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Petrographic Report on Clay-Rich Samples From Permian Unit 4 Salt, G. Friemel #1 Well, Palo Duro Basin, Deaf Smith County, Texas: Unanalyzed Data

Technical Report

September 1983

Larry M. Fukui
of
Bendix Field Engineering Corporation

prepared for

Office of Nuclear Waste Isolation
Battelle Memorial Institute
505 King Avenue
Columbus, OH 43201

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Office of Nuclear Waste Isolation

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The content of this report was effective as of June 1983. This report was prepared by Bendix Field Engineering Corporation under Subcontract E511-13730 with Battelle Project Management Division, Office of Nuclear Waste Isolation under Contract Nos. DE-AC06-76RL01830 and DE-AC02-83CH10140 with the U.S. Department of Energy.

Unanalyzed Data

ABSTRACT

This report presents the results of mineralogic and petrographic analyses performed on five samples of clay-rich rock from salt-bearing Permian strata sampled by drill core from G. Friemel #1 Well, Deaf Smith County, Texas. Five samples of clay-rich rock from depths of about 2,457, 2,458, 2,521, 2,548, and 2,568 feet were analyzed to determine the amounts of soluble phase (halite) and the amounts and mineralogy of the insoluble phases. The amounts of halite found were 59, 79, 47, 40, and 4 weight percent, respectively, for the samples. The insoluble minerals are predominately clay (20 to 60 volume percent) and anhydrite (up to 17 volume percent), with minor (about 1.0 percent) and trace amounts of quartz, dolomite, muscovite, and gypsum. The clays include illite, chlorite, and interstratified chlorite-smectite.

The results presented in this petrographic report are descriptive, uninterpreted data.

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INTRODUCTION

This report presents the results of mineralogic and petrographic analyses performed on samples of salt-bearing rock from a potential repository site in the Palo Duro Basin, Texas. The samples are from Permian Unit 4 salt, Lower San Andres Formation, G. Friemel #1 well, Deaf Smith County, Texas.

The mineralogic and petrographic data were obtained from polished thin sections cut parallel to the axis of the core for each sample. The polished thin sections were examined in order to determine the abundances of soluble (halite, polyhalite) and insoluble components (anhydrite, clay, dolomite, quartz, gypsum, etc.). The information reported includes mineral associations (detrital, authigenic, cement, alteration, etc.), texture, grain size, and sedimentary fabrics. This report also includes representative photomicrographs with bar scales. Photomicrographs of polished thin sections have the up-core direction, or when up-core direction was unknown, the core axis direction, designated. X-ray diffraction was used for identification of soluble and insoluble minerals.

PROCEDURES

This section describes the procedures used to obtain mineralogic and petrographic data. Detailed descriptions of these procedures may be found in the Bendix Field Engineering Corporation (BFEC) Petrology Laboratory Preliminary Procedures Manual (PLPPM) or Fukui (1982).

SAMPLE PREPARATION

Drill core samples from the G. Friemel #1 borehole were received February 15, 1983, and prepared for chemical and petrographic analyses. In general, these samples consisted of one quarter of a 4-in. core, 0.2 to

0.4 ft long. One or two polished thin sections were prepared from vertical slabs of each sample.

Hand specimen descriptions were prepared for each sample according to procedures in the PLPPM. These descriptions are presented with each petrographic description.

Drill core samples were cut in a saturated calcium chloride brine to prevent the loss of water-soluble phases and to prevent contamination of samples by hydrocarbon-based cutting oils. Calcium chloride solution was used in drilling the borehole. Portions of each sample were removed for chemical analysis, polished thin section preparation, and grinding for X-ray studies.

Procedures for Thin Section Preparation, Petrographic Description, Bulk Rock X-Ray Diffraction, and Clay Separation and Analysis by X-ray Diffraction can be found in the PLPPM. These procedures can also be found in previous BFEC Petrographic Reports to NWTS (Fukui, 1982).

CHEMICAL ANALYSES

Portions of the same intervals sampled for polished thin sections were submitted to the BFEC Chemistry Laboratory for analysis of the water-soluble and insoluble fractions of the rock. The soluble fraction was leached using deionized water. Table 1 lists the weights of the fractions and the calculated weight percents of insoluble residue. The insoluble residues were returned to the Petrology Lab in case any additional mineral identifications were necessary. The insoluble residues will be retained for possible future analysis by the Chemistry Lab.

EXPLANATION OF THE APPENDICES

Petrographic descriptions, point count data (Table 2), and representative photomicrographs are in Appendix A of this report. X-ray diffraction

charts for clay mineralogy are in Appendix B. Portions of each sample removed for thin section preparation were photographed using positive/ negative black and white Polaroid film. These photographs show a ruler for scale, and arrows to designate the up-core, or when up-core direction was unknown, the orientation of the core axis. Photographs of samples are in Appendix C.

TABLE 1

PERCENT INSOLUBLE RESIDUE

BFEC SAMPLE TICKET NUMBER	AASSN	WEIGHT LEACHED	WEIGHT INSOL. RESIDUE	WT. PERCENT INSOL. RESIDUE	VOL. PERCENT INSOL. RESIDUE*
MMP-243	82413	20.5	6.0	29.3	40.8
MMP-244	82414	23.6	8.8	37.3	20.7
MMP-245	82415	30.6	8.8	28.8	52.8
MMP-246	82416	32.2	24.5	76.1	59.5
MMP-247	82417	31.7	28.8	90.9	95.3

*By the point count method
All weights are in grams

REFERENCES

Bendix Field Engineering Corporation Petrology Lab Staff, 1982, Petrology laboratory preliminary procedure manual, 14 p.

Fukui, L.M., 1982, Petrographic report: Insoluble residue analysis, Permian Cycle 5 salt, G. Friemel #1 and Detten #1 wells, Palo Duro Basin, Texas: BFEC Petrology Lab report to NWTS, 92 p.

APPENDIX A

PETROGRAPHIC DESCRIPTIONS

PETROGRAPHIC REPORT: PALO DURO SALT SAMPLE MMP-243

Sample Information:

Rock Name: Clayey Evaporite (Chaotic Halite-Claystone)

NWTS Palo Duro Drill Core G. Friemel #1

NWTS Sample No.: None BFEC Sample No.: MMP-243

Depth of Polished Thin Section Coverage: 2457.5 to 2457.7 ft (Two polished thin sections)

BFEC Petrology Request No.: 600164 BFEC Project No.: 7N0130

Petrologist: L. M. Fukui

Hand Specimen Description of Drill Core: The quartered four-inch core is 0.20 foot long. Both ends have broken along partings in clay laminae. No up-core direction is designated on the core. The sample consists of one major piece with clay partings (pieces) from the two clay laminae. The salt is medium- to coarse-grained (1.1 cm maximum). The sample is a chaotic halite-mudstone. Few euhedral halite crystals are evident on the sample surfaces. Clay laminae/beds range up to 1.5 cm thick, although the laminae/beds at each end of the core are incomplete. Color of the salt is grayish red (5R4/2). Claystone laminae/beds are medium light gray (N/6). The clay intergranular to halite is finely laminated (<0.1 to 0.25 cm) with contorted laminations. This clay/detritus is medium dark gray (N4), medium light-gray (N6), light brownish gray (5YR6/1), and brownish gray (5YR4/1). Moderate reddish orange (10R6/6), fibrous halite occurs as a fracture-filling in one clay lamina/bed.

Salt Mineralogy: Halite was identified using X-ray diffraction for both the grayish red salt and the moderate reddish orange, fibrous fracture-fillings.

Clay Mineral Analysis: The clay minerals are randomly interstratified chlorite-smectite (dominant), illite (moderate), and 2:1 regularly interstratified chlorite-illite (minor to moderate).

Thin Section Description:

MINERAL/COMPONENT	%	COMMENTS
Soluble Phases		
Halite	59	Medium- to coarse-grained (14 mm maximum), anhedral to subhedral. Microcrystalline inclusions observed.
Polyhalite(?)	tr	Very fine-grained (0.03 mm maximum), subhedral. Inclusions in halite with inclined extinction.
Insoluble Phases		

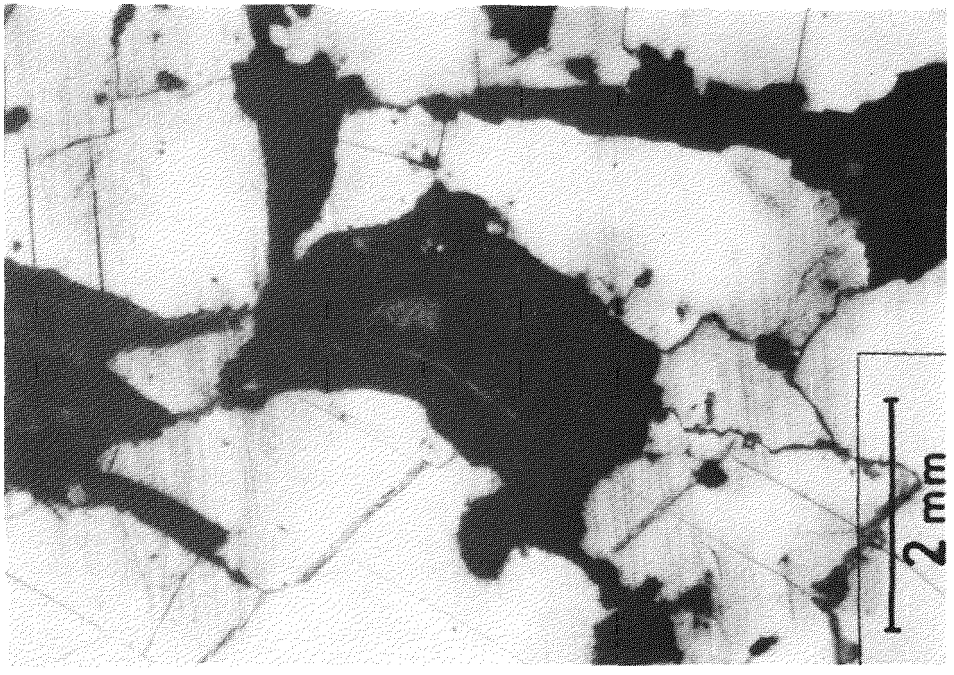
Continued next page

PETROGRAPHIC REPORT: PALO DURO SALT SAMPLE MMP-243 (Continued)

Thin Section Description:

MINERAL/COMPONENT	%	COMMENTS
Insoluble Phases		
Clay	29	Iron-stained. Occurs intergranular to halite and as discontinuous laminae up to 9 mm thick. Usually finely mixed with anhydrite. Also occurs as claystone clasts up to 2 mm in clay matrix.
Anhydrite	11	Three textures: Finely mixed with clay, as clasts consisting of mosaics of microcrystalline anhedra up to 1.64 mm in clay, and as very fine-grained (0.04 mm maximum) euhedral inclusions in halite.
Quartz	1	Two textures: detrital up to 0.1 mm (very fine sand), occasionally occurs as lenses of detrital quartz up to 2.89 mm in clay; and as authigenic(?) euhedral grains up to 0.24 mm, occurring at halite-halite grain boundaries.
Carbonate	tr	Fine-grained (up to 0.35 mm), euhedral. Occurs at halite-halite grain boundaries. Dolomite confirmed using X-ray diffraction.

PHOTOMICROGRAPH OF SAMPLE MMP-243



Intergranular clay patches are present in the chaotic halite-claystone. The photomicrograph was taken in plane polarized light with a magnification of 16x. The blue-colored fracture-filling material is the impregnating epoxy.

PETROGRAPHIC REPORT: PALO DURO SALT SAMPLE MMP-244

Sample Information:

Rock Name: Clayey Evaporite (Chaotic Halite-Claystone)

NWTS Palo Duro Drill Core G. Friemel #1

NWTS Sample No.: None BFEC Sample No.: MMP-244

Depth of Polished Thin Section Coverage: 2458.1 to 2458.33 (Two polished thin sections)

BFEC Petrology Request No.: 600164 BFEC Project No.: 7N0130

Petrologist: L. M. Fukui

Hand Specimen Description of Drill Core: The quartered four-inch core is 0.23 foot long. Both ends have broken along intergranular clay. No up-core direction is designated on the sample. The sample consists of one major piece with small pieces of clay from the intergranular material. The sample is a chaotic halite-claystone. The salt is medium- to coarse-grained (2.2 cm maximum). Clay fills intergranular patches up to 3.8 cm and forms discontinuous laminae/beds up to 2.5 cm thick. The salt is predominately anhedral to subhedral. Color of the salt is clear to blackish red (5R2/2). Color of the clay is grayish red (4R4/2). Moderate reddish orange (10R4/6), fibrous halite occurs as a fracture-filling phase in the intergranular clay.

Salt Mineralogy: Halite was identified using X-ray diffraction.

Clay Mineral Analysis: The clay minerals are randomly interstratified chlorite-smectite (dominant), illite (subdominant to moderate), and a 2:1 regularly interstratified chlorite-illite (minor to moderate).

Thin Section Description:

MINERAL/COMPONENT	%	COMMENTS
Soluble Phase		
Halite	79	Medium- to coarse-grained (up to 18 mm), anhedral to subhedral., Abundant micro-crystalline inclusions. Recrystallized; former grain boundaries defined by anhydrite/ clay stringers and planar arrangements of elongate fluid inclusions.
Insoluble Phases		

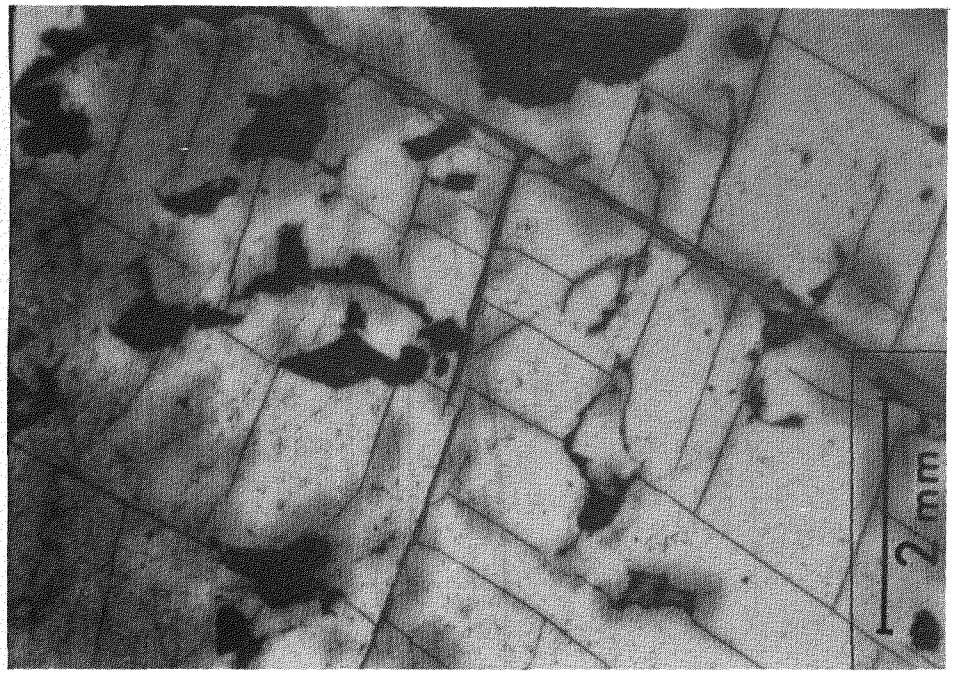
Continued next page

PETROGRAPHIC REPORT: PALO DURO SALT SAMPLE MMP-244 (Continued)

Thin Section Description:

MINERAL/COMPONENT	%	COMMENTS
Insoluble Phases		
Clay	20	Iron-stained. Intergranular to halite and as discontinuous laminae up to 7 mm thick. Finely mixed with anhydrite.
Anhydrite	tr	Three textures: finely mixed with clay intergranular to halite and in discontinuous laminae; as clasts up to 0.7 mm composed of a microcrystalline mosaic of anhedra; and as very fine-grained, euhedral inclusions in halite.
Carbonate	tr	Fine-grained (up to 0.35 mm), euhedral. Occurs at halite-halite grain boundaries.
Quartz	tr	Two textures: as detrital grains up to 0.04 mm (silt) in clay and as authigenic(?) grains up to 0.22 mm at halite-halite grain boundaries and at clay-halite boundaries.
Muscovite	tr	Detrital. Up to 0.13 mm (fine sand). Thin flakes in clay.

PHOTOMICROGRAPH OF SAMPLE MMP-244



↕ core axis

Clay patches, which were formerly intergranular to fine- to medium-grained halite, are now inclusions in recrystallized, coarse-grained halite in the chaotic halite-claystone. The photomicrograph was taken in plane polarized light with a magnification of 16x.

PETROGRAPHIC REPORT: PALO DURO SALT SAMPLE MMP-245

Sample Information:

Rock Name: Clayey Evaporite (Claystone Beds and Chaotic Halite-Claystone)

NWTS Palo Duro Drill Core G. Friemel #1

NWTS Sample No.: None BFEC Sample No.: MMP-245

Depth of Polished Thin Section Coverage: 2521.2 to 2521.3 and 2521.4 to 2521.5 ft. (Two polished thin sections)

BFEC Petrology Reqeust No.: 600164 BFEC Project No.: 7N0130

Petrologist: L. M. Fukui

Hand Specimen Description of Drill Core: The quartered four-inch core is 0.38 foot long with both ends broken along clay partings. The up-core direction is assumed from numbers on the outer surface of the core and the orientation of chevrons in halite below a claystone-anhydrite bed. The sample is in one piece covering the interval 2521.2 to 2521.58 feet depth. The interval 2521.20 to 2521.27 is a grayish red (10R4/2) claystone laminae. The interval 2521.27 to 2521.30 feet is predominately clear to blackish red (5R2/2), medium- to coarse-grained (1.5 cm maximum), subhedral to euhedral halite with zones of chaotic halite-claystone. Intergranular clay is grayish red (10R4/2). The interval 2521.30 to 2521.31 is a grayish red (10R4/2) clay lamina. The interval 2521.31 to 2521.36 is clear to blackish red (5R2/2), coarse-grained (2.1 cm maximum) salt with trace amounts of intergranular clay. The interval 2521.36 to 2521.43 feet is a grayish red (5R4/2) to pale red (5R6/2) clay bed. The bottom of this bed is very light gray (N8) anhydrite which conforms to the shape of halite crystals (chevrons) below the bed. The interval 2521.43 to 2521.58 feet is massive, clear to blackish red (5R2/2), medium- to coarse-grained (1.9 cm maximum) salt with a discontinuous lamina (0.1 to 0.2 cm thick) of anhydrite and clay at 2521.46 feet.

Salt Mineralogy: Halite was identified using X-ray diffraction.

Clay Mineral Analysis: The clay minerals are chlorite (dominant), illite (subdominant), and randomly interstratified chlorite-smectite (minor to trace).

Thin Section Description:

MINERAL/COMPONENT	%	COMMENTS
Soluble Phases		
Halite	47	Medium- to coarse-grained (14 mm maximum), anhedral to euhedral. Microcrystalline inclusions observed. Fluid inclusions up to 0.16 mm and negative crystals up to 0.24 mm observed.

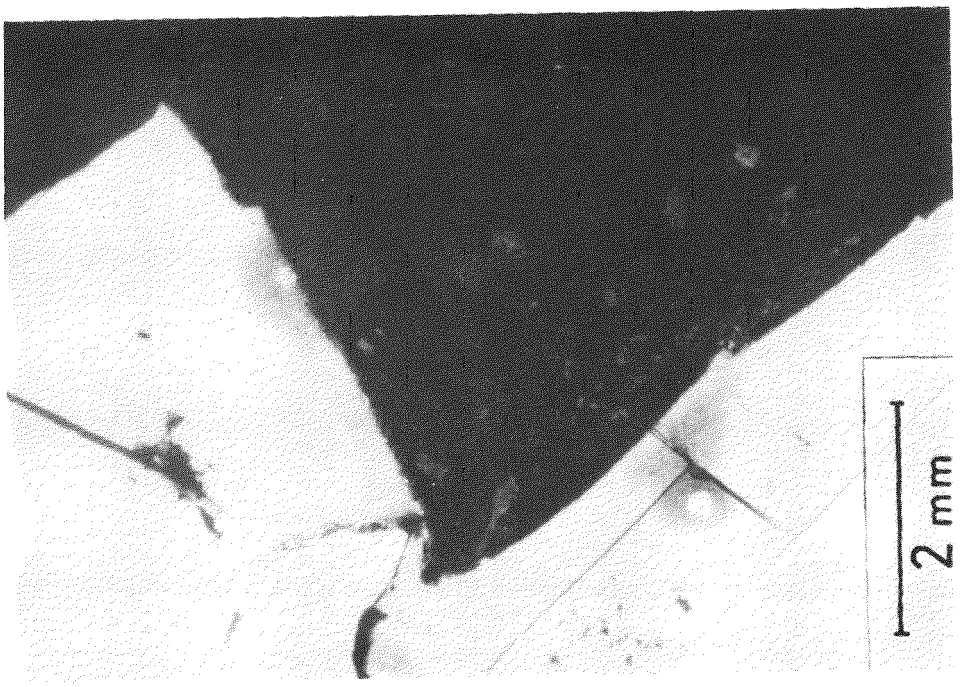
Soluble Phases
Continued next page

PETROGRAPHIC REPORT: PALO DURO SALT SAMPLE MMP-245 (Continued)

Thin Section Description:

MINERAL/COMPONENT	%	COMMENTS
Soluble Phases		
Polyhalite(?)	tr	Very fine-grained (up to 0.05 mm), anhedral to subhedral. As inclusions in halite.
Insoluble Phases		
Clay	42	Iron-stained. Occurs as beds up to 17 mm thick, intergranular to halite, and as inclusions in halite.
Anhydrite	10	Three textures: finely mixed with clay; as clasts up to 0.53 mm composed of a mosaic of microcrystalline anhedra; and as subhedral inclusions in halite up to 0.12 mm.
Carbonate	1	Fine-grained (up to 0.53 mm), anhedral to euhedral. Occurs at halite-halite grain boundaries as clusters and single grains as inclusions in halite.
Quartz	tr	Mostly as detrital grains up to 0.05 mm (silt). Few authigenic grains up to 0.08 mm, euhedral at halite-clay boundaries.
Additional Detrital Components	tr	Component and maximum grain size: Muscovite (0.1 mm); hematite/goethite (0.04 mm).
Gypsum(?)	tr	A 0.20 mm patch of microcrystalline anhedra in clay. May be a clast.

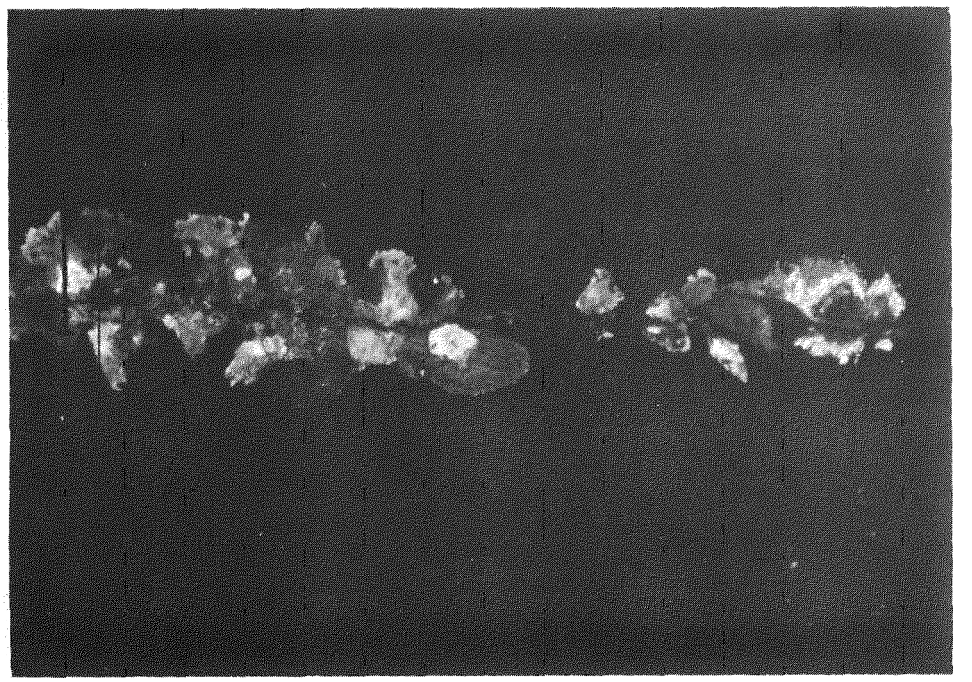
PHOTOMICROGRAPH OF SAMPLE MMP-245



Euhedral halite grains point upward; the claystone bed was deposited on top of the halite. The photomicrograph was taken in plane polarized light with a magnification of 16x.

PHOTOMICROGRAPHS OF SAMPLE MMP-245
(CONTINUED)

↑ Up Core



A cluster of fine-grained carbonate grains is present at a grain boundary between two halite grains. The upper photomicrograph was taken in plane polarized light; the lower with polarizers crossed. The magnification of these photomicrographs is 40x.

PETROGRAPHIC REPORT: PALO DURO SALT SAMPLE MMP-246

Sample Information:

Rock Name: Clayey Evaporite (Claystone and Chaotic Halite-Claystone)

NWTS Palo Duro Drill Core G. Friemel #1

NWTS Sample No.: None BFEC Sample No.: MMP-246

Depth of Polished Thin Section Coverage: 2548.1 to 2548.5 ft. (Two polished thin sections)

BFEC Petrology Request No.: 600164 BFEC Project No.: 7N0130

Petrologist: L. M. Fukui

Hand Specimen Description of Drill Core: The quartered four-inch core is in one major piece (0.22 foot long) and many small clay partings. No up-core direction is designated on any portion of this sample. The interval covered (2548.1 to 2548.5 feet) is predominately a claystone bed of unknown thickness. The color of the claystone is mottled pale red (5R6/2) and grayish red (5R4/2). The largest coherent piece of this sample is in part a claystone bed; the remainder of the piece is chaotic halite-claystone. The salt in this piece is medium- to coarse-grained (1.5 cm maximum), anhedral to euhedral, and blackish red (5R2/2) in color. The clay in this piece is pale red (5R6/2).

Salt Mineralogy: Halite was identified using X-ray diffraction.

Clay Mineral Analysis: The clay minerals are illite (codominant), chlorite (codominant), randomly interstratified chlorite-smectite (minor to moderate), and a 2:1 regularly interstratified chlorite-illite (minor to moderate).

Thin Section Description:

MINERAL/COMPONENT	%	COMMENTS
Soluble Phase		
Halite	40	Medium- to coarse-grained (12 mm maximum), anhedral to euhedral. Local concentrations of anhydrite inclusions.
Insoluble Phases		

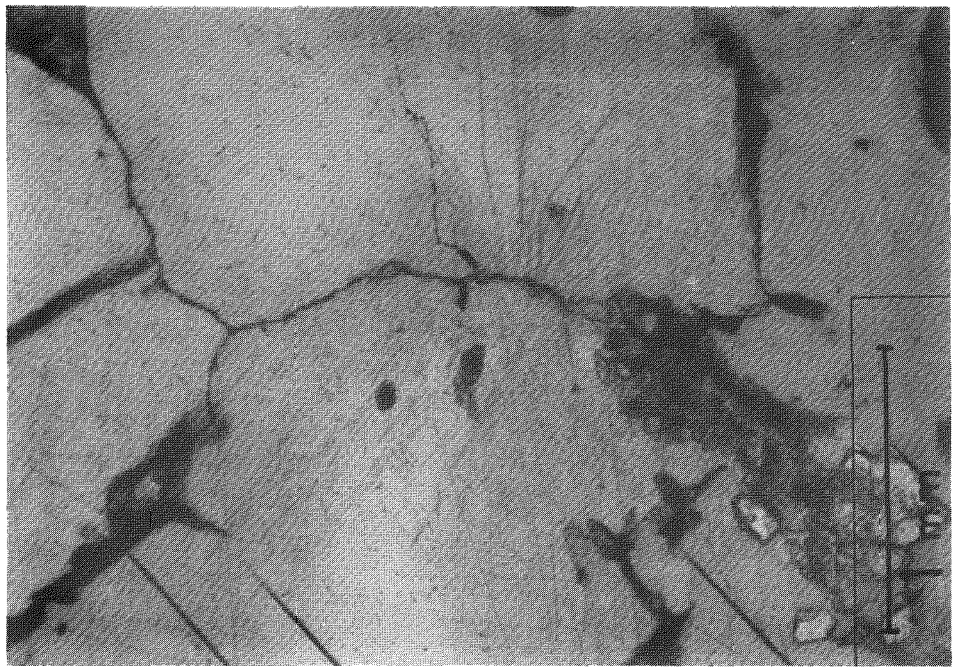
Continued next page

PETROGRAPHIC REPORT: PALO DURO SALT SAMPLE MMP-246 (Continued)

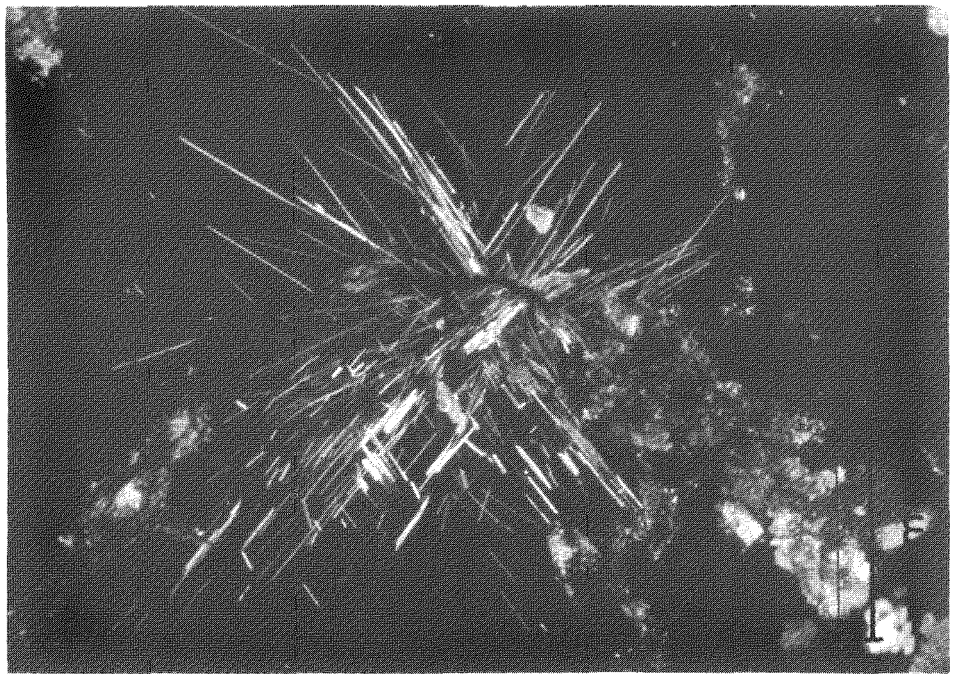
Thin Section Description:

MINERAL/COMPONENT	%	COMMENTS
Insoluble phases		
Clay	48	Iron-stained. Occurs as claystone beds of unknown thickness, intergranular to halite, and as inclusions in halite.
Anhydrite	10	Three textures: finely mixed with clay, mosaics of microcrystalline anhedra as inclusions in halite, and as very-fine to fine-grained (0.91 mm maximum) inclusions in halite. The inclusions are tabular, and as slender elongate needles arranged radially.
Quartz	1	Two textures: very fine-grained (up to 0.16 mm) euhedra occurring at halite-halite grain boundaries and halite clay boundaries; detrital, up to 0.05 mm (silt). Detrital fraction is present in the claystone bed.
Carbonate	tr	Fine-grained (up to 0.31 mm), subhedral to euhedral. Occurs at halite-halite grain boundaries. Tends to form clusters.

PHOTOMICROGRAPHS OF SAMPLE MMP-246



↕ Core Axis



A radial cluster of anhydrite needles is present at the boundary between two halite grains in the chaotic halite-claystone portion of the sample. The upper photomicrograph was taken in plane polarized light; the lower with polarizers crossed. The magnification of these photomicrographs is 40x.

PETROGRAPHIC REPORT: PALO DURO SALT SAMPLE MMP-247

Sample Information:

Rock Name: Shale

NWTS Palo Duro Drill Core G. Friemel #1

NWTS Sample No.: None BFEC Sample No.: MMP-247

Depth of Polished Thin Section Coverage: 2568.2 to 2568.5 ft (One polished thin section)

BFEC Petrology Request No.: 600164 BFEC Project No.: 7N0130

Petrologist: L. M. Fukui

Hand Specimen Description of Drill Core: This sample consists of many clay partings with no up-core direction designated. The sample is a claystone or shale, grayish red (10R4/2) in color. The clay is cut by veinlet/fracture-fillings of moderate reddish brown (10R4/6) halite. The halite is fibrous (columnar) with the fibers oriented perpendicular to the veinlet/fracture walls.

Salt Mineralogy: Halite was identified, using X-ray diffraction, as a component of the claystone and as the veinlet/fracture-filling phase.

Clay Mineral Analysis: The clay minerals are illite (dominant), chlorite (subdominant), randomly interstratified chlorite-smectite (moderate), and a 2:1 regularly interstratified chlorite-illite (minor to moderate).

Thin Section Description:

MINERAL/COMPONENT	%	COMMENTS
Soluble Phase		
Halite	4	Very fine- to coarse-grained (5 mm maximum), anhedral to euhedral. Occurs as a fracture-filling phase and filling pores in clay. The fracture-filling phase has two distinct morphologies: slender elongate, completely filling fractures, with the crystals perpendicular to the fracture walls, exhibiting fibrous to columnar cleavage; and discrete euhedra in open fractures. Fractures are predominately parallel to bedding.
Insoluble Phases		

Continued next page

PETROGRAPHIC REPORT: PALO DURO SALT SAMPLE MMP-247 (Continued)

MINERAL/COMPONENT	%	COMMENTS
Insoluble Phases		
Clay	68	Iron-stained. Thinly bedded and finely mixed with anhydrite. Also occurs as rounded claystone clasts up to 0.29 mm (fine sand).
Anhydrite	17	Microcrystalline, anhedral to fine-grained (0.23 mm maximum), euhedral; finely mixed with clay. Also occurs as clasts to 0.42 mm (medium sand) and occasional euhedral inclusions in the columnar, fracture-filling halite.
Quartz	8	Clast size up to 0.09 mm (very fine sand). Angular to subangular grains.
Gypsum	2	Mosaics of microcrystalline anhedra occurring as rounded to subangular clasts up to 0.56 mm (coarse sand).
Additional Detrital Components	1	Component and maximum grain size: muscovite (0.08 mm), goethite/hematite (0.06 mm), epidote (0.03 mm), biotite (0.06 mm), K-feldspar (0.04 mm), zircon (0.03 mm), and monzaite (0.02 mm).

PHOTOMICROGRAPHS OF SAMPLE MMP-247

↕ Core Axis

Halite in fractures has two textures in the shale. This photomicrograph shows fine-grained euhedra (cubes) partially filling fractures subparallel to bedding. The photomicrograph was taken in plane polarized light with a magnification of 40x.

Non-Oriented

A portion of fracture-filling halite showing columnar cleavage and a reddish color. The photomicrograph was taken in plane polarized light with a magnification of 16x.

TABLE 2
POINT COUNT DATA

WELL NAME: G. Friemel #1
Unit 4 Salt

BFEC Sample No.	MMP-243		MMP-244		MMP-245	
Thin Section Letter Designation	A	B	A	B	A	B
Depths of Thin Section coverage (ft.)	*	*	*	*	2521.2-2521.3	2521.4-2521.5
Halite	228	126	239	237	102	181
Polyhalite(?)	1	-	-	-	-	-
Anhydrite	24	40	-	-	22	37
Clay	46	125	60	63	175	78
Carbonate	1	1	1	-	1	4
Quartz	-	8	-	-	-	-
Goethite/Hematite	-	-	-	-	-	-
Gypsum	-	-	-	-	-	-

*No up core designation was provided with the sample; no specific depth footages were assigned to individual polished thin sections.

Continued

TABLE 2
POINT COUNT DATA (CONTINUED)

WELL NAME: G. Friemel #1
Unit 4 Salt

BFEC Sample No.	MMP-246		MMP-247
Thin Section Letter Designation	A	B	A
Depths of Thin Section coverage (ft.)	*	*	*
Halite	243	-	14
Polyhalite(?)	-	-	-
Anhydrite	14	43	51
Clay	41	249	204
Carbonate	2	-	-
Quartz	-	8	25
Goethite/Hematite	-	-	1
Gypsum	-	-	5

*No up core designation was provided with the sample; no specific depth footages were assigned to individual polished thin sections.

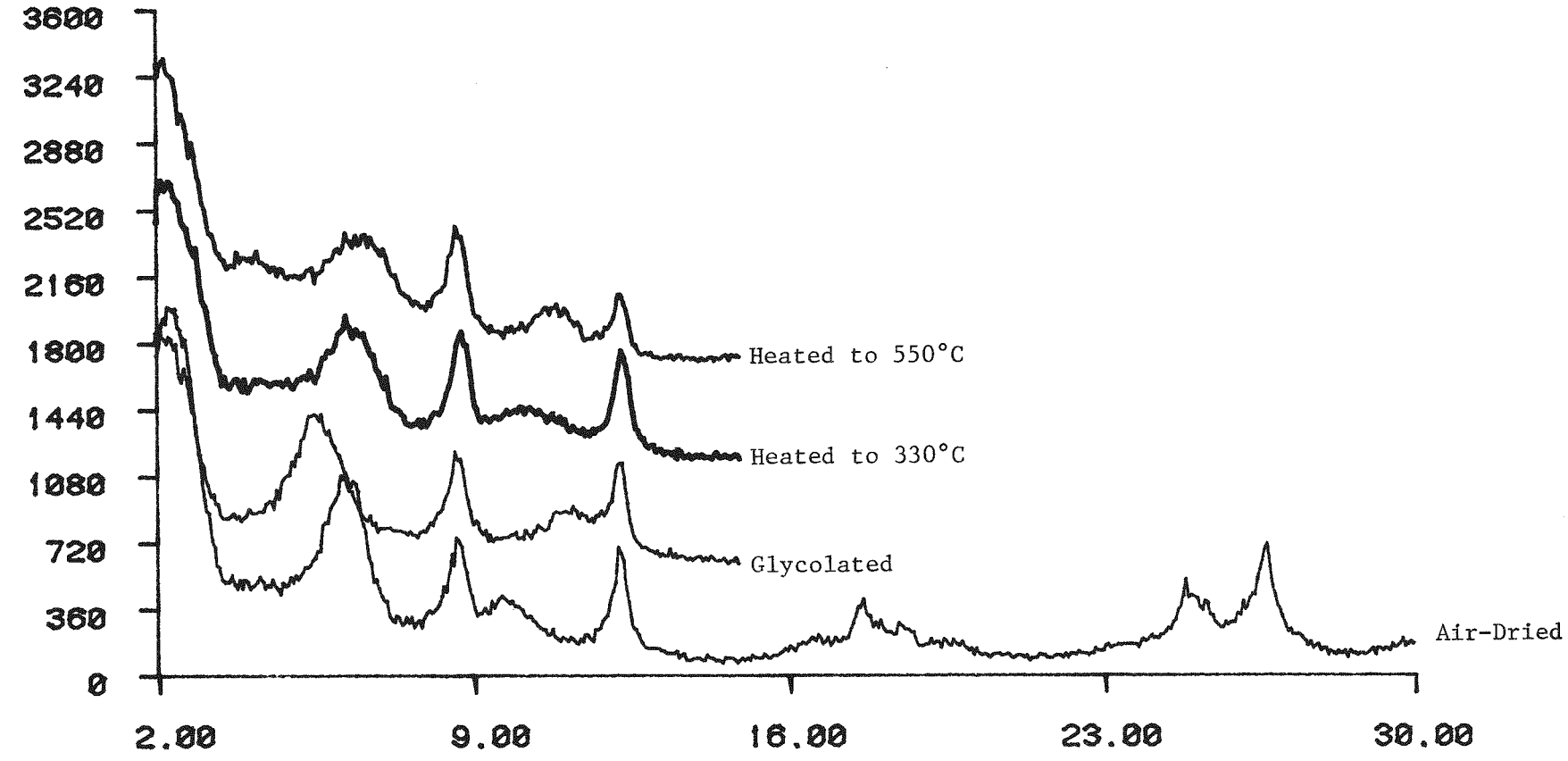
APPENDIX B

X-RAY DIFFRACTION CHARTS FOR CLAY MINERALOGY

File name: DF0:Z80035.RAW

File: 16-MAR-83 08:07:10
Today: 16-MAR-83 10:33:31

Sample Id: HEATED 550 MMP-243 CLAY C4 G.FRIEMEL #1



AIR DRIED GLYCOLATED **HEATED 330** HEATED 550
1833. 1450. **1584.** 1701.

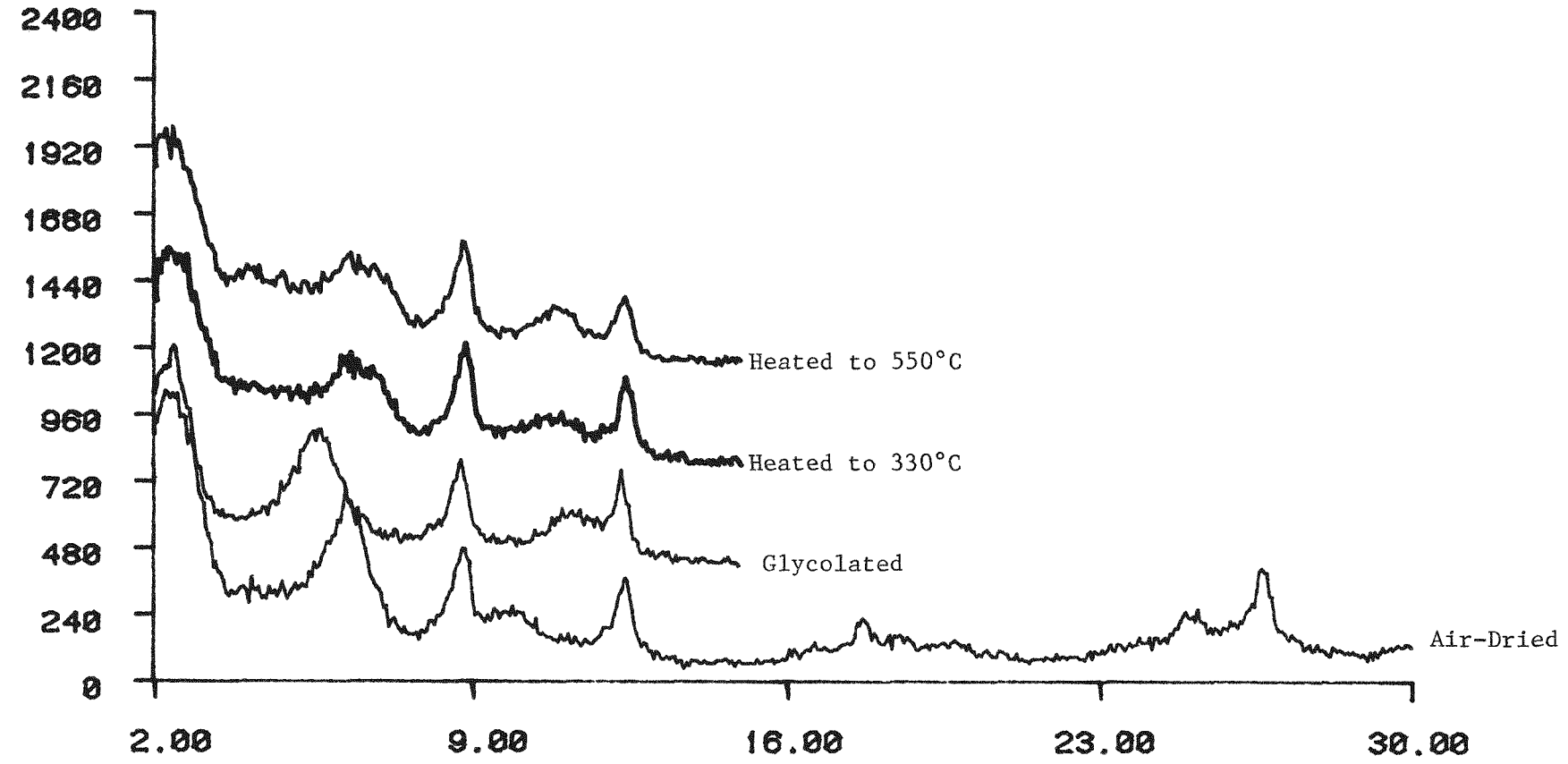
BENDIX

Unanalyzed Data

File name: DF0:Z80036.RAW

File: 16-MAR-83 08:26:11
Today: 16-MAR-83 10:44:05

Sample Id: HEATED 550 MMP-244 CLAY C4 G.FRIEMEL #1



AIR DRIED GLYCOLATED **HEATED 330** HEATED 550
1036. 839. **823.** 907.

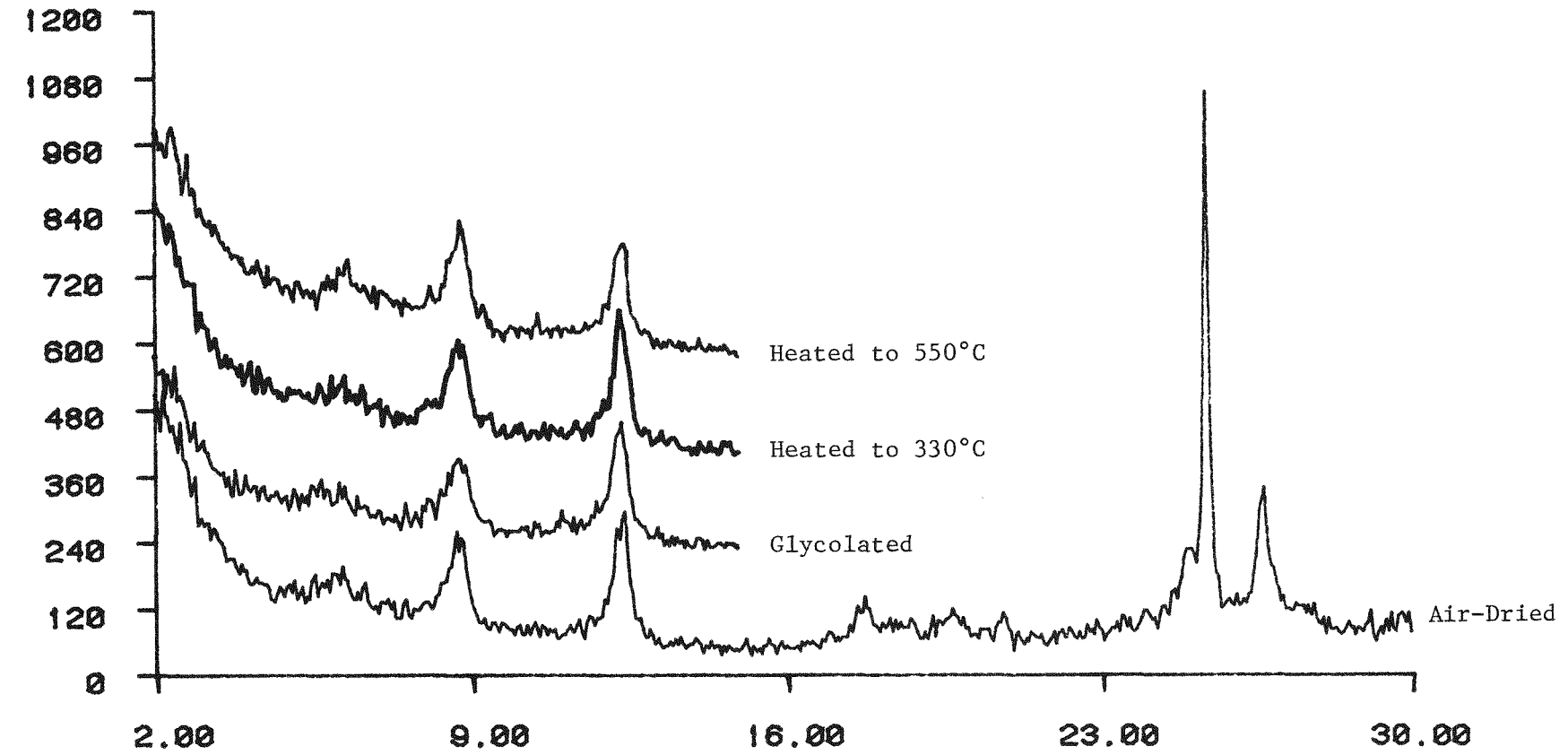
BENDIX

Unanalyzed Data

File name: DF0:Z80037.RAW

File: 16-MAR-83 08:34:00
Today: 16-MAR-83 10:55:17

Sample Id: HEATED 550 MMP-245 CLAY C4 G.FRIEMEL #1



AIR DRIED GLYCOLATED HEATED 330 HEATED 550
1053. 394. 490. 446.

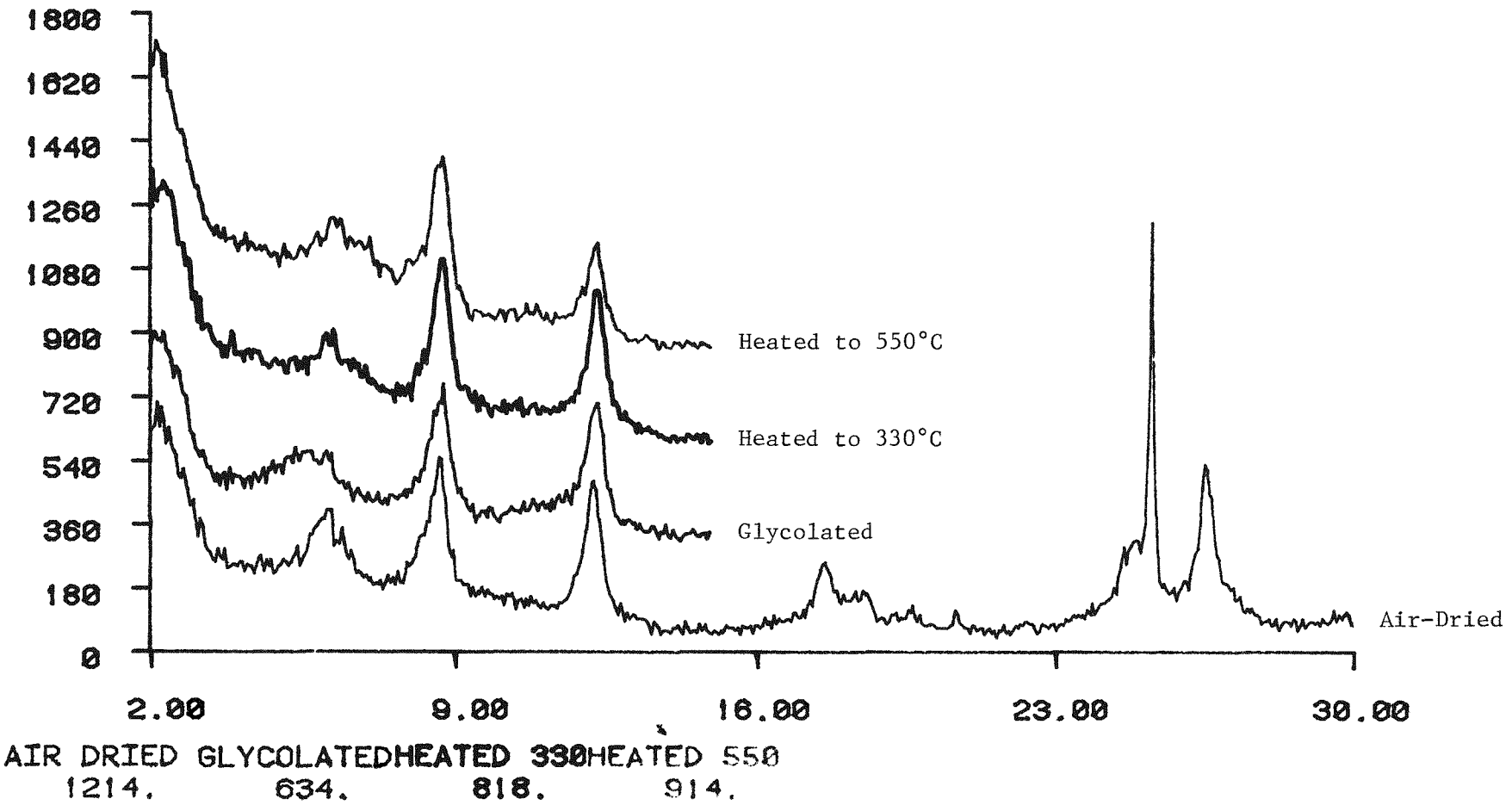
BENDIX

Unanalyzed Data

File name: DF0:Z80038.RAW

File: 16-MAR-83 08:44:00
Today: 16-MAR-83 11:48:31

Sample Id: HEATED 550 MMP-246 CLAY C4 G.FRIEMEL #1



AIR DRIED GLYCOLATED HEATED 330 HEATED 550
1214. 634. 818. 914.

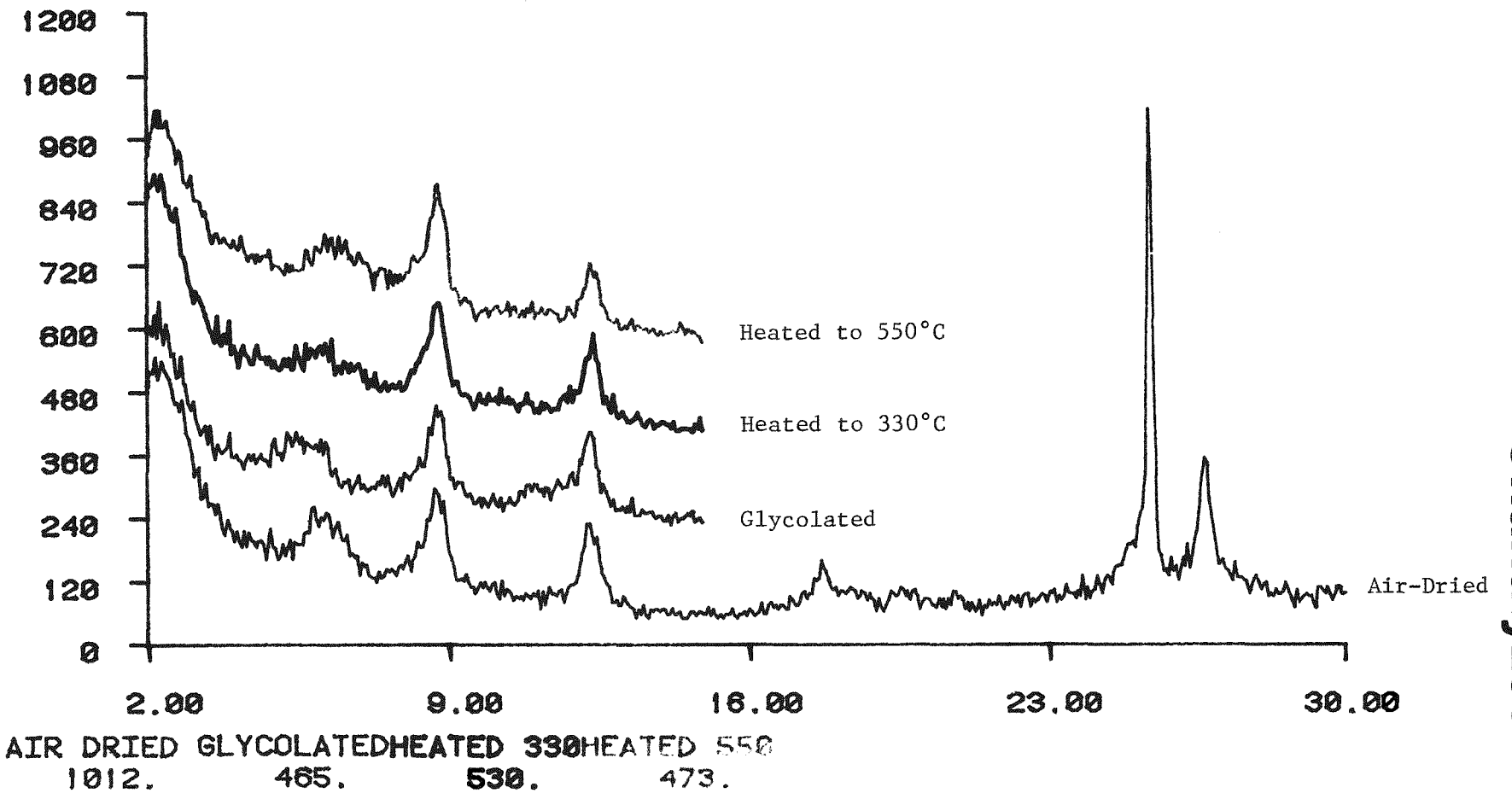
BENDIX

Unanalyzed Data

File name: DF0:Z80039.RAW

File: 16-MAR-83 09:01:14
Today: 16-MAR-83 11:56:54

Sample Id: HEATED 550 MMP-247 CLAY C4 G.FRIEMEL #1



AIR DRIED GLYCOLATEDHEATED 330HEATED 550
1012. 465. 530. 473.

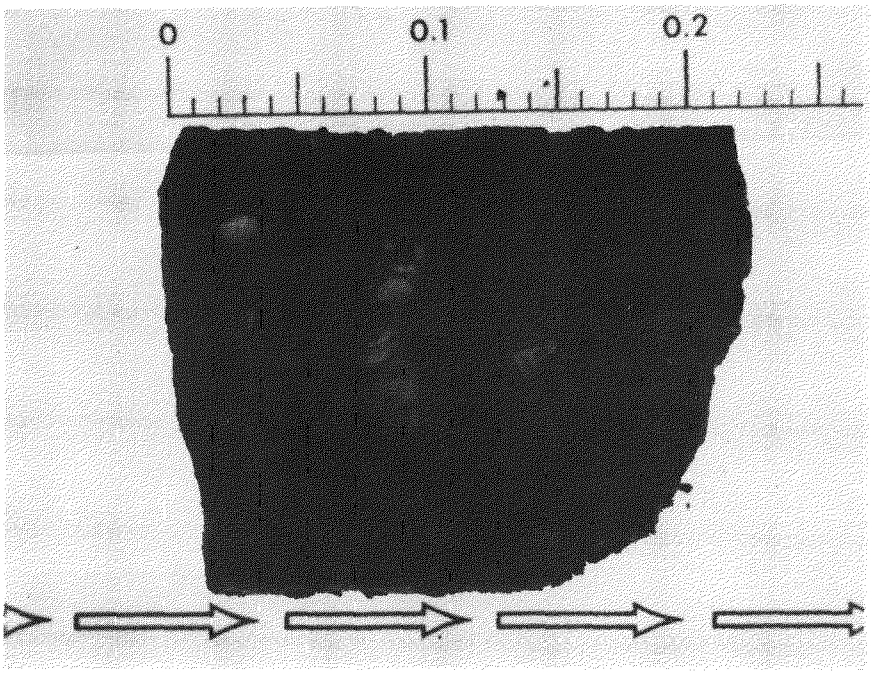
BENDIX

Unanalyzed Data

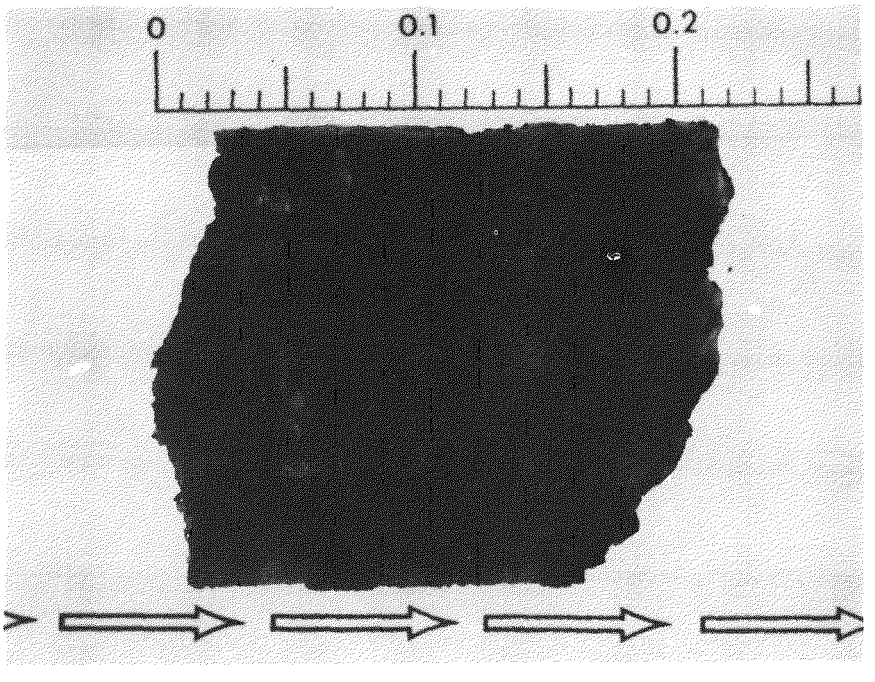
Unanalyzed Data

APPENDIX C

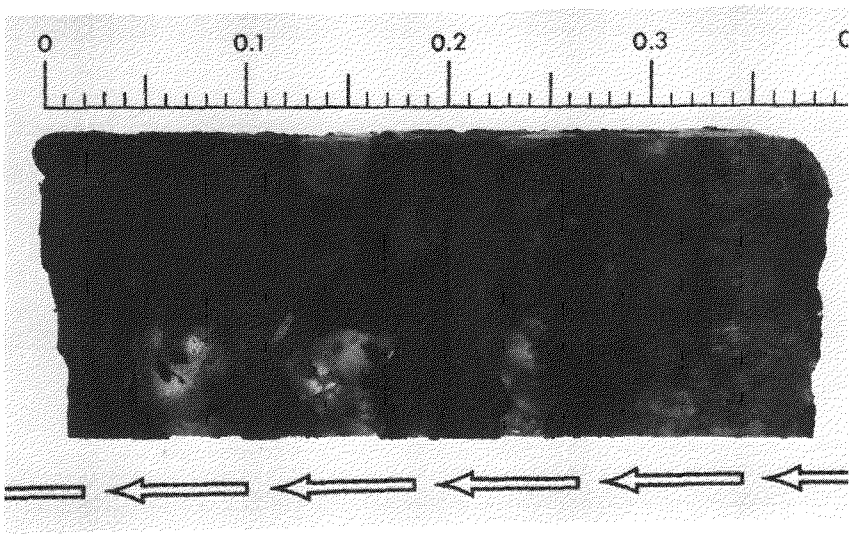
ROCK SLAB PHOTOGRAPHS



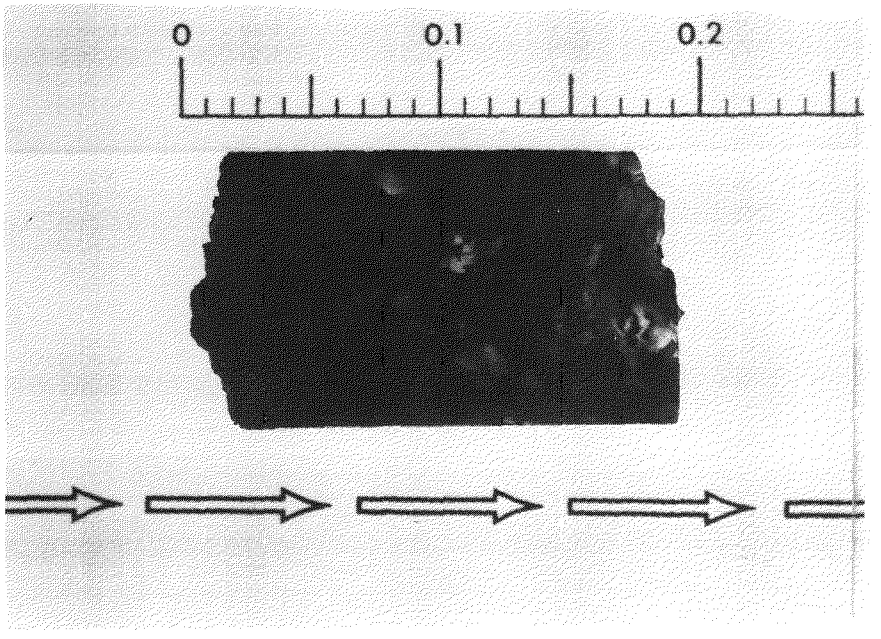
Photograph of the slab of sample MMP-243. The arrows indicate the orientation of the core axis; no up-core direction was indicated on the sample as received. The scale is in tenths of a foot.



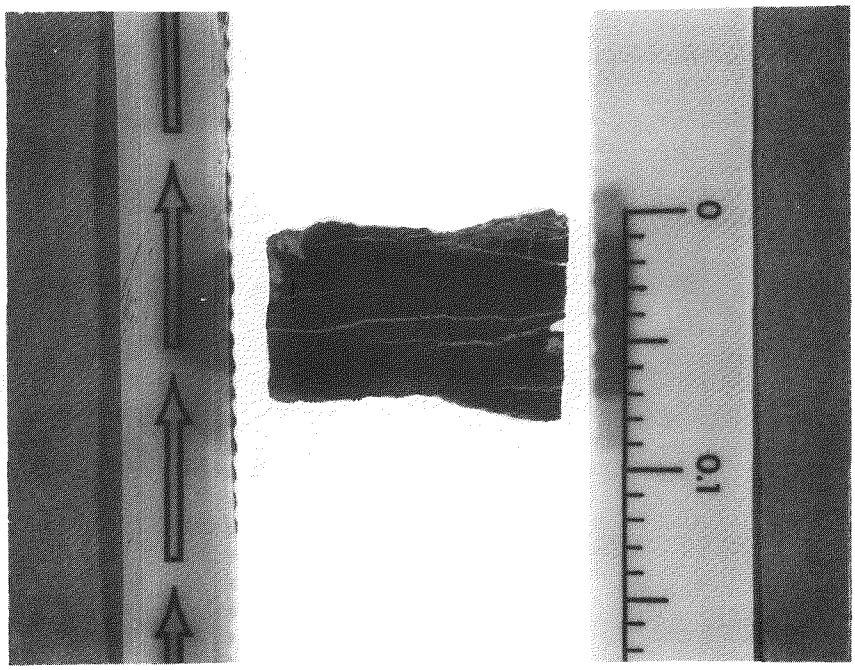
Photograph of the slab of sample MMP-244. The arrows indicate the orientation of the core axis; no up-core direction was indicated on the sample as received. The scale is in tenths of a foot.



Photograph of the slab of sample MMP-245. The arrows indicate the up-core direction. The scale is in tenths of a foot.



Photograph of the slab of sample MMP-246. The arrows indicate the orientation of the core axis; no up-core direction was indicated on the sample as received. The scale is in tenths of a foot.



Photograph of the slab of sample MMP-247. The arrows indicate the orientation of the core axis; no up-core direction was indicated on the sample as received. The scale is in tenths of a foot.

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