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

PRESENTATION TO
THE NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: HYDROCHEMICAL CHARACTERIZATION OF WATER IN THE SATURATED ZONE

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OBJECTIVES

- DESCRIBE SPATIAL HYDROCHEMICAL VARIATIONS IN THE SATURATED ZONE
- PROVIDE INFORMATION TO DEFINE CONCEPTUAL GEOHYDROLOGIC MODELS
- PROVIDE A BASE OF SATURATED-ZONE HYDROCHEMICAL DATA
LOCATIONS OF EXISTING WATER-TABLE HOLES

ADRILL HOLE
O PROPOSED DRILL HOLE

HGHCWSSP.125.NWTRB/6-25/27-91
PROPOSED WATER-TABLE HOLES IN FORTYMILE WASH
EIGHT PLANNED WATER-TABLE HOLES DESCRIBED IN THE SCP

125 MILES
200 KILOMETERS

DRILL HOLE

PROPOSED DRILL HOLE
ADDITIONAL PLANNED BOREHOLES
**DISSOLVED INORGANIC SPECIES**

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**He** | **F** | **Ne** | **B** | **C** | **N** | **O** | **F** | **Ne** | **Al** | **Si** | **P** | **S** | **Cl** | **Ar** | **Br** | **Kr** | **I** | **Xe** | **At** | **Rn** | **Lu** | **Lr**
DISSOLVED INORGANIC SPECIES

INORGANIC CATIONS AND ANIONS

- SPATIAL DESCRIPTION
- THERMODYNAMIC CALCULATION
- CONTAMINATION
- GROUND-WATER FLOW PATH AND MIXING
- HYDROCHEMICAL EVOLUTION
UZ AND DISSOLVED GASES

GASES (HOH, CO$_2$, N, CH$_4$, SF$_6$, FREON SPECIES, NOBLE GASES)

- SPATIAL DESCRIPTION
- CONTAMINATION
- "RECHARGE" TEMPERATURE
- FLUXES THROUGH THE UZ
## ISOTOPIC RATIOS

![Periodic Table](image)

*Note: The image contains a periodic table of elements with isotopic ratios.*
ISOTOPIC RATIOS

ISOTOPIC RATIOS (H, C, O, S, Cl, Sr, NOBLE GÁSÈS, Pb, U)

- SPATIAL DESCRIPTION
- GROUND-WATER FLOW PATH AND MIXING
- SOLUTE SOURCES
- HYDROCHEMICAL EVOLUTION
- FLUX THROUGH THE UZ
### RADIOISOTOPES

| H | Li | Na | K | Ca | Sc | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Ga | Ge | As | Se | Br | Kr |
|---|----|----|---|----|----|----|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|
|   | Be | Mg | Al | Si | P | S | Cl | Ar | B | C | N | O | F | He |
| Rb | Sr | Y | Zr | Nb | Mo | Tc | Ru | Rh | Pd | Ag | Cd | In | Sn | Sb | Te | I  | Xe |
| Cs | Ba | La | Hf | Ta | W | Re | Os | Ir | Pt | Au | Hg | Tl | Pb | Bi | Po | At | Rn |
| Fr | Ra | Ac | Ce | Pr | Nd | Pm | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu |
| Th | Pa | U | Np | Pu | Am | Cm | Bk | Cf | Es | Fm | Md | No | Lr |

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RADIOISOTOPES

RADIOISOTOPES (H, C, Cl, Kr, Rn, U)

- GROUND-WATER AGE
- CONTAMINATION
- UZ FLUX MECHANISM
- HYDROCHEMICAL EVOLUTION
DISSOLVED ORGANIC CARBON (HIGH AND LOW-MOLECULAR-WEIGHT COMPOUNDS)

- SPATIAL DESCRIPTION
- PALEOCLIMATE
- CARBON SOURCES
SAMPLING IN WATER-TABLE BOREHOLES

DRY CORE
- MATRIX-WATER CHEMISTRY

GAS SAMPLES
- GAS CONCENTRATIONS
- STABLE ISOTOPIC RATIOS
  [CO₂, HOH, He, Ne]
  [FRACTIONATION BETWEEN VAPOR AND LIQUID PHASES]
- RADIOISOTOPES
  [H, C, Kr]

WATER TABLE

~25 m

SATURATED CORE
MATRIX-WATER CHEMISTRY
[FROM GRAVITY-DRAINED OR CENTRIFUGED CORE]
SAMPLING & FIELD DATA COLLECTION EQUIPMENT

UMBILICAL HOSE AND REEL
DATA COMMUNICATION
POWER SUPPLY
SUSPENSION TUBING
HYDROCHEMICAL TOOL
SLIDING SCREEN
SAMPLE COLLECTION
FIELD DATA COLLECTION
ION CHROMATOGRAPH
BENNETT PUMP
PACKERS
BOREHOLE WALL
WATER-TABLE BOREHOLE SAMPLING EQUIPMENT

- **Positive-Displacement Sampling Pump**
- **Umbilicus**
- **Extruded Sheath**
- **Air & Water Transit Tubing**
- **Multiconductor Cable**
- **KeVlar/Stainless Steel Braid**
- **SKB Hydrochemical Tool**
- **Borehole Wall**
- **Sliding-Screen Sampling Port**
- **Suspension Tubing**
- **Pneumatic Packer**