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QA: N/A

SEP 26 2002

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TRANSMITTAL OF REPORT ADDRESSING KEY TECHNICAL ISSUE (KTI) AGREEMENT
ITEMS EVOLUTION OF THE NEAR-FIELD ENVIRONMENT (ENFE) 1.07 AND TOTAL SYSTEM
PERFORMANCE ASSESSMENT AND INTEGRATION (TSPA) 2.02, COMMENTS J-9 AND J-21

- References: 1. Ltr, Brocoum to Reamer, dtd 3/30/02
2. Ltr, Brocoum to Reamer, dtd 4/30/01

This letter transmits a report entitled *Response to ENFE 1.07: Additional Results of Side-Wall Sampling Min-Pet Analyses of Drift Scale Test Samples* which satisfies the subject KTI agreements. Agreements ENFE 1.07 and TSPA 2.02, Comments J-9 and J-21, are as follows:

ENFE 1.07: "Provide physical evidence that supports the model of matrix-fracture interaction precipitation effects (e.g., coring).

The DOE will provide the following evidence that supports the model of matrix/fracture interaction precipitation effects: (1) Existing data from the Single Heater Test (SHT) of post-test overcoring Mineralogy-Petrology (Min-Pet) analysis (SHT final report [MOL.20000103.0634] and DTN LASL831151.AQ98.001) is expected to be provided to the NRC in March 2001. (2) Results of ongoing side-wall sampling Min-Pet analyses of DST samples are expected to be provided to the NRC in FY 02. (3) The DOE expects to provide the Drift-Scale Coupled Processes (DST and THC Seepage) Models AMR (MDL-NBS-HS-000001) Rev 01 to the NRC as evidence of matrix-fracture interaction March 2001."

TSPA 2.02, J-9: U.S. Nuclear Regulatory Commission/U.S. Department of Energy (NRC/DOE) Agreed Path Forward for Features, Events and Processes (FEP) 2.2.08.03.00, Geochemical Interactions in Geosphere and Effects on Radionuclide Transport: "This issue is addressed by existing agreements between DOE and NRC (ENFE Subissue 1 Agreements 4 and 7 and ENFE Subissue 2 Agreement 6). Features, Events, and Processes in UZ Flow and Transport, ANL-NBS-MD-000001 will be revised upon completion of this work."

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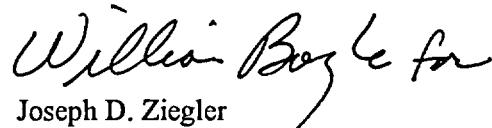
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TSPAI 2.02, J-21: NRC/DOE Agreed Path Forward for FEP 2.2.11.02.00, Gas Pressure Effects: "This issue is addressed by existing agreements between DOE and NRC (ENFE Subissue 1 Agreements 5 and 7, and ENFE Subissue 4 Agreement 3). Features, Events, and Processes in UZ Flow and Transport, ANL-NBS-MD-000001 will be revised upon completion of this work."

As discussed with your staff on September 11, 2002, the enclosed report provides the additional results of ongoing side-wall sampling Min-Pet analyses of the Drift Scale Test samples to satisfy part 2 of the agreement. Reports and supporting data have been delivered previously to the NRC that addressed parts 1 and 3 of the agreement (References 1 and 2). Because this submittal completes the agreement ENFE 1.07, it, along with the earlier submittals addressing ENFE 1.07 (References 1 and 2), also satisfies the part of TSPAI 2.02, Comments J-9 and J-21, concerning ENFE 1.07.

The DOE considers ENFE 1.07 to be fully addressed by the enclosed information, and pending review and acceptance by NRC, it should be closed.

There are no new regulatory commitments in the body or enclosure to this letter. Please direct any questions concerning this letter and its enclosure to Timothy C. Gunter at (702) 794-1343 or Deborah L. Barr at (702) 794-1479.



Joseph D. Ziegler
Acting Assistant Manager, Office of
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OL&RC:TCG-1804

Enclosure:

*Response to ENFE 1.07: Additional Results of
Side-Wall Sampling Min-Pet Analyses of Drift
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**RESPONSE TO ENFE 1.07: RESULTS OF SIDE-WALL SAMPLING
MIN-PET ANALYSES OF DRIFT SCALE TEST SAMPLES**

QA:NA

September 2002

Preparation:

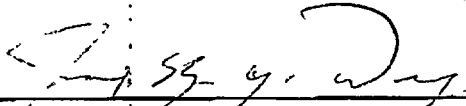


S.S. Levy, Unsaturated Zone Department, Natural Systems

09/24/2002

Date

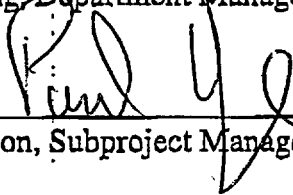
Approval:



J.S. Wang, Department Manager, Unsaturated Zone

9/24/2002

Date

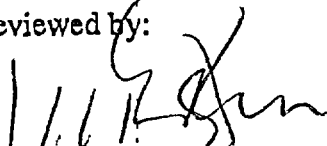


P.R. Dixon, Subproject Manager, Natural Systems

9/24/2002

Date

Reviewed by:



Ming Zhu, License Application Project

09/24/02

Date

ENCLOSURE

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ACRONYMS AND ABBREVIATIONS

AMR	analysis and model report
DOE	U.S. Department of Energy
DST	Drift Scale Test
DTN	Data Tracking Number
ENFE	Evolution of the Near-Field Environment
ESF	Exploratory Studies Facility
FEPs	features, events, and processes
KTI	Key Technical Issue
Min-Pet	mineralogy-petrology
NRC	U.S. Nuclear Regulatory Commission
SEM	scanning electron microscope
SHT	Single Heater Test
THC	thermal-hydrological-chemical
XRD	X-ray diffraction
YMRP	Yucca Mountain Review Plan

RESPONSE TO ENFE 1.07: RESULTS OF SIDE-WALL SAMPLING MIN-PET ANALYSES OF DRIFT SCALE TEST SAMPLES

This report describes the last part of the basis for resolving and closing Key Technical Issue (KTI) Agreement 7 related to Evolution of the Near-Field Environment (ENFE) Subissue 1: Effects of Coupled Thermal-Hydrological-Chemical (THC) Processes on Seepage and Flow (ENFE 1.07). The item in question is the U.S. Department of Energy–U.S. Nuclear Regulatory Commission (DOE-NRC) agreement that the DOE provide results of ongoing side-wall sampling mineralogy-petrology (Min-Pet) analyses of Drift Scale Test (DST) samples.

1. BACKGROUND

ENFE 1.07 is related to providing physical evidence that supports the model of matrix-fracture interaction precipitation effects (e.g., coring) associated with the Drift Scale Test (DST). The DOE determined that the THC effects of mineral precipitation on hydrologic properties are insignificant to the total system performance assessment and indicated that the conclusions are supported by results from the DST (see meeting summaries of the KTI Technical Exchange and Management Meeting held on January 9-11, 2001, in Pleasanton, California [Williams 2001]). In response to the NRC comments on this issue, the DOE agreed at that meeting to provide physical evidence that supports the model of precipitation effects at the matrix/fracture interface.

1.1 NRC INITIAL COMMENTS

In discussions of Subissue 1 (Effects of Coupled Thermal-Hydrological-Chemical Processes on Seepage and Flow) at the January 9-11, 2001, ENFE KTI meeting (Williams 2001), the NRC inquired as to the validity of the active fracture model during the thermally perturbed period of the DST and requested information on available physical evidence from the DST that would support the DOE mineral precipitation predictions using the DST THC model.

1.2 DOE INITIAL RESPONSE

In response to the NRC comments, the DOE originally agreed to provide the following evidence that supports the model of matrix/fracture interaction precipitation effects (Williams 2001):

- Existing data from the Single Heater Test (SHT) of post-test overcoring Min-Pet analysis (*Single Heater Test Final Report* [MOL.20010103.0634] [CRWMS M&O 1999] and Data Tracking Number [DTN]: LASL831151.AQ98.001).
- Results of ongoing side-wall sampling Min-Pet analyses of DST samples.
- The analysis and model report (AMR) *Drift-Scale Coupled Processes (DST and THC Seepage) Models* (MDL-NBS-HS-000001, Rev 01) (CRWMS M&O 2001).

2. APPLICABLE NUCLEAR SAFETY STANDARDS/REQUIREMENTS/GUIDANCE

2.1 APPLICABLE REGULATORY REQUIREMENTS/GUIDANCE

The following 10 CFR Part 63 requirements and *Yucca Mountain Review Plan, Draft for Comment* (YMRP) (CNWRA 2002) guidance are considered applicable to this part of KTI agreement ENFE 1.07, which is related to providing data to justify the exclusion of specific features, events, and processes (FEPs):

- 10 CFR 63.114(a): Include data related to the geology, hydrology, and geochemistry (including disruptive processes and events) of the Yucca Mountain site, and the surrounding region to the extent necessary, and information on the design of the engineered barrier system used to define parameters and conceptual models used in the assessment.
- 10 CFR 63.114(e): Provide the technical basis for either inclusion or exclusion of specific features, events, and processes in the performance assessment. Specific features, events, and processes must be evaluated in detail if the magnitude and time of the resulting radiological exposures to the reasonably maximally exposed individual, or radionuclide releases to the accessible environment, would be significantly changed by their omission.
- 10 CFR 63.114(f): Provide the technical basis for either inclusion or exclusion of degradation, deterioration, or alteration processes of engineered barriers in the performance assessment, including those processes that would adversely affect the performance of natural barriers. Degradation, deterioration, or alteration processes of engineered barriers must be evaluated in detail if the magnitude and time of the resulting radiological exposures to the reasonably maximally exposed individual, or radionuclide releases to the accessible environment, would be significantly changed by their omission.
- Draft YMRP Revision 2, Section 4.2.1.3.3, Acceptance Criteria for Model Abstraction for Quantity and Chemistry of Water Contacting Waste Packages and Waste Forms, Acceptance Criterion 1 – System description and model integration are adequate.
- Draft YMRP Revision 2, Section 4.2.1.3.3, Acceptance Criteria for Model Abstraction for Quantity and Chemistry of Water Contacting Waste Packages and Waste Forms, Acceptance Criterion 2 – Data are sufficient for model justification.
- Draft YMRP Revision 2, Section 4.2.1.3.3, Acceptance Criteria for Model Abstraction for Quantity and Chemistry of Water Contacting Waste Packages and Waste Forms, Acceptance Criterion 3 – Data uncertainty is characterized and propagated through model abstraction.

2.2 KTI AGREEMENT

ENFE 1.07 reads as follows: "Provide physical evidence that supports the model of matrix-fracture interaction precipitation effects (e.g., coring). The DOE will provide the following

evidence that supports the model of matrix/fracture interaction precipitation effects: (1) Existing data from the Single Heater Test (SHT) of post-test overcoring Mineralogy-Petrology (Min-Pet) analysis (SHT final report [MOL.20000103.0634] and DTN LASL831151.AQ98.001) is expected to be provided to the NRC in March 2001. (2) Results of ongoing side-wall sampling Min-Pet analyses of DST samples are expected to be provided to the NRC in FY 02. (3) The DOE expects to provide the Drift-Scale Coupled Processes (DST and THC Seepage) Models AMR (MDL-NBS-HS-000001) Rev 01 to the NRC as evidence of matrix-fracture interaction in March 2001.”

2.3 STATUS OF AGREEMENT

To satisfy agreement ENFE 1.07, the DOE has submitted the following documents and data:

- *Single Heater Test Final Report*, Rev 00 ICN 01 (CRWMS M&O 1999) and supporting DTN: LA0009SL831151.001 and DTN: LA0009SL831151.002 (Brocoum 2001a), which superseded DTN: LASL831151AQ98.001 (this addresses part 1 of ENFE 1.07).
- The AMR *Drift-Scale Coupled Processes (DST and THC Seepage) Models*, MDL-NBS-HS-000001, Rev 01 ICN 00 (CRWMS M&O 2001; Brocoum 2001b) (this addresses part 3 of ENFE 1.07).

The NRC staff has reviewed these submittals for parts (1) and (3) of the agreement, and has made no comments. Currently the agreement is listed by the NRC as “Partly Received,” pending the delivery and acceptance of part (2) of ENFE 1.07. This report is the last submittal to satisfy the remainder of this agreement, part 2. Therefore, this agreement can be closed upon the review and acceptance by the NRC.

2.4 RELATED AGREEMENTS

The following agreement, TSPA I 2.02, Comments J-9 and J-21, is associated with ENFE 1.07.

TSPA I 2.02, J-9: NRC/DOE Agreed Path Forward for FEP # 2.2.08.03.00, Geochemical Interactions in Geosphere and Effects on Radionuclide Transport: “This issue is addressed by existing agreements between DOE and NRC (ENFE Subissue 1 Agreements 4 and 7 and ENFE Subissue 2 Agreement 6). Features, Events, and Processes in UZ Flow and Transport, ANL-NBS-MD-000001 will be revised upon completion of this work.”

TSPA I 2.02, J-21: NRC/DOE Agreed Path Forward for FEP # 2.2.11.02.00, Gas Pressure Effects: “This issue is addressed by existing agreements between DOE and NRC (ENFE Subissue 1 Agreements 5 and 7, and ENFE Subissue 4 Agreement 3). Features, Events, and Processes in UZ Flow and Transport, ANL-NBS-MD-000001 will be revised upon completion of this work.”

As stated in Section 2.3, parts 1 and 3 of ENFE 1.07 have been fulfilled through earlier submittals (Brocoum 2001a; 2001b), and this report addresses the remainder of the agreement. Therefore, this response along with the earlier submittals also satisfies the part of TSPA I 2.02, Comments J-9 and J-21 concerning ENFE 1.07.

3. BASIS FOR REGULATORY COMPLIANCE STATEMENT

3.1 MINERALOGIC AND PETROLOGIC ANALYSES

The Drift Scale Test (DST) at Yucca Mountain is an underground test in the unsaturated zone to investigate coupled thermal, mechanical, hydrological, and geochemical processes expected to occur in a geologic repository heated by high-level radioactive waste. The location of the test and schematic diagrams of the boreholes are given in *Drift Scale Test As-Built Report* (CRWMS M&O 1998, pp. 1-2 and 4-14). The eight-year test consists of a four-year heating phase, now complete, followed by a four-year cooling phase. Heaters, in an excavated drift about 50 m long, and in the adjacent rock, raised the temperature of the rock surrounding the drift. As the rock was heated, the fluids naturally present in the rock migrated away from the heat sources. Direct evidence of mineralogic alteration from migrating fluids is obtained from side-wall samples drilled from the walls of pre-test boreholes. The side-wall samples were taken in November 2000 and June 2001 towards the end of the heating phase of the DST.

Mineralogic characterization data provide quantitative information on mineral distribution and abundance in the pre-test rock under ambient conditions. Mineralogic changes while the test is in process are also documented. These data support the coupled thermal-hydrological-chemical (THC) modeling effort (DST models will be documented in an update to the AMR *Drift-Scale Coupled Processes (DST and THC Seepage) Models*, MDL-NBS-HS-000001 Rev 02, which is currently scheduled for completion in fiscal year 2003). Observations of mineralogic changes during the DST can be used to compare with locations and types of mineral precipitation/dissolution predicted by the DST THC model to validate the conceptual DST THC model. The validated THC model will then be used to evaluate effects of thermally-induced THC processes on repository performance.

The DOE expected that detectable mineralogic changes from the test would be restricted to the natural fracture system and the surfaces of pre-test boreholes that function as preferential fluid-flow paths. Mineralogic changes within the rock matrix were expected to be undetectably minute. These expectations were supported by qualitative examination of the SHT post-test overcores and by quantitative X-ray diffraction analysis (XRD) of pre- and post-test crushed Topopah Spring middle nonlithophysal tuff from a hydrothermal column test (Lowry 2001, p. 29; Brocoum 2002). These studies found no detectable mineralogic alteration of the rock matrix at the conclusion of the hydrothermal tests. Evidence of mineralogic alteration was limited to fractures and borehole surfaces of the SHT and to crushed-tuff fragment surfaces from the column test.

Mineralogic characterization of the natural rock-fracture surfaces was accomplished by study of pre-heat drill core from the DST block. A decision was made to employ stereoscopic examination of fracture surfaces, supplemented by scanning-electron microscopy (SEM) and XRD, for mineralogic analysis so as to characterize as much fracture surface as possible. Compared to the exclusive use of microanalytical techniques, this strategy sacrifices achievable precision and accuracy but maximizes the representativeness of the data because more fracture surface is examined. The end product is a quantitative mineralogic inventory of the fracture system that can be input to the modeling activities. Mineral abundances of stellerite (a zeolite

mineral), manganese minerals, crystalline silica and feldspar, clay, and calcite on the fracture surfaces are in the Technical Data Management System under the DTN: LA9912SL831151.002.

The DOE learned from the SHT that mineralogic sampling while a test is in progress would be more valuable than collecting samples only after the test is finished because the thermal/hydrologic history of a sampling site is better constrained during the test. To realize this goal for the DST, a side-wall sampling tool was designed and built to provide an in-progress sampling capability. The tool operates within existing boreholes, targeting intervals of fractured rock that were identified from borehole video recordings. Two coring sessions have been conducted during the transition from heating to cooling phases of the test.

In November 2000, the side-wall coring tool was used to collect six side-wall cores from inclined boreholes ESF-HD-CHE-2 and ESF-HD-CHE-3 (boreholes 53 and 54) in the DST block. In June 2001, eight samples were collected from the two previously sampled boreholes plus borehole ESF-HD-CHE-9 (borehole 59). Analysis of the side-wall cores from these holes is in progress and will provide information on mineralogic changes in the boiling zone. The elemental abundances and chemical, textural, and mineralogic characteristics of two core samples (four subsamples) from borehole 54 are in the Technical Data Management System under the DTN: LA0201SL831225.001.

3.2 RESULTS: MINERALOGY OF THE PRE-HEAT NATURAL FRACTURE SYSTEM

Systematic data on natural, pre-heat fracture-mineral coverage were collected from the drill core of hole ESF-HD-TEMP-2 (borehole 80), which is a horizontal borehole that runs the full length of the heated drift in the Topopah Spring middle nonlithophysal zone. The drill core is 195.6 ft (59.62 m) long, but the first 25 ft (7.62 m) of the core are from outside the heated drift and were excluded from study. The number of fractures in the relevant length of core was too large for all to be included in the characterization. Therefore, a conceptual model of fracture attributes was developed to guide the selection of a subset of fractures for mineralogic analysis. The conceptual model is based on a major simplification of the criteria used to define subzones of the middle nonlithophysal zone (Buesch and Spengler 1998, pp. 18 and 20).

The rock traversed by ESF-HD-TEMP-2 consists both of intervals dominated by vapor-phase features and intervals where vapor-phase features are not prominent. As seen in the drill core, the dominant vapor-phase features are vapor-phase partings and vapor-phase stringers that dip eastward at low angles parallel to the rock foliation. Both partings and stringers are fractures lined with crystalline silica and feldspar fracture coatings, commonly called vapor-phase minerals. In intervals where vapor-phase partings and stringers and associated vapor-phase cavities (lithophysae) are common, the rock-matrix color is light brownish gray. Rock-matrix color in the intervals with only rare vapor-phase features is grayish orange pink to light brown.

Reconnaissance examination of the drill core suggested that the fracture coatings are different in the vapor-phase and non-vapor-phase intervals. Based on this observation, detailed fracture-mineral studies were performed in two core sections of approximately equal length representing each type of interval. All exposed fracture surfaces in each section were included in the studies. The percent coverage of fracture surface by a mineral, referred to as the mineral coverage, was

estimated by comparison with standard charts for estimating percentage composition (e.g., Compton 1962, pp. 332 and 333). Mineral coverage on the fracture surfaces was determined for stellerite, manganese minerals, crystalline silica and feldspar (combined), clay (probably also including minor mordenite), and calcite. Estimates of fracture coverage by minerals are the principal numerical data derived from these studies (DTN: LA9912SL831151.002), as presented in Table 1. For the results presented, no formal analysis of the errors of estimation has been performed. It is likely that mineral coverages estimated to be 10 percent or less have relative errors of 50 to 100 percent (e.g., for a 50-percent relative error, the estimated 2-percent coverage by a mineral could be in the 1- to 3-percent range). Estimated mineral coverages greater than 10 percent probably have relative errors of 20 percent or less.

Table 1. Mineral Coverage on Fractures, Drill Core ESF-HD-TEMP-2

Section 1, 25.0-29.3 Ft, Non-Vapor-Phase Interval

Stellerite	Manganese Minerals	Crystalline Silica/Feldspar	Clay	Calcite
42.3%	1.5%	1.0%	4.3%	0%

Section 2, 62.15-66.45 Ft, Vapor-Phase Interval

Stellerite	Manganese Minerals	Crystalline Silica/Feldspar	Clay	Calcite
41.6%	2.0%	3.5%	4.7%	2.2%

Source: DTN LA9912SL831151.002.

For the minerals included in the inventory, differences in abundance of crystalline silica plus feldspar and in calcite between the vapor-phase and non-vapor-phase intervals were documented. The higher coverage of crystalline silica plus feldspar in the vapor-phase interval is expected because these minerals characteristically form the linings of vapor-phase void spaces.

3.3 RESULTS: EVIDENCE OF MINERAL DEPOSITION

The side-wall sampling results are presented in Table 2 (DTN: LA0201SL831225.001). The data are predominantly non-quantitative. The only quantitative data extracted from SEM images are thicknesses or other dimensions of mineral deposits. These values are estimated by comparing the feature of interest to a scale within the image. Acceptable calibration tolerance for the scale is ± 10 percent (relative), and the uncertainty in estimated dimensions of mineral features is assumed to be about the same.

Side-wall cores collected during the DST revealed new mineral deposits on borehole surfaces and on the surfaces of fractures that intersect the boreholes. New mineral deposits are common on the borehole surfaces because the boreholes act as preferential pathways for fluid flow. Deposits are less common, and quantities of new minerals are less abundant on the natural fractures within the core samples.

Mineral deposition within the boiling zone is documented by SEM examination and energy-dispersive X-ray spectroscopy of samples from borehole ESF-HD-CHE-3. The three products observed so far are amorphous silica, gypsum, and calcite (Table 2; DTN: LA0201SL831225.001). The identifications of gypsum and calcite are also based on identifications of these phases by XRD as products of the SHT (DTN: LA0009SL831151.001). The silica deposits exhibit considerable textural heterogeneity, perhaps because some were deposited when the collection site was in the condensation zone and others deposited when boiling-zone dryout conditions were reached.

Examples of possible condensation-zone silica deposits have been identified. In one example, a fracture surface is completely coated by terrace-like silica deposits up to a few micrometers thick. In another example, several discoid silica deposits (up to about 20 micrometers across) rest on a surface of earlier-deposited discs cemented and largely obscured by silica particles about one or two micrometers across. In both examples, the deposits were built up during multiple episodes of silica deposition.

Very thin (less than 0.5 micrometer thick), curled silica sheets may be products of final dryout in the boiling zone. There is no textural evidence of successive buildup in the silica sheets. Also lying atop the earlier silica deposits or on pre-heat fracture surfaces are scattered deposits of prismatic gypsum (up to 80 micrometers long) and rounded mounds of calcite (up to 25 micrometers across).

3.4 RESULTS: EVIDENCE OF MINERAL DISSOLUTION

Studies of pre-heat core from the SHT showed that some of the natural fracture minerals have experienced dissolution due to ancient or ongoing geochemical processes (CRWMS M&O 1999, pp. 6 to 38). If similar pre-heating dissolution had occurred on the surfaces from which samples were collected from the DST area, this would complicate the effort to document mineral dissolution resulting specifically from the DST. To provide documentation of natural alteration, samples of pre-test drill core from approximately the same locations as the side-wall samples were examined by SEM. Images of the typical morphologies of natural fracture-coating minerals and rock-fracture surfaces were recorded. The majority of such documentation was devoted to stellerite because it is the single most abundant fracture-coating mineral.

The natural stellerite fracture coatings in pre-test samples do not show clear evidence of dissolution. Stellerite in the side-wall core samples shows evidence of dissolution on one fracture from the 66.5-ft (20.27-m) depth in borehole ESF-HD-CHE-3. In this location, a highly corroded stellerite crystal, several slightly to moderately corroded stellerite crystals, and a moderately corroded silica crystal are adjacent to or within a lobate deposit of amorphous silica (Table 2; DTN: LA0201SL831225.001). At the time of sample collection, this sample came from within the boiling zone. However, the sampled rock volume had previously been within the condensation zone before the boiling zone moved to its farthest position away from the heaters. It is possible that the observed mineral dissolution and, perhaps, deposition occurred when the rock volume was in the condensation zone.

Table 2. Chemical, Textural, and Mineralogic Characteristics of Side-wall Samples from the Drift Scale Test

Sample Identification	Borehole Identifier	Sampling Location	Si	Al	K	Ca	Fe	S	Sample Description
LANL 3603 SSL01A1A1 point 1	ESF-HD-CHE-3	63.75	Dominant	n.d.	n.d.	n.d.	n.d.	n.d.	New disc-shaped silica deposit about 20 micrometers across
LANL 3603 SSL01A1A1 point 2	ESF-HD-CHE-3	63.75	Dominant	n.d.	n.d.	n.d.	n.d.	n.d.	New silica scale (thin silica sheet)
LANL 3603 SSL01A1A3B1 point 1	ESF-HD-CHE-3	63.75	Dominant	n.d.	n.d.	n.d.	n.d.	n.d.	New silica scale (thin silica sheet)
LANL 3603 SSL01B1B point 1	ESF-HD-CHE-3	63.75	Dominant	Trace	Trace	n.d.	n.d.	n.d.	New coalescing micrometer-scale silica deposits on silica scale
LANL 3604 SSL01F1B point 1	ESF-HD-CHE-3	66.5	Dominant	Subsidiary	n.d.	Subsidiary	n.d.	n.d.	Natural stellerite, uncorroded
LANL 3604 SSL01F1B point 2	ESF-HD-CHE-3	66.5	Dominant	Minor	Minor	Minor	n.d.	n.d.	Natural micrometer-scale silica and alkali feldspar on uncorroded stellerite
LANL 3604 SSL01F1B1 point 1	ESF-HD-CHE-3	66.5	Dominant	Subsidiary	Minor	Subsidiary	n.d.	n.d.	Natural micrometer-scale silica and alkali feldspar on uncorroded stellerite
LANL 3604 SSL01F1B1 point 2	ESF-HD-CHE-3	66.5	Dominant	Subsidiary	Minor	Subsidiary	n.d.	n.d.	Natural micrometer-scale silica and alkali feldspar on uncorroded stellerite
LANL 3604 SSL01F1C1 point 1	ESF-HD-CHE-3	66.5	Dominant	Minor	Minor	Minor	n.d.	n.d.	Natural micrometer-scale silica and alkali feldspar on uncorroded stellerite
LANL 3604 SSL01F2A point 1	ESF-HD-CHE-3	66.5	Dominant	Minor	Minor	Minor	n.d.	n.d.	Natural micrometer-scale silica and alkali feldspar on uncorroded stellerite
LANL 3604 SSL02A1A5 point 1	ESF-HD-CHE-3	66.5	Dominant	Trace	Trace	n.d.	n.d.	n.d.	Natural crystalline silica, partly dissolved, adjacent to new lobate silica deposit
LANL 3604 SSL02A1A5 point 2	ESF-HD-CHE-3	66.5	Dominant	Subsidiary	n.d.	Subsidiary	n.d.	n.d.	Natural stellerite, heavily corroded, adjacent to new lobate silica deposit
LANL 3604 SSL02A1A5B point 1	ESF-HD-CHE-3	66.5	Dominant	n.d.	n.d.	Trace	n.d.	n.d.	New lobate silica deposit about 10-20 micrometers thick, covering stellerite
LANL 3604 SSL02A1A5D1 point 1	ESF-HD-CHE-3	66.5	Dominant	Subsidiary	n.d.	Subsidiary	n.d.	n.d.	Natural stellerite, partly dissolved, adjacent to new lobate silica deposit
LANL 3604 SSL02C1A1 point 1	ESF-HD-CHE-3	66.5	Subsidiary	Trace	Trace	Dominant	n.d.	Dominant	New gypsum crystals, about 40 micrometers long, atop new silica deposit
LANL 3604 SSL02C1A1A full area	ESF-HD-CHE-3	66.5	Dominant	Minor	Minor	n.d.	n.d.	n.d.	Area of new coalescing micrometer-scale silica deposits and silica films
LANL 3604 SSL02C1A2 area 1	ESF-HD-CHE-3	66.5	Dominant	n.d.	n.d.	n.d.	n.d.	n.d.	Area of new coalescing micrometer-scale silica deposits

Table 2. Chemical, Textural, and Mineralogic Characteristics of Side-wall Samples from the Drift Scale Test (Continued)

Sample Identification	Borehole Identifier	Sampling Location	Si	Al	K	Ca	Fe	S	Sample Description
LANL 3604 SSL02A1B1 area 1	ESF-HD-CHE-3	66.5	Dominant	Trace	n.d.	Minor	n.d.	n.d.	Area of new coalescing 10-20 micrometer silica mounds
LANL 3604 SSL02A1B1 area 2	ESF-HD-CHE-3	66.5	Dominant	Subsidiary	n.d.	Subsidiary	n.d.	n.d.	Natural stellerite adjacent to area of new silica mounds appears slightly dissolved
LANL 3604 SSL02A1B2A1 full area	ESF-HD-CHE-3	66.5	Dominant	Minor	Minor	n.d.	Minor	n.d.	Natural uncoated fracture surface consists of crystalline silica, alkali feldspar, and an iron-bearing phase
LANL 3604 SSL02A1B3A area 1	ESF-HD-CHE-3	66.5	Dominant	Minor	Minor	Trace	Trace	n.d.	Natural micrometer-scale silica and alkali feldspar on uncorroded stellerite
LANL 3604 SSL02B1A1 area 1	ESF-HD-CHE-3	66.5	Trace	n.d.	n.d.	Dominant	n.d.	Dominant	New gypsum crystals, about 20-80 micrometers long, atop fracture surface
LANL 3604 SSL02B1A2 area 1	ESF-HD-CHE-3	66.5	Dominant	Subsidiary	Subsidiary	Trace	n.d.	n.d.	Natural fracture surface, mostly alkali feldspar and silica, adjacent to new gypsum deposit
LANL 3604 SSL02C1A2A1 area 1	ESF-HD-CHE-3	66.5	Dominant	n.d.	n.d.	n.d.	n.d.	n.d.	New silica film less than 0.2 micrometers thick
LANL 3604 SSL02C1B1 area 1	ESF-HD-CHE-3	66.5	Subsidiary	Trace	n.d.	Dominant	n.d.	Trace	New round calcite mound about 20 micrometers across atop new coalescing micrometer-scale silica deposits
LANL 3604 SSL02C1B1 area 2	ESF-HD-CHE-3	66.5	Dominant	n.d.	n.d.	n.d.	n.d.	n.d.	New coalescing micrometer-scale silica deposits
LANL 3604 SSL02C1C1A area 1	ESF-HD-CHE-3	66.5	Minor	n.d.	n.d.	Dominant	n.d.	Trace	New round calcite mounds about 10-12 micrometers across
LANL 3604 SSL02C1C1B area 1	ESF-HD-CHE-3	66.5	Minor	n.d.	n.d.	Dominant	n.d.	Trace	New round calcite mounds about 25 micrometers across and 12 micrometers thick
LANL 3604 SSL03A1A full area	ESF-HD-CHE-3	66.5	Dominant	Minor	Minor	Minor	Minor	n.d.	New terraced silica coating, about 5 micrometers thick, on fracture surface

Source: DTN: LA0201SL831225.001.

NOTE: Sampling location is depth along borehole in feet where side-wall sample was collected.
 Dominant>Subsidiary>Minor>Trace. Terms are unquantified.
 n.d. = not detected. Mg and Cl were not detected in any sample. Any other elements not listed were not detected.

3.5 USE OF SIDE-WALL MIN-PET SAMPLING DATA

The small number of side-wall samples collected may affect the representativeness of the data. This issue cannot be addressed quantitatively for the side-wall sample data presented herein. Planned sample analysis of continuous core collected from the zones of predicted mineral alteration and adjacent rock masses offers a promise of greater representativeness. At present, observational mineralogic data are not directly comparable to quantitative THC model predictions of the absolute abundances of precipitated secondary minerals or absolute magnitudes of dissolution. However, observational data from the test can be compared to the THC model predictions of the types of minerals and their locations of occurrence (i.e., in fractures in zones that have boiled/refluxed). The THC model validated using these data as well as data from other field and laboratory tests will then form the basis for evaluating effects of THC processes on performance of the repository.

The information transmitted in this letter report was derived from input into the in-process AMR, *Thermal Testing Measurements Report*, ANL-NBS-HS-000041 Rev 00. That report is being developed currently and is expected to be completed, approved, and issued in fiscal year 2003 as a controlled document to be used as a reference for the License Application or one of its supporting documents.

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