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WM Record File 102.7
WM Project 11
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Rev. 0

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Scientific Investigation Plan for

NNWSI WBS Element 1.2.3.4.2.A

Mineralogy/Petrology

Level I
- A. Alteration and Fracture Mineralogy
- B. Mineral Stability
- C. Mineralogy of Transport Pathways

Los Alamos National Laboratory

June, 1986

D T Oakley 6-26-86
D. T. Oakley, TPO — Date

D. T. Vaniman 6-26-86
D. T. Vaniman, PI — Date

Paul R. Guthals 6/26/86
P. R. Guthals, QA — Date

Larry W. Massen 6-26-86
QAL — Date

Gerald L DeFlorio 6/26/86
Tech. Rev. — Date

Maxwell B Blanchard 7-14-86
WMPO

James Blaylock 7/19/86
PGM

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Scientific Investigation Plan for

NNWSI WBS Element 1.2.3.4.2.A

Mineralogy/Petrology

The Mineralogy/Petrology task will provide descriptions of rock and fracture-fill petrology and mineralogy along transport pathways to the accessible environment. The information gained will provide the basis for calculating total waste element retardation along transport pathways, for determining the timing and transport phenomena from past alteration, and for examining the geologic record of mineral stability.

Although this WBS element is considered a single task for reporting and budget purposes, it essentially consists of three large subtasks. These subtasks are:

Level I
A. Alteration and Fracture Mineralogy
B. Mineral Stability
C. Mineralogy of Transport Pathways

Separate scientific investigation plans will be presented for each of these subtasks.

WBS 1.2.3.4.2.A MINERALOGY/PETROLOGY

Subtask A. Alteration and Fracture Mineralogy

1. Objectives, Issues, and Information Needs Addressed

Study the bulk rock and fracture alteration, including the alteration of primary glass to sorptive minerals.

Studies of alteration and fracture mineralogy will address the following information needs (4/15/86 Issues Hierarchy):

1.14.2 Description of the unsaturated zone hydrologic systems at the site.

1.15.4 Radionuclide retardation by sorption processes along flow paths to the accessible environment.

1.19.1 Rates of dissolution of crystalline and non-crystalline components in tuff.

1.7.3 Boundaries of the disturbed zone.

1.1.1 Site information needed to calculate the potential releases of radionuclides to the accessible environment.

4.3.2 Potential non-radiological hazards to personnel.

1.10.1 Determination that the site is not disqualified and is not likely to be disqualified for each of the disqualifying conditions.

1.10.2 Determination that the site meets the qualifying conditions and is likely to continue to meet the qualifying conditions.

2. Principal Investigators

Barbara A. Carlos, Schön S. Levy, and David T. Vaniman, Los Alamos National Laboratory.

3. Statement of Work

Petrographic studies, microprobe analysis, x-ray diffraction, and direct and indirect radiometric dating studies of fracture surfaces and fillings are in progress on core samples from Yucca Mountain. This study will include larger samples obtained from the Exploratory Shaft and from drifts extending from the shaft (Exploratory Shaft Mineralogy/Petrology Subtask, Los Alamos). Included under this subtask is the study of fault, spring, and soil mineralogy to address concerns about possible past spring activity at Yucca Mountain. Additional petrographic studies, scanning electron microscopy, electron microprobe analysis, x-ray fluorescence, instrumental neutron activation analysis, stable isotope and fluid inclusion studies, and direct and indirect radiometric dating studies are in progress on core, outcrop, and

trench samples from Yucca Mountain, and will also include samples from the Exploratory Shaft and drifts. This study will lead to an understanding of the conditions, timing, and chemical transport phenomena that caused alteration at Yucca Mountain.

4. Data and Materials Needed, Techniques, Procedures and Computer Codes

Data. The types, compositions, sources of chemical constituents, growth sequences, and ages of alteration minerals. This subtask also requires data on the temperatures of mineral growth.

Materials. Rock samples from drill cores, drill holes, outcrops, and trenches.

(a) Drill Cores: J-13, UE-25a#1, USW G-1, USW G-2, USW GU-3, USW G-4, USW G-5, USW G-6, USW G-7, USW VH-1, USW VH-2, USW H-6, and UE-25h#1.

(b) Drill Holes: USW H-3, USW H-4, USW H-5, and UE-25p#1.

(c) Outcrops: Exposures of devitrified and zeolitized tuffs, fractures, soils, and sand ramps within the 10 km boundary surrounding the exploration block at Yucca Mountain, reported spring localities at Crater Flat and Wahmonie, known spring localities of Cane Spring, Amargosa Valley, Death Valley, Oasis Valley, Steamboat Spring, Sou Spring, McCoy Spring, Brady Spring, Hyder Spring, and spring deposits in Muddy Creek Valley.

(d) Trenches: Trenches 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 14a, 15, 16, and 17 in the vicinity of Yucca Mountain, Nevada.

Techniques. Standard optical petrography, scanning electron microscope imaging through backscattered or secondary electrons with energy-dispersive x-ray analysis, wavelength-dispersive electron microprobe x-ray analysis, and fluid inclusion analysis (temperatures of formation) using a heating/cooling stage. Techniques being developed or explored include studies of heated zeolite residues by x-ray fluorescence, development of quantitative x-ray diffraction analysis of small samples using a Guinier camera and an optical densitometer, uranium-series/potassium-argon/or argon-argon dating of hydrous alteration minerals, electron spin resonance dating of quartz crystals, and strontium isotope studies of sources for materials transported during formation of secondary minerals.

Procedures.

TWS-ESS-DP-01, R2	X-Ray Powder Diffraction Analysis
TWS-ESS-DP-03, R2	Nevada Test Site Core Petrography Procedure
TWS-ESS-DP-04, R3	Sample Preparation Laboratory Procedures
TWS-ESS-DP-06, R2	Operating Instructions for DV-502 Vacuum Evaporator Used in Carbon Coating Samples
TWS-ESS-DP-07, R1	Microprobe Operating Procedure
TWS-ESS-DP-24, R0	Procedure: Alignment of the Siemens Diffractometer
TWS-ESS-DP-25, R1	Clay Mineral Separation and Preparation for X-Ray Diffraction Analysis

TWS-ESS-DP-28, R0	Nevada Test Site Fracture Filling Studies Procedure
TWS-ESS-DP-50, R0	Sputter Coater Operating Procedure for Gold Coating Samples
TWS-ESS-DP-51, R0	Mettler H80 Operation Procedure (X-Ray Fluorescence Analysis Sample Weighing Procedure)
TWS-ESS-DP-52, R0	Fusing Using the Junior Orbit Shaker
TWS-ESS-DP-53, R0	Pulverizing Using the Spex 8500 Shatterbox
TWS-ESS-DP-54, R0	Crushing, Operating of 50 Ton Hydraulic Press
TWS-ESS-DP-55, R0	Rock Splitting, Operating of 50 Ton Hydraulic Press
TWS-ESS-DP-56, R0	Brinkman Automated Grinder Procedure

To be Prepared:
Fluid Inclusion Analysis Procedure
X-Ray Fluorescence Procedure
SEM Procedure

Codes.

Electron Microprobe: SANDIA TASK8
Sandia Report SAND85-2037

XRD: DIFFRAC V; Version May 1983;
Siemens-Allis DIFFRAC V Users Manual

5. Nonstandard Methods or Techniques

Methods are being explored for K/Ar dating of smectites and zeolites.

6. Location of Work Performed

Most work will be performed at the Los Alamos National Laboratory and at the Yucca Mountain exploration site in area 25 of the Nevada Test Site and in adjoining land to the west. Isotopic and radiometric analyses will be contracted.

7. Quality Assurance Requirements

This subtask has been determined to be Quality Level I. See QALAS submission for details.

8. Application of Results

Both the fracture mineralogy and the natural alteration history studies apply to models of past fracture transport at Yucca Mountain and address the site characterization needs of 10 CRF 60.21(c)(1)(i)(A) as well as the requirements for natural alteration history studies in 10 CFR 60.21(c)(1)(ii)(F), and in 10 CFR 60.122(b)(1). These studies are also applicable to the question of Quaternary stability of mineral assemblages at the site, as referenced in 10 CFR 60.122(b)(1).

Within the NNWSI Project the results of these studies will apply to

Calculation of retardation by various mechanisms (Retardation Sensitivity Analysis, Los Alamos)

Performance Assessment (SNL)

Quaternary stability (USGS)

Paleohydrology (USGS)

SCP and EIS preparation (Los Alamos)

Data will be submitted to the Tuff Data Base.

9. Schedule

Starting date: In progress. Expected ending date: December 1989.

10. Past and Expected Achievements

Previous Work and QA Controls on Previous Work

The previous work to be used in support of this investigation is summarized in the reports listed below.

Broxton, D., D. Vaniman, F. Caporuscio, B. Arney, and G. Heiken, "Detailed Petrographic Descriptions and Microprobe Data for Drill Holes USW-G2 and UE25b-1H, Yucca Mountain, Nevada," Los Alamos Nat. Lab. Report LA-9324-MS (October 1982).

Levy, Schön S., "Petrology of Samples from Drill Holes USW H-3, H-4, and H-5, Yucca Mountain, Nevada," Los Alamos Nat. Lab. Report LA-9706-MS (June 1984).

Carlos, B. Arney, "Minerals in Fractures of the Unsaturated Zone from Drill Core USW G-4, Yucca Mountain, Nye County, Nevada," Los Alamos Nat. Lab. Report LA-10415-MS (May 1985).

The Quality Assurance controls under which this previous work was performed are summarized in Tables I and II. Table I is a summary of the administrative controls under which the previous work was performed. Table II is a summary of the Work Plans and Detailed Procedures under which the previous work was performed.

Any work used in support of this investigation and completed before the implementation of NVO-196-17, Revision 0, August 1980, will be processed in accordance with NNWSI-SOP-03-03.

For work completed subsequent to August 1980, where approved QA Procedures were not implemented, the data or data interpretations to be used will be processed as a nonconformance in accordance with NNWSI-SOP-15-01(TWS-MSTQA-QP-16,R0).

TABLE I. NNWSI QUALITY ASSURANCE PROCEDURES

TITLE	IDENTIFIER	DATE EFFECTIVE	DATE SUPERSEDED
QA PROGRAM PLAN	TWS-CMB QA-QP-01, R0	24-Oct-78	16-Aug-79
QA PROGRAM PLAN	TWS-CMB QA-QP-01, R1	16-Aug-79	09-Apr-80
QA PROGRAM PLAN	TWS-CMB QA-QP-01, R2	09-Apr-80	13-Sep-82
QA PROGRAM PLAN	TWS-CMB QA-QP-01, R3	13-Sep-82	01-Feb-84
QA PROGRAM PLAN	TWS-MSTQA-QP-01, R4	01-Feb-84	19-Sep-85
QA PROGRAM PLAN	NNWSI-QP-01, R0	19-Sep-85	
DOCUMENT CONTROL	TWS-CMB QA-QP-03, R0		14-Nov-78
DOCUMENT CONTROL	TWS-CNC-11-10/78-9R1	14-Nov-78	16-Jul-79
DOCUMENT CONTROL	TWS-CMB QA-QP-03, R2	16-Jul-79	13-Sep-82
DOCUMENT CONTROL	TWS-CMBQA-QP-03, R3	13-Sep-82	03-Jan-84
DOCUMENT CONTROL	TWS-MSTQA-QP-03, R4	03-Jan-84	19-Mar-85
DOCUMENT CONTROL	TWS-MSTQA-QP-03, R5	19-Mar-85	21-Feb-86
DOCUMENT CONTROL	TWS-MSTQA-QP-03, R6	21-Feb-86	
HANDLING, STORAGE, AND SHIPPING PROCEDURE	TWS-CMBQA-QP-04, R0	12-May-79	13-Sep-82
	TWS-CMBQA-QP-04, R1	13-Sep-82	02-Apr-85
	TWS-MSTQA-QP-04, R2	02-Apr-85	
NNWSI PROCUREMENT PROCEDURES	TWS-CMBQA-QP-06, R0	14-Sep-82	03-Jan-84
	TWS-CMBQA-QP-06, R1	03-Jan-84	21-Oct-85
	TWS-MSTQA-QP-06, R2	21-Oct-85	
PROCEDURE FOR TECHNICAL REVIEW OF PUBLICATIONS	TWS-CMBQA-QP-07, R0	02-Aug-82	04-Mar-85
	TWS-MSTQA-QP-07, R1	04-Mar-85	
PERSONNEL CERTIFICATION PROCEDURE FOR NNWSI	TWS-MSTQA-QP-08, R0	01-Jun-83	03-Jan-84
	TWS-MSTQA-QP-08, R1	03-Jan-84	20-Dec-84
	TWS-MSTQA-QP-08, R2	20-Dec-84	19-May-86
	TWS-MSTQA-QP-08, R3	19-May-86	
RECORDS CONTROL PROCEDURE	TWS-MSTQA-QP-09, R0	03-Jan-84	
NNWSI SURVEILLANCE PROCEDURE	TWS-MSTQA-QP-11, R0	01-Sep-84	
NNWSI RECEIVING INSPECTION PROCEDURE	TWS-MSTQA-QP-12, R0	21-Oct-85	

NNWSI LOS ALAMOS CONFLICT RESOLUTION COMMITTEE	TWS-MSTQA-QP-13, R0	22-May-85	30-Dec-85
QUALITY ASSURANCE PROCEDURE FOR ONE-TIME RESEARCH AND DEVELOPMENT WORK	TWS-MSTQA-QP-14, R0 TWS-MSTQA-QP-14, R1	22-May-85 19-May-86	19-May-86
NNWSI CONTROL OF NONCONFORMANCES	TWS-MSTQA-QP-16, R0	19-May-86	
ASSIGNMENT OF QUALITY LEVELS FOR LOS ALAMOS NNWSI ITEMS AND ACTIVITIES	TWS-MSTQA-QP-18, R0	17-Dec-85	
NNWSI CHANGE REQUESTS	TWS-MSTQA-QP-19, R0	19-May-86	
LOS ALAMOS QUALITY ASSURANCE MANUAL		02-Jul-84	19-Sep-85

TABLE II: WORK PLANS AND DETAILED PROCEDURES

MINERALOGY/PETROLOGY
SUBTASKS
A. ALTERATION AND FRACTURE MINERALOGY
B. MINERAL STABILITY
C. MINERALOGY OF TRANSPORT PATHWAYS

TITLE	IDENTIFIER	DATE EFFECTIVE	DATE SUPERSEDED	APPLICABLE SUBTASK
WORK PLANS				
TUFF EXPERIMENTS-MINERALOGY AND PETROLOGY STUDIES BY G-6	TWS-G6-WP-05, R1	18-Sep-79		C
	TWS-G6-WP-05, R2		24-Nov-82	C
NNWSI MINERALOGY AND PETROLOGY STUDIES	TWS-ESS-WP-05, R3	24-Nov-82		A,C
"SOAKING EXPERIMENTS"	TWS-G6-WP-07, R0	11-Jan-80	28-Apr-81	B
	TWS-G6-WP-07, R1	28-Apr-81		B
DETAILED PROCEDURES				
CLAY MINERAL SEPARATION AND PREPARATION FOR X-RAY DIFFRACTION ANALYSIS	TWS-ESS-DP-25, R0	31-Mar-83	03-Apr-86	A,B,C
	TWS-ESS-DP-25, R1	03-Apr-86		A,B,C
NEVADA TEST SITE FRACTURE FILLING STUDIES PROCEDURE	TWS-ESS-DP-28, R0	09-Sep-85		A
SPUTTER COATER OPERATION PROCEDURE FOR GOLD COATING SAMPLES	TWS-ESS-DP-50, R0	03-Apr-86		A
METTLER H80 OPERATING PROCEDURE	TWS-ESS-DP-51, R0	03-Apr-86		A,C
FUSING USING THE JUNIOR ORBIT SHAKER	TWS-ESS-DP-52, R0	03-Apr-86		A,C
CRUSHING: OPERATING OF 50 TON HYDRAULIC PRESS	TWS-ESS-DP-54, R0	03-Apr-86		A,C
ROCK SPLITTING: OPERATING OF 50 TON HYDRAULIC PRESS	TWS-ESS-DP-55, R0	03-Apr-86		A,C
TUFF HEATING EXPERIMENTS	TWS-G9-DP-13, R0	10-Mar-80		B

TITLE	IDENTIFIER	DATE EFFECTIVE	DATE SUPERSEDED	APPLICABLE SUBTASK
NTS CORE PETROGRAPHY PROCEDURE	TWS-G6-1/79-24,R0	05-Mar-79	15-Aug-79	C
	TWS-G6-DP-03, R1	15-Aug-79	24-Nov-82	C
	TWS-G6-DP-03, R2	24-Nov-82		A,B,C
SAMPLE PREPARATION LABORATORY PROCEDURES	TWS-G6-2/79-3.2.2,R0	08-Mar-79	26-Jun-79	C
	TWS-G6-DP-04, R1	26-Jun-79	24-Nov-82	C
	TWS-G6-DP-04, R2	24-Nov-82	31-Jan-83	A,B,C
	TWS-G6-DP-04, R3	31-Jan-83		A,B,C
OPERATING INSTRUCTIONS FOR DV-502 VACUUM EVAPORATOR USED IN CARBON COATING THIN SECTIONS FOR MICROPROBE ANALYSIS	TWS-G6-DP-06, R0	26-Jun-79	24-Nov-82	C
	TWS-G6-DP-06, R1	24-Nov-82	03-Apr-86	A,B,C
	TWS-G6-DP-06, R2	03-Apr-86		A,B,C
MICROPROBE OPERATING PROCEDURE	TWS-G6-DP-07, R0	26-Jun-79	24-Nov-82	C
	TWS-ESS-DP-07, R1	24-Nov-82		A,C
SIEMENS X-RAY DIFFRACTION PROCEDURE	TWS-G9-DP-16, R0	09-Jun-80	24-Nov-82	A,B,C
	TWS-G9-DP-16, R1	24-Nov-82	19-May-86	A,B,C
	TWS-ESS-DP-16, R2	19-May-86		A,B,C
SAMPLE PREPARATION: ROCK POWDERS	TWS-G9-DP-19, R0	25-Sep-80	24-Nov-82	B,C
	TWS-ESS-DP-19, R1	24-Nov-82		B,C
PROCEDURE: ALIGNMENT OF SIEMENS DIFFRACTOMETER	TWS-ESS-DP-24, R0	24-Nov-82		A,B,C
PULVERIZING USING THE SPEX 8500 SHATTERBOX	TWS-ESS-DP-53, R0	03-Apr-86		B,C
BRINKMAN AUTOMATED GRINDER PROCEDURE	TWS-ESS-DP-56, R0	03-Apr-86		A,B,C

Planned Achievements for FY86 and Later Years

FY86

Report on the mineralogy of faults, soils, and springs around Yucca Mountain and in neighboring areas.

Report on saturated zone fracture mineralogy in Drill Core USW G-4.

FY87

Report on timing, temperatures, and transport during past alteration at Yucca Mountain.

FY89

Report on fracture mineralogy based on samples from drill cores.

Report on the history of chemical alteration at Yucca Mountain.

11. Milestones and Deliverables

Milestones

Final report on saturated-zone fracture mineralogy, based on samples (R345).	7/86
Report on soil, fault, and spring mineralogy in Yucca Mountain environs (R319).	9/86
Report on bulk rock chemical variations at Yucca Mountain (R324).	3/86
Interim report on alteration timing and temperatures (R756).	3/87
Comparison of fracture mineralogy in drill cores (R757).	10/88
Report on the history of chemical alteration at Yucca Mountain (M336).	12/88

Deliverables

Data updates through semiannual progress reports throughout these studies and the milestone reports listed above.

WBS 1.2.3.4.2.A MINERALOGY/PETROLOGY

Subtask B. Mineral Stability

1. Objectives, Issues, and Information Needs Addressed

Studies of mineral stability assess the impact of the repository's thermal aureole on minerals that are important parts of the natural retardation system. These studies include investigation of the temperatures and timing of clay and zeolite formation during past hydrothermal activity at Yucca Mountain, experiments to determine thermal effects on sorption behavior, experiments on irreversible dehydration of smectites at low temperature, and comparable experiments on zeolites and glasses, including studies of reaction kinetics.

Studies of mineral stability will address the following information needs (4/15/86 Issues Hierarchy):

1.15.4 Radionuclide retardation by sorption processes along flow paths to the accessible environment.

1.16.1 Stratigraphy necessary to locate the underground facility.

1.19.1 Rates of dissolution of crystalline and non-crystalline components in tuff.

1.12.6 Predicted thermal and thermochemical response of the host rock, surrounding strata, and groundwater system.

1.7.2 Effects on the geohydrology, geochemical, and rock characteristics.

1.7.3 Boundaries of the disturbed zone.

1.1.2 Design concepts of the repository system that may reduce or delay the releases of radionuclides to the accessible environment.

1.9.1 Identification of favorable and potentially adverse conditions at the site.

1.9.2 Potential effects of favorable and potentially adverse conditions on repository performance.

1.10.2 Determination that the site meets the qualifying conditions and is likely to continue to meet the qualifying conditions.

2. Principal Investigators

David L. Bish and David T. Vaniman, Los Alamos National Laboratory

3. Statement of Work

Mineralogic studies by x-ray diffraction (including centrifugation and solvation techniques for clay mineral analysis), fluid inclusion studies

(temperature of formation), and direct or indirect radiometric dating studies have been completed for available drill-core samples. Low temperature heating tests of long duration and x-ray diffraction studies under controlled humidity and temperature are in progress on drill core samples and on untreated and cation-exchanged mineral standards. This subtask includes a complete literature review and synthesis of smectite stability and dehydration behavior. Low-temperature heating tests of long duration, x-ray diffraction studies under controlled humidity and temperature, thermogravimetric and differential scanning calorimetry studies are in progress on drill core samples. The kinetics of zeolite and glass reactions will be addressed under this subtask.

4. Data and Materials Needed, Techniques, Procedures, and Computer Codes

Data. Types of mineral alterations indicative of specific hydrothermal parameters (temperature, fluid composition) and the ages of those minerals. The nature and kinetics of water loss and mineral transformation at prolonged low temperature.

Materials. Mineral standards from Clarkson Minerals, Nevada; naturally occurring minerals and glasses from drill cores USW G-1, G-2, GU-3, G-3, G-4, G-5, G-6, G-7, and UE-25a#1.

Techniques. Centrifugation/solvation to determine the nature of interstratified clay minerals; fluid inclusion studies using a heating/cooling stage; potassium-argon or argon-argon dating of clay mineral separates; and petrographic analysis. Long-term heating of samples in low-temperature ovens; x-ray diffraction analysis of experimental materials; experiments with cation-exchanged zeolite compositions to determine the effect of composition on dehydration; sorption experiments at temperature; thermogravimetric analysis and differential scanning calorimetry to determine the kinetics of water loss from zeolites and glasses.

Procedures.

TWS-ESS-DP-01, R2	X-Ray Powder Diffraction Analysis
TWS-ESS-DP-24, R0	Procedure: Alignment of the Siemens Diffractometer
TWS-ESS-DP-25, R1	Clay Mineral Separation and Preparation for X-Ray Diffraction Analysis
TWS-ESS-DP-53, R0	Pulverizing Using the Spex 8500 Shatterbox

To be Prepared:

Thermal Analysis
Particle Size Analysis
Low-C degree heating

Codes.

XRD: DIFFRAC V; version May 1983:
Siemens-Allis DIFFRAC V Users Manual

5. Nonstandard Methods or Techniques

Methods are being explored for K/Ar dating of smectites and zeolites.

6. Location of Work Performed

Most work will be performed at the Los Alamos National Laboratory. Radiometric analyses will be contracted.

7. Quality Assurance Requirements

This subtask has been determined to be Quality Level I. See QALAS submission for details.

8. Application of Results

Studies of past hydrothermal alteration at Yucca Mountain apply to requirements for investigating natural alteration history as an analog of anticipated future alteration; 10 CFR 60.21(c)(1)(ii)(F). Experimental studies of zeolite, clay, and glass stability directly address concerns about anticipated thermal alteration; 10 CFR 60.122(b)(5). Mineral stability studies also apply to the definition of repository design limits; 10 CFR 60.130(1).

Within the NNWSI Project, these studies will apply to

Retardation Sensitivity Analysis Subtask (Los Alamos)

Performance Assessment Subtask (SNL)

SCP and EIS preparation Subtask (Los Alamos)

Data will be submitted to the Tuff Data Base.

9. Schedule

Starting date: In progress. Expected ending date: December 1989.

10. Past and Expected Achievements

Previous Work and QA Controls on Previous Work

The previous work to be used in support of this investigation is summarized in the reports listed below.

Smyth, J. R. and F. A. Caporuscio, "Review of the Thermal Stability and Cation Exchange Properties of the Zeolite Minerals Clinoptilolite, Mordenite,

and Analcime: Applications to Radioactive Waste Isolation in Silicic Tuff, Los Alamos Nat. Lab. Report LA-8841-MS (June 1981).

The Quality Assurance controls under which this previous work was performed are summarized in Tables I and II. Table I is a summary of the administrative controls under which the previous work was performed. Table II is a summary of the Work Plans and Detailed Procedures under which the previous work was performed.

Any work used in support of this investigation and completed before the implementation of NVO-196-17, Revision 0, August 1980, will be processed in accordance with NNWSI-SOP-03-03.

For work completed subsequent to August 1980, where approved QA Procedures were not implemented, the data or data interpretations to be used will be processed as a nonconformance in accordance with NNWSI-SOP-15-01 (TWS-MSTQA-QP-16,R0).

Planned Activities for FY86 and Later Years

FY86

Report on smectite stability.

FY87

Report on glass characteristics of Yucca Mountain.

FY89

Report on zeolite stability.

Report on the kinetics of zeolite reactions and zeolite stability.

11. Milestones and Deliverables

Milestones

Report on smectite stability (R323).	9/86
Report on zeolite stability and kinetics (C397).	12/88
Report on glass characteristics (M333).	5/87
Report on kinetics of clinoptilolite and heulandite dehydration (New).	9/87

Deliverables

Data updates through semiannual progress reports throughout these studies and the milestone reports listed above.

TABLE I. NNWSI QUALITY ASSURANCE PROCEDURES

TITLE	IDENTIFIER	DATE EFFECTIVE	DATE SUPERSEDED
QA PROGRAM PLAN	TWS-CMB QA-QP-01, R0	24-Oct-78	16-Aug-79
QA PROGRAM PLAN	TWS-CMB QA-QP-01, R1	16-Aug-79	09-Apr-80
QA PROGRAM PLAN	TWS-CMB QA-QP-01, R2	09-Apr-80	13-Sep-82
QA PROGRAM PLAN	TWS-CMB QA-QP-01, R3	13-Sep-82	01-Feb-84
QA PROGRAM PLAN	TWS-MSTQA-QP-01, R4	01-Feb-84	19-Sep-85
QA PROGRAM PLAN	NNWSI-QP-01, R0	19-Sep-85	
DOCUMENT CONTROL	TWS-CMB QA-QP-03, R0		14-Nov-78
DOCUMENT CONTROL	TWS-CNC-11-10/78-9R1	14-Nov-78	16-Jul-79
DOCUMENT CONTROL	TWS-CMB QA-QP-03, R2	16-Jul-79	13-Sep-82
DOCUMENT CONTROL	TWS-CMBQA-QP-03, R3	13-Sep-82	03-Jan-84
DOCUMENT CONTROL	TWS-MSTQA-QP-03, R4	03-Jan-84	19-Mar-85
DOCUMENT CONTROL	TWS-MSTQA-QP-03, R5	19-Mar-85	21-Feb-86
DOCUMENT CONTROL	TWS-MSTQA-QP-03, R6	21-Feb-86	
HANDLING, STORAGE, AND SHIPPING PROCEDURE	TWS-CMBQA-QP-04, R0	12-May-79	13-Sep-82
	TWS-CMBQA-QP-04, R1	13-Sep-82	02-Apr-85
	TWS-MSTQA-QP-04, R2	02-Apr-85	
NNWSI PROCUREMENT PROCEDURES	TWS-CMBQA-QP-06, R0	14-Sep-82	03-Jan-84
	TWS-CMBQA-QP-06, R1	03-Jan-84	21-Oct-85
	TWS-MSTQA-QP-06, R2	21-Oct-85	
PROCEDURE FOR TECHNICAL REVIEW OF PUBLICATIONS	TWS-CMBQA-QP-07, R0	02-Aug-82	04-Mar-85
	TWS-MSTQA-QP-07, R1	04-Mar-85	
PERSONNEL CERTIFICATION PROCEDURE FOR NNWSI	TWS-MSTQA-QP-08, R0	01-Jun-83	03-Jan-84
	TWS-MSTQA-QP-08, R1	03-Jan-84	20-Dec-84
	TWS-MSTQA-QP-08, R2	20-Dec-84	19-May-86
	TWS-MSTQA-QP-08, R3	19-May-86	
RECORDS CONTROL PROCEDURE	TWS-MSTQA-QP-09, R0	03-Jan-84	
NNWSI SURVEILLANCE PROCEDURE	TWS-MSTQA-QP-11, R0	01-Sep-84	
NNWSI RECEIVING INSPECTION PROCEDURE	TWS-MSTQA-QP-12, R0	21-Oct-85	

NNWSI LOS ALAMOS CONFLICT RESOLUTION COMMITTEE	TWS-MSTQA-QP-13, R0	22-May-85	30-Dec-85
QUALITY ASSURANCE PROCEDURE FOR ONE-TIME RESEARCH AND DEVELOPMENT WORK	TWS-MSTQA-QP-14, R0 TWS-MSTQA-QP-14, R1	22-May-85 19-May-86	19-May-86
NNWSI CONTROL OF NONCONFORMANCES	TWS-MSTQA-QP-16, R0	19-May-86	
ASSIGNMENT OF QUALITY LEVELS FOR LOS ALAMOS NNWSI ITEMS AND ACTIVITIES	TWS-MSTQA-QP-18, R0	17-Dec-85	
NNWSI CHANGE REQUESTS	TWS-MSTQA-QP-19, R0	19-May-86	
LOS ALAMOS QUALITY ASSURANCE MANUAL		02-Jul-84	19-Sep-85

TABLE II. WORK PLANS AND DETAILED PROCEDURES

MINERALOGY/PETROLOGY
SUBTASKS
A. ALTERATION AND FRACTURE MINERALOGY
B. MINERAL STABILITY
C. MINERALOGY OF TRANSPORT PATHWAYS

TITLE	IDENTIFIER	DATE EFFECTIVE	DATE SUPERSEDED	APPLICABLE SUBTASK
WORK PLANS				
TUFF EXPERIMENTS-MINERALOGY AND PETROLOGY STUDIES BY G-6	TWS-G6-WP-05, R1	18-Sep-79		C
	TWS-G6-WP-05, R2		24-Nov-82	C
NNWSI MINERALOGY AND PETROLOGY STUDIES	TWS-ESS-WP-05, R3	24-Nov-82		A,C
"SOAKING EXPERIMENTS"	TWS-G6-WP-07, R0	11-Jan-80	28-Apr-81	B
	TWS-G6-WP-07, R1	28-Apr-81		B
DETAILED PROCEDURES				
CLAY MINERAL SEPARATION AND PREPARATION FOR X-RAY DIFFRACTION ANALYSIS	TWS-ESS-DP-25, R0	31-Mar-83	03-Apr-86	A,B,C
	TWS-ESS-DP-25, R1	03-Apr-86		A,B,C
NEVADA TEST SITE FRACTURE FILLING STUDIES PROCEDURE	TWS-ESS-DP-28, R0	09-Sep-85		A
SPUTTER COATER OPERATION PROCEDURE FOR GOLD COATING SAMPLES	TWS-ESS-DP-50, R0	03-Apr-86		A
METTLER H80 OPERATING PROCEDURE	TWS-ESS-DP-51, R0	03-Apr-86		A,C
FUSING USING THE JUNIOR ORBIT SHAKER	TWS-ESS-DP-52, R0	03-Apr-86		A,C
CRUSHING: OPERATING OF 50 TON HYDRAULIC PRESS	TWS-ESS-DP-54, R0	03-Apr-86		A,C
ROCK SPLITTING: OPERATING OF 50 TON HYDRAULIC PRESS	TWS-ESS-DP-55, R0	03-Apr-86		A,C
TUFF HEATING EXPERIMENTS	TWS-G9-DP-13, R0	10-Mar-80		B
X-RAY POWDER DIFFRACTION	TWS-G6-2/79-23, R0	05-Mar-79	15-Aug-79	C

TITLE	IDENTIFIER	DATE EFFECTIVE	DATE SUPERSEDED	APPLICABLE SUBTASK
NTS CORE PETROGRAPHY PROCEDURE	TWS-G6-1/79-24,R0	05-Mar-79	15-Aug-79	C
	TWS-G6-DP-03, R1	15-Aug-79	24-Nov-82	C
	TWS-G6-DP-03, R2	24-Nov-82		A,B,C
SAMPLE PREPARATION LABORATORY PROCEDURES	TWS-G6-2/79-3.2.2,R0	08-Mar-79	26-Jun-79	C
	TWS-G6-DP-04, R1	26-Jun-79	24-Nov-82	C
	TWS-G6-DP-04, R2	24-Nov-82	31-Jan-83	A,B,C
	TWS-G6-DP-04, R3	31-Jan-83		A,B,C
OPERATING INSTRUCTIONS FOR DV-502 VACUUM EVAPORATOR USED IN CARBON COATING THIN SECTIONS FOR MICROPROBE ANALYSIS	TWS-G6-DP-06, R0	26-Jun-79	24-Nov-82	C
	TWS-G6-DP-06, R1	24-Nov-82	03-Apr-86	A,B,C
	TWS-G6-DP-06, R2	03-Apr-86		A,B,C
MICROPROBE OPERATING PROCEDURE	TWS-G6-DP-07, R0	26-Jun-79	24-Nov-82	C
	TWS-ESS-DP-07, R1	24-Nov-82		A,C
SIEMENS X-RAY DIFFRACTION PROCEDURE	TWS-G9-DP-16, R0	09-Jun-80	24-Nov-82	A,B,C
	TWS-G9-DP-16, R1	24-Nov-82	19-May-86	A,B,C
	TWS-ESS-DP-16, R2	19-May-86		A,B,C
SAMPLE PREPARATION: ROCK POWDERS	TWS-G9-DP-19, R0	25-Sep-80	24-Nov-82	B,C
	TWS-ESS-DP-19, R1	24-Nov-82		B,C
PROCEDURE: ALIGNMENT OF SIEMENS DIFFRACTOMETER	TWS-ESS-DP-24, R0	24-Nov-82		A,B,C
PULVERIZING USING THE SPEX 8500 SHATTERBOX	TWS-ESS-DP-53, R0	03-Apr-86		B,C
BRINKMAN AUTOMATED GRINDER PROCEDURE	TWS-ESS-DP-56, R0	03-Apr-86		A,B,C

WBS 1.2.3.4.2.A MINERALOGY/PETROLOGY

Subtask C. Mineralogy of Transport Pathways

1. Objectives, Issues, and Information Needs Addressed

The contribution of host-rock mineralogy and petrology to repository development and to geochemical retardation will be studied. Particular emphasis will be placed on transport in the unsaturated zone where transport may be particularly slow. Host-rock mineralogy and petrology will be studied to substantiate the continuity of well-characterized rock properties and to establish a petrologic and mineralogic stratigraphy for determining working elevations, should unanticipated fault offsets be crossed during repository construction. Studies of petrologic/mineralogic stratigraphy within the Topopah Spring Member are being conducted in conjunction with the USGS.

Studies of mineralogy along transport pathways address the following information needs (4/15/86 Issues Hierarchy):

1.14.2 Description of the unsaturated zone hydrologic system at the site.

1.14.3 Description of the saturated zone hydrologic system at the site.

1.15.4 Radionuclide retardation by sorption processes along flow paths to the accessible environment.

1.15.7 Radionuclide retardation by all processes along flow paths to the accessible environment.

1.16.1 Stratigraphy necessary to locate the underground facility.

1.19.1 Rates of dissolution of crystalline and non-crystalline components in tuff.

1.12.1 Site characterization information needed for design.

1.7.2 Effects on the geohydrology, geochemical, and rock characteristics.

1.7.3 Boundaries of the disturbed zone.

1.1.1 Site information needed to calculate the potential releases of radionuclides to the accessible environment.

1.9.1 Identification of favorable and potentially adverse conditions at the site.

4.8.1 Stratigraphy necessary to locate the underground facility.

4.3.2 Potential non-radiological hazards to personnel.

4.5.4 Potential impacts of rock characteristics on design.

1.10.1 Determination that the site is not disqualified and is not likely to be disqualified for each of the disqualifying conditions.

1.10.2 Determination that the site meets the qualifying conditions and is likely to continue to meet the qualifying conditions.

2. Principal Investigator

David T. Vaniman, Los Alamos National Laboratory

3. Statement of Work

Topopah Spring tuff-matrix and phenocryst analyses by optical petrography, electron microprobe analysis, and x-ray diffraction. Synthesis of quantitative x-ray diffraction data, using input from petrographic and electron microprobe studies and based on the tuff data base and the three-dimensional functional stratigraphy as used by SNL. Development of enhanced precision and accuracy in quantitative x-ray diffraction analysis of primary and secondary mineral abundances in tuff. Perform statistical evaluation of three-dimensional mineralogic models of Yucca Mountain. Internal stratigraphic models incorporating quantitative XRD and petrographic data bases will be refined using statistical techniques.

Mineralogic variability in the unsaturated and saturated zones away from the repository is being defined through studies of samples collected from deep drill holes. These studies will include samples from the lower part of the Exploratory Shaft when available. Mineral abundances and chemistry will be assessed for variability and continuity along transport pathways in three dimensions.

4. Data and Materials Needed, Techniques, Procedures and Computer Codes

Data. The modal and compositional variations in groundmass textural variants and in phenocryst abundances within the devitrified Topopah Spring Member. The abundances and compositions of minerals and glasses along transport pathways away from a repository in Yucca Mountain. Estimation of potential for interaction with waste-carrying fluids. The stored diffraction patterns and diffraction patterns already available and yet to be acquired for rock samples from Yucca Mountain.

Materials. Rock samples from drill cores and drill holes.

(a) Drill cores: J-12, J-13, UE-25a#1, UE-25b#1, USW G-1, G-2, GU-3, G-3, G-4, G-5, G-6, G-7, and H-6.
(b) Drill Holes: USW H-3, H-4, H-5, UE-25p#1, USW WT-1, WT-2.

Techniques. Modal optical petrography, electron microprobe analysis, and quantitive x-ray diffraction analysis. Improved methods for accuracy and precision are being developed and applied to stored data. Standard comparisons between representative mineral sets and corundum intensity reference. Techniques were recently developed that compare the entire XRD pattern to a calculated pattern and baseline, with unconstrained totals.

Statistical treatment of results will refine the reliability of the quantitative x-ray diffraction data and relate this to the ultimate reliability of mineralogic models of Yucca Mountain. Supplements to standard Kriging analysis; these techniques will be developed through interaction with the Statistical Division, Los Alamos National Laboratory.

Procedures

TWS-ESS-DP-01, R2	X-Ray Powder Diffraction Analysis
TWS-ESS-DP-03, R2	Nevada Test Site Core Petrography Procedure
TWS-ESS-DP-04, R3	Sample Preparation Laboratory Procedures
TWS-ESS-DP-06, R2	Operation Instructions for DV-502 Vacuum Evaporator Used in Carbon Coating Samples
TWS-ESS-DP-07, R1	Microprobe Operating Procedure
TWS-ESS-DP-24, R0	Procedure: Alignment of the Siemens Diffractometer
TWS-ESS-DP-25, R1	Clay Mineral Separation and Preparation for X-Ray Diffraction Analysis
TWS-ESS-DP-28, R0	Nevada Test Site Fracture Filling Studies Procedure
TWS-ESS-DP-50, R0	Sputter Coater Operating Procedure for Gold Coating Samples
TWS-ESS-DP-51, R0	Mettler H80 Operation Procedure (X-ray Fluorescence Analysis Sample Weighing Procedure
TWS-ESS-DP-52, R0	Fusing Using the Junior Orbit Shaker
TWS-ESS-DP-53, R0	Pulverizing Using the Spex 8500 Shatterbox
TWS-ESS-DP-54, R0	Crushing, Operating of 50 Ton Hydraulic Press
TWS-ESS-DP-55, R0	Rock Splitting, Operating of 50 Ton Hydraulic Press
TWS-ESS-DP-56, R0	Brinkman Automated Grinder Procedure

Codes

XRD: DIFFRAC V: Version May 1983;
Siemens-Allis DIFFRAC V Users Manual

Probe: SANDIA TASK8; Sandia Report SAND 85-2037

5. Nonstandard Methods and Techniques

None.

6. Location of Work Performed

All the work will be performed at the Los Alamos National Laboratory.

7. Quality Assurance Requirements

This subtask has been determined to be Quality Level I. See QALAS submission for details.

8. Application of Results

Studies of mineralogy along transport pathways apply to two primary needs for the NNWSI Project: site characterization, 10 CFR 60.122(b)(5) and 21(c)1(i); and transport code applications as required in 40 CFR 191.16 and 10 CFR 60.113(a)(1)(ii)(B).

Specific studies of internal petrographic stratigraphy of the Topopah Spring Member also apply to the repository design criteria, 10 CFR 60.130(1), which require a method for determining the ability to transfer data acquired in the Exploratory Shaft Facility.

Within the NNWSI Project these data will apply to

Retardation Sensitivity Analysis Subtask (Los Alamos)

Performance Assessment (SNL)

Preparation of SCP, PSAR, EIS (Los Alamos)

Data will be submitted to the Tuff Data Base.

9. Schedule

Start Date: In progress. Expected ending date: December 1991

10. Past and Expected Achievements

Previous Work and QA Controls on Previous Work

The previous work to be used in support of this investigation is summarized in the reports listed below.

Carroll, P. I., F. A. Caporuscio, and D. L. Bish, "Further Description of the Petrology of the Topopah Spring Member of the Paintbrush Tuff in Drill Holes UE25A-1 and USW-G1 and of the Lithic-Rich Tuff in USW-G1, Yucca Mountain, Nevada," Los Alamos Nat. Lab. Report LA-9000-MS (November 1981).

Caporuscio, F. et al., "Petrologic Studies of Drill Cores USW-G2 and UE25b-1H, Yucca Mountain, Nevada," Los Alamos Nat. Lab. Report LA-9255-MS (July 1982).

Bish, D. L. et al.. "Summary of the Mineralogy-Petrology of Tuffs of Yucca Mountain and the Secondary-Phase Thermal Stability in Tuffs," Los Alamos Nat. Lab. Report LA-9321-MS (November 1982).

Byers, F. M. Jr., and Richard G. Warren, "Revised Volcanic Stratigraphy of Drill Hole J-13, Fortymile Wash, Nevada, Based on Petrographic Modes and Chemistry of Phenocrysts," Los Alamos Nat. Lab. Report LA-9652-MS (January 1983).

Vaniman, D. et al., "Variations in Authigenic Mineralogy and Sorptive Zeolite Abundance at Yucca Mountain, Nevada, Based on Studies of Drill Cores USW GU-3 ad G-3," Los Alamos Nat. Lab. Report LA-9707-MS (June 1984).

Warren, Richard G., Frank M. Byers, Jr., and Florie A. Caporuscio, "Petrography and Mineral Chemistry of Units of the Topopah Spring, Calico Hills and Crater Flat Tuffs, and Older Volcanic Units, with Emphasis on Samples from Drill Hole USW G-1, Yucca Mountain, Nevada Test Site," Los Alamos Nat. Lab. Report LA-10003-MS (June 1984).

Byers, F. M. Jr., "Revised Volcanic Stratigraphy of Drill Hole J-13, Fortymile Wash, Nevada, Based on Petrographic Modes and Chemistry of Phenocrysts," Los Alamos Nat. Lab. Report LA-9652-MS (January 1983).

Caporuscio, F. A., and D. T. Vaniman, "Iron and Manganese in Oxide Minerals and in Glasses: Preliminary Consideration of Eh Buffering Potential at Yucca Mountain, Nevada," Los Alamos Nat. Lab. Report LA-10369-MS (April 1985).

Byers, F. M., Jr., "Petrochemical Variation of Topopah Spring Tuff Matrix with Depth (Stratigraphic Level), Drill Hole USW G-4, Yucca Mountain, Nevada," Los Alamos Nat. Lab. Report LA-10561-MS (December 1985).

Bish, D. L., and D. T. Vaniman, "Mineralogic Summary of Yucca Mountain, Nevada," Los Alamos Nat. Lab. Report LA-10543-MS (October 1985).

The Quality Assurance controls under which this previous work was performed are summarized in Tables I and II. Table I is a summary of the administrative controls under which the previous work was performed. Table II is a summary of the Work Plans and Detailed Procedures under which the previous work was performed.

Any work used in support of this investigation and completed before the implementation of NVO-196-17, Revision 0, August 1980, will be processed in accordance with NNWSI-SOP-03-03.

For work completed subsequent to August, 1980, where approved QA Procedures were not implemented, the data or data interpretations to be used will be processed as a nonconformance in accordance with NNWSI-SOP-15-01 (TWS-MSTQA-QP-16, R0).

Planned Achievements for FY-86 and Later Years

FY86

Report on petrographic stratigraphy within the Topopah, as compared between drill cores.

Report on mineralogy/petrology coincident with the functional stratigraphy of the Tuff Data Base

TABLE I. NNWSI QUALITY ASSURANCE PROCEDURES

TITLE	IDENTIFIER	DATE EFFECTIVE	DATE SUPERSEDED
QA PROGRAM PLAN	TWS-CMB QA-QP-01, R0	24-Oct-78	16-Aug-79
QA PROGRAM PLAN	TWS-CMB QA-QP-01, R1	16-Aug-79	09-Apr-80
QA PROGRAM PLAN	TWS-CMB QA-QP-01, R2	09-Apr-80	13-Sep-82
QA PROGRAM PLAN	TWS-CMB QA-QP-01, R3	13-Sep-82	01-Feb-84
QA PROGRAM PLAN	TWS-MSTQA-QP-01, R4	01-Feb-84	19-Sep-85
QA PROGRAM PLAN	NNWSI-QP-01, R0	19-Sep-85	
DOCUMENT CONTROL	TWS-CMB QA-QP-03, R0		14-Nov-78
DOCUMENT CONTROL	TWS-CNC-11-10/78-9R1	14-Nov-78	16-Jul-79
DOCUMENT CONTROL	TWS-CMB QA-QP-03, R2	16-Jul-79	13-Sep-82
DOCUMENT CONTROL	TWS-CMBQA-QP-03, R3	13-Sep-82	03-Jan-84
DOCUMENT CONTROL	TWS-MSTQA-QP-03, R4	03-Jan-84	19-Mar-85
DOCUMENT CONTROL	TWS-MSTQA-QP-03, R5	19-Mar-85	21-Feb-86
DOCUMENT CONTROL	TWS-MSTQA-QP-03, R6	21-Feb-86	
HANDLING, STORAGE, AND SHIPPING PROCEDURE	TWS-CMBQA-QP-04, R0	12-May-79	13-Sep-82
	TWS-CMBQA-QP-04, R1	13-Sep-82	02-Apr-85
	TWS-MSTQA-QP-04, R2	02-Apr-85	
NNWSI PROCUREMENT PROCEDURES	TWS-CMBQA-QP-06, R0	14-Sep-82	03-Jan-84
	TWS-CMBQA-QP-06, R1	03-Jan-84	21-Oct-85
	TWS-MSTQA-QP-06, R2	21-Oct-85	
PROCEDURE FOR TECHNICAL REVIEW OF PUBLICATIONS	TWS-CMBQA-QP-07, R0	02-Aug-82	04-Mar-85
	TWS-MSTQA-QP-07, R1	04-Mar-85	
PERSONNEL CERTIFICATION PROCEDURE FOR NNWSI	TWS-MSTQA-QP-08, R0	01-Jun-83	03-Jan-84
	TWS-MSTQA-QP-08, R1	03-Jan-84	20-Dec-84
	TWS-MSTQA-QP-08, R2	20-Dec-84	19-May-86
	TWS-MSTQA-QP-08, R3	19-May-86	
RECORDS CONTROL PROCEDURE	TWS-MSTQA-QP-09, R0	03-Jan-84	
NNWSI SURVEILLANCE PROCEDURE	TWS-MSTQA-QP-11, R0	01-Sep-84	
NNWSI RECEIVING INSPECTION PROCEDURE	TWS-MSTQA-QP-12, R0	21-Oct-85	

NNWSI LOS ALAMOS CONFLICT RESOLUTION COMMITTEE	TWS-MSTQA-QP-13, R0	22-May-85	30-Dec-85
QUALITY ASSURANCE PROCEDURE FOR ONE-TIME RESEARCH AND DEVELOPMENT WORK	TWS-MSTQA-QP-14, R0 TWS-MSTQA-QP-14, R1	22-May-85 19-May-86	19-May-86
NNWSI CONTROL OF NONCONFORMANCES	TWS-MSTQA-QP-16, R0	19-May-86	
ASSIGNMENT OF QUALITY LEVELS FOR LOS ALAMOS NNWSI ITEMS AND ACTIVITIES	TWS-MSTQA-QP-18, R0	17-Dec-85	
NNWSI CHANGE REQUESTS	TWS-MSTQA-QP-19, R0	19-May-86	
LOS ALAMOS QUALITY ASSURANCE MANUAL		02-Jul-84	19-Sep-85

TABLE II. WORK PLANS AND DETAILED PROCEDURES

MINERALOGY/PETROLOGY
SUBTASKS
A. ALTERATION AND FRACTURE MINERALOGY
B. MINERAL STABILITY
C. MINERALOGY OF TRANSPORT PATHWAYS

TITLE	IDENTIFIER	DATE EFFECTIVE	DATE SUPERSEDED	APPLICABLE SUBTASK
WORK PLANS				
TUFF EXPERIMENTS-MINERALOGY AND PETROLOGY STUDIES BY G-6	TWS-G6-WP-05, R1	18-Sep-79		C
	TWS-G6-WP-05, R2		24-Nov-82	C
NNWSI MINERALOGY AND PETROLOGY STUDIES	TWS-ESS-WP-05, R3	24-Nov-82		A,C
"SOAKING EXPERIMENTS"	TWS-G6-WP-07, R0	11-Jan-80	28-Apr-81	B
	TWS-G6-WP-07, R1	28-Apr-81		B
DETAILED PROCEDURES				
CLAY MINERAL SEPARATION AND PREPARATION FOR X-RAY DIFFRACTION ANALYSIS	TWS-ESS-DP-25, R0	31-Mar-83	03-Apr-86	A,B,C
	TWS-ESS-DP-25, R1	03-Apr-86		A,B,C
NEVADA TEST SITE FRACTURE FILLING STUDIES PROCEDURE	TWS-ESS-DP-28, R0	09-Sep-85		A
SPUTTER COATER OPERATION PROCEDURE FOR GOLD COATING SAMPLES	TWS-ESS-DP-50, R0	03-Apr-86		A
METTLER H80 OPERATING PROCEDURE	TWS-ESS-DP-51, R0	03-Apr-86		A,C
FUSING USING THE JUNIOR ORBIT SHAKER	TWS-ESS-DP-52, R0	03-Apr-86		A,C
CRUSHING: OPERATING OF 50 TON HYDRAULIC PRESS	TWS-ESS-DP-54, R0	03-Apr-86		A,C
ROCK SPLITTING: OPERATING OF 50 TON HYDRAULIC PRESS	TWS-ESS-DP-55, R0	03-Apr-86		A,C
TUFF HEATING EXPERIMENTS	TWS-G9-DP-13, R0	10-Mar-80		B
X-RAY POWDER DIFFRACTION	TWS-G6-2/79-23, R0	05-Mar-79	15-Aug-79	C

TITLE	IDENTIFIER	DATE EFFECTIVE	DATE SUPERSEDED	APPLICABLE SUBTASK
NTS CORE PETROGRAPHY PROCEDURE	TWS-G6-1/79-24,R0	05-Mar-79	15-Aug-79	C
	TWS-G6-DP-03, R1	15-Aug-79	24-Nov-82	C
	TWS-G6-DP-03, R2	24-Nov-82		A,B,C
SAMPLE PREPARATION LABORATORY PROCEDURES	TWS-G6-2/79-3.2.2,R0	08-Mar-79	26-Jun-79	C
	TWS-G6-DP-04, R1	26-Jun-79	24-Nov-82	C
	TWS-G6-DP-04, R2	24-Nov-82	31-Jan-83	A,B,C
	TWS-G6-DP-04, R3	31-Jan-83		A,B,C
OPERATING INSTRUCTIONS FOR DV-502 VACUUM EVAPORATOR USED IN CARBON COATING THIN SECTIONS FOR MICROPROBE ANALYSIS	TWS-G6-DP-06, R0	26-Jun-79	24-Nov-82	C
	TWS-G6-DP-06, R1	24-Nov-82	03-Apr-86	A,B,C
	TWS-G6-DP-06, R2	03-Apr-86		A,B,C
MICROPROBE OPERATING PROCEDURE	TWS-G6-DP-07, R0	26-Jun-79	24-Nov-82	C
	TWS-ESS-DP-07, R1	24-Nov-82		A,C
SIEMENS X-RAY DIFFRACTION PROCEDURE	TWS-G9-DP-16, R0	09-Jun-80	24-Nov-82	A,B,C
	TWS-G9-DP-16, R1	24-Nov-82	19-May-86	A,B,C
	TWS-ESS-DP-16, R2	19-May-86		A,B,C
SAMPLE PREPARATION: ROCK POWDERS	TWS-G9-DP-19, R0	25-Sep-80	24-Nov-82	B,C
	TWS-ESS-DP-19, R1	24-Nov-82		B,C
PROCEDURE: ALIGNMENT OF SIEMENS DIFFRACTOMETER	TWS-ESS-DP-24, R0	24-Nov-82		A,B,C
PULVERIZING USING THE SPEX 8500 SHATTERBOX	TWS-ESS-DP-53, R0	03-Apr-86		B,C
BRINKMAN AUTOMATED GRINDER PROCEDURE	TWS-ESS-DP-56, R0	03-Apr-86		A,B,C

FY87

Report on precision, accuracy and alternate interpretations of mineralogy and petrology models along transport pathways.

FY89

Report on mineralogy evaluations of Yucca Mountain along transport pathways, including coincidence of past chemical exchange.

FY90

Report on petrographic stratigraphy and variability within Topopah Spring Member and on mineralogy/petrology of transport pathways.

FY91

Final reports on mineralogy/petrology of transport pathways and on petrographic stratigraphy and variation within the Topopah Spring Member.

11. Milestones and Deliverables

Milestones

Report comparing petrographic stratigraphy within Topopah Spring Member at Yucca Mountain (R320).	4/86
Statistical evaluation of lateral continuity in sorptive mineral zones (M331).	7/86
Tests of quantitative mineralogic data (M335).	6/87
Report on precision, accuracy, and alternate interpretations of mineralogy and petrology models along transport pathways (M337).	12/87
Update report on mineralogy evaluations of Yucca Mountain along flow paths (R548).	12/88
Update report on mineralogy evaluations of Yucca Mountain along transport pathways, including coincidence of past chemical exchange (R701).	12/89
Update report on mineralogy evaluations of Yucca Mountain along transport pathways (R702).	12/90
Complete mineralogy evaluations of Yucca Mountain along flow paths (M382).	12/91

Deliverables

Data updates through semiannual progress reports throughout these studies and the milestone reports listed above.

QUALITY ASSURANCE LEVEL ASSIGNMENT SHEET (QALAS)

AND

QUALITY LEVEL ASSIGNMENT CRITERIA SHEET (QLACS)

SIP No. 86/4.2

Rev. 0

Activity Mineralogy/Petrology

Tasks: Alteration and Fracture Mineralogy

Mineral Stability

Mineralogy of Transport Pathways

QUALITY ASSURANCE LEVEL ASSIGNMENT SHEET (QALAS)

NNWSI QUALITY ASSURANCE LEVEL ASSIGNMENT			
Items/Activities	**QA Level**	**QA Requirements**	**Technical Justification**
Alteration and Fracture Mineralogy	I	1,2,3,4,5,6,7,8, 10,11,12,13,15, 16,17,18 See attached QLACS	NNWSI SOP-02-02: para.5.2.1bA (activity will provide site characterization data), and Step 2 of QA Level Assignment Checklist Only those items and sub-activities that directly control the quality of quantitative data will be considered Level I.

APPROVALS (Signature and Date)

PI _____ TPO _____

QAL _____ WMPO(TECH) _____

QAIM _____ WMPO(PQM) _____

PI FINAL REVIEW _____

QUALITY LEVEL ASSIGNMENT CRITERIA SHEET (QLACS)

SIP No. 86/4.2

Rev. 0

Activity: Mineralogy/Petrology

Task: Alteration and Fracture Mineralogy

PI: D. T. Vaniman

QA Criterion	Applies	Does not Apply	Comments
1. QA Organization	x		
2. QA Program	x		
3. Design and Scientific Investigation Control	x		Only scientific investigation requirements apply
4. Procurement Document Control	x		
5. Instructions, Procedures, and Drawings	x		
6. Document Control	x		
7. Control of Purchased Material, Equipment, and Services	x		
8. ID and Control of Materials, Parts, Components, and Samples	x		
9. Control of Processes		x	Activities performed under this WBS are not considered to be special processes as per definition in Appendix A SOP-02-01
10. Inspection	x		Applicable for surveillance requirements only
11. Test and Experiment/ Research Control	x		
12. Control of Measuring and Test Equipment	x		

QA Criterion	Applies	Does not Apply	Comments
13. Handling, Shipping, and Storage	x		
14. Inspection, Test, and Operating Status		x	No hardware generated in this task
15. Control of Nonconformances	x		
16. Corrective Action	x		
17. QA Records	x		
18. QA Audits	x		

QUALITY ASSURANCE LEVEL ASSIGNMENT SHEET (QALAS)

NNWSI QUALITY ASSURANCE LEVEL ASSIGNMENT			
Items/Activities	**QA Level**	**QA Requirements**	**Technical Justification**
Mineral Stability	I	1,2,3,4,5,6,7,8, 10,11,12,13,15,	NNWSI SOP-02-02: para.5.2.1bA (activity will provide site
		16,17,18 See attached QLACS	characterization data), and Step 2 of QA Level Assignment Checklist
			Only those items and sub-activities that directly control the quality of
			quantitative data will be considered Level I.

APPROVALS (Signature and Date)

PI _____ TPO _____

QAL _____ WMPO(TECH) _____

QAIM _____ WMPO(PQM) _____ 7/14/86

PI FINAL REVIEW _____

QUALITY LEVEL ASSIGNMENT CRITERIA SHEET (QLACS)

SIP No. 86/4.2

Rev. 0

Activity: Mineralogy/Petrology

Task: Mineral Stability

PI: D. T. Vaniman D.T. Vaniman, 10/20

	QA Criterion	Applies	Does not Apply	Comments
1.	QA Organization	x		
2.	QA Program	x		
3.	Design and Scientific Investigation Control	x		Only scientific investigation requirements apply
4.	Procurement Document Control	x		
5.	Instructions, Procedures, and Drawings	x		
6.	Document Control	x		
7.	Control of Purchased Material, Equipment, and Services	x		
8.	ID and Control of Materials, Parts, Components, and Samples	x		
9.	Control of Processes		x	Activities performed under this WBS are not considered to be special processes as per definition in Appendix A SOP-02-01
10.	Inspection	x		Applicable for surveillance requirements only
11.	Test and Experiment/ Research Control	x		
12.	Control of Measuring and Test Equipment	x		

QA Criterion	Applies	Does not Apply	Comments
13. Handling, Shipping, and Storage	x		
14. Inspection, Test, and Operating Status		x	No hardware generated in this task
15. Control of Nonconformances	x		
16. Corrective Action	x		
17. QA Records	x		
18. QA Audits	x		

QUALITY ASSURANCE LEVEL ASSIGNMENT SHEET (QALAS)

NNWSI QUALITY ASSURANCE LEVEL ASSIGNMENT			
Items/Activities	**QA Level**	**QA Requirements**	**Technical Justification**
Mineralogy of Transport Pathways	I	1,2,3,4,5,6,7,8, 10,11,12,13,15, ~~16,17,18~~	NNWSI SOP-02-02: para.5.2.1bA (activity will provide site ~~characterization data), and~~
		See attached OLACS	Step 2 of QA Level Assignment Checklist
			~~Only those items and sub-~~ activities that directly control the quality of
			~~quantitative data will be~~ considered Level I.

APPROVALS (Signature and Date)

PI _____ TPO _____

QAL _____ WMPO(TECH) _____

QAIM _____ WMPO(PQM) _____ 7/14/90

PI FINAL REVIEW _____

QUALITY LEVEL ASSIGNMENT CRITERIA SHEET (QLACS)

SIP No. 86/4.2

Rev. 0

Activity: Mineralogy/Petrology

Task: Mineralogy of Transport Pathways

PI: D. T. Vaniman D. T. Vaniman 7/1/86

	QA Criterion	Applies	Does not Apply	Comments
1.	QA Organization	x		
2.	QA Program	x		
3.	Design and Scientific Investigation Control	x		Only scientific investigation requirements apply
4.	Procurement Document Control	x		
5.	Instructions, Procedures, and Drawings	x		
6.	Document Control	x		
7.	Control of Purchased Material, Equipment, and Services	x		
8.	ID and Control of Materials, Parts, Components, and Samples	x		
9.	Control of Processes		x	Activities performed under this WBS are not considered to be special processes as per definition in Appendix A SOP-02-01
10.	Inspection	x		Applicable for surveillance requirements only
11.	Test and Experiment/ Research Control	x		
12.	Control of Measuring and Test Equipment	x		

QA Criterion	Applies	Does not Apply	Comments
13. Handling, Shipping, and Storage	x		
14. Inspection, Test, and Operating Status		x	No hardware generated in this task
15. Control of Nonconformances	x		
16. Corrective Action	x		
17. QA Records	x		
18. QA Audits	x		