Long-Term Monitoring of Radionuclides in Soils and Groundwater: Lessons Learned from Chernobyl

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In this presentation, I will illustrate some lessons learned from the 18-year monitoring of radionuclide transport in soils and groundwater resulting from the accident at the Chernobyl Nuclear Power Plant in Ukraine. The Chernobyl accident resulted in the transport and accumulation, in both terrestrial and aquatic ecosystems, of a variety of radionuclides (including ^{89}Sr, ^{90}Sr, ^{95}Zr, ^{99}Mo, ^{103}Ru, ^{106}Ru, ^{134}Cs, ^{137}Cs, ^{141}Ce, ^{144}Ce, ^{154}Eu, ^{155}Eu, ^{238}Pu, ^{239} Pu, ^{240}Pu) over large areas of the former USSR and the globe. Radionuclides fell from the atmosphere to the land surface and were distributed through surface water reservoirs. They then entered the soils and percolated downward through zones of preferential flow toward the water table. A significant amount of data has been collected since 1986 about the distribution and accumulation of radioactive materials in different parts of the biosphere after the accident, including the main exposure pathways and biogenic and abiogenic mechanisms for radioactive contamination of the environment and the population. One of the most important lessons learned from Chernobyl is that the environmental half-life of radionuclides in the subsurface is different from that of conventional half-life radioactivity measurements.

Chernobyl data represent a valuable source of information, by which to improve confidence in conceptual models of exposure pathways and processes, and for testing environmental transport models and technologies. Despite the fact that background conditions and expected modes of contamination for Chernobyl are not directly analogous to other contaminated sites, the lessons learned from investigations of contaminant transport within the Chernobyl exclusion zone can be used to study some of the flow and transport processes at other sites. The Chernobyl experience and long-term data sets could aid in providing critical validations of site characterization methods, monitoring programs, and performance-assessment modeling at several U.S. Department of Energy contaminated sites.

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