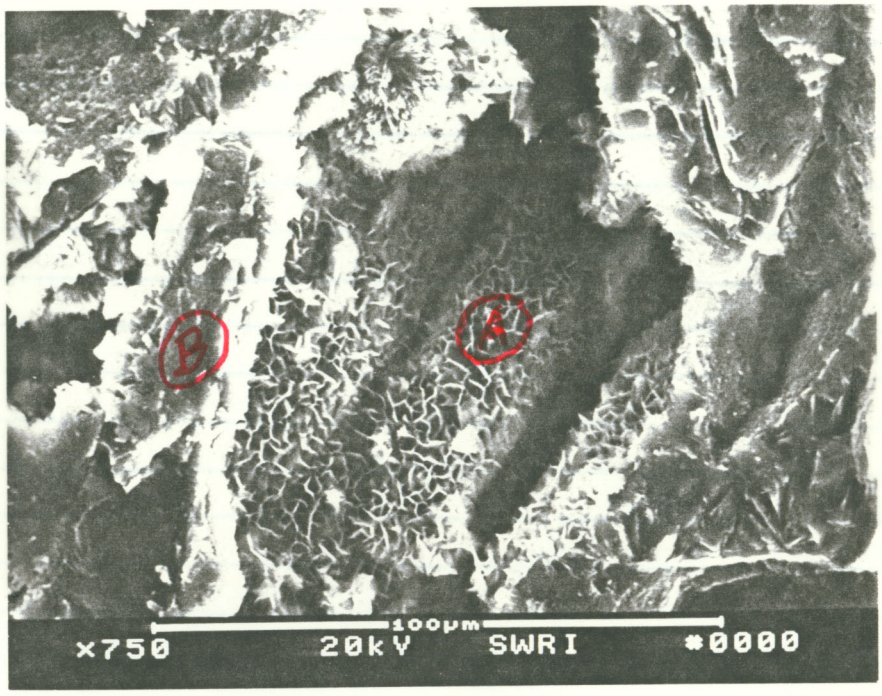
Conduct SEM and EDS work in DIN. 06 using Northern Tracor system.

Results:



Sample CGC-2
(Log # 39594)

SAMPLE CGC-2 - GRANT COUNTY, N.M.-20KV,WD=30
Standardless Analysis
20.0 KV 42.2 Degrees

Chi-sqd = 0.88

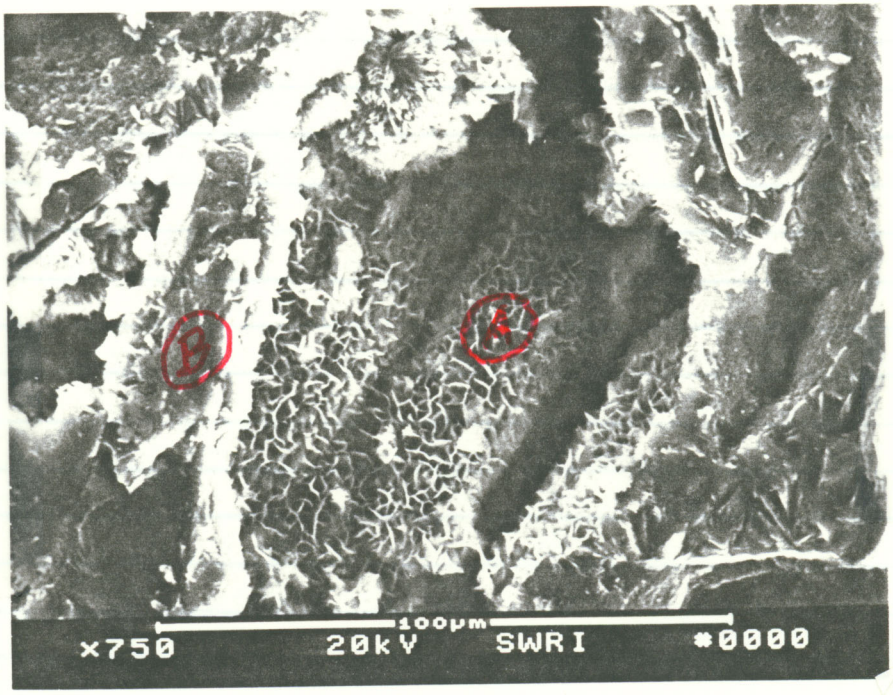
Element	Rel. K-ratio	Net Counts
Si-K	0.37022 +/- 0.00465	23790 +/- 299
Fe-K	0.43998 +/- 0.00974	10211 +/- 226
Al-K	0.05632 +/- 0.00453	3367 +/- 271
K -K	0.04971 +/- 0.00288	2605 +/- 151
Ca-K	0.05673 +/- 0.00362	2756 +/- 176
Mg-K	0.01706 +/- 0.00238	882 +/- 123
Ti-K	0.00999 +/- 0.00303	402 +/- 122

ZAF Correction 20.00 kV 42.17 deg
No.of Iterations = 4

Element	K-ratio	Z	A	F	Atom%	Wt%
Si-K	0.284	0.960	1.572	0.999	54.05	42.87
Fe-K	0.338	1.070	1.019	1.000	23.39	36.89
Al-K	0.043	0.988	1.744	0.986	9.66	7.36
K -K	0.038	1.002	1.184	0.986	4.05	4.48
Ca-K	0.044	0.978	1.147	0.987	4.27	4.83
Mg-K	0.013	0.959	2.171	0.992	3.95	2.71
Ti-K	0.008	1.069	1.085	0.966	0.64	0.86
					Total=	100.00%

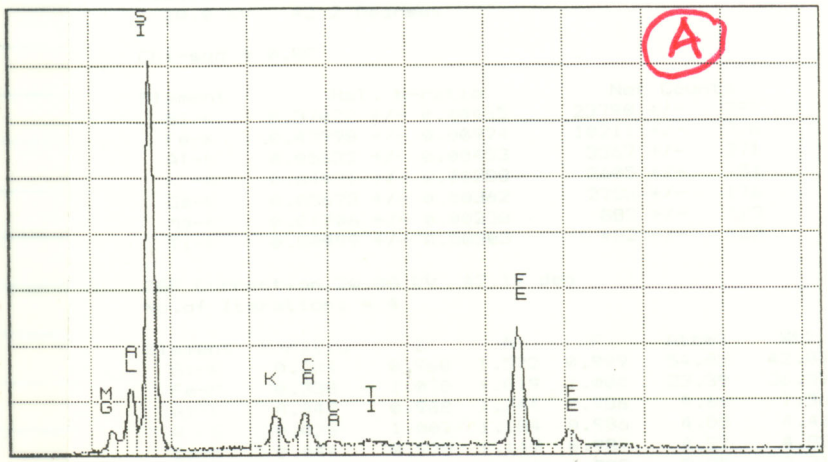
Conduct SEM and EDS work in DIV. 06 using Northern Tracor system.

Results:



Sample CGC-2
(Log # 39594)

Series II Southwest Research Institute MON 09-OCT-89 13:23
Cursor: 0.000keV = 0



SAMPLE CGC-2 - GRANT COUNTY, N.M.-20KV,WD=30
Standardless Analysis
20.0 KV 42.2 Degrees

Chi-sqd = 0.79

Element	Rel. K-ratio	Net Counts
Si-K	0.61797 +/- 0.00760	24815 +/- 305
Fe-K	0.16478 +/- 0.00786	2390 +/- 114
Al-K	0.10352 +/- 0.00744	3867 +/- 278
K -K	0.03946 +/- 0.00348	1292 +/- 114
Ca-K	0.04485 +/- 0.00415	1361 +/- 126
Mg-K	0.02266 +/- 0.00402	732 +/- 130
Ti-K	0.00676 +/- 0.00306	170 +/- 77

ZAF Correction 20.00 kV 42.17 deg
No.of Iterations = 9

Element	K-ratio	Z	A	F	Atom%	Wt%
Si-K	0.475	0.981	1.380	0.999	70.39	64.22
Fe-K	0.127	1.100	1.022	1.000	7.84	14.22
Al-K	0.080	1.010	1.348	0.973	12.03	10.54
K -K	0.030	1.027	1.228	0.993	2.99	3.80
Ca-K	0.034	1.003	1.175	0.995	3.11	4.04
Mg-K	0.017	0.981	1.526	0.983	3.25	2.56
Ti-K	0.005	1.098	1.094	0.989	0.40	0.62
					Total=	100.00%

SAMPLE CGC-2 - GRANT COUNTY, N.M.-20KV,WD=30
Standardless Analysis
20.0 KV 42.2 Degrees

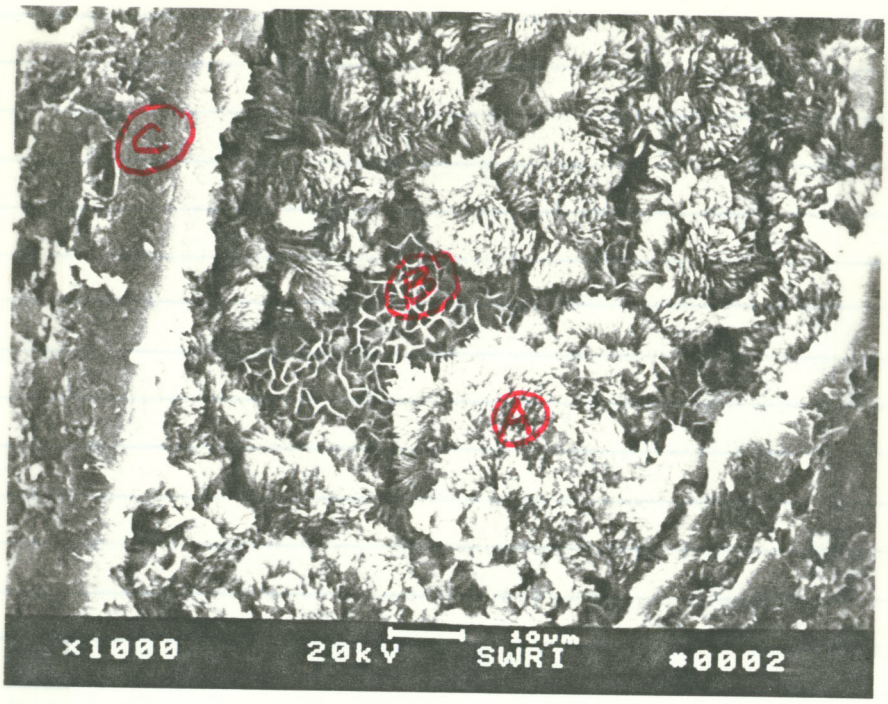
Chi-sqd = 0.87

Element	Rel. K-ratio	Net Counts
Si-K	0.69161 +/- 0.00815	26207 +/- 309
Fe-K	0.05798 +/- 0.00665	793 +/- 91
Al-K	0.13049 +/- 0.00777	4600 +/- 274
K -K	0.02993 +/- 0.00356	925 +/- 110
Ca-K	0.07331 +/- 0.00471	2100 +/- 135
Mg-K	0.00731 +/- 0.00400	223 +/- 122
Ti-K	0.00938 +/- 0.00333	223 +/- 79

ZAF Correction 20.00 kV 42.17 deg
No.of Iterations = 8

Element	K-ratio	Z	A	F	Atom%	Wt%
Si-K	0.553	0.988	1.299	0.999	74.88	70.91
Fe-K	0.046	1.109	1.025	1.000	2.79	5.26
Al-K	0.104	1.017	1.192	0.966	13.40	12.19
K -K	0.024	1.034	1.236	0.992	2.30	3.03
Ca-K	0.059	1.011	1.177	0.998	5.14	6.94
Mg-K	0.006	0.988	1.341	0.978	0.92	0.76
Ti-K	0.007	1.106	1.106	0.996	0.56	0.91
					Total=	100.00%

Sample CGC-2 (Log # 39599)
(EDS dot mapping done; data stored on hard disk)



Sample CGC-3
(Log # 38596)

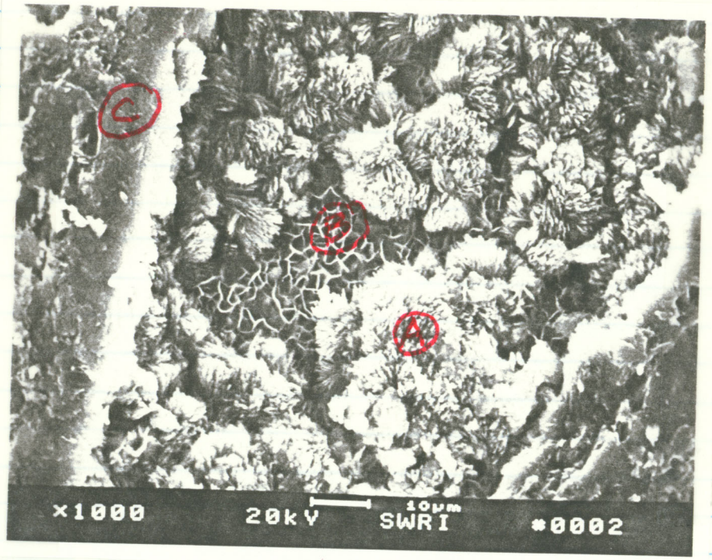
SAMPLE CGC-3 - GRANT COUNTY, N.M.-20KV,WD=29
Standardless Analysis
20.0 KV 41.7 Degrees

Chi-sqd = 0.93

Element	Rel. K-ratio	Net Counts
Si-K	0.75411 +/- 0.00907	24705 +/- 297
Fe-K	0.01054 +/- 0.00532	125 +/- 63
Al-K	0.13820 +/- 0.00857	4211 +/- 261
K -K	0.02387 +/- 0.00355	638 +/- 95
Ca-K	0.06867 +/- 0.00480	1702 +/- 119
Mg-K	0.00461 +/- 0.00440	121 +/- 116

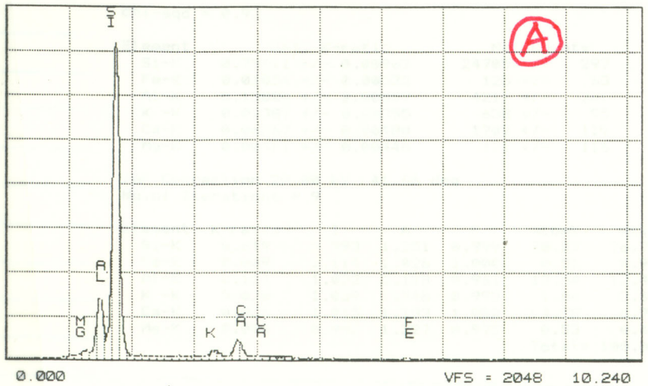
ZAF Correction 20.00 kV 41.66 deg
No.of Iterations = 9

Element	K-ratio	Z	A	F	Atom%	Wt%
Si-K	0.619	0.993	1.251	0.999	78.87	76.78
Fe-K	0.009	1.114	1.026	1.000	0.51	0.99
Al-K	0.114	1.022	1.118	0.961	13.34	12.48
K -K	0.020	1.039	1.246	0.993	1.86	2.52
Ca-K	0.056	1.015	1.183	1.000	4.88	6.78
Mg-K	0.004	0.992	1.227	0.975	0.53	0.45
					Total=	100.00%

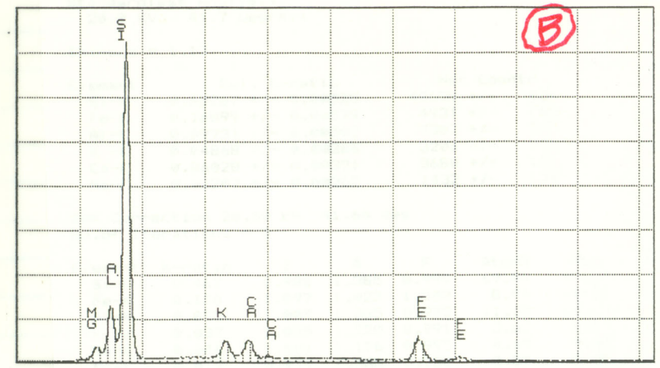


Sample CGC-3
(Log # 39596)

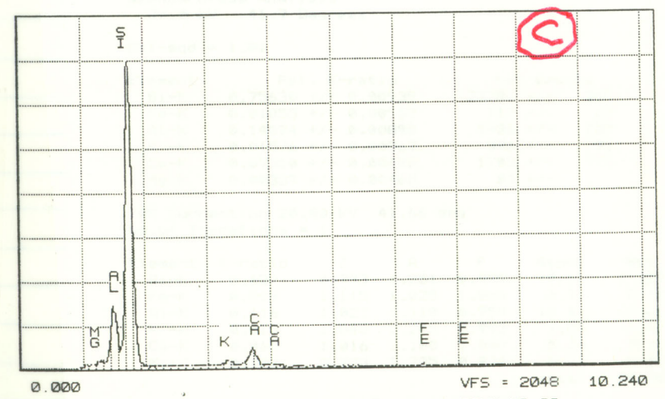
Series II Southwest Research Institute MON 09-OCT-89 14:37
Cursor: 0.000keV = 0



Series II Southwest Research Institute MON 09-OCT-89 14:42
Cursor: 0.000keV = 0



Series II Southwest Research Institute MON 09-OCT-89 14:47
Cursor: 0.000keV = 0



SAMPLE CGC-3 - GRANT COUNTY, N.M.-20KV,WD=29
Standardless Analysis
20.0 KV 41.7 Degrees

Chi-sqd = 1.12

Element	Rel. K-ratio	Net Counts
Si-K	0.60267 +/- 0.00525	48629 +/- 424
Fe-K	0.16899 +/- 0.00579	4931 +/- 169
Al-K	0.09731 +/- 0.00502	7302 +/- 377
K -K	0.04868 +/- 0.00266	3206 +/- 175
Ca-K	0.06028 +/- 0.00321	3680 +/- 196
Mg-K	0.02207 +/- 0.00262	1432 +/- 170

ZAF Correction 20.00 kV 41.66 deg
No.of Iterations = 6

Element	K-ratio	Z	A	F	Atom%	Wt%
Si-K	0.462	0.980	1.385	0.999	69.09	62.64
Fe-K	0.130	1.097	1.023	1.000	8.07	14.55
Al-K	0.075	1.009	1.385	0.975	11.68	10.17
K -K	0.037	1.025	1.220	0.991	3.67	4.63
Ca-K	0.046	1.001	1.176	0.995	4.19	5.42
Mg-K	0.017	0.979	1.585	0.985	3.30	2.59
					Total=	100.00%

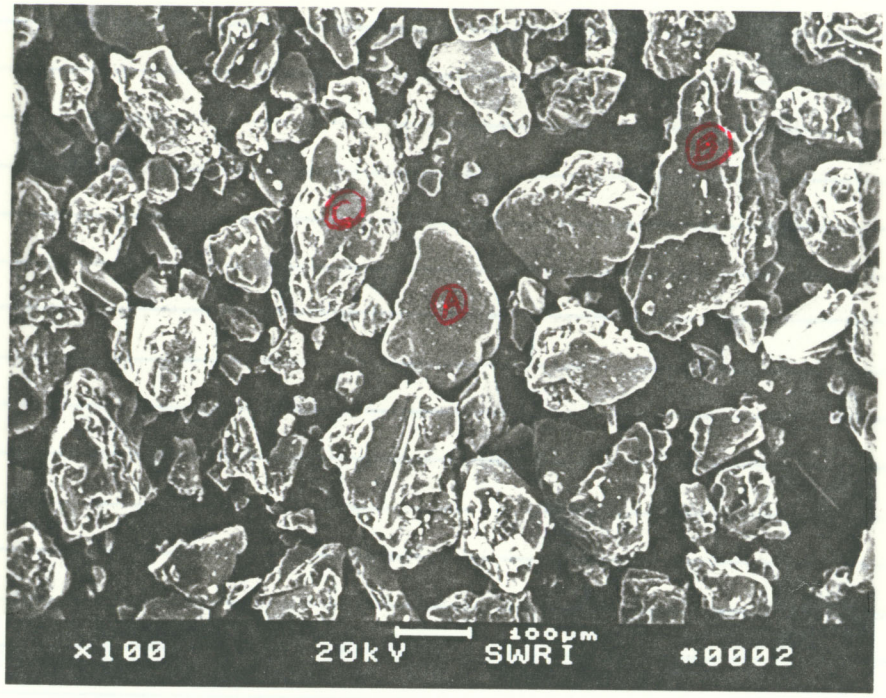
SAMPLE CGC-3 - GRANT COUNTY, N.M.-20KV,WD=29
Standardless Analysis
20.0 KV 41.7 Degrees

Chi-sqd = 1.01

Element	Rel. K-ratio	Net Counts
Si-K	0.75630 +/- 0.00939	23287 +/- 289
Fe-K	0.01053 +/- 0.00557	117 +/- 62
Al-K	0.14094 +/- 0.00898	4036 +/- 257
K -K	0.01576 +/- 0.00362	396 +/- 91
Ca-K	0.07310 +/- 0.00498	1703 +/- 116
Mg-K	0.00339 +/- 0.00468	84 +/- 116

ZAF Correction 20.00 kV 41.66 deg
No.of Iterations = 1

Element	K-ratio	Z	A	F	Atom%	Wt%
Si-K	0.622	0.993	1.251	0.999	79.22	77.20
Fe-K	0.009	1.115	1.025	1.000	0.51	0.99
Al-K	0.116	1.022	1.110	0.959	13.47	12.61
K -K	0.013	1.040	1.249	0.992	1.23	1.67
Ca-K	0.060	1.016	1.180	1.000	5.18	7.20
Mg-K	0.003	0.993	1.225	0.974	0.39	0.33
					Total=	100.00%



Sample CGC-CLN
(Log # 37597)

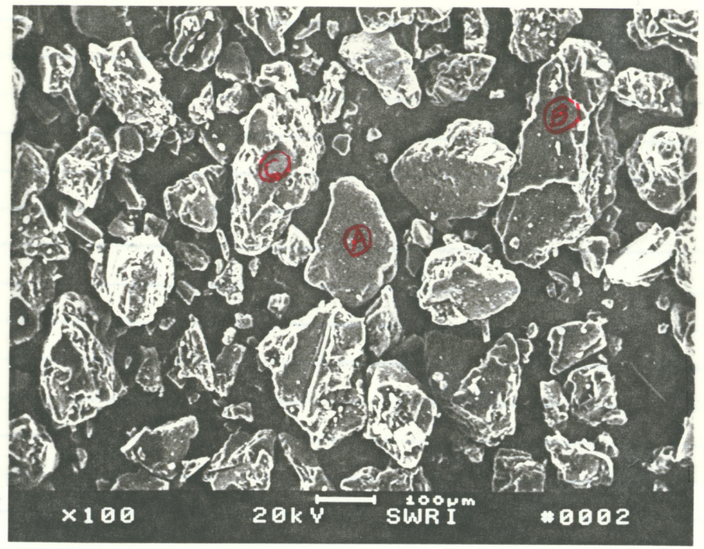
SAMPLE CGC CLEAN - GRANT COUNTY, N.M.,WD=32
Standardless Analysis
20.0 KV 43.2 Degrees

Chi-sqd = 0.73

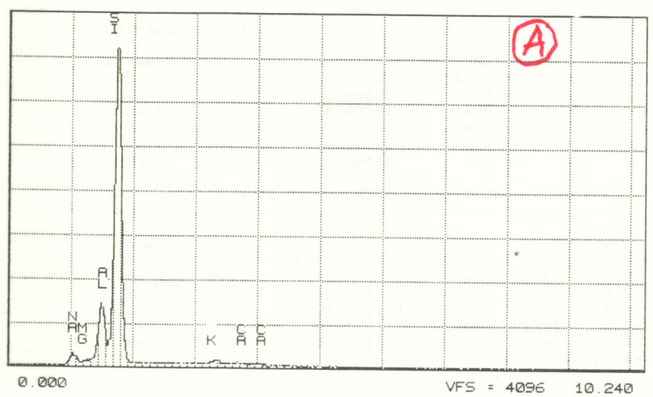
Element	Rel. K-ratio	Net Counts
Si-K	0.74862 +/- 0.00635	50078 +/- 425
Al-K	0.14471 +/- 0.00636	9010 +/- 396
Na-K	0.07314 +/- 0.00391	1498 +/- 80
K -K	0.01703 +/- 0.00222	928 +/- 121
Ca-K	0.00731 +/- 0.00240	369 +/- 121
Mg-K	0.00919 +/- 0.00419	496 +/- 226

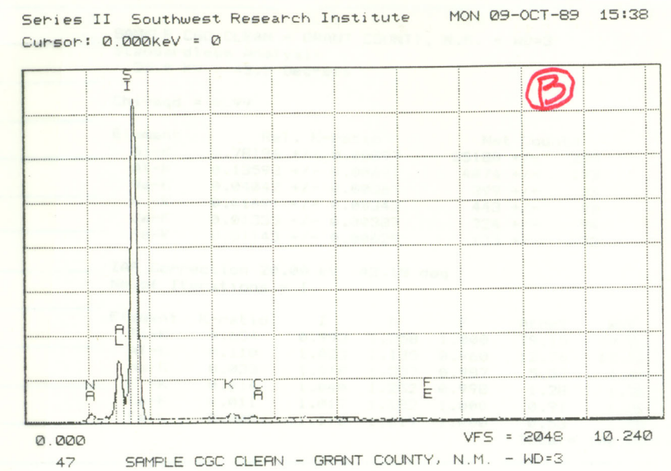
ZAF Correction 20.00 kV 43.18 deg
No.of Iterations = 12

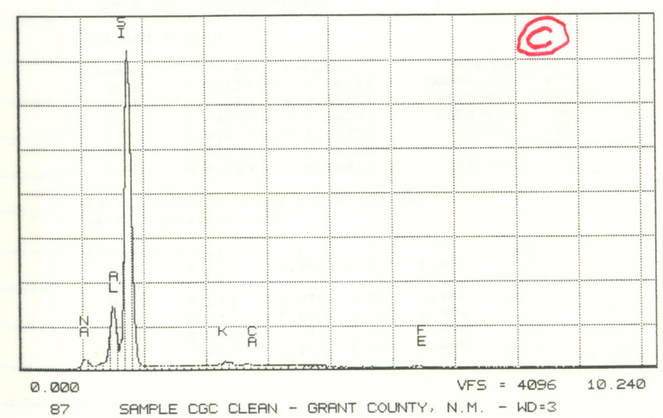
Element	K-ratio	Z	A	F	Atom%	Wt%
Si-K	0.587	0.994	1.303	1.000	74.72	75.94
Al-K	0.114	1.022	1.182	0.965	13.63	13.31
Na-K	0.058	1.018	1.275	0.988	8.88	7.39
K -K	0.013	1.040	1.247	0.999	1.23	1.74
Ca-K	0.006	1.016	1.179	1.000	0.48	0.69
Mg-K	0.007	0.992	1.329	0.978	1.06	0.93
					Total=	100.00%



Sample CGC-CLN
(Log # 39597)







SAMPLE CGC CLEAN - GRANT COUNTY, N.M. - WD=3
Standardless Analysis
20.0 KV 43.2 Degrees

Chi-sqd = 0.99

Element	Rel. K-ratio	Net Counts
Si-K	0.78196 +/- 0.00897	25180 +/- 289
Al-K	0.13592 +/- 0.00641	4074 +/- 192
Na-K	0.04042 +/- 0.00365	399 +/- 36
K -K	0.01691 +/- 0.00343	443 +/- 90
Ca-K	0.01335 +/- 0.00387	324 +/- 94
Fe-K	0.01143 +/- 0.00629	133 +/- 73

ZAF Correction 20.00 kV 43.18 deg
No.of Iterations = 1

Element	K-ratio	Z	A	F	Atom%	Wt%
Si-K	0.634	0.993	1.258	1.000	79.15	79.21
Al-K	0.110	1.023	1.135	0.960	12.76	12.26
Na-K	0.033	1.018	1.337	0.987	5.37	4.40
K -K	0.014	1.040	1.252	0.998	1.28	1.78
Ca-K	0.011	1.017	1.182	1.000	0.91	1.30
Fe-K	0.009	1.116	1.019	1.000	0.53	1.05
					Total=	100.00%

SAMPLE CGC CLEAN - GRANT COUNTY, N.M. - WD=3
Standardless Analysis
20.0 KV 43.2 Degrees

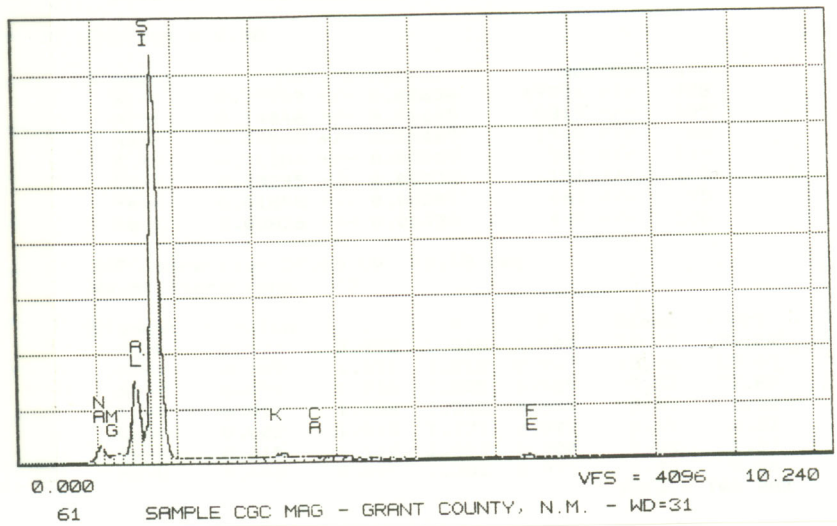
Chi-sqd = 1.18

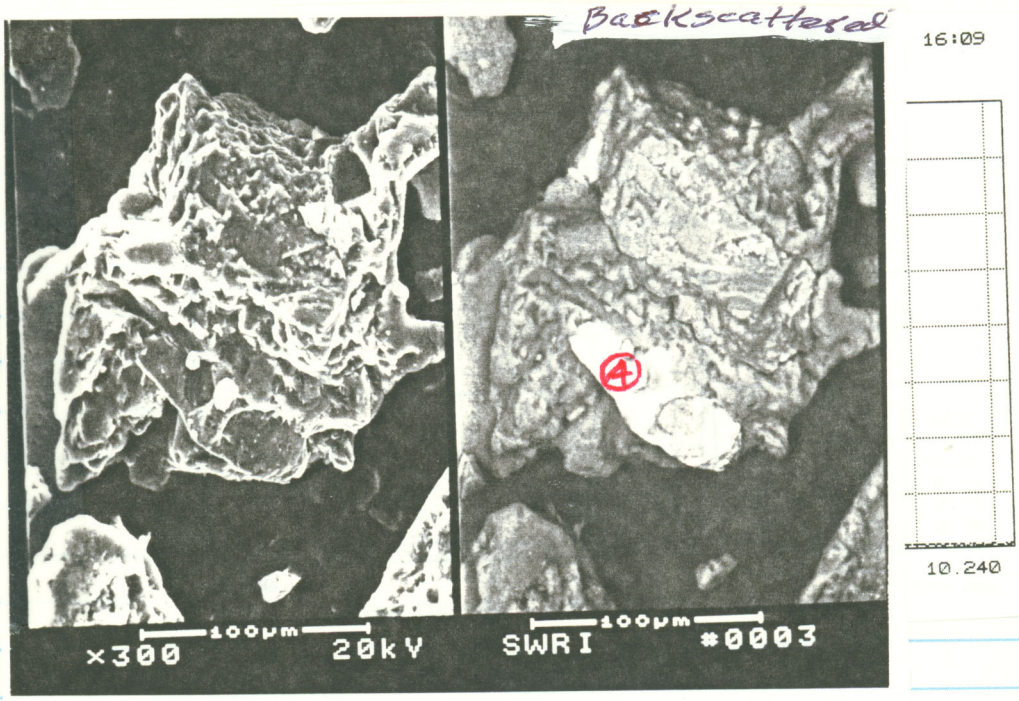
Element	Rel. K-ratio	Net Counts
Si-K	0.77120 +/- 0.00640	50006 +/- 415
Al-K	0.14008 +/- 0.00459	8455 +/- 277
Na-K	0.05137 +/- 0.00272	1020 +/- 54
K -K	0.01472 +/- 0.00239	777 +/- 126
Ca-K	0.00976 +/- 0.00268	478 +/- 131
Fe-K	0.01287 +/- 0.00411	301 +/- 96

ZAF Correction 20.00 kV 43.18 deg
No.of Iterations = 5

Element	K-ratio	Z	A	F	Atom%	Wt%
Si-K	0.616	0.993	1.276	1.000	77.72	78.07
Al-K	0.113	1.022	1.151	0.962	13.21	12.74
Na-K	0.041	1.018	1.331	0.988	6.73	5.53
K -K	0.012	1.040	1.251	0.999	1.10	1.54
Ca-K	0.008	1.016	1.181	1.000	0.66	0.94
Fe-K	0.010	1.116	1.019	1.000	0.59	1.18
					Total=	100.00%

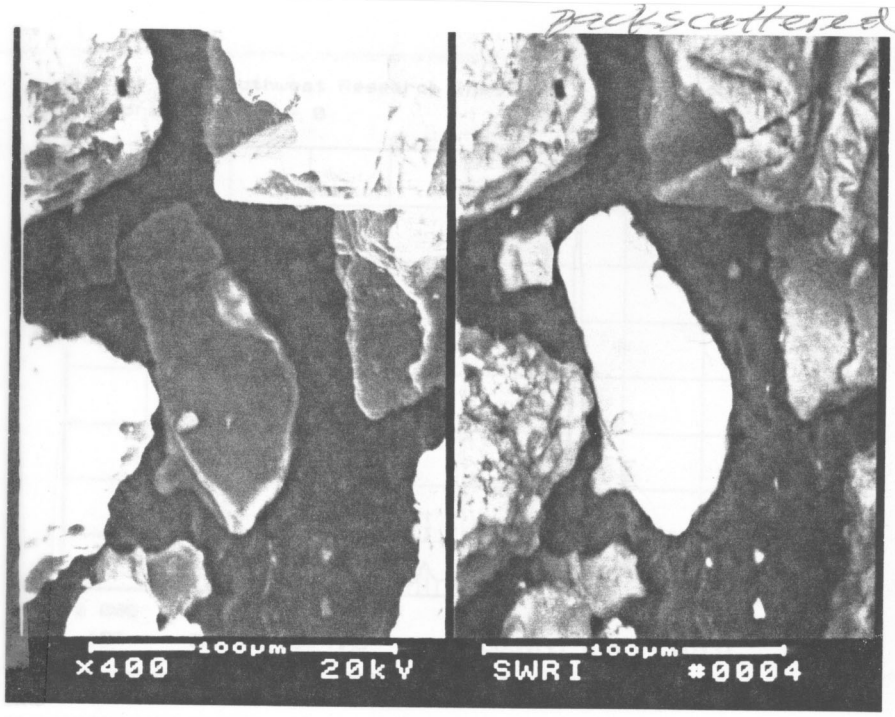
Sample CGC Mag - random grain



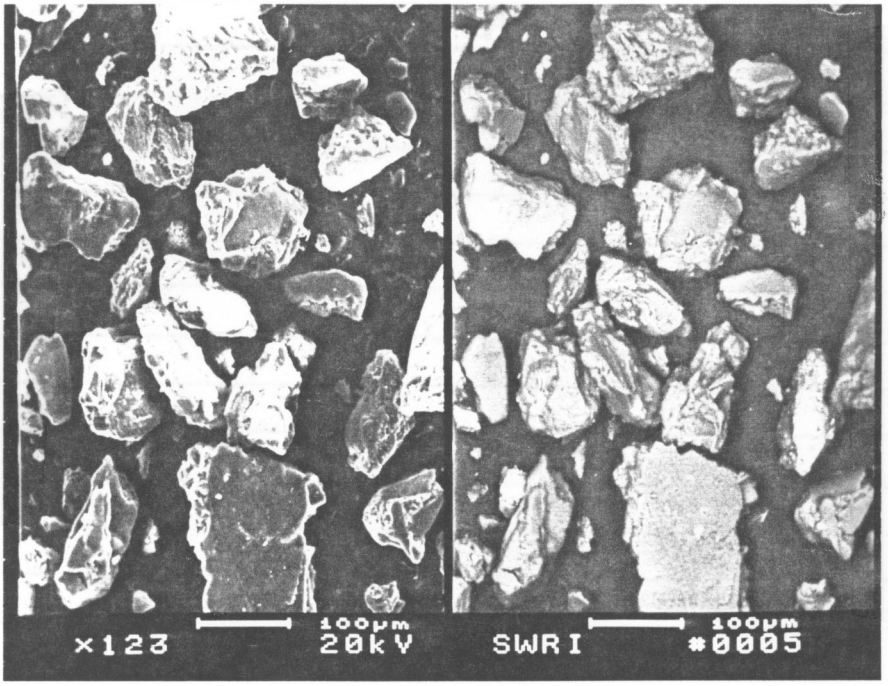


Sample CGC Mag (Log # 39598)

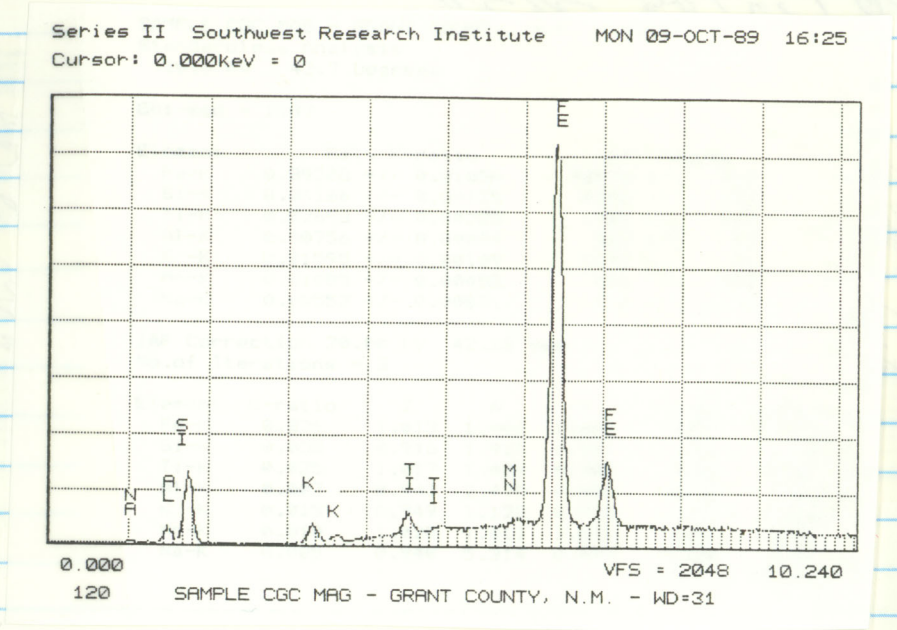
backscattered



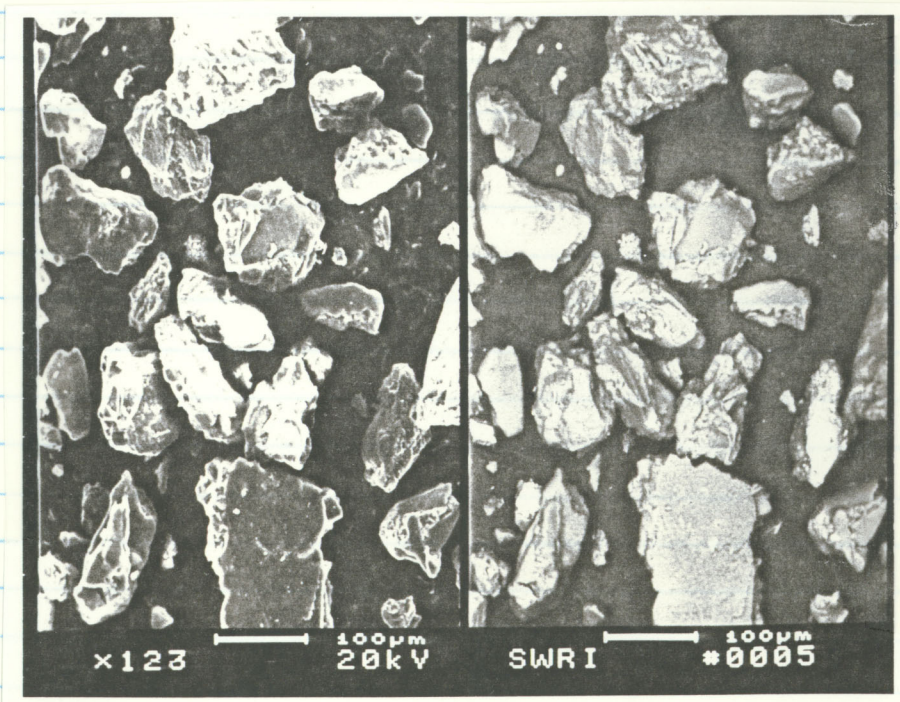
Sample CGC-Mag (Log # 39599)
Fe, Ti rich phase, bright area in backscattered image



Sample CGC-Mag (Log # 39600)
Backscattered image (right screen) shows distribution of Fe & Ti rich phases as bright areas.



Sample CGC-Mag (Log # 39599)
Fe, Ti rich phase, bright area in backscattered image



Sample CGC-Mag (Log # 39600)
Backscattered image (right screen) shows distribution of Fe & Ti rich phases as bright areas.

SAMPLE CGC MAG - GRANT COUNTY, N.M. - WD=31
Standardless Analysis
20.0 KV 42.7 Degrees

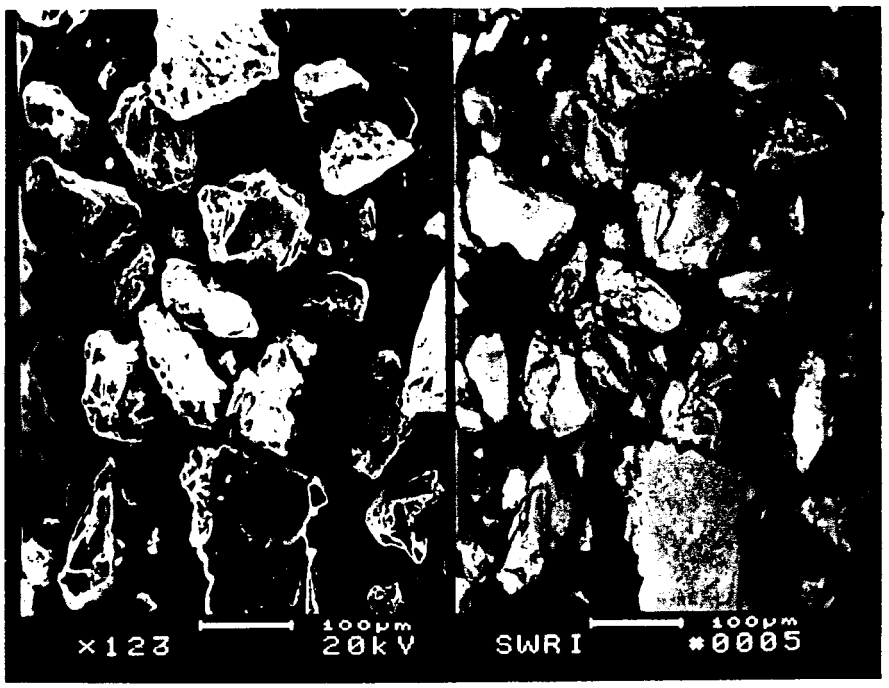
Chi-sqd = 1.87

Element	Rel. K-ratio	Net Counts
Fe-K	0.89208 +/- 0.01050	33970 +/- 400
Si-K	0.04106 +/- 0.00125	4335 +/- 132
Ti-K	0.02698 +/- 0.00233	1783 +/- 154
Al-K	0.00756 +/- 0.00099	743 +/- 97
K -K	0.01595 +/- 0.00109	1372 +/- 94
Mn-K	0.01085 +/- 0.00458	484 +/- 204
Na-K	0.00552 +/- 0.00071	178 +/- 23

ZAF Correction 20.00 kV 42.68 deg
No.of Iterations = 3

Element	K-ratio	Z	A	F	Atom%	Wt%
Fe-K	0.826	1.013	1.006	1.000	74.37	84.12
Si-K	0.038	0.916	1.935	0.999	11.83	6.73
Ti-K	0.025	1.017	1.039	0.903	2.46	2.38
Al-K	0.007	0.943	2.475	0.998	2.98	1.63
K -K	0.015	0.949	1.123	0.975	1.94	1.53
Mn-K	0.010	1.028	1.011	1.000	0.94	1.04
Na-K	0.005	0.940	5.314	0.999	5.49	2.55
					Total=	100.00%

Sample CGC-Mag (Log # 39599)
Fe, Ti rich phase, bright area in backscattered image



Sample CGC-Mag (Log # 39600)
Backscattered image (right screen) shows distribution of Fe & Ti rich phases as bright areas.

10/10/89 MJN

The following are copies of the chemical analytical results performed by Jordan Laboratories (Corpus Christi, TX) on the zeolite samples and NBS standards. Originals are in a separate file.

See 8/28/89.

TEL. 512-884-0371 PO BOX 2552 78403

JORDAN LABORATORIES, INC.
CHEMISTS AND ENGINEERS
CORPUS CHRISTI, TEXAS
SEPTEMBER 12, 1989

SOUTHWEST RESEARCH INSTITUTE
P.O. DRAWER 28510
SAN ANTONIO, TEXAS 78284

ATTENTION: MR. ROBERTO T. PABALAN

DEAR MR. PABALAN:

ENCLOSED ARE THE REPORTS COVERING ANALYSES ON THE EIGHT SILICATE SAMPLES. ANALYSIS WAS BY DIRECT ASPIRATION A.A. (P.E. 5000).

SOLUTION OF THE SAMPLES FOR SILICON DETERMINATION WAS BY POTASSIUM CARBONATE FUSION. SOLUTIONS FOR GENERAL ANALYSIS WERE MADE USING HYDROFLUORIC ACID DIGESTION. LOSS ON IGNITION WAS BY HEATING TO CONSTANT WEIGHT IN A MUFFLE FURNACE TO A MAXIMUM OF 800 DEG.C.

SINCERELY YOURS,

FRANK L. NIXON
CHIEF CHEMIST

TEL. 512-884-0371 PO BOX 2552 78403

JORDAN LABORATORIES, INC.
CHEMISTS AND ENGINEERS
CORPUS CHRISTI, TEXAS
SEPTEMBER 12, 1989

SOUTHWEST RESEARCH INSTITUTE
P.O. DRAWER 28510
SAN ANTONIO, TEXAS 78284

REPORT OF ANALYSIS

IDENTIFICATION: SAMPLE A

ALUMINUM, PPM	113000
CALCIUM, PPM	12500
IRON, PPM	430
MAGNESIUM, PPM	22
POTASSIUM, PPM	39000
SILICON, PPM	318000
SODIUM, PPM	49900

LAB. NO. M27-6010

RESPECTFULLY SUBMITTED,

CARL F. CROWNOVER

TEL. 512-884-0371 PO BOX 2552 78403

JORDAN LABORATORIES, INC.
CHEMISTS AND ENGINEERS
CORPUS CHRISTI, TEXAS
SEPTEMBER 12, 1989

SOUTHWEST RESEARCH INSTITUTE
P.O. DRAWER 28510
SAN ANTONIO, TEXAS 78284

REPORT OF ANALYSIS

IDENTIFICATION: SAMPLE B

ALUMINUM, PPM	64500
CALCIUM, PPM	23900
IRON, PPM	9800
MAGNESIUM, PPM	6800
POTASSIUM, PPM	9600
SILICON, PPM	298000
SODIUM, PPM	10500
LOSS ON IGNITION, WT.%	16.19

LAB. NO. M27-6011

RESPECTFULLY SUBMITTED,

CARL F. CROWNOVER

TEL. 512-884-0371 PO BOX 2552 78403

JORDAN LABORATORIES, INC.
CHEMISTS AND ENGINEERS
CORPUS CHRISTI, TEXAS
SEPTEMBER 12, 1989

SOUTHWEST RESEARCH INSTITUTE
P.O. DRAWER 28510
SAN ANTONIO, TEXAS 78284

REPORT OF ANALYSIS

IDENTIFICATION: SAMPLE C

ALUMINUM, PPM	130000
CALCIUM, PPM	80
IRON, PPM	170
MAGNESIUM, PPM	1
POTASSIUM, PPM	280
SILICON, PPM	272000
SODIUM, PPM	104000
LOSS ON IGNITION, WT.%	8.36

LAB. NO. M27-6012

RESPECTFULLY SUBMITTED,

CARL F. CROWNOVER

TEL. 512-884-0371 PO BOX 2552 7840

JORDAN LABORATORIES, INC.
CHEMISTS AND ENGINEERS
CORPUS CHRISTI, TEXAS
SEPTEMBER 12, 1989

SOUTHWEST RESEARCH INSTITUTE
P.O. DRAWER 28510
SAN ANTONIO, TEXAS 78284

REPORT OF ANALYSIS

IDENTIFICATION: SAMPLE D

ALUMINUM, PPM	62000
CALCIUM, PPM	23600
IRON, PPM	8900
MAGNESIUM, PPM	7100
POTASSIUM, PPM	9990
SILICON, PPM	289000
SODIUM, PPM	10700
LOSS ON IGNITION, WT.%	16.34

LAB. NO. M27-6013

RESPECTFULLY SUBMITTED,

CARL F. CROWNOVER

TEL. 512-884-0371 PO BOX 2552 78403

JORDAN LABORATORIES, INC.
CHEMISTS AND ENGINEERS
CORPUS CHRISTI, TEXAS
SEPTEMBER 12, 1989

SOUTHWEST RESEARCH INSTITUTE
P.O. DRAWER 28510
SAN ANTONIO, TEXAS 78284

REPORT OF ANALYSIS

IDENTIFICATION: SAMPLE E

ALUMINUM, PPM	96000
CALCIUM, PPM	760
IRON, PPM	510
MAGNESIUM, PPM	27
POTASSIUM, PPM	96100
SILICON, PPM	325000
SODIUM, PPM	21000

LAB. NO. M27-6014

RESPECTFULLY SUBMITTED,

CARL F. CROWNOVER

TEL. 512-884-0371 PO BOX 2552 7840

JORDAN LABORATORIES, INC.
CHEMISTS AND ENGINEERS
CORPUS CHRISTI, TEXAS
SEPTEMBER 12, 1989

SOUTHWEST RESEARCH INSTITUTE
P.O. DRAWER 28510
SAN ANTONIO, TEXAS 78284

REPORT OF ANALYSIS

IDENTIFICATION: SAMPLE F

ALUMINUM, PPM	62200
CALCIUM, PPM	3600
IRON, PPM	4700
MAGNESIUM, PPM	390
POTASSIUM, PPM	10600
SILICON, PPM	314000
SODIUM, PPM	40100
LOSS ON IGNITION, WT.%	14.35

LAB. NO. M27-6015

RESPECTFULLY SUBMITTED,

CARL F. CROWNOVER

TEL. 512-884-0371 PO BOX 2552 78403

JORDAN LABORATORIES, INC.
CHEMISTS AND ENGINEERS
CORPUS CHRISTI, TEXAS
SEPTEMBER 12, 1989

SOUTHWEST RESEARCH INSTITUTE
P.O. DRAWER 28510
SAN ANTONIO, TEXAS 78284

REPORT OF ANALYSIS

IDENTIFICATION: SAMPLE G

ALUMINUM, PPM	126000
CALCIUM, PPM	112
IRON, PPM	150
MAGNESIUM, PPM	3
POTASSIUM, PPM	260
SILICON, PPM	316000
SODIUM, PPM	103000
LOSS ON IGNITION, WT.%	8.55

LAB. NO. M27-6016

RESPECTFULLY SUBMITTED,
Carl Crownover
CARL F. CROWNOVER

TEL. 512-884-0371 PO BOX 2552 78403

JORDAN LABORATORIES, INC.
CHEMISTS AND ENGINEERS
CORPUS CHRISTI, TEXAS
SEPTEMBER 12, 1989

SOUTHWEST RESEARCH INSTITUTE
P.O. DRAWER 28510
SAN ANTONIO, TEXAS 78284

REPORT OF ANALYSIS

IDENTIFICATION: SAMPLE H

ALUMINUM, PPM	62100
CALCIUM, PPM	3700
IRON, PPM	4700
MAGNESIUM, PPM	390
POTASSIUM, PPM	10400
SILICON, PPM	315000
SODIUM, PPM	40200
LOSS ON IGNITION, WT.%	14.04

LAB. NO. M27-6017

RESPECTFULLY SUBMITTED,
Carl Crownover
CARL F. CROWNOVER

10/10/89 RPP
The following are copies of chemical analytical results on zeolite samples and NBS standards performed by Core Labs (Corpus Christi, TX). Originals are kept in a separate file. See 8/28/89.

Western Atlas International

CORE LABORATORIES

ANALYTICAL REPORT
891748
FOR
SOUTHWEST RESEARCH INSTITUTE
ROBERTO T. PABALAN
6220 CULEBRA
SAN ANTONIO, TX 78284
09/29/89

Western Atlas International

CORE LABORATORIES

LABORATORY TESTS RESULTS
09/29/89

JOB NUMBER: 891748 CUSTOMER: SOUTHWEST RESEARCH INSTITUTE ATTN: ROBERTO T. PABALAN

SAMPLE NUMBER: 1 DATE RECEIVED: 09/08/89 TIME RECEIVED: 10:30 SAMPLE DATE: / / SAMPLE TIME: :
PROJECT: 3 OMS SAMPLE: A REM:

SAMPLE NUMBER: 2 DATE RECEIVED: 09/08/89 TIME RECEIVED: 10:30 SAMPLE DATE: / / SAMPLE TIME: :
PROJECT: 200-325 MESH SAMPLE: B REM:

SAMPLE NUMBER: 3 DATE RECEIVED: 09/08/89 TIME RECEIVED: 10:30 SAMPLE DATE: / / SAMPLE TIME: :
PROJECT: <325 MESH SAMPLE: C REM:

SAMPLE NUMBER: 4 DATE RECEIVED: 09/08/89 TIME RECEIVED: 10:30 SAMPLE DATE: / / SAMPLE TIME: :
PROJECT: 35-100 MESH SAMPLE: D REM:

SAMPLE NUMBER: 5 DATE RECEIVED: 09/08/89 TIME RECEIVED: 10:30 SAMPLE DATE: / / SAMPLE TIME: :
PROJECT: 3 OMS SAMPLE: E REM:

SAMPLE NUMBER: 6 DATE RECEIVED: 09/08/89 TIME RECEIVED: 10:30 SAMPLE DATE: / / SAMPLE TIME: :
PROJECT: 35-200 MESH SAMPLE: F REM:

TEST DESCRIPTION	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6	UNITS OF MEASURE
Total Solids (TS)		93.7	99.7	93.8		94.3	% by wt.
Aluminum (Al), total	120000	60000	129000	60000	91000	57000	ppm
Calcium (Ca), total	17500	9300	188	26000	925	3600	ppm
Iron (Fe), total	403	11500	160	12000	784	4000	ppm
Magnesium (Mg), total	<200	6900	7.1	6400	179	1300	ppm
Potassium (K), total	57000	8100	<0.5	8800	43000	114000	ppm
Silicon (Si), total	324000	312000	271000	316000	288000	336000	ppm
Sodium (Na), total	48000	<100.	108000	10800	22400	44000	ppm
Acid Digest for Metals	done	done	done	done	done	done	

APPROVED BY: Chris Mercer

1733 North Padre Island Dr.
Corpus Christi, TX 78408
(512) 289-2673

PAGE:1

The analyses, opinions or interpretations contained in this report are based upon observations and material supplied by the client for whose exclusive and confidential use this report has been made. The interpretations or opinions expressed represent the best judgement of Core Laboratories. Core Laboratories assumes no responsibility and makes no warranty or representations, express or implied, as to the productivity, proper operations, or profitableness, however of any oil, gas, coal or other minerals, property, well or sand in connection with which such report is used or relied upon for any reason whatsoever.

Western Atlas International

CORE LABORATORIES

LABORATORY TESTS RESULTS
09/29/89

JOB NUMBER: 891748 CUSTOMER: SOUTHWEST RESEARCH INSTITUTE ATTN: ROBERTO T. PABALAN

SAMPLE NUMBER: 7 DATE RECEIVED: 09/08/89 TIME RECEIVED: 10:30 SAMPLE DATE: / / SAMPLE TIME: :
PROJECT: <325 SAMPLE: G REM:

SAMPLE NUMBER: 8 DATE RECEIVED: 09/08/89 TIME RECEIVED: 10:30 SAMPLE DATE: / / SAMPLE TIME: :
PROJECT: 35-200 SAMPLE: H REM:

SAMPLE NUMBER: 9
* * THIS SAMPLE NUMBER WAS NOT ASSIGNED * *

SAMPLE NUMBER: 10
* * THIS SAMPLE NUMBER WAS NOT ASSIGNED * *

SAMPLE NUMBER: 11
* * THIS SAMPLE NUMBER WAS NOT ASSIGNED * *

SAMPLE NUMBER: 12
* * THIS SAMPLE NUMBER WAS NOT ASSIGNED * *

TEST DESCRIPTION	SAMPLE 7	SAMPLE 8	SAMPLE 9	SAMPLE 10	SAMPLE 11	SAMPLE 12	UNITS OF MEASURE
Total Solids (TS)	99.7	94.2					% by wt.
Aluminum (Al), total	121000	59000					ppm
Calcium (Ca), total	200	3500					ppm
Iron (Fe), total	195	4200					ppm
Magnesium (Mg), total	27.2	1200					ppm
Potassium (K), total	8700	11000					ppm
Silicon (Si), total	253000	334000					ppm
Sodium (Na), total	108000	44000					ppm
Acid Digest for Metals	done	done					

APPROVED BY: Chris Mercer

1733 North Padre Island Dr.
Corpus Christi, TX 78408
(512) 289-2673

PAGE:2

The analyses, opinions or interpretations contained in this report are based upon observations and material supplied by the client for whose exclusive and confidential use this report has been made. The interpretations or opinions expressed represent the best judgement of Core Laboratories. Core Laboratories assumes no responsibility and makes no warranty or representations, express or implied, as to the productivity, proper operations, or profitableness, however of any oil, gas, coal or other minerals, property, well or sand in connection with which such report is used or relied upon for any reason whatsoever.

Western Atlas International

CORE LABORATORIES

QUALITY ASSURANCE REPORT
09/29/89

JOB NUMBER: 891748 CUSTOMER: SOUTHWEST RESEARCH INSTITUTE ATTN: ROBERTO T. PABALAN

Q.A. TYPE	Q.A. ID	BLANK VALUE	STANDARD VALUE	ANALYZED VALUE	BACKGROUND VALUE	SPIKE TRUE VALUE	SPIKE MEASURED VALUE	DUPLICATE SAMPLE ANALYSIS	DUPLICATE ANALYSIS	% RECOVERY	% RELATIVE ERROR
Q.A. NUMBER:897007 09/13/89 09:11					Total Solids (TS)						TECHNICIAN:JJP
BLANK	blank	0									
DUPLICATE	891748-2							93.7	93.6		0.11
Q.A. NUMBER:897143 09/18/89 14:10					Acid Digest for Metals						TECHNICIAN:EAE
Q.A. NUMBER:897284 09/21/89 20:05					Iron (Fe), total						TECHNICIAN:JEM
BLANK	DI H2O	0									
BLANK	DI H2O	0									
BLANK	DI H2O	0									
STANDARD	5 ppm std		5	5.06						101.20	
STANDARD	5 ppm std		5	5.35						107.00	
STANDARD	mal-5		5	4.8						96.00	
SPIKE	891824-1				0.09	2	1.83			87.00	
DUPLICATE	891824-1							0.09	0.1		10.53
Q.A. NUMBER:897303 09/21/89 09:26					Sodium (Na), total						TECHNICIAN:JEM
BLANK	DI H2O	0									
BLANK	DI H2O	0									
BLANK	DI H2O	0									
STANDARD	10 ppm std		10	10.16						101.60	
STANDARD	10 ppm std		10	10.85						108.50	
STANDARD	wp 686		1	0.98						98.00	
SPIKE	891875-1				0	2	1.51			75.50	
SPIKE	891748-2				13.2	2	15.2			100.00	
DUPLICATE	891875-3							0	0		0.00
DUPLICATE	891748-2							13.2	13.2		0.00

APPROVED BY: Chip Morrison

1733 North Padre Island Dr.
Corpus Christi, TX 78408
(512) 289-2673

PAGE:1

The analyses, opinions or interpretations contained in this report are based upon observations and materials supplied by the client for whose exclusive and confidential use this report has been made. The interpretations or opinions expressed represent the best judgement of Core Laboratories. Core Laboratories assumes no responsibility and makes no warranty or representations, express or implied, as to the productivity, proper operations, or profitableness however of any oil, gas, coal or other mineral, property, well or sand in connection with which such report is used or relied upon for any reason whatsoever.

Western Atlas International

CORE LABORATORIES

QUALITY ASSURANCE REPORT
09/29/89

JOB NUMBER: 891748 CUSTOMER: SOUTHWEST RESEARCH INSTITUTE ATTN: ROBERTO T. PABALAN

Q.A. TYPE	Q.A. ID	BLANK VALUE	STANDARD VALUE	ANALYZED VALUE	BACKGROUND VALUE	SPIKE TRUE VALUE	SPIKE MEASURED VALUE	DUPLICATE SAMPLE ANALYSIS	DUPLICATE ANALYSIS	% RECOVERY	% RELATIVE ERROR
Q.A. NUMBER:897411 09/26/89 11:04					Aluminum (Al), total						TECHNICIAN:JEM
Q.A. NUMBER:897415 09/26/89 11:48					Potassium (K), total						TECHNICIAN:JEM
BLANK	DI H2O	0									
BLANK	DI H2O	0									
BLANK	DI H2O	0									
STANDARD	25 ppm std		25	25.7						102.80	
STANDARD	wp 686		1	1.28						128.00	
SPIKE	891804-3				34.4	4	38.1			92.50	
DUPLICATE	891804-3							34.4	36.3		5.37
Q.A. NUMBER:897416 09/26/89 11:57					Magnesium (Mg), total						TECHNICIAN:JEM
BLANK	DI H2O	0									
BLANK	DI H2O	0									
BLANK	DI H2O	0									
STANDARD	5 ppm std		5	5.33						106.60	
STANDARD	5 ppm std		5	5.07						101.40	
STANDARD	wp 686		0.5	0.56						112.00	
SPIKE	891708-3				0.26	2	2.01			87.50	
DUPLICATE	891708-1							0.26	0.26		0.00
Q.A. NUMBER:897474 09/29/89 10:09					Silicon (Si), total						TECHNICIAN:JEM
BLANK	DI H2O	0									
BLANK	DI H2O	0									
BLANK	DI H2O	0									
STANDARD	25 ppm std		25	26.38						105.52	
STANDARD	icap-7		0.53	0.53						100.00	
SPIKE	891748-1				15.1	2	16.5			70.00	

APPROVED BY: Chip Morrison

1733 North Padre Island Dr.
Corpus Christi, TX 78408
(512) 289-2673

PAGE:2

The analyses, opinions or interpretations contained in this report are based upon observations and materials supplied by the client for whose exclusive and confidential use this report has been made. The interpretations or opinions expressed represent the best judgement of Core Laboratories. Core Laboratories assumes no responsibility and makes no warranty or representations, express or implied, as to the productivity, proper operations, or profitableness however of any oil, gas, coal or other mineral, property, well or sand in connection with which such report is used or relied upon for any reason whatsoever.

Western Atlas International

CORE LABORATORIES

QUALITY ASSURANCE REPORT
09/29/89

JOB NUMBER: 891748 CUSTOMER: SOUTHWEST RESEARCH INSTITUTE ATTN: ROBERTO T. PABALAN

Q.A. TYPE	Q.A. ID	BLANK VALUE	STANDARD VALUE	ANALYZED VALUE	BACKGROUND VALUE	SPIKE TRUE VALUE	SPIKE MEASURED VALUE	DUPLICATE SAMPLE ANALYSIS	DUPLICATE ANALYSIS	% RECOVERY	% RELATIVE ERROR
Q.A. NUMBER:897474 09/29/89 10:09					Silicon (Si), total						TECHNICIAN:JEM
DUPLICATE	891748-1							15.1	14.7		2.68
Q.A. NUMBER:897475 09/28/89 10:17					Calcium (Ca), total						TECHNICIAN:JEM
BLANK	DI H2O	0									
BLANK	DI H2O	0									
BLANK	DI H2O	0									
STANDARD	wp 686		5	5.32						106.40	
STANDARD	5 ppm std		5	5.25						105.00	
SPIKE	891748-8				7.02	2	8.98			98.00	
DUPLICATE	891748-8							7.02	7.12		1.41

APPROVED BY: Chip Morrison

1733 North Padre Island Dr.
Corpus Christi, TX 78408
(512) 289-2673

PAGE:3

The analyses, opinions or interpretations contained in this report are based upon observations and materials supplied by the client for whose exclusive and confidential use this report has been made. The interpretations or opinions expressed represent the best judgement of Core Laboratories. Core Laboratories assumes no responsibility and makes no warranty or representations, express or implied, as to the productivity, proper operations, or profitableness however of any oil, gas, coal or other mineral, property, well or sand in connection with which such report is used or relied upon for any reason whatsoever.

For comparison purposes, below are copies of the NBS certificate of analysis for SRM 99a and SRM 70a.

U. S. Department of Commerce
Malcolm Baldrige
Secretary
National Bureau of Standards
Ernest Ambler, Director

Certificate of Analysis

Standard Reference Material 70a

Feldspar

(All Analyses are Based on Samples Dried 2 hours at 105 °C)

	Percent	Element %
Silica (SiO_2)	67.1	31.37
Alumina (Al_2O_3)	17.9	9.47
Iron (as Fe_2O_3)	0.07₄	0.05₂
Titania (TiO_2)	.01	0.006
Calcium (as CaO)	.11	0.079
Barium (as BaO)	.02	0.018
Sodium (as Na_2O)	2.5₄	1.89
Potassium (as K_2O)	11.8	9.80
Rubidium (as Rb_2O)	0.06	0.05₆
Loss on Ignition	.40	

Washington, D.C. 20234
August 10, 1981
(Revision of Certificate dated
3-26-65)

George A. Uriano, Chief
Office of Standard Reference Materials

ommerce
er
ndards
ector

Certificate of Analysis

Standard Reference Material 99a

Feldspar

(All Analyses are Based on Samples Dried 2 hours at 105 °C)

	Percent	Element %
Silica (SiO_2)	65.2	30.49
Alumina (Al_2O_3)	20.5	10.85
Iron (as Fe_2O_3)	0.06₄	0.045
Titania (TiO_2)	.007	0.004₂
Calcium (as CaO)	2.14	1.53
Barium (as BaO)	0.26	0.23
Magnesium (as MgO)	.02	0.01₂
Sodium (as Na_2O)	8.2	4.60
Potassium (as K_2O)	5.2	4.3
Phosphorus (as P_2O_5)	0.02	0.009₇
Loss on Ignition	0.26	

.C. 20234
)
ertificate dated

George A. Uriano, Chief
Office of Standard Reference Materials

Note that SRM 70a corresponds to sample E, and SRM 99a corresponds to sample A (see 8/28/89).

10/10/89 BJP

U.T.S.A. Division of Earth and Physical Sciences — with Bill Murphy. Attempted to use Frantz magnetic separator to remove ~~magnetic~~ impurities from zeolite sample CGC based on differences in magnetic susceptibility. Magnetic field strength and incline slope were varied to allow separation. (see also results from 8/11/89).

Results: No measured separation was achieved even for CGC samples which contain minerals which can be separated with a hand magnet. It is likely the Frantz separator is not working properly.

11/13/89

The following are copies of results of XRD and petrographic analyses done by Susan Lutz of the Univ. of Utah Research Inst. on samples CB, CH, and CGC. (see 8/29/89). Later the initial XRD analysis, x-ray analyses of clay separates was also conducted, the results of w/c are described in the cover letter dated 11/7/89.

Originals are kept in a separate file.

UNIVERSITY OF UTAH RESEARCH INSTITUTE
UURI
EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108—1295
TELEPHONE 801-524-3422

October 17, 1989

Roberto Pabalan
Southwest Research Institute
P. O. Box 28510
6220 Culebra Road
San Antonio, Texas 78284

Dear Roberto:

Please find enclosed the results of X-ray diffraction and petrographic analyses of three samples of zeolitized tuff. The liquid used for grinding of these samples in preparation for X-ray diffraction analysis was acetone. In thin-section preparation, the samples were cut with water as a lubricant and then, were impregnated with epoxy in order to minimize the effect of water on the zeolites with continued polishing.

Just a few comments concerning these results. In samples CB and CH, there is a 10.2 angstrom phase detected in the XRD analyses that does not seem to represent either a common zeolite or a mixed-layer illite-smectite (it does not expand to a higher spacing with glycolation). It may be possible that this phase represents the nondescript opaque observed petrographically in sample CH, but it remains unidentified.

In general, the samples contain mostly well-crystallized clinoptilolite, which has completely replaced all the glass in the poorly welded tuffs. Because of the extremely fine-grained nature of the zeolites, it is not possible to distinguish the different zeolite types petrographically.

Most of the illite/mica identified in XRD can be attributed to biotite phenocrysts. However, in thin-section, other high-birefringent clay phases are present (for example, in sample CGC) that do not seem to be represented in the XRD analysis. In other samples, traces of a greenish smectite are evident. Perhaps these clay phases occur in the bulk samples in an abundance below the X-ray detection limit of 2-4 wt.%. In this case, clay separates of these samples would confirm their presence.

I hope these analyses are beneficial to your study of the tuffs. If you have any questions about the results of either the X-ray diffraction or the petrography, please call me at (801) 524-3425. (The thin-sections and the remaining rock and powder samples will be sent back to SWRI under separate cover.)

Sincerely,

Susan Lutz

Susan Lutz
Manager,
X-ray Diffraction Lab

SOUTHWEST RESEARCH INSTITUTE · ROBERTO PABALAN

ZEOLITIZED TUFF BULK XRD SAMPLE NO.	MINERALOGY, APPROX. WT.% ✓ (or) RELATIVE ABUNDANCE																		
	QUARTZ	PLAGIOCLASE	K-FELDSPAR	GOETHITE	HEMATITE	ANATASE	ILLITE (?) NOT VERIFIED BY XRD	ILLITE/SMECTITE	CLINOPTILOLITE	MORDENITE	ERIONITE				PHENOCRYST BIOTITE (?)				
CB	4	9	8	3?	TR	TR	4	TR?	59	8	TR?				2				
CH	4	6	5			TR	2	2?	67	11	2				–				
CGC	1	3	2		4		2		74	2?	2				10				

MM = PREDOMINANT M = MAJOR m = MINOR Tr = TRACE ? = TENTATIVE IDENTIFICATION

SUMMARY OF X-RAY DIFFRACTION ANALYSIS

S. Lutz
10-16-89

PETROGRAPHIC ANALYSIS

SAMPLE NAME CB

TYPE OF ROCK Quartz Latite or Dacite Tuff

MATRIX 75-85%
- Zeolitized glass with (30-60%) relict shards
- Dendritic manganese-iron oxide (goethite?)
- Many round bubble shards

GRAINS 15-25%
- Phenocrysts:
  - Quartz and feldspars
  - Biotite 4%
  - Hornblende 1%
- Lithoclasts: 1-2%
  - Chert (vein?) fragments
  - Volcanic rock fragments
  - Compacted pumice fragments, one 3 mm long

TEXTURE

Thinly laminated, one lamination of coarser grains, both quartz and relict shards up to 300 microns.

Average grain size about 100 microns.

Poorly welded, some uncompacted relict shards visible especially in the coarser lamination.

Dendritic manganese-iron oxide extends down (?) from the coarser lamination.

ALTERATION

All glass altered to zeolites.

Rare detrital ferromagnesian mineral (pyroxene or amphibole) is altered to hematite.

Some plagioclase phenocrysts altered to sericite.

Bubble shards are partially infilled with a brownish-green clay (possibly smectite?).

DEPOSITIONAL ORIGIN

Fallout tuff

PETROGRAPHIC ANALYSIS

SAMPLE NAME CGC

TYPE OF ROCK Quartz Latite or Dacite Tuff

MATRIX 90%
- Zeolitized glass shards (70-90%)
- Some round bubble shards
- Brownish opaque around shards

GRAINS 10%
- Phenocrysts:
  - Quartz 1-2%
  - Feldspars 5-8%
  - Biotite 1-2%
  - Clinopyroxene 2%
  - Hornblende trace
  - Magnetite or ilmenite trace
- Lithoclasts:
  - a few glassy lithic fragments with plagioclase microlites
  - some detrital iron-titanium oxide

TEXTURE

Poorly welded, no compaction or deformation of shards and very little glassy matrix around shards.

Phenocryst fragments are very fine grained about 100 microns in size. Relict shards are slightly larger at about 200 microns in length.

Abundant shards; many plucked from thin-section, rest are bordered with a high birefringent mineral (possibly sericite), and rimmed and replaced with zeolites.

Clinoptilolite appears better crystallized than in other samples.

ALTERATION\MINERALIZATION

Many of the plagioclase phenocrysts are altered to sericite.

Some of the magnetite is altered to hematite.

Many of relict shards appear to be rimmed; perhaps the shards were dissolved out and then infilled with zeolites. Many of the shard borders are outlined with a high birefringent mineral, possibly sericite although the XRD analysis only indicates 1-2% illite and mica.

Grungy brown opaque could be an amorphous clay (it does not have the high birefringence or relief of leucoxene/sphene).

DEPOSITIONAL ORIGIN

Fallout tuff

PETROGRAPHIC ANALYSIS

SAMPLE NAME CH

TYPE OF ROCK Quartz Latite or Dacite Tuff

MATRIX 85-90%
- Zeolitized glass with some relict shards (0-40%)
- Non-descript opaque (10-20%)

GRAINS
- Phenocrysts:
  - Quartz and feldspars 10-15%
  - Biotite 1-2%
  - Clinopyroxene trace

TEXTURE

Poorly welded, very fine grained- largest are 75 microns.

Graded laminations, exhibiting symmetric grading from one lamination which is entirely without relict shards or phenocrysts.

ALTERATION

All glass has altered to zeolites.

Veins of non-descript opaque, same mineral has also replaced some of the shards. This opaque mineral may be ultra-fine clinoptilolite or else, an amorphous clay.

DEPOSITIONAL ORIGIN

Fallout tuff or possibly, surge deposit

UNIVERSITY OF UTAH RESEARCH INSTITUTE
UURI
EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108-1295
TELEPHONE 801-524-3422

November 7, 1989

Roberto Pabalan
Southwest Research Institute
P. O. Box 28510
6220 Culebra Road
San Antonio, Texas 78284

Dear Bob:

Please find enclosed the results of both the bulk and clay X-ray diffraction analyses of three samples of zeolitized tuff. The XRD analyses of the clay separates of these samples indicate the presence of some clay minerals not evident in the bulk analyses.

The 10.2 Å peak in the XRD patterns of glycolated samples of CB and CH probably represents an illite-rich mixed-layer illite-smectite. However, even in the clay-size fraction (less than 2 microns), the large biotite peak at about 10 Å partially obscures the pattern of this illitic mixed-layer clay. In the thin-section of sample CB, there are vug-filling, very fine-crystalline, fibrous aggregates of a highly birefringent greenish clay. This mineral may be a low-temperature celandonitic or a phengitic illite which is probably represented by the illitic mixed-layer clay in the diffractograms. However, the high illite content of this late-stage void-filling mineral indicates higher temperatures than the stability of the zeolites, so there is somewhat of a contradiction in the temperature information obtained from the mineralogy of this sample. Petrographically, sample CB also contains some sericite as an alteration of plagioclase lithic fragments but this clay alteration probably occurred before deposition in the ash flow tuff.

The opaque material which replaces glass shards and fills fractures in the thin-section of sample CH remains unidentified although it may represent ultra-fine grained (submicron size) zeolites. Analysis of the bulk X-ray diffractogram of this sample does not indicate a high amorphous (clay) content and the clay X-ray diffractogram indicates the presence of only a small amount of mixed-layer illite-smectite, which would be more highly birefringent in thin-section.

XRD analysis of the clay separate of sample CGC indicates an abundance of a smectitic clay. Because this highly expandable clay has a basal spacing of only 10.8 Å in the air-dried sample (versus 12-14 Å for a smectite) and 16.7 Å with glycolation (versus 16-18 Å for a smectite), it may actually be a mixed-layer clay containing some illite. Petrographically, this highly birefringent smectite or smectite-rich illite-smectite rims many of the relict shards as well as some of the hornblende and quartz phenocrysts. This morphology suggests that formation of the smectite occurred before the dissolution of the shards and subsequent replacement of both the shards and the groundmass with zeolites.

The thin-sections, remaining samples and powders, and the diffractograms are enclosed for these three samples. I apologize for the poor quality of the copies of the X-ray diffractograms, but I would like to keep the originals for reference when continuing work on similiar zeolitized tuffs. If you have any questions about the interpretation of these samples, please call me.

Sincerely,

Susan Lutz
Manager,
X-ray Diffraction Lab

SOUTHWEST RESEARCH INSTITUTE - ROBERTO PABALAN

MINERALOGY, APPROX. WT.% ✓ (or) RELATIVE ABUNDANCE

ZEOLITIZED TUFF

CLAY XRD

SAMPLE NO.	CLINOPTILOLITE	MORDENITE	ERIONITE	AMPHIBOLE	ILLITE (HIGH INTEN.)	ILLITE (LOWER INTEN.)	SMECTITE	
CG	MM	m	m		47	*10?	33	
CH2	MM	m	TR	TR	75	*15?		
C6C	MM		m		TR	*100		

* BOTH HAVE APPROXIMATE ANALYSIS PROVIDED BY THAT OF ILLITE DOMINANT AND ILLITE-RICH ILLITE-SMECTITE.

* MM AS A SMECTITE-RICH MIXED-LAYER ILLITE SMECTITE, SWELLS FROM ~10.8 Å TO ~16.3 Å WITH GLYCOLATION

MM = PREDOMINANT M = MAJOR m = MINOR Tr = TRACE ? = TENTATIVE IDENTIFICATION

SUMMARY OF X-RAY DIFFRACTION ANALYSIS
UNIVERSITY OF UTAH RESEARCH INSTITUTE, EARTH SCIENCE LABORATORY

S. Lutz
11-7-89

12/11/89 RJN

The following are copies of XRD results on samples CT, CDV, and CCC and petrographic analysis results on samples CT and CDV performed by Susan Lutz of U.U.R.I. No cover letter was included with the results, only an invoice statement. No petrographic analysis was requested on sample CCC due to the small size of the specimens. No clay separate XRD analysis was requested.

Originals are kept in a separate file.

UURI
Invoice

Payor's Name and Address	Payor's Reference
Southwest Research Institute P.O. Box 28510 6220 Culebra Road San Antonio, TX 78284	Bob Pabalan P.O. #24547 Total Amount $290.00
Payee's Name and Address	**Payee's Reference ***
UNIVERSITY OF UTAH RESEARCH INSTITUTE Research Park 391 Chipeta Way, Suite C Salt Lake City, Utah 84108-1295 801-524-3422	5-84701-543 Invoice # 3 — Invoice Date 12-5-89 Billing Period December 1989

* Please include Payee's reference number with payment

Description		Amount
Semi-quantitative XRD; Bulk Samples	3	$240.00
Qualitative XRD; Bulk Samples	0	$0.00
Semi-quantitative XRD; Clay Mineralogy	0	$0.00
Qualitative XRD; Clay Mineralogy	0	$0.00
SUBTOTAL		$240.00
SPECIAL CHARGES		
2 General Petrographic Descriptions (CDV, CT)		$50.00
Samples of Zeolitized Tuff CDV CT CCC		
RUSH CHARGE 50%		$0.00
TOTAL		$290.00

Total amount due and payable within 30 days of invoice date

SOUTHWEST RESEARCH INSTITUTE - ROBERTO PABALAN

MINERALOGY, APPROX. WT.% ✓ (or) RELATIVE ABUNDANCE

ZEOLITIZED TUFFS

BULK XRD

SAMPLE NO.	AMOR. CT	QUARTZ	PLAGIOCLASE	K-FELDSPAR	CRISTOBALITE	AMPHIBOLE	GYPSUM	MONTMORILLONITE	ILLITE (HIGH INTEN.)	SMECTITE	CLINOPTILOLITE	MORDENITE	ERIONITE	CHABAZITE	MICROCRYSTALLINE SILICA (OPALINE)							
CT	26	1	TR?	2					2	34	35		TR?			–						
CDV		1	1	1	TR	TR			TR	2	86	TR?	1	1		6						
CCC	5	1	TR	2	TR	TR	3	1	2	16	69					–						

TR DOLOMITE?

FROM THIN-SECTIONS: ILLITE & MICA IS BIOTITE.
MONTMORILLONITE IS SEPIOLITE.

MM = PREDOMINANT M = MAJOR m = MINOR Tr = TRACE ? = TENTATIVE IDENTIFICATION

SUMMARY OF X-RAY DIFFRACTION ANALYSIS
UNIVERSITY OF UTAH RESEARCH INSTITUTE, EARTH SCIENCE LABORATORY

S. Lutz
12-5-89

PETROGRAPHIC ANALYSIS

SAMPLE NAME CDV

TYPE OF ROCK Quartz Latite or Dacite Tuff
MATRIX 95%
Zeolitized glass shards (70%)
GRAINS 5%
Phenocrysts:
Quartz Tr
Plagioclase 2%
K-feldspar (sanidine) Tr
Biotite Tr
Hornblende Tr
Lithoclasts: 1%
a few devitrified volcanic fragments (possibly from another tuff)
pumice-one with biotite, 1 mm long
bone fragments
one sandstone fragment

TEXTURE
Poorly welded, well-preserved shard texture.
Many bubble shards.
Average shard size is about 250 microns.
Subhedral to rounded and abraded feldspar phenocrysts (about 1 mm in size). Other (hornblende) phenocrysts are euhedral to subhedral and average 100 microns in size.

ALTERATION/MINERALIZATION
The glassy groundmass is altered to zeolites. Zeolites also replaced the hydrated rinds of the shards. In many of the shards, the remaining glass was dissolved out and the void partially infilled with internal rims of large (30 micron) euhedral clinoptilolite crystals. There are a few glass shards left in the sample but many of the (also still glassy ?) shards are plucked from the slide. (The presence of glass shards could account for 5% amorphous content in the XRD analysis.)
Patches of bladed to dendritic iron oxide (goethite) are present and may be spacially associated with the more mafic xenoliths or xenocrysts.
A trace amount of smectite or chlorite-smectite is present in some lithic fragments as a replacement of a mafic mineral, possibly a pyroxene. This replacement probably occurred before deposition of the ash flow tuff because the hornblende phenocrysts in the sample are completely unaltered.
This sample is very porous. The porosity is both primary (in bubbles) and secondary (a result of dissolution of glass shards).

DEPOSITIONAL ORIGIN
Fallout tuff

PETROGRAPHIC ANALYSIS*

SAMPLE NAME CT

TYPE OF ROCK Quartz Latite or Dacite Tuff

MATRIX 95%
Glass altered to a mixture of zeolites, smectite and opal-CT.
Reddish iron oxide stain of smectite (?*)
GRAINS 5%
Phenocrysts:
Quartz and feldspars 3%
Biotite 2%

TEXTURE
Poorly welded with little to no recognizable shard texture (may be obscured by zeolites and clays).
Very fine-grained phenocrysts; average size of the biotite grains is about 30 microns, a couple are up to 100 microns in length.

ALTERATION/MINERALIZATION
Smectite and clinoptilolite almost completely obscure the very fine phenocrysts, hence the phenocryst content listed above may be an underestimate. There are some rounded to elongate clumps of opal (up to a millimeter in size) without smectite which may have been larger shards in the generally shard-poor ash flow tuff. The fine ash groundmass is completely altered to clinoptilolite, smectite and iron oxides.

DEPOSITIONAL ORIGIN
Fallout tuff

* According to the Steve Koehler, the cracks and reddish color in the thin-section developed during preparation of the thin-section and do not accurately represent the sample.

12/12/89 MJP
Received samples of zeolite samples from Mineralogical Research Co. (15840 East Alta Vista Way, San Jose, CA 95127-1737, Tel# 408-223-6800).
Received ~75 gms of specimens, possibly clinoptilolite with crystals (yellowish color, ~1 mm size) in vugs and along fractures in grayish (altered?) matrix.
Need to do separation and XRD to confirm identity of crystals.
Morphology distinctly coffin-shaped, which is typical of clinoptilolite. Yellow color may indicate Fe-rich composition?
Locality: Succor Creek, Oregon

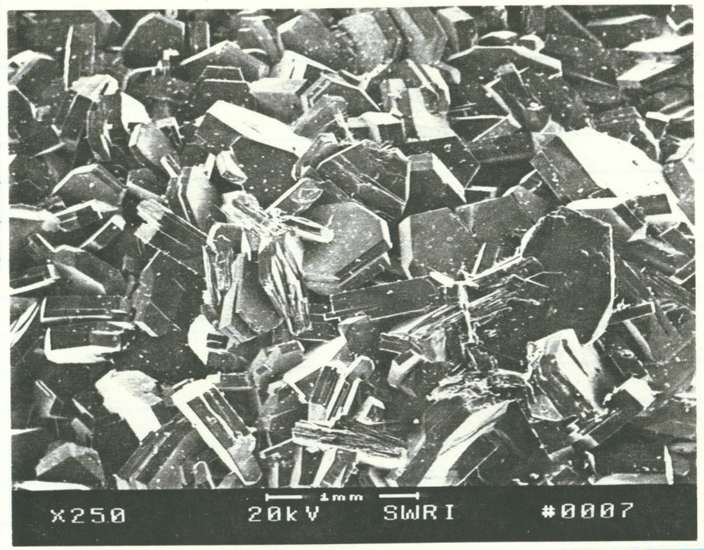
12/12/89 MJP

SEM Analysis of clinoptilolite? from Succor Creek, Oregon

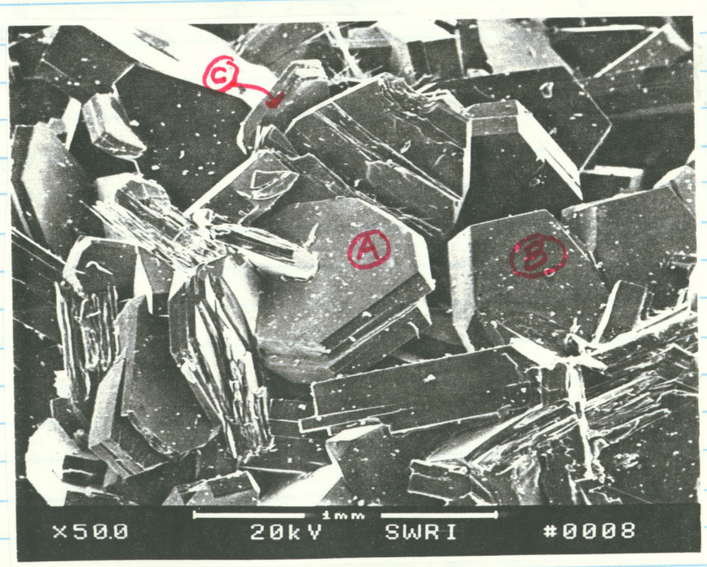
Objective:
1. Determine morphology of crystals by SEM image.
2. Determine qualitatively the composition using EDS.

Results: (Analysis of single chip about 5 mm in diameter with abundant crystals. EDS done on 3 random crystals.)

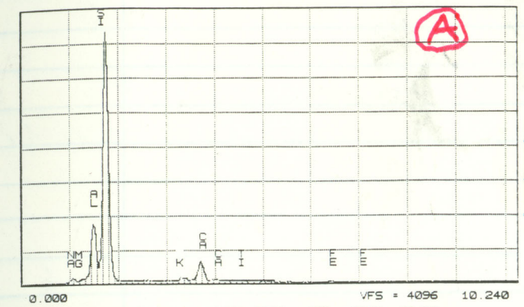
Sample CSC (Log # 40686)



Sample CSC (Log # 40687)



Series II Southwest Research Institute TUE 12-DEC-89 13:28
Cursor: 0.000keV = 0



SQ: QUANTIFY

SAMPLE CSC - SUCCOR CREEK, OR. - 20KV, WD=27
Standardless Analysis
20.0 KV 40.6 Degrees

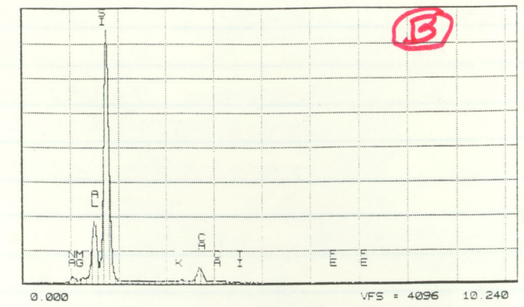
Chi-sqd = 0.98

Element	Rel. K-ratio	Net Counts
Si-K	0.68407 +/- 0.00605	49426 +/- 437
Al-K	0.16696 +/- 0.00614	11211 +/- 412
Ca-K	0.08586 +/- 0.00341	4703 +/- 187
Na-K	0.03122 +/- 0.00335	686 +/- 74
Mg-K	0.00790 +/- 0.00386	458 +/- 224
Ti-K	0.00657 +/- 0.00242	299 +/- 110
K -K	0.00946 +/- 0.00229	559 +/- 135
Fe-K	0.00797 +/- 0.00366	209 +/- 96

ZAF Correction 20.00 kV 40.60 deg
No.of Iterations = 1

Element	K-ratio	Z	A	F	Atom%	Wt%
Si-K	0.531	0.992	1.341	0.999	71.76	70.52
Al-K	0.129	1.021	1.175	0.968	15.92	15.02
Ca-K	0.067	1.014	1.173	0.999	5.65	7.92
Na-K	0.024	1.016	1.434	0.989	4.34	3.49
Mg-K	0.006	0.991	1.316	0.978	0.92	0.78
Ti-K	0.005	1.110	1.109	0.999	0.37	0.63
K -K	0.007	1.038	1.245	0.991	0.69	0.94
Fe-K	0.006	1.113	1.026	1.000	0.36	0.71
					Total=	100.00%

Series II Southwest Research Institute TUE 12-DEC-89 13:34
Cursor: 0.000keV = 0



SQ: QUANTIFY

SAMPLE CSC - SUCCOR CREEK, OR. - 20KV, WD=27
Standardless Analysis
20.0 KV 40.6 Degrees

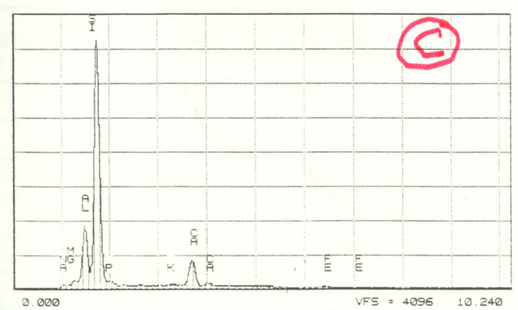
Chi-sqd = 1.02

Element	Rel. K-ratio	Net Counts
Si-K	0.70102 +/- 0.00627	48401 +/- 433
Al-K	0.17148 +/- 0.00659	11003 +/- 423
Ca-K	0.07125 +/- 0.00317	3729 +/- 166
Na-K	0.03304 +/- 0.00381	694 +/- 80
Mg-K	0.00488 +/- 0.00427	270 +/- 237
Ti-K	0.00259 +/- 0.00223	112 +/- 97
K -K	0.01070 +/- 0.00218	604 +/- 123
Fe-K	0.00505 +/- 0.00332	126 +/- 83

ZAF Correction 20.00 kV 40.60 deg
No.of Iterations = 1

Element	K-ratio	Z	A	F	Atom%	Wt%
Si-K	0.547	0.992	1.332	0.999	73.07	72.26
Al-K	0.134	1.021	1.156	0.966	16.05	15.24
Ca-K	0.056	1.015	1.177	1.000	4.70	6.63
Na-K	0.026	1.017	1.398	0.988	4.47	3.62
Mg-K	0.004	0.992	1.296	0.977	0.56	0.48
Ti-K	0.002	1.111	1.107	1.000	0.15	0.25
K -K	0.008	1.039	1.250	0.993	0.78	1.07
Fe-K	0.004	1.114	1.024	1.000	0.23	0.45
					Total=	100.00%

Series II Southwest Research Institute TUE 12-DEC-89 13:41
Cursor: 0.000keV = 0



SQ: QUANTIFY

SAMPLE CSC - SUCCOR CREEK, OR. - 20KV, WD=27
Standardless Analysis
20.0 KV 40.6 Degrees

Chi-sqd = 0.83

Element	Rel. K-ratio	Net Counts
Si-K	0.65684 +/- 0.00709	49076 +/- 530
Al-K	0.15693 +/- 0.00621	10896 +/- 431
Ca-K	0.11895 +/- 0.00360	6738 +/- 204
Na-K	0.01849 +/- 0.00328	420 +/- 75
Mg-K	0.01528 +/- 0.00392	916 +/- 235
Ti-K	0.00057 +/- 0.00228	27 +/- 107
K -K	0.00737 +/- 0.00226	450 +/- 138
Fe-K	0.01346 +/- 0.00388	364 +/- 105
P -K	0.01212 +/- 0.00325	870 +/- 233

ZAF Correction 20.00 kV 40.60 deg
No.of Iterations = 1

Element	K-ratio	Z	A	F	Atom%	Wt%
Si-K	0.507	0.991	1.337	0.998	69.19	67.13
Al-K	0.121	1.020	1.189	0.969	15.29	14.25
Ca-K	0.092	1.014	1.169	1.000	7.86	10.89
Na-K	0.014	1.016	1.489	0.989	2.69	2.14
Mg-K	0.012	0.990	1.313	0.979	1.79	1.50
Ti-K	0.000	1.109	1.117	0.999	0.03	0.05
K -K	0.006	1.037	1.242	0.988	0.54	0.72
Fe-K	0.010	1.112	1.028	1.000	0.62	1.19
P -K	0.009	1.025	2.230	0.999	2.00	2.14
					Total=	100.00%

12/15/89 RJP

X-ray Diffraction Analysis of Zeolite (Clinoptilolite ?) Samples from Succor Creek, Oregon

Objective:
1. Determine the mineralogy of the zeolite sample by comparison of measured X-ray diffraction patterns with known ~~standards~~ substances

2. Determine methods of purifying the samples to obtain monomineralic specimens of the zeolite.

Procedure:
Starting from the hand specimens obtain zeolite rich ~~chips~~ fragments about 1/2 inch or less in diameter by light crushing and handpicking under a stereomicroscope. Repeat the light crushing and handpicking a few times to isolate relatively pure crystals of the zeolites having as little matrix as possible.
Prepare about 250 ml of a heavy liquid with a density of about 2.20 by mixing known amounts of bromoform ($\rho = 2.8899$ at 20°C) and NN-Dimethyl formamide ($\rho = .93445$ at 20°C).

Grind to a fine powder the relatively pure zeolite sample in acetone using a mortar and pestle. Dry at about 80°C in an oven. After drying, let stand in a dessicator w/c ~~with about~~ contains about 100 ml of pure water overnight to allow the zeolite to rehydrate. Submit the powder sample the next day for XRD analysis.

Results: The d-spacings and relative intensities of the X-ray peaks read off the strip chart recording (w/c is kept in a separate file) are given on the next page.
Tentative peak identifications (hkl indices) are given based on comparisons with the JCPDS data files (numbers given below the table).
Clinoptilolite (+ mordenite?) peak ~~near~~ dspaci at $2\theta = 9.78$ is the most intense peak, in contrast to previous XRD results on zeolitized tuff specimens which have $2\theta = 3.97$ as the most intense. It is possible that this is due to preferred orientation since the sample powder was not sieved.
Intense peak of mordenite at $2\theta \approx 27.7$ also present.
Quartz peak also observed at $2\theta \approx 26.6$.

12/15/89
40 mA
40 kV
400 cps
τ = 4 sec
0.5° 2θ/sec
Al holder

SAMPLE CSC - CLINOPTILOLITE, SUCCOR CREEK, OREGON

2THETA	D-SPACING	I/IO	hkl
7.42	11.904	0.9	E 100?
9.21	9.594	1.0	
9.42	9.380	1.7	
9.78	9.036	100.0	020, M200
10.9	8.110	1.1	
11.1	7.964	1.7	200
12.97	6.820	1.5	$\bar{2}01$
13.29	6.656	1.4	001, M111
14.86	5.956	0.8	$\bar{2}20$
15.75	5.622	1.2	
16.56	5.349	1.2	CL?
16.84	5.260	2.1	$\bar{3}11$
17.06	5.193	1.3	
17.28	5.127	2.2	111
17.4	5.092	1.2	M221?
19	4.667	5.3	$\bar{1}31$
19.77	4.487	2.2	M330?
20.3	4.371	1.2	$\bar{4}01$
20.78	4.271	0.7	Q100
22.27	3.988	10.9	M150?; 400?
22.37	3.971	10.3	400
22.68	3.917	9.3	$\bar{4}21$
23.1	3.847	1.5	221, M241
23.7	3.751	1.5	M602
23.87	3.725	1.3	CL?
24.55	3.623	0.7	M421
24.95	3.566	1.5	$\bar{3}12$, M510
25.37	3.508	1.3	M022
25.66	3.469	1.8	M202
25.93	3.433	3.4	$\bar{2}22$, M060
26.2	3.398	2.1	$\bar{4}02$, M350
26.59	3.349	2.5	Q101
26.8	3.324	1.8	~~M322~~ CL?
27.72	3.215	14.0	M511
27.77	3.210	11.3	
28.02	3.182	3.2	$\bar{4}22$
28.46	3.133	4.0	$\bar{4}41$, M312
28.95	3.082	1.7	$\bar{1}32$, M441
29.9	2.986	12.7	151, M261
30.95	2.887	0.8	M332
31.25	2.860	0.7	
31.9	2.803	4.0	$\bar{6}21$
32.65	2.740	5.6	$\bar{6}02$, M152
33.4	2.680	0.9	CL?
35	2.561	1.0	M461
35.38	2.535	3.0	M442?
36	2.493	1.0	CL?
36.45	2.463	1.1	M641
36.64	2.451	2.4	~~M641~~ M023?
36.9	2.434	1.9	~~M023~~ CL?
37.54	2.394	0.8	
38.1	2.360	0.9	
38.68	2.326	0.9	
39.5	2.279	0.8	

M = mordenite ; E = erionite
Q = quart ; CL = clinoptilolite
~~[illegible]~~

Note: Peaks [illegible] mordenite [illegible] erionite [illegible] Erionite V.S. [illegible] (Coombs 1958)

(CONTINUED)

SAMPLE CSC - CLINOPTILOLITE, SUCCOR CREEK, OREGON

2THETA	D-SPACING	I/IO
40.1	2.247	2.1
40.78	2.211	0.7
41.05	2.197	0.6
41.83	2.158	0.8
42.39	2.130	1.5
43	2.102	1.1
43.25	2.090	1.2
43.45	2.081	1.1
43.9	2.061	0.8
44.8	2.021	1.1
45.8	1.979	1.6
46.25	1.961	1.5
46.7	1.943	0.8
47	1.932	0.9
47.28	1.921	1.1
48.65	1.870	0.8
49.9	1.826	0.9
50.82	1.795	4.7
51.55	1.771	1.4
52.3	1.748	1.2
52.75	1.734	2.0
54	1.697	1.0
55.6	1.652	1.0
56.2	1.635	0.9
56.82	1.619	0.8
57.8	1.594	0.9
59	1.564	0.9
60.6	1.527	0.8
62	1.496	1.7

JCPDS files used for comparison:
Clinoptilolite 25-1349
Mordenite 29-1257, 6-239
Quartz 33-1161
Erionite 22-854

Results above indicate that samples are not very pure. Need to do additional heavy liquid separation. Also need to regrind powder sample and sieve below ~325 mesh to minimize preferred orientation.

12/18/89 RJP

XRD Analysis of Succor Cr., Oregon clinoptilolite

Objective:
1. Obtain relatively pure samples of clinoptilolite
2. Test effectiveness of heavy liquid separation in purifying zeolite specimens.
3. Check the effectiveness of grinding and sieving powdered samples in minimizing preferred orientation in XRD analysis.

Method:
Use powdered zeolite specimens used previously (see 12/15/89). Regrind dry using mortar and pestle until all the powder passes through a 325 mesh stainless steel sieve (use Ro-Tap sieve shaker).
~~Dry at 280°C for about 1 hour.~~ Equilibrate sample with water vapor coexisting w/ pure H_2O inside a dessicator overnight.
Submit the powder sample for XRD analysis the next day.

Use previously prepared heavy liquid (2.2.2) to separate clinop. from heavier minerals. Rinse with acetone. Dry at 280°C for about 1 hr.
RJP 12/18/89

Results: X-ray peaks (location & intensity) were read off the strip chart. D-spacings and relative intensities were calculated and are tabulated below.

12/18/89
40 mA
40 kV
400 cps
τ=4 sec
0.5° 2θ/min
Al holder

SAMPLE CSC(2HL) - CLINOPTILOLITE, SUCCOR CREEK, OREGON

RP 4/10/90

2THETA	D-SPACING	I/IO	
7.38	11.968	0.3	1.6
9.05	9.763	0.3	1.5
9.3	9.501	0.3	2.6
9.8	9.018	0.3	100.0
11.1	7.964	0.3	4.8
12.98	6.815	0.3	3.4
13.28	6.661	0.3	2.5
14.84	5.964	0.3	1.8
15.76	5.618	0.3	2.0
16.55	5.352	0.3	2.8
16.82	5.266	0.3	5.5
17.26	5.133	0.3	5.7
17.45	5.078	0.3	2.7
18.97	4.674	0.3	9.6
19.7	4.503	0.3	2.0
20.3	4.371	0.3	3.2
22.27	3.988	0.3	25.6
22.65	3.922	0.3	18.4
23.06	3.854	0.3	3.2
23.68	3.754	0.3	3.0
23.89	3.722	0.3	3.0
24.9	3.573	0.3	4.1
25.29	3.519	0.3	2.4
25.62	3.474	0.3	3.0
25.91	3.436	0.3	9.9
26.16	3.404	0.3	6.0
26.55	3.354	0.3	2.0
26.74	3.331	0.3	3.9
28	3.184	0.3	8.8
28.45	3.135	0.3	7.1
28.94	3.083	0.3	4.4
29.92	2.984	0.3	18.3
30.92	2.890	0.3	1.6
31.2	2.864	0.3	1.5
31.85	2.807	0.3	9.5
32.6	2.744	0.3	7.5
33.4	2.680	0.3	2.1
35	2.561	0.3	2.4
35.3	2.540	0.3	3.8
36	2.493	0.3	2.1
36.65	2.450	0.3	3.3
36.9	2.434	0.3	3.5
37.5	2.396	0.3	1.6
38.1	2.360	0.3	1.9
38.58	2.332	0.3	1.5
40.05	2.249	0.3	1.8
41	2.199	0.3	1.5
41.8	2.159	0.3	1.4
42.28	2.136	0.3	1.8
42.5	2.125	0.3	1.9
42.68	2.117	0.3	1.7
43.02	2.101	0.3	2.2
43.2	2.092	0.3	2.3
43.4	2.083	0.3	2.0

(CONTINUED)

SAMPLE CSC(2HL) - CLINOPTILOLITE, SUCCOR CREEK, OREGON

AP 4/2/90

2THETA	D-SPACING	I/IO	
43.9	2.061	0.3	1.8
44.5	2.034	0.3	1.6
44.8	2.021	0.3	2.2
45.28	2.001	0.3	1.3
45.7	1.984	0.3	2.0
46.15	1.965	0.3	3.0
46.6	1.947	0.3	1.6
47	1.932	0.3	1.7
47.9	1.897	0.3	1.1
48.75	1.866	0.3	1.4
49.9	1.826	0.3	1.9
50.75	1.797	0.3	3.0
51.46	1.774	0.3	3.0
52.2	1.751	0.3	2.0
52.77	1.733	0.3	2.9
54	1.697	0.3	2.4
55	1.668	0.3	1.4

12/19/89
40 mA
40 kV
400 cps
2 sec
0.5° 2θ/min
As before

The X-ray diffraction results show decreases in some peak intensities compared to the previous analysis. The clinoptilolite + mordenite peak at ~ 9.7° 2-θ decreased in absolute intensities to almost half the previous value. The mordenite peaks at ~ 27.72 & 27.77 which are very intense in the previous analysis is gone. Various peaks identified with mordenite also decreased in height. The quartz peaks also decreased in intensity. A few unidentified peaks below 10° 2θ did not change significantly in intensity.

Need to redo heavy liquid separation procedure to check if additional mineral separation will take place.

12/19/89 KW

XRD Analysis of Succor Creek, Oregon Clinoptilolite

Objective and Methods as in 12/18/89.

Results:

SAMPLE CSC(3HL) - CLINOPTILOLITE, SUCCOR CREEK, OREGON

2THETA	D-SPACING	I/IO
7.4	11.936	1.6
9.2	9.604	1.7
9.4	9.400	2.6
9.81	9.008	100.0
11	8.036	1.7
11.13	7.943	4.4
13	6.804	3.3
13.3	6.651	2.2
14.9	5.941	1.4
15.8	5.604	2.2
16.6	5.336	2.5
16.85	5.257	4.9
17.32	5.116	5.2
17.47	5.072	3.2
19.02	4.662	10.6
19.76	4.489	2.1
20.35	4.360	2.6
22.31	3.981	24.3
22.7	3.914	20.6
23.15	3.839	2.6
23.73	3.746	3.0
23.97	3.709	2.5
25	3.559	4.3
25.4	3.504	2.3
25.68	3.466	2.5
25.97	3.428	7.8
26.22	3.396	5.6
26.56	3.353	1.8
26.79	3.325	3.4
28.08	3.175	7.1
28.5	3.129	7.4
29	3.076	3.8
30	2.976	20.6
31	2.882	1.7
31.96	2.798	8.8
32.7	2.736	9.0
33.45	2.677	1.7
35.05	2.558	1.9
35.4	2.533	4.1
36.05	2.489	2.1
36.4	2.466	2.4
36.7	2.447	4.0

SAMPLE CSC(3HL) - CLINOPTILOLITE, SUCCOR CREEK, OREGON

2THETA	D-SPACING	I/IO
37	2.427	3.4
37.6	2.390	1.7
38.1	2.360	1.7
38.7	2.325	2.0
40.15	2.244	1.9
41.85	2.157	1.5
42.5	2.125	1.9
43.1	2.097	1.9
43.25	2.090	2.2
43.55	2.076	2.0
44	2.056	1.3
44.83	2.020	2.1
45.85	1.977	2.4
46.3	1.959	3.2
47.15	1.926	1.7
48.75	1.866	1.6
49.9	1.826	1.5
50.9	1.792	3.0
51.36	1.777	2.0
51.6	1.770	2.9
52.2	1.751	2.1
52.8	1.732	3.4
54	1.697	2.0
55.06	1.666	1.4

The results indicate no significant differences from the second X-ray analysis (CSC(3HL)).

1/9/90 RJP
Zeolite samples and NBS standards submitted to Div. 91, SwRI for chemical analysis. Cations to be analyzed are Na, K, Ca, Mg, Al, Si and Fe. Water loss at 105°C and 900°C to be measured.
List of samples are given on p. 88 (8/28/89).
Samples were received by Becky Riddle.

1/10/90 RJP

Preparation of Powder Specimens of Different Mesh Sizes from the Death Valley Junction, California (CDV) Clinoptilolite Specimens

Objective: Prepare powder samples in the mesh size ranges 35-100, 100-200, 200-325, 325-450, and <450, of specimen CDV.

Method: Break off chunks of sample CDV into pieces about 1/4 inch in diameter or smaller using a hammer. Cover the sample with canvas cloth during crushing to minimize direct contact between the hammer and the sample.
Place the small chips into a tungsten carbide SPEX mill vial such that they occupy about 1/3 the total volume, then place one tungsten carbide ball (7/16") together with the chips. Screw the vial cap on, position the vial in the SPEX mill, and turn the mill on for about one minute. Empty the ground sample into a screw cap glass jar. Repeat procedure until enough ground sample is obtained. These initially ground material will consist of powders and chips of different sizes.
Initially clean the stainless

steel sieves of mesh size 35, 100, 200, 325, and 450 using an ultrasonic bath containing soapy water. Rotate the sieve periodically to clean the whole diameter of the sieve. Rinse with ~~ultrapure H_2O~~ deionized H_2O. Then rinse with acetone to accelerate the drying process. Blow dry the sieves using an air hose.

Stack the sieves with the smaller mesh numbers on top. Place about 150-200 grams of the initially ground material on the top sieve. ~~Position the~~ Initially use only sieves #35, 100, 200 and 325. Use #450 later. Position the sieves stack on the Ro-Tap sieve shaker. Turn on the shaker for about 5 mins. Empty the powders or chips into separate marked screw cap glass jars for each size range. Re-clean the sieves as necessary. Reground the 35 mesh samples using the Spex mill until every sample passes through the 35 mesh sieve.

Repeat until all the samples have passed through the 35 mesh sieve, replace this sieve with the 450 mesh sieve. Repeat the sieving process to make sure the samples are sieved to their respective grain size range and that

no sieve extension takes place due to clogging of the sieves, which becomes a problem at mesh size 100 and below. Eliminate clogging problems by frequent cleaning of the sieves.

Results:

1/10/89 RJP

About 510 grams of initially ground material was made.

1/11/89 RJP

An additional ~500 grams of ground material was made.

1/12/89 RJP

About 480 g. of ground material was made.

1/15/89 RJP

Initial sieving of ground material was conducted using mesh sizes 35, 100, 200, 325. Of the initial ~1560 gms, about 730 gms. did not pass through the 35 mesh sieve. These will need to be reground using the Spex mill and tungsten carbide vial.

1/16/90 RJP
The >35 mesh material was reground using the Spex mill until all of it has passed through the 35 mesh sieve.

1/16/90 RJP
Received from Arend Meijer, Principal Investigator, Los Alamos National Labs., about 40g of material containing small (<1.0mm) crystals of clinoptilolite (?). The material is very friable, highly altered (?), with vugs and cavities w/c contain the clinop. crystals. Locality is Succor Creek, Oregon.

1/17/90 RJP
Received Heulandite(?) specimen from Mineralogical Research Co. (San Jose, CA). Museum quality, 22" long, w/ 1/2" long white, vitreous luster, crystals on fine-grained, white matrix.
Need to get XRD analysis.

1/22/90

The CDV specimen powder obtained as of 1/16/90 had about 365 grams in the 100-200 mesh size range. Need to resieve these using cleaned sieves. Use 100, 200, 325 and 450 mesh stainless steel sieves, and Ro-Tap

sieve shaker. Sieve about 125g each time for about 7 minutes. Reclean sieves after each step using air hose.
Repeat the procedure.

Result: A total of about 235 gms of 100-200 mesh CDV powder was recovered. Some cotton fibers were recovered from the <100 mesh screen w/c originally came from the canvas bags used to cover the samples during crushing. About 20g were discarded (<100 mesh). Some black grains are ~~obviously~~ visibly intermixed with the clinoptilolite. Need to try heavy liquid separation to remove these black minerals

1/23/90 RJP

Purification of CDV powder by heavy liquid separation

Objective: Test efficiency of heavy liquid separation in removing mineral impurities (e.g., Fe oxides, amphibole, qtz, feldspar) present in the clinoptilolite specimen CDV.

Method: Use heavy liquid mixture prepared on 12/15/89, a 250 ml. separatory funnel, and about

30 g. of the 100-200 mesh size CDV powder.

Place 30 g. of the CDV powder in the separatory funnel. Pour about 200 ml of the heavy liquid into the funnel. Shake well for a few seconds or until the mixture becomes homogeneous. Let stand a few minutes to allow separation due to density differences.

Initially, most of the ferromagnesian mineral will quickly settle to the bottom of the funnel. On top, a cake or layer of clinoptilolite + minor ferromags and other impurities will form. In between, dispersed in the bulk of the heavy liquid, are minerals of intermediate density most likely consisting of intergranular mixtures of clinop, ferromags and quartz/feldspars.

Drain the black colored grains at the bottom into a funnel w/ a #4 filter paper. Then drain the bulk of the liquid into a different funnel + filter paper, taking care not to mix the minerals in the floating layer. The filtrant can be reused. Rinse the filtrates w/ acetone and air dry. Place ~~into~~ in labeled plastic vials.

Repeat procedure, except at this point no longer of black grains will settle at the bottom. Drain

the bulk of the heavy liquid, leaving the floating layer behind. Rinse the filtrate ~~and~~ w/ acetone and air dry. Repeat this as needed. Then wash off the floating layer from the separatory funnel with additional heavy liquid into a filter + funnel. After draining, rinse the light separates w/ acetone and dry in an oven for a few minutes at ~ 80°C.

Results:

Heavy liquid density is measured to be ~ 2.18 g/ml.

Wt. of purified sample	=	26.63 g.
Heavy separate 1 (HS1) (mostly black grains)	=	1.11
HS2	=	0.30
HS3	=	0.41
HS4 + HS5 + HS6 + HS7	=	0.28
		28.73 g

Diff of initial 30 g.

Compared to initial material, the purified sample has a smaller amount of black grains. However grains of black minerals are still evident. Under the binocular microscope, the black minerals appear to be mostly amphibole, as evidenced by its long prismatic habit. Density of liquid measured

after the separation is ~ 2.18.

1/24/90 RJD

Heavy liquid separation of black minerals using liquid of lower density

Objective: Test if liquid of lower density will result in additional separation of black minerals left in the filtrate of clinoptilolite from the test conducted on 1/23/90.

Procedure: Put the 28.7 g. of CQV powder derived from previous test inside the 250 ml separatory funnel. Pour into the funnel about 200 ml of heavy liquid (ρ ~ 2.18 g/ml). Shake well. Add a few ml. of NN-Dimethylformamide (ρ = .93445 at 20°C) and shake. Observe to see if separation of black grains is taking place. If not add a few more ml. of dimethylformamide. Wait about half an hour to let the heavy minerals settle to the bottom. The clinoptilolite powder will probably not form a distinct layer because the density of the liquid is close to the density of clinoptilolite.

Drain the minerals at the bottom, wash w/ acetone, dry and place in vial labeled HS-8.

Drain the rest of the mixture through a filter paper. Wash the minerals w/ acetone and dry in an oven at about 50°C.

Measure the density of the heavy liquid using a 10 ml volumetric flask.

Result:

Density of heavy liquid ~ 2.10.

Wt. HS-8	1.3 g.
Wt. purified sample	25.37
	26.67 g out of initial 28.73 g.

Additional black minerals were separated, leaving a clinoptilolite sample much purer than initial starting material. Some material was lost that stuck to glassware walls or to filter papers.

1/25/90 RJD

Heavy liquid (ρ ~ 2.00) separation of black minerals

Objective: Check if liquid of ρ ~ 2.00 will result in additional separation of black grains from clinoptilolite powder.

Method: Prepare heavy liquid

mixture with $\rho = 2.00$ using tetrabromoethane ($\rho = 2.96725$) and diluted with NN-dimethylformamide ($\rho = 0.93445$).

Pour about 200 ml of the mixture into a separatory funnel (250 ml cap). Pour in about 5 gms of the material purified on 1/24/90. Shake the mixture and observe if black grains will settle to the bottom.

Result: No gravitational separation took place. Black grains in the powder mixture are likely intergrown w/ clinoptilolite, thus making the density of the grain close to that of the clinoptilolite and that of the ~~mix~~ liquid.

Adjust density of the liquid mixture to 2.04 by addition of tetrabromoethane.

1/25/90 RM

Mixed previously prepared heavy liquid mixture of bromoform + dimethylformamide ($\rho = 2.18$) with a few ml. of dimethylformamide to reduce the density. Measured $\rho = 2.14$ g/ml.

1/25/90 RM

Grind and sieve ~~sample~~ about 1 gm. of sample purified on 1/24/90

and the heavy mineral separate HS1, both to less than 325 mesh. Put in separate plastic vials and label CDV-P1 and CDV-HS1, respectively. Submit to H Sabbana (Div. 01) for XRD analysis.

Results of XRD analysis:
(X-ray diffraction pattern kept in separate file)

SAMPLE CDV-P1 - CLINOPTILOLITE, DEATH VALLEY JUNCTION, CA
PURIFIED, HEAVY LIQUID SEPARATION JCPDS # 25-1349

2THETA	D-SPACING	I/IO	hkl
9.82	8.999	58.7	020
11.13	7.943	36.4	200
13	6.804	15.6	$\bar{2}01$
13.28	6.661	9.2	001
14.9	5.941	10.0	220
15.87	5.580	5.5	
16.9	5.242	15.1	311
17.28	5.127	33.3	111
19.06	4.652	22.9	$\bar{1}31$
20.39	4.352	13.4	$\bar{4}01$
22.39	3.967	100.0	400
22.72	3.910	57.5	$\bar{4}21$
23.1	3.847	15.3	221
24	3.705	13.3	CL?
25	3.559	23.0	$\bar{3}12$
26	3.424	43.8	$\bar{2}22$
26.25	3.392	28.8	$\bar{2}02$
26.8	3.324	20.2	CL?
28.15	3.167	36.4	$\bar{4}22$
28.6	3.118	22.8	441
29	3.076	23.2	$\bar{1}32$
30.1	2.966	50.3	151
31	2.882	6.6	
32	2.794	36.1	$\bar{6}21$
32.83	2.726	19.7	202
33.45	2.677	9.9	
35	2.561	9.7	
35.4	2.533	11.1	
36.1	2.486	7.9	
36.95	2.431	16.4	

Comparison of CDV-P1 XRD pattern with CDV1 (3-24-89) showed no significant changes in peak shapes and locations. Some minor changes in intensities.

SAMPLE CDV-HS1 - CLINOPTILOLITE, DEATH VALLEY JUNCTION, CA
HEAVY MINERAL SEPARATES

2THETA	D-SPACING	I/IO	hkl
7.34	12.033	12.8	
8.82	10.017	12.8	
9.9	8.927	12.8	
10.5	8.418	18.4	
11.2	7.893	8.0	
13.8	6.411	11.2	M130
15.2	5.824	8.0	M310
17.39	5.095	9.6	
19.1	4.643	9.8	M311
19.7	4.503	9.9	M400
20.4	4.350	11.2	
20.85	4.257	28.8	Q100
21.95	4.046	47.0	M130
22.35	3.974	19.2	
22.5	3.948	18.1	
22.85	3.889	25.6	M241
23.62	3.763	45.1	M002
24.4	3.645	31.0	M112
25.1	3.545	12.8	M310
25.6	3.477	18.9	M202
26.4	3.373	26.2	M350
26.6	3.348	100.0	Q101
27.75	3.212	94.4	M311
28	3.184	76.0	M441
28.32	3.149	32.3	
28.43	3.137	33.6	
29.4	3.035	16.8	
29.61	3.014	23.7	
30	2.976	18.7	
30.25	2.952	30.2	M531
30.47	2.931	21.8	
30.57	2.922	19.5	
31.4	2.846	17.8	
31.8	2.812	11.5	
32	2.794	11.2	
33.7	2.657	12.0	
35.5	2.527	18.2	
35.85	2.503	17.9	
36.59	2.454	38.9	Q110
36.69	2.447	29.6	
37.15	2.418	9.6	
37.7	2.384	9.0	
38.25	2.351	8.0	
39.48	2.281	12.8	Q102
40.3	2.236	8.0	Q111

1/30/90 RTD

Received about 200 gms of Bunch Creek clinoptilolite samples from Mineralogical Research Co. The clinoptilolite are small crystals < 0.3 mm in length in vugs and cavities of altered volcanic(?) matrix. The specimens are of lower quality than those received on 12/12/89, and are the same as those received from A. Meiger of Los Alamos on 1/16/90.

Sent back to the dealer about 150 gms. of the clinoptilolite for direct exchange.

Also received from M.U. Res. Co. about 25 gms. of mordenite specimen.

1/30/90 RTD

Continue activities initiated on 1/10/90 of preparing CDV powder specimens of different mesh sizes.

2/12/90 RTD

Activities during the past 2 weeks on grinding and sieving CDV powder samples have produced an additional ~408 g. of 100-200 mesh size fraction. Leftover from material produced on 1/22/90 is ~204 g., giving a total of 612 g. of 100-200 mesh CDV powder. Heavy liquid separation is needed to remove the qtz, ferromag, and other impurities. Also need to

remove the other size fractions, starting with the ~~325~~-450, 200-325 mesh size fraction.
About 241 g of the 35-100 mesh fraction is left.

2/13/90 RJN

Initiate heavy liquid treatment of 100-200 mesh CDV powder samples.

Objective: Remove heavy mineral impurities from CDV clinoptilolite samples.

Method: Pour about 200 ml of heavy liquid mixture ($\rho \sim 2.14$) into 250 ml separatory funnel. Add 30 g. CDV powder (100-200 mesh size). Mix until homogeneous, then let settle. The ~~heavy~~ minerals with densities greater than that of the mixture will settle to the bottom of the flask. The minerals of lesser density will form a cake layer on top. Run off the heavies into a 100 ml beaker. Filter to recover the heavy liquid mixture, then wash the heavies with acetone. Remix the liquid + minerals and do a second separation. Run off the heavies into a separate beaker. Filter the second heavies & wash w/ acetone & let dry. Repeat the above

procedure using a heavy liquid of $\rho \sim 2.08$ g/ml. This time the density of the clinoptilolite is close to that of the mixture (slightly ~~less~~ greater than 2.08) and no cake layer will form on top. Minerals heavier than clinoptilolite will settle faster (slightly), and a heavy mineral-rich layer will form at the bottom of flask. After this initial layer forms, the deposits above this layer will be less heavy mineral-rich (less ferromagnetism minerals). Swirl the flask so that the liquid + minerals above the initial layer is homogenized, then let the mixture settle. Then run off the heavy mineral-rich bottom layer into a 100 ml flask, and filter to recover the heavy liquid. Then off the bulk of the remaining mixture into a separate 100 ml flask(s), leaving the topmost layer of predominantly heavy liquid in the flask. Then run off this last layer into a separate flask and filter. Also filter the bulk of the mixture to recover the heavy liquid. Wash the solids with acetone, including the filter paper and funnel, taking care to collect the washings into a separately marked 500 ml beaker for later recovery of the bromoform ~~and~~ of tetrabromomethane.

Place the purified powder in a 100 ml flask. Add about 20 ml of

acetone, swirl, then place in ultrasonic cleaner for about 2 minutes. Decant the acetone, together with the suspended fine particles. Do 5 times. Then wash with about 20 ml of deionized H_2O in the ultrasonic cleaner for about 2 minutes. Decant the water and fines; repeat 9 times. Collect the decanted acetone and water in 500 ml. beakers, and dry at about 90°C in a convection oven.

2/16/90 RJD

Result: The above procedure was done on ten batches of 30g. CDV 100-200 mesh powder. The first heavy mineral separates totaled 12.10 gms. and placed in a plastic vial with the label CDVHS-1. The second heavy mineral concentrates totaled 4.59 gms. and labeled CDVHS-2. The third concentrate (separated using $\rho \sim 2.08$ g/L liquid) totaled 40.54 gms. and labeled CDVHS-3. The purified fractions were kept wet, and had a total mass (wet mass) of about 314g. A portion of these purified sample will be dried for characterization work, but the bulk will be used to prepare homoionic forms of clinoptilolite. The light fraction totaled 13.92 gms, put in separate jar and labeled CDVL-5.

2/19/90 RJD

Preparation of Homoionic Na-clinoptilolite (CDV, 100-200 mesh size)

Objective: To prepare homoionic Na-clinoptilolite to be used for ion exchange experiments.

Method: TOP-005. Deviation from this procedure (Section 5.2.1) involves using ~40g. of zeolite material and ~320 ml of 1 m NaCl solution instead of ~50g. zeolite and ~400 ml of NaCl solution.

Six batches of ~40g. CDV powder prepared as of 2/16/90 were placed in separate 600 ml. plastic bottles, and ~320 ml of 1.0 m NaCl solution were added to each bottle. Each bottle was swirled to initially homogenize the mixture, then placed in a shaker water bath set at 25°C and 70 r.p.m. Turned on at 1650 hrs.

The remaining CDV powder prepared on 2/16/90 were dried at about 80°C. The dried weight is 43.56 gms. These samples were then equilibrated with water vapor over a saturated NaCl solution in a dessicator.

2/21/90 RJP
1100 hrs – Decant NaCl solutions equilibrating with CDV powder samples. Replace the solutions with newly prepared 1.0 m NaCl solutions. Put back in water bath with the same settings.

2/22/90 RJP
1100 hrs – Decant and replace 1 m NaCl solutions equilibrating with CDV powder samples. Put back in water bath.

2/20/90 RJP
1400 hrs – Demonstration of Nikon Optiphot model petrographic microscope (transmitted and reflected light) with the FX II 35 mm camera system. Photomicrographs of polished tuff specimen thin sections were taken. Photos are kept in separate file and numbered R5-0 to R4-25.

2/23/90 RJP
1330 hrs – Decant and replace 1 m NaCl solutions exchanging with CDV powder samples. Put back in water bath.

2/26/90
0915 hrs – Decant and replace 1 m NaCl solutions exchanging with CDV powder samples. Put back in

water bath, same settings.

2/27/90 RJP
0900 hrs – Decant and replace 1 m NaCl solutions exchanging with CDV samples. Put back in water ~~chan~~ bath. Change settings to:
Temp: 70°C
Speed: 80 rev/min.

2/28/90 RJP
0915 hrs – Decant and replace 1 m NaCl solutions exchanging with CDV samples. Put back in water bath. Setting at 70°C, 80 rev/min.

1640 hrs – Received results of chemical analysis done by Division 01 (SwRI) on basalt and NBS standards (Reference: 8/28/89). These samples were submitted to Div. 01 on 1/9/90. Results were transmitted to the Center by fax. A copy is attached on the next page.

FEB 28 '90 16:52 SWR 5:25223649 3840 P.2

SOUTHWEST RESEARCH INSTITUTE
San Antonio, Texas 78284

Page: Pabalan
Project: 20-3704-013

Pabalan Samples

µg/g = mg/kg = ppm and noted

Sample id	Na	K	Ca	Mg*	Al	Fe	Si
A	4.89%	3.90%	1.35%	814	8.78%	490	~~0.08%~~ 0.17
B	6.99%	0.89%	2.38%	9430	5.36%	9897	~~0.19%~~ 0.08
C	10.34% (10.34)	<0.12%	<0.12%	11.7	10.8%	223	0.19%
D	1.10%	0.90%	2.35%	9660	5.28%	1.06%	0.12%
E	1.74%	7.67%	<0.12%	96.8	5.34%	531	0.10%
F	4.09%	0.75%	0.45%	896	5.03%	5502	0.26%
G	9.36%	<0.12%	<0.12%	11.7	9.77%	223	0.26%
H	4.26%	0.87%	0.45%	905	4.97	5635	0.25%

* flame analysis; all others by ICP

Date: 2/23/90 / 2/28/90 Signature: Becky Riddle

(SwR 17) Rev 8/75

Sample identifications are given on page 88.

3/1/90 RDD

1300 hrs — Decant the 1 m NaCl solutions exchanging with the CDV powder samples. These samples are in 3 6 plastic bottles (see 2/19/90). Replace the 1 m NaCl solns. in 3 bottles and place the bottles in a shaker water bath set at 25°C and 80 rpm.

Wash the other 3 samples with deionized water several times until no Cl^- can be detected with 0.1 M $AgNO_3$ solution. This was done 5 times. After washing add about 320 ml of deionized water to each bottle and replace in the water bath set at 70°C and 80 rpm. (water bath #2)

3/2/90 RDD

1330 hrs — Decant water from bottles in the water bath set at 70°C. Checked for Cl^- using 0.1 m $AgNO_3$. None detected by this method. Wash twice with deionized water. Replace water and return to water bath. Set temp. to 25°C. Reset time to 60:00 hrs. Turn water bath on. (water bath #2)

3/5/90 RDD

1330 hrs — Decant water from bottles in water bath #2. Check for Cl^- using $AgNO_3$ solution. No Cl^- detected.

Decant 1m NaCl solutions in bottles in water bath #1, w/c were equilibrating with CDV powder. The samples in each of the 3 bottles were washed with deionized water and the water was tested each time for Cl⁻. No visible AgCl ppt formation was evident after 4 washings. Two additional washings were done, then water was replaced in the bottles and the bottles were put back in the water bath (#2) set to 25°C.

The samples from water bath #2 were washed into glass containers, and placed in an oven set at about 80°C.

3/6/90 RDD

1100 hrs — Remove CDV powder samples from oven. Weigh total weight (container + sample) right away, taking care to place an insulating pad between the balance and the sample container. Label the samples A, B, C. The measured weights are:

A = 93.72 g. (container + CDV sample)
B = 88.59 g.
C = 91.59 g.

3/6/90 RDD

1130 hrs —

The CDV powder samples prepared on 2/19/90 [see p. 147, last parag.] and which were equilibrating with water vapor over a saturated NaCl solution were weighed. The total weight measured is 46.72 g. compared to a dry weight of 43.56 g. Therefore there was an uptake of about 3.2 g. of water over a two week period. Put the powder samples into one plastic vial and label the vial ~~CDV2/19~~ 3/6/90 CDVP.

The fine powder suspensions obtained during heavy liquid separation treatment of CDV powders (see p. 146, first parag.), and which were dried and then equilibrated w/ water vapor in a dessicator were weighed. Total weight of the powder sample is 11.20 g. Place in a plastic vial, and label CDVHSW (CDV heavy separation washings).

3/7/90 RDD

0930 hrs - Reweigh samples A, B, C in dessicator.

Measured weights:

A = 94.89 g.
B = 89.61
C = 92.61

(wt. of glass container + CDV powder)

1000 hrs – Remove CDV powder samples being dried in the oven. These samples were equilibrated with 1 m NaCl solutions in water bath #1, washed and equilibrated with pure water (see 3/5/90, p. 152), and then washed again on 3/6/90. No Cl^- was detected on 3/6/90, and the samples were placed in the oven on 3/6/90 at about 1125 hrs.

The total dry weight of the samples (+ glass containers) are:

RJP ~~E~~ D = 86.80
3/9/90 ~~F~~ E = 86.50
~~G~~ F = 90.55

After weighing, the samples were placed in a dessicator, together with samples A, B & C, to equilibrate with water vapor over a saturated NaCl soln.

3/9/90 RJP
1300 hrs Reweigh samples A, B, C, D, E, F from 3/6/90 and 3/7/90.

Measured weights:

A = 94.98 g.
B = 89.86
C = 92.87

D = 88.06
E = 86.83
F = 91.81

3/12/90 RJP
1045 hrs – Reweigh samples A, B, C, D, E, F w/c are equilibrating with water vapor over a saturated NaCl soln. Then place back the samples in the dessicator.

	Δ 3/9 to 3/12 (~~wt~~ %)
A = 95.10	0.13%
B = 90.00	0.16%
C = 93.03	0.17%
D = 88.22	0.18%
E = 87.00	0.20%
F = 91.97	0.17%

3/14/90 RJP
1445 hrs – Reweigh samples as in 3/12/90.

A = 95.12
B = 90.03
C = 93.06

D = 88.24
E = 87.02
F = 92.00

3/14/90 RJP
1500 hrs – Received zeolite samples and NBS standards left over from chemical analysis done by Division 01.

The following is a summary of chemical analytical results for zeolite samples and NBS standards performed by Jordan Lab., Core Lab, and SWRI Div. 01 (see 8/28/89).

RESULTS OF CHEMICAL ANALYSIS OF NBS STANDARD 99A
SAMPLE A

WEIGHT PERCENT

	NA	K	CA	MG	FE	AL	SI
JORDAN LAB	4.99	3.9	1.25	0.002	0.043	11.3	31.8
CORE LAB	4.8	5.7	1.75	<0.02	0.0403	12.0	32.4
SWRI	4.89	3.9	1.35	0.008	0.049	8.78	0.17
	5.0	4.0	1.4	<0.05	0.06	10.9	5.0
							3.5
NBS	4.6	4.315	1.53	0.012	0.0455	10.85	30.48

RESULTS OF CHEMICAL ANALYSIS OF NBS STANDARD 70A
SAMPLE E

WEIGHT PERCENT

	NA	K	CA	MG	FE	AL	SI
JORDAN LAB	2.1	9.61	0.076	0.003	0.051	9.6	32.5
CORE LAB	2.24	4.3	0.093	0.018	0.0784	9.1	28.8
SWRI	1.74	7.67	<0.12	0.0097	0.0531	5.34	0.10
NBS	1.89	9.8	0.079	0.0	0.0525	9.474	31.37

RESULTS OF CHEMICAL ANALYSIS OF CGC (35-200 MESH)
SAMPLES B AND D

WEIGHT PERCENT

	NA	K	CA	MG	FE	AL	SI
JORDAN LAB (B)	1.05	0.96	2.38	0.68	0.98	6.45	28.8
(D)	1.07	0.999	2.36	0.71	0.89	6.2	28.9
CORE LAB (B)	<0.01	0.81	0.93	0.69	1.15	6.00	31.2
(D)	1.08	0.88	2.6	0.64	1.2	6.0	31.6
SWRI (B)	0.99	0.89	2.38	0.943	0.990	5.36	0.08
(D)	1.10	0.9	2.35	0.966	1.06	5.22	0.12

Check of precision in analysis.

RESULTS OF CHEMICAL ANALYSIS OF ANALCIME
SAMPLE C (TRANSLUCENT) AND G (WHITE)

WEIGHT PERCENT

	NA	K	CA	MG	FE	AL	SI
JORDAN LAB (C)	10.4	0.028	0.008	0.0001	0.017	13.0	27.2
(G)	10.3	0.026	0.011	0.0003	0.015	12.6	31.6
CORE LAB (C)	10.8	<0.00005	0.019	0.0007	0.016	12.9	27.1
(G)	10.8	0.87	0.02	0.0027	0.0193	12.1	25.3
SWRI (C)	10.34	<0.12	<0.12	0.0012	0.0223	10.8	0.19
(G)	9.36	<0.12	<0.12	0.0012	0.0223	9.77	0.26

Check of precision in analyses

RESULTS OF CHEMICAL ANALYSIS OF CH (WASHED, 35-200 MESH)
SAMPLE F AND H

WEIGHT PERCENT

	NA	K	CA	MG	FE	AL	SI
JORDAN LAB (F)	4.01	1.06	0.36	0.039	0.47	6.22	31.4
(H)	4.02	1.04	0.37	0.039	0.47	6.21	31.5
CORE LAB (F)	4.4	11.4	0.36	0.13	0.40	5.7	33.6
(H)	4.4	1.1	0.35	0.12	0.42	5.9	33.4
SWRI (F)	4.09 ± 5%	0.75	0.45	0.090	0.55	5.03	0.26
(H)	4.26	0.87	0.45	0.091	0.56	4.97	0.25

Check of precision in analyses.

SwRI results for Si in all samples are very poor, with results mostly ~0.3 wt% instead of the expected ~30%. This is due to precipitation of silica after dissolution of the fused bead. Al concentration analyzed by SwRI are also lower than NBS standards, or results from other labs, and may be due to coprecipitation with silica. Need to modify amount of samples being fused for silica analyses. Probably need to analyze Al with Si, instead of with the other cations. Need to test differences in the two methods.

Duplicate analyses for sample CH (samples F and H) are generally very good for the 3 labs, except for Core Lab on K^+, and SwRI on K^+ also.

Precision of analyses for analcime (samples C and G) are not as good, but precision for CaC (samples B and D) are better than for analcime.

3/20/90 RJB
1540 hrs — Reweigh samples as in 3/14/90.

A = 95.09
B = 90.00
C = 93.03

D = 88.22
E = 87.00
F = 91.97

These are the same values as in 3/12/90, but slightly lower than 3/14/90 values.

3/21/90 RJB
1400 hrs — Transfer samples A, B, C into one plastic vial, labeled CDVH1 (CDV homogenic #1)

Weight of plastic vial = 29.664 ~~29.686~~
Wt. vial + CDVH1 = 110.536
Wt. CDVH1 = 80.872

Transfer D, E, F into a single vial.
Label CDVH2.

Wt. vial = 29.407 g.
Wt. vial + CDVH2 = 110.205
Wt. CDVH2 = 80.798 g

1430 hrs – Reweigh CDVP sample
(container + CDVP) = 76.128 g.
Open container and place inside
dessicator on saturated NaCl
solution.

3/23/90 RJP

1325 hrs – Reweigh CDVP sample.
Total wt = 75.930 g.
Return open container in
dessicator.

3/28/90 RJP
1030 hrs – Reweigh CDVP
sample.
Total wt = 75.800 g.
Replace sample in
dessicator.

4/3/90 RJP

1320 hrs – Reweigh CDVP.
Total wt = 75.77 g
Replace in dessicator