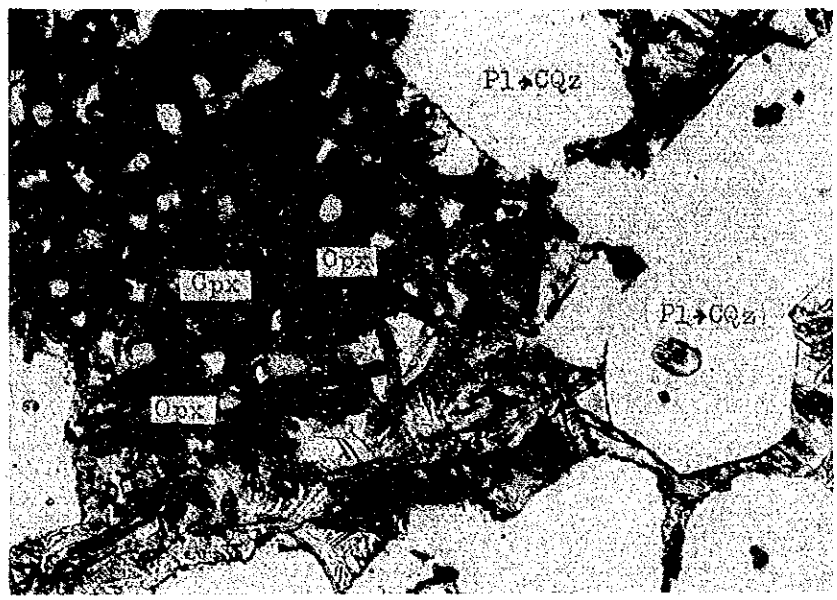
Cauayan Area

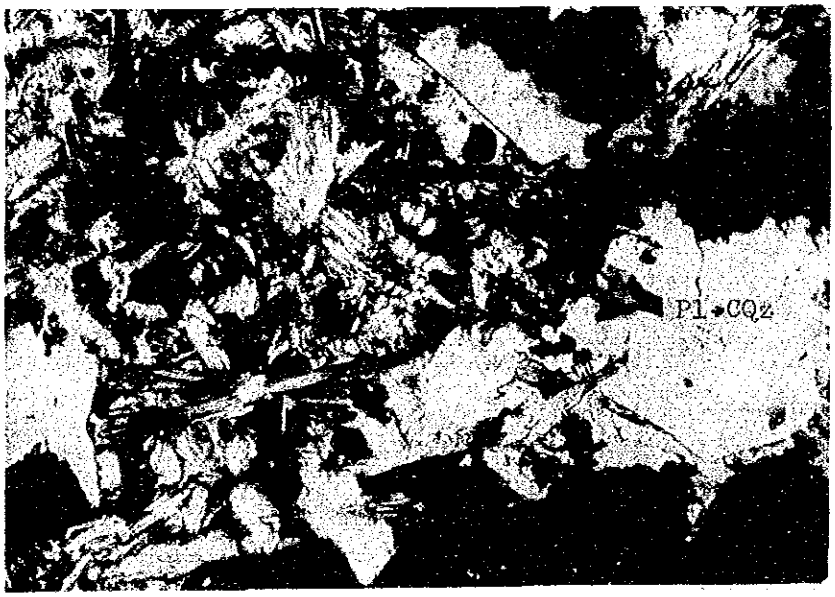


Opx ; Orthopyroxene
Cpx ; Clinopyroxene
Pl→CQz ; Plagioclase changed to Chalcedonic quartz

Parallel Nicol

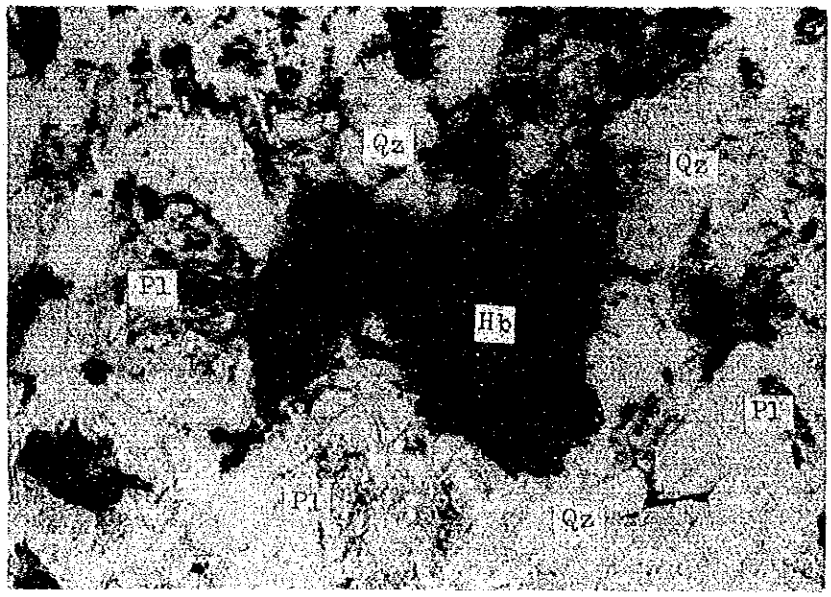
0.2 mm

Basalt, (Sample No. AL002R) in Abuan River Formation (Rapid Cooling Facies)
Locality ; 30 Km SE San Mariano, East Side of Northern Sierra Madre Range
Main mineral ; Orthopyroxene, Clinopyroxene, Plagioclase (changed to Chalcedonic quartz



Cross Nicol

0.2 mm

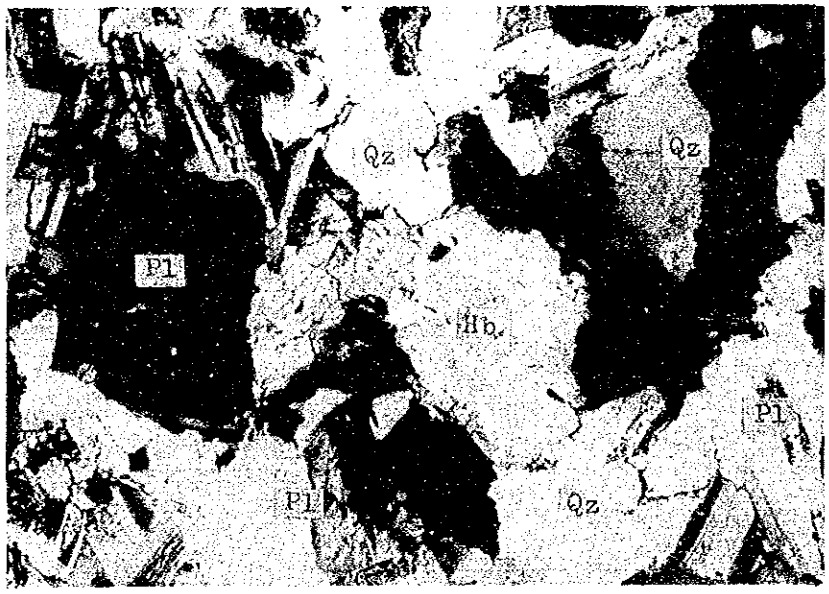


Hb ; Hornblende
Qz ; Quartz
Pl ; Plagioclase

Parallel Nicol

0.5 mm

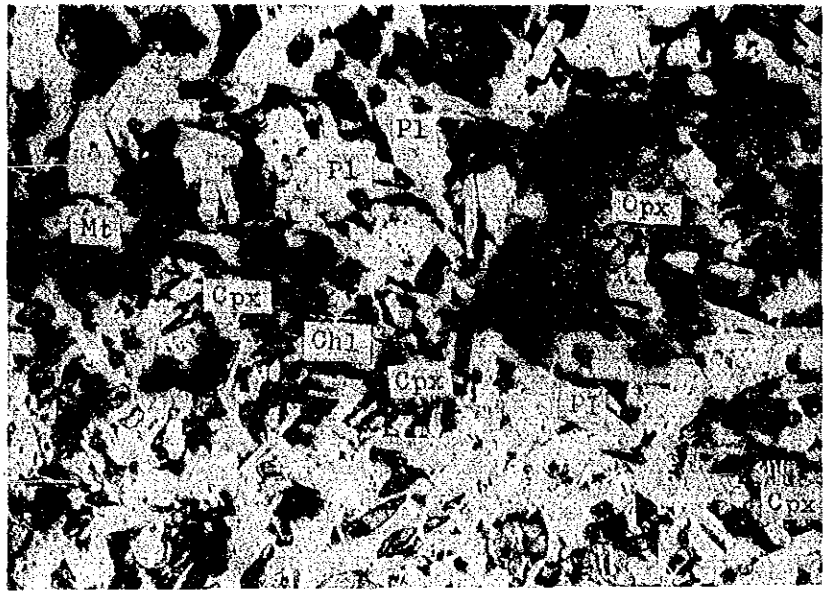
Tonalite, (Sample No. AM054R) in Siagot Diorite
Locality ; 38 Km ESE of Cauayan, East Side of Northern Sierra Madre Range
Main Mineral ; Hornblende, Quartz, Plagioclase



Cross Nicol

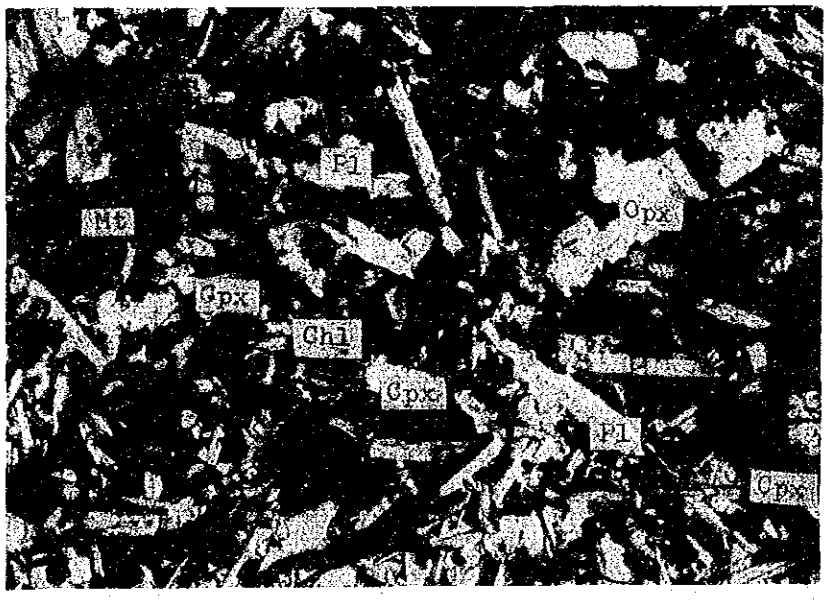
0.5 mm

Ilagan Area

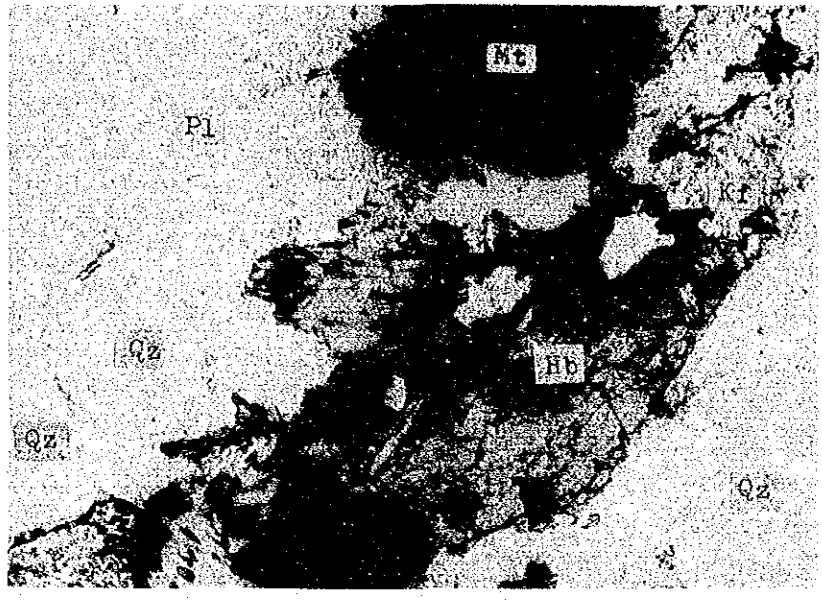


Parallel Nicol 0.5 mm

Dolerite, (Sample No. BB058) in Abuan River Formation
Locality ; 7 Km SSE of Mt. Cresta
Main mineral ;



Cross Nicol 0.5 mm

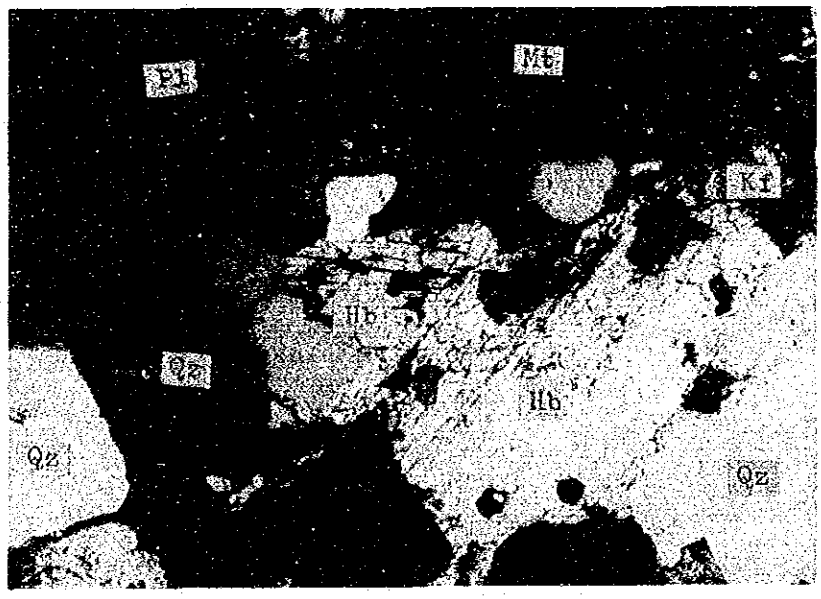


Mt ; Magnetite
Kf ; Potash Feldspar
Pl ; Plagioclase
Hb ; Hornblende
Qu ; Quartz

ParaLlel Nicol

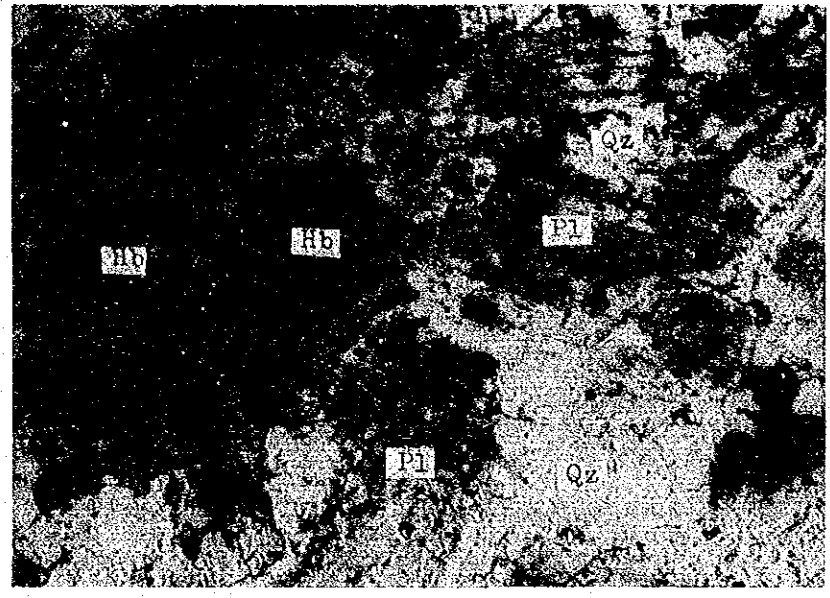
0.5 mm

Granodiorite, (Sample No. BJ052) in Siagot Diorite
Locality ; 22 Km ESE Ilagan
Main mineral ; Magnetite, Potash Feldspar, Plagioclase, Hornblende, Quartz



Cross Nicol

0.5 mm



Hb ; Hornblende
Pl ; Plagioclase
Qu ; Quartz

Parallel Nicol

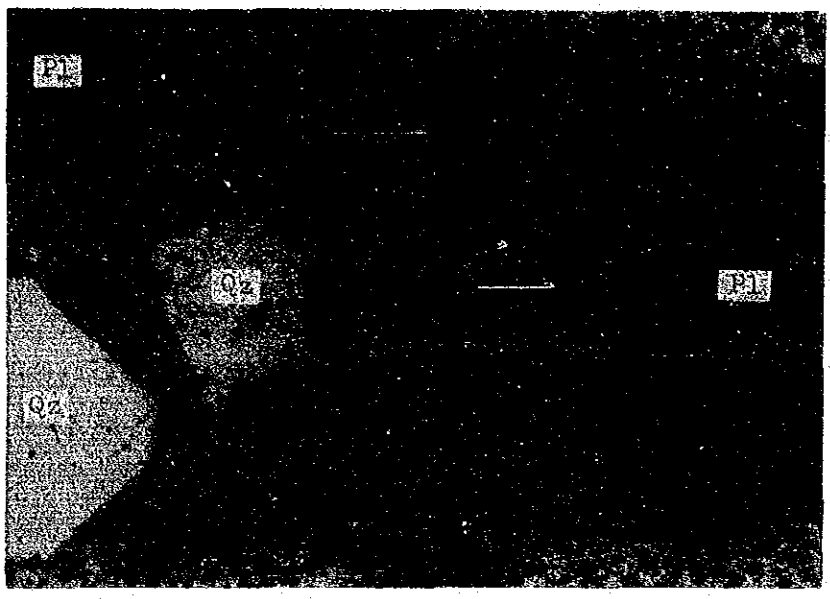
0.5 mm

Quartz diorite, (Sample No. DH-057) in Siagot Diorite
Locality ; 23 Km E of Tuguegarao
Main mineral ; Hornblende, Plagioclase, Quartz

Cross Nicol

0.5 mm

Appendix 2 Microphotograph (Polished Section)

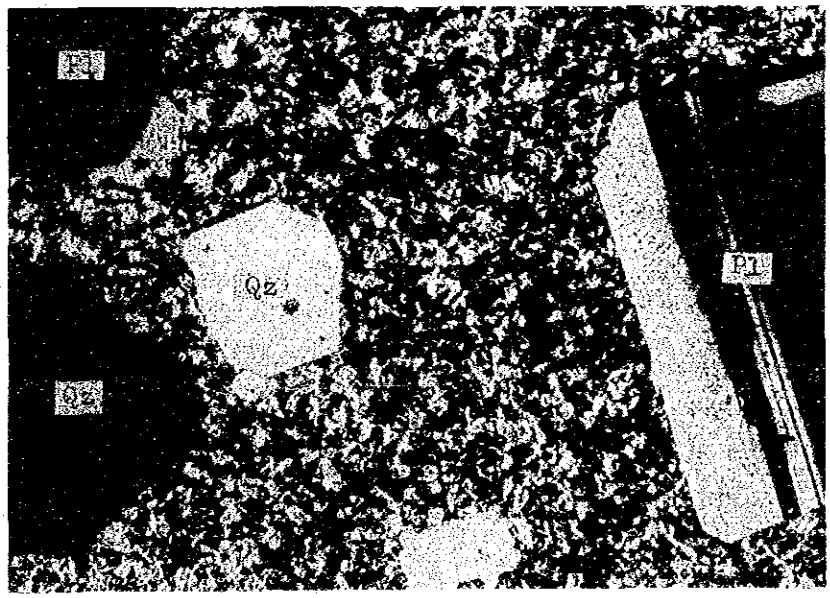


Pl ; Plagioclase
Qu ; Quartz

Parallel Nicol

0.5 mm

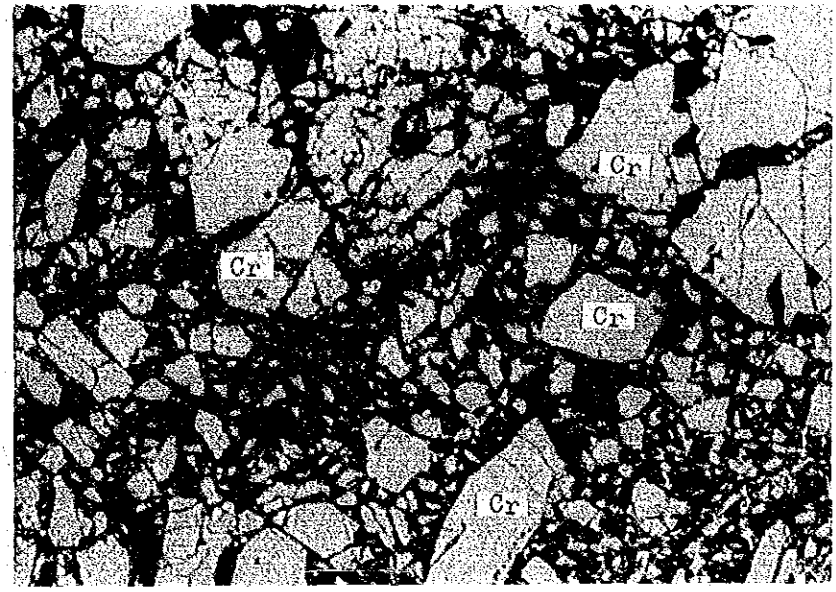
Dacite, (Sample No. DF-043) Dyke in Siagot Diorite
Locality ; 29 Km E of Tuguegarao
Main mineral ; Phenocryst ; Plagioclase, Quartz
Groundmass ; Chlorite, Plagioclase, Quartz, Silica-mineral



Cross Nicol

0.5 mm

Palanan Area
(Polished Section micro-photograph)



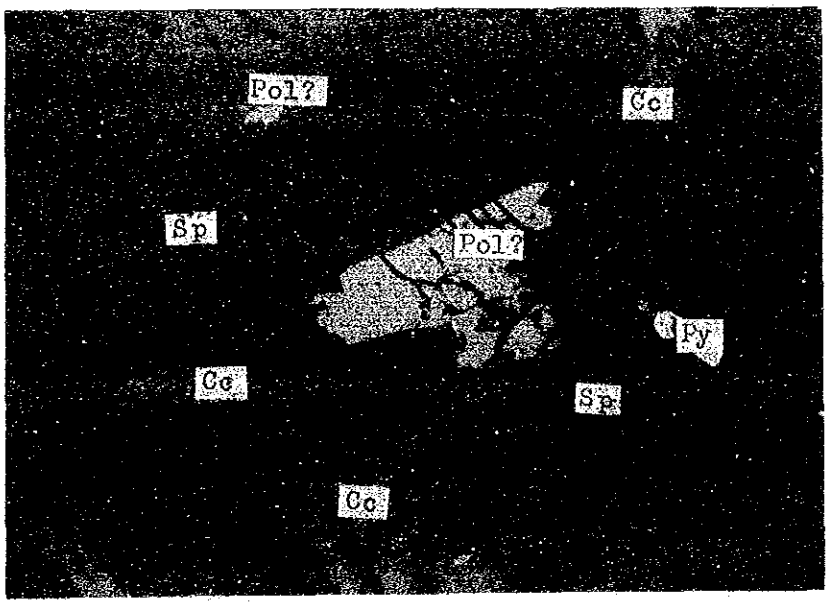
0.2 mm

Sample of Caschrome
Wasayan 2 (CA-60)

Chromite ore in Raddish brown Soil

Cr_2O_3 53.39%

Cr ; Chromite



0.1 mm

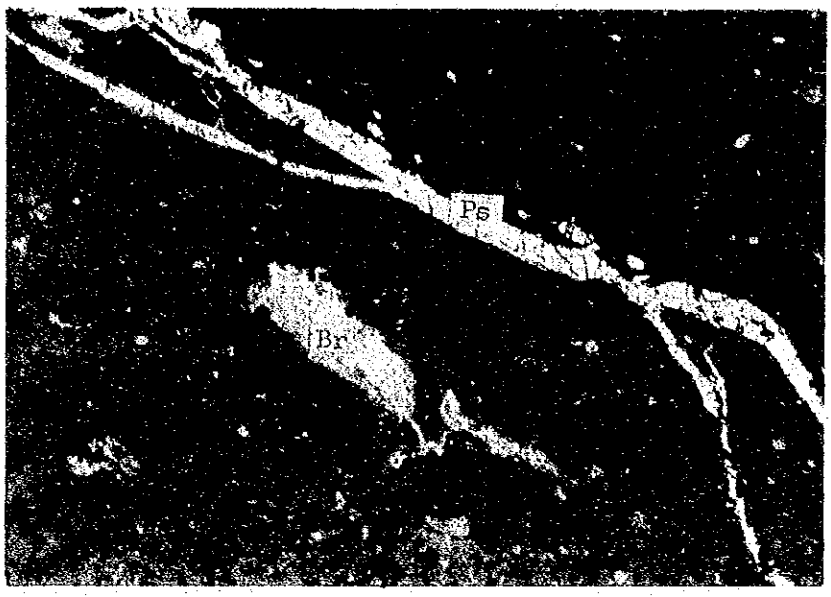
Sample of Dimakawal
Mn Prospect (MD-4)

High copper zone Ore
with Manganese mineral
in Volcanic breccia

Au g/t	Ag g/t	Cu%	Zn%
2.0	132.3	15.88	23.00

Pol;
Cc ; Chalcocite
Sp ; Sphalerite
Pol; Polybasite
Py ; Pyrite

Palanan Area
(Polished Section Micro-photograph)



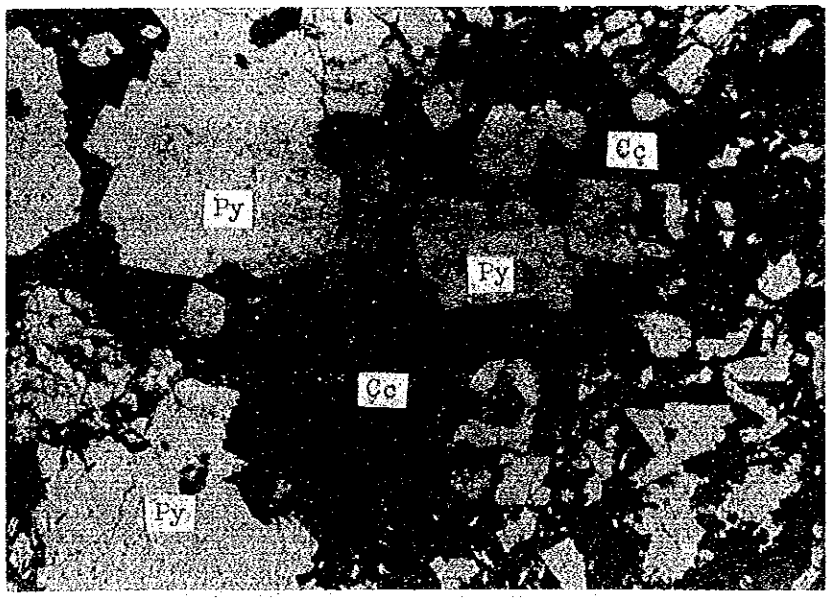
0.1 mm

Sample of Dikadioan
Mn Prospect (KR-16)
Manganiferous chert

SiO_2%	Mn%	Fe%	P%
83.7	1.24	5.29	0.05

CaO%
0.07

Ps ; Pyrolusite
Br ; Braunite



0.2 mm

Sample of Bicobian
Copper prospect.
(Bic-02)

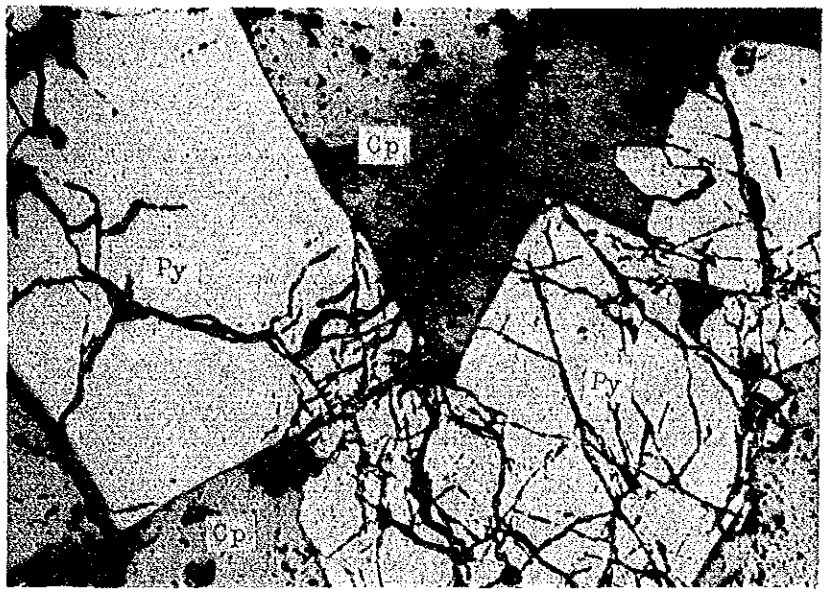
Massive Sulphide boulder

Au g/t	Ag g/t	Cu%	Zn%
5.5	168.5	54.48	0.26

S%
26.14

Py ; Pyrite
Cc ; Chalcocite

Cauayan Area
(Polished Section Micro-photograph)



0.3 mm

Sample of Dina Creek I
Copper Showing
(Sample AK051R (Sta45))

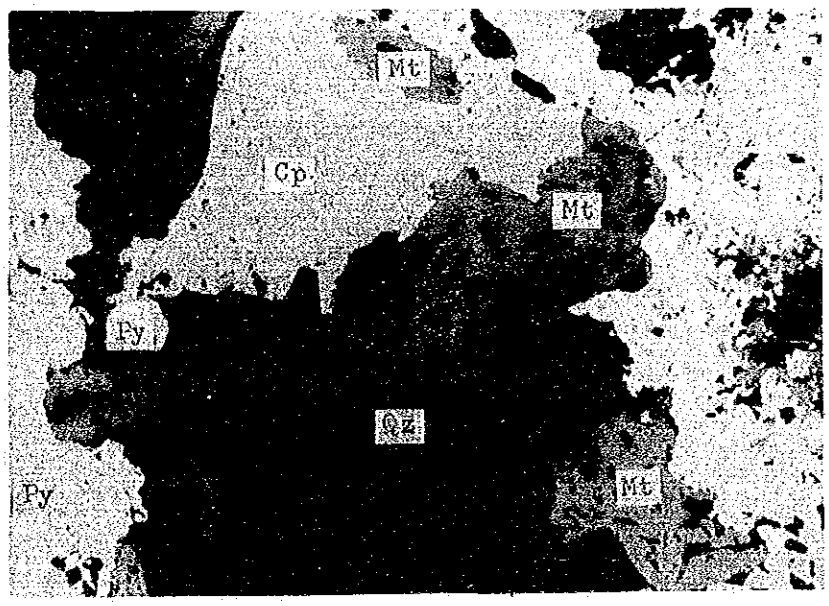
Pyrite Disseminated zone
in porphyritic andesite

Accompanied Quartz
diorite

Au g/t	Ag g/t	Cu%	Pb%
0.07	3.3	0.64	<0.01

Zn%
0.01

Py ; Pyrite
Cp ; Chalcopyrite



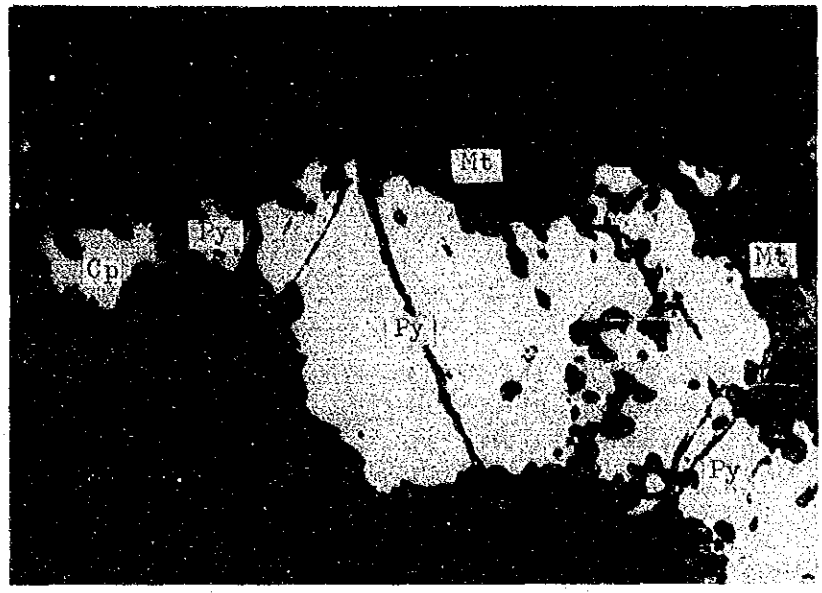
0.1 mm

Sample of Dina Creek I
Copper Showing
(AK051R (amp 2))

Massive sulphide float

Qz ; Quartz
Cp ; Chalcopyrite
Py ; Pyrite
Mt ; Magnetite

Ilagan Area
(Polished Section Micro-photograph)

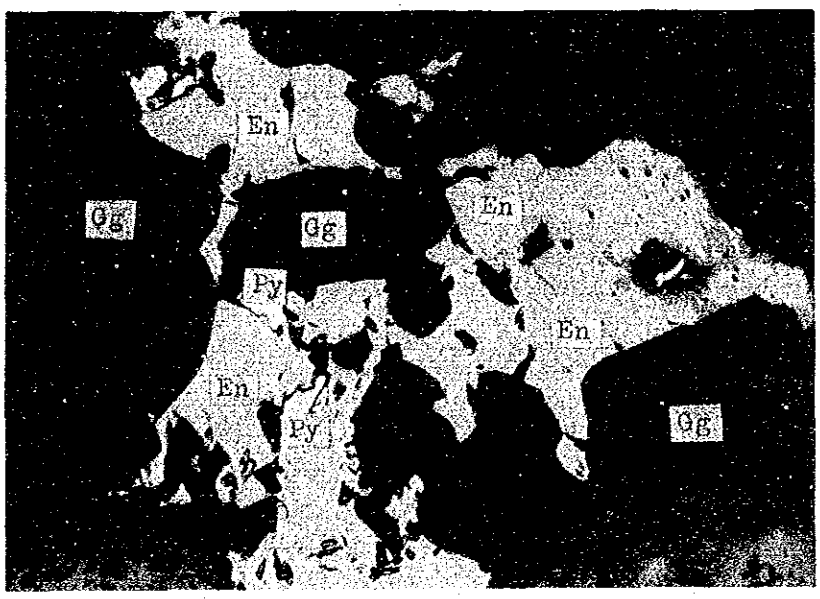


Sample of Lupigue Copper Showing. (BA005b)

Pyrite dissemination in hornfels and silicious sandstone.

Cp ; Chalcopyrite
Py ; Pyrite
Mt ; Magnetite

Tuguegarao Area



Sample of Casablangan Showing (DF039b)

Pyrite Dissemination in altered Dacite

Py ; Pyrite
Gg ; Gangue mineral
En ; Enargite

Appendix 3 Micro Fossil Correlation Table

Appendix 3 Microfossil Correlation Table

Identification Table of Radiolaria and Foraminifera Samples in Northern Sierra Madre Area

MMAJ Samples

Sample no.	Radiolarians	Foraminifers	Remarks
CCR4	Barren	Barren	Chert
BIC5	Common/Poor Thanarla conica T. pulchra(?) Holocryptocanium geysersensis Archaeodictyomitra vulgaris Archaeodictyomitra sp. (Age; Lower Cretaceous, Valanginian to Aptian	Barren	Chert
BD104	Barren	Rare/Poor Globoratalia sp.	Siltstone
CF006R	Barren	Trace Bathysiphon sp.	
DD014	Barren	Barren	Volc. sandst
CK62146A	Barren	Rare/Poor	Siliceous nodule
DJ003	Barren	Barren	
CH117R	Barren	Barren	Limestone
GN26A	Barren	Barren	
AD130R	Barren	Rare/Poor	Silitst.
VS2	Barren	Barren	Limestone
KR15	Barren	Barren	Black silic. shale
BL069	Barren	Barren	Ostrea sst.
BE054	Trace Conosphaera sp.	Rare/Poor Globigerina sp	Sandy siltst
BA001C	Barren	Barren	Sandst.
AD076R	Barren	Barren	Sandy siltst
DK082	Barren	Barren	Calc. sst.
BC044	Barren	Barren	Congl.
AD096R	Barren	Barren	Sandy siltst
CA032R	Barren	Common/Poor	Calc. sandstone
BK006	Barren	Barren	Siliceous sandstone
SF001	Barren	Barren	Volc. sandstone
AC046R	Barren	Barren	Sandy silitstone
CE007	Barren	Barren	Black siltstone
CM100	Barren	Barren	Sst. and limestone
AD114R	Barren	Rare/Poor	Siltstone
AF010R	Barren	Barren	
BH122	Barren	Barren	Calc. sst.
BK004	Barren	Common/Moderate	Siltst.
AL008R	Barren	Barren	Silty sst.
AL003R	Barren	Barren	Black sandst.
AC006R	Barren	Barren	Silty sst.
BJ028	Barren	Barren	White limestone
BH080	Barren	Rare/Poor	Siliceous siltstone
AM025R	Barren	Barren	Sandstone

After Dr. M. Okamura ; Faculity of Geology Kochi Univ. Japan

Identification Table of Nanno-Plankton Samples in Northern Sierra Madre Area

	Cauayan			Ilagan					Palanan			Tuguegarao		
SAMPLE NUMBER	AD1 14R	AD1 30R	ALO 03R	BD 104	BH 122	BJ 028	BK 004	BL 069	CK62 146A	CA 32R	CH1 17R	DJ 003	NQ 26A	DK 082
ABUNDANCE - PRESERVATION	A G	A G	R M	C G	C M	T P	C M	F M	F P	C M	T P	R G	F M	F P
ETCHING / OVERGROWTH	0/0	0/0	1/0	0/0	0/2	0/3	1/0	0/1	1/2	1/1	1/0	0/0	1/0	1/3
Braarudosphaera bigelowii	-	F	-	-	-	-	-	-	-	-	-	-	-	-
Calcidiscus leptoporus	-	-	-	C	-	-	-	-	-	F	-	-	-	-
C. macintyrei	-	-	-	F	-	-	-	-	-	F	-	+	-	-
Chiasmolithus cf. *altus*	-	R	-	-	-	-	-	-	-	-	-	-	-	-
Coccolithus miopelagicus	F	F	-	-	-	-	-	-	-	-	-	-	F	-
C. pelagicus	A	C	-	F	C	-	F	C	+	F	-	+	C	-
Coronocyclus nitscens	R	R	-	-	-	-	-	-	-	-	-	-	-	-
Cyclicargolithus abisectus	C	-	-	-	C	-	-	F	+	-	-	-	F	-
C. floridanus	A	A	-	-	A	-	-	A	+	+	+	-	A	+
Dictyococcites bisectus	-	-	-	-	-	-	-	-	+	-	-	-	-	-
D. productus	-	-	+	-	-	-	C	-	-	-	-	+	-	-
Dictyococcites sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Discoaster adamanteus	F	R	-	-	-	-	-	-	-	-	-	-	F	-
D. berggrenii	-	-	+	F	-	-	F	-	-	C	-	-	-	-
D. brouweri	-	-	-	-	-	-	-	-	-	F	-	-	-	-
D. deflandrei	A	A	-	-	F	+	-	-	-	-	-	-	F	-
D. intercalaris	-	-	-	R	-	-	-	-	-	-	-	-	-	-
D. pentaradiatus	-	-	-	-	-	-	-	-	-	F	-	-	-	-
D. quinqueramus	-	-	+	F	-	-	C	-	-	C	-	-	-	-
D. surculus	-	-	-	R	-	-	-	-	-	-	-	-	-	-
D. tani ornatus	F	F	-	-	-	-	-	-	-	-	-	-	-	-
D. variabilis	-	-	+	-	-	-	F	-	-	F	-	-	-	-
Helicosphaera carteri	-	-	-	C	-	-	C	-	-	A	-	+	-	-
Helicosphaera euphratis	C	C	-	-	F	+	-	-	-	F	-	-	-	-
H. perch-nielsenae	-	R	-	-	-	-	-	F	-	-	-	F	-	-
H. trumpeyi	R	-	-	-	-	-	-	-	-	-	-	-	-	-
H. wilcoxonii	R	-	-	-	-	-	-	-	-	-	-	-	-	-
Lophodolithus sp.	-	-	-	-	-	-	-	-	-	-	-	-	F	-
Pontosphaera japonica	-	-	-	F	-	-	-	-	-	-	-	-	-	-
P. multipora	-	-	-	F	-	-	F	-	F	-	-	-	-	-
P. pectinata	-	R	-	-	-	-	-	-	-	-	-	-	-	-
Reticulofenestra gelida	-	-	-	-	-	-	F	-	-	-	-	-	-	-
R. haquii	C	C	-	-	C	-	-	A	+	-	-	-	-	-
R. lockeri	-	-	-	-	-	-	-	-	-	-	-	-	C	-
R. minuta	-	-	+	-	-	-	C	-	-	-	-	+	-	-
R. minutula	-	-	+	A	-	-	A	-	-	C	-	+	-	-
R. pseudoumbilica	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Reticulofenestra sp.	-	-	-	-	-	-	-	-	-	-	+	-	-	+
Sphenolithus abies	-	-	+	A	-	-	A	-	-	-	-	+	-	-
S. ciperoensis	R	-	-	-	F	-	-	F	-	-	-	-	F	+
S. conicus	-	R	-	-	F	-	-	-	-	-	-	-	-	-
S. delphix	-	C	-	-	-	-	-	-	-	-	-	-	-	-
S. dissimilis	C	C	-	-	C	-	-	C	+	-	-	-	C	+
S. distentus	-	-	-	-	-	+	-	F	-	-	-	-	F	+
S. grandis	-	-	-	F	-	-	-	-	-	-	-	-	-	-
S. moriformis	C	C	-	-	C	+	-	C	+	C	-	-	C	-
S. neoabies	-	-	-	C	-	-	C	-	C	-	-	+	-	-
S. predistentus	-	-	-	-	-	-	-	F	-	-	-	-	-	-
S. verensis	-	-	-	C	-	-	C	-	C	-	-	-	-	-
Thoracosphaera spp.	-	-	-	C	-	-	F	-	-	-	-	-	-	-
Triquetrorhabdulus carinatus	-	F	-	-	-	-	-	-	-	-	-	-	-	-
T. milowii	-	F	-	-	-	-	-	-	-	-	-	-	-	-
NANNOZONE CP-	19b				19	18-19		19a	18-19		13		19a	19a
CN-		1b	9	9			9			9	5a	7-11		

After Dr. H. Okada ; Geo-Science Division
Yamagata Univ. Japan.

Appendix 4 Time Determination Data of K-Ar Method

Appendix 4
Time determination Data of K-Ar method

TELEDYNE ISOTOPES

POTASSIUM - ARGON LABORATORY

Report of Analysis

T. I. W. O. # 3-9974-122 Your P. O. # 062-1214 Date - 30 Septmber 1986 Page 1 of 2

Submitted by Teledyne Japan K.K.
Nihonseimei Akasaka Bldg.
8-1-19,Akasaka, Minato-ku
Tokyo 107, Japan

for Overseas Mineral Resourses Development Co.,Ltd.

Att: Mr. Y. Ohyama

Results of K-Ar Age Determination in Northern Sierra Madre Area

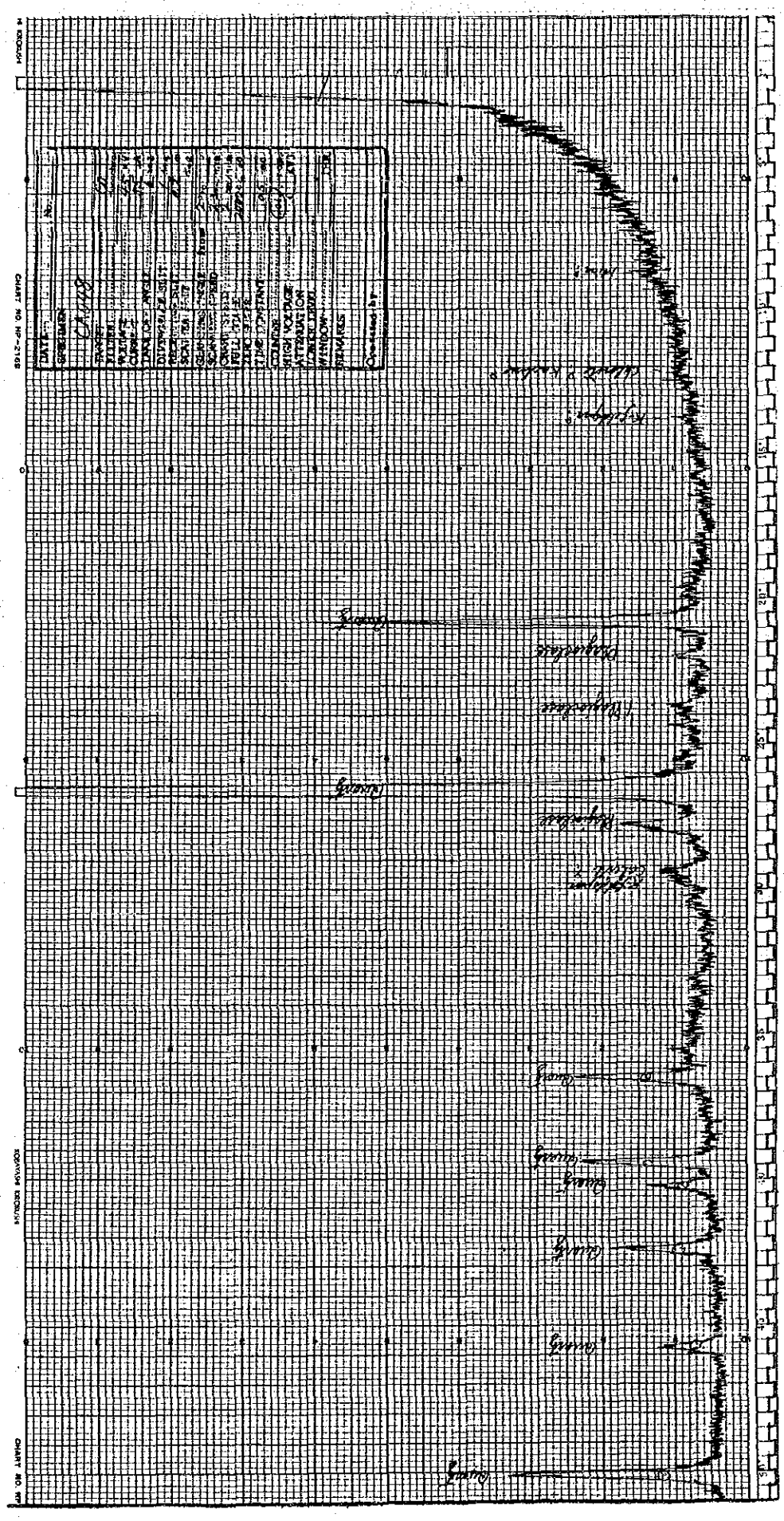
T. I. Sample #	Your Sample #		Material Analyzed	Isotopic Age (Ma)	^{40}Ar * (scc/gm x 10^{-5})	% ^{40}Ar *	% K	Notes
KA86-1307	AK051R	Cauayan	Whole Rock	28.4 ± 2.8				
					.010	23.9	.09	
					.010	28.2	.09	
KA86-1308	AM054R	"	Whole Rock	31.1 ± 1.5				
					.025	46.2	.20	
					.024	50.7	.20	
KA86-1309	BE006	Ilagan	Whole Rock	24.3 ± 1.9				
					.020	28.0	.21	
					.020	31.6	.21	
KA86-1310	BJ052C	"	Whole Rock	29.8 ± 2.6				
					.022	25.5	.18	
					.020	26.6	.18	
KA86-1311	CA021	Palanan	Whole Rock	23.2 ± 1.2				
					.048	38.5	.54	
					.050	40.3	.54	
KA86-1312	CJ005	"	Whole Rock	26.4 ± 1.4				
					.049	37.4	.47	
					.048	42.3	.47	
KA86-1313	DF024	Tuguegarao	Whole Rock	24.4 ± 1.2				
					.064	57.4	.66	
					.063	53.3	.67	
KA86-1314	DH057	Tuguegarao	Whole Rock	22.3 ± 1.1				
					.101	66.9	1.19	
					.107	69.3	1.19	

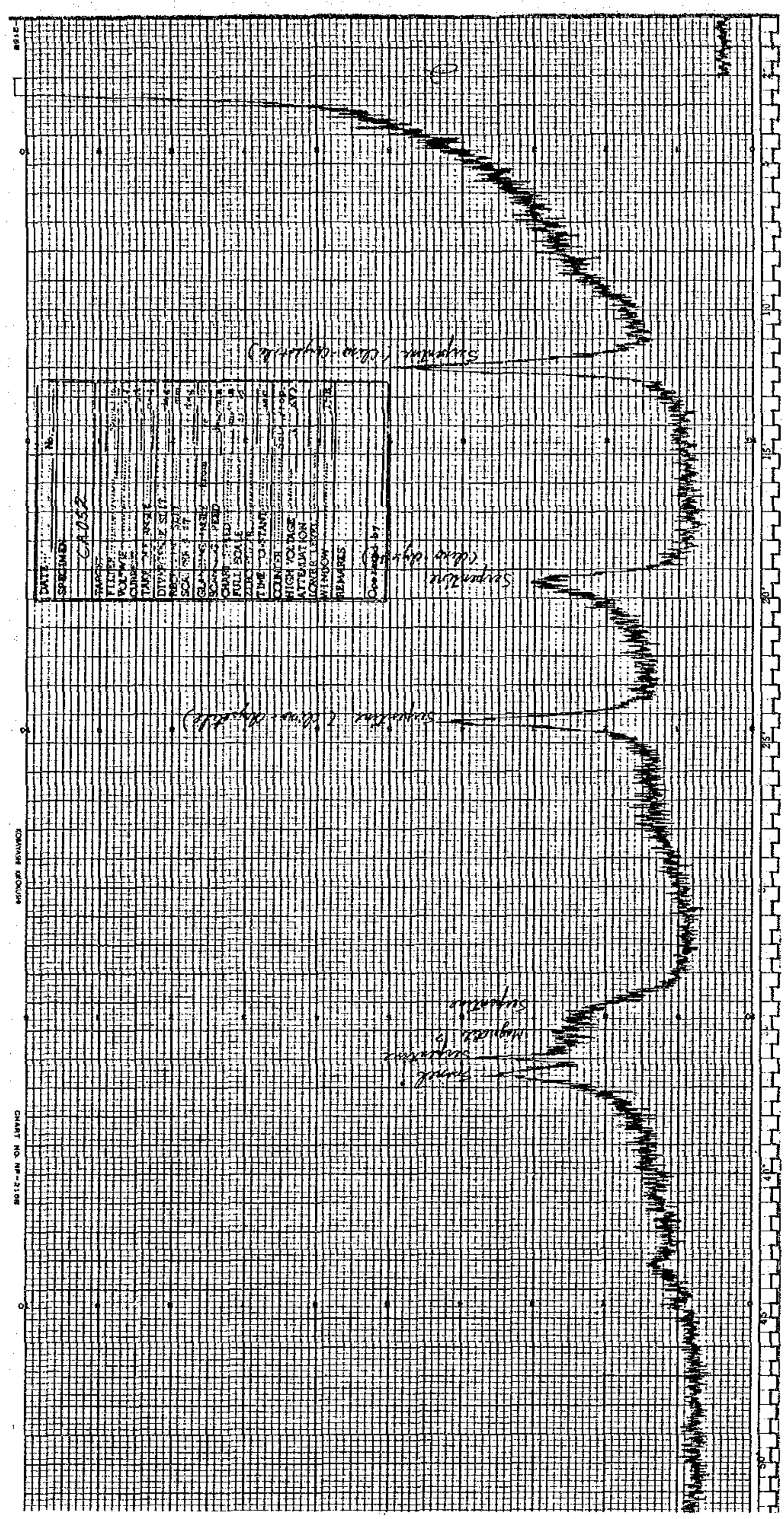
Appendix 5 X-Ray Diffraction Chert

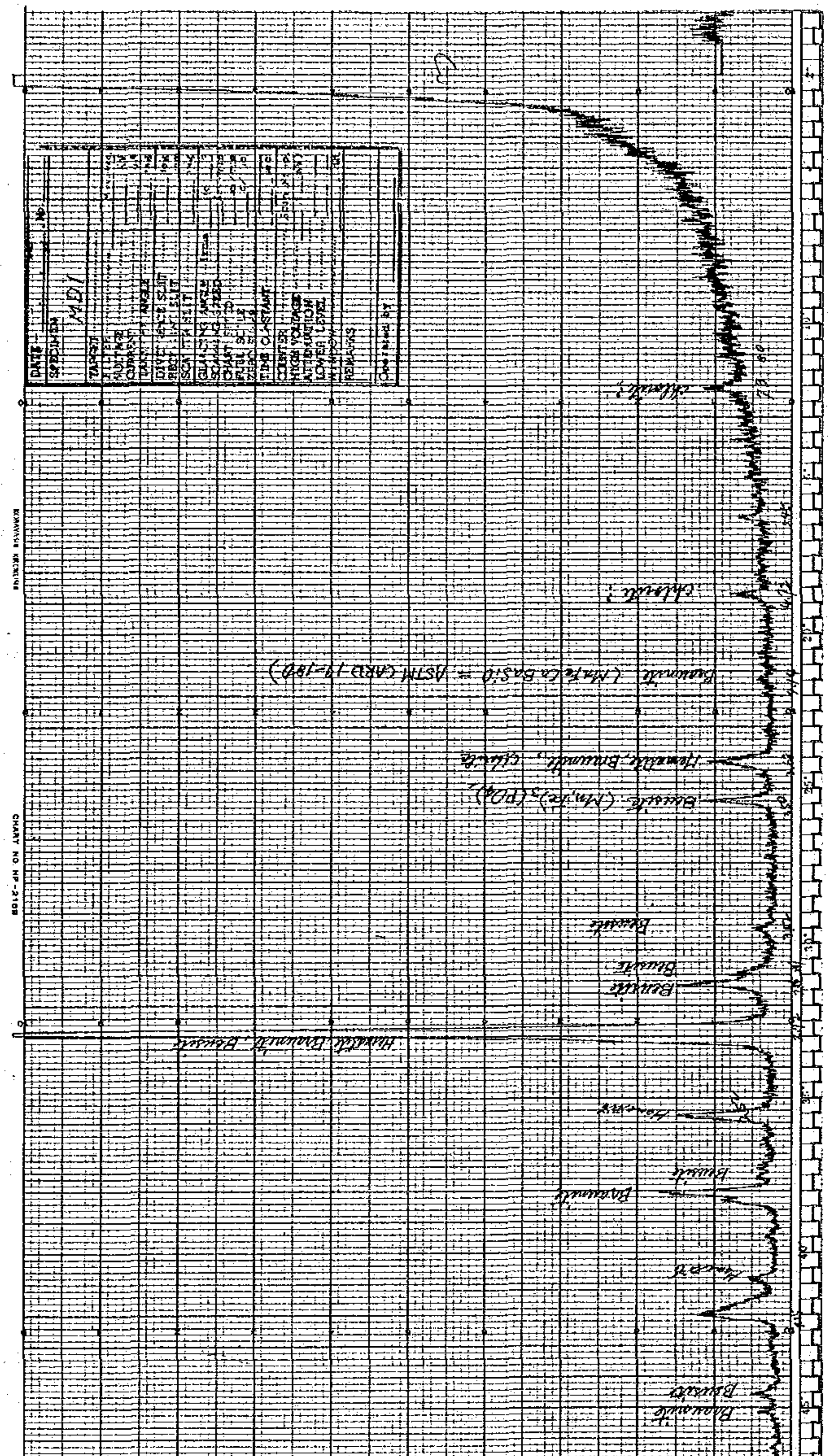
Palanan Area Result Table of X-Ray Diffraction Study

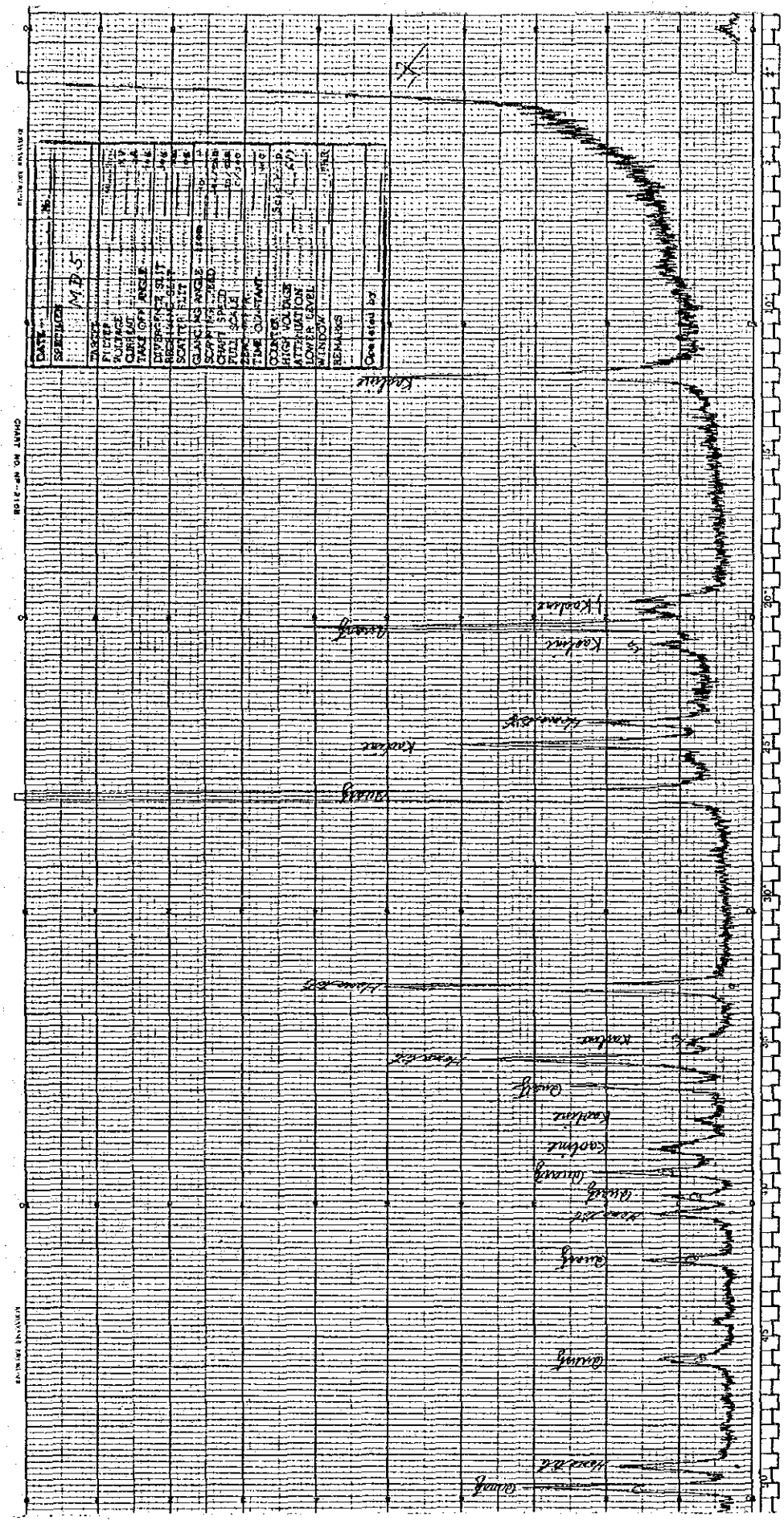
Sample	Zeolite Group						Clay Mineral										Sulphate Mineral				Carbonate Mineral				Silicate Mineral			Feld-spar		Others								
				Laumontite								Chlorite	Sericite	Mica	Kaoline	Sepiolite	Serpentine				Jarosite	Calcite				Hornblende	Quartz	Plagioclase	K-Feldspar	Pyrite	Magnetite	Spinel	Brunite	Hematite	Brusite	Sphalerite	Goethite
1 CA048												1?		1?		1?						1?					4	1	1?								
2 CA052																	3														1?	2?					
3 MD1												1?																				1	4	1		
4 MD5																3											4						3			
5 MD6														1		1											4	1		2					3	
6 MD12												1?				1	2				1						4									
7 KR5				1								1										1?				3		4	2							
8 KR12																											4	4	4	2						
9 KR14																											4									2
10 CJ2												3	1?														4	4	1	1						

Comparable Amount 4; Abundant 3; Medium 2; Small 1; Rare ?; Doubtful








DATE
SECTION MD-5
TRACES
FILTER
VOLTAGE
CURRENT
TAKE OFF ANGLE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
GUARD WIRE
SCANNING MED
CHART SPEED
FULL SCALE
ZERO SETTING
TIME CONSTANT
COUNTER
HIGH VOLTAGE
ATTENUATION
LOWER LEVEL
WINDOW
REMARKS
Checked by
CHART NO. MP-2-18M
Kaolin
Quartz
Kaolin
Kaolin
Quartz
Quartz
Kaolin
Quartz
Quartz
Kaolin
Quartz
Quartz
Quartz

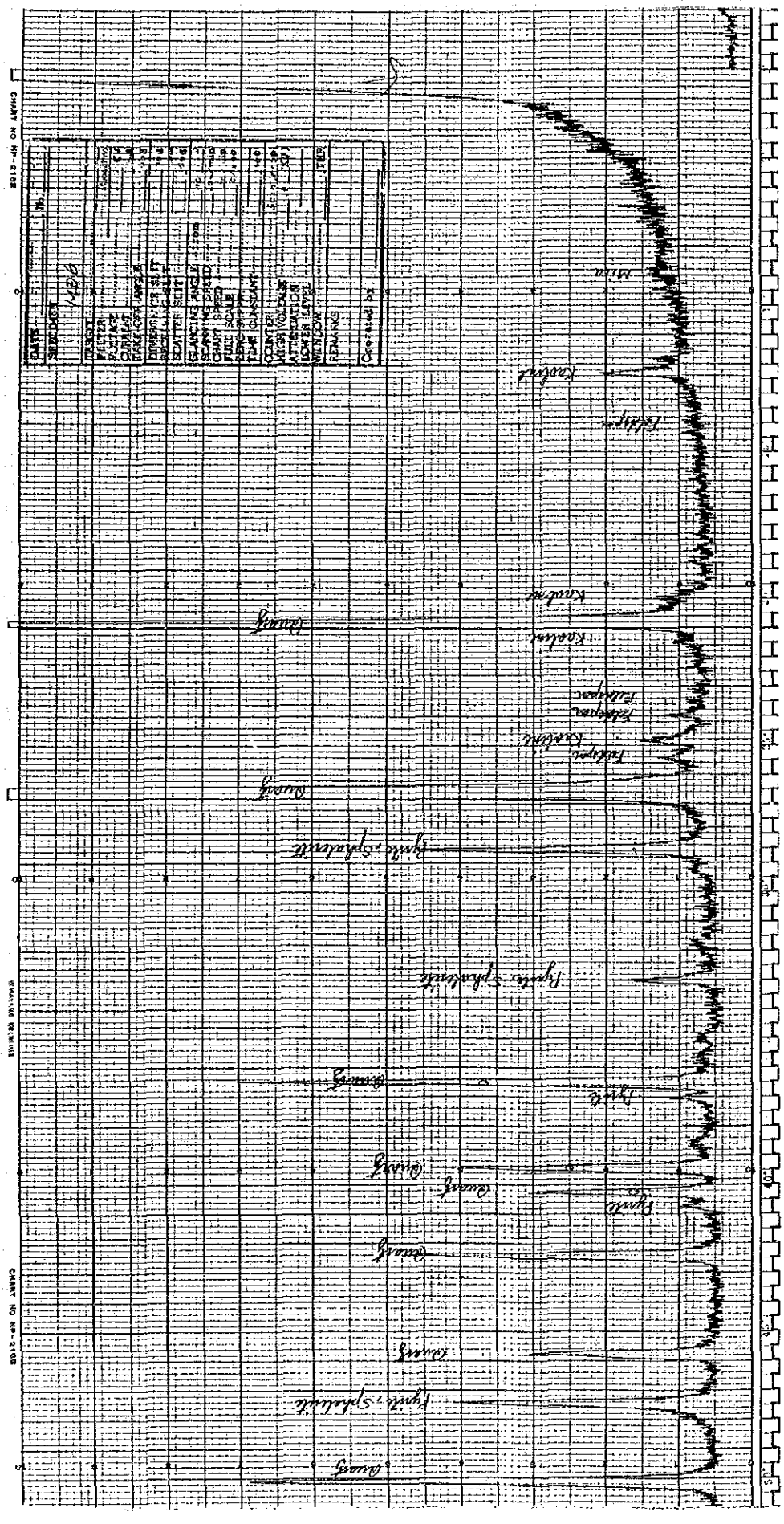
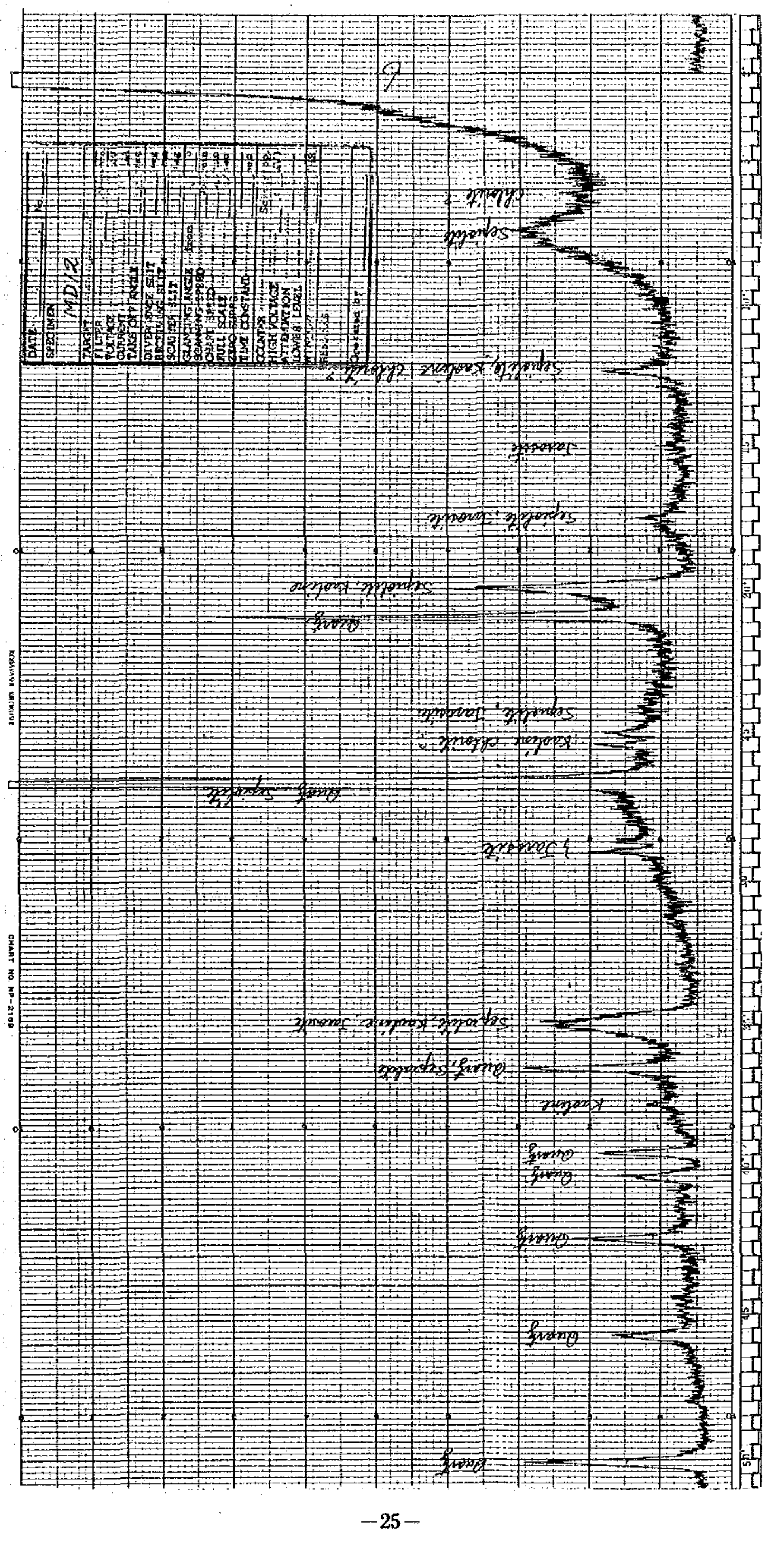
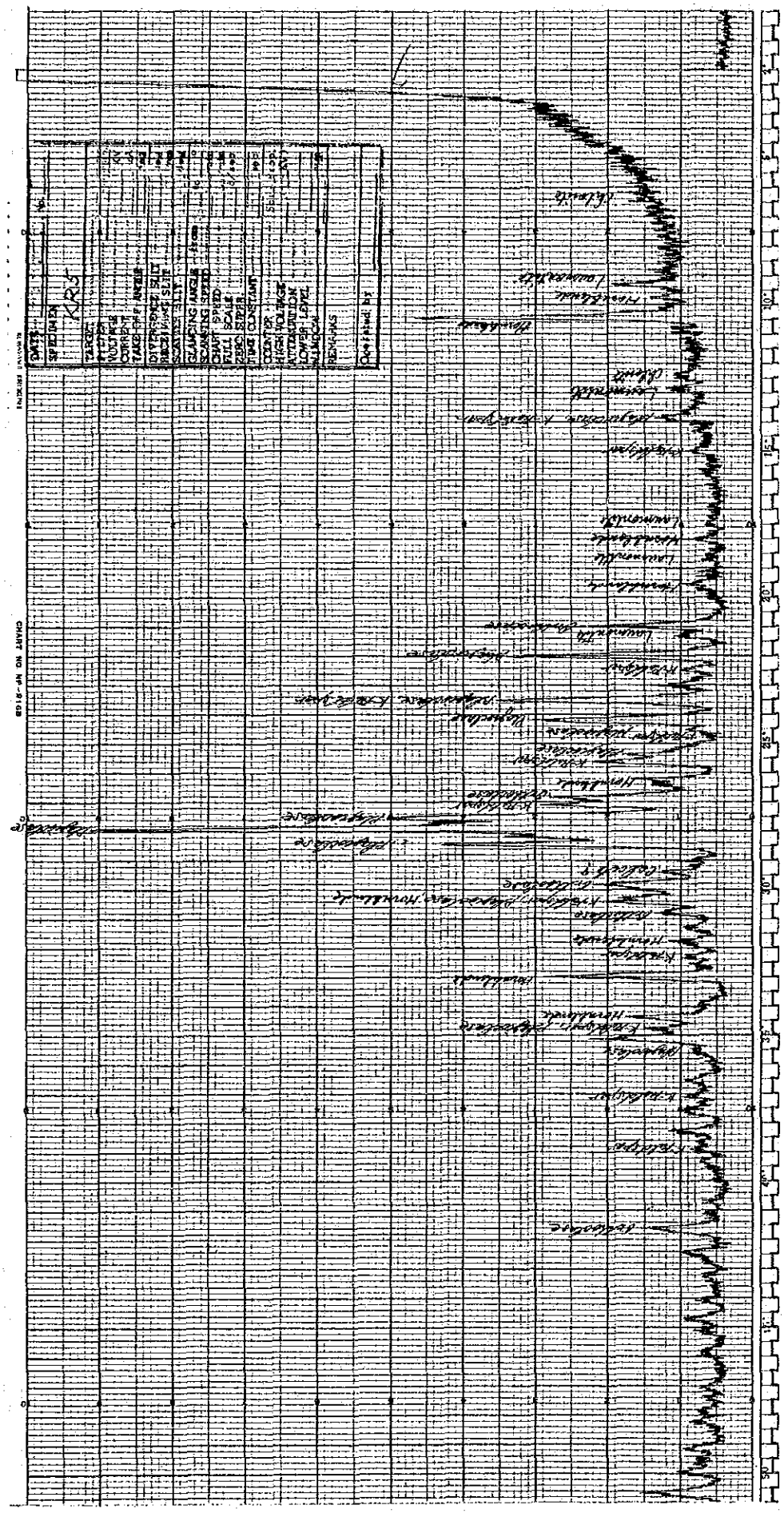


CHART NO NP-2108
CHART NO NP-2108
DATE
SPECIMEN
TARGET
FILTER
X-RAY TUBE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
GONIOMETER
SCANNING SPEED
CHART SPEED
TIME CONSTANT
COUNTER
KILOVOLTAGE
MILLIAMPERAGE
ATTENUATION
LOWER LEVEL
WINDOW
REMARKS
Quartz
Quartz
Quartz


DATE
SPECIMEN
MD/2
TARGET
FILTER
VOLTAGE
CURRENT
TAKE OFF ANGLE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
GLANCING ANGLE
SCANNING SPEED
CHART SPEED
FULL SCALE
TIME CONSTANT
COUNTER
HIGH VOLTAGE
ATTENUATION
LOWER LEVEL
OPERATED BY



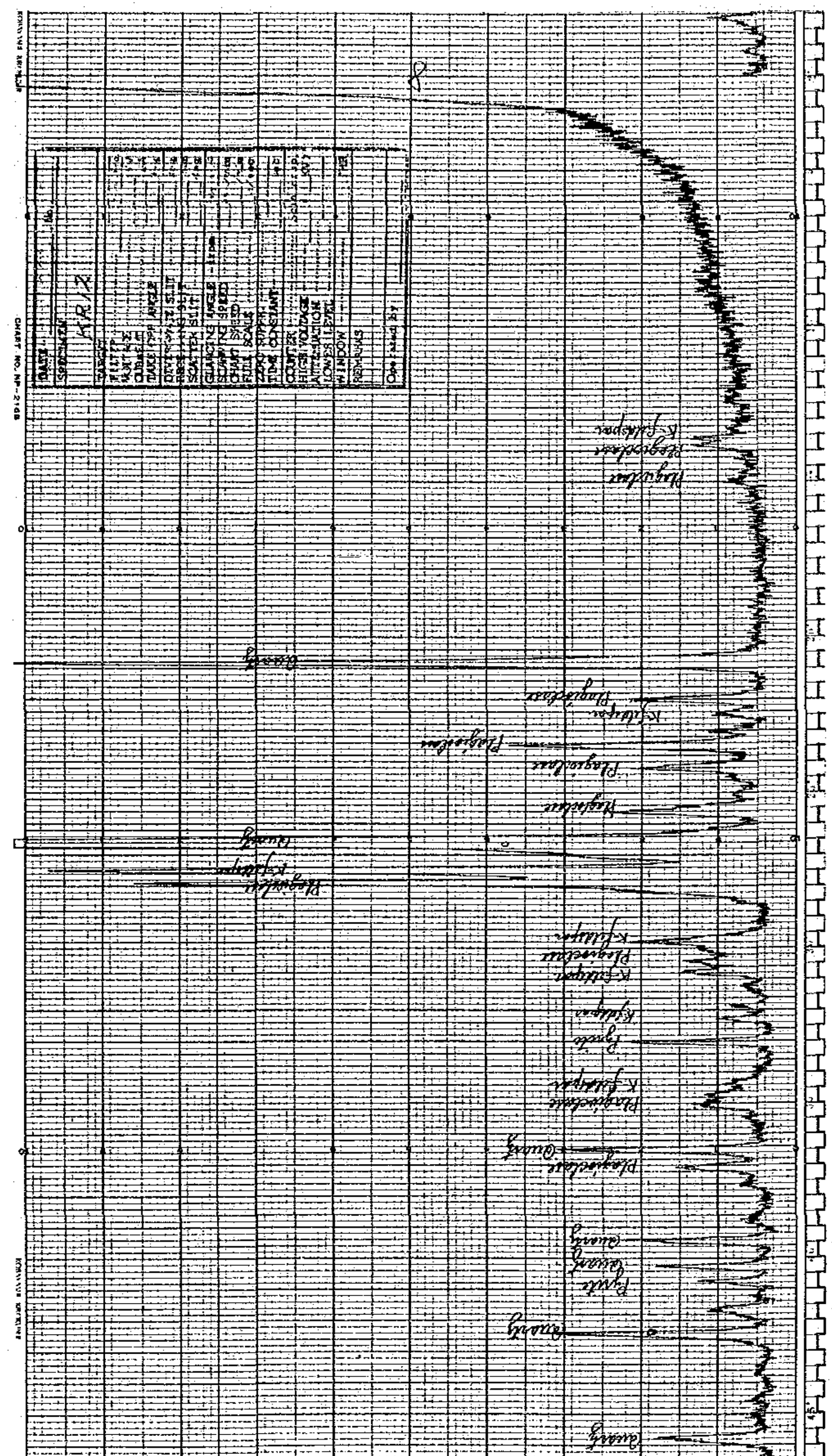


CHART NO. NP-216B
DATE
SPECIMEN
KR12
TARGET
FILTER
VOLTAGE
CURRENT
TAKE OFF ANGLE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
GLANCING ANGLE
SCANNING SPEED
CHART SPEED
FULL SCALE
TIME CONSTANT
COUNTER
HIGH VOLTAGE
ATTENUATION
LOWER LEVEL
WINDOW
REMARKS
Operated by
Quartz
Plagioclase
K-feldspar
Pyrite

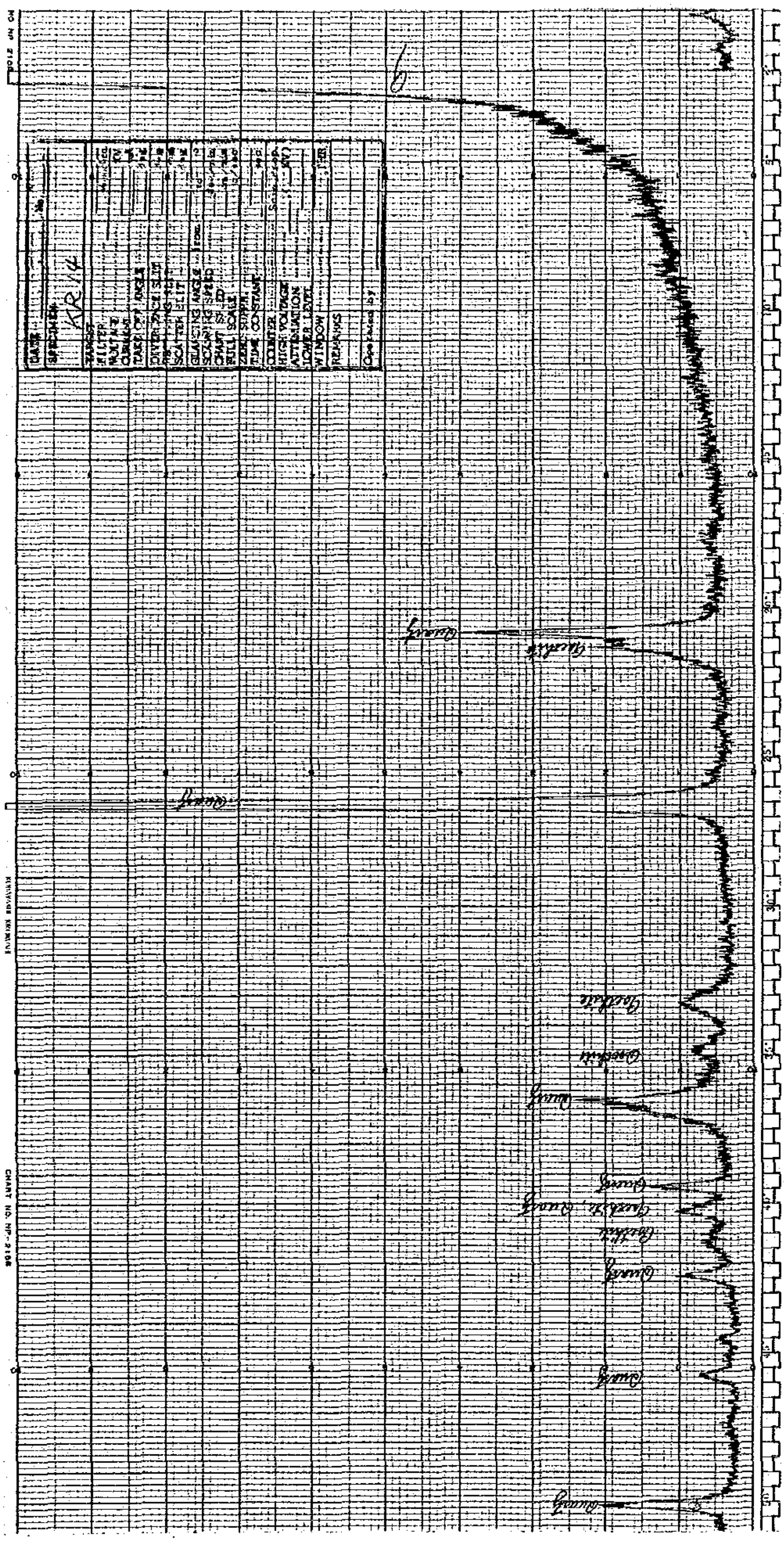
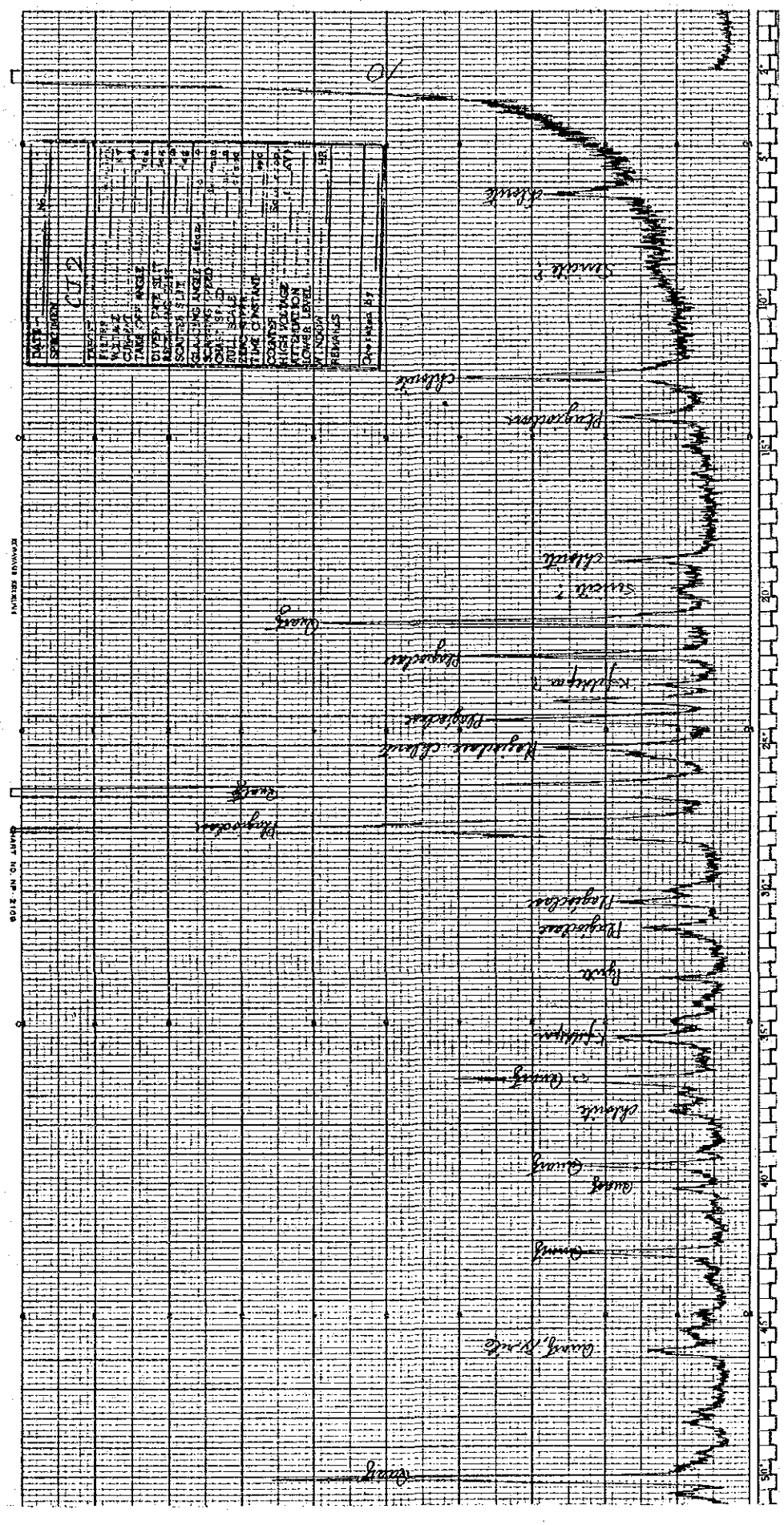


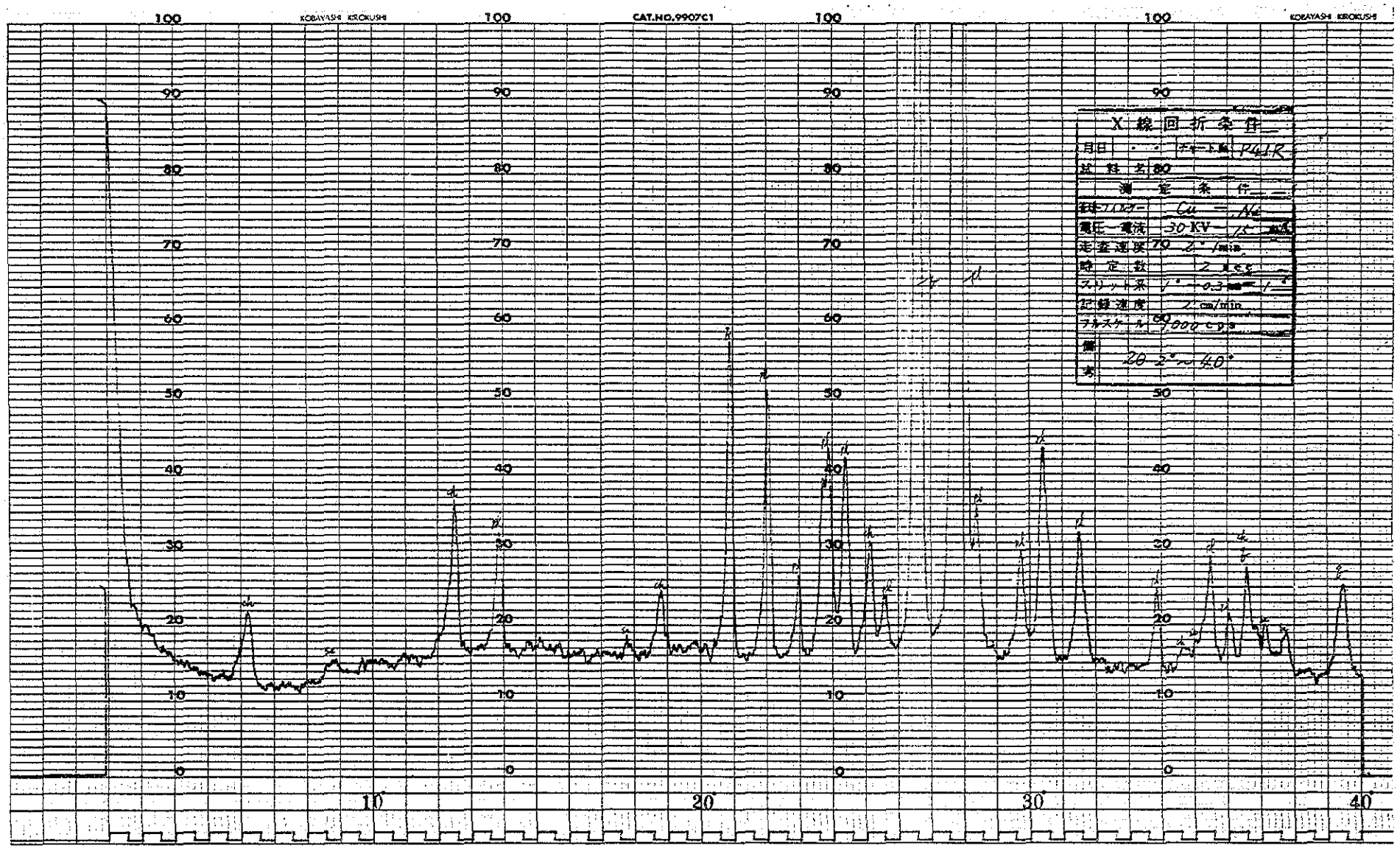
CHART NO. NP-210B
KR/14
Quartz
Calcite

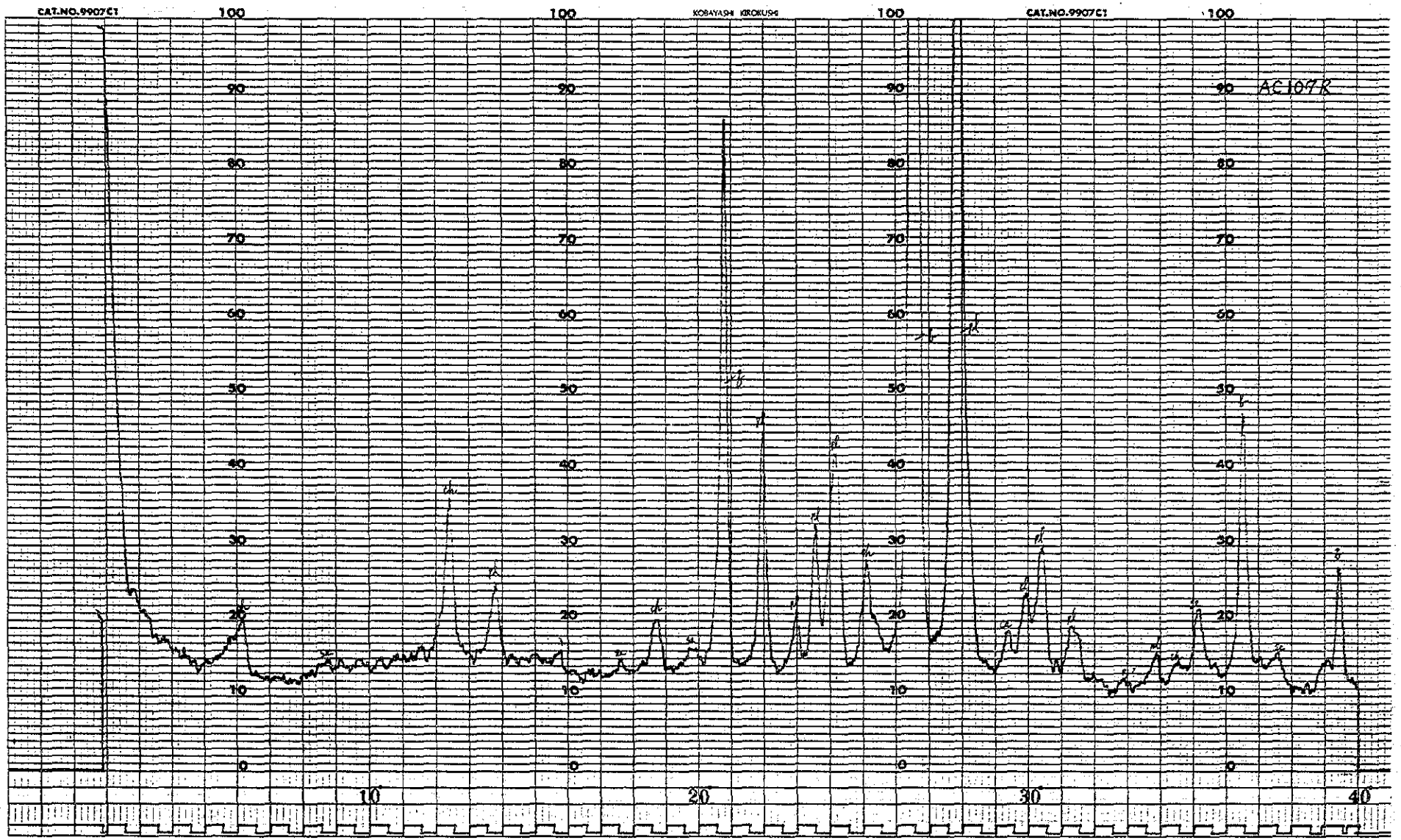


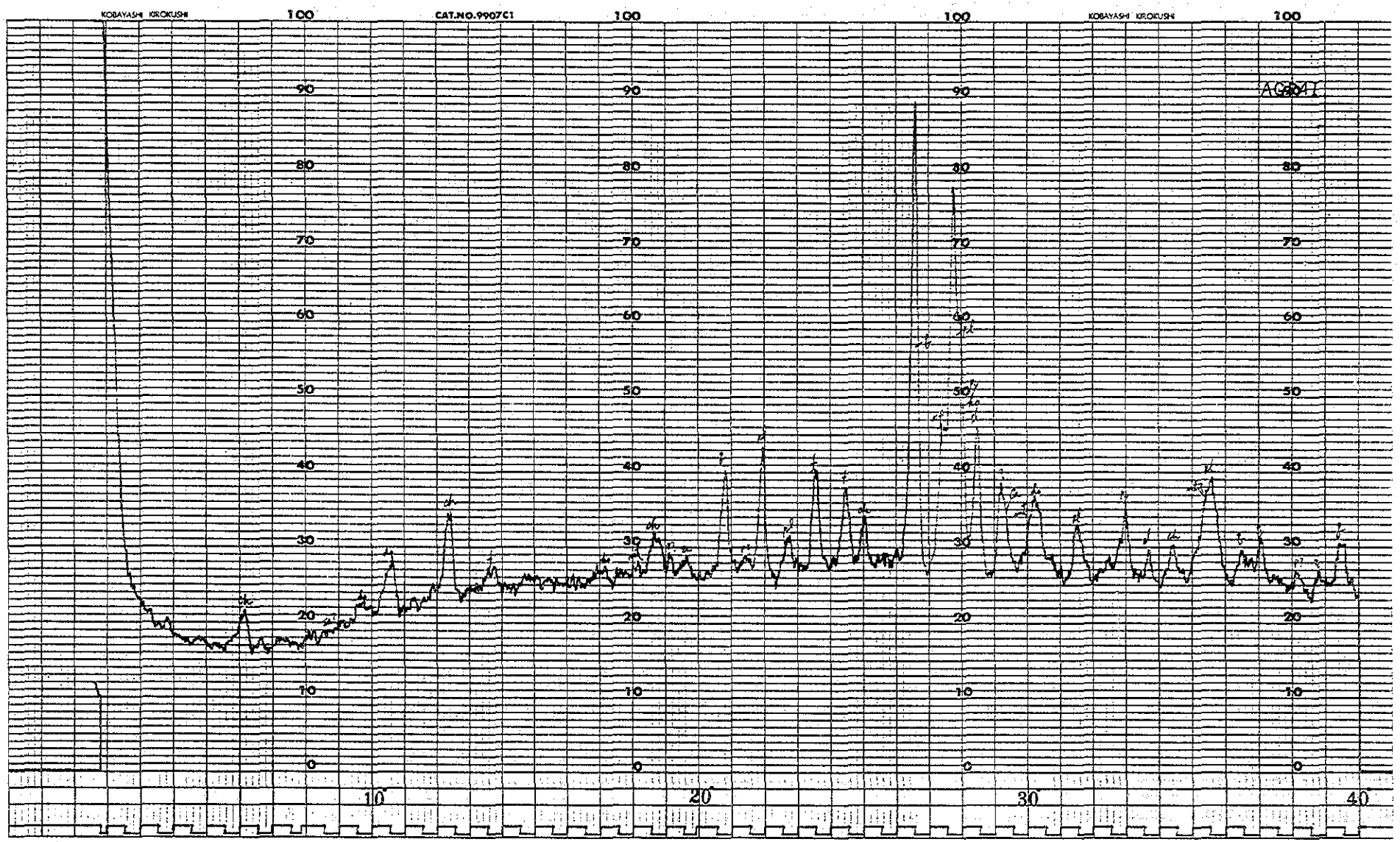
Cauayan Area Result Table of X-Ray Diffraction Study

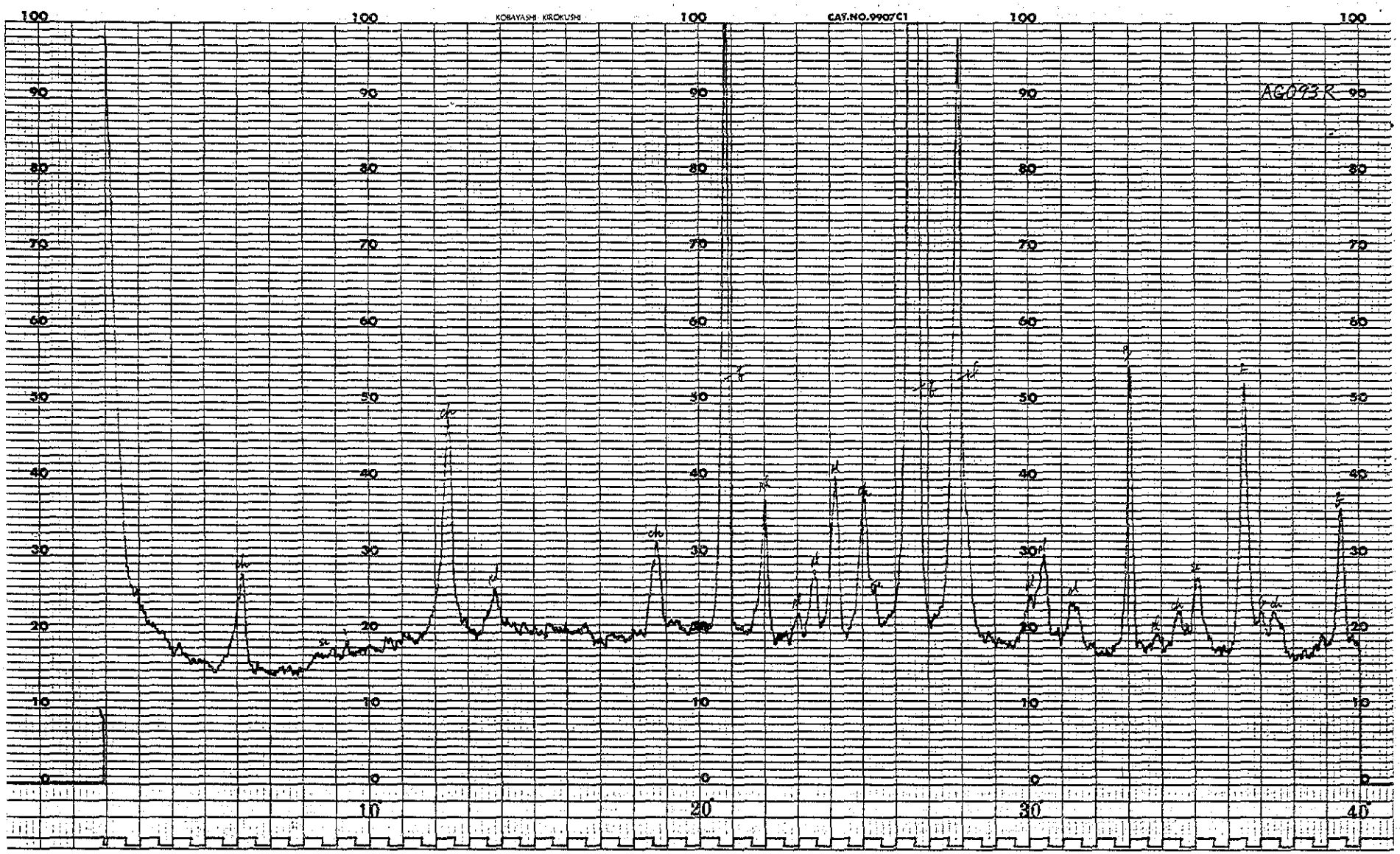
Sample No.	Mineral								
	Ch	Se	Qu	Kr	Pl	Ho	Ca	Py	Mt
P41R	2	1	3		4				
AC107R	2	1	4		3		2	1	
AGPA1	2	1?	3	2	3	2	2?	2	2
AG093R	2	1	4		3			2	
AK051R (Sta44)	4	1	4		3				
ditto (Sta48)	4	1	4		3				
ditto (Sta55)	3	1?	4		4				
ditto (Sta75)	3		2		4	2	1	2	
ditto (Sta134)	3		3		4			1	1
ditto (Sta356)	3	1			3	4		2	

Ch ; Chlorite Se ; Sericite Qu ; Quartz
Kf ; K-Feldspr Pl ; Plagioclase Ho ; Hornblend
Ca ; Calcite Py ; Pyrite Mt ; Magnetite
Comparable Amount; 4; Abundant 1; Rare
?; Doubtful


KOBAYASHI KIROKUSHI
CAT.NO.9907C1
X 線 回 折 条 件
試 料 名
測 定 条 件
ターゲット Cu
管電圧・電流 30 KV
走査速度 2°/min
時 定 数 2
スリット系
記録速度 2 cm/min
フルスケール
備 考 2θ 2°～40°
10
20
30
40


CAT.NO.9907C1
100
90
80
70
60
50
40
30
20
10
0
10
KOBAYASHI KIROKUSHI
20
CAT.NO.9907C1
30
AC107K
40


KOBAYASHI KIROKUSHI
100
CAT.NO.9907C1
100
100
KOBAYASHI KIROKUSHI
100
AG84T
90
80
70
60
50
40
30
20
10
0
10
20
30
40


KOBAYASHI KIROKUSHI
CAT.NO.9907C1
AG093R
100
90
80
70
60
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30
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0
10
20
30
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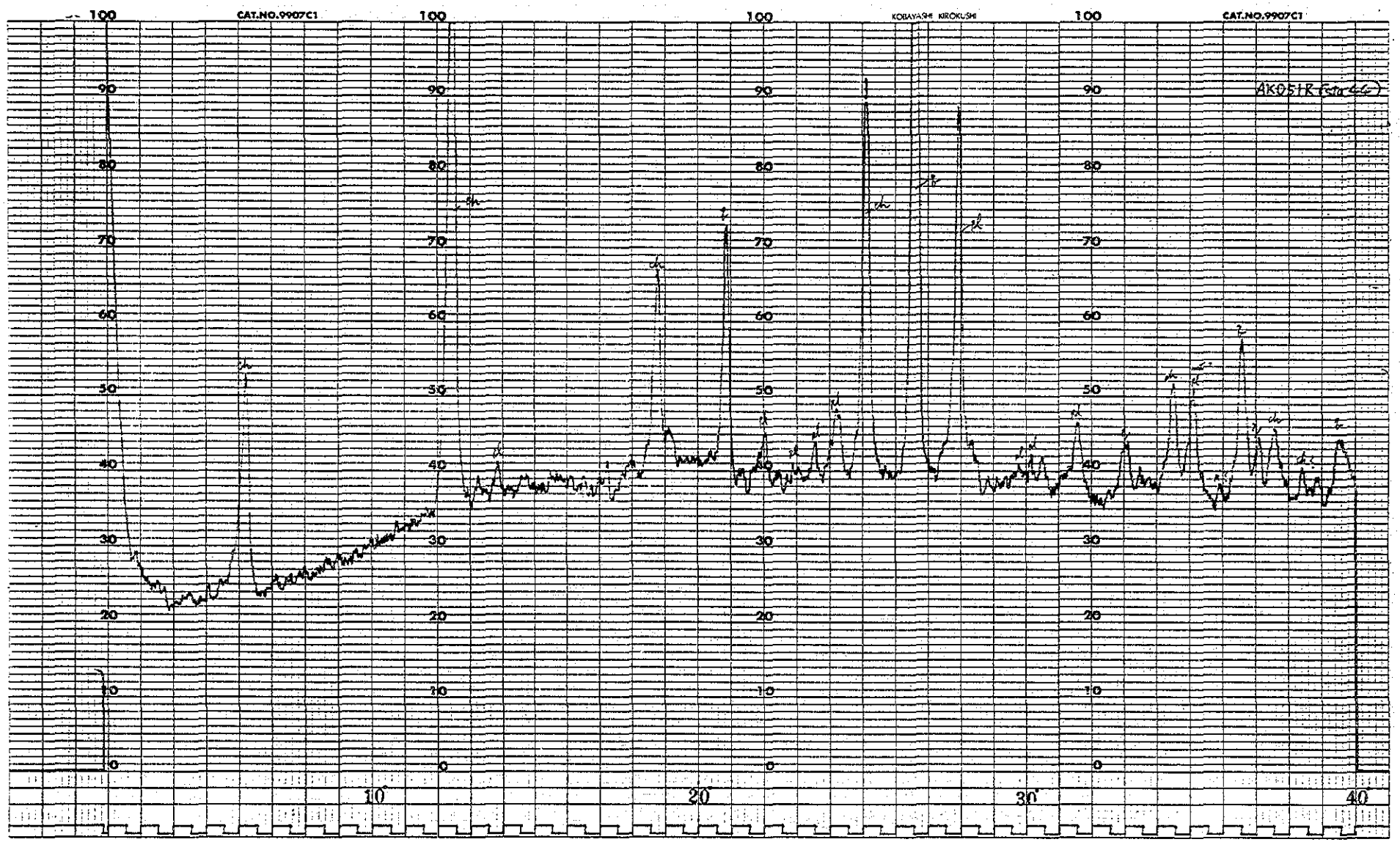
CAT.NO.9907C1
KOBAYASHI KIROKUSHI
CAT.NO.9907C1
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60
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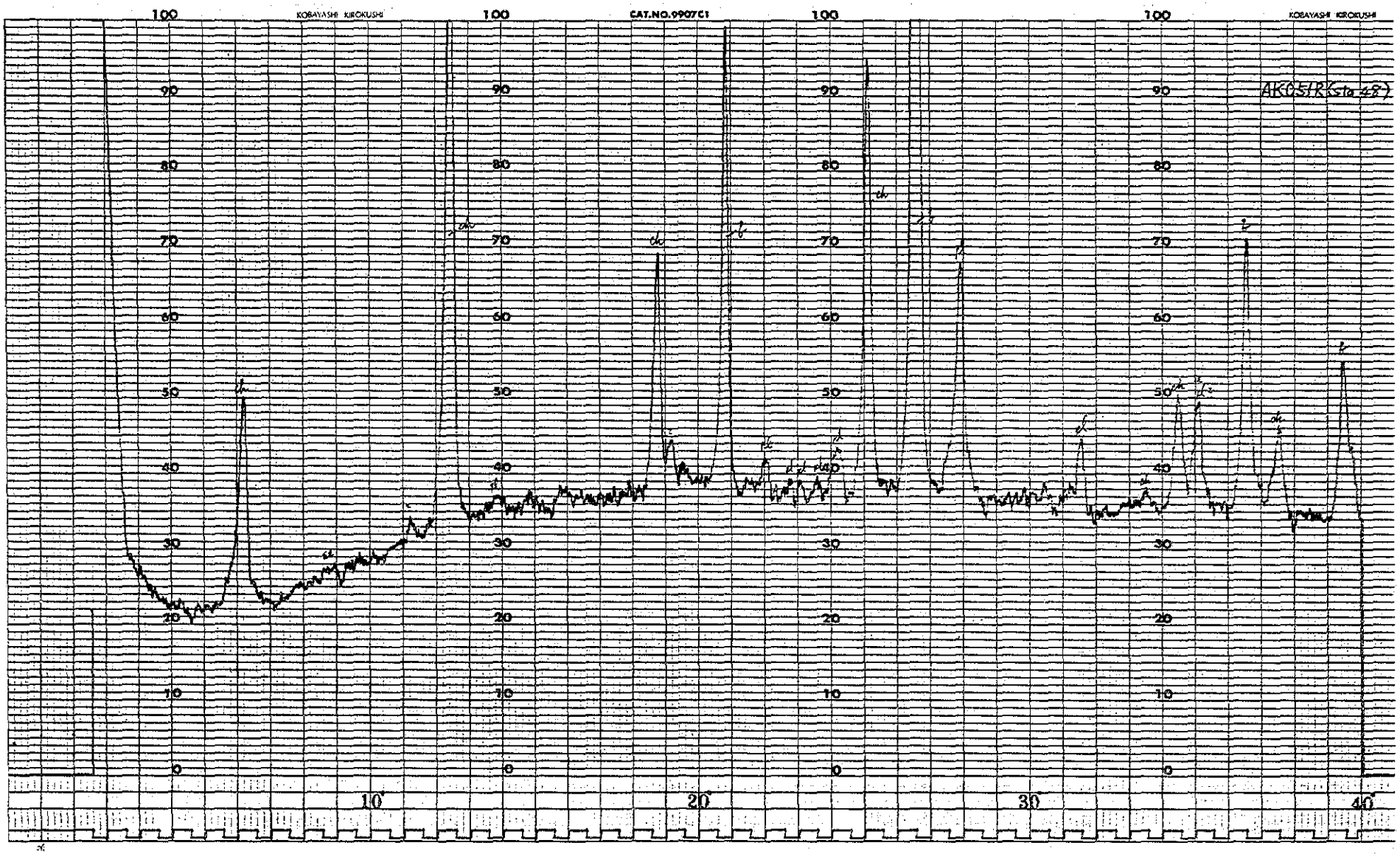
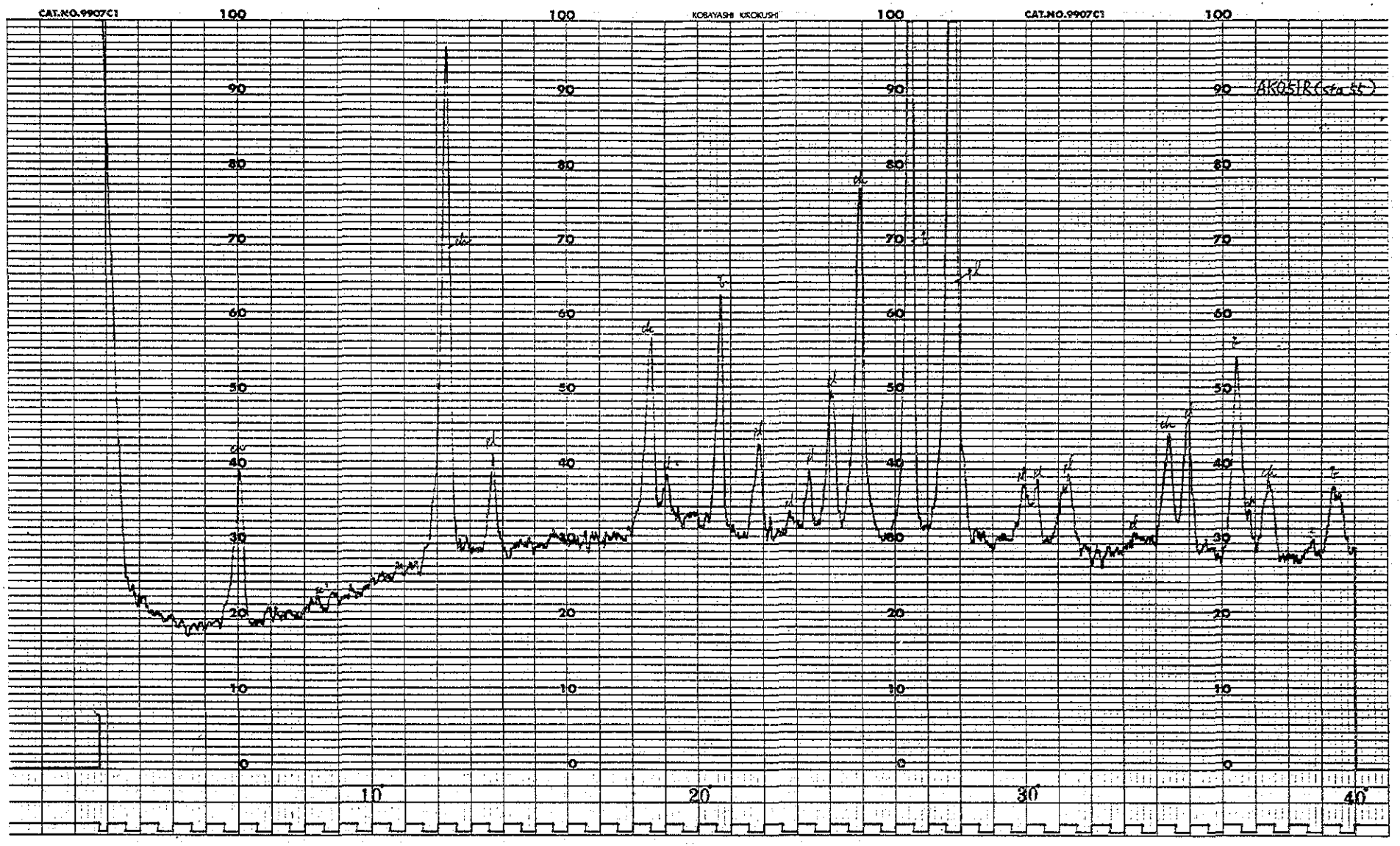
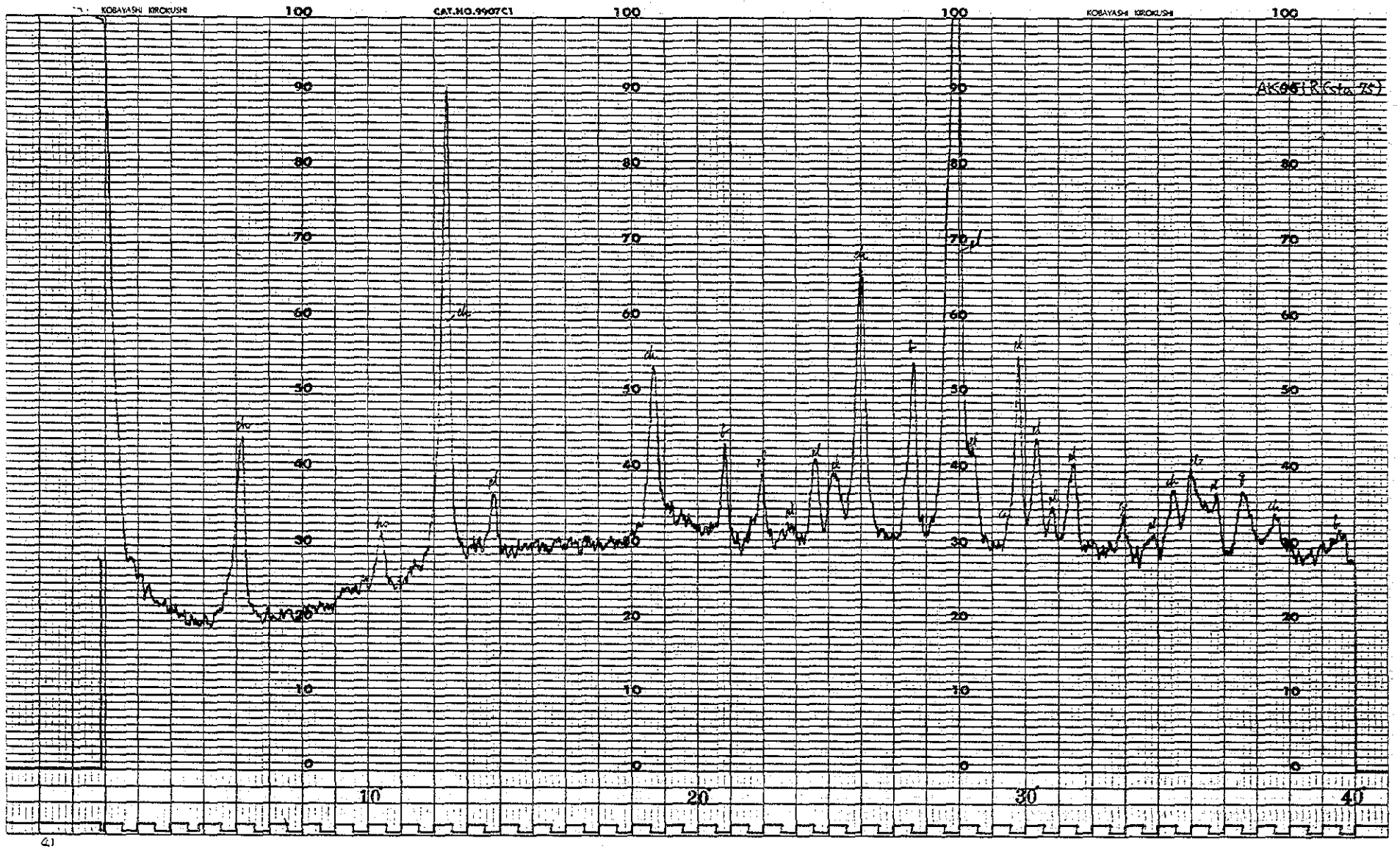
10
0
10
20
30
40


KOBAYASHI KIROKUSHI
CAT.NO.9907C1
KOBAYASHI KIROKUSHI
AKOSIRK(sta 48)
100
90
80
70
60
50
40
30
20
10
0
10'
20'
30'
40'


CAT.NO.9907C1
KOBAYASHI KIKOKUSHI
CAT.NO.9907C1
AKOSIR(sta 55)
100
90
80
70
60
50
40
30
20
10
0
10'
20'
30'
40'


KOBAYASHI KIROKUSHI
CAT.NO.9907C1
KOBAYASHI KIROKUSHI
100
90
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70
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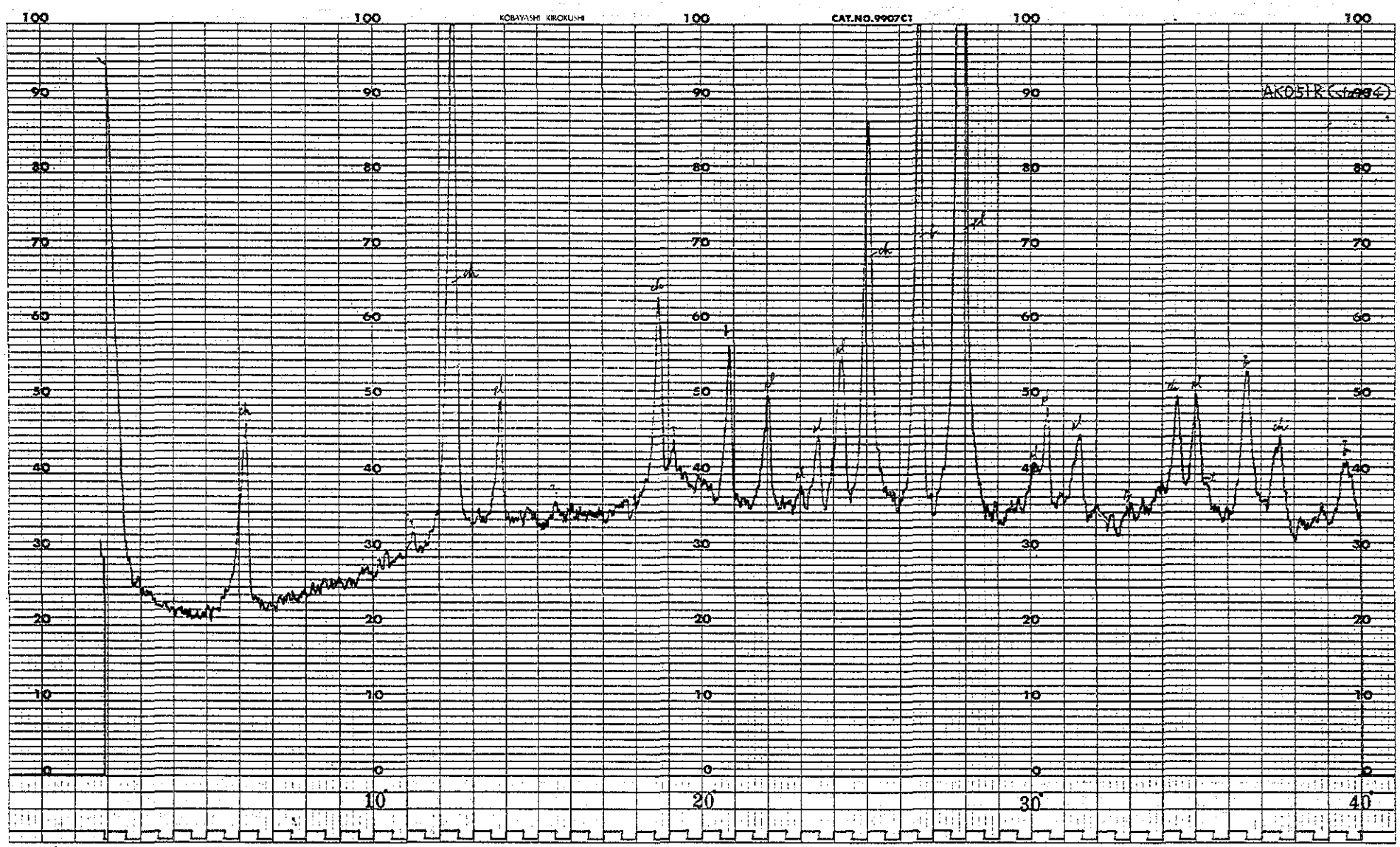
30
20
10
0
10
20
30
40


KOBAYASHI KIROKUKI
CAT.NO.9907C1
AKOSIRI(station)
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40