

**U.S. DEPARTMENT OF ENERGY  
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

**PRESENTATION TO  
THE NUCLEAR WASTE TECHNICAL REVIEW BOARD**

**SUBJECT: SUMMARY OF  
UNSATURATED-ZONE STUDIES**

**PRESENTER: BARNEY D. LEWIS**

**PRESENTER'S TITLE  
AND ORGANIZATION: UNSATURATED-ZONE HYDROLOGY SECTION CHIEF  
YUCCA MOUNTAIN PROJECT  
U.S. GEOLOGICAL SURVEY  
DENVER, COLORADO**

**PRESENTER'S  
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**REGISTRY HOTEL, DENVER, COLORADO  
JUNE 25-27, 1991**

# **CHARACTERIZATION OF METEOROLOGY (ALAN FLINT, USGS)**

## **OBJECTIVE:**

- **CHARACTERIZE THE METEOROLOGICAL CONDITIONS SURROUNDING YUCCA MOUNTAIN WITH PARTICULAR EMPHASIS ON PRECIPITATION**

# **CHARACTERIZATION OF INFILTRATION (ALAN FLINT, USGS)**

## **OBJECTIVES:**

- **CHARACTERIZE INFILTRATION-RELATED HYDROLOGIC PROPERTIES AND CONDITIONS OF SURFICIAL MATERIALS**
- **CHARACTERIZE PRESENT-DAY INFILTRATION PROCESSES AND NET-INFILTRATION RATES IN SURFICIAL MATERIALS**
- **CHARACTERIZE THE RANGE AND SPATIAL VARIABILITY OF INFILTRATION RATES, FLOW VELOCITIES, AND FLOW PATHWAYS IN SURFICIAL MATERIALS; AND TO CHARACTERIZE THE RELATION AMONG PRECIPITATION, RUNOFF, INFILTRATION, AND EVAPORATION UNDER VARYING CLIMATIC CONDITIONS**

# **MATRIX HYDROLOGIC PROPERTIES**

## **(ALAN FLINT, USGS)**

### **OBJECTIVE:**

- **DETERMINE FLOW-RELATED, MATRIX HYDROLOGIC PROPERTIES OF THE MAJOR UNSATURATED-ZONE GEOHYDROLOGIC UNITS BY LABORATORY TESTS ON SAMPLES TAKEN FROM THESE UNITS AND TO ESTIMATE THE VALUES AND UNCERTAINTIES OF THESE PROPERTIES OVER LARGE VOLUMES OF ROCK BENEATH YUCCA MOUNTAIN USING STATISTICAL AND GEOSTATISTICAL METHODS**

# **MEASUREMENT OF FLUID-FLOW POTENTIAL FIELD (JOE ROUSSEAU, USGS)**

## **OBJECTIVE:**

- **DEFINE THE FLUID POTENTIAL FIELDS AND TO DETERMINE THE *IN SITU* BULK PERMEABILITY OF THE UNSATURATED ROCK OF THE PROPOSED REPOSITORY HOST ROCK AND SURROUNDING UNITS**
- **EXAMINE THE EXTENT OF FRACTURING, BRECCIATION, AND GOUGE DEVELOPMENT ASSOCIATED WITH THE SOLITARIO CANYON FAULT AND TO EVALUATE THE GEOHYDROLOGIC SIGNIFICANCE OF FAULT-RELATED FEATURES ON WATER MOVEMENT WITHIN THE UNSATURATED ZONE**

# **AIR-PERMEABILITY TESTING PROGRAM**

## **(GARY LECAIN, USGS)**

### **OBJECTIVES:**

- **MEASURE IN-SITU MATRIX AND FRACTURE AIR PERMEABILITY**
- **QUANTIFY THE VOLCANIC TUFF HETEROGENEITY AND ANISOTROPY**
- **MEASURE AND QUANTIFY AIR-PERMEABILITY CHARACTERISTICS OF FAULTED ROCK**
- **ESTIMATE THE MATRIX AND FRACTURE IN-SITU EFFECTIVE POROSITIES**
- **PROVIDE EFFECTIVE PERMEABILITIES AND POROSITIES TO AID IN ESTIMATING WATER VAPOR AND GAS STORAGE AND TRANSPORT AT YUCCA MOUNTAIN**

# **GASEOUS AND SEMI-VOLATILE RADIONUCLIDES (U-SUN PARK, SAIC)**

## **PRESENTATION TOPICS:**

- **RADIONUCLIDES THAT COULD POTENTIALLY UNDERGO GASEOUS TRANSPORT AT REPOSITORY TEMPERATURES**
- **TRANSPORT OF SEMI-VOLATILE RADIONUCLIDES UNDER GASEOUS CONDITIONS AT REPOSITORY TEMPERATURES**
- **DATA NEEDS AND TEST PLANS TO ADDRESS REGULATORY COMPLIANCE**

# **PHYSICAL AND CHEMICAL CHARACTERISTICS OF TOPOGRAPHICALLY AFFECTED AIR FLOW IN OPEN BOREHOLES (ED WEEKS AND DON THORSTENSON, USGS)**

## **OBJECTIVES:**

- **DESCRIBE THE PRE-WASTE EMPLACEMENT, GAS-FLOW FIELD IN THE PRESENCE OF OPEN BOREHOLES**
- **DEVELOP AND UNDERSTANDING OF THE FACTORS THAT PRODUCE AND AFFECT THIS FLOW FIELD**
- **DETERMINE TRANSMISSIVE AND STORATIVE PROPERTIES FOR GASEOUS FLOW**
- **DEVELOP A PRELIMINARY MODEL OF THE TRANSPORT OF INDIVIDUAL GASEOUS SPECIES**



# **EFFECTS OF REPOSITORY DEVELOPMENT**

**(DALE WILDER, LLNL)**

## **PRESENTATION TOPICS:**

- **PHYSICAL EFFECTS OF WASTE PACKAGE  
EMPLACEMENT**
  - **IMPROVED BY ADVANCES IN HYDROLOGIC AND  
CHEMICAL UNDERSTANDING**
- **MODELING ACTIVITIES NEED TO DESCRIBE THE  
HYDROLOGIC AND GEOCHEMICAL ASPECTS OF  
LABORATORY AND FIELD SYSTEMS**
- **MODEL SIMULATIONS COMPARED TO LABORATORY  
AND FIELD STUDIES IDENTIFY ADDITIONAL DATA NEEDS  
AND MODELING DIRECTIONS**
- **MODEL VALIDATION WILL BE CONCENTRATED FOR  
FUTURE WORK**

# **ROLE OF NON-EQUILIBRIUM FRACTURE - MATRIX FLOW IN SITE CHARACTERIZATION (TOM BUSCHECK, LLNL)**

## **PRESENTATION TOPICS:**

- **DISCUSSED EFFECTS OF EQUILIBRATED AND NON-EQUILIBRATED CONDITIONS BETWEEN FRACTURES AND MATRIX MATERIAL AND BETWEEN WELDED AND NON-WELDED UNITS OF VARYING PERMEABILITY**
  
- **CONCLUDED THAT**
  - **EPISODIC INFILTRATION OCCURS AS FRACTURE-DOMINATED FLOW IN THE LOW PERMEABILITY UNITS AND MATRIX-DOMINATED FLOW IN THE HIGH PERMEABILITY UNITS**
  
  - **GREATER FRACTURE DENSITIES IN THE WELDED LOW PERMEABILITY UNITS MAY FACILITATE VAPOR PHASE REMOVAL OF MOISTURE**
  
- **INCLUSION OF WASTE MATERIAL IN THE SIMULATIONS SHOW THAT THE FRACTURE SYSTEM SHEDS CONDENSATE**

# **GEOCHEMICAL AND ISOTOPE METHODS FOR DETERMINING FLOWPATHS AND TRAVEL TIME USING CARBON, OXYGEN AND TRITIUM DATA (IN CHE YANG, USGS)**

## **OBJECTIVES:**

- **UNDERSTAND THE GAS TRANSPORT MECHANISM, DIRECTION, FLUX AND TRAVEL TIME WITHIN THE UNSATURATED ZONE**
- **DESIGN AND IMPLEMENT METHODS FOR EXTRACTING PORE FLUIDS FROM THE TUFF**
- **PROVIDE INDEPENDENT EVIDENCE OF FLOW DIRECTION, FLUX, AND TRAVEL TIME OF WATER IN THE UNSATURATED ZONE**
- **DETERMINE THE EXTENT OF THE WATER-ROCK INTERACTION, AND MODEL GEOCHEMICAL EVOLUTION OF WATER IN THE UNSATURATED ZONE**

# **ISOTOPIC CONSTRAINTS ON TRANSPORT MODELS BASED ON <sup>36</sup>Cl (JUNE FABRYKA-MARTIN, LANL)**

## **OBJECTIVES:**

- **DISCUSS <sup>36</sup>Cl CHARACTERISTICS AS RELATED TO THE ISOTOPE'S USE AS AN AQUEOUS TRACER:**
  - **GEOCHEMICAL AND ISOTOPIC CHARACTER**
  - **QUANTITATIVE ANALYSIS BY AMS**
  - **HYDROLOGIC SOURCES FOR ISOTOPE**
  
- **DETERMINE APPLICATIONS OF <sup>36</sup>Cl AS AN AQUEOUS TRACER AT YUCCA MOUNTAIN:**
  - **DETERMINE MATRIX-RELATED DEEP PERCOLATION RATES**
  - **TEST UZ CONCEPTUAL FLOW MODEL HYPOTHESES**
  - **EXPAND SHALLOW INFILTRATION RATE DATA BASE**
  - **MIGRATION OF <sup>99</sup>Tc ANALOGUE**
  - **TEST REGIONAL GROUND-WATER FLOW MODEL**

# **UNSATURATED-ZONE PERCOLATION: ESF PROGRAM**

## **OBJECTIVES:**

- **SUPPLEMENT AND COMPLEMENT THE SURFACE-BASED HYDROLOGIC INFORMATION NEEDED TO CHARACTERIZE THE YUCCA MOUNTAIN SITE**
- **PROVIDE INFORMATION FOR ANALYZING FLUID FLOW AND THE POTENTIAL FOR RADIONUCLIDE TRANSPORT THROUGH UNSATURATED TUFF**

# **STUDIES TO PROVIDE A DESCRIPTION OF THE UNSATURATED-ZONE HYDROLOGIC SYSTEM AT THE SITE**

## **OBJECTIVE:**

- **DEVELOP A MODEL OF THE UNSATURATED-ZONE HYDROLOGIC SYSTEM AT YUCCA MOUNTAIN THAT WILL ASSIST IN ASSESSING THE SUITABILITY OF THE SITE TO CONTAIN AND ISOLATE WASTE**
- **DEVELOPING THIS MODEL REQUIRES AN UNDERSTANDING OF THE MANNER IN WHICH WATER AND GASES MOVE THROUGH THE UNSATURATED ZONE, INCLUDING THE DIRECTIONS, PATHS, AND RATES IN WHICH FLOW OCCURS**