Remedy Selection and Implementation for Radionuclides in Soil and Ground Water

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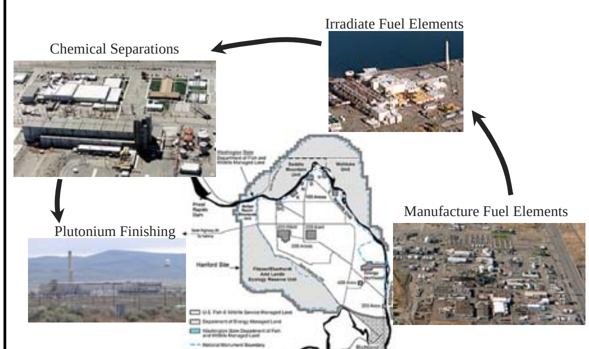
Context

- Attenuation and transport processes are important to consider for remediation decisions in the vadose zone and groundwater
  - important for both remedy selection and remedy implementation
- Remedy technology decisions consider the intersection of
  - radionuclide characteristics
  - the target problem
  - remedy functionality
  - remediation objective

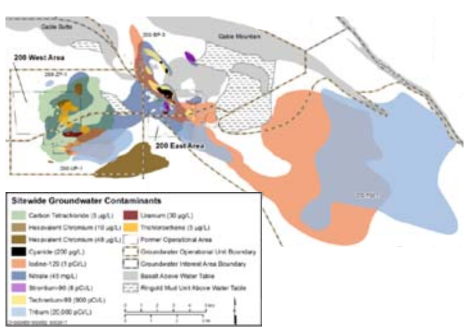
Outline

- Case study background – Hanford Site
- Attenuation and transport processes
- Remedy selection considerations
- Remedy implementation considerations
- Conclusions

Hanford Background

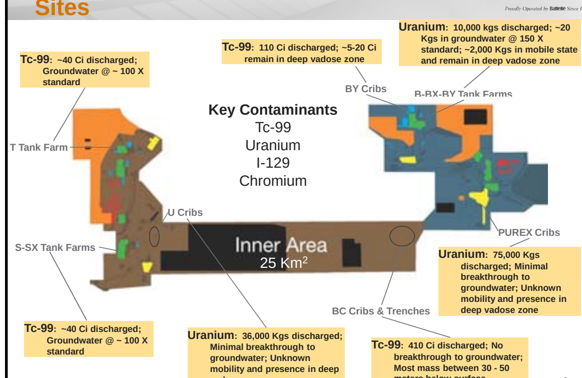


Hanford Background



DOE 2017

Central Plateau: Deep Vadose Zone Sites



Hanford Background

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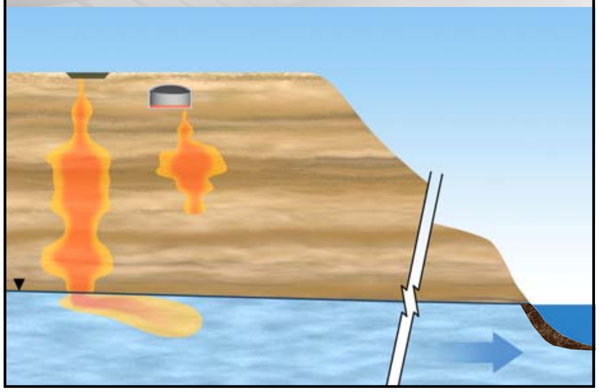

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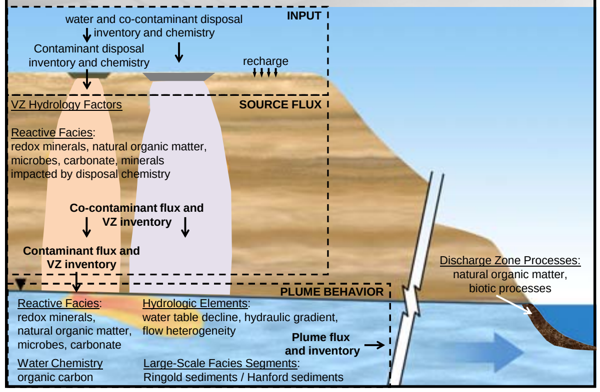

Attenuation and transport processes

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- What do we need to know?
  - Vadose Zone
    - Quantify vadose zone contaminant flux to groundwater
    - Determine where and what type of mitigation is needed
  - Groundwater
    - Quantify plume dynamics and secondary source characteristics
    - Exit strategy for P&T
      - Transition to MNA
  - Coupled System
    - Assess continuing and long-term sources not related to current plumes

9

Hanford Background

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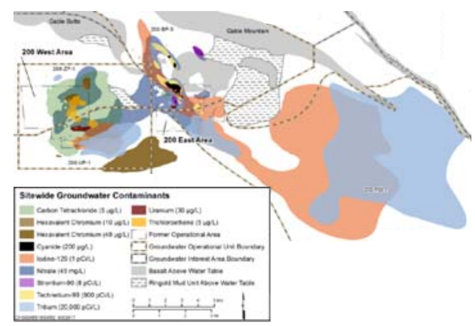

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10

Central Plateau: Deep Vadose Zone Sites

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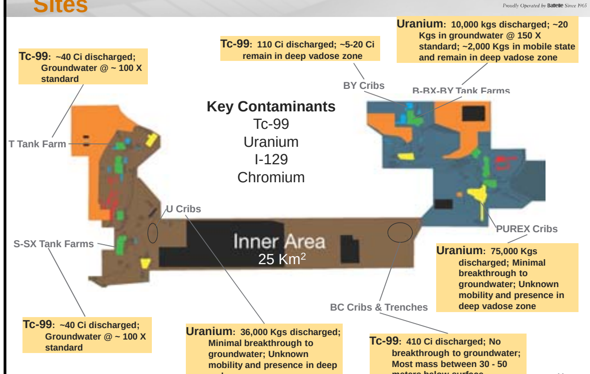

11

Attenuation and transport processes

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- Processes
  - Hydraulic attenuation
  - Adsorption
  - Transformation
  - Sequestration
- Ramifications
  - Temporal profile of source flux and concentrations
  - Inventory of mobile contaminants
  - Spatial distribution information
  - Plume dynamics

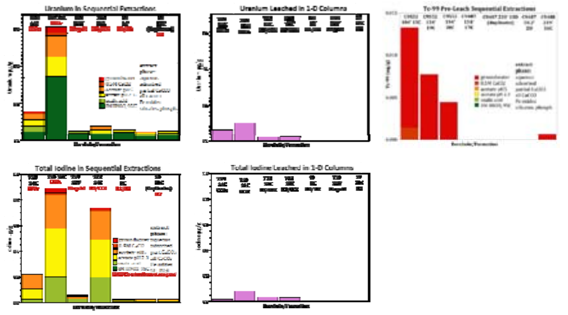
12

Attenuation and transport processes

- Vadose zone attenuation/transport SAP
  - Target sampling and analysis for
    - Important hydrologic units
    - Representative contaminant discharges
    - Problematic waste sites
  - Define analyses based on national guidance for attenuation tailored to site needs
    - COC and primary biogeochemistry
    - Sequential extractions and other indicator diagnostics
    - Leaching or batch Kd studies to support estimating transport parameters
    - Hydraulic/physical properties where needed to support model configuration

13

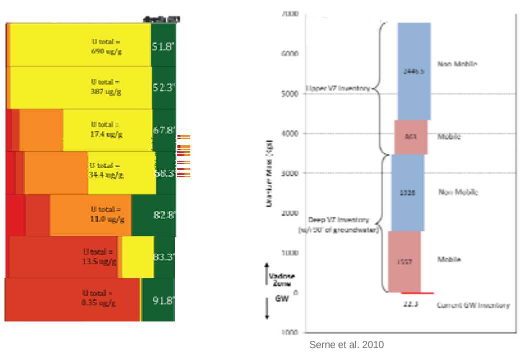
Reaction and Mobility – Vadose Zone



Truex et al. 2017a
Szecsody et al. 2017

14

Distribution and Mobility

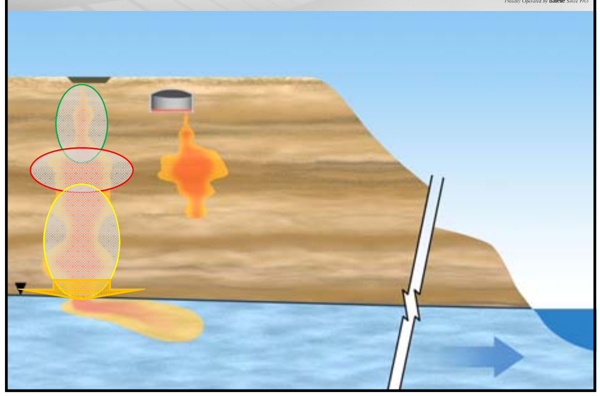


Szecsody et al. 2010

Serne et al. 2010

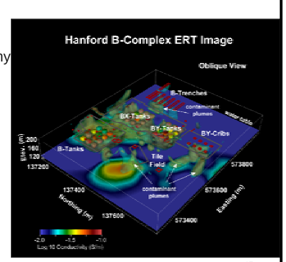
15

Source characteristics (location/flux)



Evaluation of VZ Transport

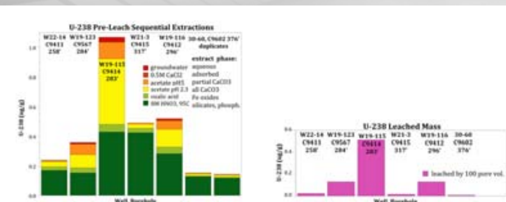
- Contaminant Distribution
  - Geophysical logging
    - Spectral gamma log
    - Neutron moisture log
  - Geophysics
    - Electrical Resistivity Tomography



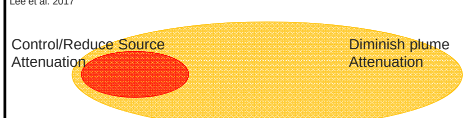
Johnson and Wellman 2013; https://e4d.pnnl.gov/

17

Reaction and Mobility - Groundwater



Lee et al. 2017

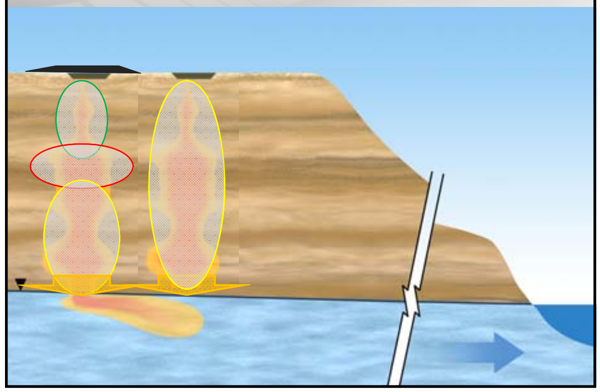


18

Technology evaluation

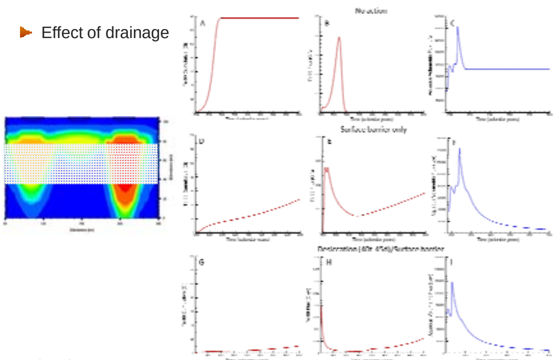
- Treatability tests and assessments
  - Determine technology in relation to
    - radionuclide characteristics
    - the target problem
    - remedy functionality
    - remediation objectives
- Examples
  - Soil flushing
  - Surface barriers/desiccation
  - Uranium sequestration

Source characteristics (location/flux)



Surface Barrier

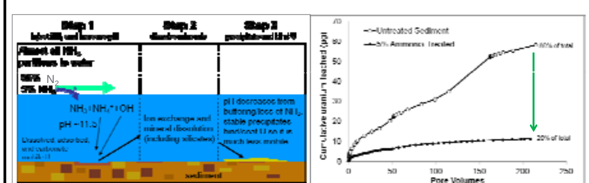
- Effect of drainage



Truex et al. 2017b

Geochemical stabilization – vadose zone

- Ammonia gas for uranium sequestration



Szecsody et al. 2012

Remedy Implementation

- Vadose zone remediation target
  - Where
  - What chemical form
  - How much flux reduction
- Diminishing plumes
  - How much is needed
  - Secondary or continuing sources
- Transition to MNA
- Current plumes versus long-term sources

Remedy Implementation

- Adaptive Site Management
  - National Research Council
  - ITRC
    - Remediation Management of Complex Sites
    - http://rmcs-1.itrcweb.org/
- Exit Strategies (P&T)
  - http://bioprocess.pnnl.gov/Pump-and-Treat.htm
- Monitoring
  - Objectives based
  - Performance metrics
  - Transition for long-term

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