

**APPENDIX F**  
**PHYSICAL PROPERTY ANALYSES**

808211: 9-12-89



## CORPORATE OFFICE &amp; CENTRAL LABORATORY

3400 N. Lincoln Okla. City, OK 73105 (405) 528-0541

## Field Offices

902 Trails West Loop	Enid, OK 73703	(405) 237-3130
900 S.E. 2nd	Lawton, OK 73501	(405) 353-0872
208 Eastside Blvd.	Muskogee, OK 74403	(918) 682-7853
660 Distributors Row	Suite C, Harahan, LA 70123	(504) 734-8378

REPORT Permeability Tests Date 4/3/89  
Structure Cimarron Corporation Site Assessment Specification ASTM DG98 & ASTM STP-479  
Project Sample PP-1 Quantity See Below  
Station James L. Grant and Associates, Inc. Sampled by Client  
Location James L. Grant and Associates, Inc.  
Architect (Kerr McGee) by Order of Wyndal Goodman  
Engineer James Grant Date 4/25/89 Order Number \_\_\_\_\_

## TEST RESULTS

Laboratory Number G109Soil Sample: PP-1Standard Proctor Test:Percent Moisture

11.0  
13.1  
14.7  
13.1 Optimum

Dry Density, pcf

118.8  
119.7  
118.3  
119.7 Maximum

Permeability Results:Percent Moisture

13.4  
12.8  
14.3

Percent Compaction

80.8  
89.6  
96.1

Coefficient of Permeability k, cm/sec.

$1.02 \times 10^{-4}$   
 $1.18 \times 10^{-5}$   
 $3.0 \times 10^{-7}$

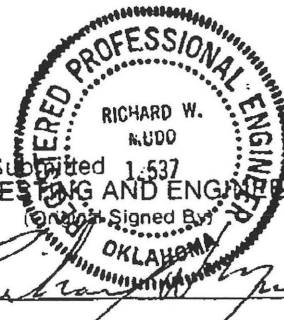
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Charge: Kerr McGeeOrig. & lcc To James Grantlcc To Kerr McGeelcc to Lab

Construction Materials, Testing & Inspections  
Fabrications Weldment & Erection Inspections  
Geo-technical Investigations  
Chemical & Bacteriological Analysis

"TEST FOR ASSURANCE"

Respectfully Submitted 1-537  
STANDARD TESTING AND ENGINEERING CO.

By Richard W. Mudd, P.E.





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REPORT Permeability Tests Date 4/3/89  
Structure Cimarron Corporation Site Assessment Specification ASTM DG98 & ASTM STP 479  
Project Sample PP-2 Quantity See Below  
Station Sample PP-2 Represented See Below  
Architect James L. Grant and Associates, Inc. Sampled by Client  
Engineer James L. Grant and Associates, Inc. by Order of Wyndal Goodman  
Contractor (Kerr McGee) Reported To James Grant Date 4/25/89 Order Number \_\_\_\_\_

## TEST RESULTS

Laboratory Number G109Soil Sample: PP-2Standard Proctor Test:

<u>Percent Moisture</u>	<u>Dry Density, pcf</u>
11.9	119.4
13.7	120.2
15.9	116.0
13.0 Optimum	120.5 Maximum

Permeability Results:

<u>Percent Moisture</u>	<u>Percent Compaction</u>	<u>Coefficient of Permeability,</u> <u>k, cm/sec</u>
15.3	77.9	$1.98 \times 10^{-5}$
14.7	88.2	$2.99 \times 10^{-6}$
14.6	97.4	$3.08 \times 10^{-8}$

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REPORT Permeability Date 4/3/89  
Structure Cimarron Corporation Site Assessment Specification ASTM DG98 & ASTM STP 479  
Project Sample PB. 3 Quantity See Below  
Station James L. Grant and Associates, Inc. Represented Client  
Location James L. Grant and Associates, Inc. Sampled by Client  
Architect James L. Grant and Associates, Inc. by Order of Wyndal Goodman  
Engineer James L. Grant and Associates, Inc.  
Contractor (Kerr McGee)  
Reported To James Grant Date 4/25/89 Order Number \_\_\_\_\_

## TEST RESULTS

Laboratory Number G109

Soil Sample: PP-3  
Standard Proctor Test:

Percent Mixture	Dry Density, pcf
12.7	116.4
14.2	117.8
15.8	116.1
14.0 Optimum	117.8 Maximum

## Permeability Results:

Percent Moisture	Percent Compaction:	Coefficient of Permeability, k, cm/sec.
16.9	77.1	$1.38 \times 10^{-4}$
15.5	87.7	$1.60 \times 10^{-5}$
16.0	97.1	$2.48 \times 10^{-8}$

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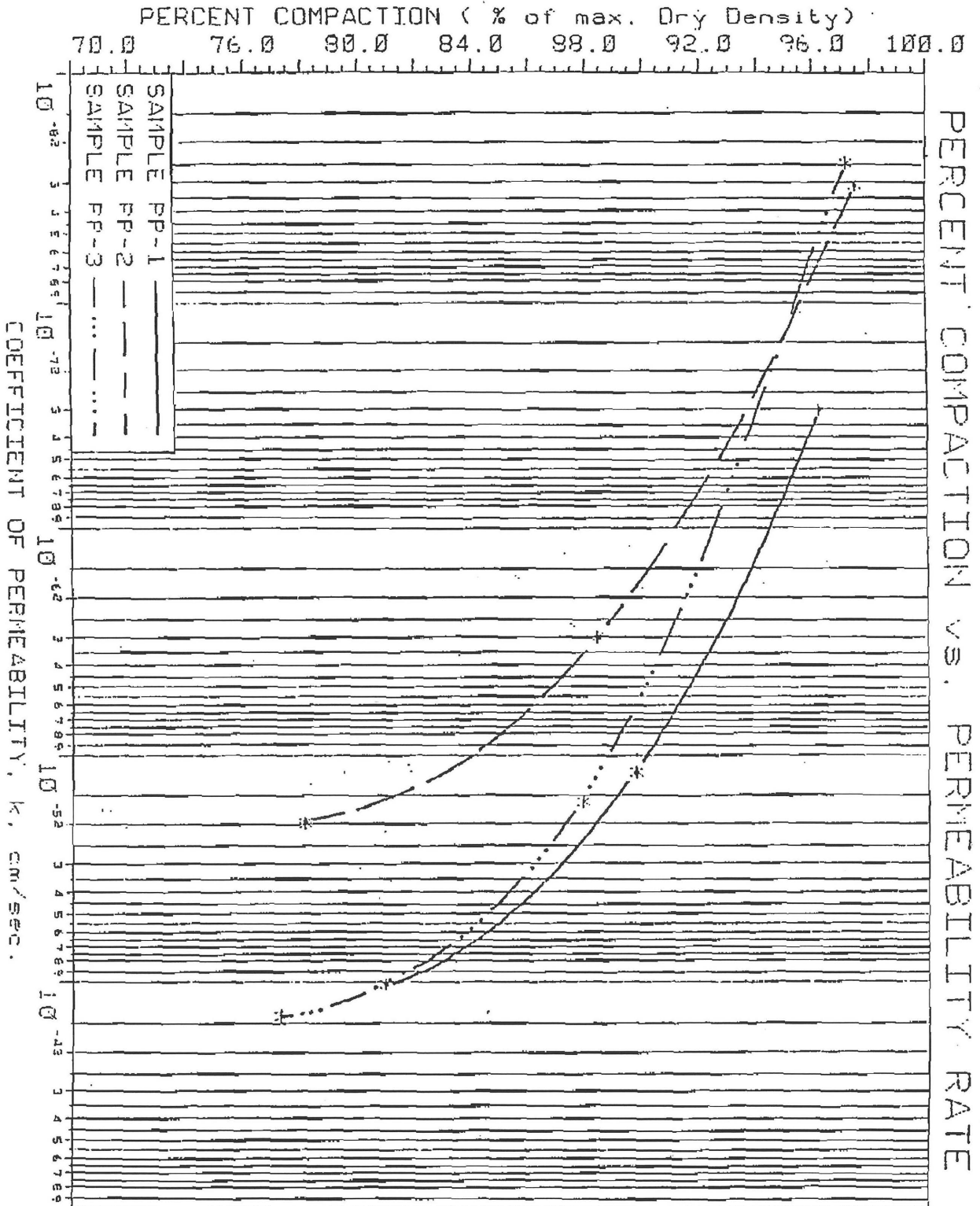


By Richard W. Mudd, P.E.

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2KE22  
KE22

REPORT SOIL CLASSIFICATION Date 4-3-89  
Structure Cimarron Corporation Site Assessment Specification AASHTO M-145  
Project Crescent, Okla. - See Below Quantity Represented  
Station James L. Grant & Associates Sampled by Client  
Location Kerr McGee by Order of Wyndal Goodman  
Architect Kerr McGee Date 4-25-89 Order Number   
Engineer

## TEST RESULTS

Page 1 of 2 Pages

Laboratory Number	5885	5886	5887	5888	5889
Field Number	PP-1	PP-2	PP-3	PP-4	PP-5
% Passing #10 Sieve	93.8	98.3	97.3	100.0	100.0
" " #40 "	90.0	95.4	93.5	94.8	95.6
" " #200 "	70.5	73.3	72.9	62.8	87.7
Liquid Limit	24	23	23	26	34
Plasticity Index	10	9	8	8	9
AASHTO Classification	A-4(4)	A-4(3)	A-4(3)	A-4(3)	A-4(8)

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Charge: Kerr McGee  
Orig. & 1cc To James L. Grant  
1-cc Kerr McGee  
1-cc Laboratory



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STANDARD TESTING AND ENGINEERING CO.  
(Officially Signed By)

By Richard W. Mudd, P.E.

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2KE22  
KE22

REPORT SOIL CLASSIFICATION Date 4-3-89  
Structure Cimarron Corporation Site Assessment Specification AASHTO M-145  
Project Crescent, Okla. (See Below) Quantity  
Station James L. Grant & Associates Represented  
Location Client  
Architect Kerr McGee Sampled by Wyndal Goodman  
Engineer Kerr McGee by Order of Wyndal Goodman  
Contractor Kerr McGee Date 4-25-89 Order Number   
Reported To Kerr McGee

**TEST RESULTS**

Page 2 of 2 Pages

Laboratory Number	5890	5891	5892	5893
Field Number	PP-6	PP-7	PP-8	PP-9
% Passing #10 Sieve	100.0	100.0	100.0	100.0
" #40 "	99.9	99.2	99.9	98.5
" #200 "	39.2	89.2	94.6	94.1
Liquid Limit	NP	NP	25	36
Plasticity Index	NP	NP	8	13
AASHTO Classification	A-4(0)	A-4(0)	A-4(6)	A-6(13)

(PP-10)

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Orig. & 1cc To J. Grant  
1-cc Kerr McGee  
cc Laboratory



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STANDARD TESTING AND ENGINEERING CO.  
(Original Signed By)

By Richard W. Mudd, P.E.

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2KE22  
KE22

MAY 5 1989

REPORT SOIL CLASSIFICATION Date 4-28-89  
Structure Cimarron Corporation Site Assessment Specification AASHTO M-145  
Project Crescent, Oklahoma Quantity Represented  
Station James L. Grant & Associates Sampled by Client  
Location Kerr McGee by Order of Wyndal Goodman  
Architect James L. Grant Date 5-1-89 Order Number   
Engineer

## TEST RESULTS

Laboratory Number 5894

pp#10

SIEVES	% PASSING
#4	100.0
#10	95.9
#20	71.8
#200	44.7
Liquid Limit	NP
Plasticity Index	NP
AASHTO Classification	A-4(0)

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1cc Laboratory



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(Original Signed By)

By Thomas J. Kelly, P.E.

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**APPENDIX G**  
**SOIL AND ROCK MINERALOGICAL ANALYSES**

808211: 9-12-89

## GEOLOGIC DESCRIPTION

CH-1 Red (2.5YR 4/8) clay-silt mudstone, with greenish-white clasts and/or bioturbations. Moderately fissiled, fine visible mica grains.

CH-2 Light gray (10YR 7/2) clay-silt mudstone, interlayered with a few thin red layers, moderate fissility, with some low angle cross bedding

CH-5 Dark reddish brown (2.5YR 3/4) weakly consolidated sand cemented with iron oxides and calcite.

CH-6 Massive red (10R 4/6) mudstone, poor fissility, some evidence of bioturbation with light greenish gray silty material in burrows.

CH-8 Red (10R 4/8) with orange-white mottles poorly cemented mudstone, poorly layered. Visible quartz grains are well rounded.

CH-9 Massive red (2.5YR 4/6) sandy mudstone, mottled with light greenish gray. Gray material is up to 3/8 in. long, includes moderately cemented bedded quartz sand.

CH-12 Light gray (2.5Y 7/2) very fine sand - silt mudstone, poorly cemented with no layering. Includes clay clasts

CH-14 Light olive gray (5Y 6/2) and pinkish gray (10YR 7/2) conglomerate of soft sediment clasts, some layering, calcite in isolated grains.

CH-15 Red (10R 4/8) very fine sand and silt mudstone, massive, moderately consolidated. Few isolated calcite and quartz clusters. Some evidence of slickensides or pressure faces.



Table 1. Grain size distribution  
Less than 2mm fraction

Sample	Size Distribution		
	Sand	Silt	Clay
	-----%		
CH-1	0.70	78.74	20.56
CH-2	15.50	64.94	19.56
CH-3	57.70	27.82	14.48
CH-4	18.70	47.22	34.08
CH-5	82.40	10.48	7.12
CH-6	2.50	58.18	39.32
CH-7	39.60	45.56	14.84
CH-8	80.00	13.08	6.92
CH-9	37.50	39.66	22.84
CH-10	74.20	16.12	9.68
CH-11	56.40	25.56	18.04
CH-12	47.00	43.44	9.56
CH-13	25.50	55.34	19.16
CH-14	59.20	24.16	16.64
CH-15	21.90	51.94	26.16

Table 2. Sand-size distribution (percent of sand)

Sample	Sand Size Distribution (mm)				
	2-1	1-.5	.5-.25	.25-.1	.1-.05
	-----%				
CH-1	0.00	0.00	0.00	0.00	100.00
CH-2	5.88	8.50	7.84	14.38	63.40
CH-3	0.00	0.17	0.17	29.34	70.31
CH-4	6.95	14.97	12.83	19.25	45.99
CH-5	28.68	15.31	15.07	32.81	8.14
CH-6	20.83	12.50	4.17	41.67	20.83
CH-7	2.78	2.28	1.01	2.78	91.14
CH-8	3.51	5.89	6.14	68.30	16.17
CH-9	3.73	6.40	6.67	31.47	51.73
CH-10	0.14	0.27	3.51	78.38	17.70
CH-11	7.09	14.01	16.31	39.72	22.87
CH-12	2.77	2.13	5.74	15.11	74.26
CH-13	1.19	2.37	1.98	13.04	81.42
CH-14	20.88	21.90	18.00	19.52	19.69
CH-15	5.02	4.11	3.65	14.16	73.06

Table 3. Exchangeable cations, pH and Cation Exchange Capacity

Sample	Exchangeable Cations				CEC	pH
	Ca	Mg	K	Na		
-----meq/100g-----						
CH-1	6.96	3.29	0.32	0.30	10.83	8.43
CH-2	17.25	2.78	0.23	0.28	7.96	8.72
CH-3	5.01	1.61	0.16	0.11	7.71	6.87
CH-4	27.37	6.62	0.47	0.30	18.56	8.53
CH-5	18.84	1.14	0.08	0.21	2.55	9.18
CH-6	26.26	5.97	0.48	0.35	22.75	8.18
CH-7	8.35	1.62	0.11	0.33	4.59	7.91
CH-8	10.93	1.43	0.07	0.33	3.37	8.30
CH-9	21.14	2.94	0.25	0.21	9.93	8.76
CH-10	10.50	1.36	0.10	0.17	2.96	5.99
CH-11	17.82	5.71	0.22	0.29	6.00	8.86
CH-12	9.29	4.03	0.50	0.27	6.20	8.69
CH-13	20.24	4.95	0.34	0.47	8.02	8.89
CH-14	17.71	4.20	0.50	0.21	6.87	8.95
CH-15	12.35	5.18	0.58	0.15	11.32	8.62

Table 4. Mineralogical Composition of Whole Soils

Sample	Kaolin	Fe-Oxyhy	2:1 Exp * & Mica	Feldspars	Calcite	Quartz	Ads.H2O
-----%-----							
CH-1	15) <i>fr</i>	4	12	17	<1	48	1.63
CH-2	12	2	8	17	<1	56	2.25
CH-5	1) <i>fr</i>	3	3	5	29	58	0.50
CH-6	27) <i>fr</i>	8	23	27	<1	12	3.63
CH-8	1) <i>fr</i>	<1	3	3	1	90	0.38
CH-9	8	3	10	14	3	59	1.63
CH-12	7) <i>fr</i>	1	6	9	3	72	1.00
CH-14	7	1	7	11	12	59	1.25
CH-15	10) <i>fr</i>	4	11	17	3	52	1.88

\* 2:1 Exp Expanding layer silicates

Feldspars and mica are given as mica equivalent (10% K<sub>2</sub>O = 100%)

# ELEMENTAL COMPOSITION (OXIDES)

Sample	CaO	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	K <sub>2</sub> O	MgO	SiO <sub>2</sub>	MnO
-----%							
CH-1	0.59	11.42	3.87	1.70	1.12	66.84	0.04
CH-2	0.45	10.90	1.73	1.72	1.14	74.92	0.01
CH-5	22.38	3.47	3.03	0.54	2.67	62.50	0.22
CH-6	1.69	18.26	7.52	2.66	2.67	51.57	0.07
CH-8	1.06	1.42	0.46	0.28	0.13	93.51	0.00
CH-9	2.91	8.50	3.49	1.38	1.23	75.86	0.05
CH-12	2.16	6.47	0.78	0.94	1.14	83.41	0.03
CH-14	7.11	6.44	1.23	1.13	3.28	72.36	0.09
CH-15	2.11	10.05	4.44	1.72	1.49	72.03	0.04

Jones Grant Samples

Material Description of Air-Dried Samples

- CH-1 Strongly cemented, fine-grained, massive soil material
- CH-2 Light gray, moderately to strongly cemented, fine-grained soil material
- CH-3 Unconsolidated fine-grained soil material
- CH-4 Weakly consolidated fines in thin platy layers soil material
- CH-5 Moderately consolidated, calcareous, sandstone coarse-grained soil material
- CH-6 Weakly consolidated fines in thin platy layers soil material
- CH-7 Moderately consolidated, fine-grained, massive soil material
- CH-8 Weakly cemented sandstone with some fines soil material
- CH-9 Unconsolidated sand and clay with about 5% small fragments less than one inch in diameter
- CH-10 Unconsolidated loose sand and fines
- CH-11 Unconsolidated loose sand and fines, very f?
- CH-12 Light gray, weakly cemented to unconsolidated fine-grained soil material, few very hard rock fragments and gravels.
- CH-13 Weakly cemented to unconsolidated sand and clay
- CH-14 Light gray, weakly to moderately consolidated, fine-grained soil material
- CH-15 Moderately consolidated, fine-grained, massive soil material

## Determination of soil water retention curves

Soil water retention curves (Table 1) were determined following standard procedures as outlined by Klute (Klute, A. 1986. Water Retention: Laboratory Methods. In A. Klute (ed.) Methods of Soil Analysis. Part 1. 2nd ed. Agronomy 9:635-662). Tempe pressure cells were used for soil water pressure head values ranging from 0 to -300 cm of water, while a pressure cooker was used in the range from -1,000 to -4,000 cm of water.

The soil samples were first air dried, passed through a 2-mm sieve, and then packed into cylinders to bulk density values similar to those determined on two undisturbed clods (Blake G.R. and K.H. Hartge. 1986. Bulk density. In A. Klute (ed.) Methods of Soil Analysis. Part 1. 2nd ed. Agronomy 9:371-373).

The reported bulk density values (Table 2) were calculated from the final amount of oven dry soil packed into each cylinder. The corresponding porosity values (Table 2) are based on these bulk density values and an assumed particle density of  $2.65 \text{ g/cm}^3$ .

Table 1. Volumetric water content as a function of soil water pressure head.

Soil water pressure head	Volumetric water content $\text{cm}^3/\text{cm}^3$			
cm of water	Sample			
	CH-16	CH-17	CH-18	CH-19
0	0.327	0.332	0.331	0.320
-10	0.327	0.332	0.331	0.320
-20	0.327	0.332	0.331	0.320
-40	0.327	0.332	0.331	0.320
-80	0.327	0.332	0.331	0.305
-100	0.316	0.332	0.331	0.273
-150	0.274	0.332	0.331	0.248
-300	0.239	0.305	0.282	0.214
-1,000	0.207	0.254	0.233	0.180
-4,000	0.177	0.206	0.200	0.147

Table 2. Bulk density and porosity.

Sample	Bulk density $\text{g}/\text{cm}^3$	Porosity $\text{cm}^3/\text{cm}^3$
CH-16	1.78	0.328
CH-17	1.78	0.328
CH-18	1.76	0.336
CH-19	1.79	0.325

# Classification for $K_d$ Analysis

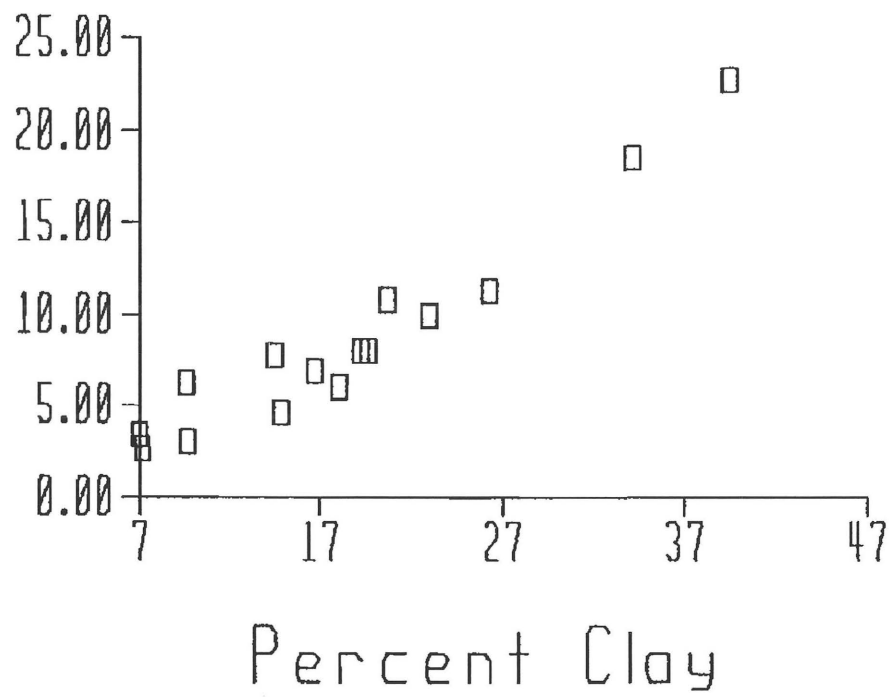
Color	Red Soil Material	Calcite	Clay	Typical $K_d$ Analysis	Comp
	CH-1		X	X	A
	CH-3				E
	CH-4		XX		D
	CH-5	XX		X	B
	CH-6		XX	X	D
	CH-7				E
	CH-8			X	E
	CH-9	X	X		F
	CH-10				E
	CH-11		X		A
	CH-13		X		A
	CH-15	X	X		F
	Gray Soil Material				
	CH-2		X	X	G
	CH-12	X			C
	CH-14	XX		X	C

%Calcite \_<3, X 3, XX>3

%Clay \_ < 18, X 18-30, XX >30%

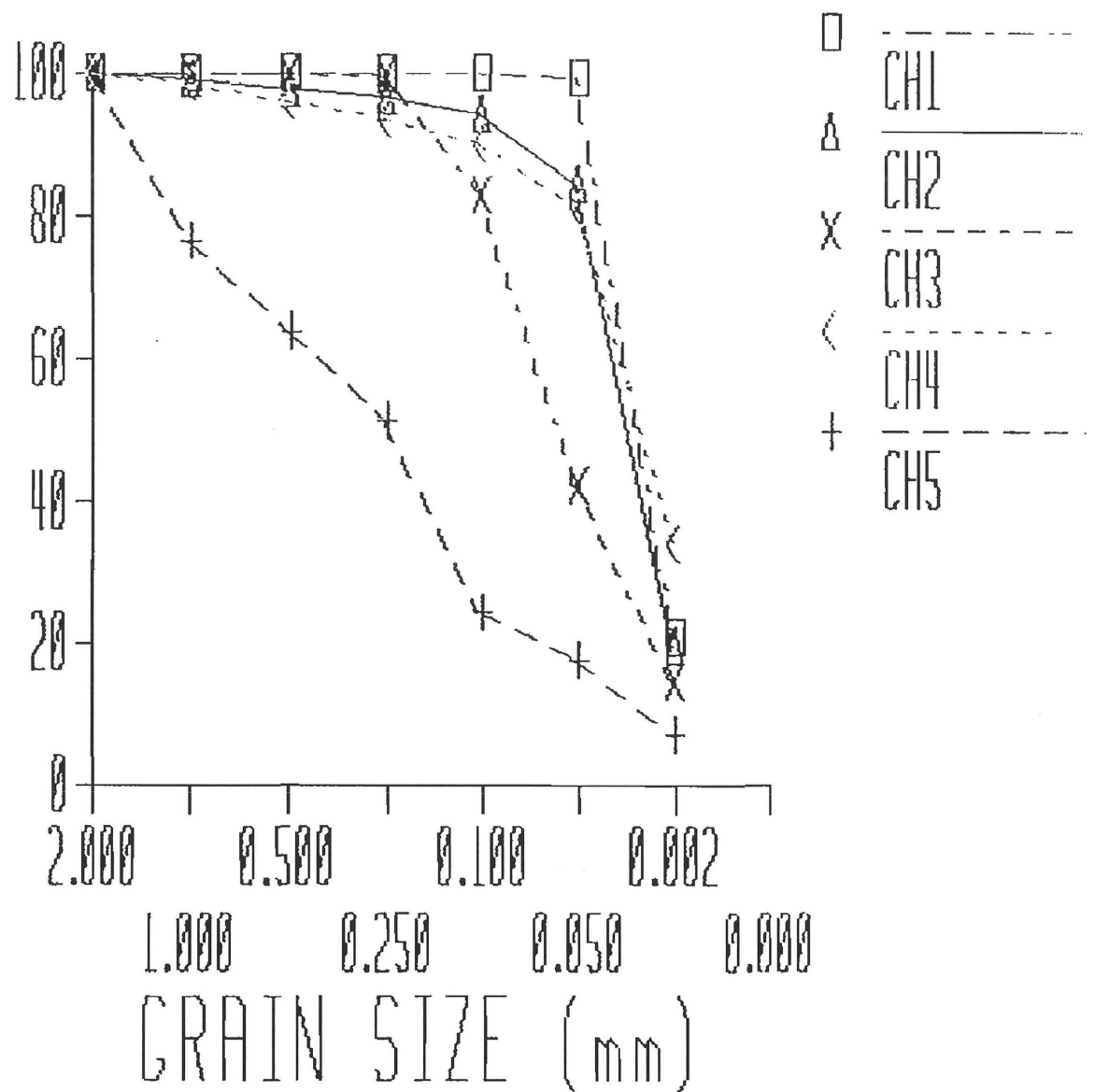


# CEC as a fct of Clay



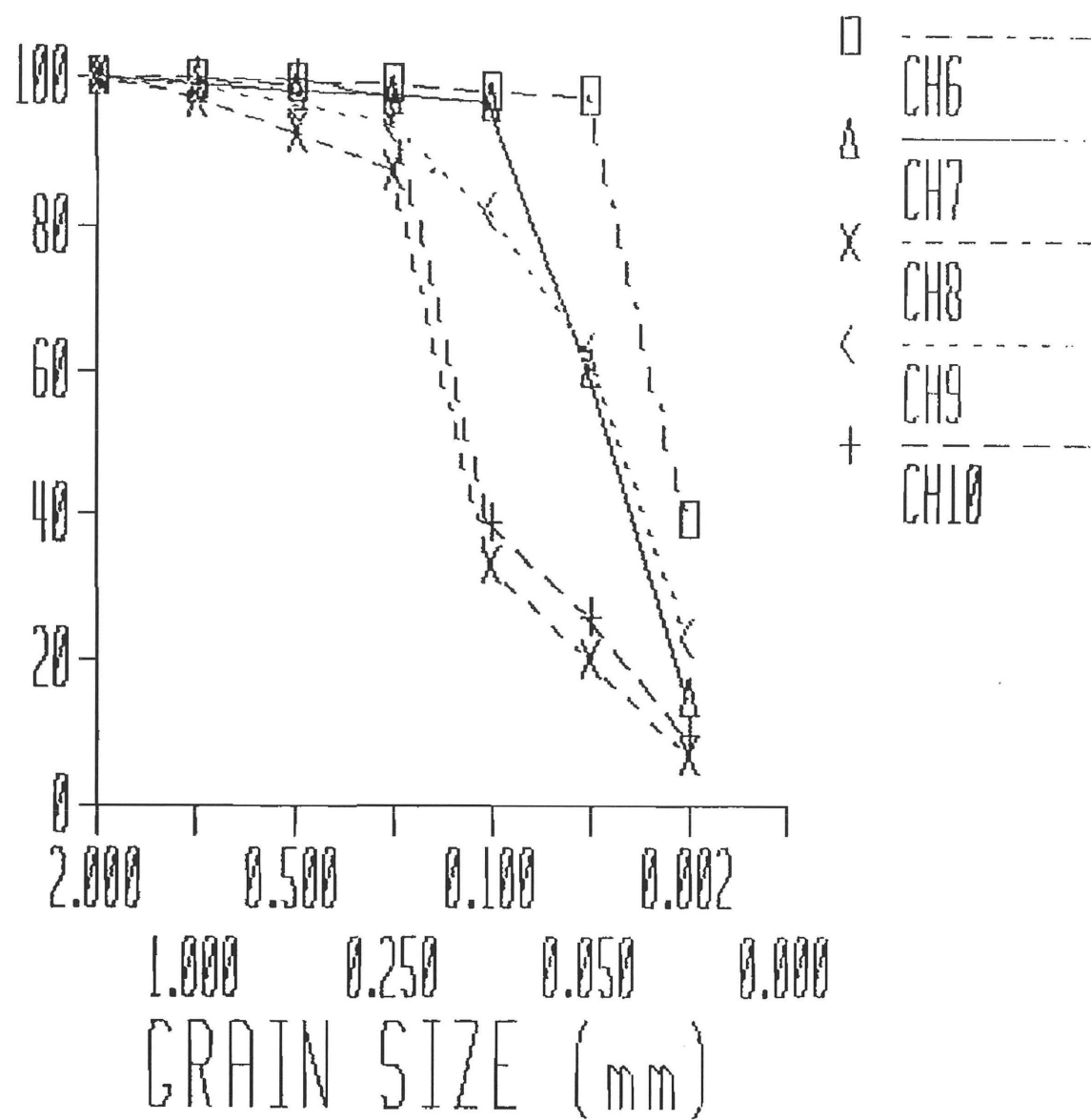
# GRAIN SIZE DISTRIBUTION

PERCENT PASSING

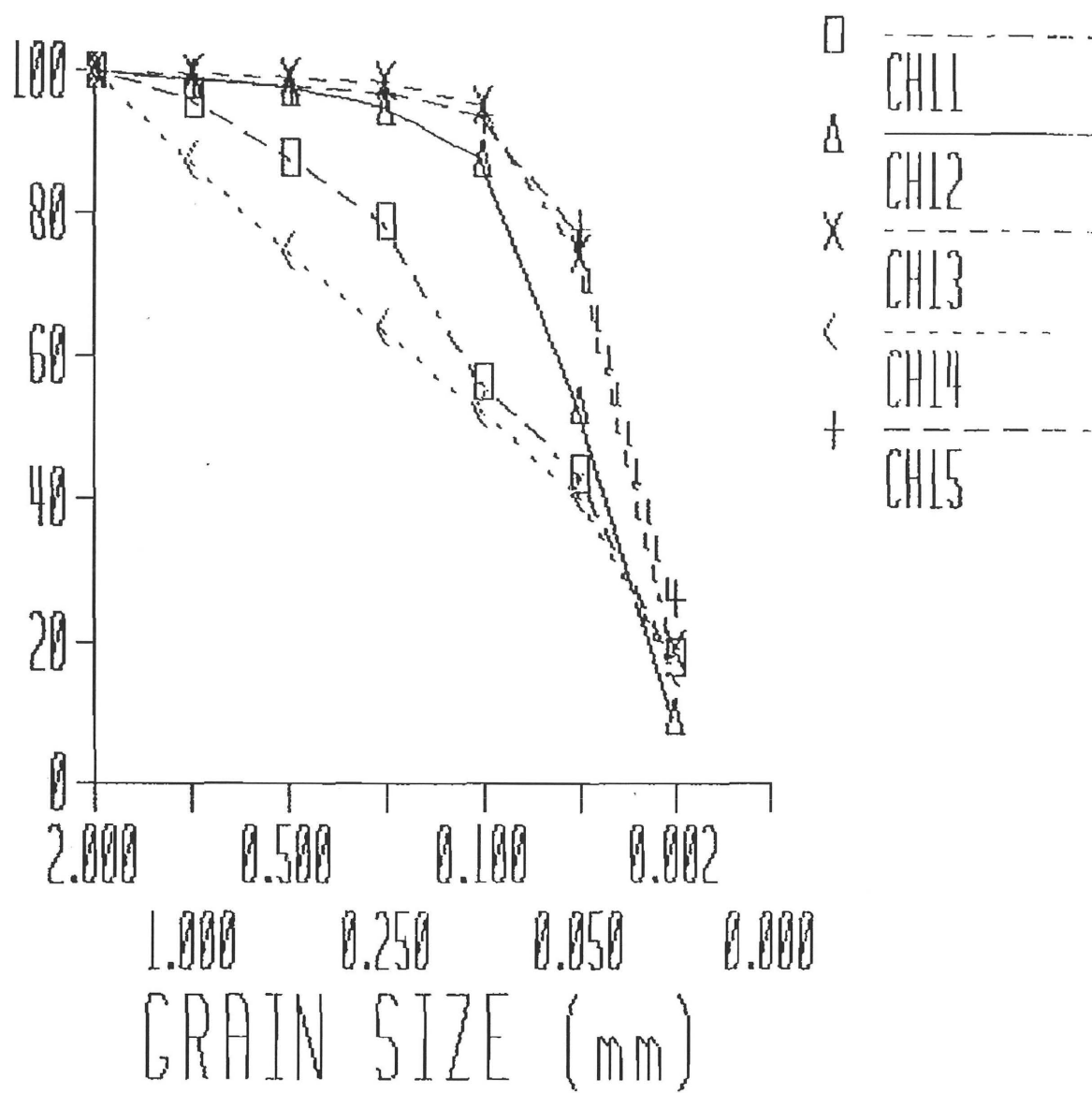


# GRAIN SIZE DISTRIBUTION

UNSATURATED



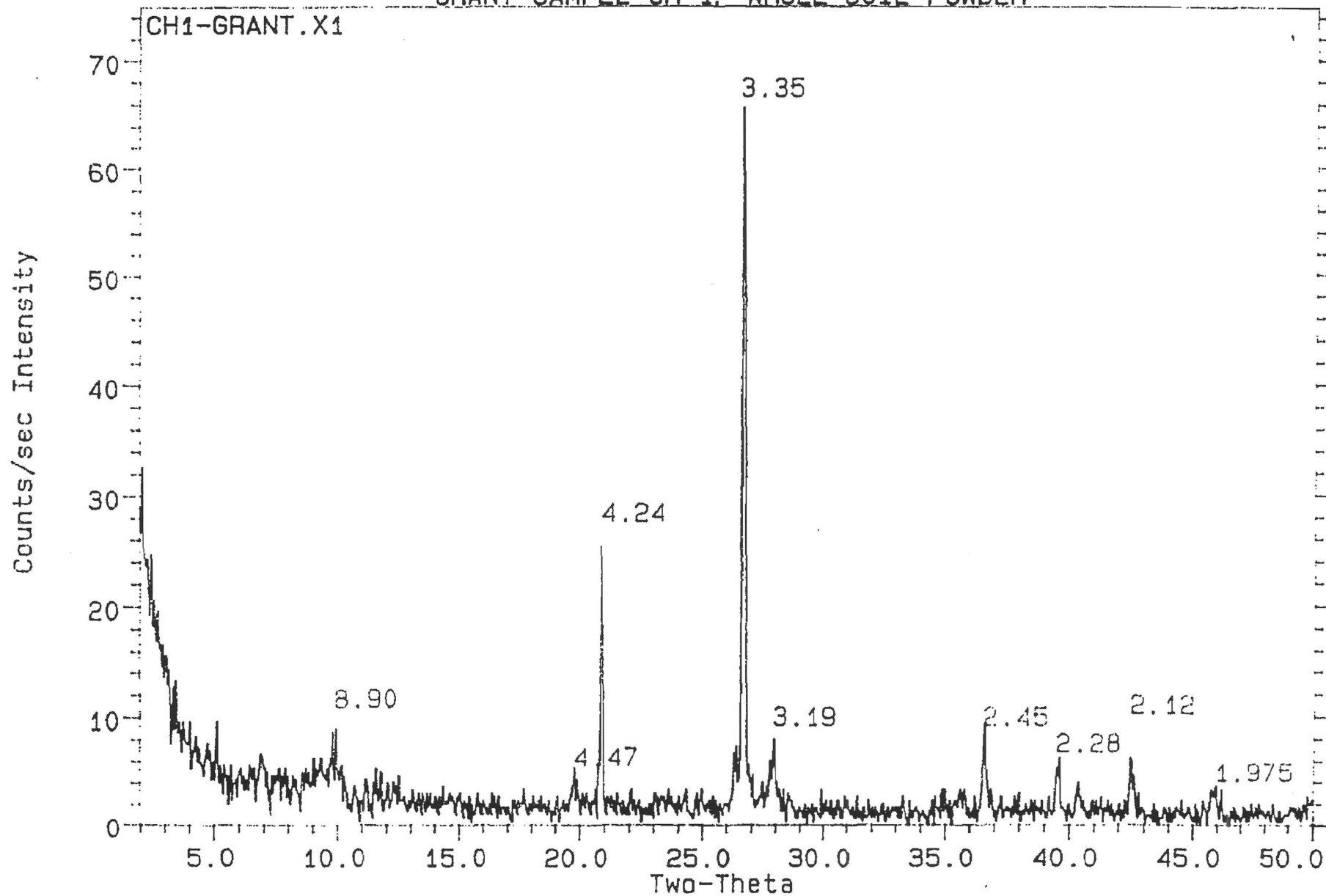
## GRAIN SIZE DISTRIBUTION



Siemens Analytical X-Ray Instruments Inc.

2-MAY-89

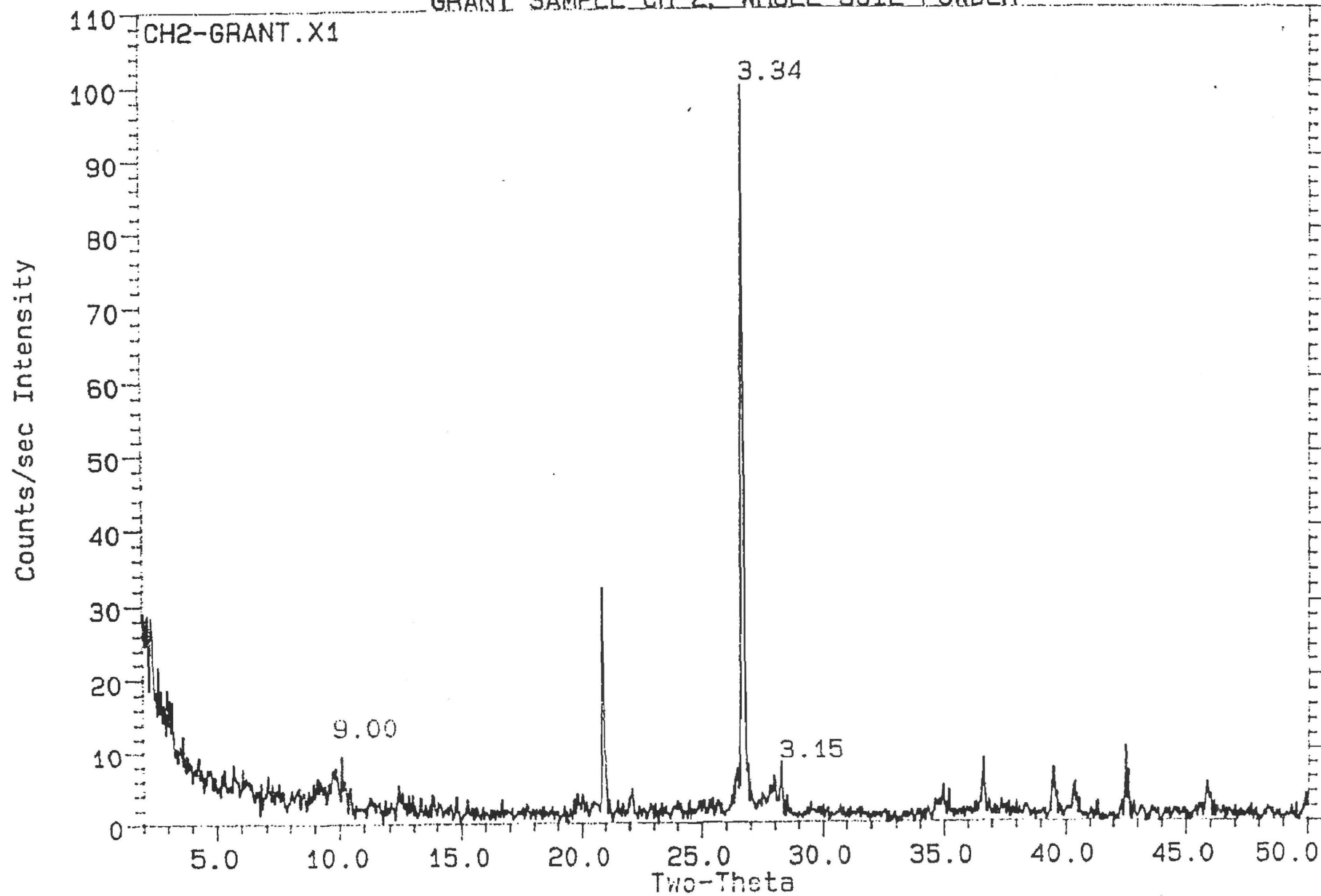
GRANT SAMPLE CH-1. WHOLE SOIL POWDER



Siemens Analytical X-Ray Instruments Inc.

2-MAY-89

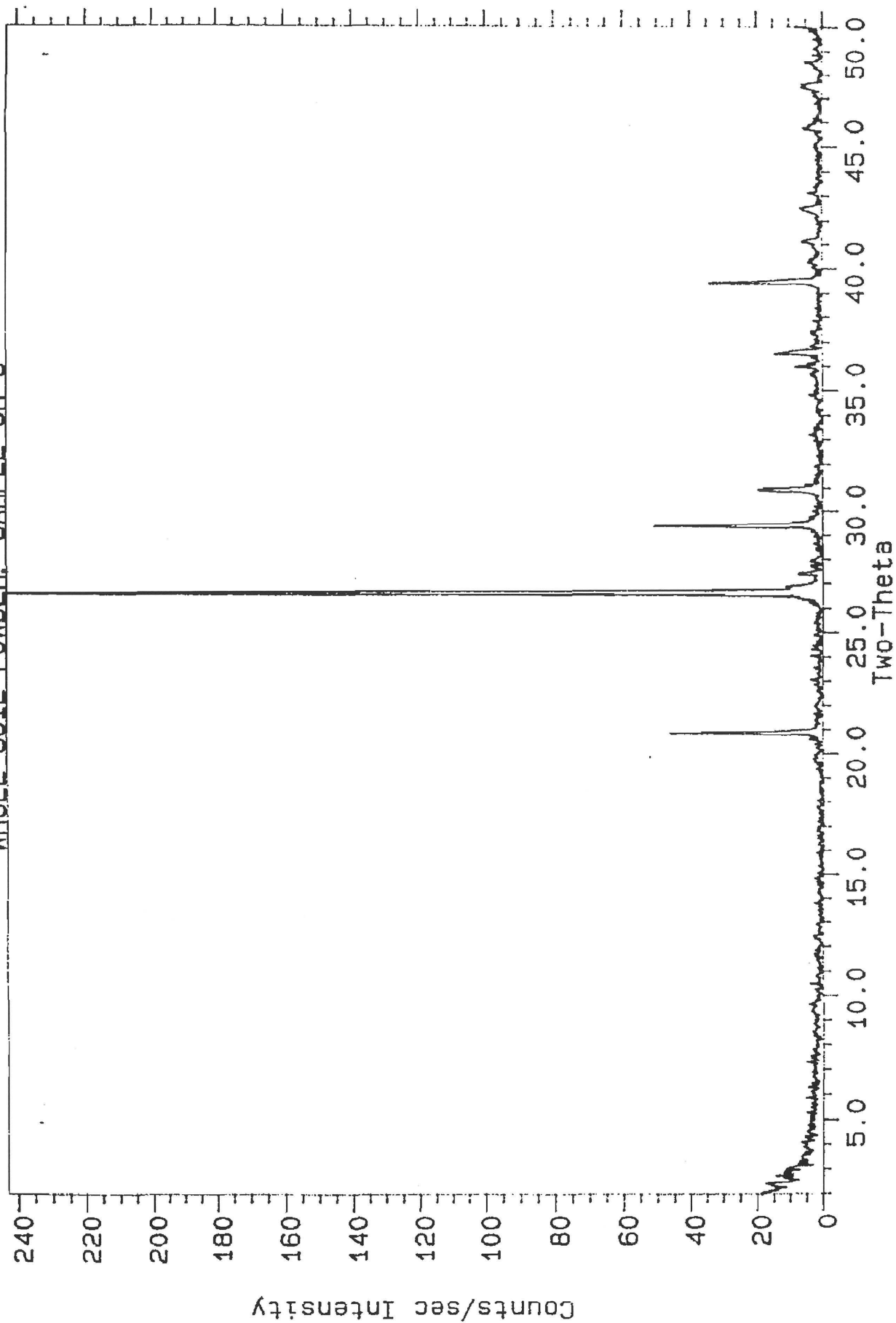
GRANT SAMPLE CH-2, WHOLE SOIL POWDER



Nicolet Instruments Corp.

18-APR-89

WHOLE SOIL POWDER, SAMPLE CH-5

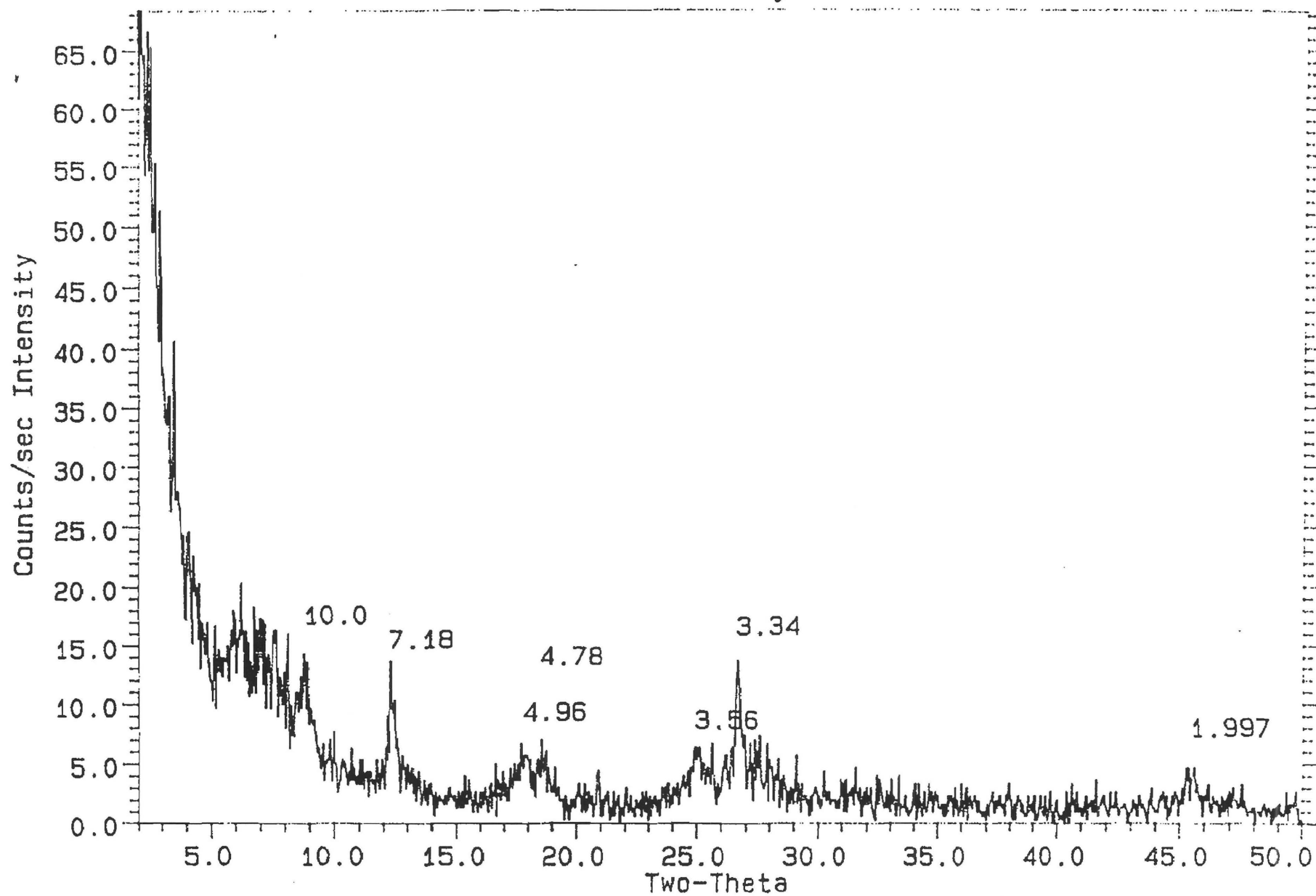


CH-6 ~ f

Siemens Analytical X-Ray Instruments Inc.

Day

5-MAY-89

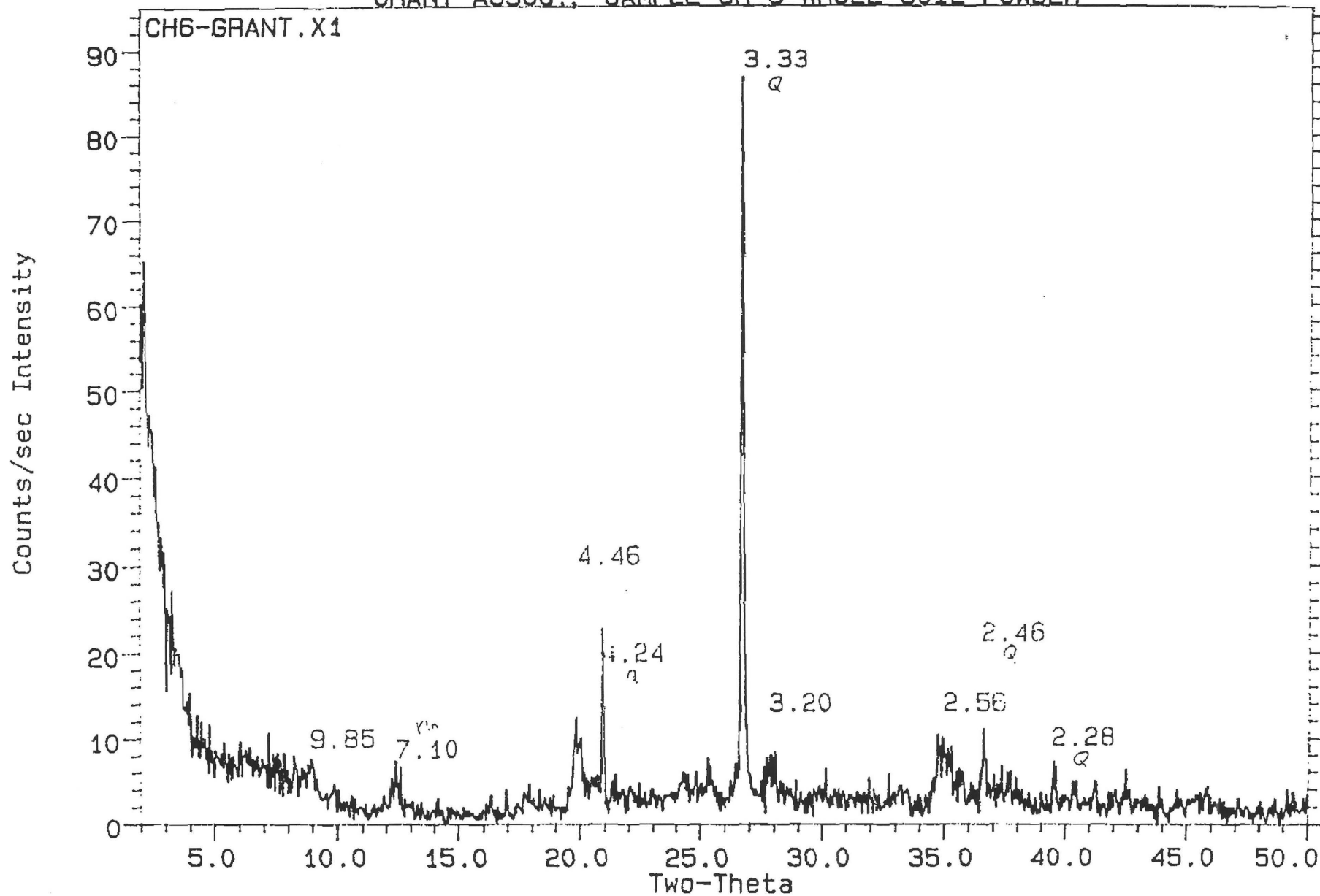




Nicolet Instruments Corp.

18-APR-89

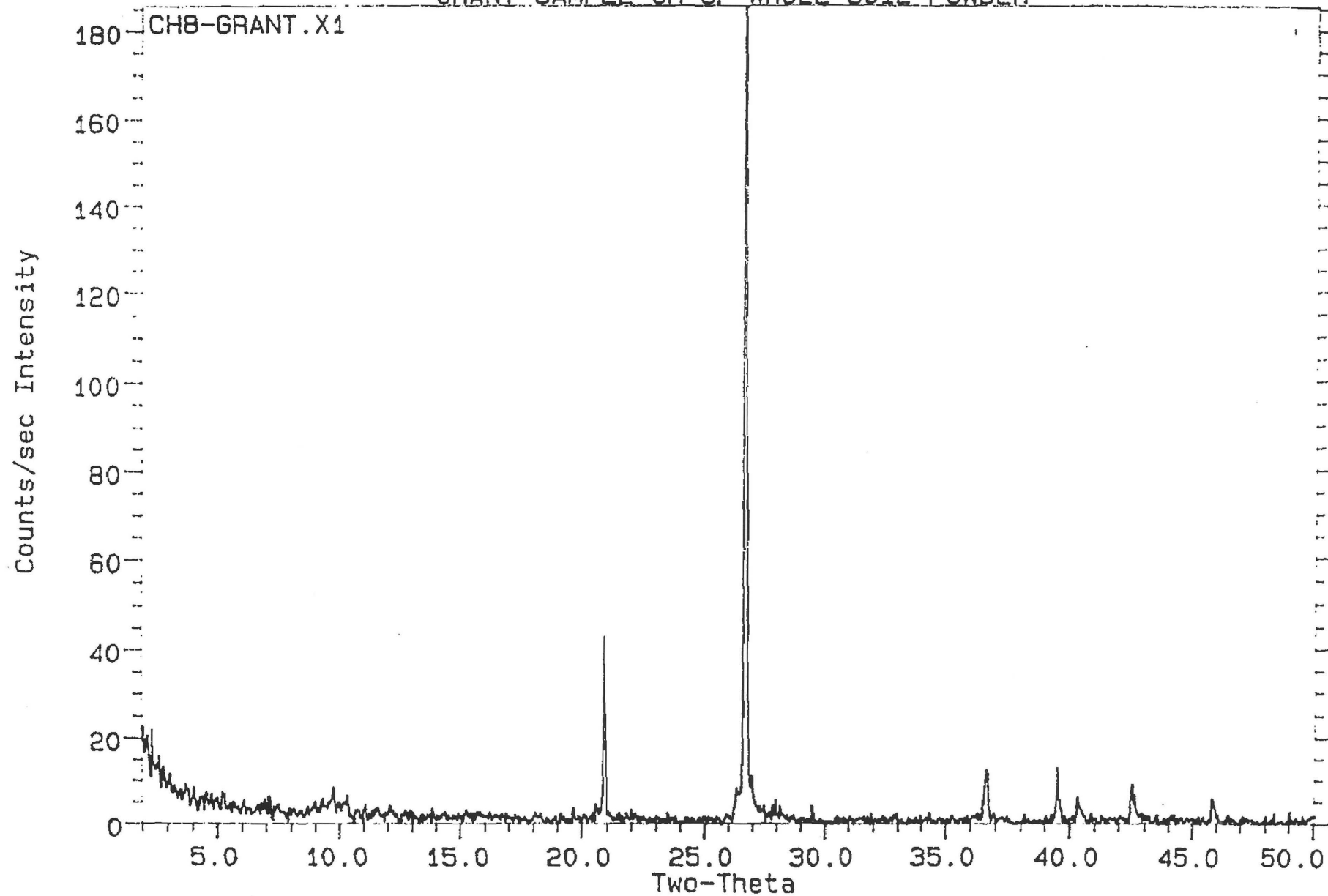
GRANT ASSOC., SAMPLE CH-6 WHOLE SOIL POWDER



Siemens Analytical X-Ray Instruments Inc.

2-MAY-89

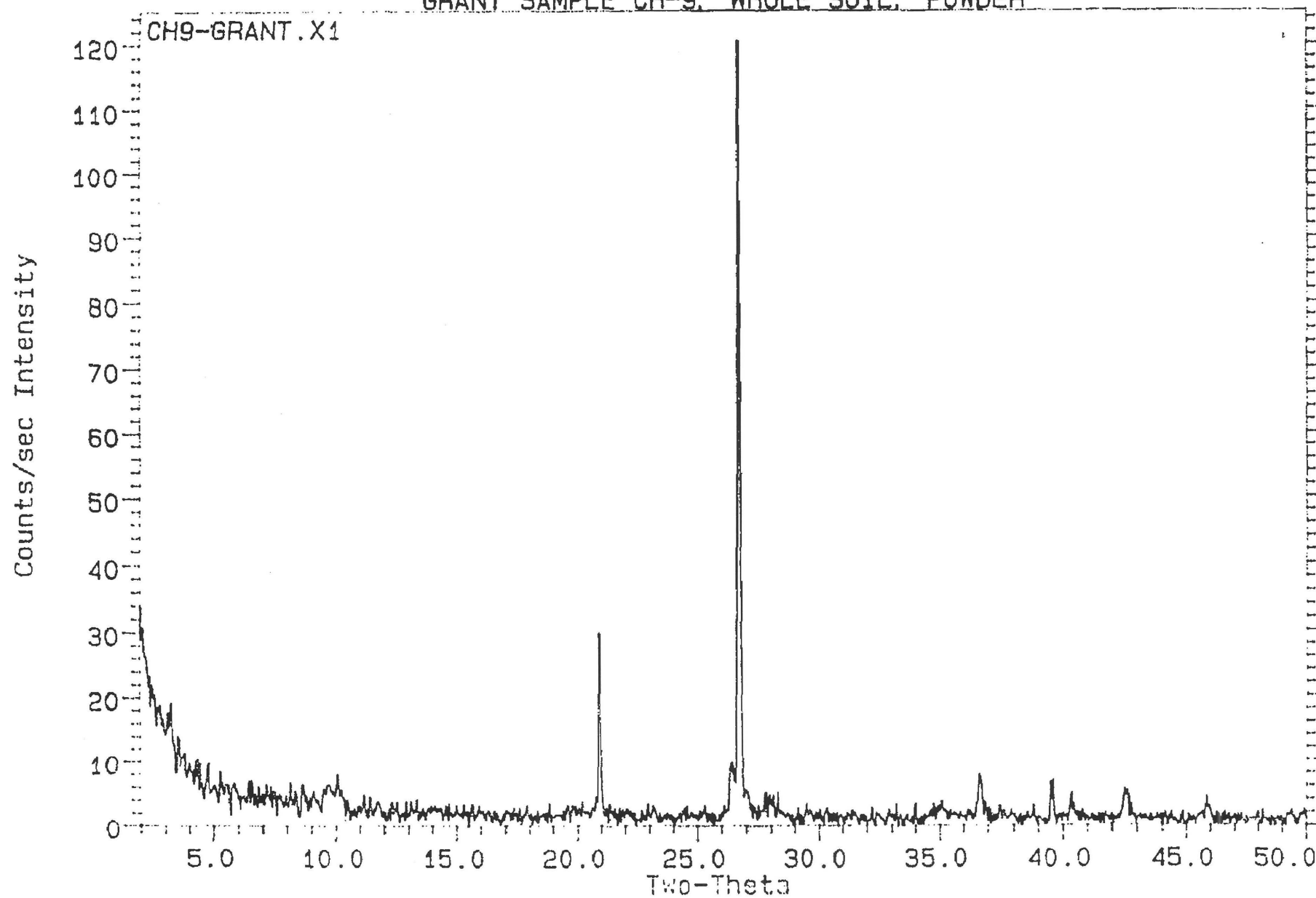
GRANT SAMPLE CH-8. WHOLE SOIL POWDER



Siemens Analytical X-Ray Instruments Inc.

2-MAY-89

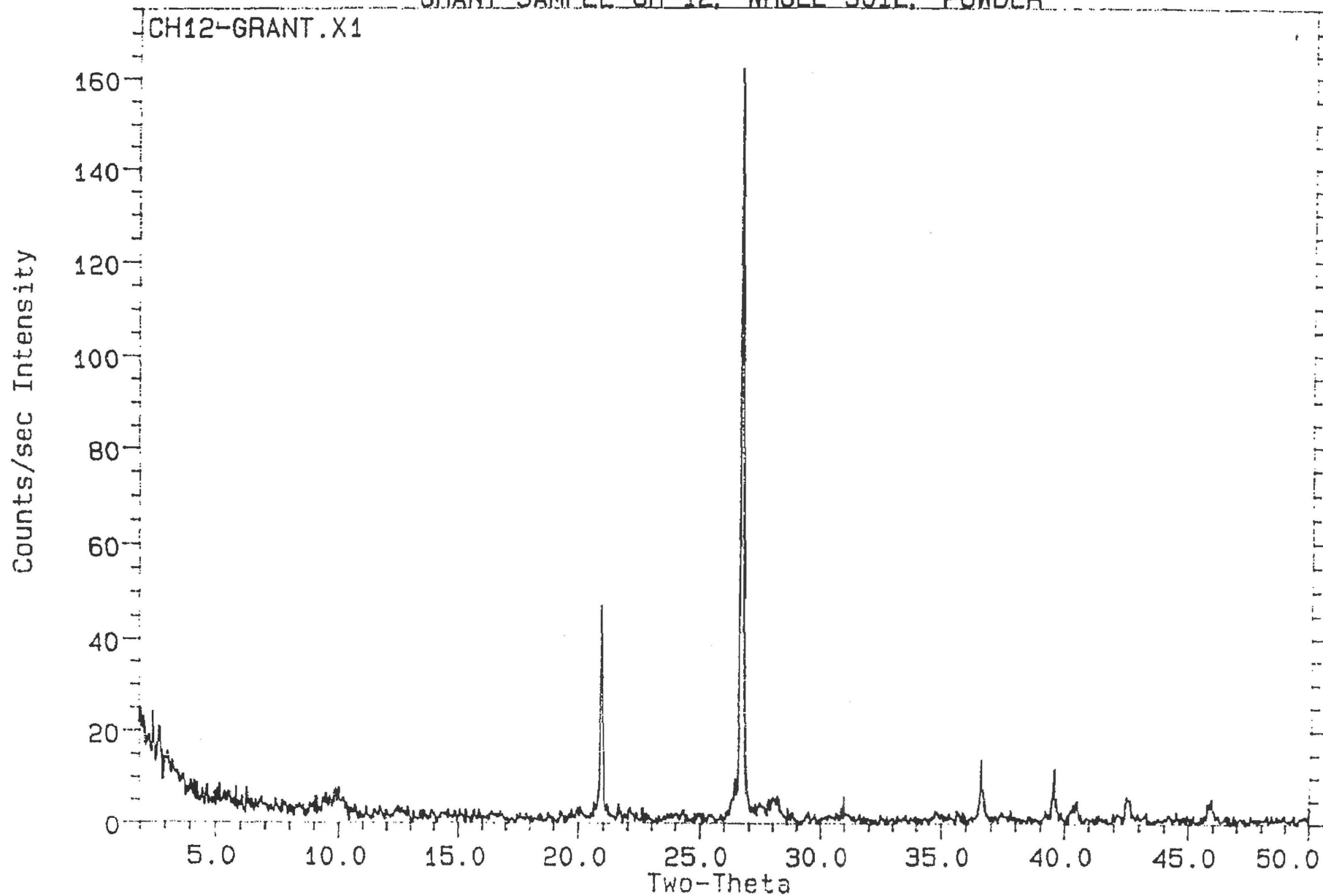
GRANT SAMPLE CH-9. WHOLE SOIL. POWDER



Siemens Analytical X-Ray Instruments Inc.

2-MAY-89

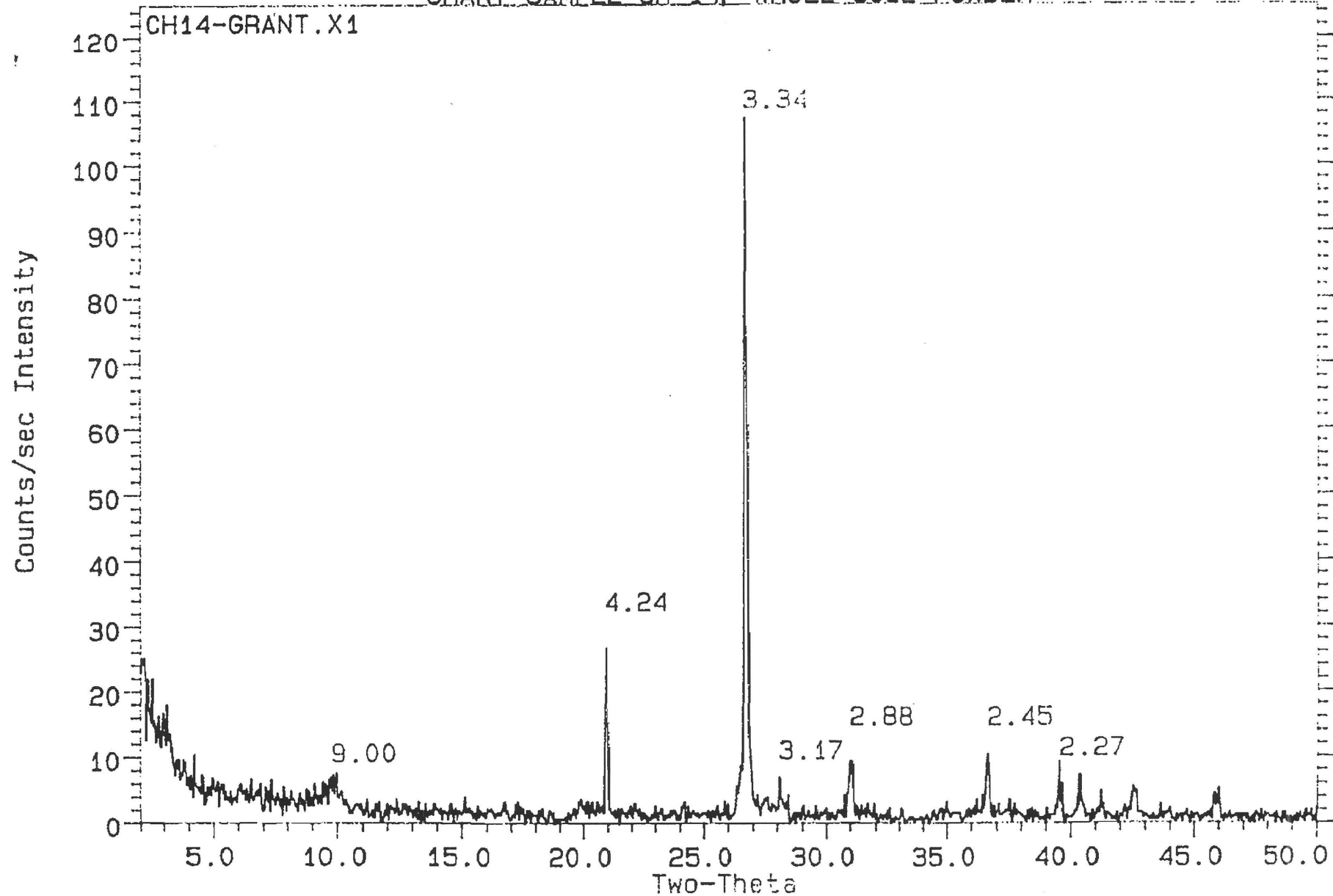
GRANT SAMPLE CH-12, WHOLE SOIL, POWDER



Siemens Analytical X-Ray Instruments Inc.

1-MAY-89

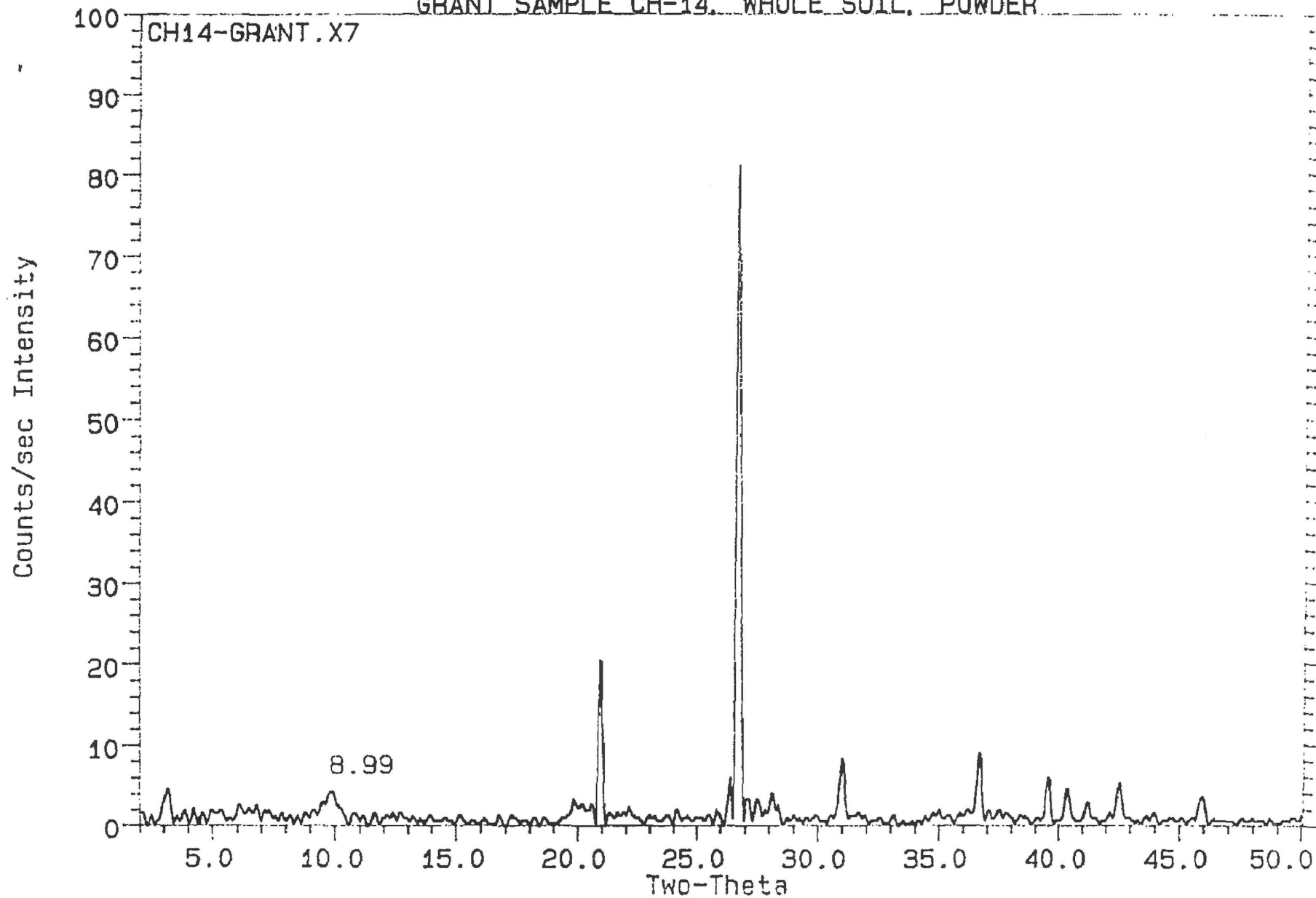
GRANT SAMPLE CH-14, WHOLE SOIL POWDER



Siemens Analytical X-Ray Instruments Inc.

1-MAY-89

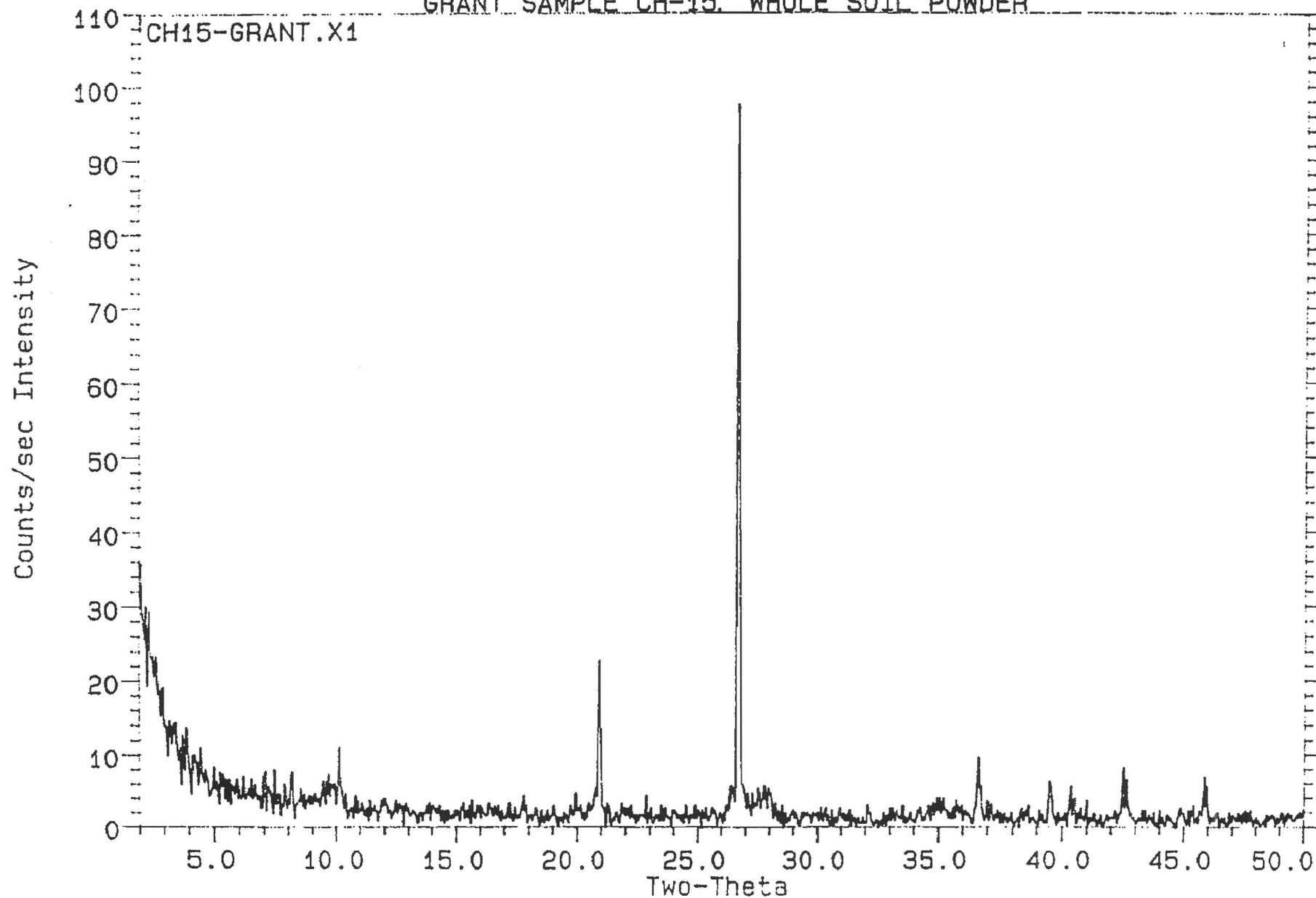
GRANT SAMPLE CH-14. WHOLE SOIL. POWDER



Siemens Analytical X-Ray Instruments Inc.

2-MAY-89

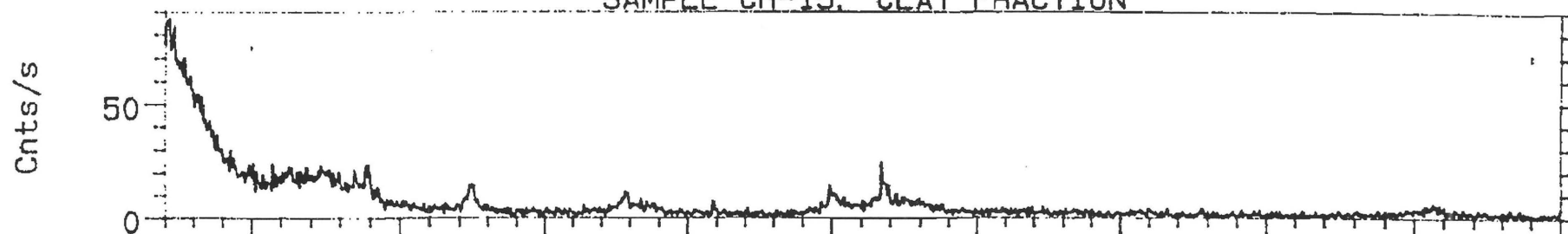
GRANT SAMPLE CH-15. WHOLE SOIL POWDER



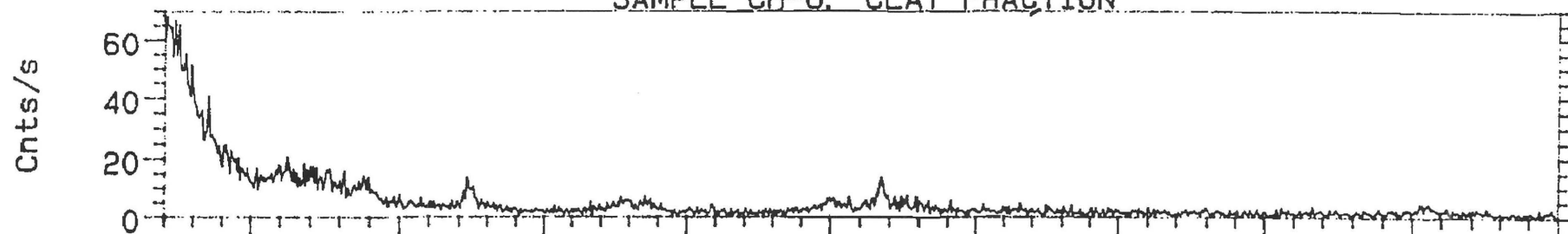
Siemens Analytical X-Ray Instruments Inc.

6-MAY-89

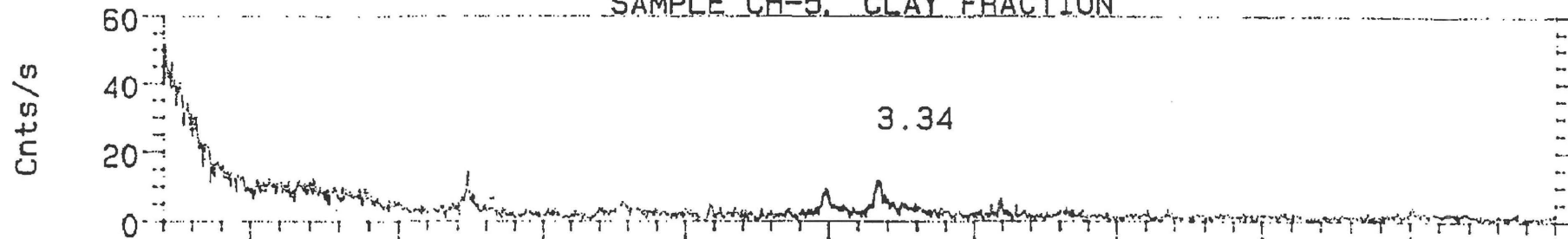
SAMPLE CH-15. CLAY FRACTION



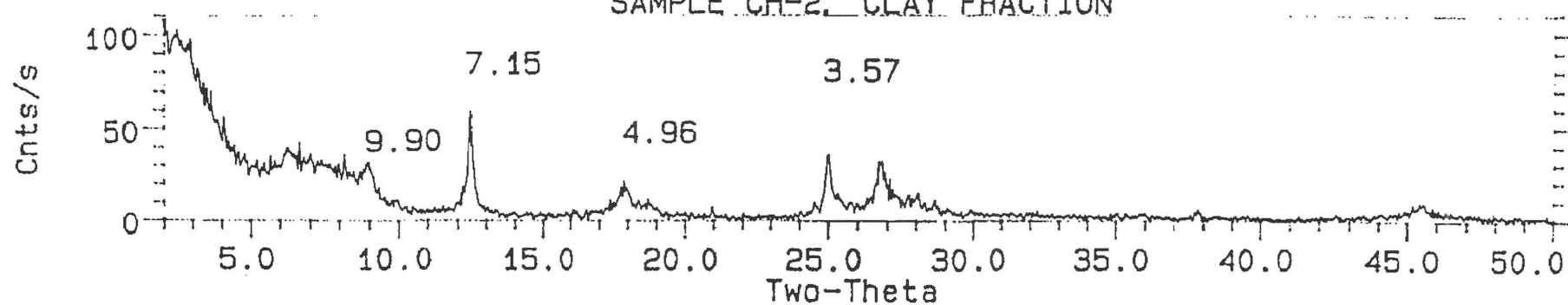
SAMPLE CH-6. CLAY FRACTION



SAMPLE CH-5. CLAY FRACTION



SAMPLE CH-2. CLAY FRACTION





PART NO. 990090

RUN NO. DATE 4/10/89OPERATOR  
SAMPLE:CH-14ATM 0

FLOW RATE

## T-AXIS

SCALE, °C/in 100

PROG. RATE, °C/min

HEAT COOL ISO

SHIFT, in 0

## DTA-DSC

SCALE, °C/in

(mcal/sec)/in

WEIGHT, mg

REFERENCE

## TGA

SCALE, %/in 2.5SUPPRESSION, mg 10.3

WEIGHT, mg

TIME CONST., sec

dY, (mg/min)/in

## TMA

SCALE, mils/in

MODE

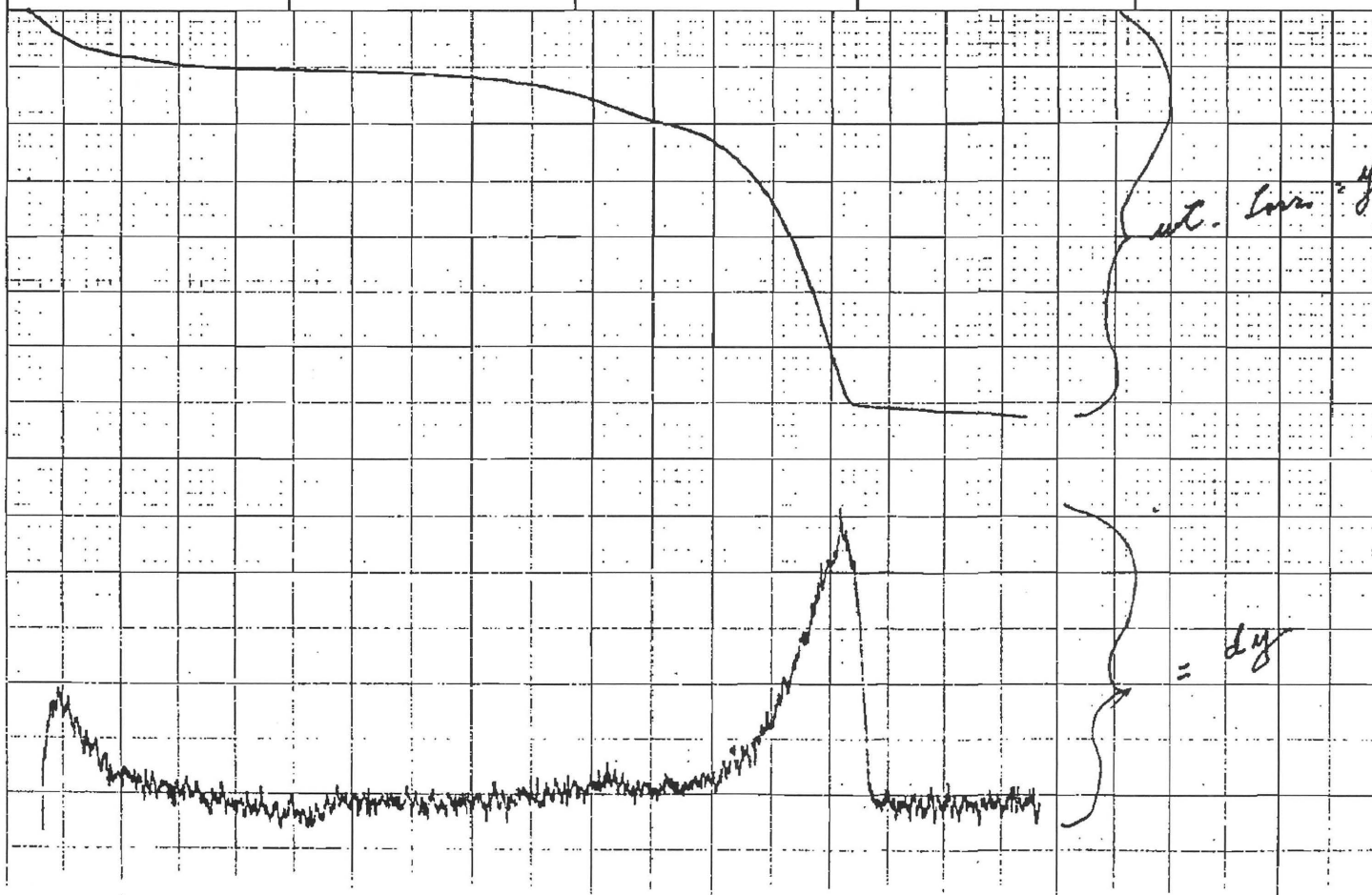
SAMPLE SIZE

LOAD, g

dY, (10X), (mils/min)/in

DU PUN / INSTRUMENTS

MEASURED VARIABLE %



70 2:1  
27 2:1  
3 2:1 CaCO<sub>3</sub>

2.5%

same for  
patterns all

PART NO. 990090

RUN NO. \_\_\_\_\_ DATE 4/15/99

OPERATOR \_\_\_\_\_

SAMPLE:

CH-1

ATM \_\_\_\_\_ (r \_\_\_\_\_)

FLOW RATE \_\_\_\_\_

## T-AXIS

SCALE, °C/in 100

PROG. RATE, °C/min \_\_\_\_\_

HEAT \_\_\_\_\_ COOL \_\_\_\_\_ ISO \_\_\_\_\_

SHIFT, in 0

## DTA-DSC

SCALE, °C/in \_\_\_\_\_

(mcal/sec)/in \_\_\_\_\_

WEIGHT, mg \_\_\_\_\_

REFERENCE \_\_\_\_\_

## TGA

SCALE, 2.5 mg/in 2.5SUPPRESSION, mg 2200

WEIGHT, mg \_\_\_\_\_

TIME CONST., sec \_\_\_\_\_

dY, (mg/min)/in \_\_\_\_\_

## TMA

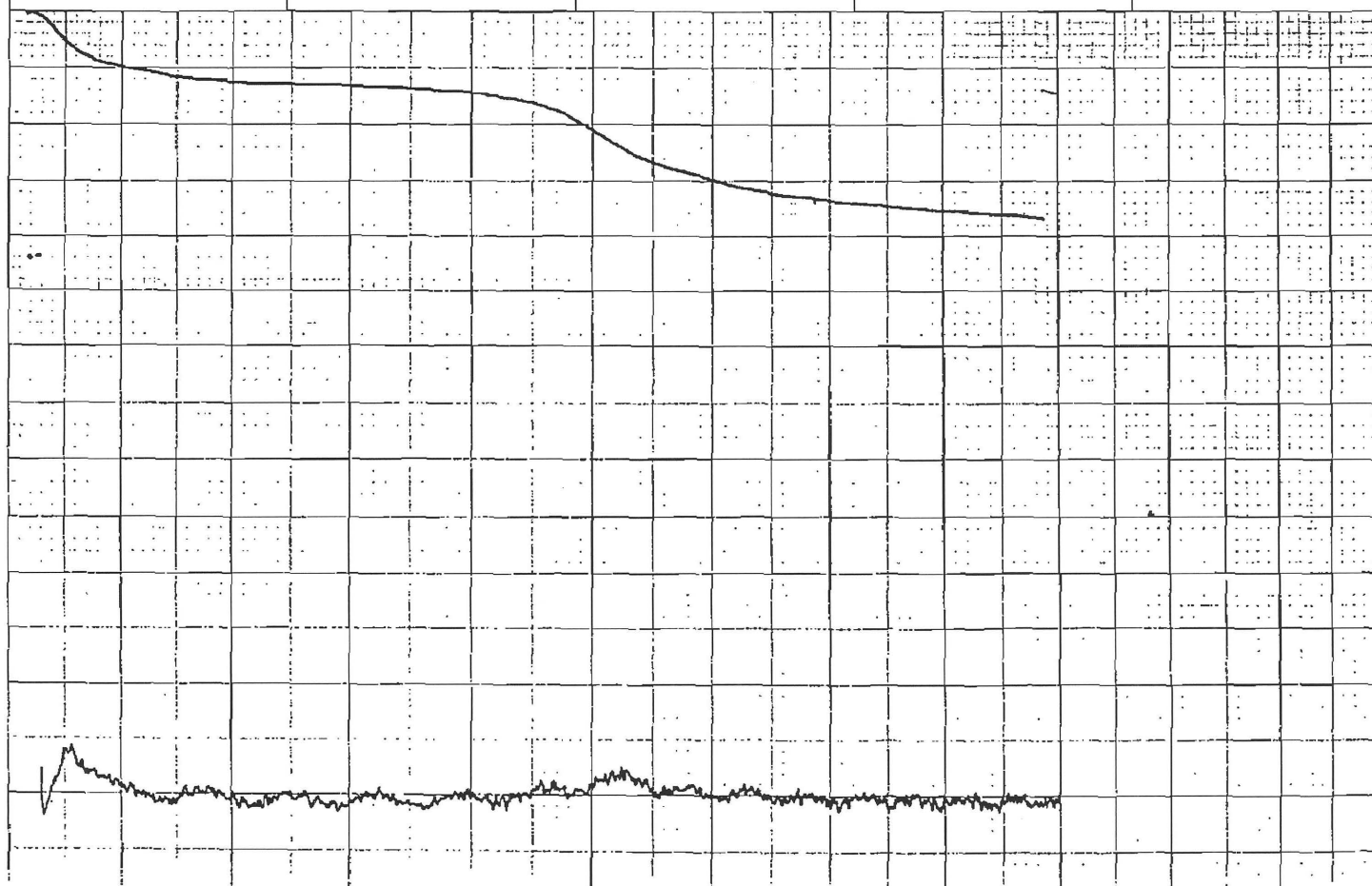
SCALE, mils/in \_\_\_\_\_

MODE \_\_\_\_\_

SAMPLE SIZE \_\_\_\_\_

LOAD, g \_\_\_\_\_

dY, (10X), (mils/min)/in \_\_\_\_\_



7 % 2:1 expanding  
14 % kaolinite

SUPPLY INSURANCE

MEASURED VARIABLE

PART NO. 990090

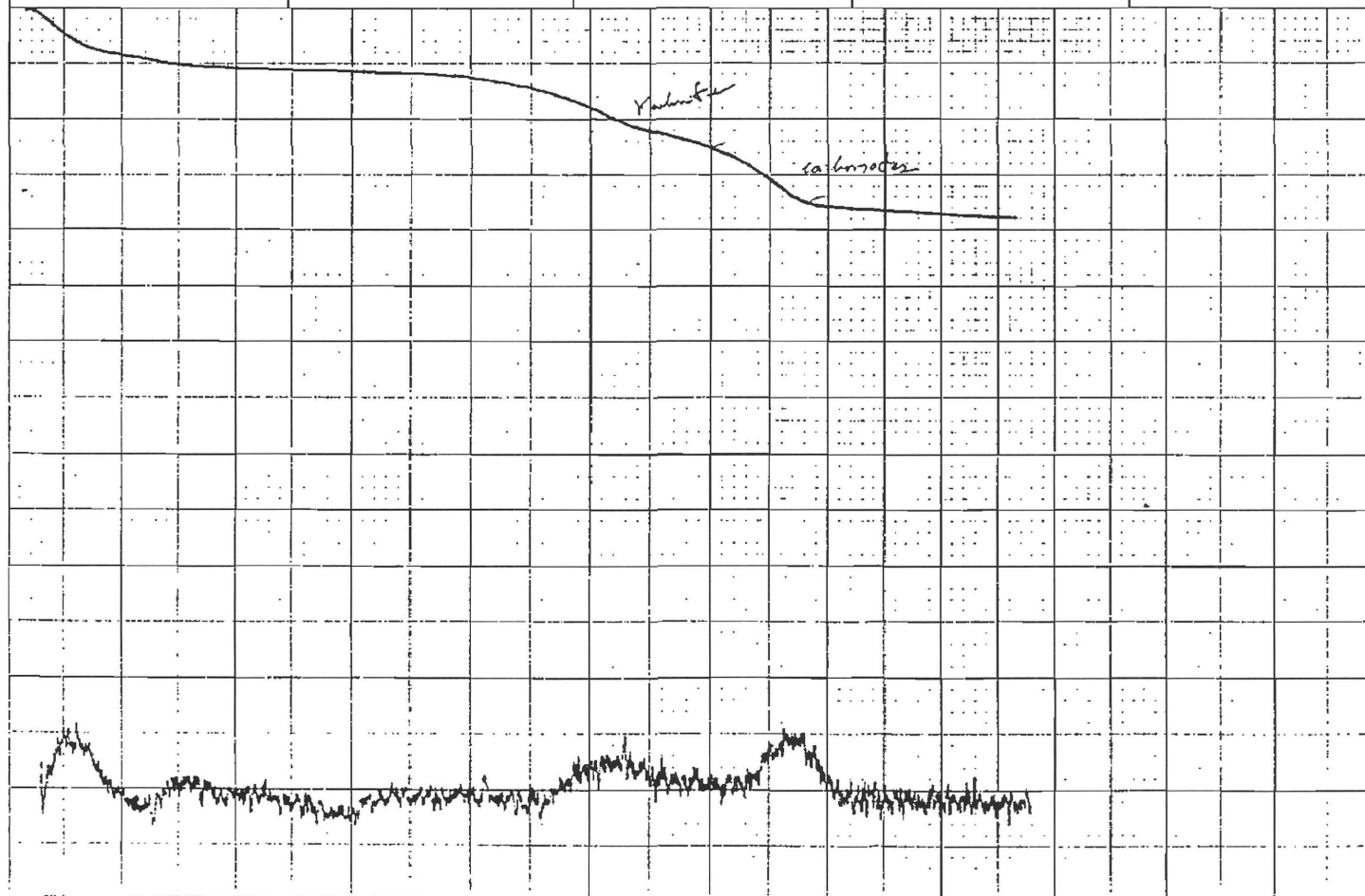
RUN NO. _____ DATE <u>3/3/82</u>	<b>T-AXIS</b> SCALE, °C/in <u>100</u> PROG. RATE, °C/min <u>10</u> HEAT <input checked="" type="checkbox"/> COOL <input type="checkbox"/> ISO <input type="checkbox"/> SHIFT, in <u>0</u>	<b>DTA-DSC</b> SCALE, °C/in _____ (mcal/sec)/in _____ WEIGHT, mg _____ REFERENCE _____	<b>TGA</b> SCALE, mg/in <u>2.5</u> SUPPRESSION, mg <u>11.69</u> WEIGHT, mg <u>11.69 / 1.8</u> TIME CONST., sec <u>2</u> dY, (mg/min)/in <u>0.5</u>	<b>TMA</b> SCALE, mils/in _____ MODE _____ SAMPLE SIZE _____ LOAD, g _____ dY, (10 X), (mils/min)/in _____	
----------------------------------	---	--	---	---	--

Trace Carbonate  
Trace Limestone

PART NO. 990090

RUN NO. _____ DATE _____	<u>T-AXIS</u>	<u>DTA-DSC</u>	<u>TGA</u>	<u>TMA</u>
OPERATOR _____	SCALE, °C/in <u>100</u>	SCALE, °C/in _____	SCALE, mg/in <u>2.5</u>	SCALE, mils/in _____
SAMPLE: <u>CH-9</u>	PROG. RATE, °C/min _____	(mcal/sec)/in _____	SUPPRESSION, mg/LP. <u>0.2</u>	MODE _____
ATM _____	HEAT _____ COOL _____ ISO _____	WEIGHT, mg _____	WEIGHT, mg _____	SAMPLE SIZE _____
FLOW RATE _____	SHIFT, in <u>0</u>	REFERENCE _____	TIME CONST., sec _____	LOAD, g _____
			dY, (mg/min)/in _____	dY, (10X), (mils/min)/in _____



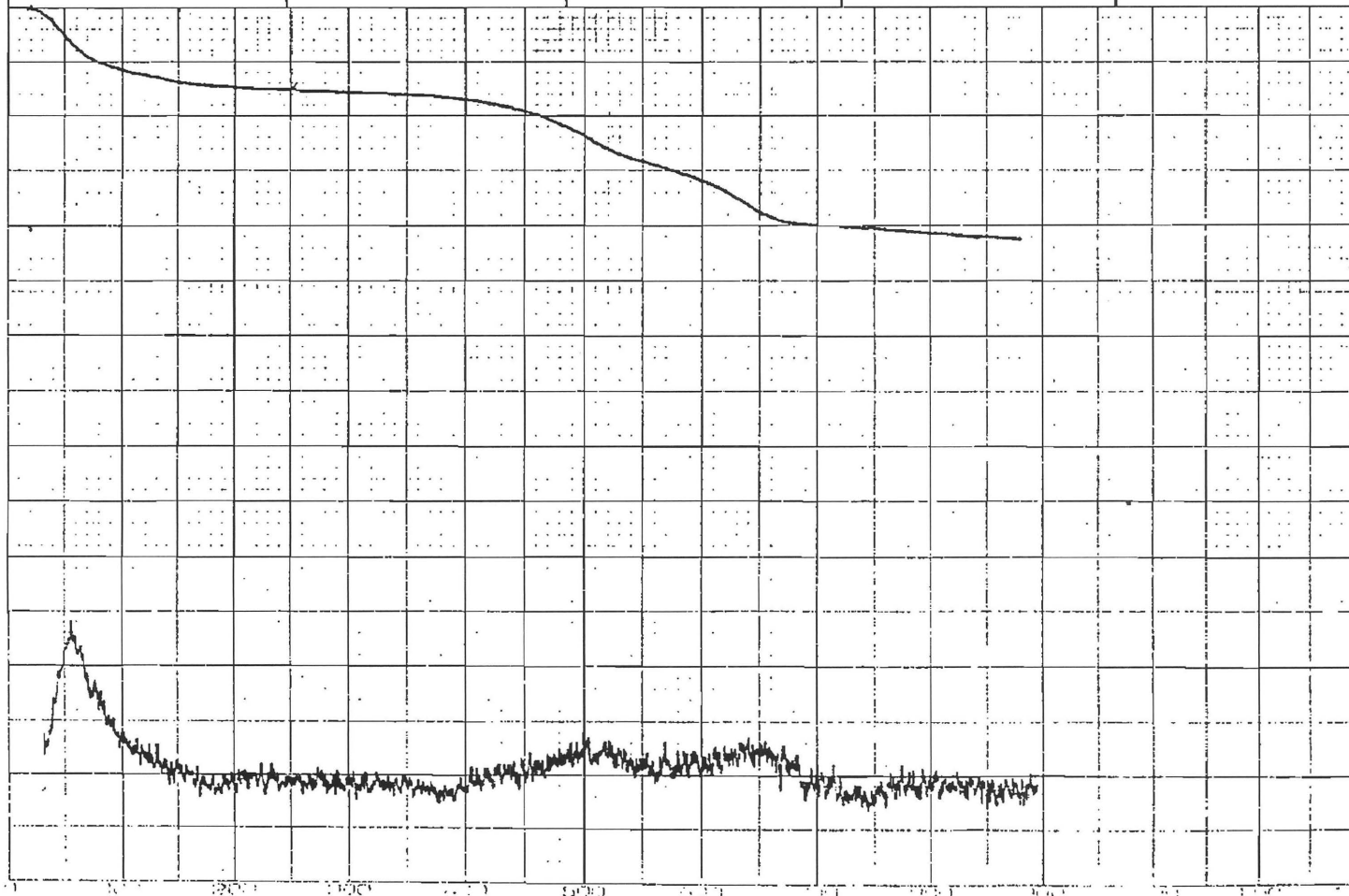
6% 2:1  
 ~ 1/2 1/4  
 7 1/2 100%

DU PUI / MON MONITOR

MEASURED VARIABLE

PART NO. 990090

RUN NO. _____ DATE _____	<u>T-AXIS</u>	<u>DTA-DSC</u>	<u>TGA</u> <u>2.5</u>	<u>TMA</u>
OPERATOR _____	SCALE, °C/in <u>100</u>	SCALE, °C/in _____	SCALE, <u>mg</u> /in _____	SCALE, mils/in _____
SAMPLE: <u>CH-15</u>	PROG. RATE, °C/min _____	(mcal/sec)/in _____	SUPPRESSION, mg <u>9.43</u>	MODE _____
ATM _____ (t) _____	HEAT _____ COOL _____ ISO _____	WEIGHT, mg _____	WEIGHT, mg _____	SAMPLE SIZE _____
FLOW RATE _____	SHIFT, in <u>0</u>	REFERENCE _____	TIME CONST., sec _____	LOAD, g _____
			dY, (mg/min)/in _____	dY, (10X), (mils/min)/in _____



8.5% 2:1  
10% K<sub>2</sub>O  
2.8 CaCO<sub>3</sub>

UPRINT

PART NO. 990090

RUN NO. \_\_\_\_\_ DATE \_\_\_\_\_  
 OPERATOR \_\_\_\_\_  
 SAMPLE: \_\_\_\_\_  
 ATM \_\_\_\_\_  
 FLOW RATE \_\_\_\_\_

## T-AXIS

SCALE, °C/in 100  
 PROG. RATE, °C/min \_\_\_\_\_  
 HEAT COOL ISO \_\_\_\_\_  
 SHIFT, in 0

## DTA-DSC

SCALE, °C/in \_\_\_\_\_  
 (mcal/sec)/in \_\_\_\_\_  
 WEIGHT, mg \_\_\_\_\_  
 REFERENCE \_\_\_\_\_

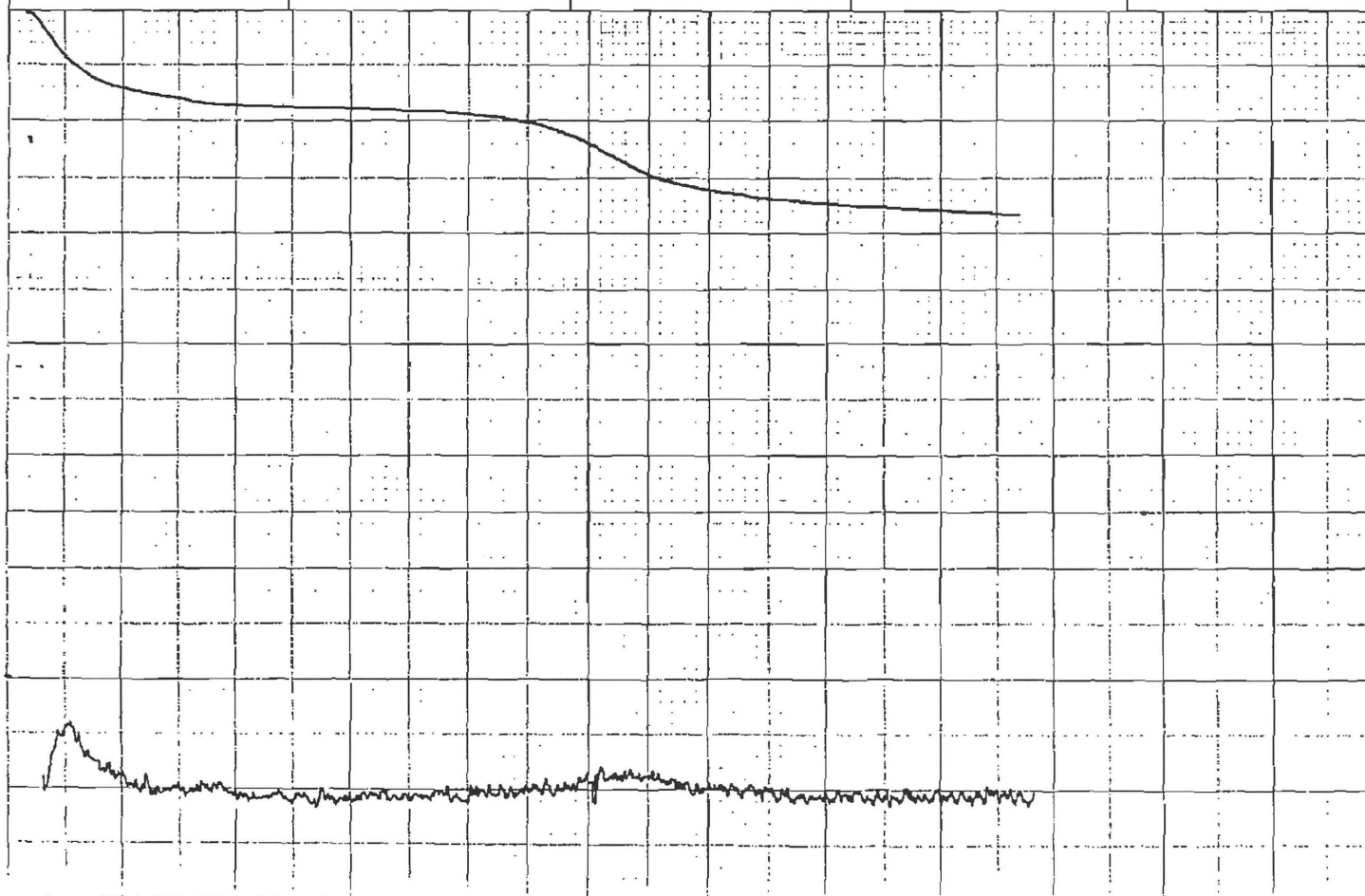
## TGA

SCALE, mg/in 2.5  
 SUPPRESSION, % 10.0  
 WEIGHT, mg \_\_\_\_\_  
 TIME CONST., sec \_\_\_\_\_  
 dY, (mg/min)/in \_\_\_\_\_

## TMA

SCALE, mils/in \_\_\_\_\_  
 MODE \_\_\_\_\_  
 SAMPLE SIZE \_\_\_\_\_  
 LOAD, g \_\_\_\_\_  
 dY, (10X), (mils/min)/in \_\_\_\_\_

CH-2



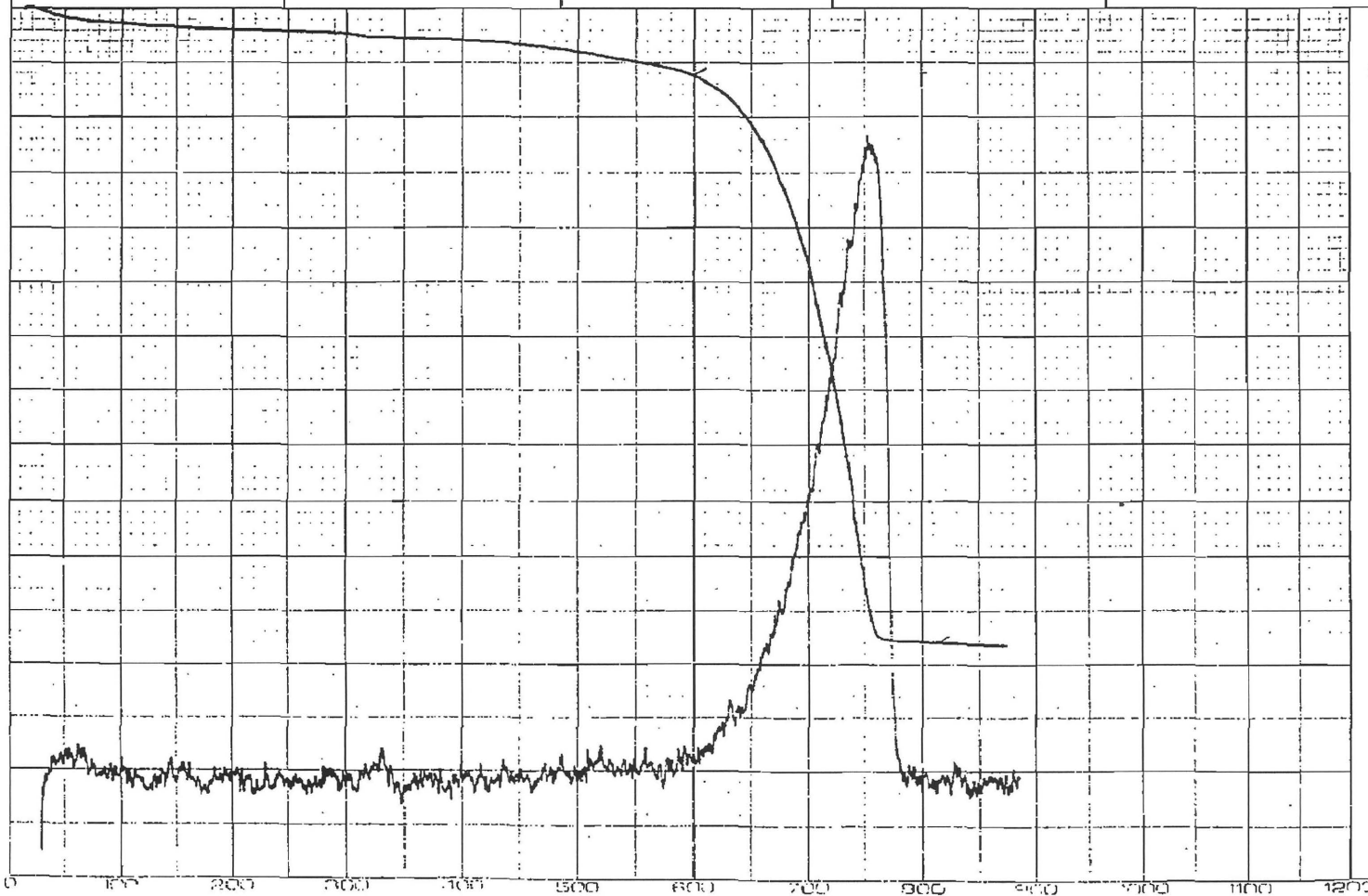
12.5 % KIn  
 10 % 2:1 depending

WUPUNT 880417100000

MEASURED VARIABLE

PART NO. 990090

RUN NO. _____ DATE _____	T-AXIS	DTA-DSC	TGA	TMA	CH-5
OPERATOR _____	SCALE, °C/in 100	SCALE, °C/in _____	SCALE, mg/in 2.5	SCALE, mils/in _____	
SAMPLE: _____	PROG. RATE, °C/min _____	(mcal/sec)/in _____	SUPPRESSION, mg 12.88	MODE _____	
ATM _____ @ _____	HEAT COOL ISO _____	WEIGHT, mg _____	WEIGHT, mg 12.88/1.8	SAMPLE SIZE _____	
FLOW RATE _____	SHIFT, in 0	REFERENCE _____	TIME CONST., sec 2	LOAD, g _____	
			dY, (mg/min)/in 0.05	dY, (10 X), (mils/min)/in _____	



Trace baseline  
 (5.2 \* 2.5) / 44  
 29 %  $\text{CaCO}_3$  equivalent

5.2  
 2.5  
 ---  
 130  
 130 \* 7  
 910

PART NO. 990090

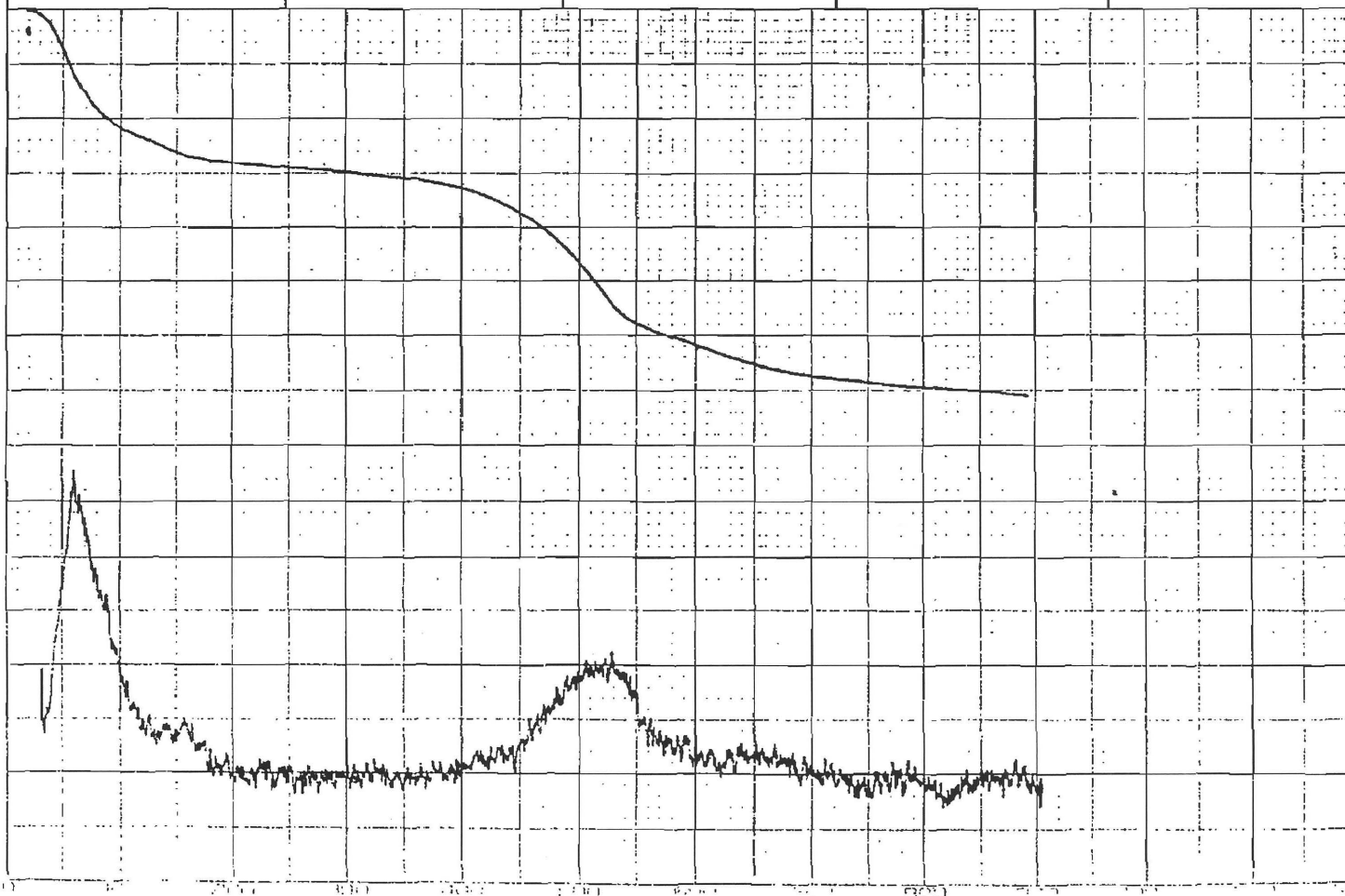
RUN NO. \_\_\_\_\_ DATE \_\_\_\_\_  
 OPERATOR \_\_\_\_\_  
 SAMPLE: CH-6  
 ATM \_\_\_\_\_  
 FLOW RATE \_\_\_\_\_

T-AXIS  
 SCALE, °C/in 100  
 PROG. RATE, °C/min \_\_\_\_\_  
 HEAT \_\_\_\_\_ COOL \_\_\_\_\_ ISO \_\_\_\_\_  
 SHIFT, in 0

DTA-DSC  
 SCALE, °C/in \_\_\_\_\_  
 (mcal/sec)/in \_\_\_\_\_  
 WEIGHT, mg \_\_\_\_\_  
 REFERENCE \_\_\_\_\_

TGA  
 SCALE, mg/in 2.5  
 SUPPRESSION, mg 2.37  
 WEIGHT, mg 12.33/80  
 TIME CONST., sec \_\_\_\_\_  
 dY, (mg/min)/in \_\_\_\_\_

TMA  
 SCALE, mils/in \_\_\_\_\_  
 MODE \_\_\_\_\_  
 SAMPLE SIZE \_\_\_\_\_  
 LOAD, g \_\_\_\_\_  
 dY, (10X), (mils/min)/in \_\_\_\_\_



16 % 2:1 expansion  
 27 % baseline

DU PONT INSTRUMENTS

MEASURED VARIABLE



CHAIN OF CUSTODY RL

ENVIRONMENTAL SAMPLES KM-6775



KERR-MCGEE CORPORATION

FACILITY		SAMPLING FIRM		SAMPLE	
NAME CIMARRON FACILITY		NAME JAMES L GRANT & Assoc.		<input type="checkbox"/> Effluent <input type="checkbox"/> Groundwater	
ADDRESS HIGHWAY 74 N		ADDRESS 8301 E. PRENTICE #402, ENCLAWOOD CO. 80111		<input checked="" type="checkbox"/> Solid <input type="checkbox"/> Surface Water	
CRESCENT, OK 73028		SIGNATURE Patricia P. Brown			

NO.	LOCATION	DATE	TIME	WEATHER		SAMPLE TYPE AND METHOD				TIMES CASING CLEARED	NO OF CONTAINERS	ANALYSIS REQUIRED	REMARKS
				TEMP	PREC	COMP.	GRAB	MECH	MAN				
1	WELL 1323						X				1	EXCHANGEABLE CATION (EXC) MINERALOGY (MIN) CATION EXCHANGE CAPACITY (CEC) GRAIN SIZE (GS)	
2	WELL 1323					X					1	CEC, EXC, MIN, GS	
3	WELL 1326					X					1	CEC, EXC, GS	
4	WELL 1328						X				1	CEC, EXC, GS	
5	WELL 1328						X				1	CEC, EXC, GS, MIN	
6	WELL 1336						X				1	CEC, EXC, GS, MIN	
7	WELL 1321						X				1	CEC, EXC, GS	
8	WELL 1321						X				1	MIN.	
9	BORROW MAT'L					X					1	CEC, EXC, GS, MIN	
10	WELL 1324					X					1	CEC, EXC, GS	
11	WELL 1325					X					1	CEC, EXC, GS	

SIGNED BY (SIGNATURE) Patricia P. Brown		RECEIVED BY (SIGNATURE)		DATE	TIME	ADDITIONAL REMARKS  PLEASE CALL PAT BROWN (303) 779-0576 WITH QUESTIONS	
SIGNED BY (SIGNATURE)		RECEIVED BY (SIGNATURE)		DATE	TIME		
SIGNED BY (SIGNATURE)		RECEIVED BY (SIGNATURE)		DATE	TIME		
SIGNED BY (SIGNATURE)		RECEIVED BY (SIGNATURE)		DATE	TIME		
SPATCHED BY (SIGNATURE)		DATE	TIME	RECEIVED FOR LABORATORY (SIGNATURE)		DATE	TIME
CARRIER Fed Ex Air Mail # 3041510404		LABORATORY DEPT. AGRONOMY & SOIL, AUBURN UNIV.		ADDRESS 202 FINCHES HALL, AUBURN, ALA. 36849-5402		ALL ANALYSIS PERFORMED BY EPA APPROVED PROCEDURES OR ASTM	
ETHICAL SHIPMENT						<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	

FACILITY	SAMPLING FIRM	SAMPLE
NAME <u>CIMARRON FACILITY</u>	NAME <u>JAMES L. GRANT &amp; ASSOC.</u>	<input type="checkbox"/> Effluent <input type="checkbox"/> Groundwater <input checked="" type="checkbox"/> Solid <input type="checkbox"/> Surface Water <input type="checkbox"/>
ADDRESS <u>HIGHWAY 74</u>	ADDRESS <u>8301 E. PROCTER #402 ENCLAWOOD, CO. 80111</u>	
<u>CRESCENT, OK 73028</u>	SIGNATURE <u>Patricia Breen</u>	

NO.	LOCATION	DATE	TIME	WEATHER		SAMPLE TYPE AND METHOD				TIMES CASING CLEARED	NO OF CONTAINERS	ANALYSIS REQUIRED	REMARKS
				TEMP	PREC	COMP.	GRAB	MECH	MAN				
12	BORROW MAT'L					X					1	EXCHANGEABLE CATION (EXC) GRAIN SIZE (G-S)	
13	WELL 1332					X					1	CATION EXCHANGE CAPACITY (CEC) MINERALOGY (MIN)	
14	WELL 1334						X				1	CEC, EXC, G-S	
15	WELL 1334						X				1	CEC, EXC, G-S, MIN	
16	BORROW MAT'L					X					1	MATRIC POTENTIAL	
17	WELL 1332					X					1	MATRIC POTENTIAL	
18	WELL 1326					X					1	MATRIC POTENTIAL	
19	WELL 1336						X				1	MATRIC POTENTIAL	

RELINQUISHED BY (SIGNATURE) <u>Patricia Breen</u>	RECEIVED BY (SIGNATURE)  	DATE 	TIME 	ADDITIONAL REMARKS  <u>PLEASE CALL PAT BREEN</u> <u>(303) 779-0576 WITH</u> <u>QUESTIONS</u>
RELINQUISHED BY (SIGNATURE)	RECEIVED BY (SIGNATURE)	DATE	TIME	
RELINQUISHED BY (SIGNATURE)	RECEIVED BY (SIGNATURE)	DATE	TIME	
PATCHED BY (SIGNATURE)	RECEIVED FOR LABORATORY (SIGNATURE)	DATE	TIME	
PRIOR <u>ED EXP. AIRBILL # 3041510404</u>	LABORATORY <u>DEPT OF AGRONOMY &amp; SOIL, AUBURN UNIV.</u>	ALL ANALYSIS PERFORMED BY EPA APPROVED PROCEDURES OR ASTM		
ADDRESS <u>202 FUNCHESS HALL</u>	ADDRESS <u>AUBURN ALA 36849-5412</u>			

**APPENDIX H**  
**DISTRIBUTION COEFFICIENT ANALYSES**

808211: 9-12-89



JUN 12 1989

Equilibrium Distribution Coefficients -  
Batch Determination Techniques

submitted to

Kerr McGee Tech Center  
Oklahoma City, Oklahoma

June 6, 1989

by

B. F. Hajek

## Equilibrium Distribution Coefficients - Batch Determination Techniques

B. F. Hajek

### Introduction

The equilibrium distribution coefficient ( $K_d$ ) is an easily determined equilibrium constant for trace ion adsorption on soils. In using this coefficient the assumption is made that ion exchange extends over a short, nearly linear, section of an adsorption isotherm. This assumption is usually valid since trace ions are present in small concentrations and do not occupy a significant portion of all ion exchange sites (1, 2, 3).

The  $K_d$  is calculated from data obtained in batch equilibrium tests by use of the equation,

$$K_d = \frac{C_0 - C}{C} \frac{\text{ml soln}}{\text{g soil}},$$

in which  $C_0$  is the initial concentration of radionuclide in solution and  $C$  is the equilibrium concentration after solution - soil contact.

### Batch Equilibrium Method

Five grams of soil obtained from samples collected by test borings are equilibrated with 20 ml of solution by shaking continuously for 16 hours (overnight). The solution used should simulate, as closely as possible, the solution that will actually flow through the soil. This can be groundwater or seepage water obtained on-site, simulated acid process solution, or ground water-acid process solution mixtures. The solution used is traced with ions of interest such as U, Ra, Th, and As. A higher soil-solution ratio may be required for U adsorption tests since adsorption will probably be low (<2). A 1:1 ratio may be needed in this case. A lower ratio may be needed for Ra and Th since  $K_d$ 's may exceed 500 ml/g.

Radionuclide concentration in the equilibrium solution should be such that > 10,000 counts can be accumulated in a reasonable period of time to give a counting error of less than one percent. All  $K_d$  tests should be made in duplicate.

The soil sample is usually that fraction that passes a 2 mm sieve. If porous rock or porous gravel are tested for adsorption the solid-solution ratio should be increased and a value for in-place density (bulk density) will be needed to express adsorption on a volume basis.

Solution characteristics required:

1. initial pH
2. final pH
3. concentration of major competing cations and anions

Soil characteristics:

1. grain size distribution
2. qualitative mineralogy
3. approximate bulk density
4. pH of a 1:1, soil:water suspension

References

1. D. W. Bensen. 1960. Review of soil chemistry research at Hanford. HW-67201. General Electric Co., Richland, Washington.
2. W. J. Kaufman. 1963. An appraisal of the distribution coefficient for estimating underground movement of radioisotopes. HNS-1229-21. Hazelton - Nuclear Sci. Corp., Pal Alto, California.
3. W. E. Prout. 1958. Adsorption of radioactive waste by Savannah River Plant Soil. Soil Sci. Vol. 86, pp. 13-17.

FE/PROJECT NUMBER: 84007  
DATE RECEIVED: 14-JUN-89

21-JUN-1989  
SAMPLE ID: 967479  
02:27 p.m.

LOCATION: Cimarron  
SUBMITTED BY: R. Fine

FILE NAME: RF \CIM\14-JUN-89\CH-1R  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967479  
Results by 6-21-89: 1705-JAE-18P71  
20 ml Spiked Water: Spiked U232 850pCi/l

Th-228	0.60+-0.52 pCi/l	pH initial	7.45
U232	1.2+-0.60 pCi/l	pH final	7.90

Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

\*\*\*\*\*  
\*  
\* APPROVED: *[Signature]* 6/21/89 *[Signature]* 6/27/89 \*  
\*  
\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.

IFE/PROJECT NUMBER: 84007  
DATE RECEIVED: 12-JUN-89

SAMPLE ID: 967484  
02:27 p.m.

LOCATION: Cimarron  
SUBMITTED BY: R. Fine

E NAME: RF \CIM\12-JUN-89\ CH-1RR  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967479  
Results by 6-21-89;1705-JAE-18P72  
100 ml Spiked Water;Spiked U232 850pCi/l

Th-228	1.50+-0.74 pCi/l	pH initial	7.11
J232	7.5+-1.5 pCi/l	pH final	7.38

Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

\*\*\*\*\*  
\*  
\* APPROVED: David A. Kerr \*  
\*  
\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.



FE/PROJECT NUMBER: 84007  
DATE RECEIVED: 12-JUN-89

27-Jun-1989  
SAMPLE ID: 967474  
07:53 a.m.

LOCATION: Cimarron  
TESTED BY: R. Fine

SAMPLE NAME: RF \CIM\12-JUN-89\ CH-1X  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967474  
XRD of crystalline phases  
1688-JAH-22P82;1724-SMA-6P4,5,11,12

	Quartz = SiO <sub>2</sub>		
Major		+20	45.72 %
Accessory	<u>I, M, F</u>	+60	73.05 %
Bulk Density	77 lbs/ft <sup>3</sup>	+100	77.60 %
PH of 1:1 soil	7.6	+200	82.41 %
-8	0.17 %	+325	87.04 %

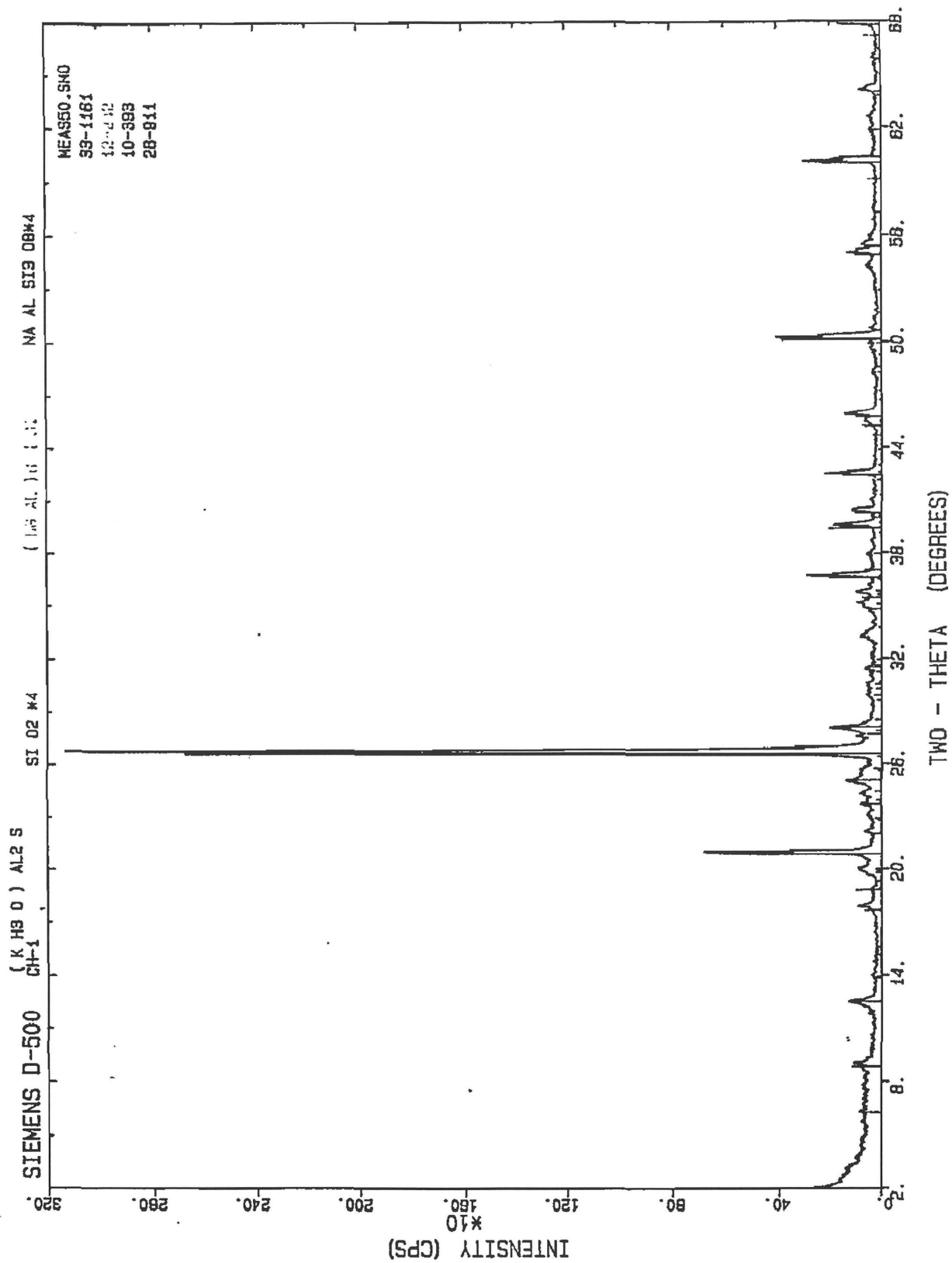
Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

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\*  
\* APPROVED: CDE AB QAL  
\* 6-27-89 6-27-89  
\*  
\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.

I - Illite clay -  $(K, H_3O)Al_2Si_3AlO_{10}(OH)_2$   
M - Montmorillonite - Chlorite clay  
F - Feldspar -  $NaAlSi_3O_8$



FE/PROJECT NUMBER: 84007  
ATE RECEIVED: 12-JUN-89

21-JUN-1989  
SAMPLE ID: 967480  
02:27 p.m.

LOCATION: Cimarron  
SUBMITTED BY: R. Fine

NAME: RF \CIM\12-JUN-89\ CH-5R  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967479  
Results needed by 6-21-89  
20 ml Spiked Water; Spiked U232 850pCi/l

h-228	0.90+-0.60 pCi/l	pH initial	7.45
1232	2.7+-0.90 pCi/l	pH final	7.76

Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

\*\*\*\*\*  
\*  
\* APPROVED: *[Signature]* 6/21/89 A. Kirk \*  
\*  
\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.

PROJECT NUMBER: 84007  
DATE RECEIVED: 12-JUN-89

SAMPLE ID: 967485  
02:27 p.m.

LOCATION: Cimarron  
SUBMITTED BY: R. Fine

NAME: RF \CIM\12-JUN-89\ CH-5RR  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967479  
Results needed by 6-21-89  
100 ml Spiked Water: Spiked U232 850pCi/l

1-228	0.90+-0.60 pCi/l	pH initial	7.22
232	3.6+-1.0 pCi/l	pH final	7.46

Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

\*\*\*\*\*  
\*  
\* APPROVED: Q. St. Aubert D. Kerr \*  
\*  
\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.

WFE/PROJECT NUMBER: 84007  
DATE RECEIVED: 12-JUN-89

27-Jun-1989  
SAMPLE ID: 967475  
07:53 a.m.

LOCATION: Cimarron  
TESTED BY: R. Fine

SAMPLE NAME: RF \CIM\12-JUN-89\ CH-5X  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967474  
XRD of crystalline phases

Major Quartz = $\text{SiO}_2$ & Calcite = $\text{CaCO}_3$	+20	32.44 %
Accessory Dolomite = $\text{CaMg}(\text{CO}_3)_2$ & Kaolinite =	+60	56.56 %
Bulk Density 87 lbs/ft <sup>3</sup>	+100	78.36 %
pH of 1:1 soil 8.8	+200	92.97 %
+8 0.03 %	+325	96.94 %

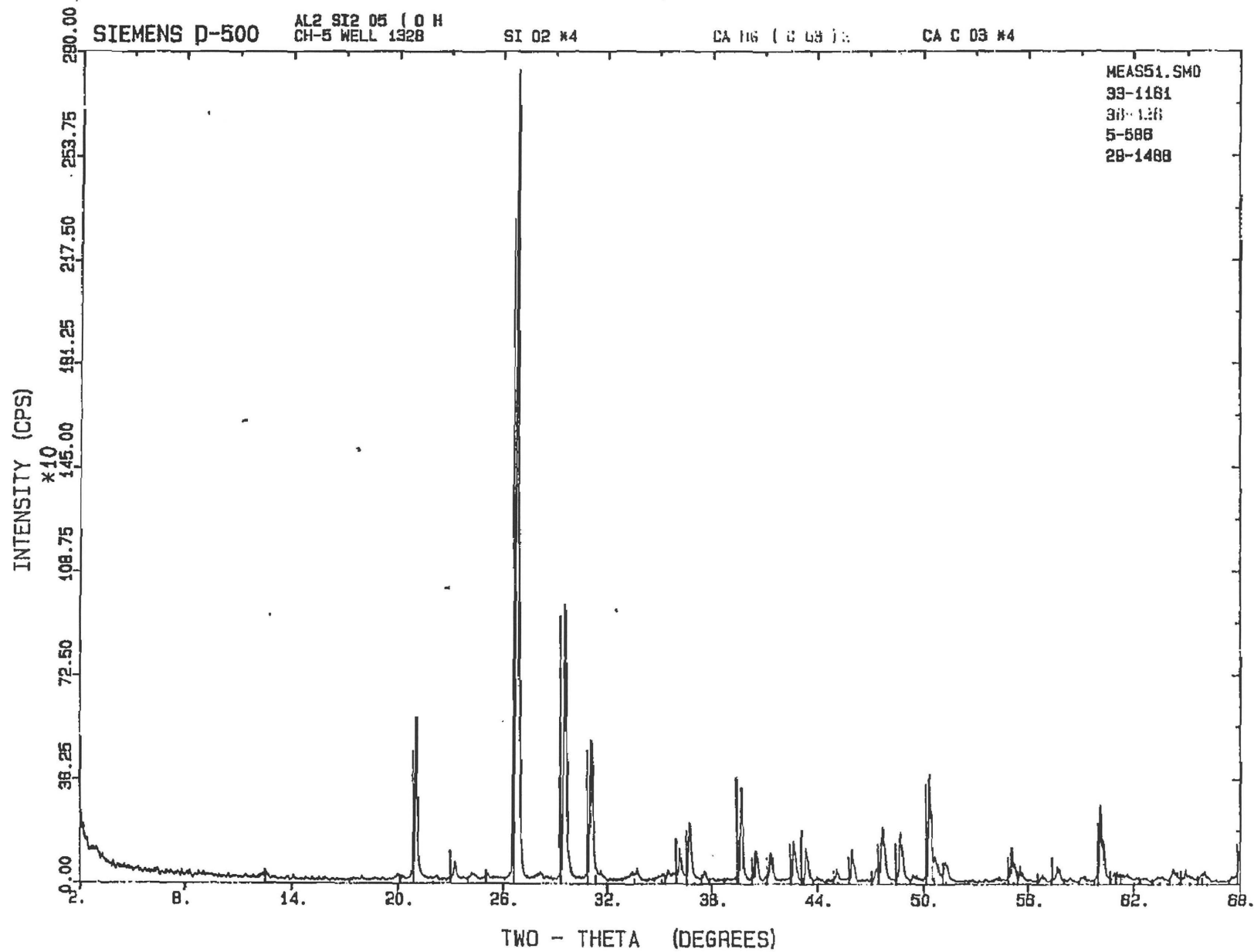
$\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$

Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

\*\*\*\*\*  
\*  
\* APPROVED: CDE ABG/27/89 \*  
\*  
\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.



AFE/PROJECT NUMBER: 84007  
DATE RECEIVED: 12-JUN-89

21-JUN-1989  
SAMPLE ID: 967481  
02:27 p.m.

LOCATION: Cimarron  
SUBMITTED BY: R. Fine

E NAME: RF \CIM\12-JUN-89\ CH-6R  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967479  
Results needed by 6-21-89  
20 ml Spiked Water: Spiked U232 850pCi/l

Th-228	0.60+-0.52 pCi/l	pH initial	7.50
U232	9.3+-1.7 pCi/l	pH final	7.82

Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

\*\*\*\*\*  
\*  
\* APPROVED: *D. S. [Signature]* \*  
\*  
\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.

AFE/PROJECT NUMBER: 84007  
DATE RECEIVED: 12-JUN-89

21 JUN 1989  
SAMPLE ID: 967486  
02:27 p.m.

LOCATION: Cimarron  
SUBMITTED BY: R. Fine

E NAME: RF \CIM\12-JUN-89\ CH-6RR  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967479  
Results needed by 6-21-89  
100 ml Spiked Water; Spiked U232 850pCi/l

Th-228	0.90+-0.60 pCi/l	pH initial	7.19
U232	9.9+-1.7 pCi/l	pH final	7.40

Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

\*\*\*\*\*  
\*  
\* APPROVED: Dashley D. Kerr \*  
\*  
\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.



PROJECT NUMBER: 84007  
DATE RECEIVED: 12-JUN-89

27-Jun-1989  
SAMPLE ID: 967476  
08:17 a.m.

LOCATION: Cimarron  
TESTED BY: R. Fine

SAMPLE NAME: RF \CIM\12-JUN-89\ CH-6X  
SAMPLE DESCRIPTION: Soil

TESTS: NBR same as 967474  
XRD on crystalline phases

	Quartz = SiO <sub>2</sub>		
	I, M, F		
Major		+20	41.63 %
Necessary		+60	80.97 %
Bulk Density	77 lbs/ft <sup>3</sup>	+100	88.43 %
H of 1:1 soil	8.1	+200	94.85 %
B	0.14 %	+325	97.83 %

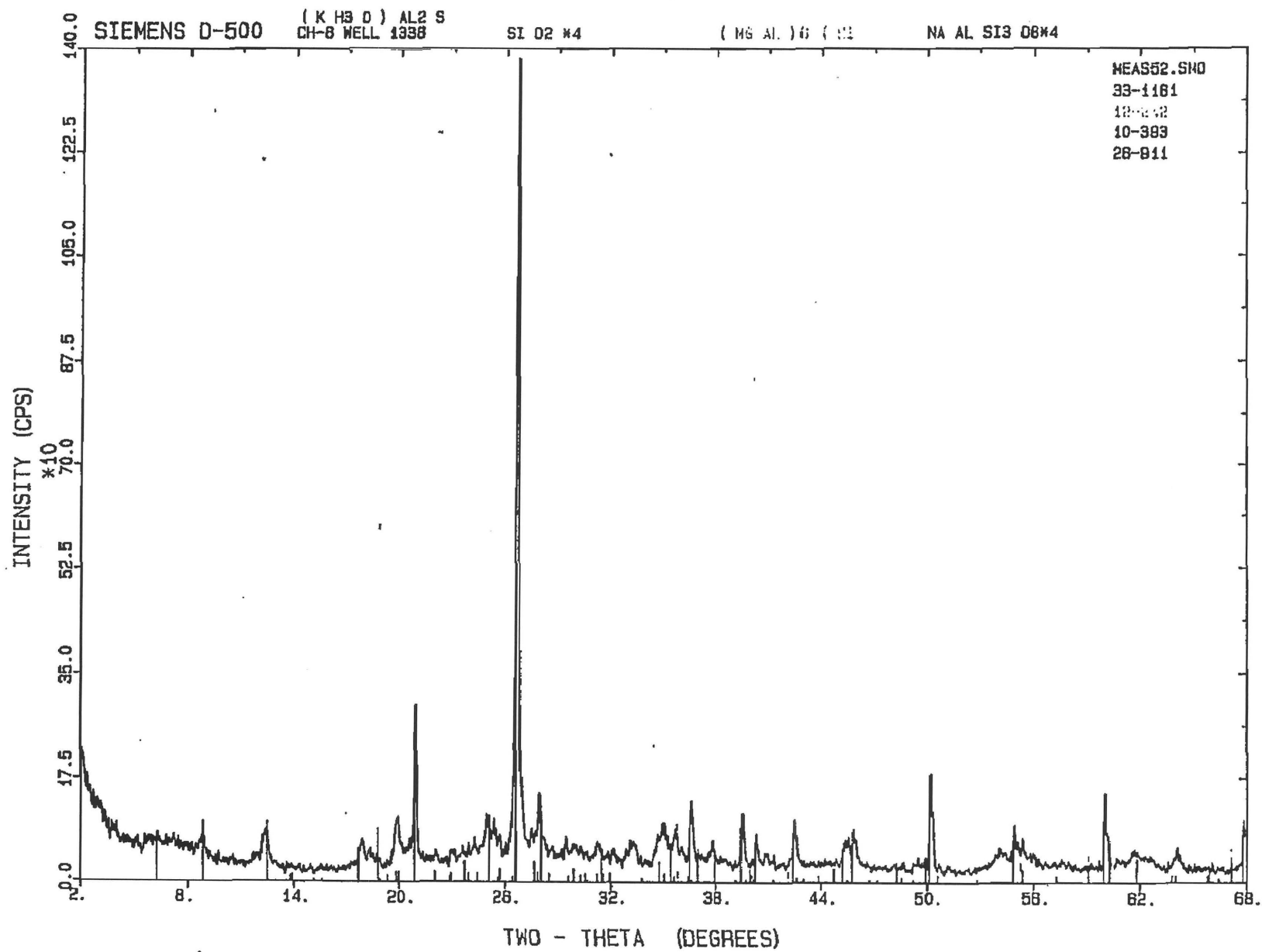
Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

\*\*\*\*\*  
\*  
\* APPROVED: EDC  
\* 6-27-89 AB-2789 \*  
\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.

I - Illite clay -  $(K, H_3O)Al_2Si_3AlO_{10}(OH)_2$   
M - Montmorillonite - Chlorite clay  
F - Feldspar -  $NaAlSi_3O_8$



AFE/PROJECT NUMBER: 84007  
DATE RECEIVED: 12-JUN-89

21-JUN-1989  
SAMPLE ID: 967482  
02:27 p.m.

LOCATION: Cimarron  
SUBMITTED BY: R. Fine

NAME: RF \CIM\12-JUN-89\ CH-8R  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967479  
Results needed by 6-21-89  
20 ml Spiked Water: Spiked U232 850pCi/l

Th-228	1.20+-0.42 pCi/l	pH initial	7.49
U232	1.2+-0.60 pCi/l	pH final	7.75

Where noted by a "\*\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

\*\*\*\*\*  
\*  
\* APPROVED: *D. Kerk* \*  
\*  
\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.

FE/PROJECT NUMBER: 84007  
DATE RECEIVED: 12-JUN-89

21-JUN-1989  
SAMPLE ID: 967487  
02:27 p.m.

LOCATION: Cimarron  
SUBMITTED BY: R. Fine

NAME: RF \CIM\12-JUN-89\ CH-8RR  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967479  
Results needed by 6-21-89  
100 ml Spiked Water: Spiked U232 850pCi/l

h-228	0.90+-0.60 pCi/l	pH initial	7.20
1232	1.5+-0.67 pCi/l	pH final	7.42

Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

\*\*\*\*\*

\*  
\* APPROVED: *D. K. K. 6/21/89 D. K. K.*  
\*

\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.

27-Jun-1989

FE/PROJECT NUMBER: 84007

SAMPLE ID: 967477

DATE RECEIVED: 12-JUN-89

07:53 a.m.

LOCATION: Cimarron

TESTED BY: R. Fine

SAMPLE NAME: RF \CIM\12-JUN-89\ CH-8X

SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967474

XRD of crystalline phases

Major	Quartz = SiO <sub>2</sub>	+20	11.72 %
Accessory	C, D, I, M	+60	29.35 %
Bulk Density	84 lbs/ft <sup>3</sup>	+100	57.80 %
pH of 1:1 soil	8.2	+200	91.93 %
pH	0.01 %	+325	97.14 %

Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

\*\*\*\*\*  
 \*  
 \* APPROVED: CWE 6-27-89 06-27-89  
 \*  
 \*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
 Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

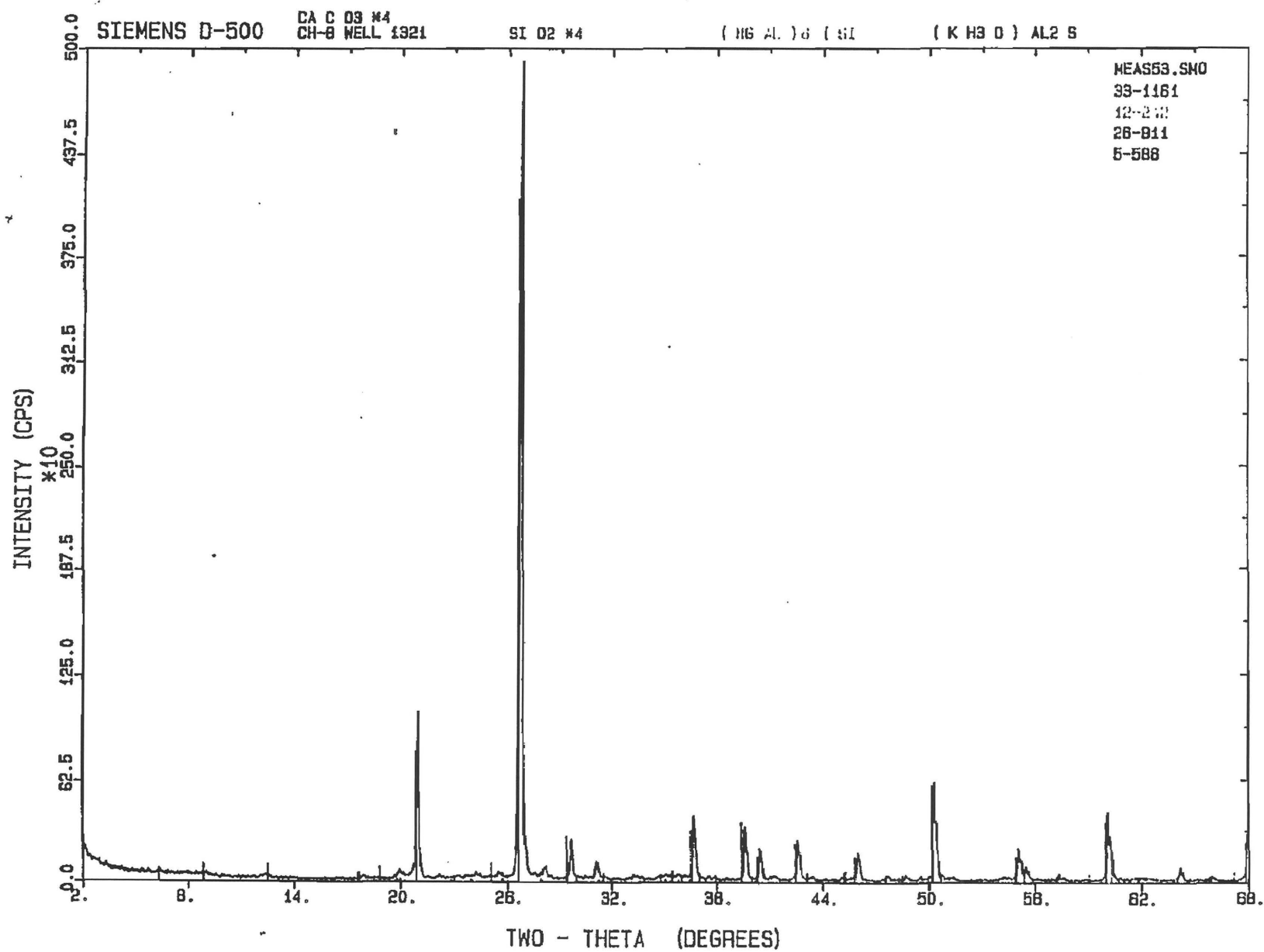
This/these samples are being returned to you.

C - Calcite - CaCO<sub>3</sub>

D - Dolomite - CaMg(CO<sub>3</sub>)<sub>2</sub>

I - Illite clay - (K, H<sub>3</sub>O) Al<sub>2</sub> Si<sub>3</sub> AlO<sub>10</sub> (OH)<sub>2</sub>

M - Montmorillonite - Chlorite clay



FE/PROJECT NUMBER: 84007  
DATE RECEIVED: 12-JUN-89

21-Jun-1989  
SAMPLE ID: 967483  
02:27 p.m.

LOCATION: Cimarron  
SUBMITTED BY: R. Fine

NAME: RF \CIM\12-JUN-89\ CH-14R  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967479  
Results needed by 6-21-89  
20 ml Spiked Water: Spiked U232 850pCi/l

h-228	1.20+-0.42 pCi/l	pH initial	7.50
1232	3.0+-0.95 pCi/l	pH final	7.82

Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

\*\*\*\*\*  
\*  
\* APPROVED: *D. K. K. 6/21/89 D. K. K.* \*  
\*  
\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.

FE/PROJECT NUMBER: 84007  
DATE RECEIVED: 12-JUN-89

21-JUN-1989  
SAMPLE ID: 967488  
02:27 p.m.

LOCATION: Cimarron  
SUBMITTED BY: R. Fine

NAME: RF \CIM\12-JUN-89\ CH-14RR  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967479  
Results needed by 6-21-89  
100 ml Spiked Water; Spiked U232 850pCi/l

h-228	0.60+-0.52 pCi/l	pH initial	7.23
1232	2.1+-0.99 pCi/l	pH final	7.46

Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

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\*  
\* APPROVED: *David Charles D. Rice*  
\*  
\*\*\*\*\*

KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.



27-Jun-1989

FE/PROJECT NUMBER: 84007  
DATE RECEIVED: 12-JUN-89

SAMPLE ID: 967478  
07:53 a.m.

LOCATION: Cimarron  
TESTED BY: R. Fine

SAMPLE NAME: RF \CIM\12-JUN-89\ CH-14X  
SAMPLE DESCRIPTION: Soil

NOTES: NBR same as 967474  
XRD of crystalline phases

Major	Quartz = $\text{SiO}_2$	& Dolomite = $\text{CaMg}(\text{CO}_3)_2$	+20	26.23 %
Accessory	C, I, M		+60	58.53 %
Bulk Density	84	lbs/ft <sup>3</sup>	+100	68.44 %
pH of 1:1 soil	8.7		+200	84.63 %
MB	0.05 %		+325	92.63 %

Where noted by a "\*", the analysis follows an indirect methodology and the concentration noted is inferred from the test protocol.

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\*  
\* APPROVED: CQE 6-27-89 6-27-89 \*  
\*  
\*\*\*\*\*

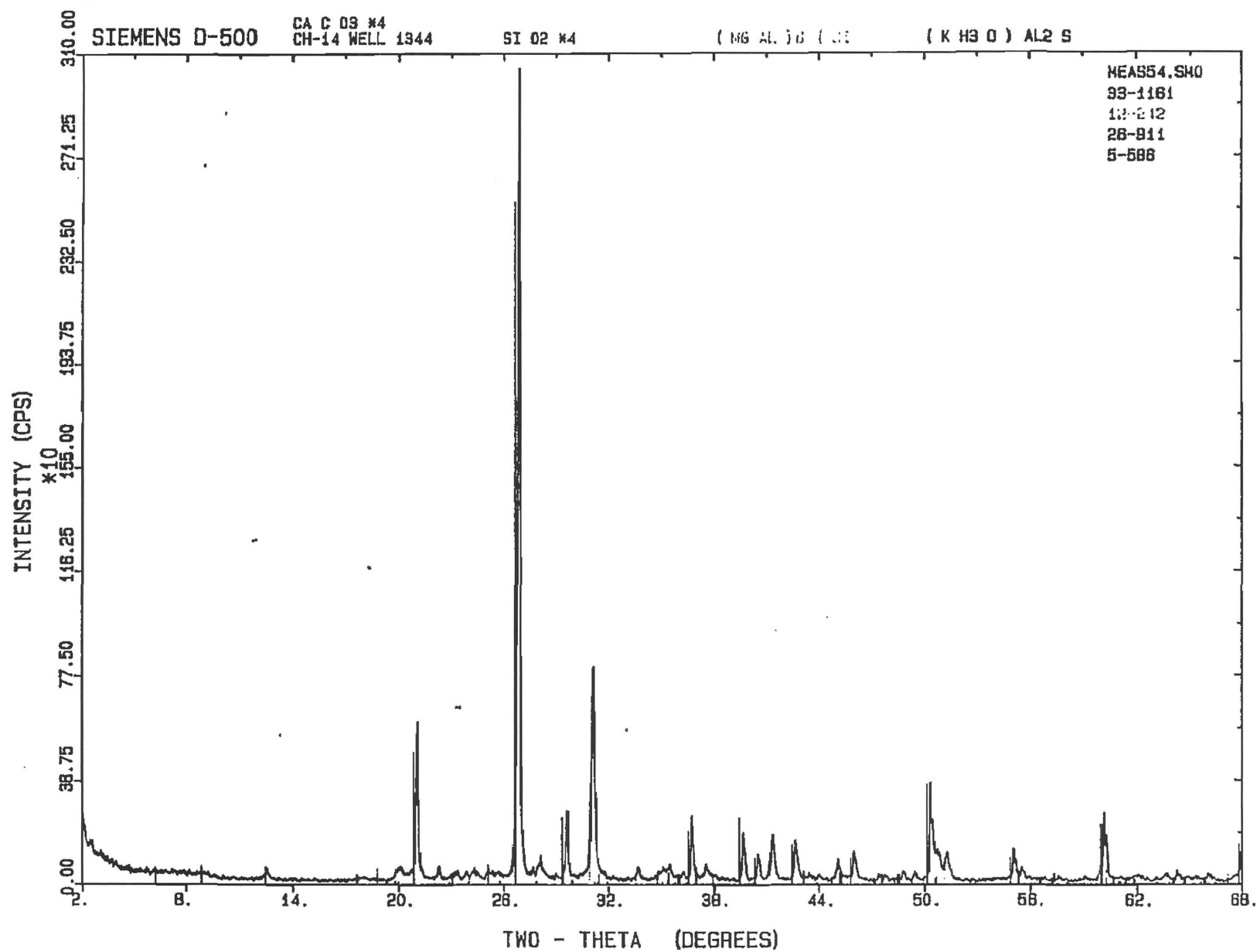
KERR-MCGEE CORPORATION Technology Division  
Proprietary Information of the Company TO BE KEPT CONFIDENTIAL

This/these samples are being returned to you.

C - Calcite -  $\text{CaCO}_3$

I - Illite clay -  $(\text{K}, \text{H}_3\text{O})\text{Al}_2\text{Si}_3\text{AlO}_{10}(\text{OH})_2$

M - Montmorillonite - Chlorite clay



FACILITY		SAMPLING FIRM		SAMPLE	
NAME	CIMARRON FACILITY	NAME	CIMARRON CORP	<input type="checkbox"/> Effluent	<input type="checkbox"/> Groundwater
ADDRESS	CRESCENT, OK	ADDRESS	CRESCENT, OK	<input type="checkbox"/> Solid	<input type="checkbox"/> Surface Water
		SIGNATURE	Roll & Li	<input type="checkbox"/>	

[illegible]

RELINQUISHED BY (SIGNATURE) <i>Red of LD</i>		RECEIVED BY (SIGNATURE)		DATE	TIME	ADDITIONAL REMARKS <i>This sample submitted at request of PAT BREENE, J.L. GRANT ASSOC., for analysis as discussed with Dr. Van de Streep.</i>
RELINQUISHED BY (SIGNATURE)		RECEIVED BY (SIGNATURE)		DATE	TIME	
RELINQUISHED BY (SIGNATURE)		RECEIVED BY (SIGNATURE)		DATE	TIME	
DISPATCHED BY (SIGNATURE)		DATE	TIME	RECEIVED FOR LABORATORY (SIGNATURE) <i>Julie Spuhart</i>	DATE <i>6/28/89</i>	TIME <i>8:00</i>
CARRIER		LABORATORY				
ADDRESS		ADDRESS				
METHOD OF SHIPMENT						
				ALL ANALYSIS PERFORMED BY EPA APPROVED PROCEDURES <input type="checkbox"/> Yes <input type="checkbox"/> No, explain above		

**APPENDIX I**  
**HELP MODEL SIMULATIONS**

808211: 9-12-89

DEFAULT, UNVEGETATED, UNCOMPACTED SOIL CHARACTERISTICS

SOIL TEXTURE			DIMENSIONLESS			SAT. HYD.
			POROSITY	FIELD	WILTING	CONDUCTIVITY
HELP	USDA	USCS		CAPACITY	POINT	(CM/SEC)
1	CoS	GS	0.417	0.045	0.018	1.0E-02
2	S	SW	0.437	0.062	0.024	5.8E-03
3	FS	SM	0.457	0.083	0.033	3.1E-03
4	LS	SM	0.437	0.105	0.047	1.7E-03
5	LFS	SM	0.457	0.131	0.058	1.0E-03
6	SL	SM	0.453	0.190	0.085	7.2E-04
7	FSL	SM	0.473	0.222	0.104	5.2E-04
8	L	ML	0.463	0.232	0.116	3.7E-04
9	SiL	ML	0.501	0.284	0.135	1.9E-04
10	SCL	SC	0.398	0.244	0.136	1.2E-04
11	CL	CL	0.464	0.310	0.187	6.4E-05
12	SiCL	CL	0.471	0.342	0.210	4.2E-05
13	SC	CH	0.430	0.321	0.221	3.3E-05

ENTER RETURN TO VIEW THE REST OF THE SOIL TYPES.

11	CL	CL	0.464	0.310	0.187	6.4E-05
12	SiCL	CL	0.471	0.342	0.210	4.2E-05
13	SC	CH	0.430	0.321	0.221	3.3E-05

ENTER RETURN TO VIEW THE REST OF THE SOIL TYPES.

SOIL TEXTURE			DIMENSIONLESS			SAT. HYD.
			POROSITY	FIELD	WILTING	CONDUCTIVITY
HELP	USDA	USCS		CAPACITY	POINT	(CM/SEC)
14	SiC	CH	0.479	0.371	0.251	2.5E-05
15	C	CH	0.475	0.378	0.265	1.7E-05
16	Liner Soil		0.430	0.366	0.280	1.0E-07
17	Liner Soil		0.400	0.356	0.290	1.0E-08
18	Mun. Waste		0.520	0.294	0.140	2.0E-04
19	USER SPECIFIED SOIL CHARACTERISTICS					
20	USER SPECIFIED SOIL CHARACTERISTICS					

5.9 ENTER SOIL TEXTURE OF SOIL LAYER 1.

2.67  
.67

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CIMARRON DECOMMISSIONING PROGRAM, CASE LF1  
CIMARRON FUEL FABRICATION FACILITY  
05-22-89

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\*\*\*\*\*

LAYER 1  
-----

\*\*\*\*\*

AVERAGE MONTHLY VALUES IN INCHES FOR 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-----						
PRECIPITATION						
-----						
TOTALS	0.87 2.88	1.25 2.27	2.09 4.40	3.04 3.27	4.85 1.77	3.03 1.13
STD. DEVIATIONS	0.55 1.97	0.75 1.59	1.10 2.55	1.90 2.00	2.74 1.67	1.27 0.77
RUNOFF						
-----						
TOTALS	0.011 0.010	0.012 0.000	0.045 0.013	0.357 0.120	0.883 0.159	0.039 0.039
STD. DEVIATIONS	0.050 0.044	0.052 0.000	0.119 0.037	0.707 0.347	1.398 0.597	0.120 0.122
EVAPOTRANSPIRATION						
-----						
TOTALS	0.790 4.491	0.882 2.456	1.456 2.689	1.789 1.727	3.284 1.044	6.254 0.857
STD. DEVIATIONS	0.384 2.071	0.479 1.330	0.617 1.202	0.611 0.563	0.705 0.384	0.672 0.421
PERCOLATION FROM LAYER 2						
-----						
TOTALS	0.1267 0.0440	0.1199 0.0000	0.1494 0.0049	0.1771 0.0652	0.2237 0.1075	0.1723 0.1332

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AVERAGE ANNUAL TOTALS (AND STD. DEVIATIONS) FOR 1 THROUGH 20

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	30.85 ( 5.709)	257073.	100.00
RUNOFF	1.687 ( 2.218)	14056.	5.47
EVAPOTRANSPIRATION	27.719 ( 3.734)	230989.	89.85
PERCOLATION FROM LAYER 2	1.3239 ( 0.5450)	11033.	4.29

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PEAK DAILY VALUES FOR 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	4.63	38583.3
RUNOFF	3.217	26805.3
PERCOLATION FROM LAYER 2	0.0103	85.5
HEAD ON LAYER 2	24.3	
SNOW WATER	1.28	10681.1
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4200	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1028	

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CIMARRON DECOMMISSIONING PROGRAM, CASE LF2  
CIMARRON FUEL FABRICATION FACILITY  
5-22-89

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\*\*\*\*\*

LAYER 1  
-----

VERTICAL PERCOLATION LAYER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4200 VOL/VOL
FIELD CAPACITY	=	0.2400 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1886 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.0000999999975 CM/SEC

LAYER 2  
-----

BARRIER SOIL LINER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.3300 VOL/VOL
FIELD CAPACITY	=	0.2400 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.0000010000000 CM/SEC

GENERAL SIMULATION DATA  
-----

CS RUNOFF CURVE NUMBER	=	65.00
TOTAL AREA OF COVER	=	100000. SQ FT
EVAPORATIVE ZONE DEPTH	=	24.00 INCHES
UPPER LIMIT VEG. STORAGE	=	10.0800 INCHES
INITIAL VEG. STORAGE	=	4.5275 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.



# CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND  
SOLAR RADIATION FOR OKLAHOMA CITY OKLAHOMA

MAXIMUM LEAF AREA INDEX = 2.00  
START OF GROWING SEASON (JULIAN DATE) = 98  
END OF GROWING SEASON (JULIAN DATE) = 307

\*\*\*\*\*

AVERAGE MONTHLY VALUES IN INCHES FOR 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.87 2.88	1.25 2.27	2.09 4.40	3.04 3.27	4.85 1.77	3.03 1.13
STD. DEVIATIONS	0.55 1.97	0.75 1.59	1.10 2.55	1.90 2.00	2.74 1.67	1.27 0.77
RUNOFF						
TOTALS	0.000 0.010	0.000 0.000	0.000 0.012	0.051 0.121	0.234 0.057	0.000 0.000
STD. DEVIATIONS	0.000 0.045	0.000 0.000	0.000 0.037	0.201 0.349	0.505 0.257	0.000 0.000
EVAPOTRANSPIRATION						
TOTALS	0.781 3.007	0.885 2.449	1.459 2.691	1.803 1.745	3.306 1.037	5.454 0.858
STD. DEVIATIONS	0.372 1.768	0.482 1.325	0.618 1.217	0.613 0.566	0.751 0.396	1.133 0.410
PERCOLATION FROM LAYER 2						
TOTALS	0.2337 0.0348	0.2089 0.0000	0.3218 0.0447	0.6076 0.5105	1.0633 0.6927	0.5912 0.5559
STD. DEVIATIONS	0.4050 0.0962	0.2692 0.0000	0.3677 0.1061	0.5195 0.7241	0.8079 0.7733	0.6397 0.6571

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AVERAGE ANNUAL TOTALS (AND STD. DEVIATIONS) FOR 1 THROUGH 20

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	30.85 ( 5.709)	257075.	100.00

RUNOFF	0.485 ( 0.923)	4043.	1.57
EVAPOTRANSPIRATION	25.477 ( 3.570)	212310.	82.59
PERCOLATION FROM LAYER 2	4.8651 ( 2.6231)	40542.	15.77

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PEAK DAILY VALUES FOR 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	4.63	38583.3
RUNOFF	1.566	13053.3
PERCOLATION FROM LAYER 2	0.1018	848.2
HEAD ON LAYER 2	24.1	
SNOW WATER	1.28	10681.1
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4200	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1028	

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CIMARRON DECOMMISSIONING PROGRAM, CASE LF3  
CIMARRON FUEL FABRICATION FACILITY  
05-22-89

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# LAYER 1

## VERTICAL PERCOLATION LAYER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4200 VOL/VOL
FIELD CAPACITY	=	0.2900 VOL/VOL
WILTING POINT	=	0.1870 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2544 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000049999987 CM/SEC

# LAYER 2

## BARRIER SOIL LINER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.3300 VOL/VOL
FIELD CAPACITY	=	0.2900 VOL/VOL
WILTING POINT	=	0.1870 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.0000001000000 CM/SEC

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AVERAGE MONTHLY VALUES IN INCHES FOR 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.87	1.25	2.09	3.04	4.85	3.03
	2.68	2.27	4.40	5.07	1.75	1.13

1.77 1.87 2.35 2.90 1.87 0.77

# RUNOFF

TOTALS	0.009	0.000	0.063	0.467	1.109	0.085
	0.124	0.034	0.305	0.407	0.188	0.030
STD. DEVIATIONS	0.039	0.000	0.178	0.828	1.452	0.181
	0.326	0.124	0.476	0.736	0.688	0.093

# EVAPOTRANSPIRATION

TOTALS	0.836	0.947	1.532	1.900	3.498	5.878
	3.092	2.388	2.741	1.844	1.094	0.925
STD. DEVIATIONS	0.388	0.493	0.728	0.655	0.824	1.025
	1.878	1.342	1.215	0.624	0.446	0.450

# PERCOLATION FROM LAYER 2

TOTALS	0.1247	0.1184	0.1476	0.1765	0.2169	0.1328
	0.0093	0.0000	0.0050	0.0621	0.1110	0.1387
STD. DEVIATIONS	0.1149	0.1046	0.1153	0.0964	0.0729	0.0639
	0.0174	0.0000	0.0115	0.0980	0.1149	0.1163

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# AVERAGE ANNUAL TOTALS (AND STD. DEVIATIONS) FOR 1 THROUGH 20

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	30.85 ( 5.709)	257075.	100.00
RUNOFF	2.822 ( 2.657)	23513.	9.15
EVAPOTRANSPIRATION	26.676 ( 3.673)	222303.	86.47
PERCOLATION FROM LAYER 2	1.2427 ( 0.5148)	10356.	4.03

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# PEAK DAILY VALUES FOR 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	4.63	38583.3
RUNOFF	3.177	26478.0
PERCOLATION FROM LAYER 2	0.0102	85.4
HEAD ON LAYER 2	24.2	

SNOW. WATER

1.28

10681.1

MAXIMUM VEG. SOIL WATER (VOL/VOL)

0.4200

MINIMUM VEG. SOIL WATER (VOL/VOL)

0.1857

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CIMARRON DECOMMISSIONING PROGRAM, CASE LF4  
CIMARRON FUEL FABRICATION FACILITY  
05-22-89

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# LAYER 1

## VERTICAL PERCOLATION LAYER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4200 VOL/VOL
FIELD CAPACITY	=	0.2400 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1876 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000099999975 CM/SEC

# LAYER 2

## BARRIER SOIL LINER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.3300 VOL/VOL
FIELD CAPACITY	=	0.2900 VOL/VOL
WILTING POINT	=	0.1870 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.0000000100000 CM/SEC

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AVERAGE MONTHLY VALUES IN INCHES FOR 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.87	1.25	2.09	3.04	4.85	3.03
	2.88	2.27	4.40	3.27	1.77	1.17

1.97 1.59 2.55 2.00 1.67 0.77

# RUNOFF

TOTALS	0.032	0.076	0.224	0.543	1.168	0.075
	0.010	0.000	0.013	0.127	0.176	0.063
STD. DEVIATIONS	0.102	0.229	0.469	0.946	1.525	0.251
	0.044	0.000	0.037	0.356	0.654	0.197

# EVAPOTRANSPIRATION

TOTALS	0.789	0.887	1.461	1.788	3.221	6.315
	4.833	2.458	2.690	1.722	1.043	0.859
STD. DEVIATIONS	0.383	0.478	0.617	0.611	0.689	0.574
	1.990	1.338	1.199	0.560	0.384	0.422

# PERCOLATION FROM LAYER 2

TOTALS	0.0137	0.0132	0.0164	0.0189	0.0235	0.0185
	0.0057	0.0000	0.0005	0.0066	0.0111	0.0140
STD. DEVIATIONS	0.0132	0.0119	0.0127	0.0106	0.0080	0.0069
	0.0047	0.0000	0.0011	0.0097	0.0124	0.0129

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# AVERAGE ANNUAL TOTALS (AND STD. DEVIATIONS) FOR 1 THROUGH 20

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	30.85 ( 5.709)	257075.	100.00
RUNOFF	2.508 ( 2.687)	20899.	8.13
EVAPOTRANSPIRATION	28.066 ( 3.508)	233886.	90.98
PERCOLATION FROM LAYER 2	0.1422 ( 0.0574)	1185.	0.46

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# PEAK DAILY VALUES FOR 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	4.63	38583.3
RUNOFF	3.312	27598.7
PERCOLATION FROM LAYER 2	0.0010	8.6
HEAD ON LAYER 2	24.3	

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1028

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CIMARRON DECOMMISSIONING PROGRAM, CASE NA1  
CIMARRON FUEL FABRICATION FACILITY  
05-22-89

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LAYER 1  
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VERTICAL PERCOLATION LAYER

THICKNESS	=	36.00 INCHES
POROSITY	=	0.4200 VOL/VOL
FIELD CAPACITY	=	0.2400 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2056 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.0000999999975 CM/SEC

LAYER 2  
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THICKNESS	=	12.00 INCHES
POROSITY	=	0.3300 VOL/VOL
FIELD CAPACITY	=	0.2400 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.0000010000000 CM/SEC

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AVERAGE MONTHLY VALUES IN INCHES FOR 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.87 2.88	1.25 2.27	2.09 4.40	3.04 3.27	4.85 1.77	3.03 1.13
STD. DEVIATIONS	0.55 1.97	0.75 1.59	1.10 2.55	1.90 2.00	2.74 1.67	1.27 0.77
RUNOFF						
TOTALS	0.000 0.010	0.000 0.000	0.000 0.012	0.051 0.121	0.152 0.012	0.000 0.000
STD. DEVIATIONS	0.000 0.045	0.000 0.000	0.000 0.037	0.202 0.349	0.350 0.054	0.000 0.000
EVAPOTRANSPIRATION						
TOTALS	0.780 2.914	0.885 2.449	1.459 2.698	1.803 1.741	3.306 1.039	5.253 0.866
STD. DEVIATIONS	0.370 1.768	0.482 1.325	0.618 1.212	0.613 0.572	0.752 0.395	1.204 0.421
PERCOLATION FROM LAYER 2						
TOTALS	0.2733 0.2592	0.2087 0.0077	0.3131 0.0369	0.5762 0.4647	1.0641 0.6638	0.7856 0.6193
STD. DEVIATIONS	0.4515 0.4416	0.2976 0.0346	0.3449 0.0879	0.4838 0.6657	0.7934 0.7562	0.7764 0.7237

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AVERAGE ANNUAL TOTALS (AND STD. DEVIATIONS) FOR 1 THROUGH 20

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	30.85 ( 5.709)	257075.	100.00

EVAPOTRANSPIRATION	25.192 ( 3.646)	207766.	21.00
PERCOLATION FROM LAYER 2	5.2727 ( 2.9241)	43939.	17.09

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	PEAK DAILY VALUES FOR 1 THROUGH 20	
	(INCHES)	(CU. FT.)
PRECIPITATION	4.63	38583.3
RUNOFF	1.519	12658.6
PERCOLATION FROM LAYER 2	0.1086	904.7
HEAD ON LAYER 2	26.4	
SNOW WATER	1.28	10681.1
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3921	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1028	

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CIMARRON DECOMMISSIONING PROGRAM, CASE NA2  
CIMARRON FUEL FABRICATION FACILITY  
05-22-89

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# LAYER 1

## VERTICAL PERCOLATION LAYER

THICKNESS	=	36.00 INCHES
POROSITY	=	0.4200 VOL/VOL
FIELD CAPACITY	=	0.2900 VOL/VOL
WILTING POINT	=	0.1870 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2497 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.0000499999987 CM/SEC

# LAYER 2

## BARRIER SOIL LINER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.3300 VOL/VOL
FIELD CAPACITY	=	0.2900 VOL/VOL
WILTING POINT	=	0.1870 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.0000010000000 CM/SEC

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AVERAGE MONTHLY VALUES IN INCHES FOR 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.87	1.25	2.09	3.04	4.85	3.03
	2.88	2.27	4.40	1.17	1.77	1.15

# RUNOFF

TOTALS	0.000	0.000	0.014	0.189	0.577	0.035
	0.125	0.034	0.306	0.397	0.082	0.000

STD. DEVIATIONS	0.000	0.000	0.061	0.472	0.893	0.108
	0.326	0.124	0.476	0.750	0.355	0.000

# EVAPOTRANSPIRATION

TOTALS	0.834	0.948	1.540	1.906	3.542	4.823
	2.697	2.387	2.735	1.834	1.102	0.923

STD. DEVIATIONS	0.395	0.496	0.721	0.657	0.867	1.291
	1.779	1.344	1.208	0.640	0.437	0.460

# PERCOLATION FROM LAYER 2

TOTALS	0.1773	0.1476	0.2632	0.4975	0.8370	0.4777
	0.0295	0.0000	0.0339	0.3759	0.5397	0.3885

STD. DEVIATIONS	0.3343	0.1813	0.3549	0.4833	0.7287	0.5712
	0.1132	0.0000	0.0826	0.5893	0.5925	0.5714

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# AVERAGE ANNUAL TOTALS (AND STD. DEVIATIONS) FOR 1 THROUGH 20

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	30.85 ( 5.709)	257075.	100.00

RUNOFF	1.759 ( 1.950)	14658.	5.70
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EVAPOTRANSPIRATION	25.271 ( 3.707)	210591.	81.92
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PERCOLATION FROM LAYER 2	3.7678 ( 2.1737)	31398.	12.21
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# PEAK DAILY VALUES FOR 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	4.63	38583.3

RUNOFF	2.789	23242.1
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PERCOLATION FROM LAYER 2	0.1119	932.6
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HEAD ON LAYER 2	27.6
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SHOW WATER

1.25

1/22/11

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4141

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1856

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**APPENDIX J**  
**TRANSS MODEL SIMULATIONS**

808211: 9-12-89

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*****
*
*       ONE-DIMENSIONAL CONVECTIVE-DISPERSIVE EQUATION
*       *11/26/85* VERSION
*       SEMI-INFINITE PROFILE
*
*       NUCLIDE DECAY (THALF)
*       LINEAR ADSORPTION (R)
*       GENERAL NUCLIDE RELEASE CURVE
*       TRANSPORT SUM OVER PATHLINES
*
*       CIMARRON LANDFILL: Kd=2000 controlled release - U-238
*       VADOSE ZONE
*****

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NUCLIDE: U-238

INPUT PARAMETERS  
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```

V =          1.38          D =          1.00
R =        10600.0          TO = 4.4377E+05
TOTAL =1.81E+12            TDECAY=0.000E-01
THALF= 4.5000E+09          CO = 1.931E+06
XL =2.0000E+01
NUCLIDE DECAY CONSTANT = 1.54033E-10

```

CONTROL FLAGS:

IOPTBC= 0 IFLUX= 0 ITYPE= 1 IOPT= 3

RELEASE MODEL PARAMETERS:

```

PLAN VIEW AREA=8.0000E+04
DEPTH=1.0000E+01
WATER FLUX Q=3.3000E-01
THETA =0.3000
MAX CONCENTRATION=1.0000E+12
RELEASE CURVE ERROR=1.0000E-02

```

FRACTION REMAINING CURVE

TIME	FRACTION
0.00E-01	1.00000
1.73E+03	0.98199
3.46E+03	0.96437
5.18E+03	0.94713
6.89E+03	0.93027
8.60E+03	0.91376
1.03E+04	0.89760
1.20E+04	0.88179
1.37E+04	0.86632
1.54E+04	0.85117
1.70E+04	0.83634
1.87E+04	0.82183
2.04E+04	0.80762

2.20E+04	0.79370
2.37E+04	0.78008
2.53E+04	0.76673
2.69E+04	0.75367
2.86E+04	0.74087
3.02E+04	0.72834
3.18E+04	0.71606
3.34E+04	0.70403
3.50E+04	0.69225
3.66E+04	0.68071
3.82E+04	0.66940
3.98E+04	0.65832
4.14E+04	0.64746
4.29E+04	0.63683
4.45E+04	0.62640
4.61E+04	0.61618
4.76E+04	0.60616
4.92E+04	0.59635
5.07E+04	0.58672
5.22E+04	0.57729
5.38E+04	0.56804
5.53E+04	0.55897
5.68E+04	0.55008
5.83E+04	0.54136
5.98E+04	0.53281
6.13E+04	0.52443
6.28E+04	0.51621
6.43E+04	0.50814
6.58E+04	0.50023
6.73E+04	0.49247
6.87E+04	0.48486
7.02E+04	0.47739
7.17E+04	0.47006
7.31E+04	0.46288
7.46E+04	0.45582
7.60E+04	0.44890
7.74E+04	0.44211
7.89E+04	0.43544
8.03E+04	0.42890
8.17E+04	0.42248
8.31E+04	0.41618
8.45E+04	0.40999
8.59E+04	0.40392
8.73E+04	0.39796
8.87E+04	0.39210
9.01E+04	0.38636
9.15E+04	0.38071
9.29E+04	0.37517
9.43E+04	0.36973
9.56E+04	0.36439
9.70E+04	0.35914
9.83E+04	0.35399
9.97E+04	0.34892
1.01E+05	0.34395
1.02E+05	0.33906
1.04E+05	0.33427
1.05E+05	0.32955
1.06E+05	0.32492
1.08E+05	0.32037
1.09E+05	0.31590



1.10E+05	0.31150
1.12E+05	0.30718
1.13E+05	0.30294
1.14E+05	0.29877
1.15E+05	0.29467
1.17E+05	0.29064
1.18E+05	0.28668
1.19E+05	0.28279
1.21E+05	0.27896
1.22E+05	0.27520
1.23E+05	0.27150
1.24E+05	0.26786
1.26E+05	0.26428
1.27E+05	0.26077
1.28E+05	0.25731
1.29E+05	0.25391
1.31E+05	0.25057
1.32E+05	0.24728
1.33E+05	0.24404
1.34E+05	0.24086
1.35E+05	0.23773
1.37E+05	0.23465
1.38E+05	0.23162
1.39E+05	0.22864
1.40E+05	0.22571
1.41E+05	0.22283
1.43E+05	0.21999
1.44E+05	0.21720
1.45E+05	0.00000

RELEASE INTERVAL NUMBER= 102

PATHLINE PARAMETERS:

TRAVELTIME	PATH LENGTH	VELOCITY	PDF
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1.4500E+01	2.0000E+01	1.3793E+00	1.0000E+00
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ADDITIONAL ZONE PARAMETERS:

XV=2.0000E+01 TV=1.4500E+01

AVERAGES:

LENGTH=2.0000E+01 TIME=1.4500E+01 VELOCITY=1.3793E+00

\*\*\* QUANTITY IS CONCENTRATION \*\*\*

CONVERSION FACTOR = 1.4713E-06

DISTANCE (X)	TIME (T)	PORE VOLUME (VVO)	QUANTITY (Q)
2.0000E+01	1.0000E+04	6.8966E+02	6.32404E-41
2.0000E+01	1.9900E+04	1.3724E+03	4.59880E-18
2.0000E+01	2.9800E+04	2.0552E+03	1.77129E-10
2.0000E+01	3.9700E+04	2.7379E+03	9.49663E-07
2.0000E+01	4.9600E+04	3.4207E+03	1.43651E-04
2.0000E+01	5.9500E+04	4.1034E+03	3.63469E-03
2.0000E+01	6.9400E+04	4.7862E+03	3.30567E-02

2.0000E+01	7.9300E+04	5.4690E+03	1.58705E-01
2.0000E+01	8.9200E+04	6.1517E+03	4.98107E-01
2.0000E+01	9.9100E+04	6.8345E+03	1.16238E+00
2.0000E+01	1.0900E+05	7.5172E+03	2.18954E+00
2.0000E+01	1.1890E+05	8.2000E+03	3.51740E+00
2.0000E+01	1.2880E+05	8.8828E+03	5.00680E+00
2.0000E+01	1.3870E+05	9.5655E+03	6.49063E+00
2.0000E+01	1.4860E+05	1.0248E+04	7.81966E+00
2.0000E+01	1.5850E+05	1.0931E+04	8.88887E+00
2.0000E+01	1.6840E+05	1.1614E+04	9.64826E+00
2.0000E+01	1.7830E+05	1.2297E+04	1.00907E+01
2.0000E+01	1.8820E+05	1.2979E+04	1.02429E+01
2.0000E+01	1.9810E+05	1.3662E+04	1.01543E+01
2.0000E+01	2.0800E+05	1.4345E+04	9.91208E+00
2.0000E+01	2.1790E+05	1.5028E+04	9.66537E+00
2.0000E+01	2.2780E+05	1.5710E+04	9.56757E+00
2.0000E+01	2.3770E+05	1.6393E+04	9.65571E+00
2.0000E+01	2.4760E+05	1.7076E+04	9.81249E+00
2.0000E+01	2.5750E+05	1.7759E+04	9.84787E+00
2.0000E+01	2.6740E+05	1.8441E+04	9.61004E+00
2.0000E+01	2.7730E+05	1.9124E+04	9.04534E+00
2.0000E+01	2.8720E+05	1.9807E+04	8.19481E+00
2.0000E+01	2.9710E+05	2.0490E+04	7.15628E+00
2.0000E+01	3.0700E+05	2.1172E+04	6.04219E+00
2.0000E+01	3.1690E+05	2.1855E+04	4.94985E+00
2.0000E+01	3.2680E+05	2.2538E+04	3.94842E+00
2.0000E+01	3.3670E+05	2.3221E+04	3.07687E+00
2.0000E+01	3.4660E+05	2.3903E+04	2.34915E+00
2.0000E+01	3.5650E+05	2.4586E+04	1.76169E+00
2.0000E+01	3.6640E+05	2.5269E+04	1.30054E+00
2.0000E+01	3.7630E+05	2.5952E+04	9.46915E-01
2.0000E+01	3.8620E+05	2.6634E+04	6.81088E-01
2.0000E+01	3.9610E+05	2.7317E+04	4.84630E-01
2.0000E+01	4.0600E+05	2.8000E+04	3.41554E-01
2.0000E+01	4.1590E+05	2.8683E+04	2.38675E-01
2.0000E+01	4.2580E+05	2.9366E+04	1.65519E-01
2.0000E+01	4.3570E+05	3.0048E+04	1.14007E-01
2.0000E+01	4.4560E+05	3.0731E+04	7.80465E-02
2.0000E+01	4.5550E+05	3.1414E+04	5.31352E-02
2.0000E+01	4.6540E+05	3.2097E+04	3.59958E-02
2.0000E+01	4.7530E+05	3.2779E+04	2.42752E-02
2.0000E+01	4.8520E+05	3.3462E+04	1.63042E-02
2.0000E+01	4.9510E+05	3.4145E+04	1.09099E-02
2.0000E+01	5.0500E+05	3.4828E+04	7.27570E-03
2.0000E+01	5.1490E+05	3.5510E+04	4.83709E-03
2.0000E+01	5.2480E+05	3.6193E+04	3.20676E-03
2.0000E+01	5.3470E+05	3.6876E+04	2.12042E-03
2.0000E+01	5.4460E+05	3.7559E+04	1.39877E-03
2.0000E+01	5.5450E+05	3.8241E+04	9.20697E-04
2.0000E+01	5.6440E+05	3.8924E+04	6.04801E-04
2.0000E+01	5.7430E+05	3.9607E+04	3.96552E-04
2.0000E+01	5.8420E+05	4.0290E+04	2.59562E-04
2.0000E+01	5.9410E+05	4.0972E+04	1.69625E-04
2.0000E+01	6.0400E+05	4.1655E+04	1.10575E-04
2.0000E+01	6.1390E+05	4.2338E+04	7.20459E-05
2.0000E+01	6.2380E+05	4.3021E+04	4.68819E-05
2.0000E+01	6.3370E+05	4.3703E+04	3.04708E-05
2.0000E+01	6.4360E+05	4.4386E+04	1.97825E-05
2.0000E+01	6.5350E+05	4.5069E+04	1.28301E-05
2.0000E+01	6.6340E+05	4.5752E+04	8.31299E-06

2.0000E+01	6.7330E+05	4.6434E+04	5.38139E-06
2.0000E+01	6.8320E+05	4.7117E+04	3.48068E-06
2.0000E+01	6.9310E+05	4.7800E+04	2.24953E-06
2.0000E+01	7.0300E+05	4.8483E+04	1.45278E-06
2.0000E+01	7.1290E+05	4.9166E+04	9.37573E-07
2.0000E+01	7.2280E+05	4.9848E+04	6.04684E-07
2.0000E+01	7.3270E+05	5.0531E+04	3.89751E-07
2.0000E+01	7.4260E+05	5.1214E+04	2.51071E-07
2.0000E+01	7.5250E+05	5.1897E+04	1.61648E-07
2.0000E+01	7.6240E+05	5.2579E+04	1.04022E-07
2.0000E+01	7.7230E+05	5.3262E+04	6.69072E-08
2.0000E+01	7.8220E+05	5.3945E+04	4.30154E-08
2.0000E+01	7.9210E+05	5.4628E+04	2.76434E-08
2.0000E+01	8.0200E+05	5.5310E+04	1.77577E-08
2.0000E+01	8.1190E+05	5.5993E+04	1.14029E-08
2.0000E+01	8.2180E+05	5.6676E+04	7.31964E-09
2.0000E+01	8.3170E+05	5.7359E+04	4.69700E-09
2.0000E+01	8.4160E+05	5.8041E+04	3.01309E-09
2.0000E+01	8.5150E+05	5.8724E+04	1.93232E-09
2.0000E+01	8.6140E+05	5.9407E+04	1.23884E-09
2.0000E+01	8.7130E+05	6.0090E+04	7.94042E-10
2.0000E+01	8.8120E+05	6.0772E+04	5.08776E-10
2.0000E+01	8.9110E+05	6.1455E+04	3.25951E-10
2.0000E+01	9.0100E+05	6.2138E+04	2.08756E-10
2.0000E+01	9.1090E+05	6.2821E+04	1.33656E-10
2.0000E+01	9.2080E+05	6.3503E+04	8.55342E-11
2.0000E+01	9.3070E+05	6.4186E+04	5.47820E-11
2.0000E+01	9.4060E+05	6.4869E+04	3.50263E-11
2.0000E+01	9.5050E+05	6.5552E+04	2.24032E-11
2.0000E+01	9.6040E+05	6.6234E+04	1.43323E-11
2.0000E+01	9.7030E+05	6.6917E+04	9.19831E-12
2.0000E+01	9.8020E+05	6.7600E+04	5.84928E-12
2.0000E+01	9.9010E+05	6.8283E+04	3.76945E-12
2.0000E+01	1.0000E+06	6.8966E+04	2.38406E-12

```

*****
*
*       ONE-DIMENSIONAL CONVECTIVE-DISPERSIVE EQUATION
*       *11/26/85* VERSION
*       SEMI-INFINITE PROFILE
*
*       NUCLIDE DECAY (THALF)
*       LINEAR ADSORPTION (R)
*       GENERAL NUCLIDE RELEASE CURVE
*       TRANSPORT SUM OVER PATHLINES
*
*       CIMARRON LANDFILL: Kd=300 controlled release - U-238
*       VADOSE ZONE
*****

```

NUCLIDE: U-238

#### INPUT PARAMETERS

=====

```

V =          1.38          D =          1.00
R =          1600.0        T0 = 6.6984E+04
TOTAL =1.81E+12          TDECAY=0.000E-01
THALF= 4.5000E+09        C0 = 1.931E+06
XL =2.0000E+01
NUCLIDE DECAY CONSTANT = 1.54033E-10

```

#### CONTROL FLAGS:

IOPTBC= 0 IFLUX= 0 ITYPE= 1 IOPT= 3

#### RELEASE MODEL PARAMETERS:

```

PLAN VIEW AREA=8.0000E+04
DEPTH=1.0000E+01
WATER FLUX Q=3.3000E-01
THETA    =0.3000
MAX CONCENTRATION=1.0000E+12
RELEASE CURVE ERROR=1.0000E-02

```

#### FRACTION REMAINING CURVE

TIME	FRACTION
0.00E-01	1.00000
2.62E+02	0.98199
5.22E+02	0.96437
7.82E+02	0.94713
1.04E+03	0.93027
1.30E+03	0.91376
1.55E+03	0.89760
1.81E+03	0.88179
2.06E+03	0.86632
2.32E+03	0.85117
2.57E+03	0.83634
2.82E+03	0.82183
3.07E+03	0.80762

3.32E+03	0.79370
3.57E+03	0.78008
3.82E+03	0.76673
4.07E+03	0.75367
4.31E+03	0.74087
4.56E+03	0.72834
4.80E+03	0.71606
5.04E+03	0.70403
5.29E+03	0.69225
5.53E+03	0.68071
5.77E+03	0.66940
6.01E+03	0.65832
6.24E+03	0.64746
6.48E+03	0.63683
6.72E+03	0.62640
6.95E+03	0.61618
7.19E+03	0.60616
7.42E+03	0.59635
7.65E+03	0.58672
7.89E+03	0.57729
8.12E+03	0.56804
8.35E+03	0.55897
8.58E+03	0.55008
8.80E+03	0.54136
9.03E+03	0.53281
9.26E+03	0.52443
9.48E+03	0.51621
9.71E+03	0.50814
9.93E+03	0.50023
1.02E+04	0.49247
1.04E+04	0.48486
1.06E+04	0.47739
1.08E+04	0.47006
1.10E+04	0.46288
1.13E+04	0.45582
1.15E+04	0.44890
1.17E+04	0.44211
1.19E+04	0.43544
1.21E+04	0.42890
1.23E+04	0.42248
1.25E+04	0.41618
1.28E+04	0.40999
1.30E+04	0.40392
1.32E+04	0.39796
1.34E+04	0.39210
1.36E+04	0.38636
1.38E+04	0.38071
1.40E+04	0.37517
1.42E+04	0.36973
1.44E+04	0.36439
1.46E+04	0.35914
1.48E+04	0.35399
1.50E+04	0.34892
1.52E+04	0.34395
1.55E+04	0.33906
1.57E+04	0.33427
1.59E+04	0.32955
1.61E+04	0.32492
1.63E+04	0.32037
1.64E+04	0.31590

1.66E+04	0.31150
1.68E+04	0.30718
1.70E+04	0.30294
1.72E+04	0.29877
1.74E+04	0.29467
1.76E+04	0.29064
1.78E+04	0.28668
1.80E+04	0.28279
1.82E+04	0.27896
1.84E+04	0.27520
1.86E+04	0.27150
1.88E+04	0.26786
1.90E+04	0.26428
1.91E+04	0.26077
1.93E+04	0.25731
1.95E+04	0.25391
1.97E+04	0.25057
1.99E+04	0.24728
2.01E+04	0.24404
2.03E+04	0.24086
2.04E+04	0.23773
2.06E+04	0.23465
2.08E+04	0.23162
2.10E+04	0.22864
2.12E+04	0.22571
2.13E+04	0.22283
2.15E+04	0.21999
2.17E+04	0.21720
2.19E+04	0.00000

RELEASE INTERVAL NUMBER= 102

PATHLINE PARAMETERS:

TRAVELTIME	PATH LENGTH	VELOCITY	PDF
1.4500E+01	2.0000E+01	1.3793E+00	1.0000E+00

ADDITIONAL ZONE PARAMETERS:

XV=2.0000E+01 TV=1.4500E+01

AVERAGES:

LENGTH=2.0000E+01 TIME=1.4500E+01 VELOCITY=1.3793E+00

\*\*\* QUANTITY IS CONCENTRATION \*\*\*

CONVERSION FACTOR = 1.4713E-06

DISTANCE (X)	TIME (T)	PORE VOLUME (VVO)	QUANTITY (Q)
2.0000E+01	5.0000E+03	3.4483E+02	3.80731E-08
2.0000E+01	5.9896E+03	4.1307E+02	6.21516E-06
2.0000E+01	6.9792E+03	4.8132E+02	2.23932E-04
2.0000E+01	7.9687E+03	5.4957E+02	3.12617E-03
2.0000E+01	8.9583E+03	6.1782E+02	2.31289E-02
2.0000E+01	9.9479E+03	6.8606E+02	1.09677E-01
2.0000E+01	1.0937E+04	7.5431E+02	3.76197E-01

2.0000E+01	1.1927E+04	8.2256E+02	1.01204E+00
2.0000E+01	1.2917E+04	8.9080E+02	2.25872E+00
2.0000E+01	1.3906E+04	9.5905E+02	4.35414E+00
2.0000E+01	1.4896E+04	1.0273E+03	7.46753E+00
2.0000E+01	1.5885E+04	1.0955E+03	1.16510E+01
2.0000E+01	1.6875E+04	1.1638E+03	1.68223E+01
2.0000E+01	1.7865E+04	1.2320E+03	2.27791E+01
2.0000E+01	1.8854E+04	1.3003E+03	2.92352E+01
2.0000E+01	1.9844E+04	1.3685E+03	3.58657E+01
2.0000E+01	2.0833E+04	1.4368E+03	4.23497E+01
2.0000E+01	2.1823E+04	1.5050E+03	4.84038E+01
2.0000E+01	2.2812E+04	1.5733E+03	5.38029E+01
2.0000E+01	2.3802E+04	1.6415E+03	5.83841E+01
2.0000E+01	2.4792E+04	1.7098E+03	6.20688E+01
2.0000E+01	2.5781E+04	1.7780E+03	6.48211E+01
2.0000E+01	2.6771E+04	1.8463E+03	6.66601E+01
2.0000E+01	2.7760E+04	1.9145E+03	6.76427E+01
2.0000E+01	2.8750E+04	1.9828E+03	6.78521E+01
2.0000E+01	2.9740E+04	2.0510E+03	6.74008E+01
2.0000E+01	3.0729E+04	2.1193E+03	6.64572E+01
2.0000E+01	3.1719E+04	2.1875E+03	6.52792E+01
2.0000E+01	3.2708E+04	2.2557E+03	6.41974E+01
2.0000E+01	3.3698E+04	2.3240E+03	6.35212E+01
2.0000E+01	3.4687E+04	2.3922E+03	6.34178E+01
2.0000E+01	3.5677E+04	2.4605E+03	6.38398E+01
2.0000E+01	3.6667E+04	2.5287E+03	6.45399E+01
2.0000E+01	3.7656E+04	2.5970E+03	6.51537E+01
2.0000E+01	3.8646E+04	2.6652E+03	6.53060E+01
2.0000E+01	3.9635E+04	2.7335E+03	6.47002E+01
2.0000E+01	4.0625E+04	2.8017E+03	6.31672E+01
2.0000E+01	4.1615E+04	2.8700E+03	6.06752E+01
2.0000E+01	4.2604E+04	2.9382E+03	5.73101E+01
2.0000E+01	4.3594E+04	3.0065E+03	5.32397E+01
2.0000E+01	4.4583E+04	3.0747E+03	4.86751E+01
2.0000E+01	4.5573E+04	3.1430E+03	4.38376E+01
2.0000E+01	4.6562E+04	3.2112E+03	3.89291E+01
2.0000E+01	4.7552E+04	3.2795E+03	3.41242E+01
2.0000E+01	4.8542E+04	3.3477E+03	2.95567E+01
2.0000E+01	4.9531E+04	3.4159E+03	2.53212E+01
2.0000E+01	5.0521E+04	3.4842E+03	2.14756E+01
2.0000E+01	5.1510E+04	3.5524E+03	1.80470E+01
2.0000E+01	5.2500E+04	3.6207E+03	1.50386E+01
2.0000E+01	5.3490E+04	3.6889E+03	1.24352E+01
2.0000E+01	5.4479E+04	3.7572E+03	1.02099E+01
2.0000E+01	5.5469E+04	3.8254E+03	8.32850E+00
2.0000E+01	5.6458E+04	3.8937E+03	6.75333E+00
2.0000E+01	5.7448E+04	3.9619E+03	5.44606E+00
2.0000E+01	5.8437E+04	4.0302E+03	4.36965E+00
2.0000E+01	5.9427E+04	4.0984E+03	3.48965E+00
2.0000E+01	6.0417E+04	4.1667E+03	2.77486E+00
2.0000E+01	6.1406E+04	4.2349E+03	2.19769E+00
2.0000E+01	6.2396E+04	4.3032E+03	1.73415E+00
2.0000E+01	6.3385E+04	4.3714E+03	1.36368E+00
2.0000E+01	6.4375E+04	4.4397E+03	1.06895E+00
2.0000E+01	6.5365E+04	4.5079E+03	8.35436E-01
2.0000E+01	6.6354E+04	4.5761E+03	6.51134E-01
2.0000E+01	6.7344E+04	4.6444E+03	5.06186E-01
2.0000E+01	6.8333E+04	4.7126E+03	3.92560E-01
2.0000E+01	6.9323E+04	4.7809E+03	3.03759E-01
2.0000E+01	7.0312E+04	4.8491E+03	2.34552E-01

2.0000E+01	7.1302E+04	4.9174E+03	1.80757E-01
2.0000E+01	7.2292E+04	4.9856E+03	1.39043E-01
2.0000E+01	7.3281E+04	5.0539E+03	1.06771E-01
2.0000E+01	7.4271E+04	5.1221E+03	8.18565E-02
2.0000E+01	7.5260E+04	5.1904E+03	6.26598E-02
2.0000E+01	7.6250E+04	5.2586E+03	4.78962E-02
2.0000E+01	7.7240E+04	5.3269E+03	3.65616E-02
2.0000E+01	7.8229E+04	5.3951E+03	2.78738E-02
2.0000E+01	7.9219E+04	5.4634E+03	2.12248E-02
2.0000E+01	8.0208E+04	5.5316E+03	1.61435E-02
2.0000E+01	8.1198E+04	5.5999E+03	1.22655E-02
2.0000E+01	8.2187E+04	5.6681E+03	9.30967E-03
2.0000E+01	8.3177E+04	5.7364E+03	7.05936E-03
2.0000E+01	8.4167E+04	5.8046E+03	5.34811E-03
2.0000E+01	8.5156E+04	5.8728E+03	4.04820E-03
2.0000E+01	8.6146E+04	5.9411E+03	3.06174E-03
2.0000E+01	8.7135E+04	6.0093E+03	2.31386E-03
2.0000E+01	8.8125E+04	6.0776E+03	1.74738E-03
2.0000E+01	8.9115E+04	6.1458E+03	1.31866E-03
2.0000E+01	9.0104E+04	6.2141E+03	9.94459E-04
2.0000E+01	9.1094E+04	6.2823E+03	7.48741E-04
2.0000E+01	9.2083E+04	6.3506E+03	5.63911E-04
2.0000E+01	9.3073E+04	6.4188E+03	4.24463E-04
2.0000E+01	9.4062E+04	6.4871E+03	3.19322E-04
2.0000E+01	9.5052E+04	6.5553E+03	2.40099E-04
2.0000E+01	9.6042E+04	6.6236E+03	1.80441E-04
2.0000E+01	9.7031E+04	6.6918E+03	1.35542E-04
2.0000E+01	9.8021E+04	6.7601E+03	1.01768E-04
2.0000E+01	9.9010E+04	6.8283E+03	7.63769E-05
2.0000E+01	1.0000E+05	6.8966E+03	5.72969E-05



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*****
*
*       ONE-DIMENSIONAL CONVECTIVE-DISPERSIVE EQUATION
*       *11/26/85* VERSION
*       SEMI-INFINITE PROFILE
*
*       NUCLIDE DECAY (THALF)
*       LINEAR ADSORPTION (R)
*       GENERAL NUCLIDE RELEASE CURVE
*       TRANSPORT SUM OVER PATHLINES
*
*       CIMARRON LANDFILL: Kd=2000 controlled release - U-238
*       SATURATED ZONE
*****

```

NUCLIDE: U-238

INPUT PARAMETERS  
=====

```

V =      130.38          D =      1.00
R =      10600.0         T0 = 4.8815E+05
TOTAL =1.81E+12         TDECAY=0.000E-01
THALF=  4.5000E+09      C0 =  4.539E+05
XL =1.0000E+03
NUCLIDE DECAY CONSTANT = 1.54033E-10

```

CONTROL FLAGS:  
IOPTBC= 0 IFLUX= 0 ITYPE= 1 IOPT= 3

RELEASE MODEL PARAMETERS:  
PLAN VIEW AREA=8.0000E+04  
DEPTH=1.0000E+01  
WATER FLUX Q=3.0000E-01  
THETA =0.3000  
MAX CONCENTRATION=1.0000E+12  
RELEASE CURVE ERROR=1.0000E-02

FRACTION REMAINING CURVE  
TIME            FRACTION

0.00E-01	1.00000
1.91E+03	0.98199
3.81E+03	0.96437
5.70E+03	0.94713
7.58E+03	0.93027
9.46E+03	0.91376
1.13E+04	0.89760
1.32E+04	0.88179
1.50E+04	0.86632
1.69E+04	0.85117
1.87E+04	0.83634
2.06E+04	0.82183
2.24E+04	0.80762

2.42E+04	0.79370
2.60E+04	0.78008
2.78E+04	0.76673
2.96E+04	0.75367
3.14E+04	0.74087
3.32E+04	0.72834
3.50E+04	0.71606
3.68E+04	0.70403
3.85E+04	0.69225
4.03E+04	0.68071
4.20E+04	0.66940
4.38E+04	0.65832
4.55E+04	0.64746
4.72E+04	0.63683
4.90E+04	0.62640
5.07E+04	0.61618
5.24E+04	0.60616
5.41E+04	0.59635
5.58E+04	0.58672
5.75E+04	0.57729
5.91E+04	0.56804
6.08E+04	0.55897
6.25E+04	0.55008
6.42E+04	0.54136
6.58E+04	0.53281
6.75E+04	0.52443
6.91E+04	0.51621
7.07E+04	0.50814
7.24E+04	0.50023
7.40E+04	0.49247
7.56E+04	0.48486
7.72E+04	0.47739
7.88E+04	0.47006
8.04E+04	0.46288
8.20E+04	0.45582
8.36E+04	0.44890
8.52E+04	0.44211
8.68E+04	0.43544
8.83E+04	0.42890
8.99E+04	0.42248
9.14E+04	0.41618
9.30E+04	0.40999
9.45E+04	0.40392
9.61E+04	0.39796
9.76E+04	0.39210
9.91E+04	0.38636
1.01E+05	0.38071
1.02E+05	0.37517
1.04E+05	0.36973
1.05E+05	0.36439
1.07E+05	0.35914
1.08E+05	0.35399
1.10E+05	0.34892
1.11E+05	0.34395
1.13E+05	0.33906
1.14E+05	0.33427
1.16E+05	0.32955
1.17E+05	0.32492
1.18E+05	0.32037
1.20E+05	0.31590

1.21E+05	0.31150
1.23E+05	0.30718
1.24E+05	0.30294
1.26E+05	0.29877
1.27E+05	0.29467
1.28E+05	0.29064
1.30E+05	0.28668
1.31E+05	0.28279
1.33E+05	0.27896
1.34E+05	0.27520
1.35E+05	0.27150
1.37E+05	0.26786
1.38E+05	0.26428
1.40E+05	0.26077
1.41E+05	0.25731
1.42E+05	0.25391
1.44E+05	0.25057
1.45E+05	0.24728
1.46E+05	0.24404
1.48E+05	0.24086
1.49E+05	0.23773
1.50E+05	0.23465
1.52E+05	0.23162
1.53E+05	0.22864
1.54E+05	0.22571
1.56E+05	0.22283
1.57E+05	0.21999
1.58E+05	0.21720
1.59E+05	0.00000

RELEASE INTERVAL NUMBER= 102

PATHLINE PARAMETERS:

TRAVELTIME	PATH LENGTH	VELOCITY	PDF
2.2010E+01	1.0190E+03	4.6297E+01	5.5556E+01
2.2019E+01	1.0200E+03	4.6324E+01	5.0000E+02
2.2020E+01	1.0210E+03	4.6367E+01	0.0000E-01

ADDITIONAL ZONE PARAMETERS:

XV=2.0000E+01 TV=1.4500E+01

AVERAGES:

LENGTH=1.0000E+03 TIME=2.2016E+01 VELOCITY=4.6329E+01

\*\*\* QUANTITY IS CONCENTRATION \*\*\*

CONVERSION FACTOR = 3.2695E-05

DISTANCE (X)	TIME (T)	PORE VOLUME (VVO)	QUANTITY (Q)
1.0000E+03	2.0699E+05	9.5897E+03	8.66687E-76
1.0000E+03	2.0799E+05	9.6360E+03	8.62836E-70
1.0000E+03	2.0899E+05	9.6823E+03	3.17715E-64
1.0000E+03	2.0999E+05	9.7286E+03	6.42212E-59
1.0000E+03	2.1099E+05	9.7748E+03	7.18788E-54

1.0000E+03	2.1199E+05	9.8211E+03	4.49258E-49
1.0000E+03	2.1298E+05	9.8674E+03	1.58123E-44
1.0000E+03	2.1398E+05	9.9136E+03	3.15993E-40
1.0000E+03	2.1498E+05	9.9599E+03	3.61465E-36
1.0000E+03	2.1598E+05	1.0006E+04	2.38584E-32
1.0000E+03	2.1698E+05	1.0052E+04	9.15884E-29
1.0000E+03	2.1798E+05	1.0099E+04	2.06094E-25
1.0000E+03	2.1898E+05	1.0145E+04	2.73963E-22
1.0000E+03	2.1998E+05	1.0191E+04	2.16808E-19
1.0000E+03	2.2097E+05	1.0238E+04	1.02935E-16
1.0000E+03	2.2197E+05	1.0284E+04	2.95472E-14
1.0000E+03	2.2297E+05	1.0330E+04	5.16805E-12
1.0000E+03	2.2397E+05	1.0376E+04	5.55195E-10
1.0000E+03	2.2497E+05	1.0423E+04	3.69344E-08
1.0000E+03	2.2597E+05	1.0469E+04	1.53464E-06
1.0000E+03	2.2697E+05	1.0515E+04	4.01964E-05
1.0000E+03	2.2797E+05	1.0561E+04	6.70478E-04
1.0000E+03	2.2896E+05	1.0608E+04	7.20154E-03
1.0000E+03	2.2996E+05	1.0654E+04	5.05334E-02
1.0000E+03	2.3096E+05	1.0700E+04	2.35763E-01
1.0000E+03	2.3196E+05	1.0747E+04	7.48886E-01
1.0000E+03	2.3296E+05	1.0793E+04	1.67476E+00
1.0000E+03	2.3396E+05	1.0839E+04	2.76649E+00
1.0000E+03	2.3496E+05	1.0885E+04	3.60737E+00
1.0000E+03	2.3596E+05	1.0932E+04	4.02280E+00
1.0000E+03	2.3695E+05	1.0978E+04	4.13995E+00
1.0000E+03	2.3795E+05	1.1024E+04	4.13679E+00
1.0000E+03	2.3895E+05	1.1070E+04	4.10350E+00
1.0000E+03	2.3995E+05	1.1117E+04	4.06559E+00
1.0000E+03	2.4095E+05	1.1163E+04	4.02750E+00
1.0000E+03	2.4195E+05	1.1209E+04	3.98973E+00
1.0000E+03	2.4295E+05	1.1256E+04	3.95232E+00
1.0000E+03	2.4395E+05	1.1302E+04	3.91525E+00
1.0000E+03	2.4494E+05	1.1348E+04	3.87853E+00
1.0000E+03	2.4594E+05	1.1394E+04	3.84216E+00
1.0000E+03	2.4694E+05	1.1441E+04	3.80613E+00
1.0000E+03	2.4794E+05	1.1487E+04	3.77043E+00
1.0000E+03	2.4894E+05	1.1533E+04	3.73507E+00
1.0000E+03	2.4994E+05	1.1579E+04	3.70004E+00
1.0000E+03	2.5094E+05	1.1626E+04	3.66534E+00
1.0000E+03	2.5194E+05	1.1672E+04	3.63097E+00
1.0000E+03	2.5293E+05	1.1718E+04	3.59692E+00
1.0000E+03	2.5393E+05	1.1765E+04	3.56318E+00
1.0000E+03	2.5493E+05	1.1811E+04	3.52977E+00
1.0000E+03	2.5593E+05	1.1857E+04	3.49667E+00
1.0000E+03	2.5693E+05	1.1903E+04	3.46387E+00
1.0000E+03	2.5793E+05	1.1950E+04	3.43139E+00
1.0000E+03	2.5893E+05	1.1996E+04	3.39921E+00
1.0000E+03	2.5993E+05	1.2042E+04	3.36733E+00
1.0000E+03	2.6092E+05	1.2088E+04	3.33575E+00
1.0000E+03	2.6192E+05	1.2135E+04	3.30447E+00
1.0000E+03	2.6292E+05	1.2181E+04	3.27347E+00
1.0000E+03	2.6392E+05	1.2227E+04	3.24278E+00
1.0000E+03	2.6492E+05	1.2273E+04	3.21237E+00
1.0000E+03	2.6592E+05	1.2320E+04	3.18224E+00
1.0000E+03	2.6692E+05	1.2366E+04	3.15240E+00
1.0000E+03	2.6792E+05	1.2412E+04	3.12283E+00
1.0000E+03	2.6891E+05	1.2459E+04	3.09354E+00
1.0000E+03	2.6991E+05	1.2505E+04	3.06453E+00
1.0000E+03	2.7091E+05	1.2551E+04	3.03579E+00

1.0000E+03	2.7191E+05	1.2597E+04	3.00732E+00
1.0000E+03	2.7291E+05	1.2644E+04	2.97912E+00
1.0000E+03	2.7391E+05	1.2690E+04	2.95118E+00
1.0000E+03	2.7491E+05	1.2736E+04	2.92350E+00
1.0000E+03	2.7591E+05	1.2782E+04	2.89609E+00
1.0000E+03	2.7690E+05	1.2829E+04	2.86893E+00
1.0000E+03	2.7790E+05	1.2875E+04	2.84202E+00
1.0000E+03	2.7890E+05	1.2921E+04	2.81537E+00
1.0000E+03	2.7990E+05	1.2968E+04	2.78896E+00
1.0000E+03	2.8090E+05	1.3014E+04	2.76281E+00
1.0000E+03	2.8190E+05	1.3060E+04	2.73690E+00
1.0000E+03	2.8290E+05	1.3106E+04	2.71123E+00
1.0000E+03	2.8390E+05	1.3153E+04	2.68580E+00
1.0000E+03	2.8489E+05	1.3199E+04	2.66062E+00
1.0000E+03	2.8589E+05	1.3245E+04	2.63567E+00
1.0000E+03	2.8689E+05	1.3291E+04	2.61095E+00
1.0000E+03	2.8789E+05	1.3338E+04	2.58646E+00
1.0000E+03	2.8889E+05	1.3384E+04	2.56220E+00
1.0000E+03	2.8989E+05	1.3430E+04	2.53818E+00
1.0000E+03	2.9089E+05	1.3477E+04	2.51437E+00
1.0000E+03	2.9189E+05	1.3523E+04	2.49079E+00
1.0000E+03	2.9288E+05	1.3569E+04	2.46743E+00
1.0000E+03	2.9388E+05	1.3615E+04	2.44429E+00
1.0000E+03	2.9488E+05	1.3662E+04	2.42137E+00
1.0000E+03	2.9588E+05	1.3708E+04	2.39866E+00
1.0000E+03	2.9688E+05	1.3754E+04	2.37617E+00
1.0000E+03	2.9788E+05	1.3800E+04	2.35388E+00
1.0000E+03	2.9888E+05	1.3847E+04	2.33181E+00
1.0000E+03	2.9988E+05	1.3893E+04	2.30994E+00
1.0000E+03	3.0087E+05	1.3939E+04	2.28828E+00
1.0000E+03	3.0187E+05	1.3986E+04	2.26682E+00
1.0000E+03	3.0287E+05	1.4032E+04	2.24556E+00
1.0000E+03	3.0387E+05	1.4078E+04	2.22450E+00
1.0000E+03	3.0487E+05	1.4124E+04	2.20364E+00
1.0000E+03	3.0587E+05	1.4171E+04	2.18297E+00
1.0000E+03	3.0687E+05	1.4217E+04	2.16250E+00
1.0000E+03	3.0787E+05	1.4263E+04	2.14222E+00
1.0000E+03	3.0886E+05	1.4309E+04	2.12213E+00
1.0000E+03	3.0986E+05	1.4356E+04	2.10223E+00
1.0000E+03	3.1086E+05	1.4402E+04	2.08251E+00
1.0000E+03	3.1186E+05	1.4448E+04	2.06298E+00
1.0000E+03	3.1286E+05	1.4495E+04	2.04363E+00
1.0000E+03	3.1386E+05	1.4541E+04	2.02447E+00
1.0000E+03	3.1486E+05	1.4587E+04	2.00548E+00
1.0000E+03	3.1586E+05	1.4633E+04	1.98667E+00
1.0000E+03	3.1685E+05	1.4680E+04	1.96804E+00
1.0000E+03	3.1785E+05	1.4726E+04	1.94959E+00
1.0000E+03	3.1885E+05	1.4772E+04	1.93130E+00
1.0000E+03	3.1985E+05	1.4818E+04	1.91319E+00
1.0000E+03	3.2085E+05	1.4865E+04	1.89525E+00
1.0000E+03	3.2185E+05	1.4911E+04	1.87747E+00
1.0000E+03	3.2285E+05	1.4957E+04	1.85987E+00
1.0000E+03	3.2385E+05	1.5004E+04	1.84242E+00
1.0000E+03	3.2484E+05	1.5050E+04	1.82515E+00
1.0000E+03	3.2584E+05	1.5096E+04	1.80803E+00
1.0000E+03	3.2684E+05	1.5142E+04	1.79107E+00
1.0000E+03	3.2784E+05	1.5189E+04	1.77428E+00
1.0000E+03	3.2884E+05	1.5235E+04	1.75764E+00
1.0000E+03	3.2984E+05	1.5281E+04	1.74115E+00
1.0000E+03	3.3084E+05	1.5327E+04	1.72482E+00

1.0000E+03	3.3184E+05	1.5374E+04	1.70865E+00
1.0000E+03	3.3283E+05	1.5420E+04	1.69262E+00
1.0000E+03	3.3383E+05	1.5466E+04	1.67675E+00
1.0000E+03	3.3483E+05	1.5512E+04	1.66103E+00
1.0000E+03	3.3583E+05	1.5559E+04	1.64545E+00
1.0000E+03	3.3683E+05	1.5605E+04	1.63002E+00
1.0000E+03	3.3783E+05	1.5651E+04	1.61473E+00
1.0000E+03	3.3883E+05	1.5698E+04	1.59959E+00
1.0000E+03	3.3983E+05	1.5744E+04	1.58459E+00
1.0000E+03	3.4082E+05	1.5790E+04	1.56973E+00
1.0000E+03	3.4182E+05	1.5836E+04	1.55500E+00
1.0000E+03	3.4282E+05	1.5883E+04	1.54042E+00
1.0000E+03	3.4382E+05	1.5929E+04	1.52597E+00
1.0000E+03	3.4482E+05	1.5975E+04	1.51166E+00
1.0000E+03	3.4582E+05	1.6021E+04	1.49749E+00
1.0000E+03	3.4682E+05	1.6068E+04	1.48344E+00
1.0000E+03	3.4782E+05	1.6114E+04	1.46953E+00
1.0000E+03	3.4881E+05	1.6160E+04	1.45575E+00
1.0000E+03	3.4981E+05	1.6207E+04	1.44210E+00
1.0000E+03	3.5081E+05	1.6253E+04	1.42857E+00
1.0000E+03	3.5181E+05	1.6299E+04	1.41518E+00
1.0000E+03	3.5281E+05	1.6345E+04	1.40190E+00
1.0000E+03	3.5381E+05	1.6392E+04	1.38876E+00
1.0000E+03	3.5481E+05	1.6438E+04	1.37573E+00
1.0000E+03	3.5581E+05	1.6484E+04	1.36283E+00
1.0000E+03	3.5680E+05	1.6530E+04	1.35005E+00
1.0000E+03	3.5780E+05	1.6577E+04	1.33739E+00
1.0000E+03	3.5880E+05	1.6623E+04	1.32485E+00
1.0000E+03	3.5980E+05	1.6669E+04	1.31242E+00
1.0000E+03	3.6080E+05	1.6716E+04	1.30011E+00
1.0000E+03	3.6180E+05	1.6762E+04	1.28792E+00
1.0000E+03	3.6280E+05	1.6808E+04	1.27584E+00
1.0000E+03	3.6380E+05	1.6854E+04	1.26388E+00
1.0000E+03	3.6479E+05	1.6901E+04	1.25202E+00
1.0000E+03	3.6579E+05	1.6947E+04	1.24028E+00
1.0000E+03	3.6679E+05	1.6993E+04	1.22865E+00
1.0000E+03	3.6779E+05	1.7039E+04	1.21713E+00
1.0000E+03	3.6879E+05	1.7086E+04	1.20571E+00
1.0000E+03	3.6979E+05	1.7132E+04	1.19441E+00
1.0000E+03	3.7079E+05	1.7178E+04	1.18321E+00
1.0000E+03	3.7179E+05	1.7225E+04	1.17211E+00
1.0000E+03	3.7278E+05	1.7271E+04	1.16112E+00
1.0000E+03	3.7378E+05	1.7317E+04	1.15023E+00
1.0000E+03	3.7478E+05	1.7363E+04	1.13944E+00
1.0000E+03	3.7578E+05	1.7410E+04	1.12875E+00
1.0000E+03	3.7678E+05	1.7456E+04	1.11817E+00
1.0000E+03	3.7778E+05	1.7502E+04	1.10768E+00
1.0000E+03	3.7878E+05	1.7548E+04	1.09729E+00
1.0000E+03	3.7978E+05	1.7595E+04	1.08700E+00
1.0000E+03	3.8077E+05	1.7641E+04	1.07681E+00
1.0000E+03	3.8177E+05	1.7687E+04	1.06671E+00
1.0000E+03	3.8277E+05	1.7734E+04	1.05671E+00
1.0000E+03	3.8377E+05	1.7780E+04	1.04681E+00
1.0000E+03	3.8477E+05	1.7826E+04	1.03726E+00
1.0000E+03	3.8577E+05	1.7872E+04	1.03246E+00
1.0000E+03	3.8677E+05	1.7919E+04	1.08024E+00
1.0000E+03	3.8777E+05	1.7965E+04	1.49252E+00
1.0000E+03	3.8876E+05	1.8011E+04	3.42473E+00
1.0000E+03	3.8976E+05	1.8057E+04	8.91009E+00
1.0000E+03	3.9076E+05	1.8104E+04	1.79456E+01

1.0000E+03	3.9176E+05	1.8150E+04	2.49223E+01
1.0000E+03	3.9276E+05	1.8196E+04	2.32933E+01
1.0000E+03	3.9376E+05	1.8242E+04	1.45954E+01
1.0000E+03	3.9476E+05	1.8289E+04	6.13730E+00
1.0000E+03	3.9576E+05	1.8335E+04	1.73579E+00
1.0000E+03	3.9675E+05	1.8381E+04	3.31003E-01
1.0000E+03	3.9775E+05	1.8428E+04	4.26679E-02
1.0000E+03	3.9875E+05	1.8474E+04	3.72808E-03
1.0000E+03	3.9975E+05	1.8520E+04	2.21190E-04
1.0000E+03	4.0075E+05	1.8566E+04	8.94757E-06
1.0000E+03	4.0175E+05	1.8613E+04	2.47445E-07
1.0000E+03	4.0275E+05	1.8659E+04	4.69373E-09
1.0000E+03	4.0375E+05	1.8705E+04	6.12791E-11
1.0000E+03	4.0474E+05	1.8751E+04	5.50359E-13

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*****
*
*       ONE-DIMENSIONAL CONVECTIVE-DISPERSIVE EQUATION
*       *11/26/85* VERSION
*       SEMI-INFINITE PROFILE
*
*       NUCLIDE DECAY (THALF)
*       LINEAR ADSORPTION (R)
*       GENERAL NUCLIDE RELEASE CURVE
*       TRANSPORT SUM OVER PATHLINES
*
*       CIMARRON LANDFILL: Kd=300 controlled release - U-238
*       SATURATED ZONE
*****

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NUCLIDE: U-238

INPUT PARAMETERS  
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V =      130.38          D =      1.00
R =      1600.0          T0 = 7.3683E+04
TOTAL =1.81E+12          TDECAY=0.000E-01
THALF= 4.5000E+09        C0 = 4.539E+05
XL =1.0000E+03
NUCLIDE DECAY CONSTANT = 1.54033E-10

```

CONTROL FLAGS:  
IOPTBC= 0 IFLUX= 0 ITYPE= 1 IOPT= 3

RELEASE MODEL PARAMETERS:  
PLAN VIEW AREA=8.0000E+04  
DEPTH=1.0000E+01  
WATER FLUX Q=3.0000E-01  
THETA =0.3000  
MAX CONCENTRATION=1.0000E+12  
RELEASE CURVE ERROR=1.0000E-02

FRACTION REMAINING CURVE  
TIME FRACTION

0.00E-01	1.00000
2.88E+02	0.98199
5.75E+02	0.96437
8.60E+02	0.94713
1.14E+03	0.93027
1.43E+03	0.91376
1.71E+03	0.89760
1.99E+03	0.88179
2.27E+03	0.86632
2.55E+03	0.85117
2.83E+03	0.83634
3.10E+03	0.82183
3.38E+03	0.80762



3.66E+03	0.79370
3.93E+03	0.78008
4.20E+03	0.76673
4.47E+03	0.75367
4.74E+03	0.74087
5.01E+03	0.72834
5.28E+03	0.71606
5.55E+03	0.70403
5.81E+03	0.69225
6.08E+03	0.68071
6.34E+03	0.66940
6.61E+03	0.65832
6.87E+03	0.64746
7.13E+03	0.63683
7.39E+03	0.62640
7.65E+03	0.61618
7.91E+03	0.60616
8.16E+03	0.59635
8.42E+03	0.58672
8.67E+03	0.57729
8.93E+03	0.56804
9.18E+03	0.55897
9.43E+03	0.55008
9.68E+03	0.54136
9.93E+03	0.53281
1.02E+04	0.52443
1.04E+04	0.51621
1.07E+04	0.50814
1.09E+04	0.50023
1.12E+04	0.49247
1.14E+04	0.48486
1.17E+04	0.47739
1.19E+04	0.47006
1.21E+04	0.46288
1.24E+04	0.45582
1.26E+04	0.44890
1.29E+04	0.44211
1.31E+04	0.43544
1.33E+04	0.42890
1.36E+04	0.42248
1.38E+04	0.41618
1.40E+04	0.40999
1.43E+04	0.40392
1.45E+04	0.39796
1.47E+04	0.39210
1.50E+04	0.38636
1.52E+04	0.38071
1.54E+04	0.37517
1.56E+04	0.36973
1.59E+04	0.36439
1.61E+04	0.35914
1.63E+04	0.35399
1.66E+04	0.34892
1.68E+04	0.34395
1.70E+04	0.33906
1.72E+04	0.33427
1.74E+04	0.32955
1.77E+04	0.32492
1.79E+04	0.32037
1.81E+04	0.31590

1.83E+04	0.31150
1.85E+04	0.30718
1.87E+04	0.30294
1.90E+04	0.29877
1.92E+04	0.29467
1.94E+04	0.29064
1.96E+04	0.28668
1.98E+04	0.28279
2.00E+04	0.27896
2.02E+04	0.27520
2.04E+04	0.27150
2.06E+04	0.26786
2.09E+04	0.26428
2.11E+04	0.26077
2.13E+04	0.25731
2.15E+04	0.25391
2.17E+04	0.25057
2.19E+04	0.24728
2.21E+04	0.24404
2.23E+04	0.24086
2.25E+04	0.23773
2.27E+04	0.23465
2.29E+04	0.23162
2.31E+04	0.22864
2.33E+04	0.22571
2.35E+04	0.22283
2.37E+04	0.21999
2.39E+04	0.21720
2.41E+04	0.00000

RELEASE INTERVAL NUMBER= 102

PATHLINE PARAMETERS:

TRAVELTIME	PATH LENGTH	VELOCITY	PDF
2.2010E+01	1.0190E+03	4.6297E+01	5.5556E+01
2.2019E+01	1.0200E+03	4.6324E+01	5.0000E+02
2.2020E+01	1.0210E+03	4.6367E+01	0.0000E-01

ADDITIONAL ZONE PARAMETERS:

XV=2.0000E+01 TV=1.4500E+01

AVERAGES:

LENGTH=1.0000E+03 TIME=2.2016E+01 VELOCITY=4.6329E+01

\*\*\* QUANTITY IS CONCENTRATION \*\*\*

CONVERSION FACTOR = 3.2695E-05

DISTANCE (X)	TIME (T)	PORE VOLUME (VVO)	QUANTITY (Q)
1.0000E+03	3.1955E+04	1.4805E+03	1.39843E-49
1.0000E+03	3.2953E+04	1.5267E+03	1.64081E-23
1.0000E+03	3.3951E+04	1.5729E+03	2.06558E-07
1.0000E+03	3.4949E+04	1.6192E+03	3.18349E+00
1.0000E+03	3.5947E+04	1.6654E+03	2.73703E+01

1.0000E+03	3.6945E+04	1.7116E+03	2.57405E+01
1.0000E+03	3.7943E+04	1.7579E+03	2.41840E+01
1.0000E+03	3.8941E+04	1.8041E+03	2.27217E+01
1.0000E+03	3.9939E+04	1.8503E+03	2.13477E+01
1.0000E+03	4.0937E+04	1.8966E+03	2.00569E+01
1.0000E+03	4.1935E+04	1.9428E+03	1.88441E+01
1.0000E+03	4.2933E+04	1.9890E+03	1.77046E+01
1.0000E+03	4.3931E+04	2.0353E+03	1.66340E+01
1.0000E+03	4.4929E+04	2.0815E+03	1.56282E+01
1.0000E+03	4.5927E+04	2.1277E+03	1.46832E+01
1.0000E+03	4.6925E+04	2.1740E+03	1.37953E+01
1.0000E+03	4.7923E+04	2.2202E+03	1.29611E+01
1.0000E+03	4.8921E+04	2.2665E+03	1.21774E+01
1.0000E+03	4.9919E+04	2.3127E+03	1.14411E+01
1.0000E+03	5.0916E+04	2.3589E+03	1.07492E+01
1.0000E+03	5.1914E+04	2.4052E+03	1.00993E+01
1.0000E+03	5.2912E+04	2.4514E+03	9.48857E+00
1.0000E+03	5.3910E+04	2.4976E+03	8.91481E+00
1.0000E+03	5.4908E+04	2.5439E+03	8.37575E+00
1.0000E+03	5.5906E+04	2.5901E+03	7.86929E+00
1.0000E+03	5.6904E+04	2.6363E+03	7.39345E+00
1.0000E+03	5.7902E+04	2.6826E+03	6.94641E+00
1.0000E+03	5.9898E+04	2.7750E+03	1.91932E+00
1.0000E+03	6.0896E+04	2.8213E+03	1.61312E-09

CIMARRON FACILITY  
MONITORING WELL SUMMARY  
U-238, pCi/l

<u>Well No.</u>	<u>Avg. + 1 Std.</u>	<u>Max.</u>	<u>Min.</u>	<u>Number of Samples</u>	<u>Sampling Period</u>
1301	3.7 $\pm$ 3.2	13	0.7	35	1971-1988
1302	2.5 $\pm$ 0.7	3.3	1.7	4	1971-1981
1303	1.4 $\pm$ 0.9	4.3	0.3	30	1971-1985
1304	157 $\pm$ 276	765	1.7	7	1971
1305	4.2 $\pm$ 9.1	53	0.1	32	1971-1988
1306	8.9 $\pm$ 16.2	42	1.3	6	1974-1988
1307	1.8 $\pm$ 1.6	7.0	0.7	34	1971-1988
1309	1.9 $\pm$ 0.2	2.0	1.7	2	1987-1988
1311	1.3 $\pm$ 0.5	1.7	0.7	4	1985-1988
1312	39 $\pm$ 36	86	5.6	4	1985-1988
1313	29 $\pm$ 8.7	42	23	4	1985-1988
1314	1.4 $\pm$ 0.8	2.3	0.7	4	1985-1988
1315	1880 $\pm$ 350	2310	1340	6	1985-1988
1316	218 $\pm$ 214	530	63	4	1985-1988
1317	15 $\pm$ 17	42	0.7	5	1985-1988
1318	2.0 $\pm$ 0.9	3.0	1.3	3	1986-1988