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REPLACE: Binder Cover and Spine.

REPLACE: Inside Cover Page, Rev. 0, dated 06/08/89 with new Inside Cover Page, Rev. 1, dated 02/28/91.

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REPLACE: Pages 3.3-35 to 3.3-42 (within Tab 3.3) with revised pages.

REPLACE: Pages 3.4-15 to 3.4-20 (within Tab 3.4) with revised pages.

REPLACE: Pages 3.5-43 to 3.5-50 (within Tab 3.5) with revised pages.

REMOVE: Pages 7.2-1 to 7.2-5 and the unnumbered QALA sheets following page 7.2-5 (within Tab 7 Appendices).

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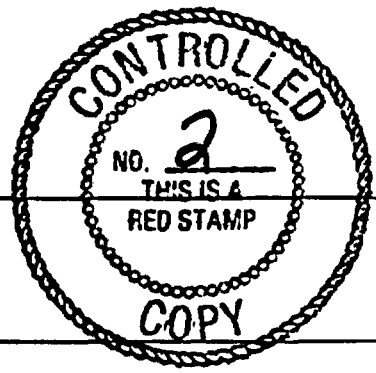

Study Plan for
Study 8.3.1.5.2.1

Characterization of the Yucca Mountain Quaternary Regional Hydrology

Revision 1

U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Washington, DC 20585

Prepared by
U.S. Geological Survey

Study 8.3.1.5.2.1	*Characterization of the Yucca Mountain Quaternary Regional Hydrology*

YUCCA MOUNTAIN PROJECT
STUDY PLAN APPROVAL FORM

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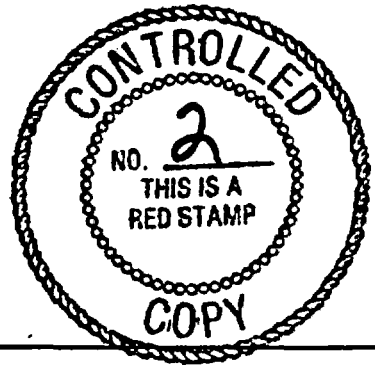

Study Plan Number 8.3.1.5.2.1

Study Plan Title Characterization of the Yucca Mountain Quaternary Regional Hydrology

Revision Number 1

Prepared by: U. S. Geological Survey

Date: January, 1991

Approved:

2/12/91

Director, Regulatory and Site Evaluation Division / Date

Effective Date: February 28, 1991

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parameter-value range. The alternate methods will be utilized only if the primary (selected) method is impractical to measure the parameter(s) of interest. In some cases, there are many approaches to conducting the test. In those cases, only the most common methods are included in the tables. The selected methods in Table 3.3-3 were chosen wholly or in part on the basis of accuracy, precision, duration of methods, expected range, and interference with other tests and analyses.

The accuracy and precision of methods are difficult to quantify before actual testing and implementation of the methodology. Generally, for method selection, the accuracy and precision prediction is a relative judgement based on the USGS investigators' familiarity with, and understanding of, the method. For selected methods, if values for accuracy and precision exist, they will be listed within the USGS technical procedures.

Similarly, the duration of a method is difficult to quantify. The duration of some methods may be seconds, whereas the duration of others may be months. The methods, however, have been selected so that the parameters of interest can be evaluated reasonably within the schedule of the study (Section 5.1). The total duration of the method is dependent on the number of times it is implemented, which is dependent on the spatial variability of a parameter within or among geohydrologic units, the accuracy and precision of the method, the number of available samples, and desired level of confidence in reproducibility of the measurement.

The methods were also selected by considering their ranges of measurement. It would be senseless to select a method that could not provide accurate data within the expected range of the site-characterization parameter of interest. Again, the expected range of method is difficult to quantify without actual testing or implementation of the technique. The USGS investigators, however, have selected methods which they believe are suitable to provide accurate data within the expected range of the site-characterization parameter. Some of the expected ranges of site-characterization parameters have been bracketed by previous data collection and are shown in Table 3.3-3.

Finally, the interference of a given method with other tests in the site-characterization program was considered in selecting the method. Generally, the selected methods will have little or no interference with other tests and analyses. In cases where methods do interfere, the USGS investigators have planned their testing sequences accordingly, in order to maximize data collection and minimize interference.

3.3.4 Technical procedures and quality-assurance program

The USGS quality-assurance (QA) program for the YMP requires the evaluation of study plan activities to determine the applicable QA criteria. A QA Grading Report that identifies the criteria applied to this activity will be prepared and approved following applicable YMP procedures. The QA Grading Report is distributed as a separate controlled document from the study plan.

The technical procedures which will be utilized in this activity are standard procedures derived from the scientific literature appropriate to the various techniques. These procedures have been adapted to compensate for site-specific conditions and incorporate the quality-assurance requirements of the Yucca Mountain Project.

Table 3.3-4 provides a tabulation of technical procedures applicable to this activity technical procedures for chemical analyses for this activity appear in Table 3.5-2). The technical procedures are listed according to the tests/analyses of Table 3.3.3. Approved procedures are identified with a number and a procedure effective date. Procedures that require preparation do not have procedure numbers. Procedures that are identified as "needed" in the table will be completed and available 30 days before the associated testing is started.

Equipment requirements and instrument calibration are described in the technical procedures. Lists of equipment stepwise procedures for the use and calibration of equipment, limits, accuracy, handling, and calibration needs, quantitative or qualitative acceptance criteria of results, description of data documentation, identification, treatment, and control of samples, and records requirements are included in these documents.

Table 3.3-4. Technical procedures for the past discharge areas (SCP Activity 8.3.2.5.2.1.3)

(Dashes (--) indicate information is not available and to be determined.

(Technical procedures will be in place 30 and 60 days prior to commencement of work for standard and non-standard procedures, respectively.)

Technical procedure number (NNN-USGS-)	Technical procedure	Effective date
	Remote-sensing analysis and verification	
GP-01,R1	Geologic mapping	11/08/88
HP-128,R0	Development of methods to calibrate remote-sensing surficial data against hydrologic and related properties of representative materials in a Southern-Nevada ground-water basin, Nevada and California	In prep.
HP-158,R0	Hydrology and hydraulic nature of fracture zones and lineaments determined from remote sensing and hydrologic analysis (tentative procedure)	In prep.
HP-173,R0	Data collection protocol for plant community analysis	06/23/88
	Estimate character of ground-water discharge using paleontologic, isotopic, and geochemical data	
GCP-01,R0	Radiometric-age data bank	06/15/81
GCP-02,R1	Labeling, identification, and control of samples for geochemistry and isotope geology	06/20/87
GCP-03,R1	Uranium-series dating	03/09/88
GCP-05,R1	Radium-equivalent uranium, thorium, and potassium analysis by gamma-ray spectrometry	03/09/88
GCP-06,R0	Potassium-argon dating	06/15/81
GCP-08,R1	Fission-track dating	05/26/88
GP-02,R0	Subsurface investigations	03/01/83
GP-03,R0	Stratigraphic studies	03/01/83

Table 3.3-4. Technical procedures for the past discharge areas (SCP Activity 8.3.2.5.2.1.3)--Continued

Technical procedure number (NNN-USGS-)	Technical procedure	Effective date
	Estimate character of ground-water discharge using paleontologic, isotopic, and geochemical data	
NP-01,R0	Methods for determining water level	01/11/82
NP-08,R0	Methods for determination of inorganic substances in water	08/06/82
NP-11,R0	Methods for determination of radioactive substances in water	06/18/82
NP-13,R0	Collection and field analysis of unsaturated-zone ground-water samples	08/29/83
NP-23,R1	Collection and field analysis of saturated-zone ground-water samples	11/04/83
NP-25,R0	Methods for measuring water levels using the Dodge Logging Van (I-127410)	07/20/84
NP-26,R0	Method for calibrating water-level measurement equipment using the reference steel tape	08/14/84
NP-34,R0	Preliminary method for measuring discharge for an aquifer test using a staff gage and a calibrated container	05/15/85
NP-37,R1	Drilling and coring unconsolidated sediments	11/18/88
NP-39,R0	Method for determining water levels using the trailer-mounted hoist (I-134719)	In prep.
NP-54,R0	Water-flow measurements using weirs, flumes, and barrels	05/16/88
NP-71,R0	Method for monitoring water-level changes using a Campbell Scientific 21X Micrologger	09/01/87
NP-75,R0	Method for measuring water levels in wells using reeled (2,600-ft and 2,800-ft) steel tape	06/22/87
NP-76,R0	Diatom enumeration studies	04/08/85

Table 3.3-4. Technical procedures for the past discharge areas (SCP Activity 8.3.2.5.2.1.3)--Continued

Technical procedure number (NNM-USGS-)	Technical procedure	Effective date
Estimate character of ground-water discharge using paleontologic, isotopic, and geochemical data		
NP-78,R1	Nonmarine calcareous-microfossil sample preparation and data acquisition procedures	06/13/88
NP-79,R0	Analysis of fossil pollen from lake sediments	10/20/86
NP-83,R0	Drilling and casing of observation holes in sand deposits	06/22/87
NP-91,R0	Collection and field analysis of surface-water samples	10/07/87
NP-99,R0	Instructions for operation of a well sounder for measuring water levels	06/08/88
Needed	Underwater procedures	--
TWS-ESS-OP-16,R2	Siemens X-ray diffractometer procedure	02/02/86
TWS-ESS-OP-24,R0	Alignment of Siemens diffractometer	11/24/82
TWS-ESS-OP-25,R1	Clay-mineral separation and preparation for X-ray diffraction	02/05/86
TWS-ESS-OP-51,R0	Mettler M80 sample-weighing procedure	02/05/86
TWS-ESS-OP-52,R0	Making fused discs with Junior orbit shaker	02/05/86
TWS-ESS-OP-53,R0	Pulverizing with Spex 8500 Shatterbox	02/05/86
TWS-ESS-OP-117,R0	Instrumental neutron activation	08/15/88
GCP-17,R1	Determination of the isotopic ratio H/D in water	07/19/88
NP-173,R0	Data collection protocol for plant community analysis	06/23/88
NP-85,R0	Method of monitoring water-level changes using a pressure transducer and the Fluke 2280 B Data Logger	In prep.

Table 3.3-4. Technical procedures for the past discharge areas (SCP Activity 8.3.2.5.2.1.3)--Continued

Technical procedure number (NWM-USGS-)	Technical procedure	Effective date
	Estimate character of ground-water discharge using paleontologic, isotopic, and geochemical data	
TWS-ESS-OP-11,R0	Procedure for x-ray fluorescence analysis	01/14/88
TWS-ESS-OP-112,R0	Operating instruction for International Scientific Instrument Model DS-130 scanning electron microscope and TRACOR northern series II x-ray analyzer	01/27/88
GCP-04,R1	Uranium-trend dating	05/27/88
GCP-07,R1	Mineral separation for geochemistry and isotopic analysis	05/27/88
	Estimation of past-potentiometric head by analysis of mineral deposits	
GCP-01,R0	Radiometric-age data bank	06/15/81
GCP-02,R1	Labeling, identification, and control of samples for geochemistry and isotope geology	06/20/87
GCP-03,R1	Uranium-series dating	03/09/88
GCP-05,R1	Radium-equivalent uranium, thorium, and potassium analysis by gamma-ray spectrometry	03/09/88
GCP-06,R0	Potassium-argon dating	06/15/81
GCP-08,R1	Fission-track dating	05/26/88
GP-02,R0	Subsurface investigations	03/01/83
GP-03,R0	Stratigraphic studies	03/01/83
HP-08,R0	Methods for determination of inorganic substances in water	08/06/82

Table 3.3-4. Technical procedures for the past discharge areas (SCP Activity 8.3.1.5.2.1.3)--Continued

Technical procedure number (NNM-USGS-)	Technical procedure	Effective date
	Estimation of past-potentiometric head by analysis of mineral deposits	
NP-11,R0	Methods for determination of radioactive substances in water	06/18/82
NP-23,R1	Collection and field analysis of saturated-zone ground-water samples	11/04/83
NP-37,R1	Drilling and coring unconsolidated sediments	11/18/88
NP-75,R0	Method for measuring water levels in wells using reeled (2,600-ft and 2,800-ft) steel tape	06/22/87
NP-78,R1	Nonmarine calcareous-microfossil sample preparation and data acquisition procedures	06/13/88
NP-79,R0	Analysis of fossil pollen from lake sediments	10/20/86
Needed	Underwater procedures	--
Needed	Procedure for conducting well inventory	--
NP-166,R0	Processing of soil, sediment, and water samples for chrysophyte cysts	01/27/89
GCP-04,R1	Uranium-trend dating	05/27/88
GCP-07,R1	Mineral separation for geochemistry and isotopic analysis	05/27/88
Needed	Seismic-reflection surveys	--
	Electromagnetic (EM) ground conductivity	
Needed	Radio-frequency ground-conductivity measurements for mapping of water tables	--

Table 3.3-4. Technical procedures for the past discharge areas (SCP Activity 8.3.2.5.2.1.3)--Continued

Technical procedure number (NNN-USGS-)	Technical procedure	Effective date
	Estimation of storage coefficient	
Needed	Storage coefficient estimation by vertical-variability method	--

Table 3.4-1. Summary of tests and methods for the analog recharge activity (SCP 8.3.1.5.2.1.4)--Continued

Methods (selected and alternate)	Site-characterization parameter	Expected range
Geochemistry of arid-zone infiltration		
Characterization of unsaturated-zone mineralogy and chemistry (selected)	Chemistry, unsaturated-zone water	Soil mineralogy 0-100 wt% soil chemistry 0-100 wt% (general published literature)
Geochronology of unsaturated zone by all practicable methods (selected)	"	C-14 0-50 ka U-series 0-400 ka desert varnish, not yet known for site TL, not yet known for site (limits of technique)
Measurement of unsaturated-zone hydrologic characteristics (selected)	"	K, 10^{-3} to 10^{-10} cm/sec n_e, 0-60 vol % (general published literature)
Measurement of site runoff characteristics (selected)	"	0-1 m^3/sec (general published literature)
Develop and test unsaturated-zone mass-balance model (selected)	"	--

precision prediction is a relative judgement based on the USGS investigators' familiarity with, and understanding of, the method. For selected methods, if values for accuracy and precision exist, they will be listed within the USGS technical procedures.

Similarly, the duration of a method is difficult to quantify exactly. The duration of some methods may be seconds, whereas the duration of others may be months. The methods, however, have been selected so that the parameters of interest can be evaluated reasonably within the schedule of the study (Section 5.1). Furthermore, the total duration of the method is dependent on the number of times it is implemented, which is dependent on the spatial variability of a parameter within or among geohydrologic units, the accuracy and precision of the method, the number of available samples, and desired level of confidence in reproducibility of the measurement.

The methods were also selected by considering their ranges of measurement. It would be senseless to select a method that could not provide accurate data within the expected range of the site-characterization parameter of interest. Again, the expected range of method is difficult to quantify without actual testing or implementation of the technique. The USGS investigators, however, have selected methods which they believe are suitable to provide accurate data within the expected range of the site-characterization parameter. Some of the expected ranges of site-characterization parameters have been bracketed by previous data collection and are shown in Table 3.4-1.

Finally, the interference of a given method with other tests in the site-characterization program was considered in selecting the method. Generally, the selected methods will have little or no interference with other tests and analyses. In cases where methods do interfere, the USGS investigators have planned their testing sequences accordingly, in order to maximize data collection and minimize interference.

3.4.4 Technical procedures and quality-assurance program

The USGS quality-assurance (QA) program for the YMP requires the evaluation of study plan activities to determine the applicable QA criteria. A QA Grading Report that identifies the criteria applied to this activity will be prepared and approved following applicable YMP procedures. The QA Grading Report is distributed as a separate controlled document from the study plan.

The technical procedures which will be utilized in this activity are standard procedures derived from the scientific literature appropriate to the various techniques. These procedures have been adapted to compensate for site-specific conditions and

incorporate the quality-assurance requirements of the Yucca Mountain Project.

Table 3.4-2 provides a tabulation of technical procedures applicable to this activity. The technical procedures are listed according to the tests/analyses of Table 3.4-1. Approved procedures are identified with a number and a procedure effective date. Procedures that require preparation do not have procedure numbers. Procedures that are identified as "needed" in the table will be completed and available 30 days before the associated testing is started.

Equipment requirements and instrument calibration are described in the technical procedures. Lists of equipment stepwise procedures for the use and calibration of equipment, limits, accuracy, handling, and calibration needs, quantitative or qualitative acceptance criteria of results, description of data documentation, identification, treatment, and control of samples, and records requirements are included in these documents.

Table 3.4-2 Technical procedures for analog recharge activity
(SCP Activity 8.3.1.5.2.1.4)

(Dashes (--) indicate information is not available and to be determined.

(Technical procedures will be in place 30 and 60 days prior to commencement of work for standard and non-standard procedures, respectively.)

Technical procedure number (NNN-USGS-)	Technical procedure	Effective date
Data collection for mesic-zone sites by hydrologic-budget modeling and chloride-ion, mass-balance modeling		
HP-08,R0	Methods for determination of inorganic substances in water	08/06/82
HP-16,R2	Collection and preservation of atmospheric precipitation samples for deuterium and oxygen-18 analyses	06/13/88
HP-54,R0	Water-flow measurements using weirs, flumes, and barrels	05/16/88
HP-71,R0	Method for monitoring water-level changes using a Campbell Scientific 21X Micrologger	09/01/87
HP-91,R0	Collection and field analysis of surface-water samples	10/07/87
HP-110,R0	Extraction of pore waters by centrifuge methods	06/08/88
HP-125,R0	Method for extraction of pore water from tuff cores by triaxial compression	05/20/88
HP-126,R0	Extraction of residual water from tuff samples by vacuum distillation	06/15/88
Needed	Soil hydrologic properties	--
Needed	Evaluation of contemporary packrat middens	--
HP-93,R0	Method for processing electronic data from a Campbell Scientific 21X Micrologger into water levels	05/11/88
GP-27,R1	Trench wall and natural outcrop sampling for coordinated studies	06/07/88
HP-173,R0	Data collection protocol for plant community analysis	06/23/88
HP-163,R0	Meteorological monitoring of Yucca Mountain and vicinity (tentative procedure)	In prep.
HP-166,R0	Stream discharge measurements using a pygmy meter	05/18/88

Table 3.4-2 Technical procedures for analog recharge activity (SCP Activity 8.3.1.5.2.1.4)--Continued

Technical procedure number (NNM-USGS-)	Technical procedure	Effective date
Data collection for mesic-zone sites by hydrologic-budget modeling and chloride-ion, mass-balance modeling		
HP-170,R0	Method for measuring temperature using a Campbell Scientific, Inc. 107 temperature probe	05/27/88
HP-167,R0	Precipitation measurement using a Belfort weighing rain gage	06/09/88
HP-168,R0	Measurement of energy flux density by a pyranometer	06/09/88
HP-171,R0	Low-tension vadose moisture sampling	06/08/88
HP-172,R0	Water level measurement using a ten-turn potentiometer	06/09/88
HP-25,R1	Method for measuring water level using a portable multiconductor cable	--
Estimation of recharge by hydrologic-budget modeling		
Needed	Hydrologic budget modeling	--
Estimation of recharge by chloride-ion, mass-balance modeling		
Needed	Chloride mass-balance modeling	--
Needed	Reference software documentation	--
Geochemistry of arid-zone infiltration		

Table 3.4-2 Technical procedures for analog recharge activity (SCP Activity 8.3.1.5.2.1.4)--Continued

Technical procedure number (NWM-USGS-)	Technical procedure	Effective date
	Geochemistry of arid-zone infiltration	
Needed	Mass-balance modeling	--

methods do interfere, the USGS investigators have planned their testing sequences accordingly, in order to maximize data collection and minimize interference.

3.5.4 Technical procedures and quality-assurance program

The USGS quality-assurance (QA) program for the YMP requires the evaluation of study plan activities to determine the applicable QA criteria. A QA Grading Report that identifies the criteria applied to this activity will be prepared and approved following applicable YMP procedures. The QA Grading Report is distributed as a separate controlled document from the study plan.

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Table 3.5-2 provides a tabulation of technical procedures applicable to this activity. The technical procedures are listed according to the tests/analyses of Table 3.5-1. Approved procedures are identified with a number and a procedure effective date. Procedures that require preparation do not have procedure numbers. Procedures that are identified as "needed" in the table will be completed and available 30 days before the associated testing is started.

Equipment requirements and instrument calibration are described in the technical procedures. Lists of equipment stepwise procedures for the use and calibration of equipment, limits, accuracy, handling, and calibration needs, quantitative or qualitative acceptance criteria of results, description of data documentation, identification, treatment, and control of samples, and records requirements are included in these documents.

Table 3.5-2 Technical procedures for the calcite and opaline silica vein deposits (SCP Activity 8.3.1.5.2.1.4)

(Dashes (--) indicate information is not available and to be determined.

(Technical procedures will be in place 30 and 60 days prior to commencement of work for standard and non-standard procedures, respectively.)

Technical procedure number (YMM-USGS-)	Technical procedure	Effective date
	Field investigations	
GP-01,R0	Geologic mapping	03/01/83
GP-05,R0	Geologic support activities	03/01/83
GP-07,R0	Geologic trenching studies	08/14/84
GP-15,R0	Inventory of drill-hole core	03/20/87
GP-16,R0	Procedure for the handling and storage of drill core at the core library	03/20/87
GP-19,R0	Procedure for the identification, handling, and disposition of drill-hole core and cutting samples from the drill site to the core library	03/06/87
HP-37,R0	Preliminary procedure for drilling and coring of wet- and dry-lake sediments	08/14/84
TWS-ESS-QP-04,R2	Handling, storage, and shipping of samples	04/02/85
TWS-ESS-DP-101,R0	Sample, identification, and control for mineralogy and petrology studies	04/17/87
GP-27,R1	Trench wall and natural outcrop sampling for coordinated studies	06/07/88
	Mineralogical tests	
TWS-ESS-QP-04,R2	Handling, storage, and shipping of samples	04/02/85
TWS-ESS-DP-04,R4	Thin-section preparation	07/08/86
TWS-ESS-DP-16,R2	Siemens X-ray diffractometer procedure	02/02/86

Table 3.5-2 Technical procedures for the calcite and opaline silica vein deposits (SCP Activity 8.3.1.5.2.1.4)--Continued

Technical procedure number (NNW-USGS-)	Technical procedure	Effective date
	Mineralogical tests	
TWS-ESS-OP-24,R0	Alignment of Siemens diffractometer	11/24/82
TWS-ESS-OP-25,R1	Clay-mineral separation and preparation for X-ray diffraction	02/05/86
TWS-ESS-OP-50,R0	Sputter coating with gold	04/03/86
TWS-ESS-OP-56,R0	Brinkman automated grinding procedure	02/05/86
GCP-07,R1	Mineral separation for geochemistry and isotopic analysis	05/27/88
	Geochemical tests	
TWS-ESS-OP-04,R2	Handling, storage, and shipping of samples	04/02/85
TWS-ESS-OP-06,R2	Carbon coating of samples with DV-502 vacuum	02/05/86
TWS-ESS-OP-07,R2	Microprobe operating procedure	07/08/86
TWS-ESS-OP-19,R1	Sample preparation: Rock powders	11/24/82
TWS-ESS-OP-20,R1	Preparation of fused-glass beads from rock powder	11/24/82
TWS-ESS-OP-50,R0	Sputter coating with gold	04/03/86
TWS-ESS-OP-51,R0	Mettler M80 sample-weighing procedure	02/05/86
TWS-ESS-OP-52,R0	Making fused discs with Junior erbit shaker	02/05/86
TWS-ESS-OP-53,R0	Pulverizing with Spex 8500 Shatterbox	02/05/86
TWS-ESS-OP-54,R0	Crushing with 50-ton hydraulic press	02/05/86

Table 3.5-2 Technical procedures for the calcite and opaline silica vein deposits (SCP Activity 8.3.1.5.2.1.4)--Continued

Technical procedure number (NNN-USGS-)	Technical procedure	Effective date
	Geochemical tests	
TWS-ESS-DP-55,R0	Rock-splitting with 50-ton hydraulic press	02/05/86
TWS-ESS-DP-56,R0	Brinkman automated grinding procedure	02/05/86
Needed	Instrumental neutron activation	--
TWS-ESS-DP-11,R0	Procedure for x-ray fluorescence analysis	01/14/88
TWS-ESS-DP-112,R0	Operating instruction for International Scientific Instrument Model DS-130 scanning electron microscope and TRACOR northern series II x-ray analyzer	01/27/88
	Fluid-inclusion investigations	
TWS-ESS-GP-04,R2	Handling, storage, and shipping of samples	04/02/85
GCP-14,R1	Extraction and recovery of water from calcite-hosted inclusion fluids	07/19/88
TWS-ESS-DP-113,R0	Temperature determination from fluid inclusion studies	01/27/88
Needed	Quadrupole mass spectrometry	--
	Geochronologic investigations	
GCP-02,R1	Labeling, identification, and control of samples for geochemistry and isotope geology	01/20/87
GCP-03,R1	Uranium-series dating	03/09/88

Table 3.5-2 Technical procedures for the calcite and opaline silica vein deposits (SCP Activity 8.3.1.5.2.1.4)--Continued

Technical procedure number (NNN-USGS-)	Technical procedure	Effective date
	Geochronologic investigations	
GCP-06,R0	Potassium-argon dating	06/15/81
GCP-08,R1	Fission-track dating	05/26/88
GCP-09,R0	Spike calibration	06/15/81
GCP-11,R1	Laboratory preparation of pedogenic carbonate rinds for radiometric dating	04/29/88
TWS-ESS-GP-04,R2	Handling, storage, and shipping of samples	04/02/85
TWS-NTSQA-GP-14,R1	One-time research and development work	05/19/89
TWS-ESS-DP-20,R1	Preparation of fused-glass beads from rock powder	11/24/82
TWS-ESS-DP-50,R0	Sputter coating with gold	04/03/86
TWS-ESS-DP-51,R0	Mettler M80 sample-weighing procedure	02/05/86
TWS-ESS-DP-52,R0	Making fused discs with Junior orbit shaker	02/05/86
TWS-ESS-DP-53,R0	Pulverizing with Spex 8500 Shatterbox	02/05/86
TWS-ESS-DP-54,R0	Crushing with 50-ton hydraulic press	02/05/86
TWS-ESS-DP-55,R0	Rock-splitting with 50-ton hydraulic press	02/05/86
TWS-ESS-DP-56,R0	Brinkman automated grinding procedure	02/05/86
Needed	Instrumental neutron activation	--
Needed	Electron spin resonance dating	--
TWS-ESS-DP-113,R0	Temperature determination from fluid inclusion studies	01/27/88

Table 3.5-2 Technical procedures for the calcite and opaline silica vein deposits (SCP Activity 8.3.1.5.2.1.4)--Continued

Technical procedure number (NNN-USGS-)	Technical procedure	Effective date
	Geochronologic investigations	
TWS-ESS-DP-11,R0	Procedure for x-ray fluorescence analysis	01/14/88
GCP-04,R1	Uranium-trend dating	05/27/88
	Tracer-isotope investigations	
GCP-02,R1	Labeling, identification, and control of samples for geochemistry and isotope geology	01/20/87
GCP-13,R0	U-Th-Pb isotope geochemistry	04/29/88
GCP-12,R0	Rb-Sr isotope geochemistry	01/25/88
	Stable-isotope investigations	
TWS-ESS-QP-06,R2	Handling, storage, and shipping of samples	04/02/85
GCP-14,R1	Extraction and recovery of water from calcite-hosted inclusion fluids	07/19/88
GCP-15,R1	Oxygen isotope analysis of opaline-silica, chalcedony, and quartz	07/19/88
GCP-16,R1	Carbonate carbon and oxygen isotope analyses	07/19/88
GCP-17,R1	Determination of the isotopic ratio H/D in water	07/19/88

Table 3.5-2 Technical procedures for the calcite and opaline silica vein deposits (SCP Activity 8.3.1.5.2.1.4)--Continued

Technical procedure number (NNM-USGS-)	Technical procedure	Effective date
	Paleontological investigations	
NP-08,R0	Methods for determination of inorganic substances in water	08/06/82
NP-11,R0	Methods for determination of radioactive substances in water	06/18/82
NP-23,R1	Collection and field analysis of saturated-zone ground-water samples	11/04/83
NP-76,R0	Diatom enumeration studies	04/08/85
NP-78,R1	Nonmarine calcareous-microfossil sample preparation and data acquisition procedures	06/13/88
NP-79,R0	Analysis of fossil pollen from lake sediments	10/20/86
TWS-ESS-QP-04,R2	Handling, storage, and shipping of samples	04/02/85
NP-164,R0	Processing of soil, sediment, and water samples for chrysophyte cysts	In prep.
	Hydrologic investigations and analyses	
NP-23,R1	Collection and field analysis of saturated-zone ground-water samples	11/04/83
NP-91,R0	Collection and field analysis of surface-water samples	10/07/87
TWS-ESS-QP-04,R2	Handling, storage, and shipping of samples	04/02/85
NP-164,R0	Processing of soil, sediment, and water samples for chrysophyte cysts	In prep.

Table 3.5-2 Technical procedures for the calcite and opaline silica vein deposits (SCP Activity 8.3.1.5.2.1.4)--Continued

Technical procedure number (NWM-USGS-)	Technical procedure	Effective date
	Data integration and analysis	
--	No technical procedures identified	--