

## RESPONSES TO QUESTIONS ON ACTINIDE MIGRATION STUDIES

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### **Comment 1: $K_d$**

*What is  $K_d$ ? Bruce Honeyman and Peter Santschi say that "for a radioactive element, the  $K_d$  is simply the ratio of the activity (disintegration's per minute) concentration of an element in the particle phase... to the corresponding activity concentration in the 'dissolved' phase" ("A Conceptual model of Pu Movement through RFETS Soils," may 26, 1997; Document #CSM-3-97, p.2 [this definition gets repeated in the Panel's FY 1997 Final Report, p. 14]). This paper goes on to say that an element with a high  $K_d$  is more likely to be insoluble and thus not very mobile in water. This is clear. What isn't clear is how and why activity concentration has anything to do with  $K_d$  wouldn't the activity of a given quantity of Pu-239 be identical regardless of its chemical form? Please explain.*

Response 1: A  $K_d$  (partition coefficient) value can be thought of in the way: In a simple partitioning model, the element of interest, in this case plutonium (Pu), resides in two forms: associated with particles and associated with the solution phase. The element with a low  $K_d$  has a greater representation in the solution phase than with the particle phase. The chemical form of Pu regulates the partitioning of Pu between solution and particle phases. The activity of Pu can simply be considered to be a surrogate for number of atoms (i.e., a given activity of 239,240Pu will yield a corresponding number of 239,240Pu atoms). Thus, the activity of Pu (e.g., pCi/g Pu) is independent of its chemical form. However, the distribution of the Pu activity in the environmental (i.e., the distribution of Pu atoms) does depend on the chemical form.

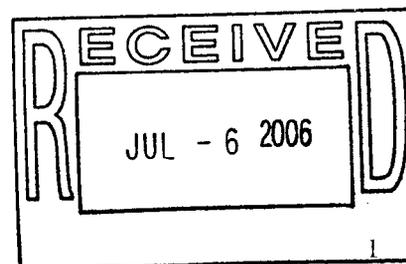
### **Comment 2: Sequence in the protocol for extracting Pu:**

*The Actinide Migration Panel's sequence for extracting Pu (exchangeable, carbonates, sesquioxides, organic matter and residual) differs from that employed by Litaor and Ibrahim (soluble, exchangeable, carbonates, organic matter, sesquioxides, and residual). As Litaor points out, this difference in approach produces different results. Please provide an explanation in lay person's terms of the meaning of these terms, the difference between the two approaches, the relative strengths and weaknesses of the two approaches, and the different outcomes of the two approaches.*

Response 2: There are a number of approaches to selective extraction. The fiscal year 1997 (FY97) report outlines a few of them and provides some citations. The approach that is taken depends on the kind of information that a person wants to get. In the case of the FY97 work, we were interested in the potential of metal oxide reductive dissolution for the release of Pu. Consequently, we positioned the 'sesquioxide' step earlier in the sequence than was the case with Imbrahim and Litaor so that the samples would be minimally altered before the step of greatest interest. However, in both cases, neither of the extraction schemes are 'calibrated'. For example, it is not unambiguously clear that the extractants are specific for the target 'phase'. As a consequence, one of the objects this year is to evaluate the issue of particle associations of Pu by analyzing the 239,240Pu/241Am ratios. A constant 'extractant' ratio throughout the series will be indicative of a close particle association between Pu and relatively refractory particle phases.

### **Comment 3: Questions regarding soil sampling:**

a.) *Who takes samples for the Actinide Migration Panel?*



**ADMIN RECORD**

Response 3a: Surface soil samples taken in FY97 for the Actinide Migration Studies (AMS) were taken by the Site Sampling Team (under the supervision of Rocky Mountain Remediation Services [RMRS]); at that time, the team members were hourly Kaiser-Hill employees. Since then the team members have been moved to Advanced Sciences Incorporated (ASI), a third tier subcontractor. This sampling team also collected the surface soil samples for the Walnut and Woman Creek Watershed Modeling effort.

Subsurface soil samples for the FY97 study were collected using a truck-mounted Geoprobe by the groundwater sampling team composed of employees of Tiera Incorporated, a third tier contractor at the Site.

Pond sediment samples have been collected for AMS by ASI. Surface water samples for the FY98 ultrafiltration task will be collected by RMRS surface water sampling personnel.

b.) *Who determines where the samples are to be taken?*

Response 3b: The locations of samples are decided by the AMS Group in consultation with Site personnel knowledgeable of Site history. For the surface soil sampling just completed, the Environmental Protection Agency (EPA) and the Colorado Department of Public Health and the Environment (CDPHE) were also consulted.

c.) *Litaor said samples used by the panel were taken in areas where the soil have been disturbed by previous activities. Litaor wasn't present, so he could be mistaken. But isn't it true that members of the Actinide Migration Panel also were not present and that therefore they do not have control over the soil samples they analyze?*

Response 3c: As indicated in the attachment to my letter to you dated February 25, 1998, Ms. Annette Primrose, former Operable Unit 2 Manager from 1990-1996, staked and collocated surface and subsurface soil sampling sites using locations specified by Dr. Honeyman and Dr. Santschi. AMS Group Members were not present at the time of sampling, but were consulted in detail about the sampling locations. The samples are controlled through chain-of-custody documentation from the time of sampling until the samples are delivered to the laboratory.

d.) *Who determines what sampling method to follow?*

The sampling methods followed for the FY97 sampling events were specified in the Work Scope Document written by Dr. Honeyman and Dr. Santschi, dated May 26, 1997. The sampling method followed for the FY98 surface soil sampling for the Watershed Modeling was the RFP method; this is a documented Rocky Flats soil sampling procedure. It was chosen in consultation with AMS Group Members, the EPA, and the CDPHE.

e.) *What factors govern the number of samples collected?*

The number of samples is governed by the data quality objective (DQO) of the particular task and budget. For the AMS, these are determined by the AMS Group.

- f.) *Originally the Panel stipulated that samples should be frozen before being sent to Santschi for analysis. What was the reason for freezing the samples? Was this approach abandoned at least for some samples? Who made the decision? On what basis?*

One intact sediment core was frozen from each pond that was sampled per the Honeyman and Santschi Work Scope Document, dated May 26, 1997. The cores were frozen in the upright position to preserve the vertical structure of the cores. While frozen the cores were cut into 1-centimeter intervals to analyze to produce radionuclide profiles. The approach was used for a specific purpose, as detailed in the FY97 Work Scope document. It was not abandoned.

***Comment 4: Inventory of Actinides in Soil***

*In reply to CDPHE Actinide Migration investigators indicated that they were "not planning to inventory the total quantity of actinides in the soils" (Response to CDPHE comments on Actinide Migration Documents, DCS-015-97 [August 5, 1997], p.3). Explain this decision and describe what approach is proposed as a substitute method for determining quantities of actinides in the soil at Rocky Flats.*

This is not a major focus of the Actinide Migration Study. The main purpose of the study is to further our understanding of actinide movement in the Rocky Flats environment. After the transport processes are better defined, information on the distribution of actinides in the Rocky Flats environment will be used to quantify their movement in the short- and long-term by chemical and physical processes.

***Comment 5: Locating hot spots:***

- a.) *Does the Actinide Migration Investigation envision a program of sampling throughout the contaminated area at Rocky Flats to detect all hot spots? If not, why not? What method will be used instead? Explain the reasons for the choice.*
- b.) *If gamma survey is intended as the method for detecting hot spots, what are the strengths and weaknesses of this approach? What is the margin of error? What may be missed?*

Response 5: The charter of the AMS is not to conduct a hot spot sampling program. However, in accordance with the "Accelerating Cleanup: Focus on 2006" Plan, Industrial Area characterization will be conducted for volatile organic and radionuclide hot spots over the next two fiscal years. This will be conducted by the Kaiser-Hill Site Closure Projects Group. The analytical methodology for this sampling has not yet been determined. In addition, at Site Closure, any residual contamination (which could be as hot spots) will be evaluated as part of the final Site Corrective Action Decision/Record of Decision (CAD/ROD).

***Comment 6: Other modes of actinide transport***

- a.) *The work plans for various future research related to the Actinide Migration Studies do not show that attention will be paid to routine (e.g., freezing and thawing of soil) and exceptional (e.g., earthquake disturbance) sources of possible actinide transport. How will these be included in the final result?*

Response 6a: These mechanisms, both the routine and the exceptional, would result in physical transport of actinides. This can be evaluated as what-if scenarios using the Watershed Erosion Model after it has been calibrated to the Site surface water drainages.

b.) *What about transport due to the plant uptake? What about animal ingestion and transport?*

Response 6b: These mechanisms will be evaluated as part of the refinement of the Conceptual Model for the Site surface water drainages.

**Comment 7: Budget**

*What budget projections have been made for the Actinide Migration Investigation for FY 1999? Or 2000? Have projections made for work beyond FY2000?*

Response 7: The budget projections for FY99 and FY00 are \$750K. After that time, the budget is uncertain because the work scope has not yet been defined.

**Comment 8. Recent events**

a.) *Litaor had in place an elaborate system for monitoring actinide movement downhill of the 903 Pad. Has this equipment been disassembled? Or is it still in use?*

Response 8a: The system of Dr. Litaor's was for the purpose of sampling shallow groundwater. It did not measure inputs to surface water. Much of the system is in place, but is not currently functional.

b.) *Was any real-time monitoring of actinide migration happening during the unusually wet period of August 1996?*

Response 8b: Real-time monitoring of actinide migration in surface water occurs continuously. Surface water monitoring stations located at RFCA Points of Evaluation and Compliance collect water samples during runoff events as well as baseflow conditions. The sampling is flow weighted so that more samples are collected during large events. Samples are analyzed for total suspended solids, and plutonium, americium, and uranium isotopes.