DETECTION AND DIFFERENTIATION OF CONTAMINATION THROUGH A COMPARISON OF OBSERVED LEVELS IN HISTORICAL ENVIRONMENTAL SAMPLING DATA

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ABSTRACT

In summarizing more than a decade of environmental monitoring data from the Hanford Site, we noted that grouping data by analysis, rather than by medium, enhanced visual as well as statistical interpretations. By plotting running-averages of individual radionuclides on the same graph, for different media, we evaluated environmental trends to determine whether or not a local impact had been observed. This approach may enhance ones ability to interpret environmental monitoring data collected following an unplanned release of radionuclides. This technique provides a more holistic approach to the evaluation of environmental monitoring data than has traditionally been practiced.

INTRODUCTION

Nuclear operations at the Hanford Site have been conducted since the mid 1940s. The Hanford Site, comprising an area of just under 1500 km^2, is located in a semi-arid region of southcentral Washington State and is effectively bounded on the north and east by the Columbia River. Air, water, and native vegetation samples have been collected for analysis of radionuclide levels since Site operations began. Other media, such as selected foodstuffs and wildlife, were added to the routine program in the 1960s, and during the 1980s fruit, wine, wheat, and alfalfa samples were added.

Establishing appropriate and logical interpretations of environmental monitoring data is difficult in the absence of similar data obtained either concurrently from another location or from an historical trend. Thus, grouping techniques have been used to provide better interpretation of historical Hanford environmental data (over time or space or both) for visual as well as statistical interpretation. The traditional method has been to compare the data representing potentially affected locations (i.e., indicator locations) with data for background or control locations.

Plotting individual radionuclide data together, for each of several media, rather than by medium (the traditional method of grouping environmental data), permits the comparison of trends in one medium with similar or dissimilar trends in another. For long-lived radionuclides, such as strontium-90 or cesium-137, similar long-term trends might be expected for air, native vegetation, soil, and farm products. If similar trends are not observed, then either a sampling and/or analytical bias may have occurred in one or more of the media evaluated, or more importantly a local impact may have been detected. In the former case, these dissimilarities could suggest the need to reevaluate the monitoring program for representativeness of samples and accuracy of data. On the other hand, if a local impact appears to have been observed, additional confirmatory sampling and analysis may be required. It is important to note that short-term changes in some media may not be reflected in other media because of differences in environmental pathways or sampling frequencies.

Determining how to best use environmental monitoring data in the event of an emergency is especially challenging, because the data are often not available until well after protective action recommendations have been made. Because only a limited number of environmental samples are available in the early stages of an emergency, it is essential that the available data be appropriately evaluated and interpreted.[1] During an emergency, having available plots of long-term data trends and preestablished protocols for grouping the data are critical for evaluating environmental monitoring data.

EVALUATION TECHNIQUE

The method used to display data for this paper was sequential plotting of 5-year running averages as a function of time, which has the potential advantage of revealing trends or periodicity in the data. In this technique, 5-year groups of data are averaged to provide the result to be plotted for the last year of that group (e.g., the 1977 through 1981 results were averaged to provide the result to be plotted for 1981). Similarly, the 1978 through 1982 values were averaged to provide the 1982 running-average result. Then, the next 5-year period of values were averaged and similarly plotted and the process was continued until the latest year value was obtained. These running-average graphs were then plotted, by individual radionuclide, for several media collected from a given location or region.

Running-average summaries of the observed radiological conditions in both upwind and downwind locations from the Site are included for strontium-90, cesium-137, and plutonium-239 in several media. The environmental media include airborne particulates (A), milk (M), produce (P, leafy vegetables), soil (S), and native vegetation (V). Although other sampling media (e.g., wildlife, fruit and wine, wheat and alfalfa) are included in the routine Hanford surveillance program, the relatively small number of data available precluded this type of comparative analyses.

OBSERVATIONS

Examples of the long-term trends for strontium-90, cesium-137, and plutonium-239,240 are shown in Figures 1 through 3, respectively, using data from reports for the Hanford Site.[2-8] The dissimilar trend shown in Figure 1 for soil compared to the other media is apparently the result of

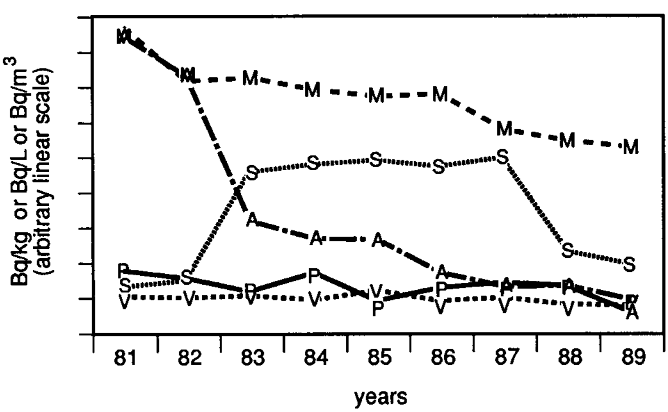

FIGURE 1. Five-Year Running Average Concentrations of Strontium-90 at an Upwind, Background Location

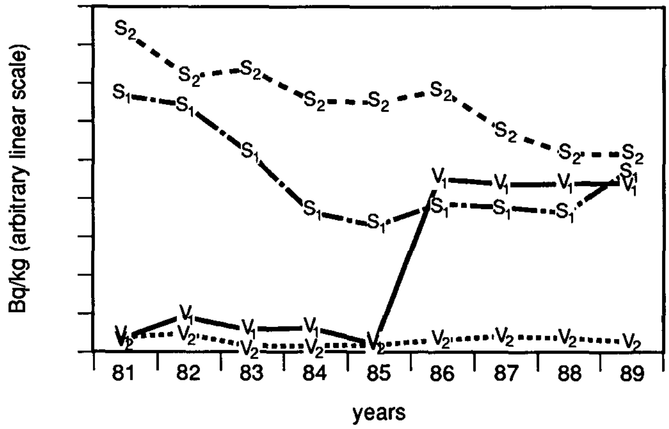

FIGURE 2. Five-Year Running Average Concentrations of Cesium-137 at Two Different Downwind Locations

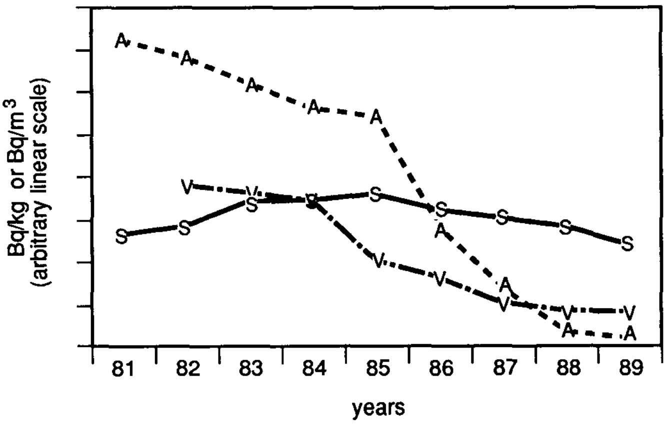

FIGURE 3. Five-Year Running Average Concentrations of Plutonium-239, 240 at an Upwind, Background Location

sampling or analytical biases. Figure 2 clearly shows the influence of fallout from Chernobyl in 1986 on native vegetation samples collected soon after the accident. The samples from location 1 were collected shortly after Chernobyl fallout in the Tri Cities, whereas the samples from location 2 were collected prior to that time. Figure 3 provides a comparison of long-term plutonium concentrations in air, soil, and vegetation samples from the local environs. The apparent precipitous decrease in airborne levels of plutonium was caused by a change in analytical procedures. However, the overall trend has been downward since the world-wide cessation of atmospheric testing of nuclear weapons occurred in the early 1980s.

CONCLUSIONS

The use of this technique provides a better understanding of historical contamination levels and enhances the ability to detect and differentiate the presence of local contaminants from those contaminants that might have originated elsewhere. This technique may also be useful following the release of contaminants during an emergency situation.

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