Sr-90 in the Vadose Zone at INTEC

Breakout Group Report

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Can science help address Sr-90 Problem?

- **Is there enough time?**
  - **RI/BRA/FS has been submitted.**
  - **ROD planned Dec 2006.**

  ⇒**Yes, CERCLA requires 5 year reviews to evaluate effectiveness. Could incorporate new information at review.**

Can science help address Sr-90 Problem? (continued)

- Current solutions
  - Infiltration control – caps, water diversions.
  - Hydraulic conditions not appropriate for pump and treat of perched water
  - Contingent remedy, pump and treat the Snake River Plain Aquifer if Sr-90 breakthrough occurs.
- No currently proven options to prevent migration by interception or immobilization of Sr-90.

Mass balance

- Where is the Sr-90?
  - Surficial alluvium
  - Perched water bodies
  - Sedimentary interbeds
- Significant uncertainty in mass balance
  - Few sampling data in source zone.
  - Few sampling data from solids in basalt and interbeds.
  - Currently no wells access perched zones directly under tank farm.
  - Limited well distribution elsewhere.

Mass balance (continued)

- **Mass balances on other contaminants also incomplete.**
  - **Tc-99, inorganic chemicals, other isotopes**
- **Knowing the location matters from a public-relations perspective**
  - **DOE can't afford to be caught off guard if Sr-90 appears in an unexpected location**

Hydrology – many unknowns

- Flow paths through vadose zone uncertain:
  - Residence time in perched water
  - Flow paths around or through interbeds
  - Flow path alterations in response to recharge
- "Sr-90 will follow the Tc-99 through the vadose zone."
  - True statement??
- Sr-90 retention capacity of flow path(s) unknown.
- Other issues:
  - Dual porosity model—appropriate or not?
  - Dead-end flow paths—are they important?
  - Residence time distribution of flow paths unknown.

Retention Mechanisms

- Retention of Sr-90 can occur in:
  - alluvium
  - interbeds / perched water zones
  - Fracture fill material in basalts
- Is retention reversible (ion exchange, isotope exchange) or irreversible (coprecipitation in calcite)
- Mechanisms probably change over time and location
  - Conditions immediately after release (ca. 1970s) were different from current and long-term conditions (~400 yrs).

Objectives of science program

- **Near-term:**
  - **Better support existing model because can't get additional data for independent verification.**
- **Longer-term:**
  - **Develop methods to intercept Sr-90 in the vadose zone / perched water.**

Approach – short term

- Study the existing core from the Tank Farm area.
  - Cores of alluvium and interbed material currently stored at INTEC
  - Compare Sr-90 associations in core with expected distribution based on processes included in conceptual model (ion exchange, co precipitated with calcite).
    - Sequential extraction
    - microautoradiography
    - spectroscopy
  - Predict the mobility of Sr-90 in source and interbeds based on understanding of retention mechanisms.

Approach – short term (continued)

- **Replicate release in lab column experiment with simulated waste to study processes under controlled conditions.**
- **Field sampling data for isotopes and chemicals with mobility less than Tc-99 and greater than Sr-90. Definition of flow paths and velocity distribution in vadose zone.**

Approach – longer term

- Investigate methods to intercept Sr-90 above the water table, for example:
  - apatite reactive barriers
  - viscosity altering polymers
  - aqueous phase microbially activated reagents
    - urea hydrolysis
  - gas phase microbially activated reagents
    - Triethyl phosphate

Approach – longer term (continued)

- Placement of barriers / treatment zones
  - horizontal / vertical
  - Identify paths along which contaminants migrate
    - Placement of treatment
    - Intercept or block

Conclusions

- The science program can help within a 5-year time frame
  - Where the Sr-90 is now and where it will appear next
  - Methods to immobilize the Sr-90 in perched water and vadose zone