Actinide Migration Evaluation (AME)

- AME group established to provide guidance on issues of actinide behavior and mobility in surface water, groundwater and soil environs
- Draws on state-of-the-art scientific understanding of actinide chemistry, geochemistry, migration and erosional transport
- Knowledge used to help characterize current environmental conditions and recommend a pathway forward for site personnel
  - Long-term protection of surface water quality during/after closure

AME External Advisory Group

- Where appropriate, external advisory members identify research/techniques and approaches that can be used to solve short and long-term issues
- External advisors cover broad range of expertise
- External advisors explicitly independent of RFETS-funded projects

Fundamental Actinide Environmental Behavior

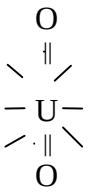
- Extensive US/International research on environmental behavior in diverse matrices (30-40 yrs.) has provided a good base of fundamental understanding

Plutonium

- In natural waters, Pu solubility is limited by formation of amorphous $Pu(OH)_4$ or polycrystalline PuO_2
- Total solubility ~10^{-8} – 10^{-9} M limited by $Pu(OH)_4$
- Pu(IV) sorbs strongly to mineral surfaces
  - Accountable for low Pu concentrations even in preserve of $Pu(OH)_4$ (am) and PuO_2(c)
  - A dominant and often controlling feature of Pu geochemistry

Uranium

- Uranium shows less redox activity and is present in natural and sea waters as soluble U(VI) complexes



- U(IV) is insignificant in natural waters

Development of a Conceptual Model

- AME recognized the need for a conceptual model early in process
- Conceptual model used to document understanding of potential migration of pathways and processes for radionuclides
- Served air an integration focus for Site, Advisory Team, and Public Evaluation
- Path forward: specific paths defined, prioritized and implemented

Environmental Chemistry Issues – Pu/Am

- Data amassed at RFETS is consistent with expectations of Pu/Am environmental behavior
- Pu/Am in RFETS surface waters has extremely low solubility – femptomolar range (10^{-15}M) similar to global fallout
- Reducing conditions do not remobilize Pu
- Bulk of Pu/Am associated with small (<2ym) colloidal particles that settle in ponded water
- EXAFS studies show unambiguously that Pu in soils (903 Pad)
  - In oxidation state IV
  - Chemical for PuO_2

Environmental Chemistry Issues – U

- Leakage of liquids from solar ponds has produced a contaminant plume containing nitrates and U
- Isotopic analysis 235/236/238 – U is being used to help identify origins of plume
- Geochemical modeling (USGS) suggests U should be free to migrate in groundwater (SPP) unless attenuated
- Data suggests U is attenuated relative to nitrate
  - Mechanism not yet identified
  - Sorption or precipitation

Transport Models

- Transport models that assume soluble forms are relevant for U
- Transport models that assume soluble forms are irrelevant for Pu
- Use of RESRAD is not scientifically defensible for Pu
- For Pu transport predictions, a particulate – transport model is needed (Erosion Model)