Assessment of radionuclide distributions at an Australian legacy radioactive waste site

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Abstract

During the 1960s, low level radioactive waste was buried in shallow trenches at a disposal site in south-eastern Australia, known as the Little Forest Burial Ground. This paper discusses preliminary findings of research into the distribution of radionuclides at the site, including soils, groundwater and biota. In particular, we are studying the mobility of radionuclides; and their uptake by plants, insects and small animals. Groundwater monitoring indicates that there has been limited movement of radioactivity, other than a tritium plume that extends at least 100 m. The tritium results are being used to define the groundwater flowpaths, and the effects of seasonal and climatic factors. The pattern of tritium distribution suggests that the source of tritium is predominantly within the waste materials. However, tritium derived from a nearby municipal landfill contributes to tritium concentrations in some groundwaters, with smaller amounts from cosmogenic tritium and atmospheric deposition originating from the nearby HIFAR reactor (shut down in 2007). The tritium data provide a record of water movement against which the relative mobility of other radionuclides can be assessed. There are measurable amounts of ^{60}Co, ^{90}Sr, ^{137}Cs and traces of actinides in some soils, groundwater and vegetation samples taken in close proximity to the disposal area. Isotopic ratios such as $\delta^{13}C$, $\delta^{18}O$, $\delta^{2}H$, $\delta^{34}S$ and $^{87}Sr/^{86}Sr$ are being measured in groundwater, in addition to the radioactive isotopes originating from the disposed wastes. Synchrotron EXAFS and XANES studies are being applied to study elemental chemical environments and oxidation states in the soils at the site. We have recently undertaken a major geophysical investigation and drilling program; and installation of an improved array of water sampling boreholes is planned. Therefore, many more samples of groundwater and soils are becoming available for analysis.