

APPENDIX A
SAMPLE DESCRIPTION AND COLLECTION
LOCATION

Appendix A : Sample description and collection

Central pit

Sample no.	Mine/zone	Location	Description
C1RB	576653	red bed zone	unconsolidated sediments
C1TRAN	576478	transition zone	claystone partings
C1J1	576421	J zone	lignite
C1J1/J2	576421	J zone	claystone partings
C1J2	576421	J zone	lignite
C1J2/J3A	576421	J zone	claystone partings
C1J3A	576340	J zone	lignite
C1J3A/J3B	576335	J zone	claystone partings
C1J3B	576335	J zone	lignite
C1J3B/J4	576332	J zone	claystone partings
C1J4	576332	J zone	lignite
C1J4/J5A	576505	J zone	claystone partings
C1J5A	576459	J zone	lignite
C1J5A/J5B	576459	J zone	claystone partings
C1J5B	576459	J zone	lignite
C1J5B/J5C	576455	J zone	claystone partings
C1J5C	576455	J zone	lignite
C1J5C/J6A	576455	J zone	claystone partings
C1J6A	576015	J zone	lignite
C1J6A/J6B	576015	J zone	claystone partings
C1J6B	576015	J zone	lignite

North cast pit samples

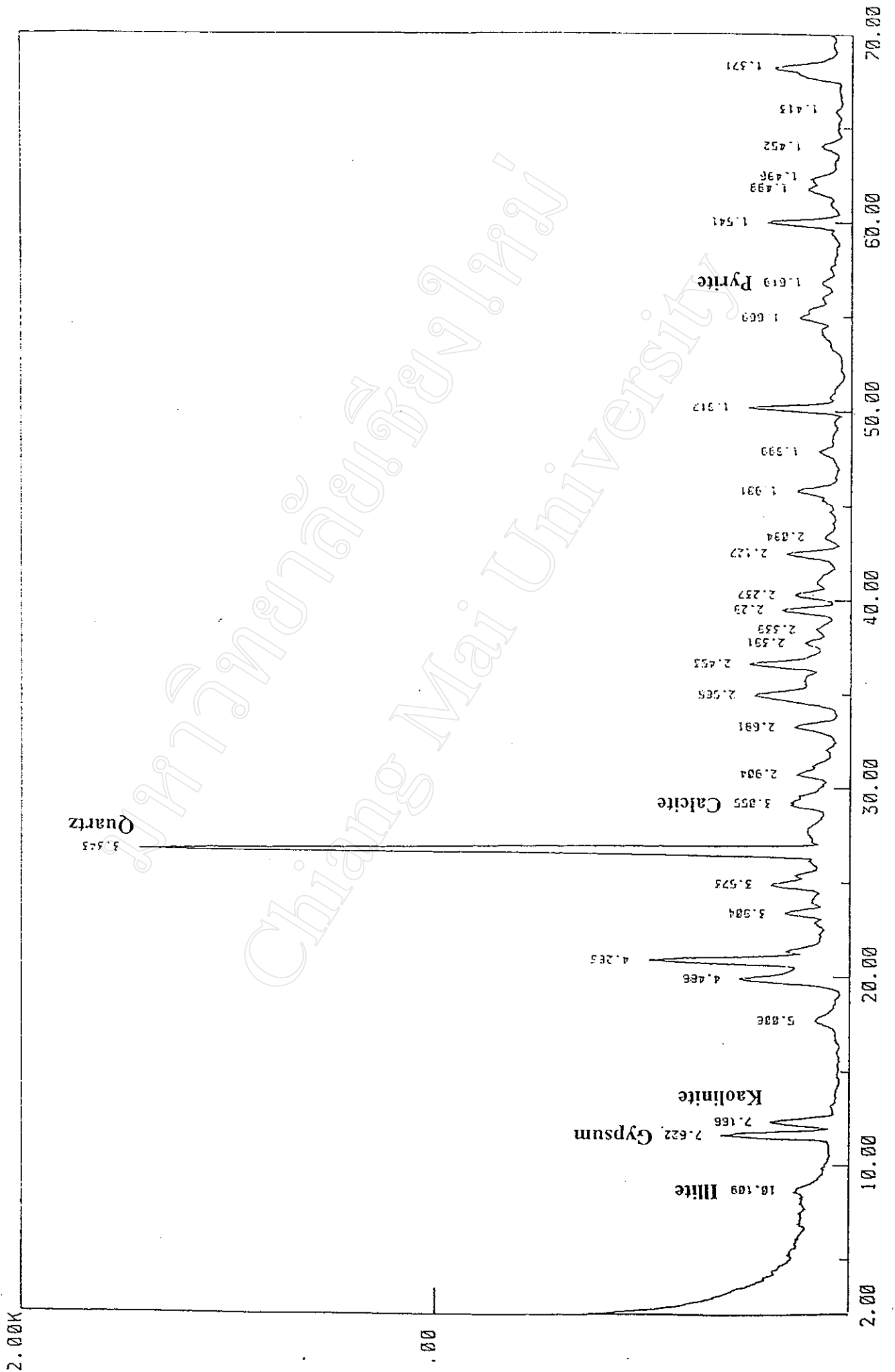
Sample no.	Mine/zone	Location	Description
NEK1	K zone	577740	lignite
NEK1/K2	K zone	577735	claystone partings
NEK2	K zone	577758	lignite
NEK2/K3	K zone	577640	claystone partings
NEK3	K zone	577548	lignite
NEK3/K4	K zone	577655	claystone partings
NEK4	K zone	577930	lignite
NEIB	interburden	577932	claystone partings
NEQ1	Q zone	577934	lignite
NEQ1/Q2	Q zone	577941	claystone partings
NEQ2	Q zone	577950	lignite
NEQ2/Q3	Q zone	577956	claystone partings
NEQ3	Q zone	577961	lignite
NEQ3/Q4	Q zone	577967	claystone partings
NEQ4	Q zone	577970	lignite
NEUB	underburden	577975	claystone partings

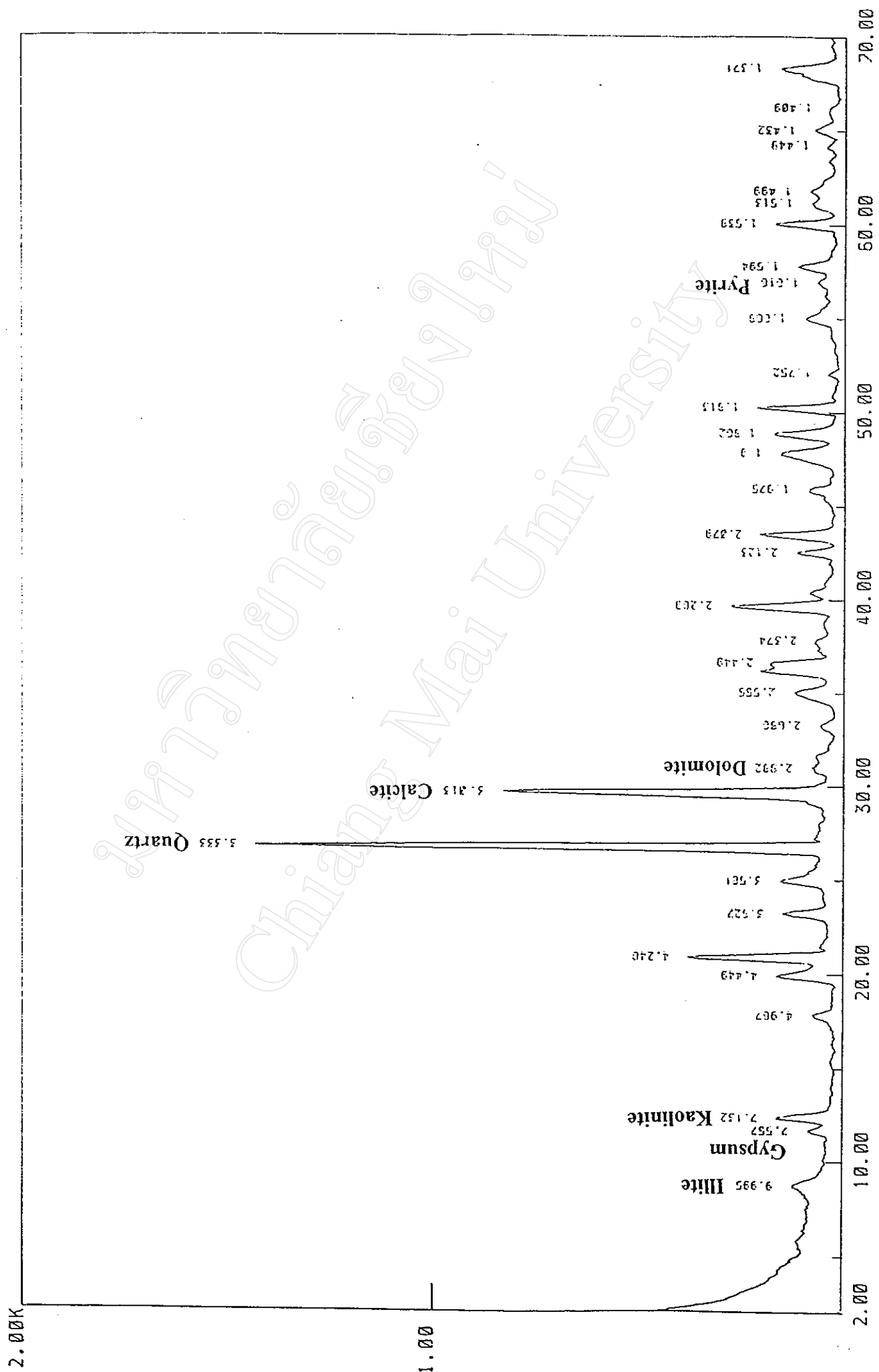
North west pit samples

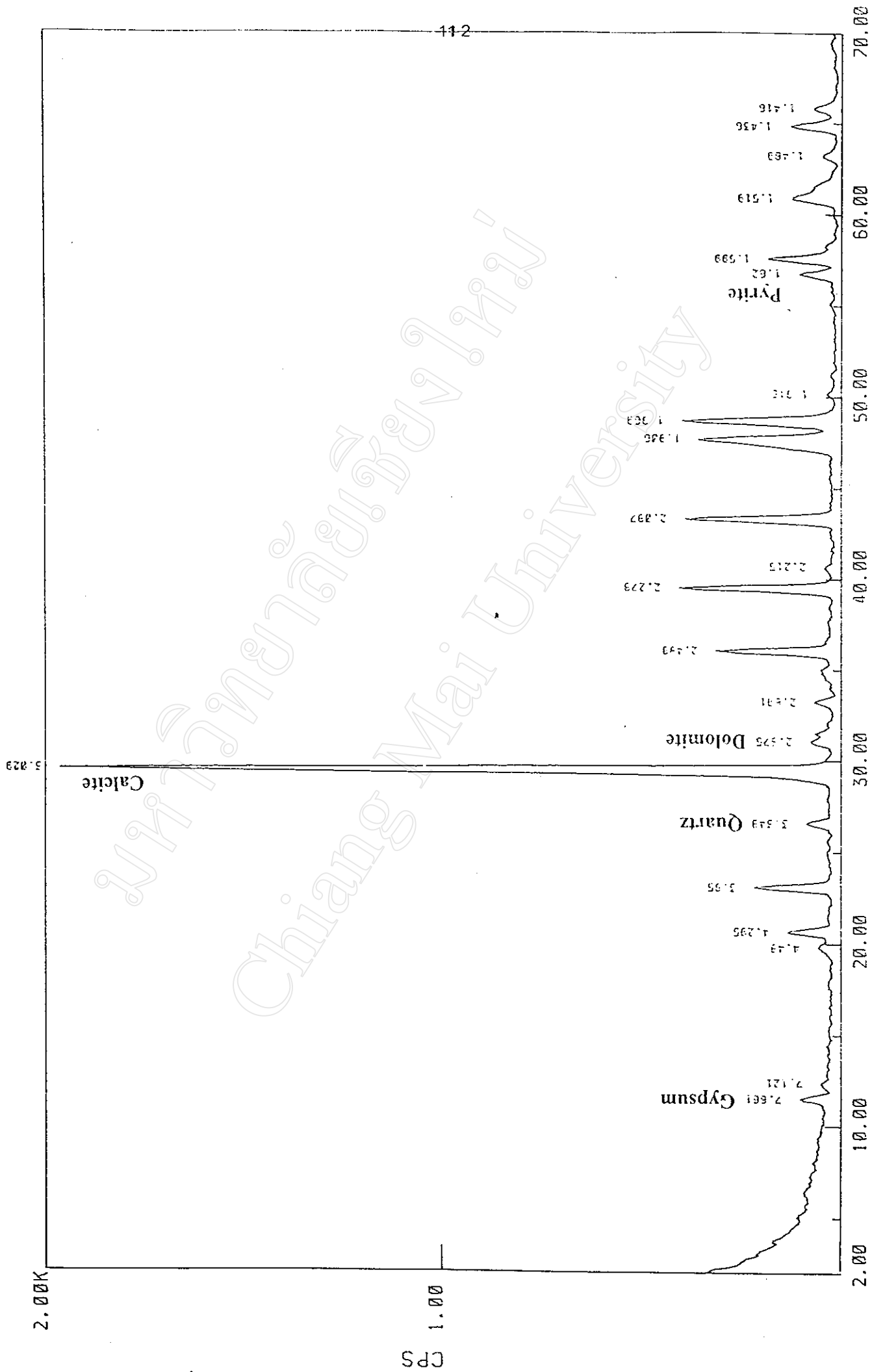
Sample no.	Mine/zone	Location	Description
NWK1	K zone	575040	lignite
NWK1/K2	K zone	575040	claystone partings
NWK2	K zone	575040	lignite
NWK2/K3	K zone	574959	claystone partings
NWK3	K zone	574959	lignite
NWK3/K4	K zone	575533	claystone partings
NWK4	K zone	575216	lignite
NWIB	interburden	575587	claystone partings
NWQ1	Q zone	575786	lignite
NWQ1/Q2	Q zone	575766	claystone partings
NWQ2	Q zone	575786	lignite
NWQ2/Q3	Q zone	575571	claystone partings
NWQ3	Q zone	575571	lignite
NWQ3/Q4	Q zone	575730	claystone partings
NWQ4	Q zone	575550	lignite
NWUB	underburden	575486	claystone partings

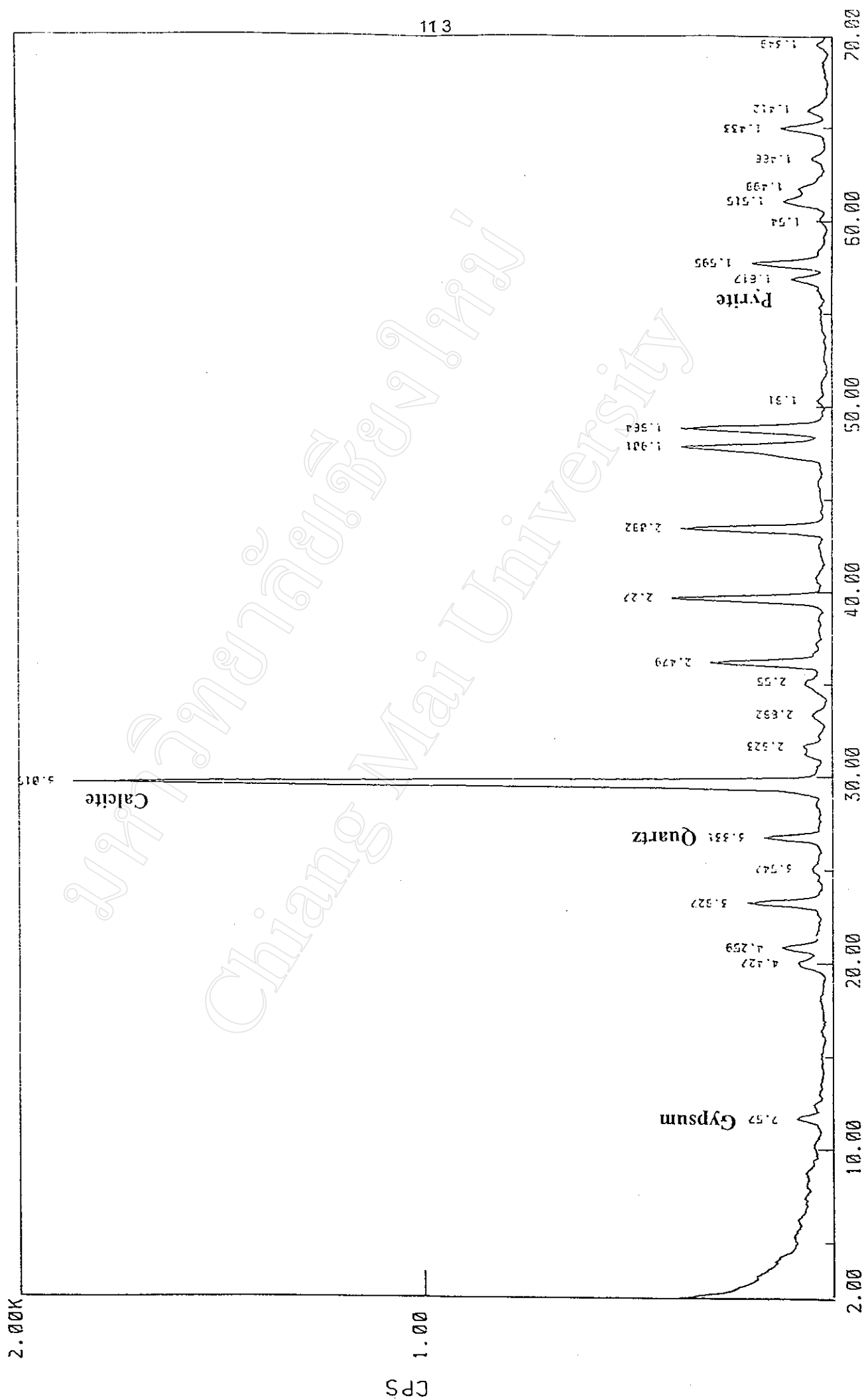
APPENDIX B

DIAGRAM FROM XRD SHOWING QUALITATIVE OF MINERALS

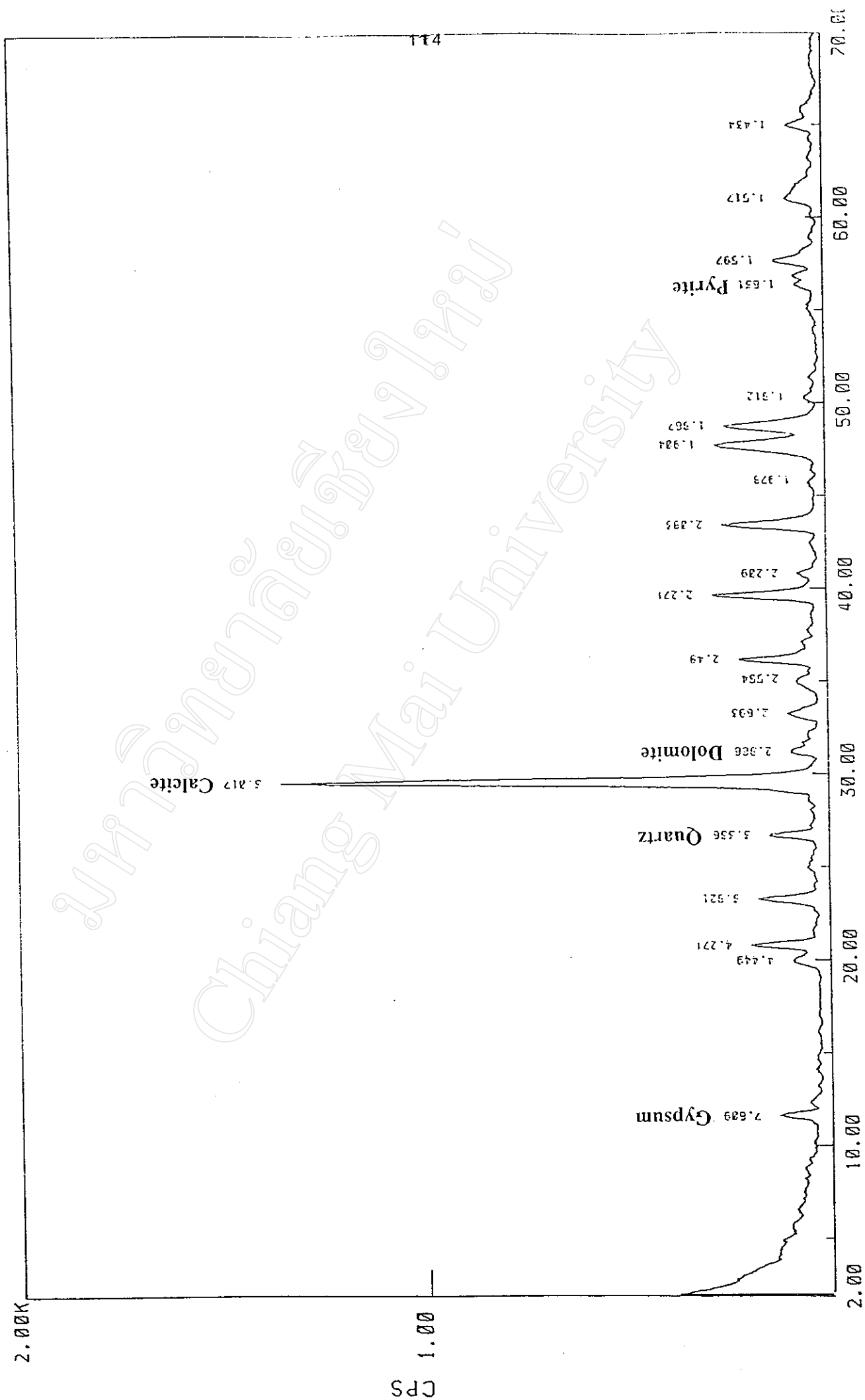


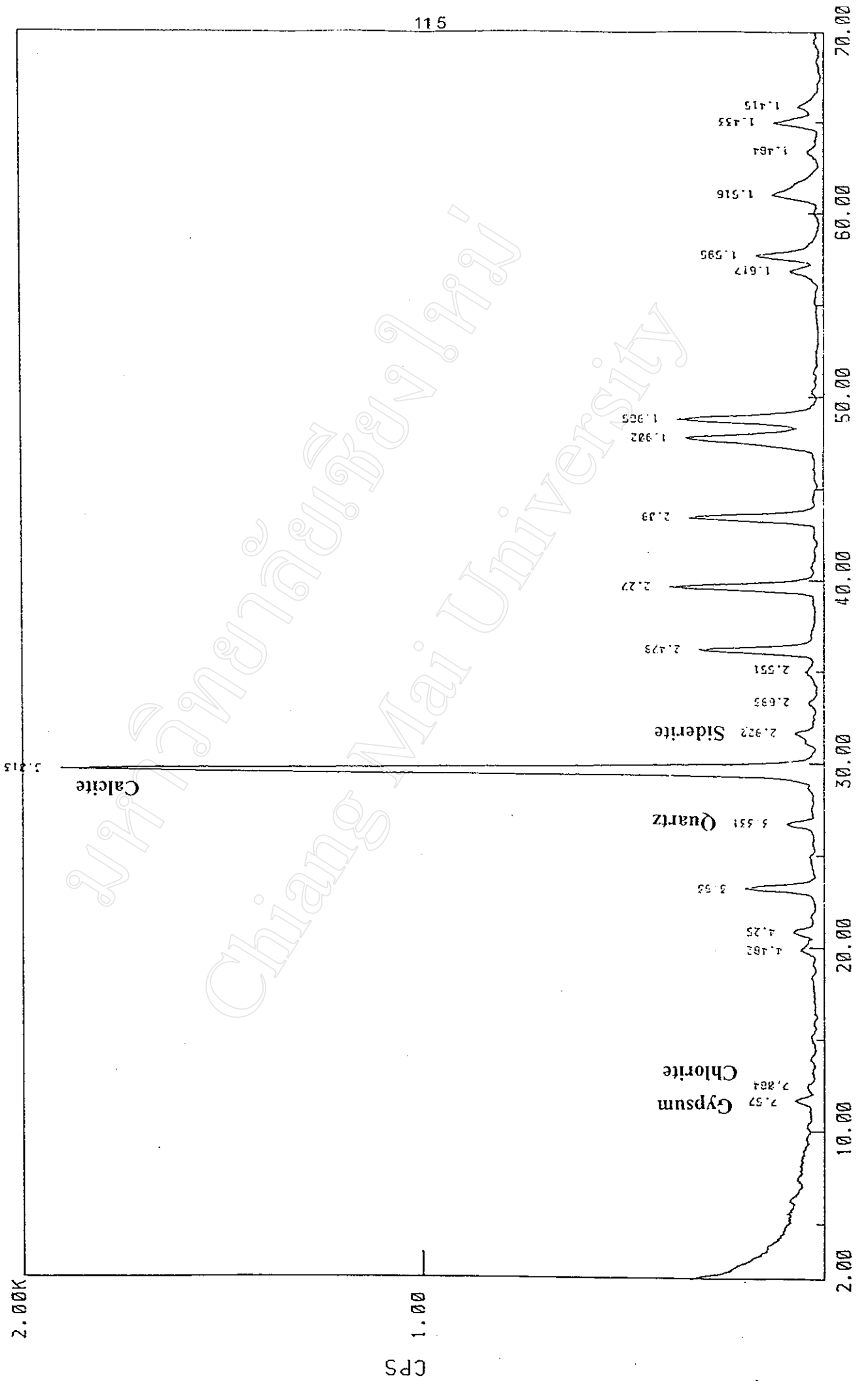




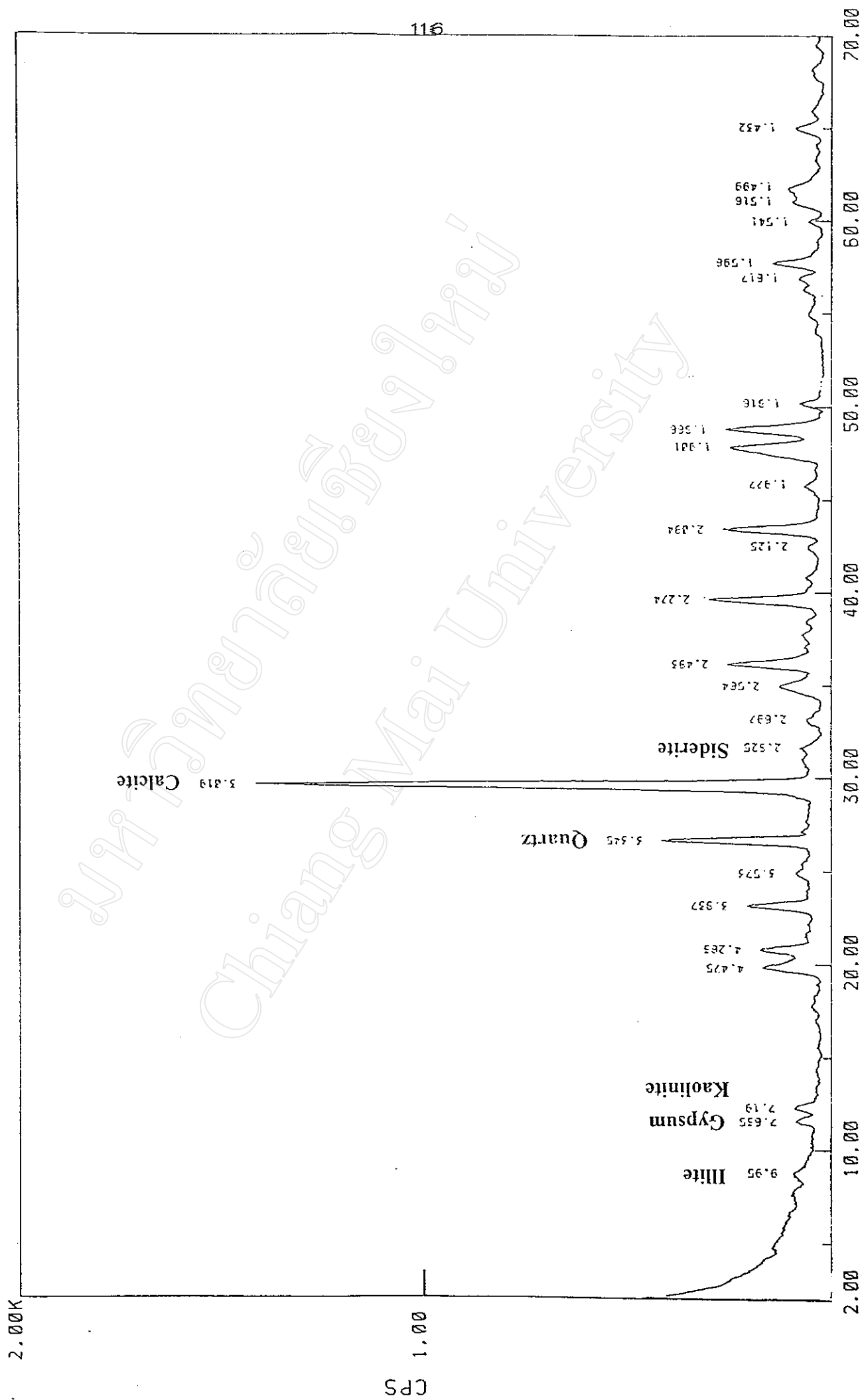


Sample Name : L1J5H/J00

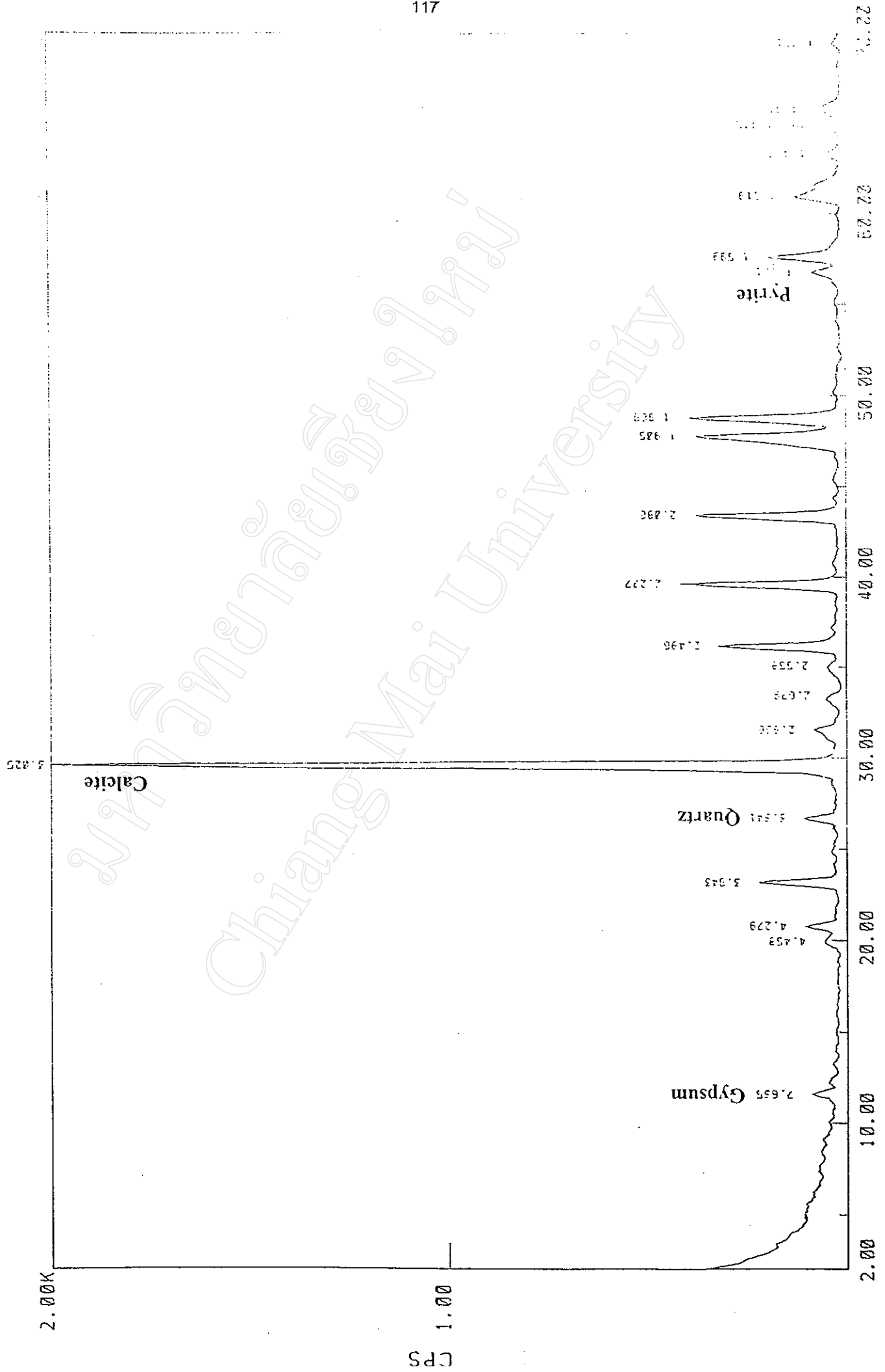


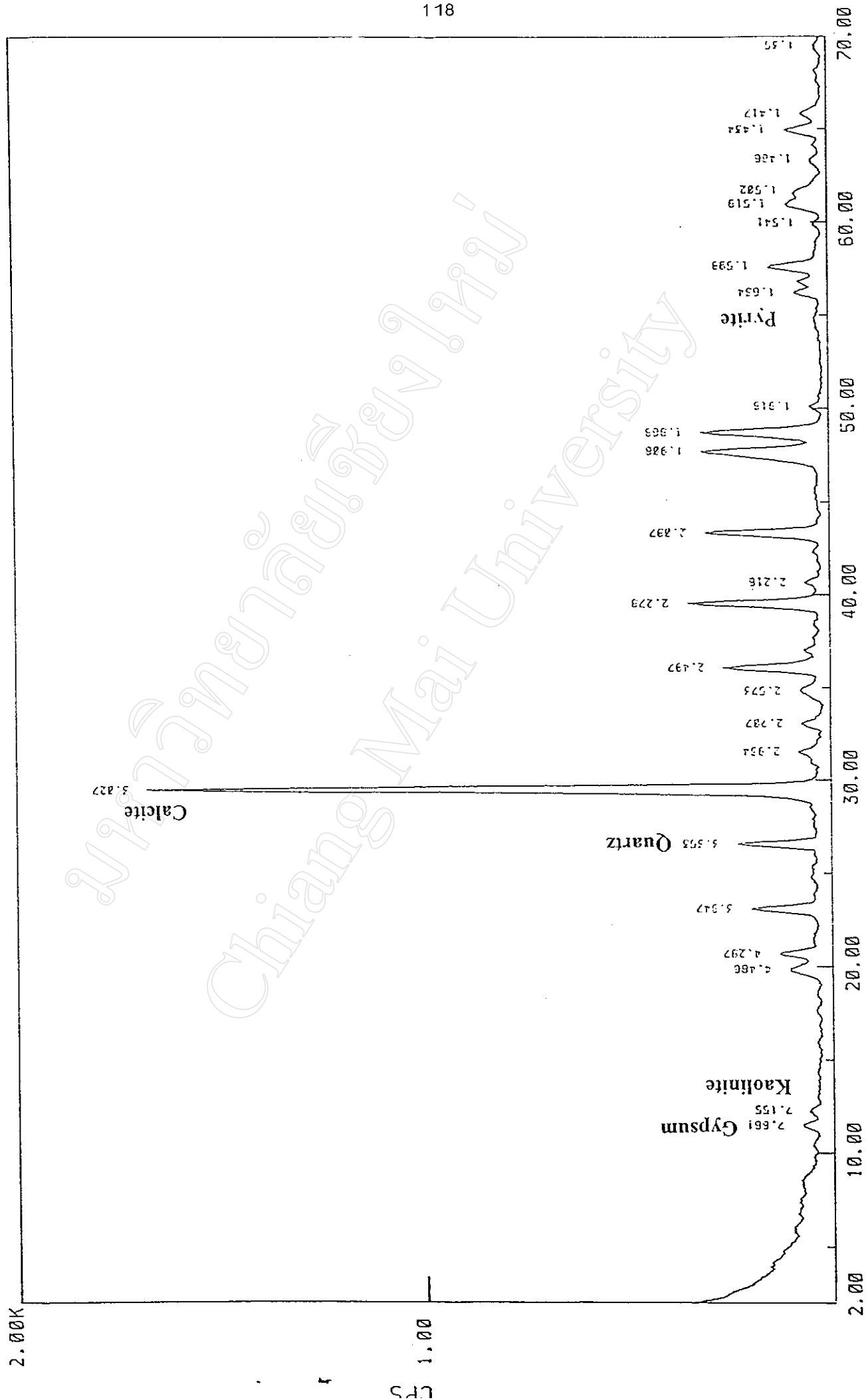


Sample Name : L1J4/J5

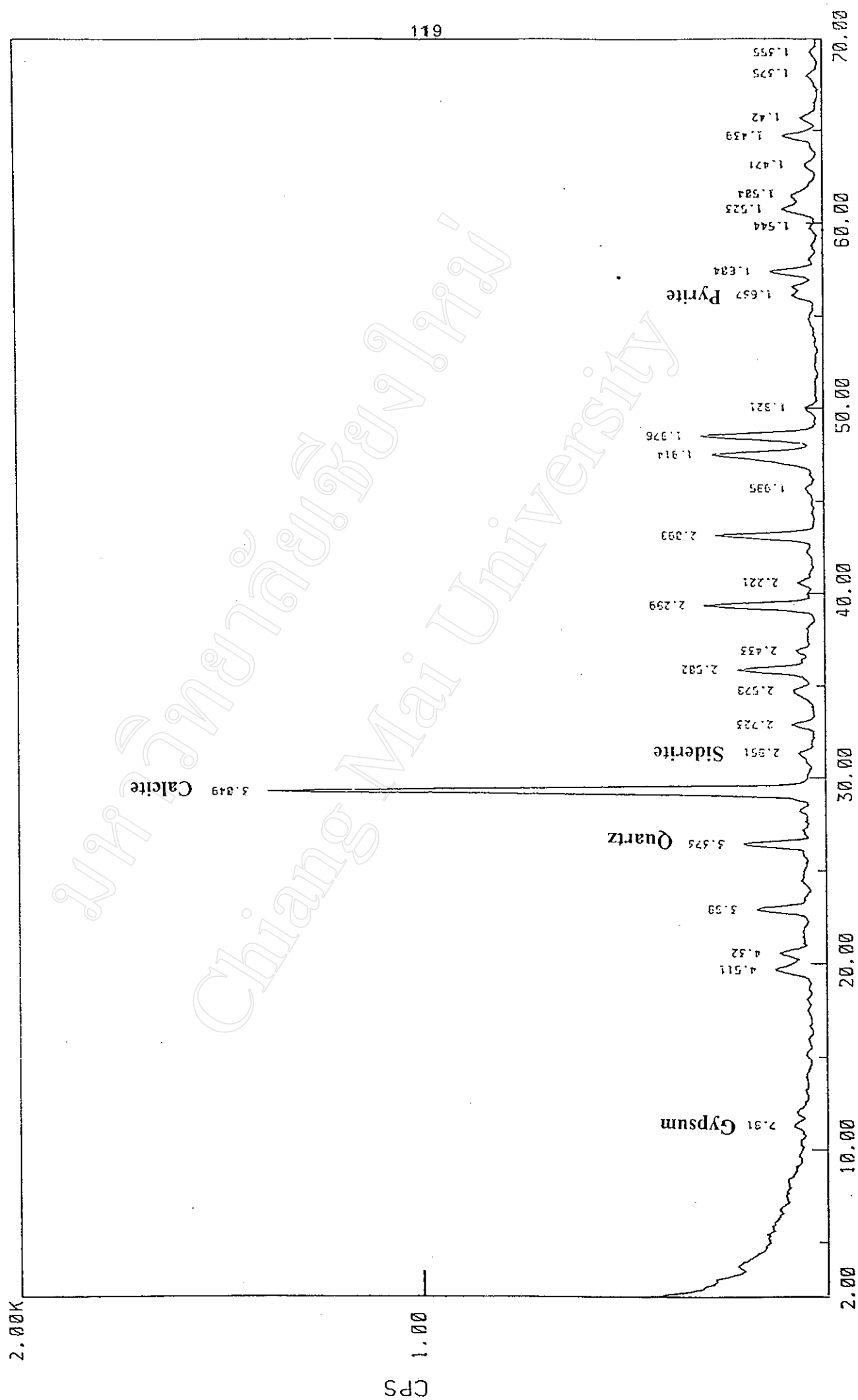


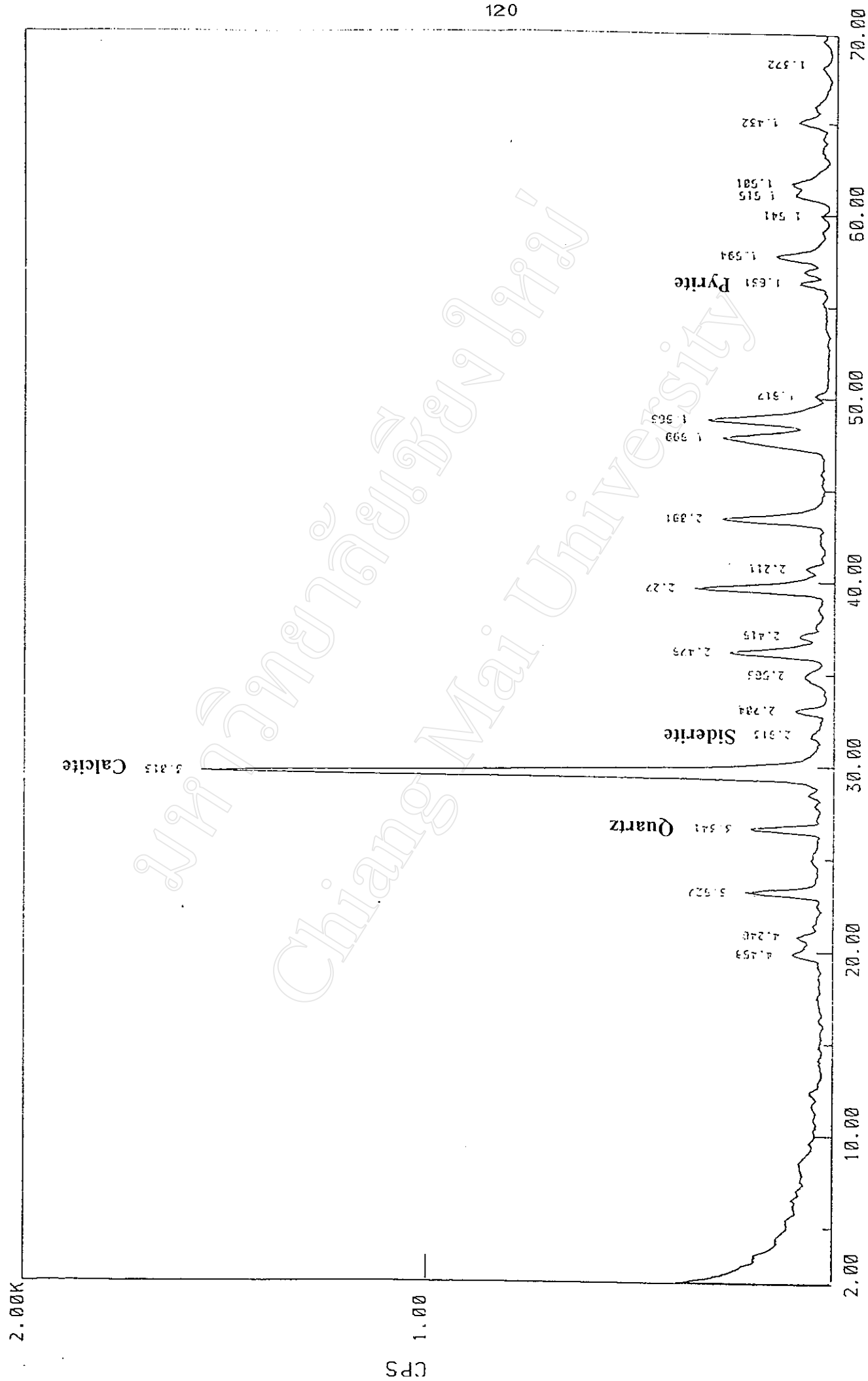
Sample Name : C1J5A/J5B

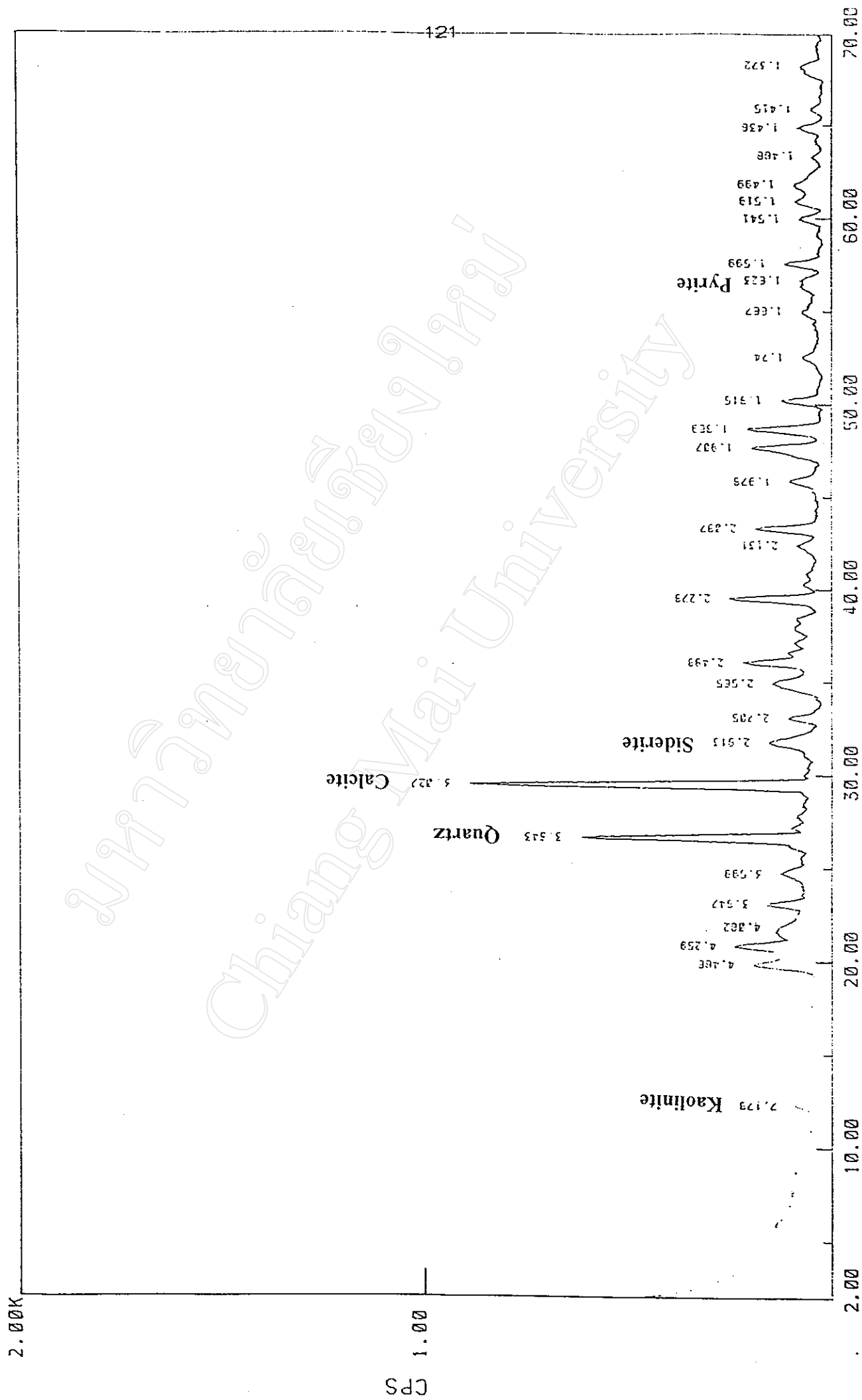




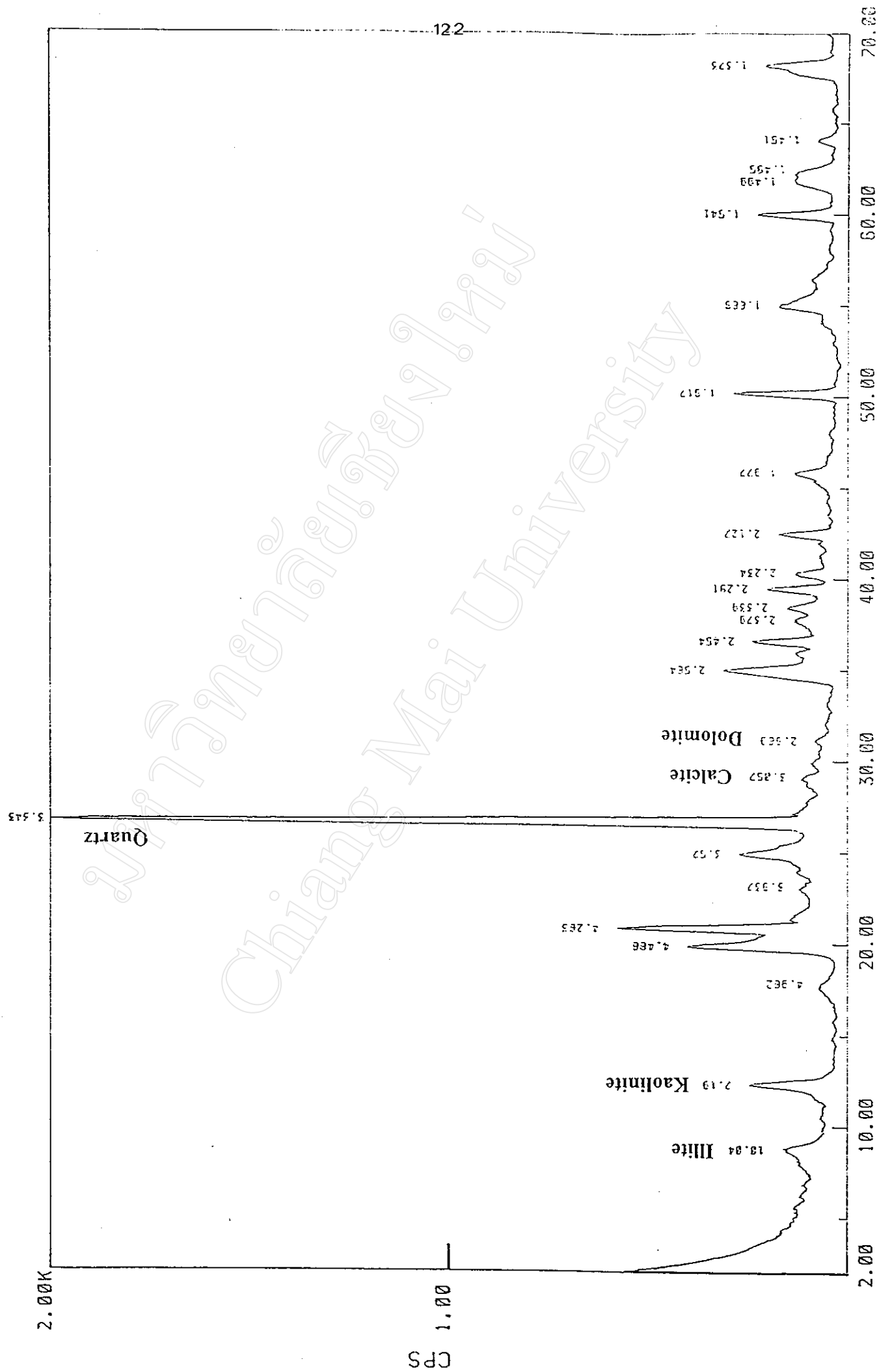
Sample Name : C1J6A/J6B



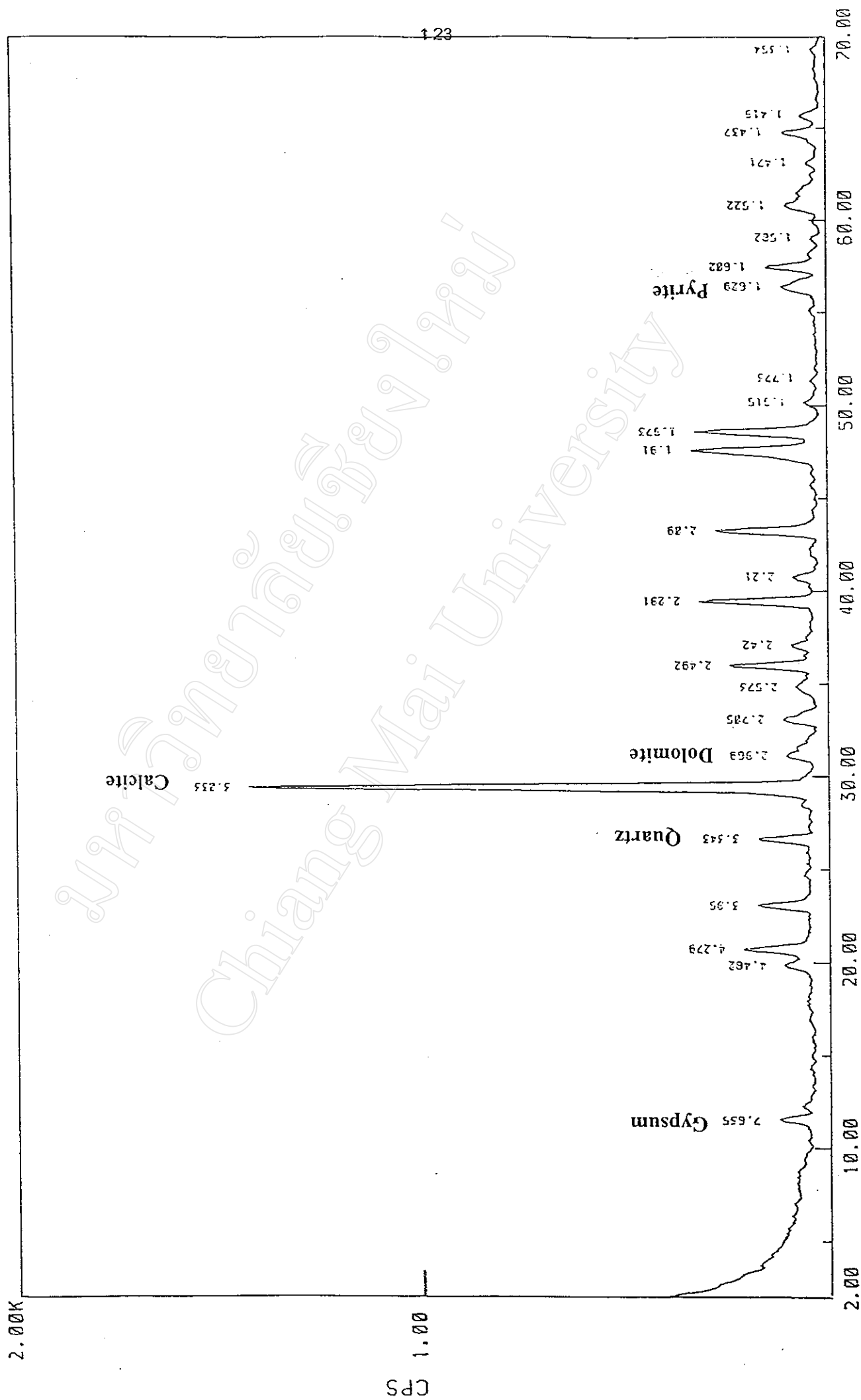




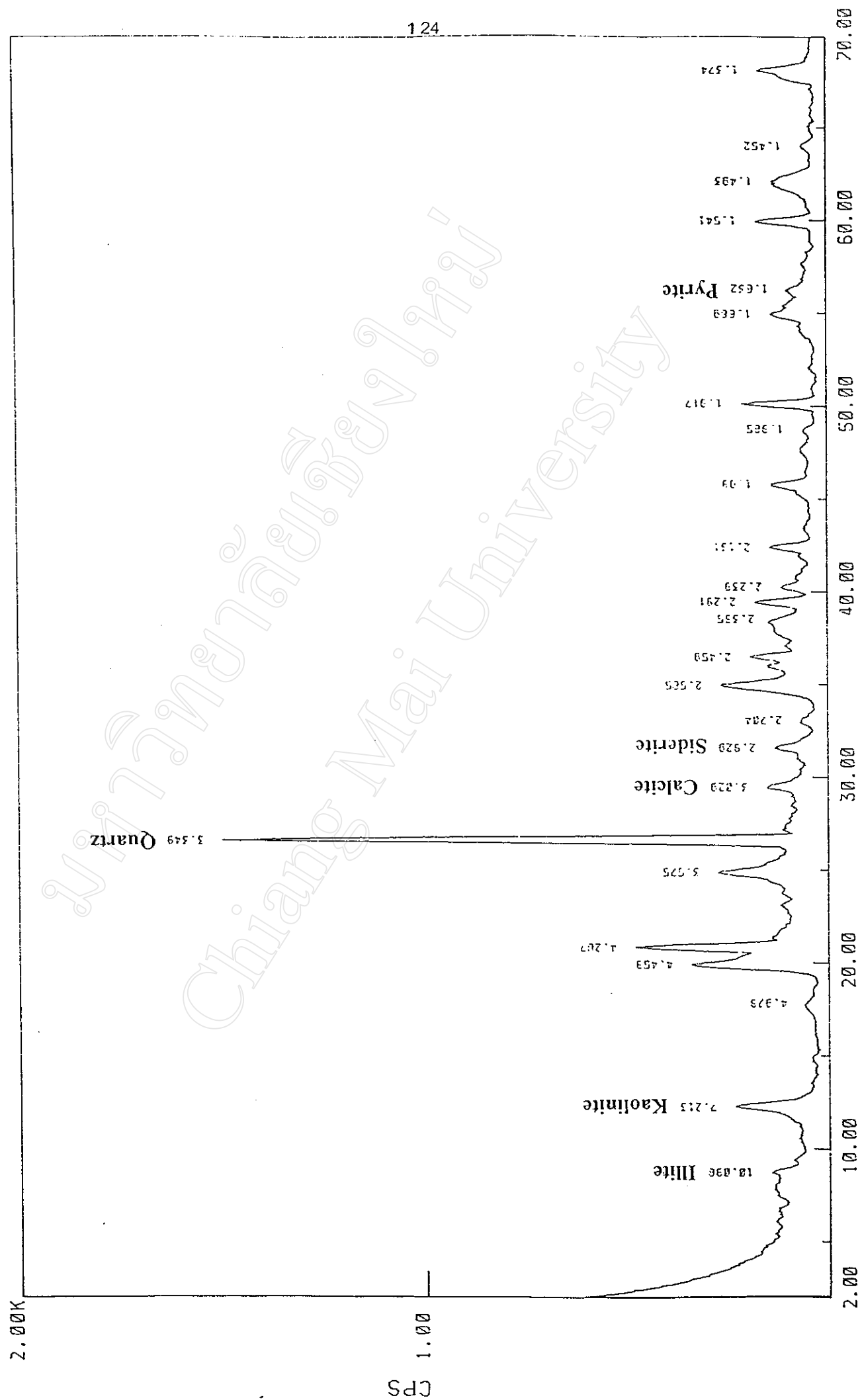
Sample Name : NEK2/K3



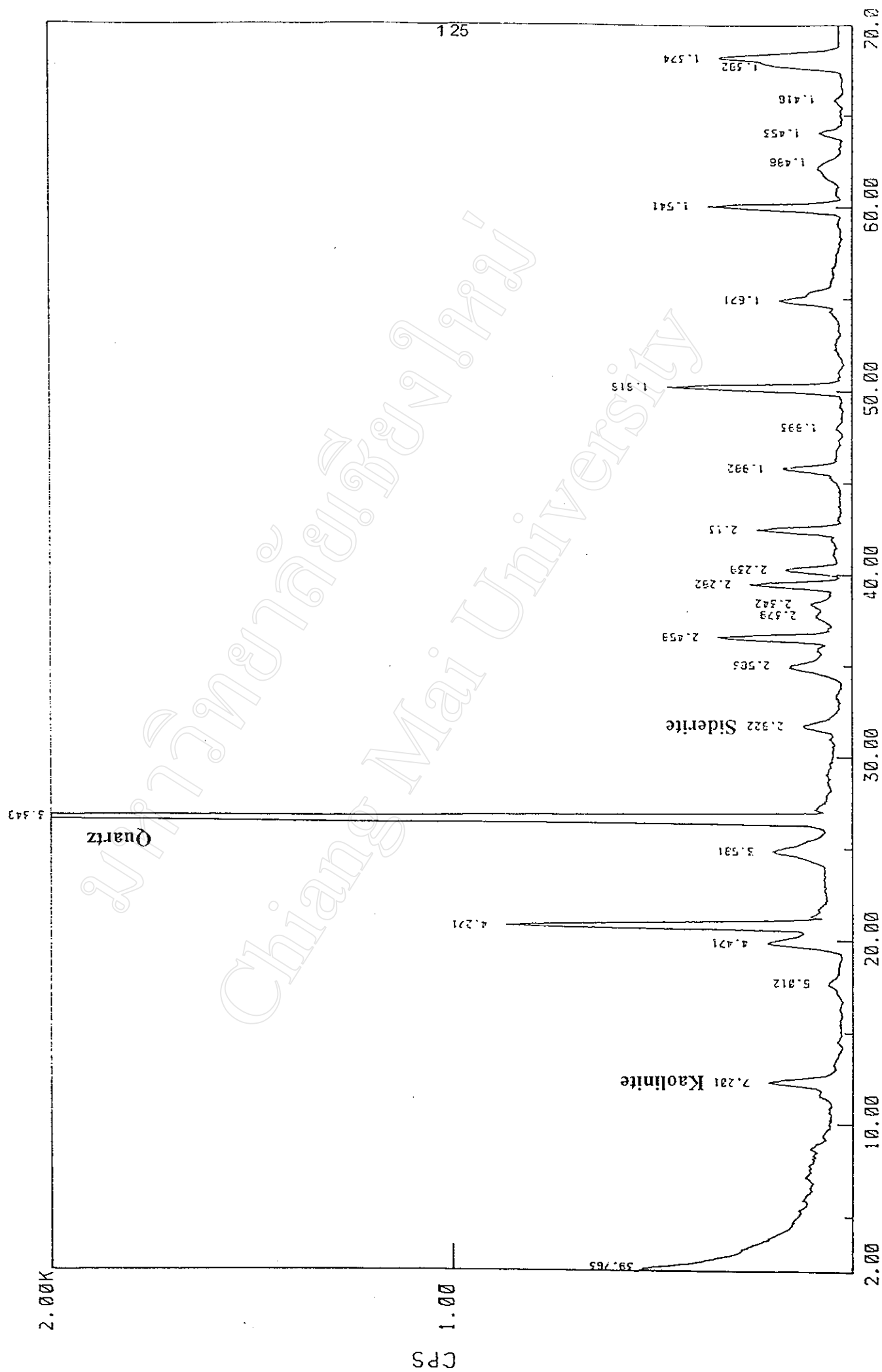
SAMPLE NAME : NW03/14



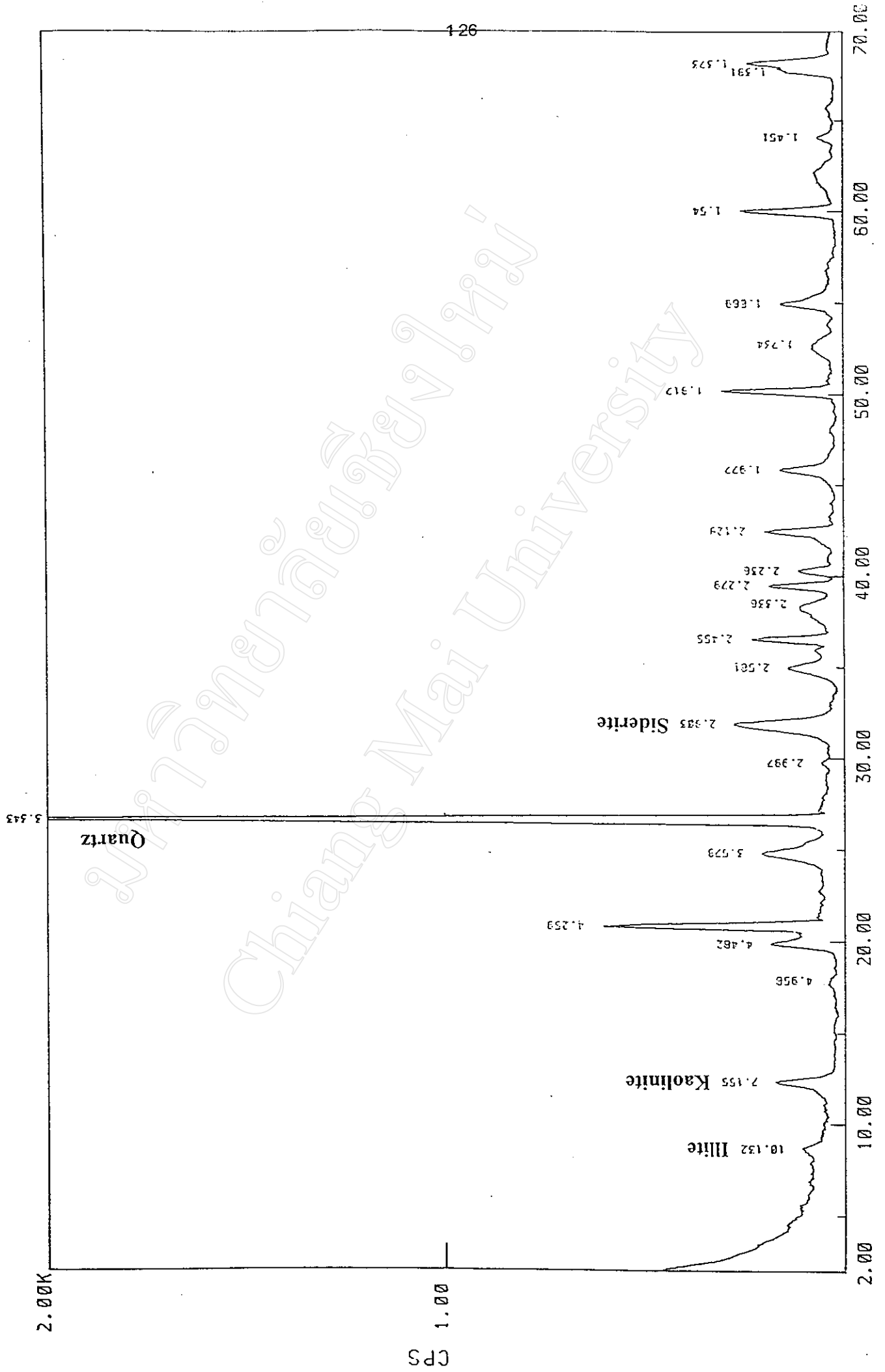
Sample Name : NEQ1/Q2



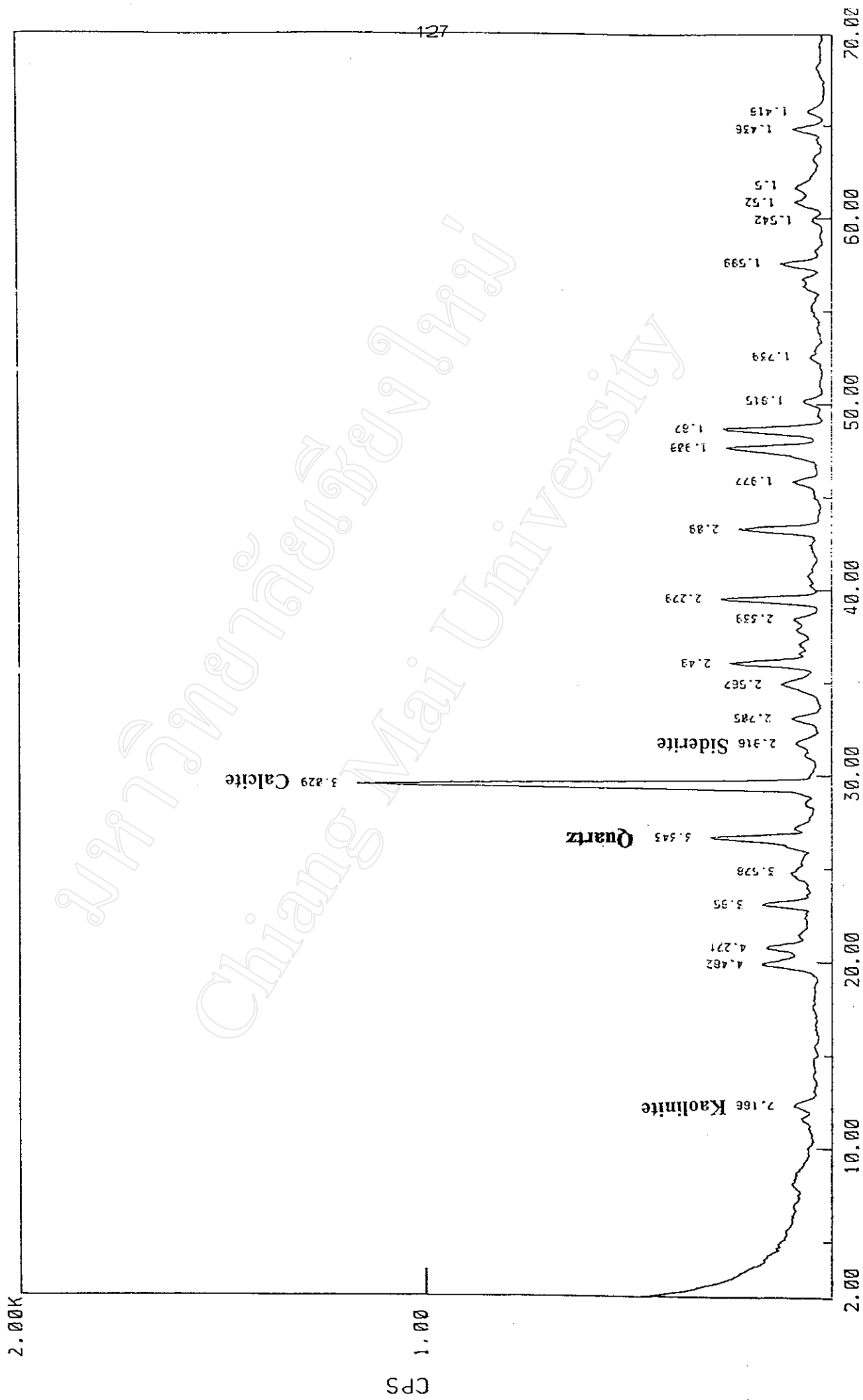
Sample Name : NEQ2/03



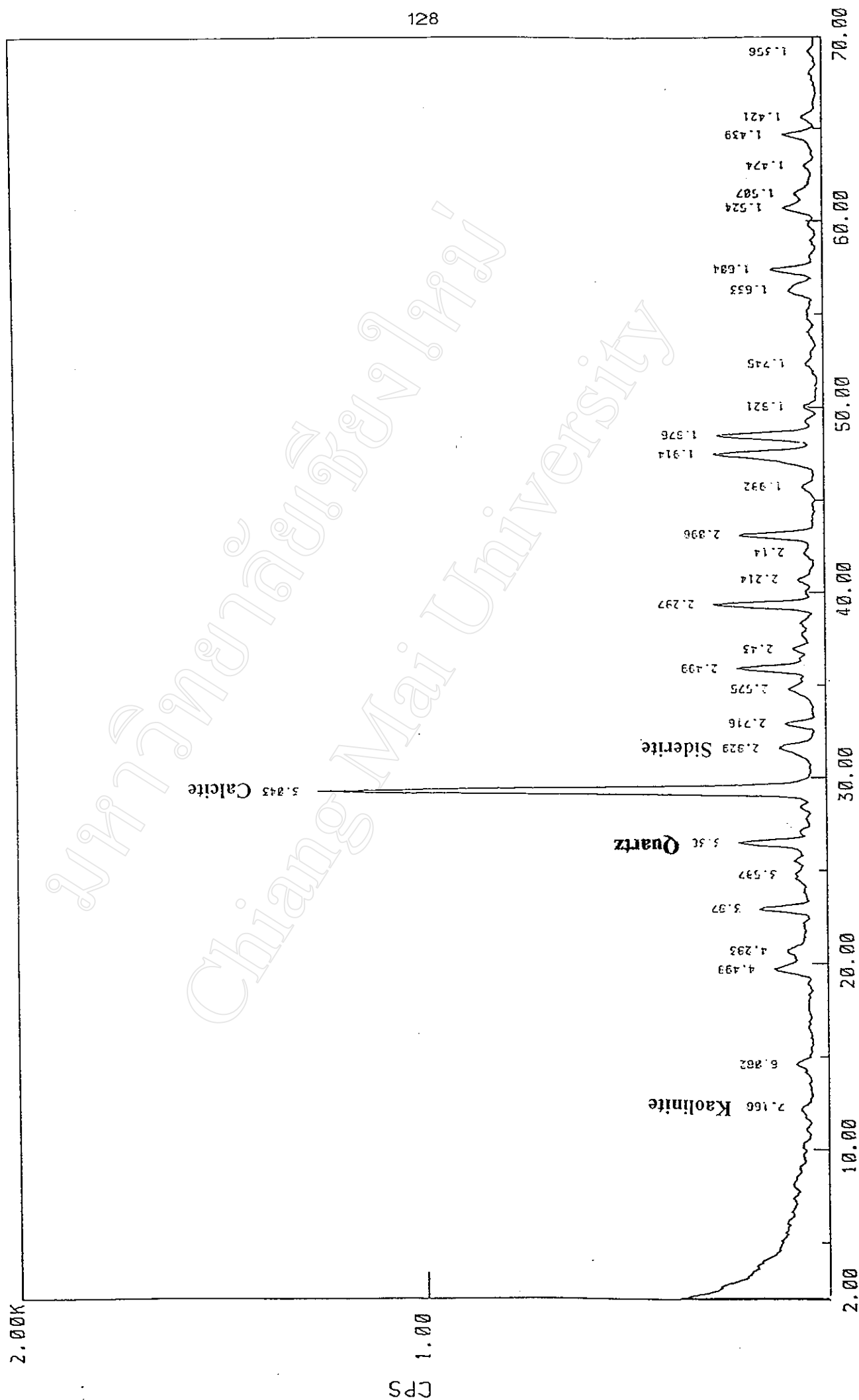
Sample Name : NEUC/W4



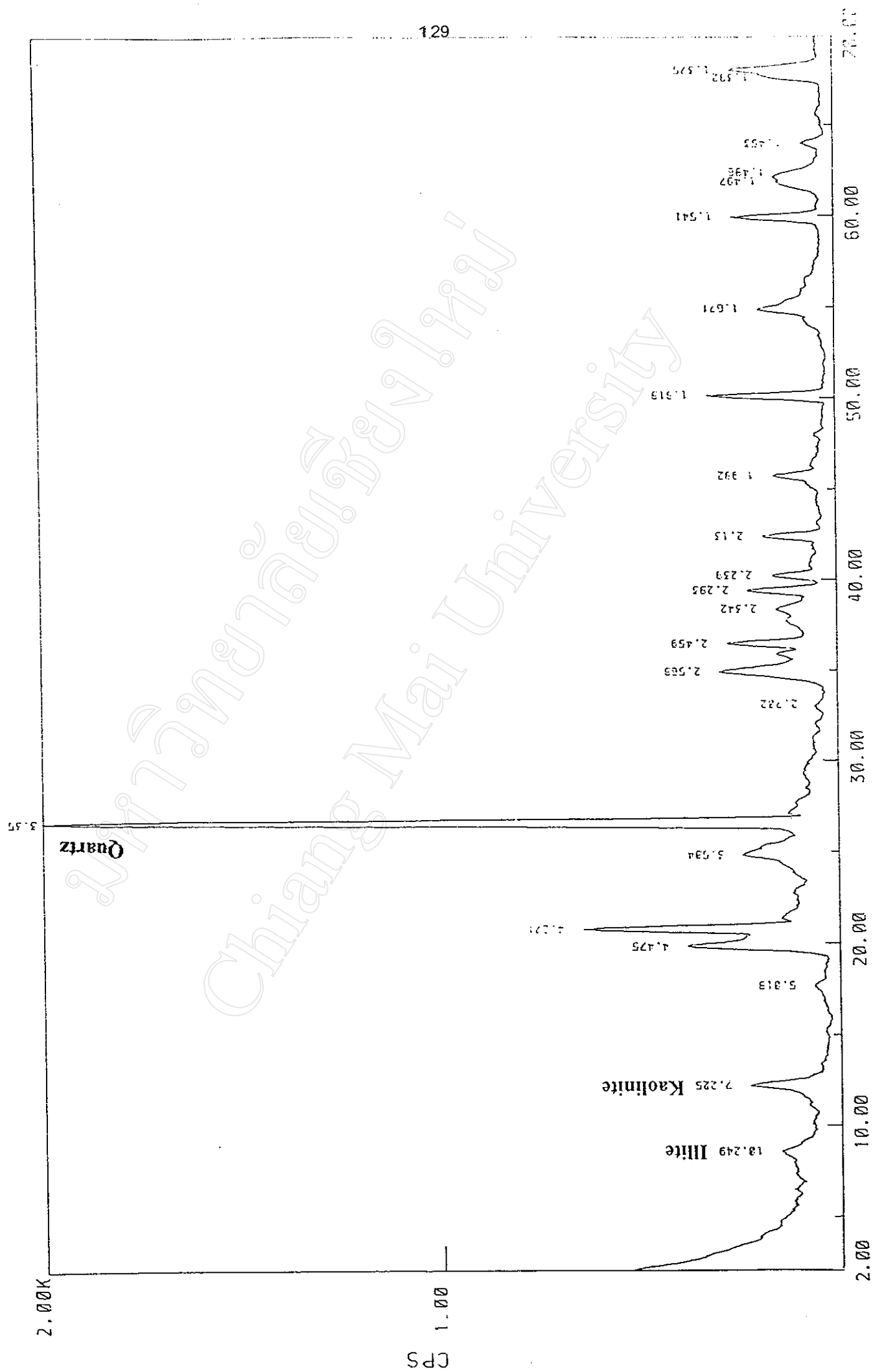
Sample Name : NWK1/KZ



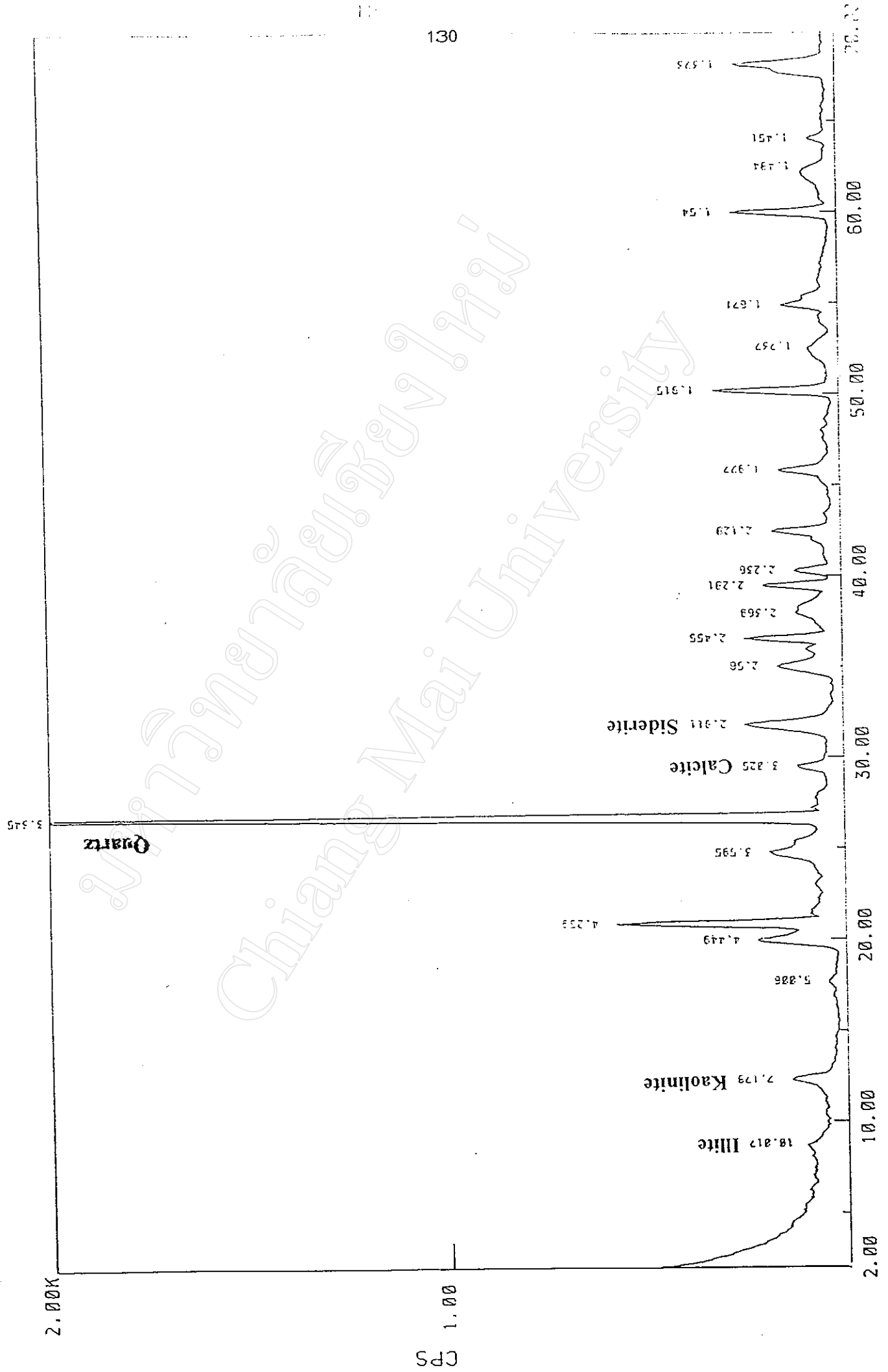
Sample Name : NWK2/K3



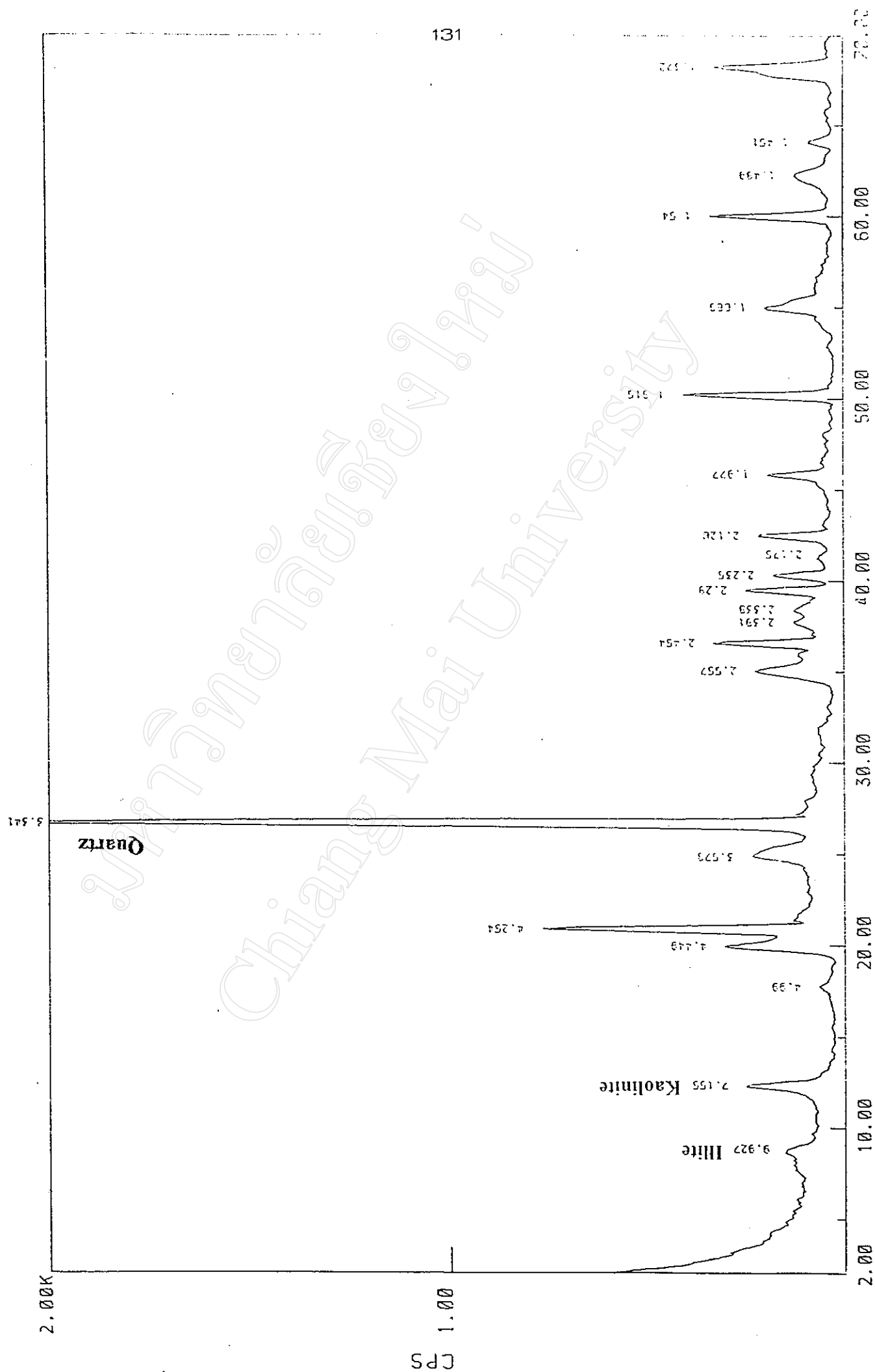
Sample Name : NWQ1/Q2

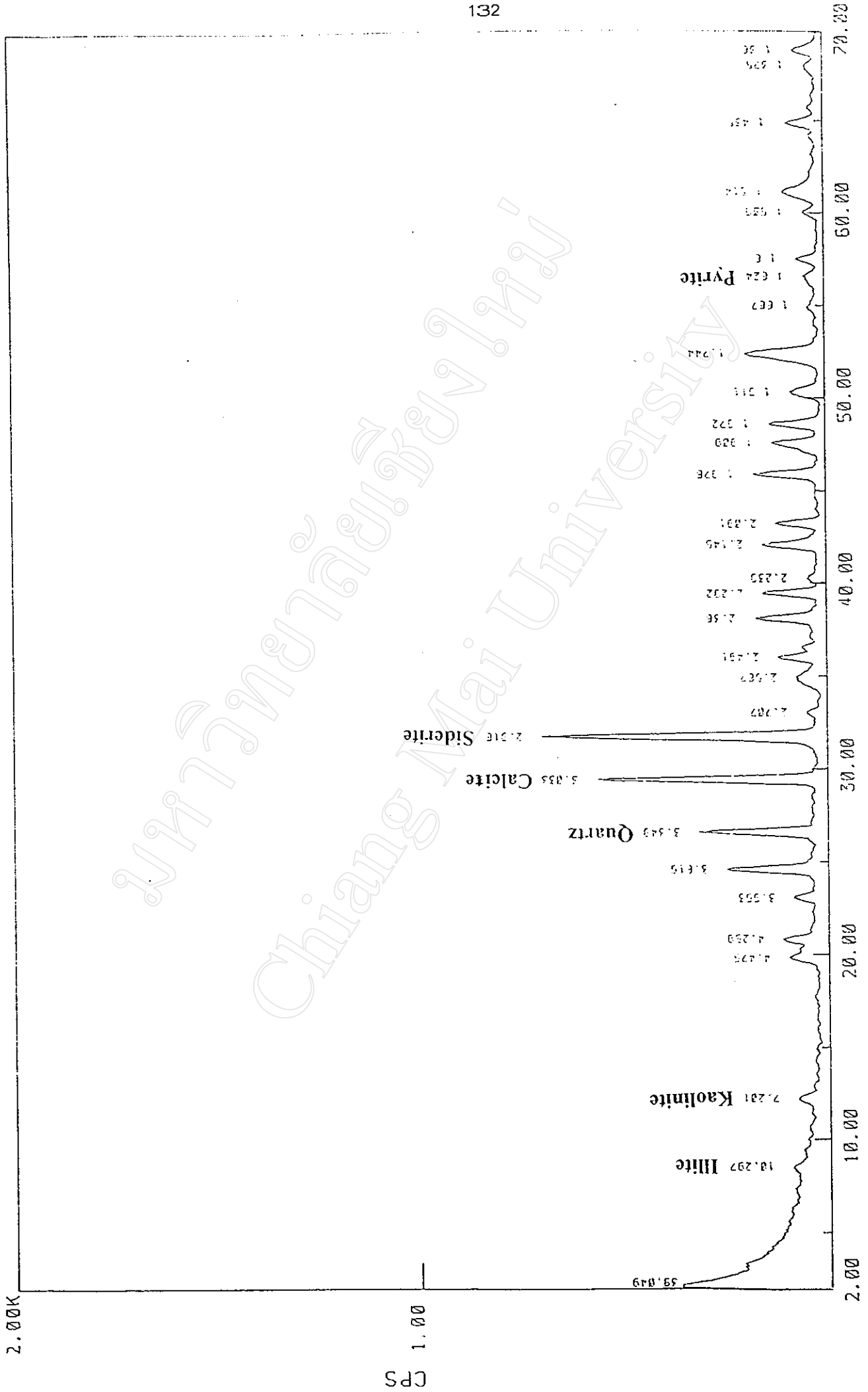


Sample Name : NW02/U3



Sample Name : NWQ3/Q4





APPENDIX C

MAJOR, MINOR ELEMENT COMPOSITIONS FOR LIGNITE AND SEDIMENT SAMPLES

	Na ₂ O	MgO	Al ₂ O ₃	SiO ₂	P ₂ O ₅	K ₂ O	CaO	TiO ₂	MnO	Fe ₂ O ₃	SO ₃	Total(wt%)
C1J1	0	2.95	5.27	12.84	1.56	0.83	19.72	0.38	0.07	30.44	16.83	90.88
C1J1/J2	0.39	0.81	3.6	11.13	0.83	1.51	50.54	0.04	0.05	2.4	1.12	72.37
C1J2	0	1.62	20.19	36.76	0.15	2.44	3.58	0.54	0.07	25.23	3.21	93.79
C1J2/J3A	0.18	0.65	5.82	16.27	0.71	1.82	43.43	0.07	0.04	2.39	0.98	72.36
C1J3A	0	6.07	2.92	7.94	2.7	0.61	28.53	0.16	0.08	13.99	29.2	92.2
C1J3A/J3B	0	1.26	5.85	16.55	0.68	1.73	38.99	0.09	0.06	4.22	0.84	70.3
C1J3B	0	3.29	6.47	14.99	1.71	0.87	21.73	0.31	0.06	24.1	17.89	91.43
C1J3B/J4	0.93	1.25	2.86	10.14	0.84	1.32	50.7	0.004	0.06	1.44	1.04	70.58
C1J4	0	0.81	5.03	12.91	1.68	1	28.9	0.25	0.03	20.88	16.86	88.35
C1J4/J5A	0.57	1.71	11.04	29.31	0.95	1.49	29.99	0.24	0.07	3.13	0.77	79.25
C1J5A	0	5.62	3.22	8.92	1.65	0.58	21.85	0.41	0.05	28.95	18.48	89.73
C1J5A/5B	0.89	0.47	3.91	12.39	0.86	1.5	50.89	0.02	0.07	2.63	1.18	74.77
C1J5B	0	6.33	4.32	10.22	1.77	0.7	23.26	0.32	0.04	24.52	19.49	90.96
C1J5B/J5C	1.09	1.37	6.09	18.85	0.58	1.7	39.44	0.12	0.07	2.36	0.91	72.57
C1J5C	0	2.11	15.19	32.53	0.98	1.83	13.56	0.52	0.03	16.99	8.42	92.15
C1J5C/J5A	1.12	2.85	8.83	28.43	0.4	2.26	27.24	0.25	0.09	3.09	0.73	75.29
C1J6A/J6B	1.48	0.8	6.61	19.93	0.5	1.72	34.45	0.11	0.04	2.91	0.78	69.32
C1J6B	0.92	10.24	5.72	14.17	2.05	0.97	24.01	0.19	0.04	11.91	21.7	91.92
C1J6B/K	0.7	2.28	5.42	16.89	0.6	1.67	40.45	0.1	0.09	2.58	0.96	71.72

	Na2O	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	SO3	Total(wt%)
NWI	0	7.23	11.18	8.11	0	0.71	26.75	0.67	0.04	6.11	42.67	77.35
NWK1	0	2.85	23.31	44.28	0.29	3.2	5.93	0.44	0.02	9.33	4.34	93.99
NWMDK1/K2	0.75	0.54	9.87	25.89	0.4	1.96	26.24	0.19	0.07	3.34	0.7	69.96
NWK2	0.15	2.59	21.45	40.99	0.29	2.87	6.49	0.4	0.04	14	3.79	93.06
NWK2/K3	0.14	1.15	19.45	56.87	0.03	2.71	0.2	0.74	0.02	2.74	0.54	84.6
NWK3	0.69	6.49	11.82	32.09	1.32	0.85	18.86	0.14	0.07	7.19	15.07	94.59
NWMDK3/K4	0.72	0	5.32	15.5	0.57	1.58	35.84	0.1	0.09	6.03	0.87	66.62
NWK4	0	1.12	11.61	40.4	1.47	2.52	17.06	0.41	0.08	12.66	12.29	99.62
NWIB	0	2.04	16.46	41.41	0.07	2.22	9.22	0.42	0.01	2.5	0.03	74.38
NWQ1	0.06	2.87	28.79	49.82	0.16	3.01	1.51	0.54	0.02	6.83	1.15	94.75
NWQ1/Q2	0.38	1.3	22.01	56.6	0.02	1.73	0.37	0.69	0.01	1.8	0.04	84.96
NWQ2	0.74	2.72	24.14	42.38	0.21	2.99	2.57	0.5	0.03	14.37	3.2	93.85
NWQ2/Q3	0.22	0.99	16.07	52.83	0.15	1.12	3.16	0.65	0.13	10.52	0.13	85.97
NWQ3	0.2	1.99	26.99	49.07	0.08	3	0.57	0.58	0.02	5.48	1.35	89.35
NWQ3/Q4	0.71	1.05	20.22	62.32	0.04	1.37	0.51	0.78	0.01	1.8	0.01	88.82
NWQ4	0.07	2.65	19.86	50.33	0.15	2.67	1.73	0.52	0.02	8.33	1.62	87.95
NWUBQ4	0.42	0.21	7.62	23.88	0.32	1.51	17.29	0.3	0.4	21.09	0.71	73.73

	Na2O	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	SO3	Total(wt%)
NEK1	0.24	6.11	4.97	10.8	2.59	0.89	28.99	0.15	0.02	10.05	25.78	90.61
NEK1/K2	0.52	1.17	10.28	37.22	0.047	1.89	18.27	0.34	0.08	6.58	0.68	77.6
NEK2	0.78	2.36	25.81	48.85	0.05	3.21	1	0.6	0.03	8.38	0.89	91.95
NEMDK2/K3	0.92	1.07	22.27	55.39	0.02	2.42	0.08	0.62	0.01	2.37	0.07	85.24
NEK3	0.84	1.88	26.64	50.82	0.05	3.3	0.75	0.55	0.04	6.63	0.86	92.33
NEMDK3/K4	0.66	0.59	7.2	21.17	0.49	1.55	25.64	0.22	0.3	14.41	0.83	73.05
NEK4	1.38	3.91	13.38	26.69	0.22	1.58	7.66	0.52	0.09	37.56	2.65	95.62
NEIBK/Q	1.43	1.16	10.18	29.21	0.44	2.14	31.03	0.28	0.06	4.12	0.74	80.78
NEQ1	0.09	2.86	26.13	45.24	0.12	2.74	2.73	0.53	0.05	13.82	1.12	95.43
NEMDQ1/Q2	0.32	0.86	8.67	58.47	0.1	0.94	2.28	0.63	0.1	13.86	0.57	86.81
NEQ2	0.24	1.72	22.96	44.03	0.08	2.87	1.26	0.6	0.05	16.08	1.55	91.69
NEMDQ2/Q3	0.48	0.69	12.28	68.64	0.03	1.19	0.65	0.81	0.07	5.89	0.54	91.28
NEQ3	0.24	1.96	24.66	49.03	0.05	3.27	0.5	0.63	0.03	12.47	0.95	93.79
NEMDQ3/Q4	0.63	1.37	11.98	56.31	0.54	1.32	1.58	0.74	0.1	12.8	0.56	87.94
NEQ4	0.02	1.28	20.27	42.18	0.07	3.02	0.88	0.65	0.04	8.55	1.42	78.36
NEUBQ4	0.83	0.53	11.12	30.14	0.41	1.99	22.78	0.32	0.25	11.84	0.72	80.92

APPENDIX D

CONCENTRATION RANGE FOR SELECTED MAJOR AND TRACE ELEMENTS IN THE UPPER CONTINENTAL CRUST

Element	Taylor (1) mean	min	Bowen (2) max	mean	Valkovic min	max	mean	Swaine (4) min	max
%Si	26.8	0.5	11	3	0.38	6.3	2.3	nd	nd
%Al	8.4	0.3	3	1	0.31	3.1	1.3	nd	nd
%Fe	0.71	0.05	4.3	0.8	0.3	4.1	1.34	nd	nd
%Ca	5.3	0.05	3.7	0.15	0.01	3.8	0.946	nd	nd
%K	0.9	0.005	0.65	0.3	0.01	0.68	0.156	nd	nd
%S	0.02	0.1	12	1.5	nd*	nd	2	nd	nd
As	10	0.3	93	5	0.1	1650	14	0.01	344
Ba	250	1	3000	200	5	1600	267	2	2000
Br	0.00025	1.00	50	5	0.5	52	9.9	0.3	678
Ce	33	1.0	30	12	2.8	48	7.7	1	10
Cl	130	10.0	8000	500	100	80000	800	13	4900
Co	29	1.00	90	4	0.05	930	6.7	0.26	198
Cr	185	2.0	400	10	0.05	200	15	0.1	544
Cs	1	0.0	9	0.3	0.02	6.2	1.3	0.11	20
Dy	3.7	0.2	5	2.5	0.22	3.5	2.2	0.3	433
Eu	1.1	0.10	0.9	0.5	0.07	0.92	0.45	0.1	2
Hf	3	0.10	4	0.9	0.13	2.2	0.6	0.06	7
In	0.1	0.01	0.6	0.02	0.01	0.63	0.46	nd	nd
La	16	0.3	40	5	1.8	23	9	2	70
Mn	1400	3	900	50	0.01	4500	52	1	1075
Mo	1	0.30	30	3	0.01	280	3	0.03	280
Na	24000	100	6000	400	100	6000	60	nd	nd
Nb	11	5.00	40	10	nd	nd	4.5	1	80
Nd	16	4.0	38	9	nd	nd	37	3	30
Ni	105	1.0	80	10	0.14	990	13	0.7	191
Pb	8	2.0	370	10	0.06	1300	15	0.1	300
Rb	32	1.0	150	20	0.3	63	15	0.1	82
Sb	0.2	0.10	9	1	0.04	43	1	0.06	9
Sc	30	0.50	30	5	0.5	9.3	3.2	0.05	16
Se	0.05	0.04	10	3	0.1	150	1.7	0.1	18
Sm	3.5	0.20	6	1.2	0.22	4.3	0.42	0.5	6
Sr	260	20	1000	150	1	550	141	1	2200
Ta	1	0.06	8	0.2	0.04	1.1	0.21	0.02	2
Tb	0.6	0.10	2	0.22	0.04	0.65	0.1	0.1	1
Th	3.5	0.10	10	2	0.62	9	2.9	0.1	28
Ti	530	200	1800	500	200	1600	600	40	7500
U	0.91	0.01	200	1	0.06	2700	2.6	0.01	75
V	230	2.0	130	20	0.03	51000	96	0.1	330
Y	20	1.5	25	7	3	100	10	1	725
Yb	2.2	0.1	1.5	0.37	0.13	0.78	1	0.3	3
Zn	nd	3	300	50	0.85	5100	23	1	1311
Zr	100	8	500	50	8	170	42	1	530

Concentration range for selected major and trace elements in the upper continental crust (1), global coal resources (2), U.S. coal resources (3), and global lignite resources (3)

APPENDIX E
TRACE ELEMENT COMPOSITIONS FOR
LIGNITE AND SEDIMENT SAMPLES

	La	Ce	Ba	Cr	V	Cu	Zr	Zn	Co	Ni	Sr	Cd	Be	Y
NEK1	30.6	60.8	826.3	104.3	198.1	94.6	143.5	185.5	27.6	30.0	454.8	0.1	3.1	37.2
NEK2	32	63.8	575.3	102.8	140.3	45.6	102.7	144.1	16.7	22.3	243.2	0.0	2.7	38.3
NEK3	24.2	54.1	1919	126.9	154.0	64.9	92.7	130.8	18.9	50.9	1243.6	0.2	3.1	36.6
NEK4	11.2	20.1	1671	236.3	157.4	55.7	99.3	149.1	39.0	70.9	1306.6	0.4	6.6	20.6
NEIBK/Q	13.8	32.6	389.4	37.9	38.7	17.5	74.6	71.1	7.0	10.1	435.1	0.0	1.1	14.1
NEQ1	28.2	49.5	1138	98.5	162.7	72.6	109.2	172.5	39.7	38.1	476.1	0.1	5.3	43.5
NEQ2	40.7	79.3	522.7	131.8	191.1	91.7	137.5	327.2	17.3	28.4	178.8	0.0	3.3	37.9
NEQ3	38.7	69.4	11.9	72.1	159.5	62.0	110.1	192.4	15.7	14.1	147.8	0.0	3.1	35.3
NEQ4	43.3	85.6	731.5	81.2	170.3	72.2	105.0	255.9	19.5	18.1	224.3	0.0	4.1	39.1
NEUB	9.7	7.3	323.4	25.7	25.0	13.7	59.3	25.8	8.2	7.3	431.6	0.1	0.8	11.6

	La	Ce	Ba	Cr	V	Cu	Zr	Zn	Co	Ni	Sr	Cd	Be	Y
CIRB	30.1	60.9	435.9	113.0	121.8	68.2	108.9	83.7	15.9	19.0	154.0	0.1	2.5	26.0
CITRAN	21.5	40.2	274.0	70.4	78.8	25.7	53.1	51.2	11.3	14.5	306.1	0.0	2.2	26.1
CIJ1	20.7	38.3	762.1	1196.3	169.9	52.9	83.8	105.5	32.2	233.2	560.6	0.2	2.6	15.6
CIJ2	23.8	57.0	812.9	204.6	258.2	67.0	101.5	119.8	27.2	45.1	353.9	0.3	3.4	18.3
CIJ3A	40.5	79.3	598.0	204.8	220.1	89.3	122.4	154.5	20.1	37.6	245.9	0.0	4.3	24.7
CIJ3B	38.9	66.7	570.6	154.8	198.3	85.5	121.5	135.6	20.7	33.3	267.0	0.0	4.1	26.8
CIJ4	11.4	13.0	580.1	129.4	121.3	59.2	70.4	77.1	43.1	60.4	1357.1	0.4	2.9	12.3
CIJ5A	1.9	3.9	880.5	270.0	641.6	52.4	253.7	104.2	40.7	78.3	1794.3	0.4	15.1	9.0
CIJ5B	3.2	7.3	1180.9	140.1	179.6	47.2	91.3	83.0	39.3	58.0	1800.0	0.4	2.4	9.4
CIJ5C	10.4	24.7	2267.2	82.6	185.0	41.8	118.4	32.2	22.2	32.8	1577.8	0.3	4.4	10.1
CIJ6A	10.5	26.1	811.8	118.3	93.4	29.4	55.9	60.2	18.7	32.0	1582.5	0.1	4.4	7.9
CIJ6B	11.0	15.4	746.9	134.9	103.6	50.9	81.4	66.6	18.9	35.0	1650.4	0.1	4.8	12.5
CIJ6B/K	9.7	10.2	517.6	56.6	18.8	12.9	59.3	63.6	11.2	14.0	811.6	0.0	0.7	9.3

	La	Ce	Ba	Cr	V	Cu	Zr	Zn	Co	Ni	Sr	Cd	Be	Y
NWRB	26.2	52.3	181.4	50.1	69.0	22.3	108.9	52.0	27.1	10.1	100.8	0.1	2.2	23.9
NWI	22.7	55.7	6094.3	153.3	232.2	39.3	56.5	58.9	21.1	12.0	1631.4	0.1	16.7	370.0
NWUI	38.4	78.2	293.4	80.9	98.5	29.4	136.3	83.2	12.3	14.0	107.6	0.0	2.1	28.5
NWK1	28.9	61.2	485.8	81.0	151.3	70.2	98.5	102.7	16.4	17.4	495.6	0.1	3.2	43.8
NWK2	21.7	37.2	579.1	72.1	139.6	66.2	76.3	122.2	20.5	20.7	883.6	0.1	2.8	24.6
NWK3	6.7	0.0	1517.2	3374.0	81.3	62.9	62.5	20.4	62.2	664.9	1494.7	0.1	0.7	8.9
NWK4	23.2	39.8	573.9	257.6	109.6	44.4	117.6	133.6	23.3	53.7	447.1	0.1	2.1	18.3
NWIB	28.1	51.1	399.9	49.8	82.1	26.9	113.7	76.6	9.3	7.8	503.2	0.0	1.5	30.8
NWQ1	37.1	65.3	554.1	95.1	340.2	79.3	210.8	213.5	15.8	20.9	303.1	0.0	4.4	54.4
NWQ2	24.5	48.3	687.3	161.0	271.9	76.4	188.9	180.5	38.8	44.0	481.9	0.1	7.1	68.9
NWQ3	33.8	68.8	344.6	71.7	162.3	59.9	154.0	147.2	14.9	15.4	163.6	0.0	2.3	34.4
NWQ4	29.4	53.8	973.1	73.3	192.9	72.2	201.2	172.2	19.7	21.2	321.1	0.0	4.6	59.2
NWUB	9.7	18.2	268.4	30.8	36.9	14.9	69.5	40.2	12.4	11.0	243.7	0.2	1.5	11.8

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