta-genomics will be discussed when used in environmental detection of microbial functions in soil microbial communities. Detection resolution was increased by enriching target genetic information from overall microbial communities. For this, heavy DNA and RNA samples could be enriched from environmental samples using density-gradient ultracentrifugation after biphenyl degrading populations were selectively labelled with isotopic stable carbon (13C). The

applicabilities of DNA microarrays, metagenomics and enrichment techniques are anticipated to be expanded into the evaluation of other microbial services (heavy metal reduction, N and P controls) as well as the detection of microbial pathogens in air, water, wastewater, soil and high-density biosolids.

Key words: microbial genomics, DNA microarrays, SIP (stable isotope probing), PCB (polychlorinated biphenyls), bioremediation