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

PRESENTATION TO THE NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: ANTHROPOGENIC ANALOGUES - RADIONUCLIDE TRANSPORT AT DOE SITES

PRESENTER: DR. EVERETT P. SPRINGER

PRESENTER'S TITLE AND ORGANIZATION: STAFF MEMBER,
EARTH AND ENVIRONMENTAL SCIENCES DIVISION
LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

PRESENTER'S TELEPHONE NUMBER: (505) 667-9836

RENO, NEVADA
APRIL 16-17, 1991

THIS IS A TASK OF SCP STUDY 8.3.1.3.7.2, WHICH IS COMPOSED OF FOUR ACTIVITIES

- CONTROLLED FIELD TESTS
- INTERMEDIATE-SCALE EXPERIMENTS
- NATURAL ANALOGUES
- ANTHROPOGENIC ANALOGUES FOR RADIONUCLIDE TRANSPORT

VALIDATION IN THE RADIONUCLIDE TRANSPORT PROGRAM IS REQUIRED FOR

- MODELS (PROCESS)
- PARAMETERS

SCP STUDY 8.3.1.3.7.2 WILL USE BOTH CONTROLLED EXPERIMENTS AND ANALOGUES (NATURAL AND ANTHROPOGENIC) FOR MODEL AND PARAMETER VALIDATION

ANTHROPOGENIC ANALOGUES

- ANALOGUES ARE ASSOCIATED WITH LONGER TIME SCALES THAN ARE ASSOCIATED WITH LABORATORY AND FIELD EXPERIMENTS. SPACE SCALES ARE GENERALLY LARGER

- ANALOGUES SUFFER FROM THE DIFFICULTY OF DEFINING THE INITIAL CONDITIONS, AND GENERALLY, PROCESSES ARE COUPLED, MAKING IDENTIFICATION MORE DIFFICULT

ANTHROPOGENIC ANALOGUES

(CONTINUED)

ROLE OF ANALOGUES

- INDICATE IMPORTANT MECHANISMS NOT INCLUDED IN THE MODEL
- TEST RELEVANCY OF LABORATORY MEASUREMENTS OVER LONG TIME FRAMES
- RELATIVE MIGRATION RATES OF DIFFERENT SPECIES
- TEST MODEL "PREDICTIVE CAPABILITY" OVER RELEVANT TIME SCALES
- POTENTIAL INDICATORS OF THE IMPORTANCE OF CLIMATE OR HYDROLOGY CHANGES

ANTHROPOGENIC ANALOGUES

(CONTINUED)

ANTHROPOGENIC ANALOGUES FOR MANY OF THE RADIONUCLIDES EXIST AT VARIOUS DOE SITES. ALTHOUGH THE TIME FRAME IS RELATIVELY SHORT WHEN COMPARED WITH NATURAL ANALOGUES, THESE ANTHROPOGENIC ANALOGUES PROVIDE VALUABLE INFORMATION ON RADIONUCLIDE MIGRATION

ANTHROPOGENIC ANALOGUES

(CONTINUED)

DOE SITES LOCATED IN ARID AND SEMIARID CONDITIONS

- NEVADA TEST SITE
- HANFORD
- IDAHO NATIONAL ENGINEERING LABORATORY
- LOS ALAMOS

ANTHROPOGENIC ANALOGUES

(CONTINUED)

ENVIRONMENTAL RESTORATION ACTIVITIES AT DOE SITES PROVIDE THE YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT WITH AN OPPORTUNITY TO OBTAIN DATA ON RADIONUCLIDE MIGRATION

ANTHROPOGENIC ANALOGUES

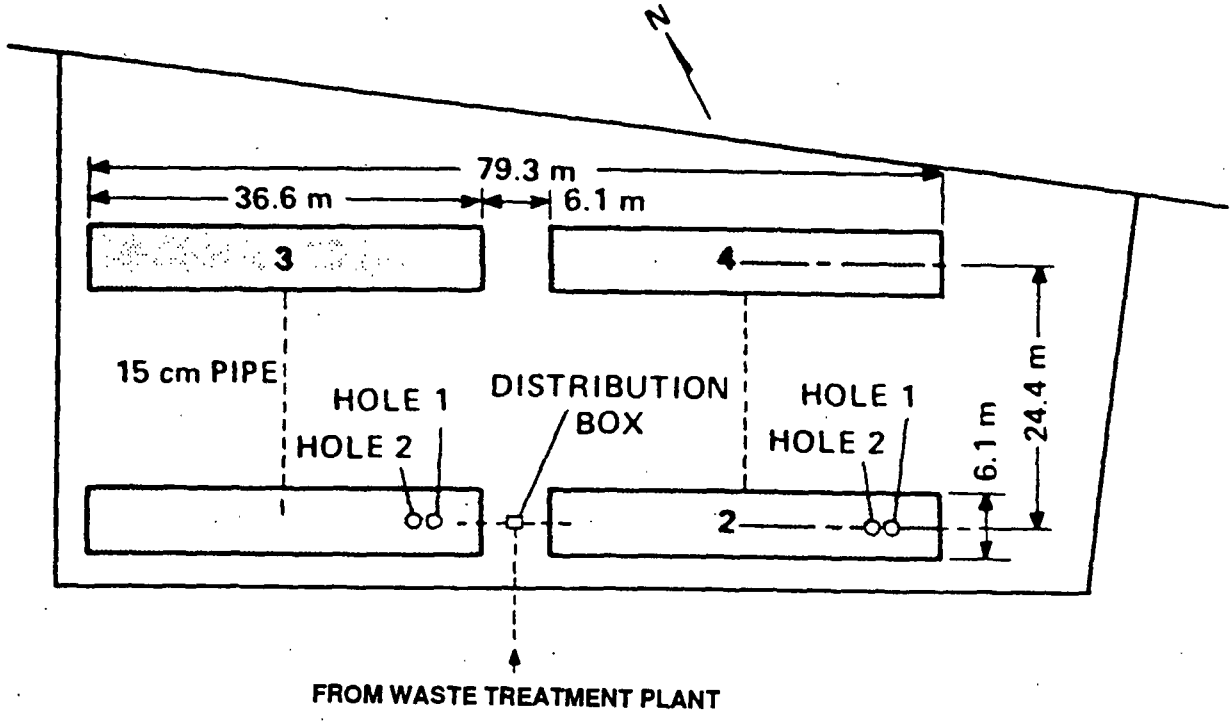
(CONTINUED)

AN EXAMPLE

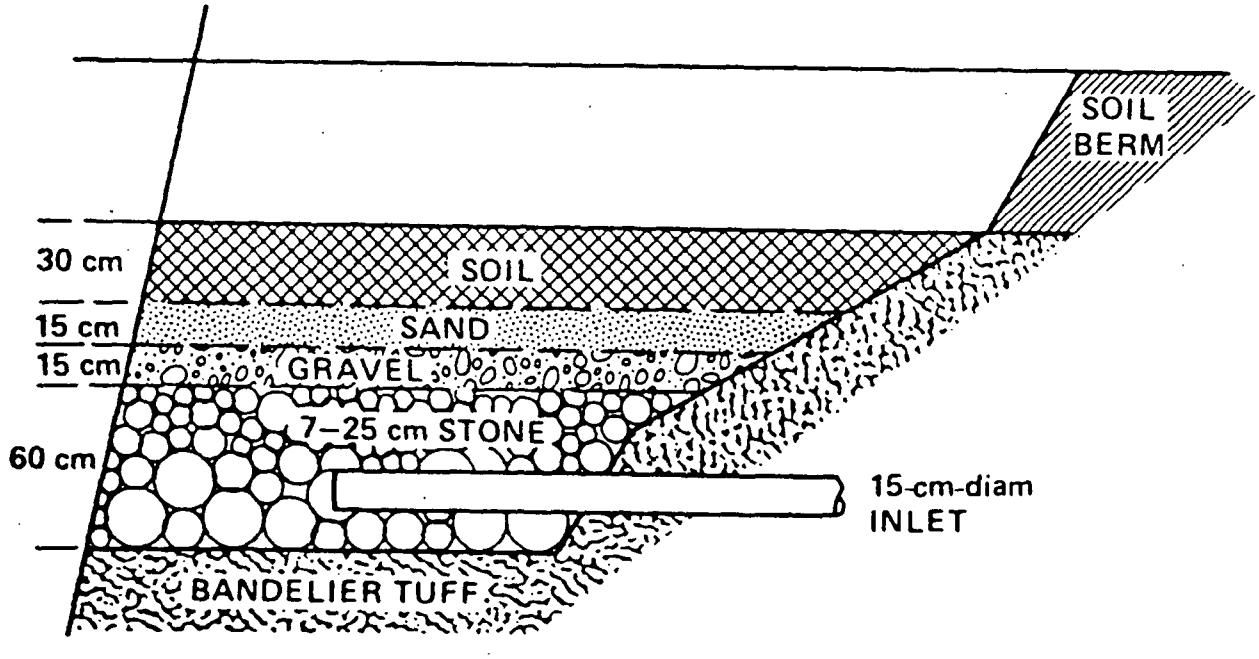
AREA - T (TA-21) AT LOS ALAMOS - WASTE DISPOSAL SITE FOR DEFENSE-WASTE LIQUID EFFLUENTS CONTAINING PLUTONIUM

DESIGN OF ABSORPTION BEDS AT AREA T

FROM NYHAN et al., (1984)



A. SITE PLAN OF ABSORPTION BED SYSTEM



B. CROSS SECTION OF AN ABSORPTION BED

ANTHROPOGENIC ANALOGUES

(CONTINUED)

LABORATORY ANALYSES BY CHRISTENSEN et al., (1958) FOR SEVEN CORES OF BANDELIER TUFF REPORTED

- Pu PENETRATED 2 INCHES
- LOCALIZED HOT SPOTS OF Pu AND Sr ASSOCIATED WITH HIGH ION EXCHANGE MATERIAL
- Cs WAS RETAINED IN TOP INCH
- Sr BREAKTHROUGH WAS DIFFERENT FOR TAP VERSUS DISTILLED WATER

ANTHROPOGENIC ANALOGUES

(CONTINUED)

INFILTRATION STUDIES WERE CONDUCTED IN BED NO. 1 IN 1960 AND 1961

1960 STUDY ADDED

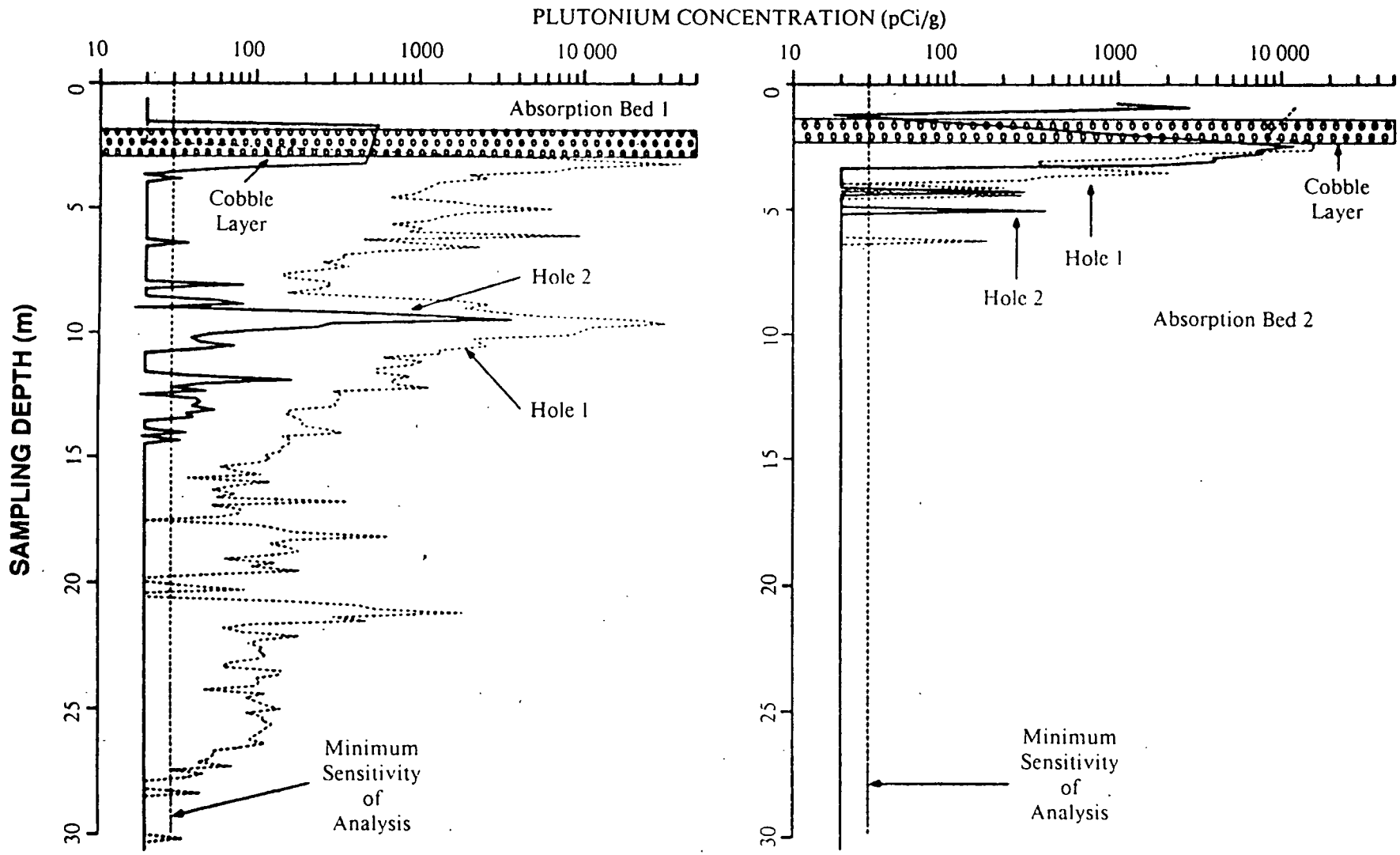
- o 200,000 GALLONS EFFLUENT IN 25 DAYS
- o 200,000 GALONS TAP WATER IN 32 DAYS

1961 STUDY ADDED

- o 211,000 GALLONS EFFLUENT IN 23 DAYS

CONCENTRATION OF PLUTONIUM AS A FUNCTION OF SAMPLING DEPTH FOR ABSORPTION BEDS 1 AND 2 IN 1978

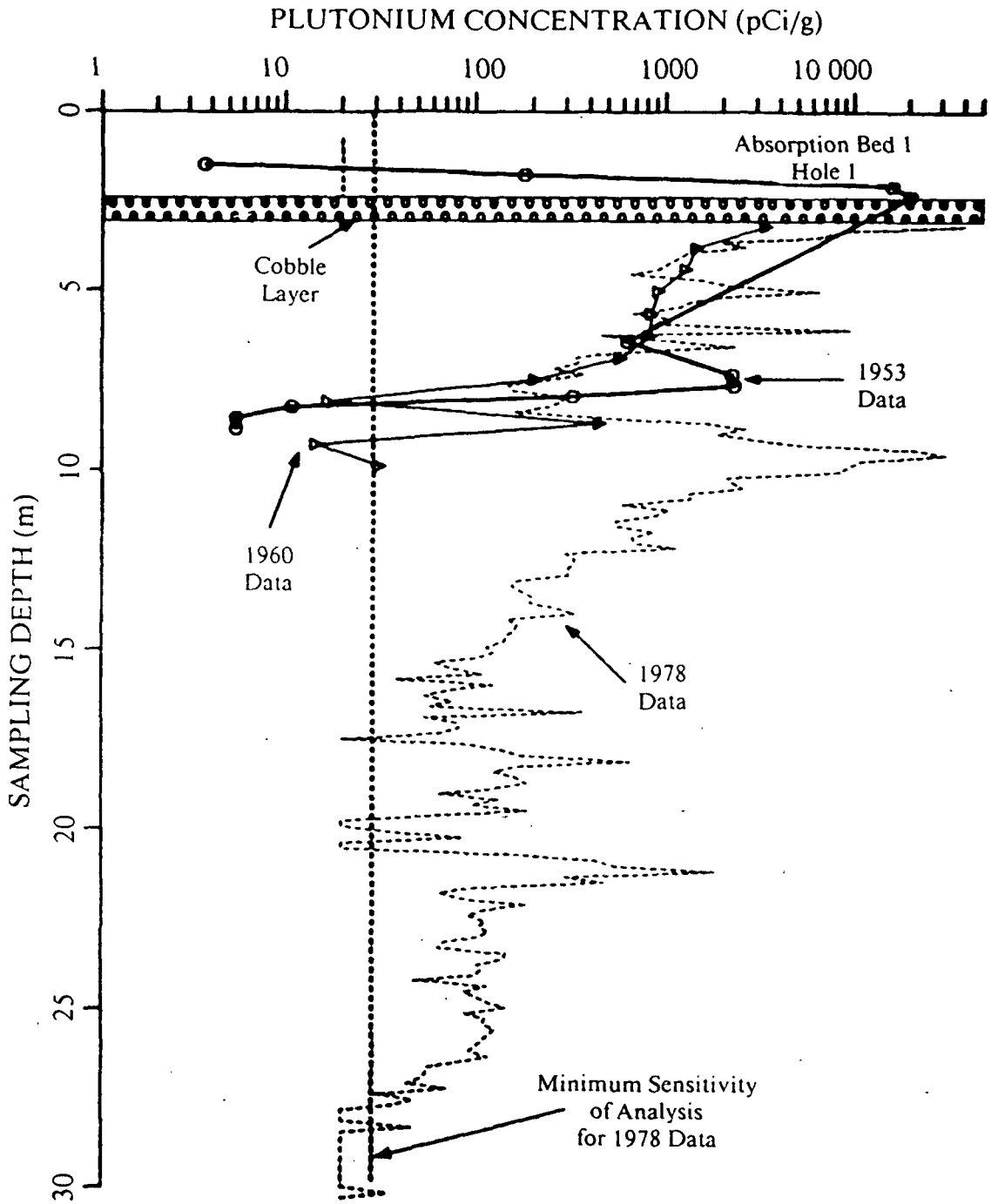
FROM NYHAN et al., (1984)



ANTHANP.125.NWTRB/4-16,17-91

CONCENTRATION OF PLUTONIUM AS A FUNCTION OF SAMPLING DEPTH IN ABSORPTION BED 1 FOUND IN 1953 (HERMAN 1954), 1960 (CHRISTENSON AND THOMAS 1962), AND IN OUR STUDY IN 1978

FROM NYHAN et al., (1984)



ANTHANP.125.NWTRB/4-16,17-91

ANTHROPOGENIC ANALOGUES

(CONTINUED)

TA-21 RESULTS

- SUBSEQUENT MODELING INDICATED THAT A POROUS MEDIUM APPROACH WITH LINEAR SORPTION WAS NOT ADEQUATE TO PREDICT THE REPSONSE AT BED 1
- OTHER MODELING ATTEMPTS USED COLLOID TRANSPORT AND SPATIALLY DISTRIBUTED SORPTION
- INSUFFICIENT KNOWLEDGE OF THE SOURCE TERM LIMITS APPLICABILITY OF THESE DATA

ANTHROPOGENIC ANALOGUES

(CONTINUED)

ENVIRONMENTAL RESTORATION WILL USE A PHASED SAMPLING APPROACH AT THE SITE. INITIALLY, 21 BOREHOLES (BOTH VERTICAL AND SLANTED) WILL BE DRILLED AT AREA-T. THIS DRILLING REPRESENTS AN OPPORTUNITY FOR YMP; SOME POTENTIAL ACTIVITIES INCLUDE

- DIFFERENCE IN MIGRATION RATES OF ISOTOPES
- MODEL TESTING BY PREDICTING TRANSPORT SINCE 1978
- ANALYSIS OF RADIONUCLIDE DISTRIBUTION BETWEEN MATRIX AND FRACTURES
- ANALYSIS OF LOCALIZED RADIONUCLIDE CONCENTRATIONS AND ASSOCIATED MINERALOGY

ANTHROPOGENIC ANALOGUES

(CONTINUED)

HYDROLOGY/RADIONUCLIDE MIGRATION PROGRAM AT THE NEVADA TEST SITE

- ESTABLISHED IN 1973 AND MANAGED BY THE NEVADA OPERATIONS OFFICE
- PARTICIPATING ORGANIZATIONS INCLUDE DRI, LANL, LLNL, AND USGS
- PROGRAM GOAL IS TO DETERMINE THE EXTENT OF MOVEMENT AWAY FROM UNDERGROUND NUCLEAR EXPLOSIONS AND TO DETERMINE MECHANISMS OF MOVEMENT

ANTHROPOGENIC ANALOGUES

(CONTINUED)

HYDROLOGY/RADIONUCLIDE MIGRATION PROGRAM

CAMBRIC

- CONDUCTED IN 1965 IN ALLUVIUM 73m BELOW THE WATER TABLE
- SATELLITE WELL USED FOR PUMPING LOCATED 91m AWAY
- WELL HAS PUMPED ALMOST CONTINUOUSLY SINCE 1974
- TRITIUM, KRYPTON-85, AND CHLORINE-36 HAVE BEEN DETECTED
- CESIUM AND STRONTIUM LEVELS DECLINE IN THE TEST CAVITY, BUT HAVE NOT BEEN DETECTED IN THE SATELLITE WELL

CHESIRE

- CONDUCTED IN 1976 IN BRECCIATED RHYOLITE AT PAHUTE MESA APPROXIMATELY 544m BELOW THE WATER TABLE
- SATELLITE HOLE DRILLED 300m FROM CHESIRE SHOT
- TRITIUM, KRYPTON, STRONTIUM, CESIUM, ANTIMONY, COBALT, CERIUM, AND EUROPIUM HAVE BEEN FOUND
- SOME ISOTOPES ARE ASSOCIATED WITH COLLOIDS

ANTHROPOGENIC ANALOGUES

(CONTINUED)

THE TUNNEL COMPLEXES AT THE NEVADA TEST SITE REPRESENT ANOTHER OPPORTUNITY

N-TUNNEL: ZEOLITIC TUFF WITH PERCHED WATER ZONES AND FLOWING WATER

P-TUNNEL: VITRIC TUFF WITH FEW DEFINED FRACTURES AND VITRIC/ZEOLITIC INTERFACE. PERCHED WATER WAS RECENTLY ENCOUNTERED IN ZEOLITIC ZONE

POSSIBLE AREAS OF INVESTIGATION

- ISOTOPIC COMPOSITION OF MATRIX VERSUS FRACTURE WATER
- VARIATION OF WATER COMPOSITION ACROSS THE MESA
- ANALYSIS OF FLOWING AND PERCHED ZONES IN TERMS OF OCCURRENCE

CONCLUSIONS

- DATA FROM DOE SITES WILL PROVIDE INFORMATION ON RADIONUCLIDE TRANSPORT FOR YMP
- THESE ANALOGUES ARE USEFUL FOR INDICATING WHETHER IMPORTANT PROCESSES ARE INCLUDED
- EXPERTISE DEVELOPED BY DOE PROGRAMS, SUCH AS ENVIRONMENTAL RESTORATION AND YMP, IS COMPLEMENTARY FOR VARIOUS DOE PROGRAMS
- INVOLVEMENT WITH THESE ACTIVITIES MUST RECOGNIZE OPERATIONAL CONSTRAINTS, AND THERE MUST BE CLEAR OBJECTIVES FROM THE YMP PERSPECTIVE