

microorganisms can indirectly immobilize radionuclides and metals through the reduction of inorganic ions that can, in turn, chemically reduce contaminants to less mobile forms. The long term stability of these reduced contaminants is as yet unknown.

NABIR Program

The goal of the NABIR program is to provide the fundamental science that will serve as the basis for development of cost-effective bioremediation and long-term stewardship of radionuclides and metals in the subsurface at DOE sites. An important aspect to the NABIR program is to assess factors controlling the long-term stability of the immobilized contaminants and to devise approaches (biological/chemical) to maintain their immobilization through the stewardship phase. Naturally-occurring subsurface microbes may be involved in intrinsic bioremediation of radionuclides and metals by reduction and immobilization, either directly or indirectly. However, these natural processes (known as natural attenuation) typically occur at fairly slow rates, and there may be a need to use biostimulation to enhance the rates. The primary focus of the NABIR program is on biostimulation strategies, due to the ubiquity of metal-reducers in nature. Immobilized radionuclides and metals are not removed from the subsurface as may occur with excavation, pump and treat, or biodegradation of organic contaminants. Thus, understanding the potential for remobilization of contaminants is of special interest.

The focus of the NABIR program is on radionuclides and metals that: (1) Pose the greatest potential risk to humans and the environment at DOE sites; and (2) are amenable to immobilization by means of bioremediation. Thus, research is focused on the radionuclides uranium, technetium and plutonium and the metals chromium and mercury. Radioactive contaminants such as tritium and cobalt are not a focus because of their relatively short half lives, and strontium and cesium are not addressed because they are not readily amenable to biotransformation. Research is focused on subsurface sediments below the zone of root influence and includes both the vadose (unsaturated) zone and the saturated zone (both groundwater and sediments). Research on phytoremediation will not be supported by this solicitation.

NABIR is oriented toward areas that have low levels of widespread contamination; it is too costly to clean up those situations with existing

technologies. Uranium, technetium, and chromium can be especially mobile in the subsurface under certain conditions; they are risk-driving contaminants at some DOE sites. The effects of co-contaminants, such as nitrate, complexing agents, (such as EDTA) and chlorinated solvents, (such as trichloroethylene and carbon tetrachloride) on the behavior of radionuclides and metals in the subsurface is also of interest to the NABIR program. The NABIR Program supports hypothesis-driven, basic research that is more fundamental in nature than demonstration projects.

The NABIR program consists of four interrelated Science Elements (Biogeochemistry, Biotransformation, Community Dynamics and Microbial Ecology, and Biomolecular Science and Engineering). Innovative method development for the Science Elements is supported under the Assessment Element. The program also includes an element addressing ethical, legal and societal issues called Bioremediation and its Societal Implications and Concerns (BASIC). The NABIR program strongly encourages researchers to integrate laboratory and field research at DOE or DOE-relevant sites. More information on the NABIR program may be found at: <http://www.lbl.gov/NABIR/>.

The NABIR Field Research Center (FRC) and Other Field Research Sites

To encourage hypothesis-based field research and process-level understanding, the NABIR program established the Field Research Center (FRC) for long-term field studies. The FRC provides a site for investigators to conduct field-scale research and to obtain DOE-relevant subsurface samples for laboratory-based studies of bioremediation, and it is located on the U.S. Department of Energy Oak Ridge Reservation in Oak Ridge, Tennessee. The FRC is operated by the Environmental Sciences Division of the Oak Ridge National Laboratory, and it includes a contaminated and a background (uncontaminated control) area for in situ studies. Both areas are located in Bear Creek Valley (BCV) within the Y-12 Plant area.

The contaminated research site at the FRC is a 98-hectare plot containing uranium, nitrate, technetium-99, strontium, and cadmium in groundwater, soils, and sediments. To a lesser extent, metals such as mercury, copper, zinc, and lead, and organics, such as acetone, methylene chloride, tetrachloroethylene, and toluene are also present. The contaminated area includes the groundwater plume that

originated from the S-3 Waste Disposal Ponds.

The background area is approximately 163 hectares and is located in West Bear Creek Valley, about 2 km from the contaminated area. The area lies directly along the geologic strike of the contaminated area and is, therefore, underlain by nearly identical geology, mineralogy, and structure. No known contaminants have been disposed at this location throughout the history of DOE operations. The majority of the area is heavily wooded, with the exception of the Bear Creek floodplain.

Both the background and contaminated areas are well-characterized and well-instrumented, and should be available for five to ten years. The water table resides between 0 and 3 meters below the surface and is readily accessible through multilevel groundwater monitoring wells.

The FRC is responsible for general site characterization activities and provides a rich database for use by NABIR researchers. The FRC is responsible for data management, systems integration, and fundamental hydrological and geochemical modeling of the contaminated and background sites. The FRC makes these data and models accessible to all researchers. See: <http://www.esd.ornl.gov/nabirfrc> for more detailed information on the NABIR FRC.

While the FRC provides a major focus for the NABIR program, it is recognized that other sites that represent the different hydrogeological regimes found at DOE sites will also be valuable to researchers. A large fraction of the national inventory of DOE wastes resides in unconsolidated, porous media in relatively thick, vadose zones and in groundwaters low in soluble organic carbon. For this reason, NABIR investigators are encouraged to take advantage of opportunities to collect and analyze samples from arid western environments that typify the Hanford Reservation and Uranium Mill Tailings Remedial Action (UMTRA) sites. For further information on NABIR Field Research, please contact Mr. Paul Bayer (paul.bayer@science.doe.gov), the NABIR Field Activities Manager.

Resources at DOE User Facilities

Applicants are encouraged to propose making use of the capabilities provided by DOE's National Scientific User Facilities. The instrumentation and experimental facilities at these user facilities are available free of charge to users who agree to publish their findings in the peer reviewed literature. Applicants may be interested in one or