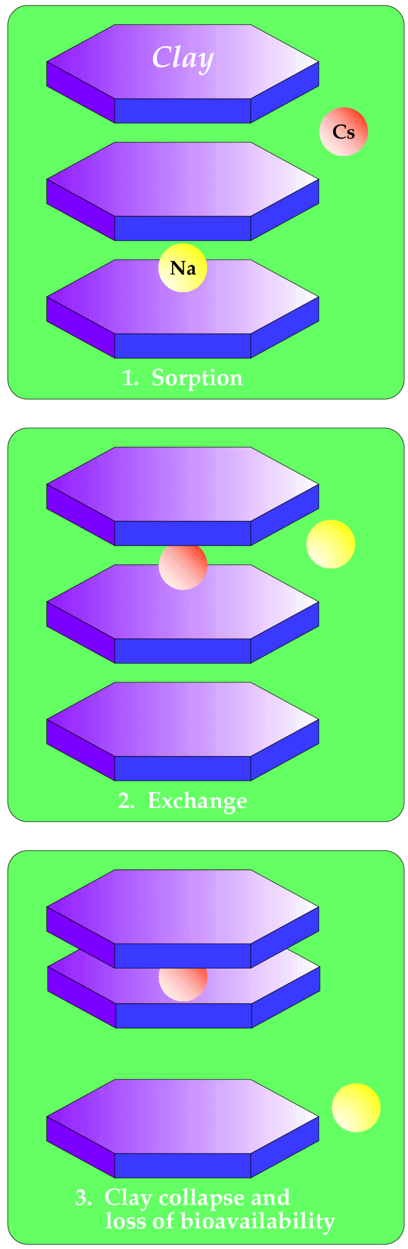
Sandia Natural Attenuation Project

Description

The Sandia Natural Attenuation Project [SNAP] is a three year program by Sandia National Laboratories to identify the mechanistic controls on metal and organic attenuation by irreversible sorption in the subsurface. SNAP will provide a scientific basis for risk-based corrective actions by helping identify only those sites where contaminants can be expected to impact the biosphere. The overall object of these efforts is to more closely tie cleanup efforts to reductions in human health risk. The ultimate benefit will be a cheaper, faster, and more efficient cleanup.



Schematic illustration of the sequence of irreversible sorption of cesium 137 on clay.

Natural Attenuation of Contaminants

Natural attenuation of subsurface contaminants occurs by a variety of mechanisms, including:

- Dilution
- Dispersion
- (Bio)degradation
- Sorption
- Radioactive decay

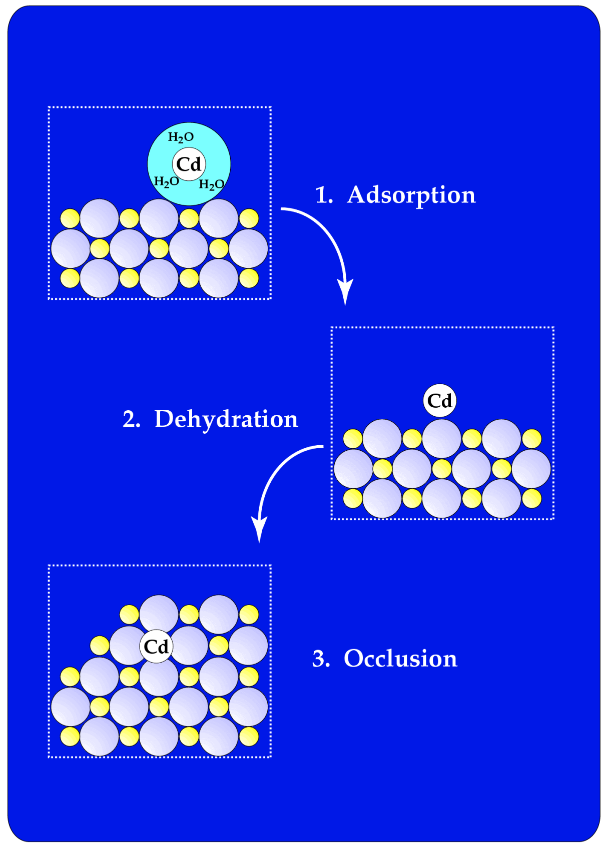
Natural attenuation causes a net reduction of contaminant toxicity and human and ecological risk, and is increasingly taken credit for in environmental remediation. Previously, contaminants in the subsurface were assumed to represent significant health risks for unlimited periods of time. In fact, many contaminants in soils and groundwaters are naturally attenuated rapidly, and in some cases, faster than they can be removed by engineered remediation schemes. A science-based approach to remediation is to monitor those contaminants that are naturally attenuated; remediate those that are not, if it can be shown that remediation actually works; and limit future exposure from mobile contaminants that remain. Recent remediation attempts at engineered removal of all contaminants have shown decidedly mixed results, with significant amounts of contaminant remaining in the subsurface, questionable reduction in health and environmental risks, and very large cost.

Natural Attenuation through Irreversible Sorption

Often metals and organics that are originally sorbed to mineral surfaces become irreversibly bound through some combination of occlusion, diffusion into dead-end pores, or clay mineral collapse (see the cesium example on the previous page). Irreversibly bound contaminants have significantly smaller potential for environmental transport. Slow desorption of short-lived radionuclides can severely limit their potential dose to the biosphere.

Technology Development

A key objective for SNAP is to develop a technical protocol for natural attenuation of metals and radionuclides that can be effectively utilized in regulatory settings. A number of technical protocols exist to guide quantification of natural attenuation of petroleum hydrocarbons and chlorinated solvents in soils. Work at Sandia is focused on generating a technically defensible protocol for guiding quantification of natural attenuation of metals and radionuclides in soils and groundwater. This general methodology will be applied to sites within the DOE complex, but the approach will be applicable to the large number of non-DOE sites contaminated with metals as well.



Schematic illustration of the sequence of irreversible sorption of cadmium on a mineral surface.

Supporting Research

Key elements of research in support of SNAP include:

- Identify soil-specific mineral sinks for metals and radionuclides of concern
- Quantify sequestering mechanisms
- Constrain metal/radionuclide release rates from surfaces
- Assess long-term stability of sequestering mechanism
- Come up with field-based methods for assessing natural attenuation

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