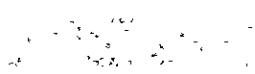
第5章　調査井の総括



第5章　調査井の総括

調査井No.6孔の調査結果は以下のように集約出来る。

(1) 調査井とその周辺において，地熱貯留層となっている地層は第三紀および白亜紀の溶岩，溶結凝灰岩および火山砕屑岩である。

(2) 調査井は深度1,157 mまで掘削された。孔底温度は200℃であり，より深部に向って温度が高くなる傾向を依然示している。

(3) 調査井周辺の地熱貯留層の水位は孔口より約100 m高い。

(4) プロダクションケーシングパイプは深度650 mまで設置された。深度650 mにおける地熱貯留層温度は約130℃であり，ケーシングパイプ設置温度としては十分なものではない。

(5) 調査井掘削中に逸泥現象は認められなかった。しかし，圧入試験の結果，深度825 mほかに割れ目の存在することが明らかになった。

(6) ポンプを使った圧入試験によって求められた圧入指数は4 m^3/h /kg/cm^2であった。

(7) 主井を開放しただけで，地熱流体の流出がみられた。その流出量は目測で蒸気量約5 t/h，熱水量約40 t/hであり，熱水のpHはおゝむね中性であった。

(8) しかしながら，地熱流体の噴出は1時間続いたが間けつ的であって連続的なものではなく，冷却された地熱流体の温度の回復を待つ必要があった。

(9) 約1週間後，地熱流体の噴出を促すためにエアリフトテストを実施したが，地熱流体は流出しなかった。しかも調査井の水位は24時間後でもエアリフト前の水位には回復しなかった。

(10) これは，おそらく，地熱流体の水みちにあたる小さな割れ目が，高温下における掘削泥水の固化あるいは他の何んらかの理由により，閉塞されたことによると推定される。

(11) 調査井No.6孔の孔底温度は調査井No.1～No.5孔よりは高いもので，しかも，No.1～No.5孔の温度が深部に向って降下するのに反し，No.6孔は引きつゞき上昇傾向にある。それ故に，出来得るなら，調査井No.6孔はより深く掘削されることがのぞまれる。

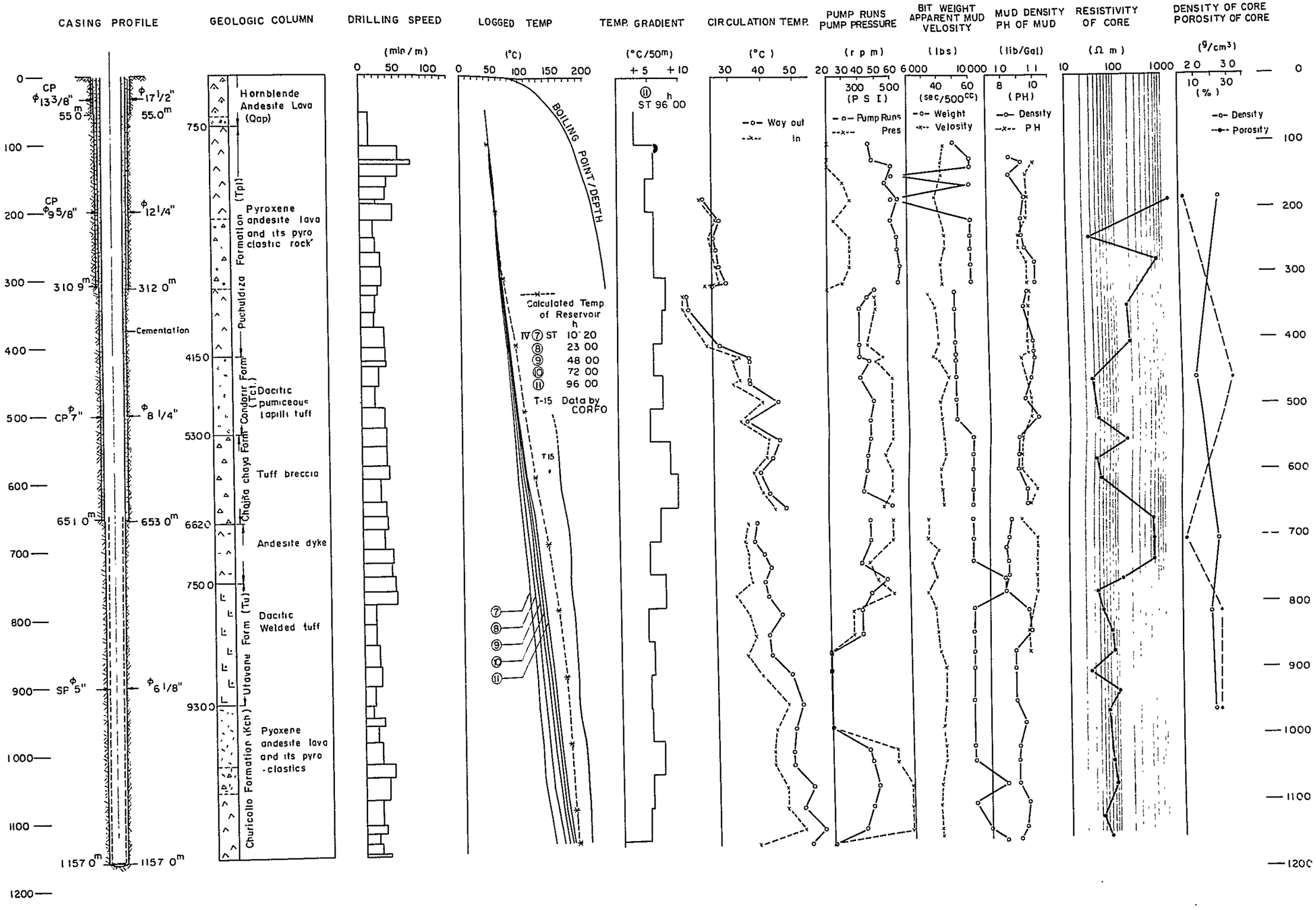
(12) 調査団の帰国後，CORFOからの報告によると，温度検層と圧入試験が実施された。その結果，温度は，200℃を越えている事が測定され，又温度も深部に向って上昇傾向を示している。しかし圧入試験の結果，地層は，不透水性であることが確認された。

以上のことから，この地区には高温の地熱貯留層が1,000 m以深に存在していると考えられる。調査井No.6孔の蒸気生産位置は深度約800 mにあり，その温度は約160℃であり，従

って期待される蒸気と熱水の比率は１：５～６であると計算される。温度検層によって得られた地下増温率から，２００℃以上の高温の地熱流体は深度1,５００mあるいはそれ以上の深度に存在するものと推定される。そして，浅層の冷い地下水による悪影響をふせぐため，より深くまでプロダクションケーシングが設置されなければならない。

地表調査の結果のみから，ある特定の深度に透水性のよい地熱貯留層を当初から予測して，調査井の位置を選定することは，おそらく，地熱技術者にとって最も困難な問題である。そして，数ミリメートル以下の小さな割れ目からでも，充分な量の地熱流体は産出するのであり，充分な注意をもってその透水性をそこなうことのないよう掘削しなければならない。

Fig. II-5-1 GENERALIZED COLUMNAR SECTION, WELL NO.6



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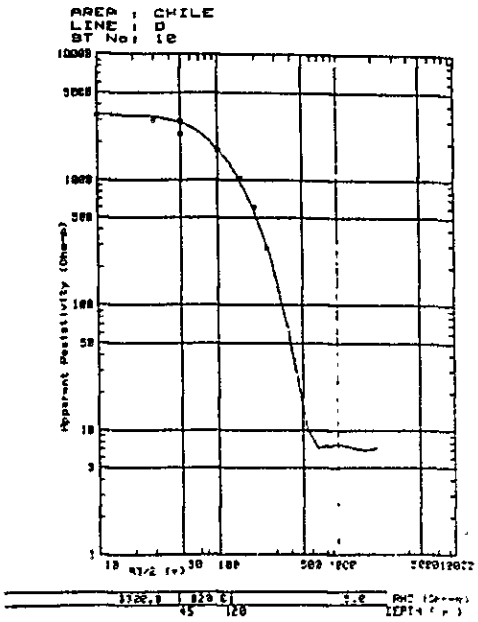
VES CURVES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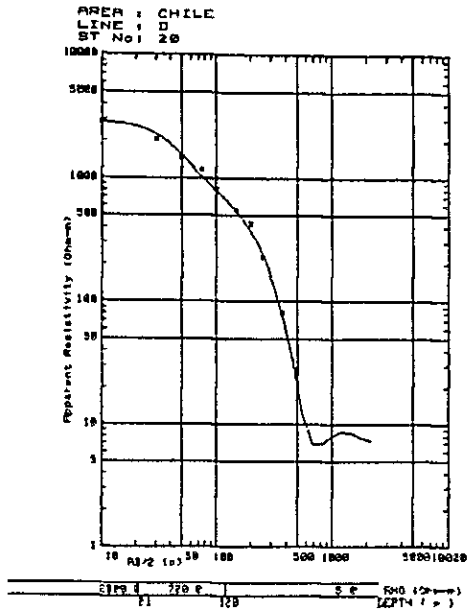
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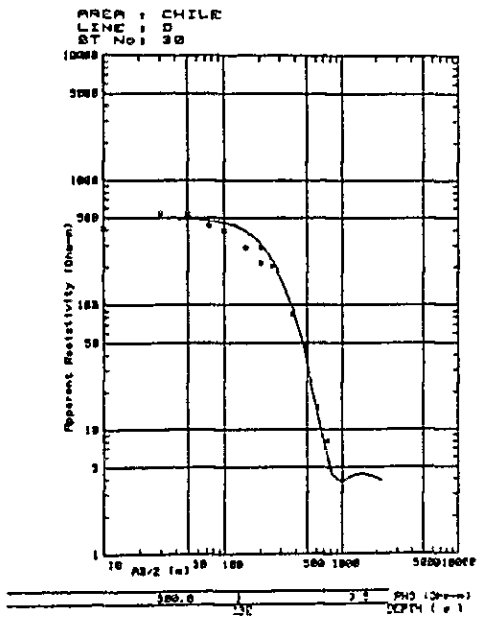
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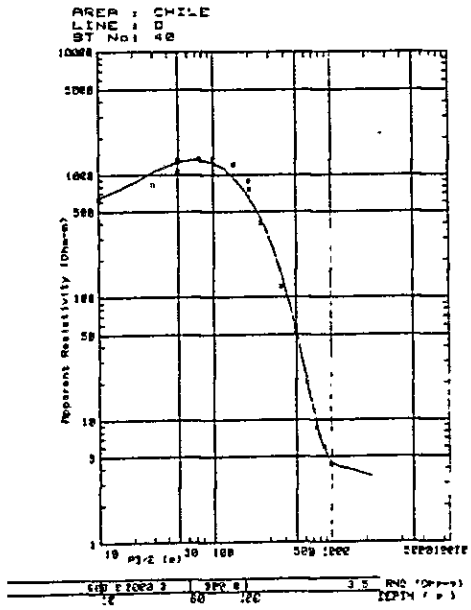
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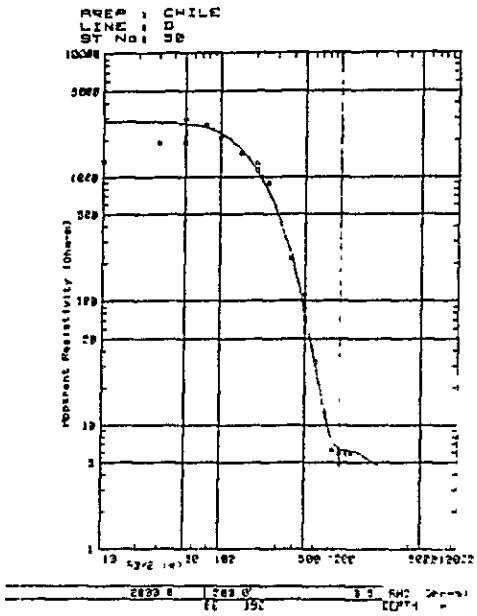
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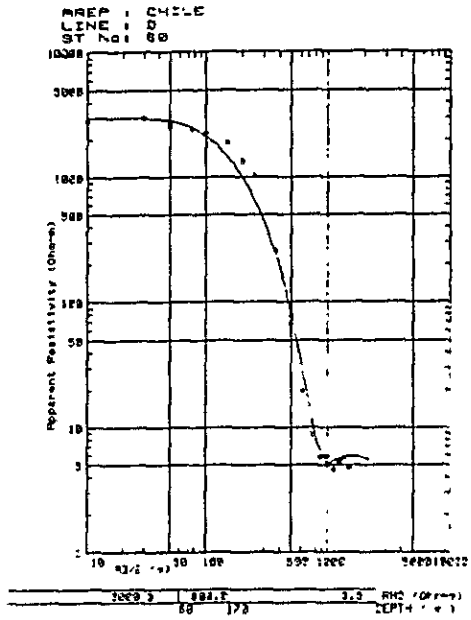
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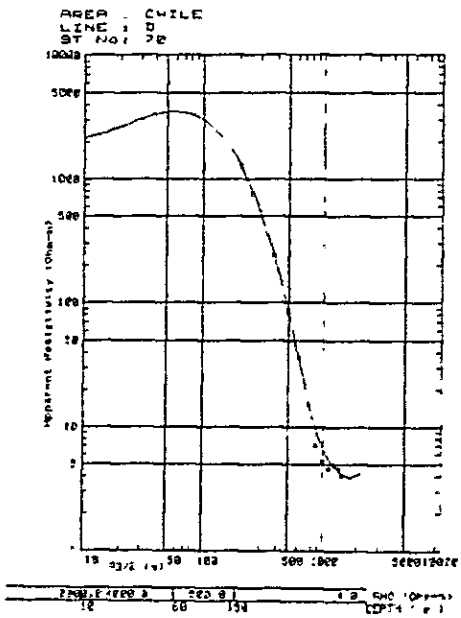
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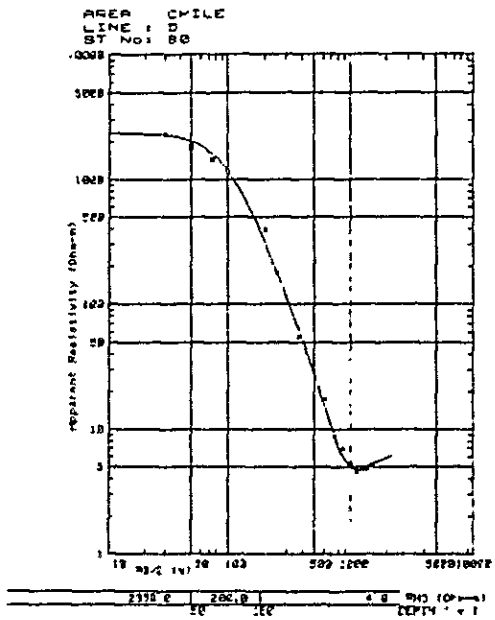
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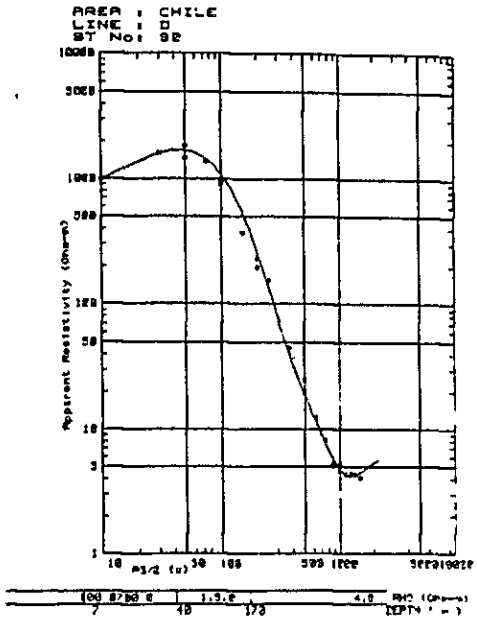
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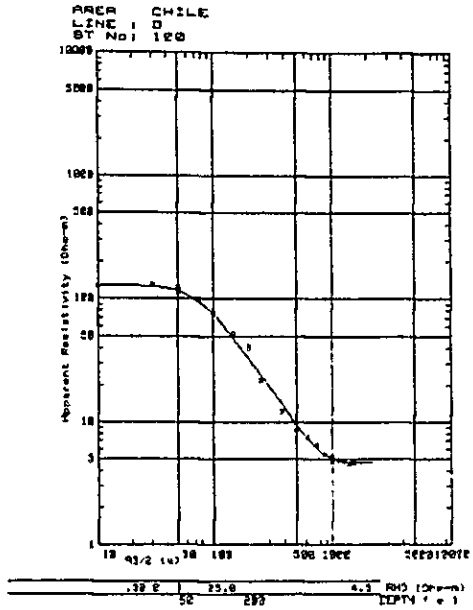
DEPTH (m)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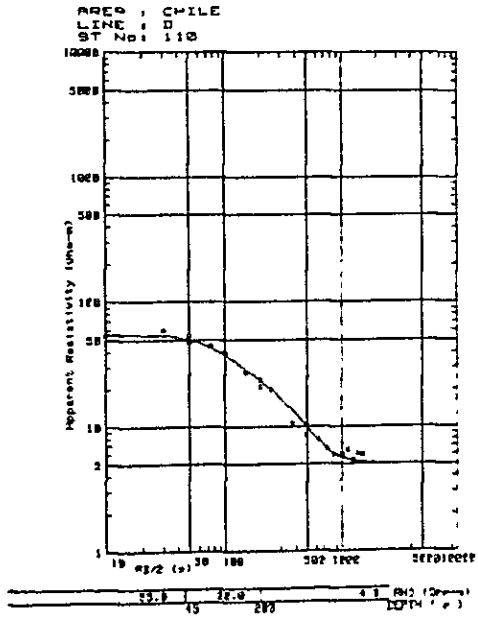
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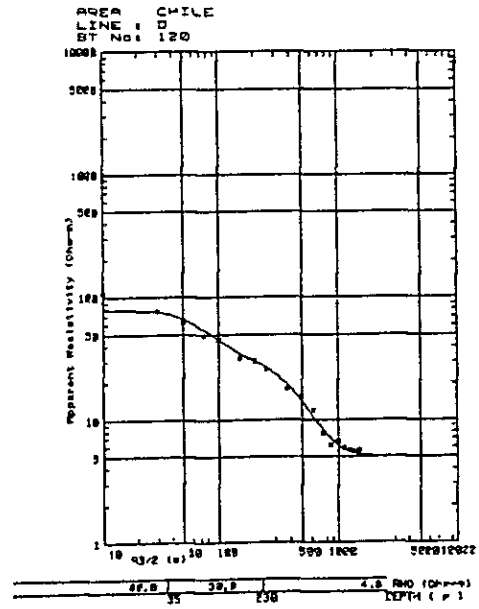
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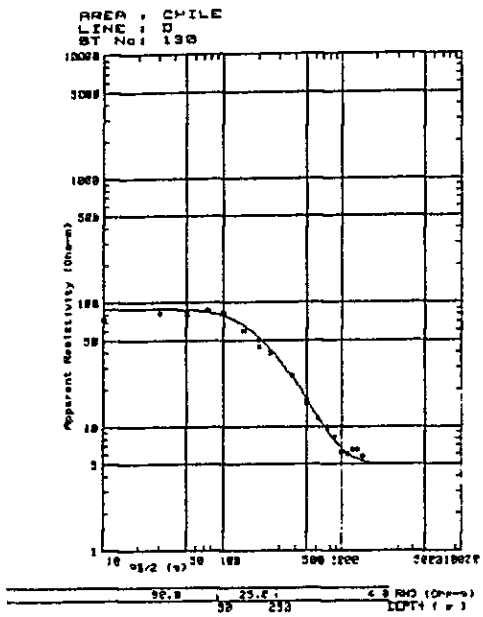
DEPTH (m)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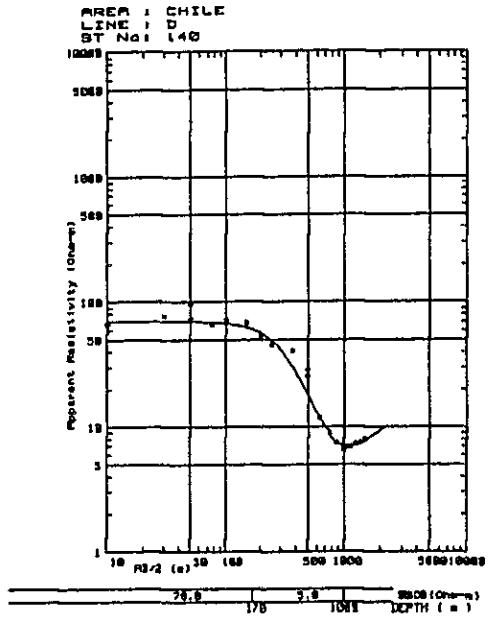
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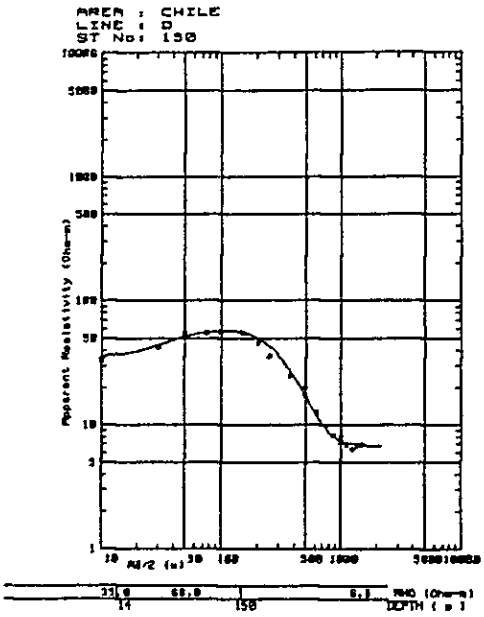
DEPTH (m)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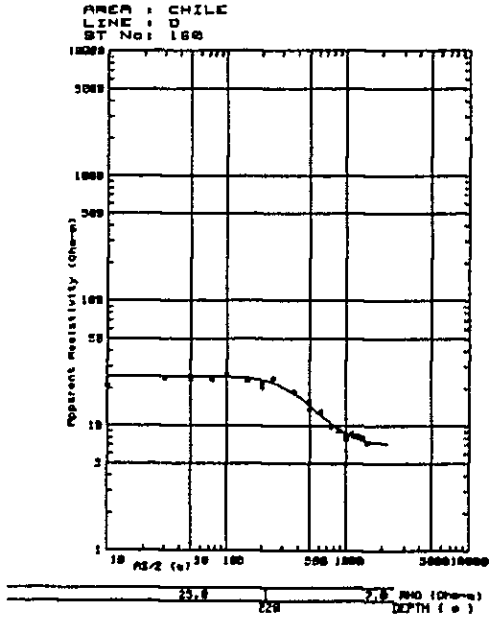
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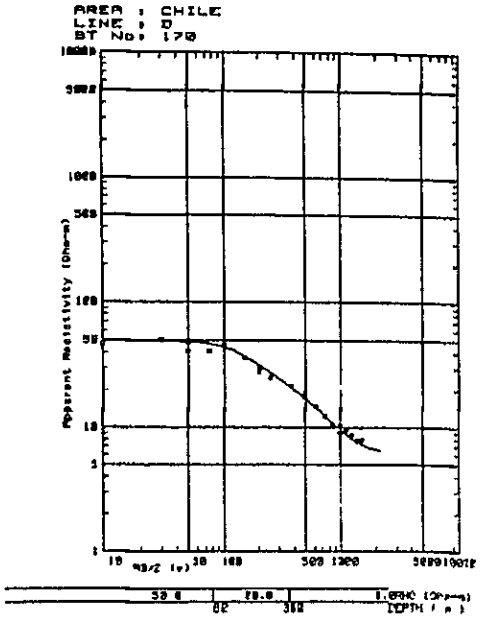
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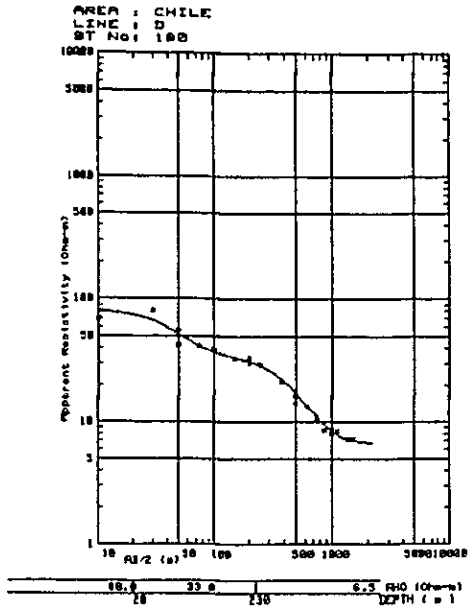
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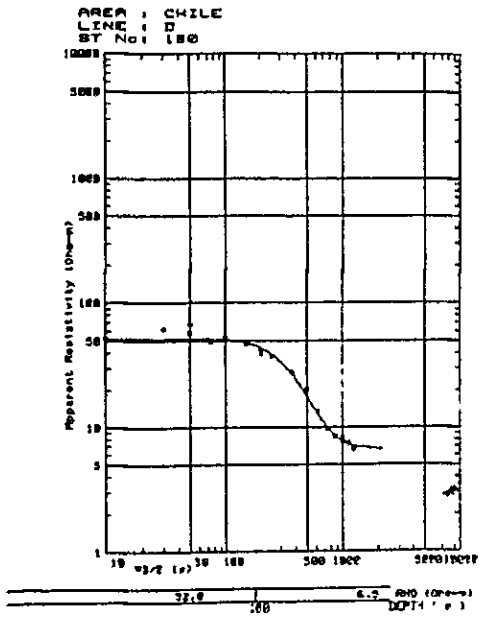
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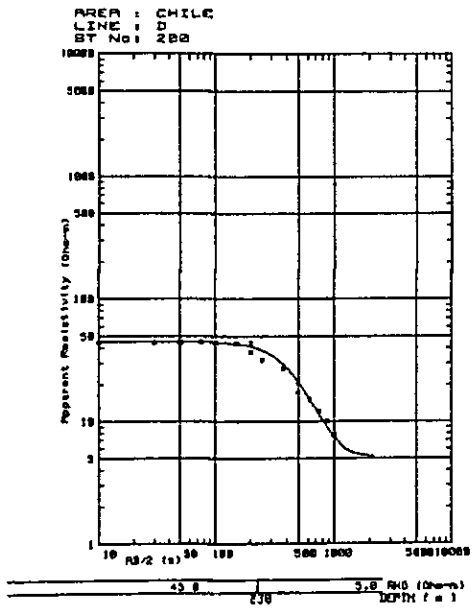
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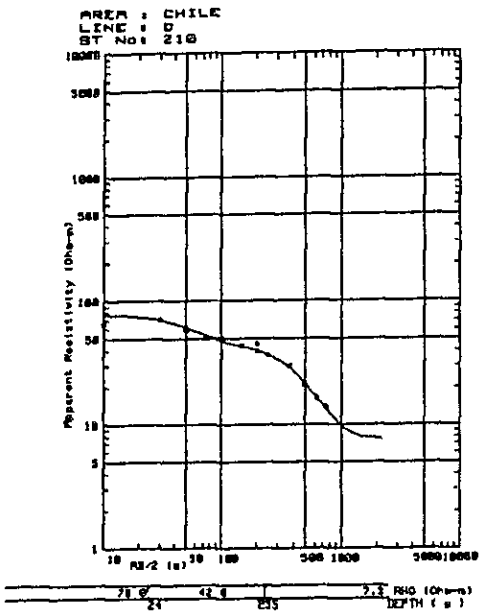
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RHO (Ohm-m)
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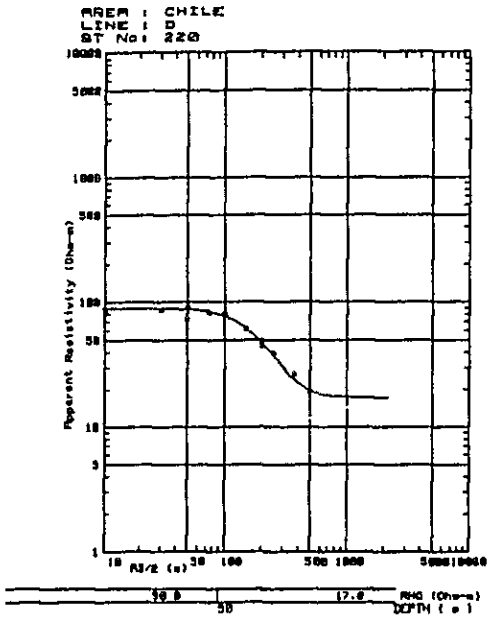
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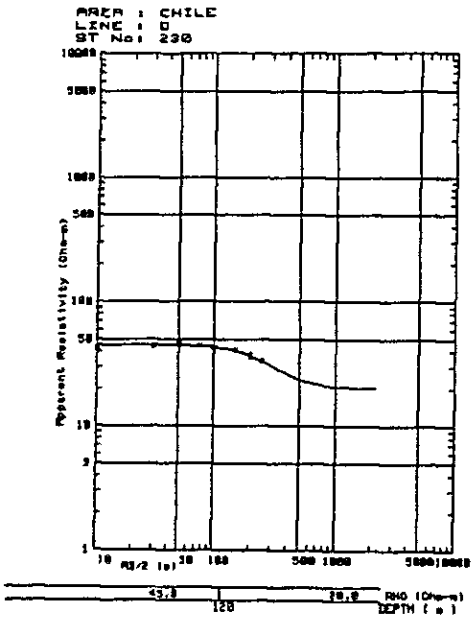
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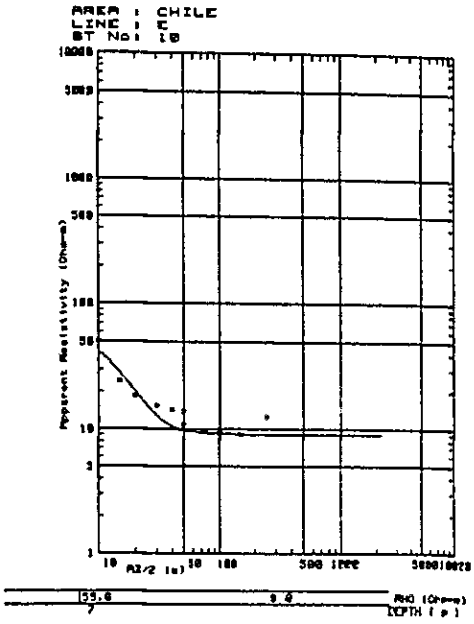
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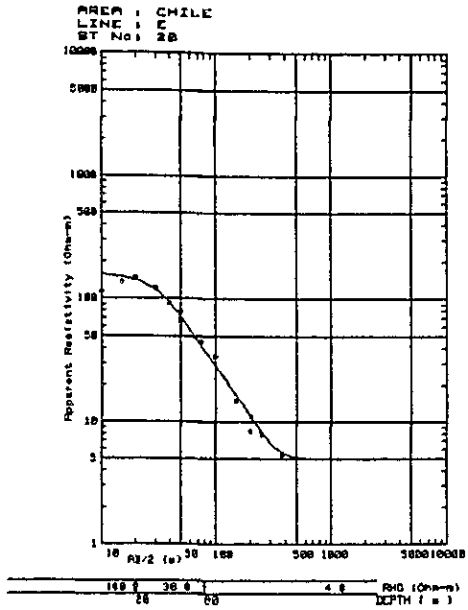
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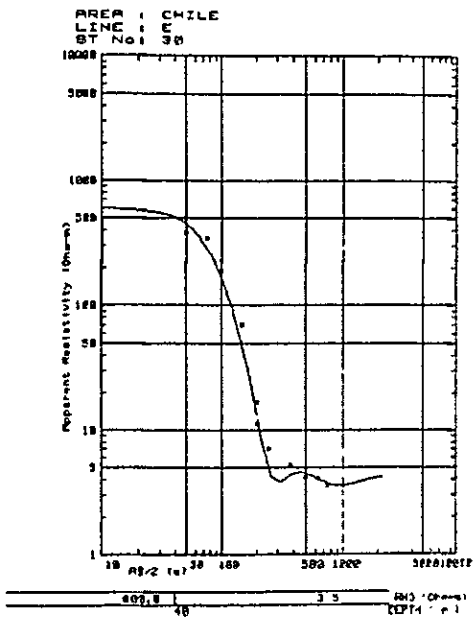
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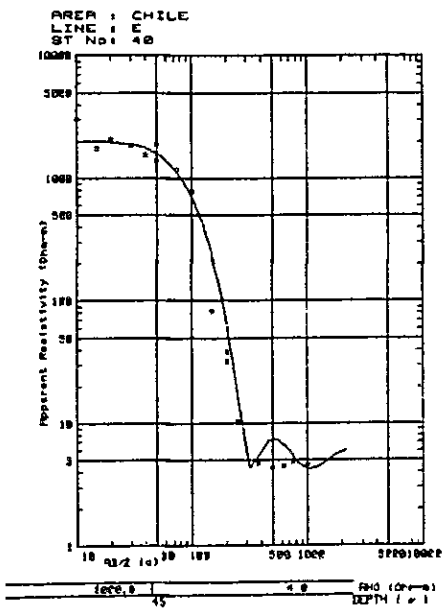
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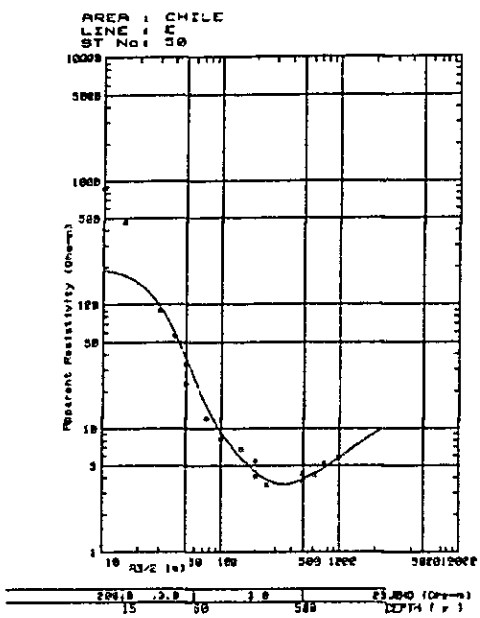
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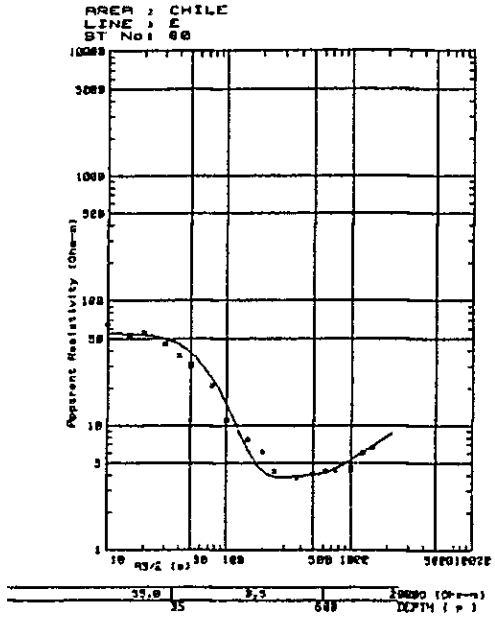
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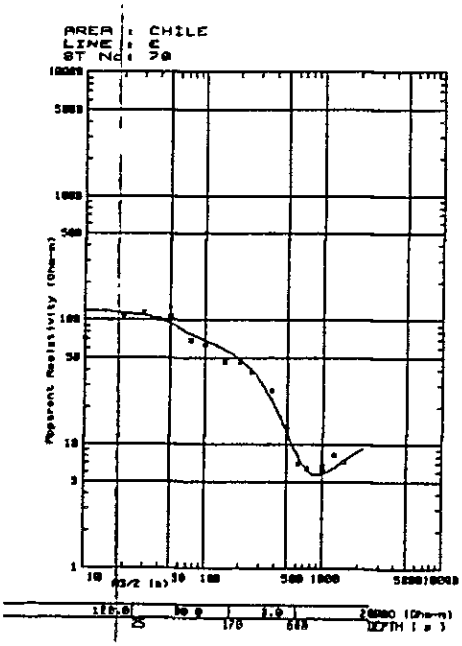
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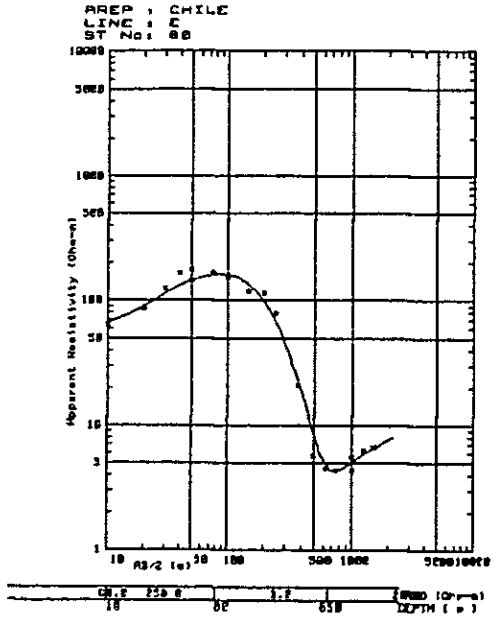
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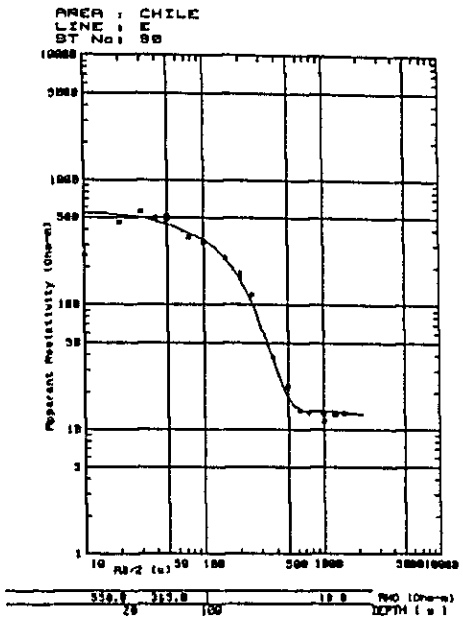
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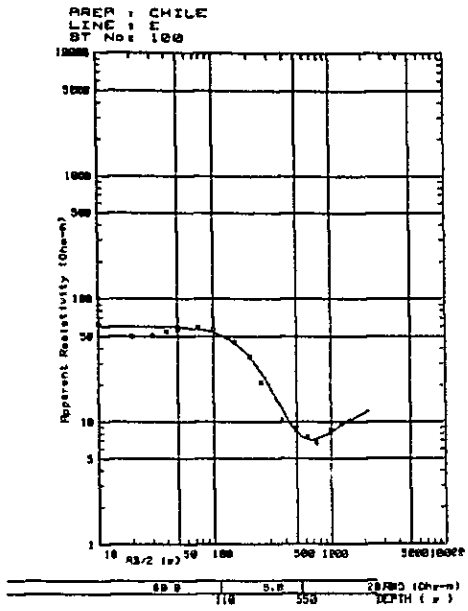
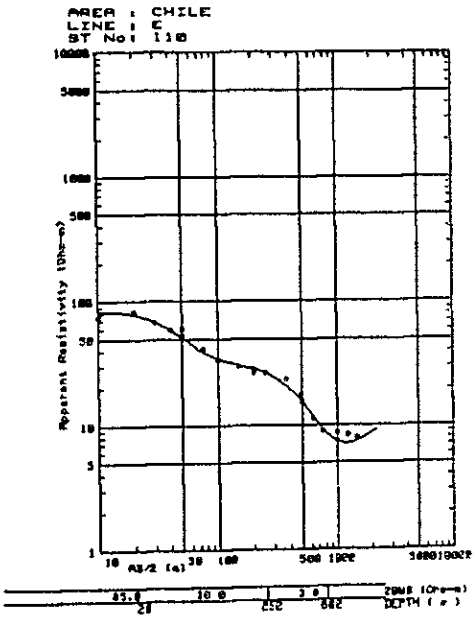
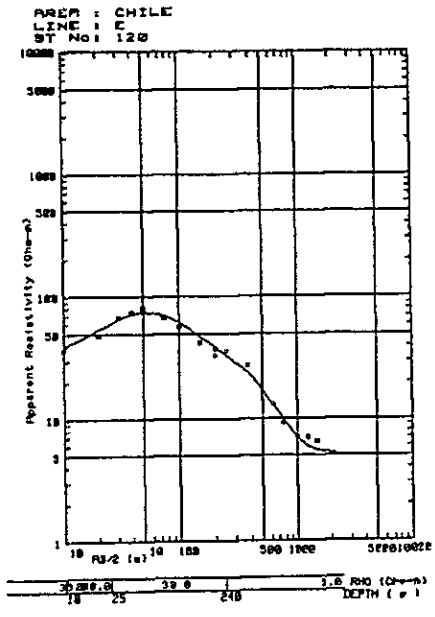
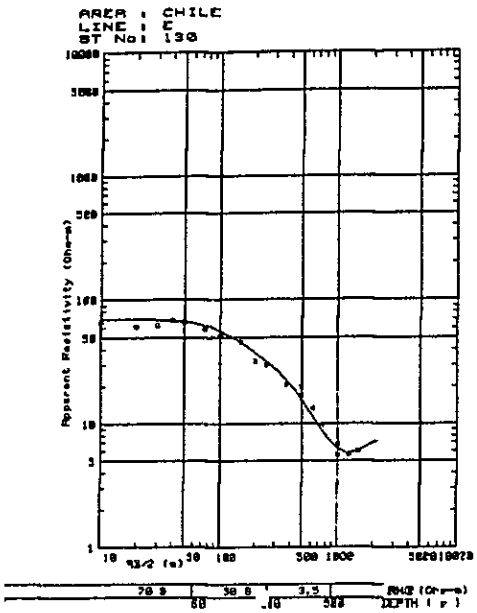
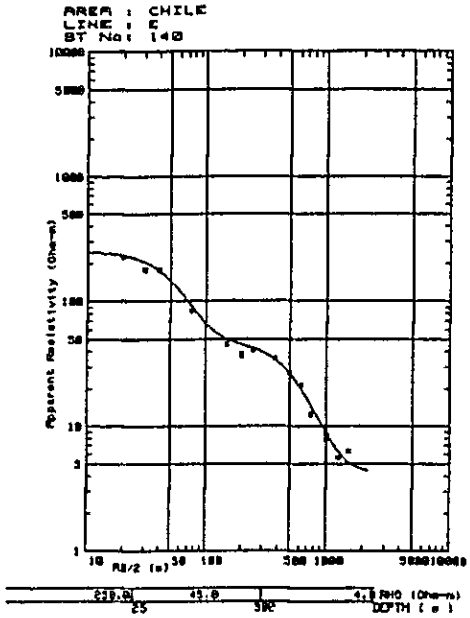
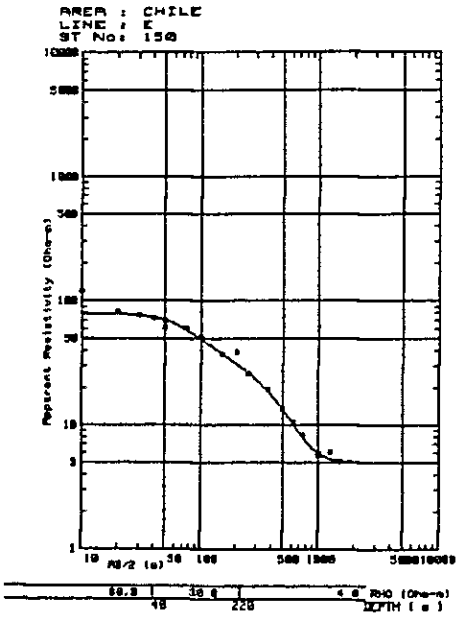

AREA : CHILE
LINE : E
ST No: 100

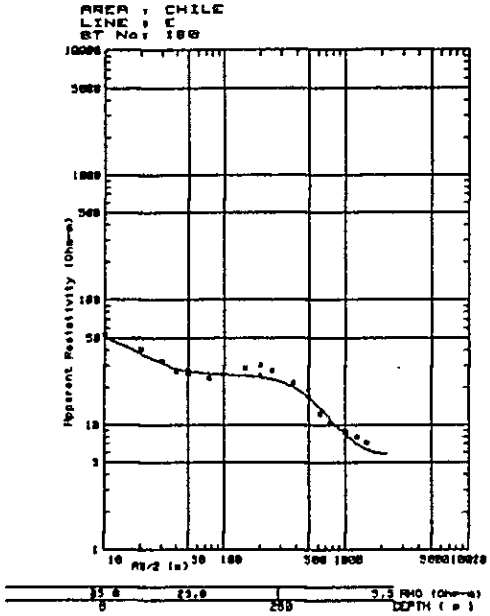

AREA : CHILE
LINE : E
ST No: 110

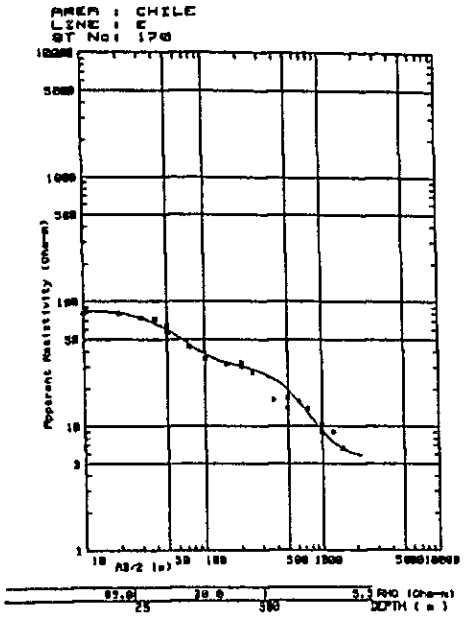

AREA : CHILE
LINE : E
ST No: 120

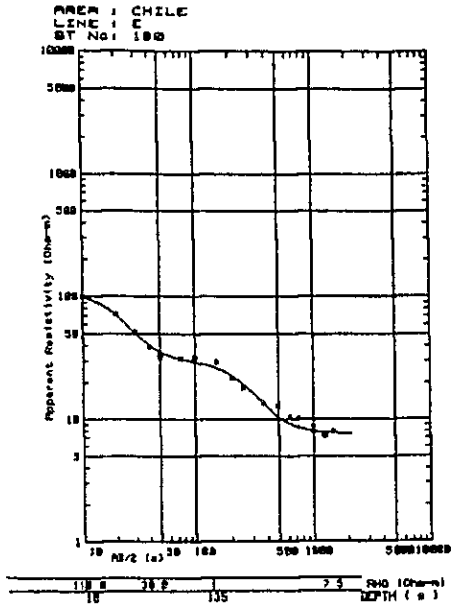

AREA : CHILE
LINE : E
ST No: 130
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

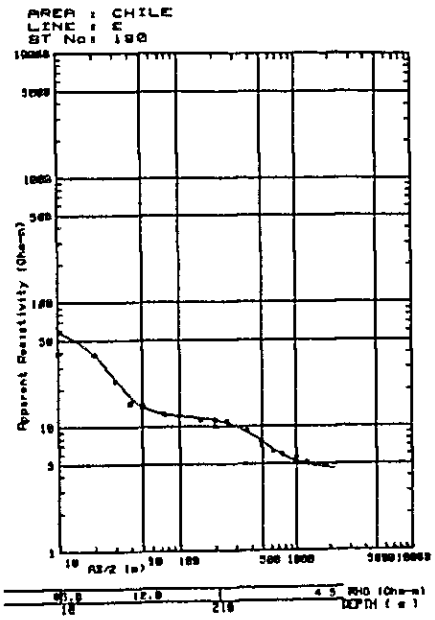

AREA : CHILE
LINE : E
ST No: 140
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

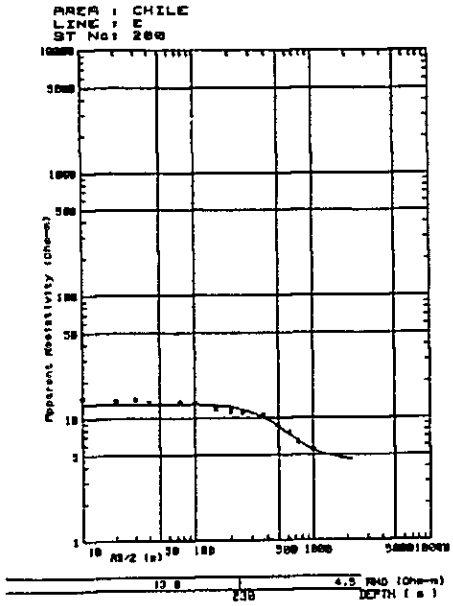

AREA : CHILE
LINE : E
ST No: 150
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

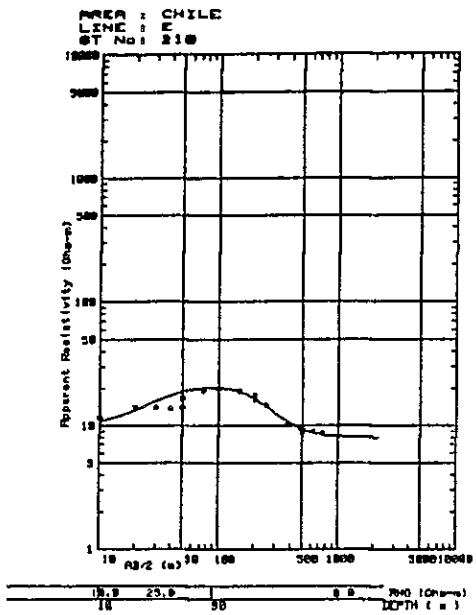

AREA : CHILE
LINE : E
ST No: 160
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

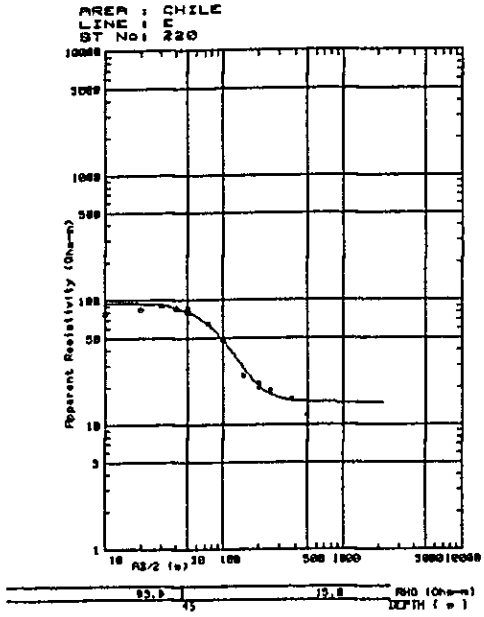

AREA : CHILE
LINE : E
ST No: 170
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

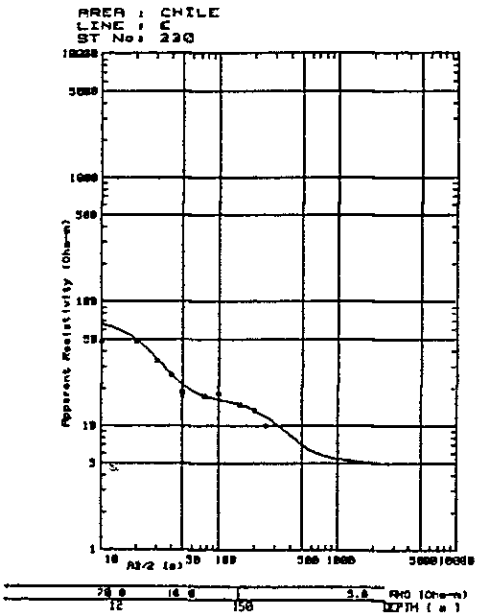

AREA : CHILE
LINE : E
ST No: 180
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

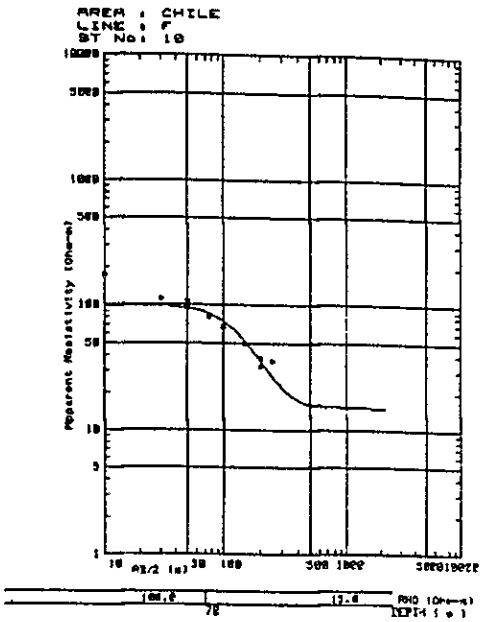

AREA : CHILE
LINE : E
ST No: 190
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

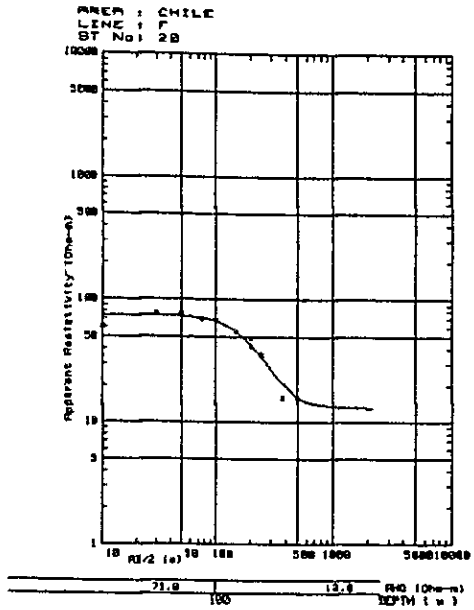

AREA : CHILE
LINE : E
ST No: 200
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

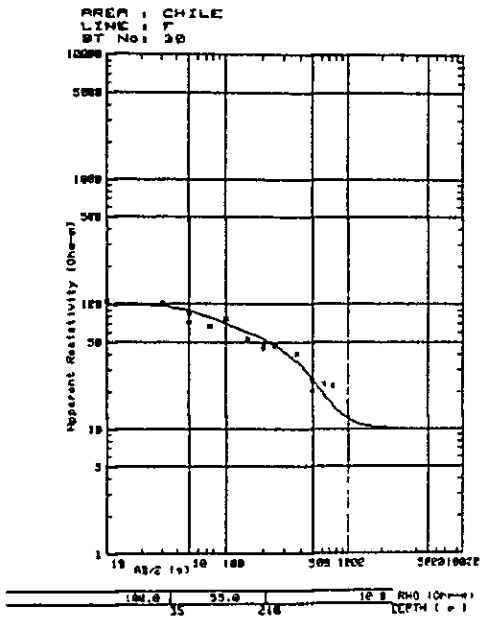

AREA : CHILE
LINE : E
ST No: 210
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

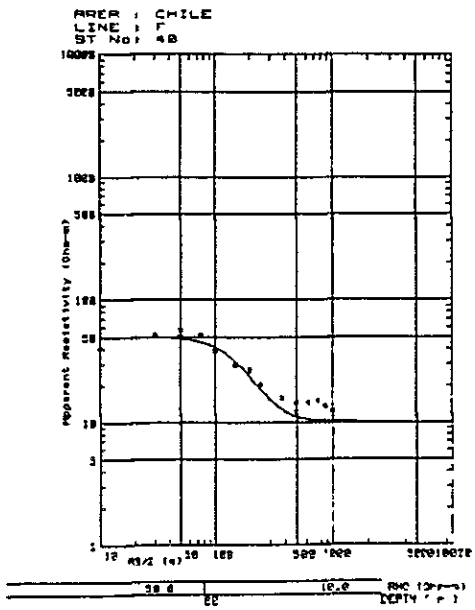

AREA : CHILE
LINE : E
ST No: 220
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

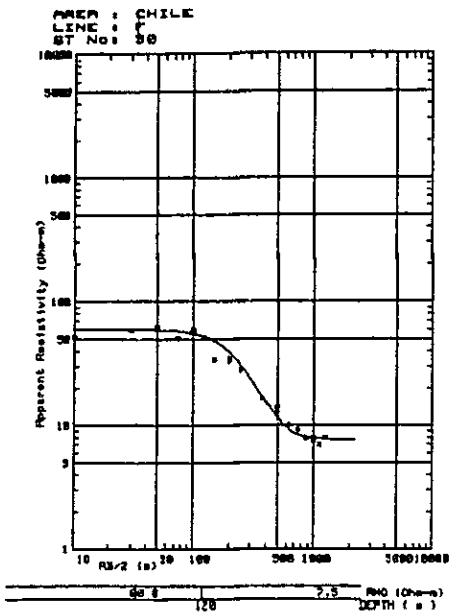

AREA : CHILE
LINE : E
ST No: 230
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

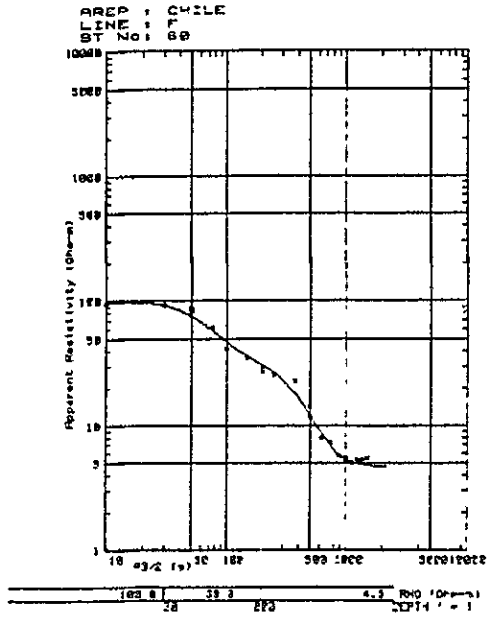

AREA : CHILE
LINE : F
ST No: 18

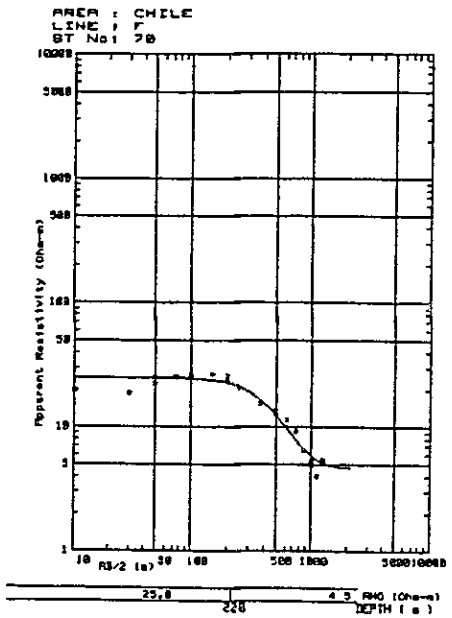

AREA : CHILE
LINE : F
ST No: 28

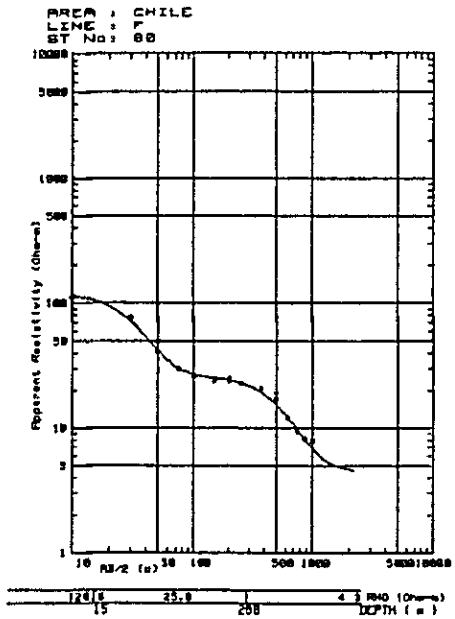

AREA : CHILE
LINE : F
ST No: 38

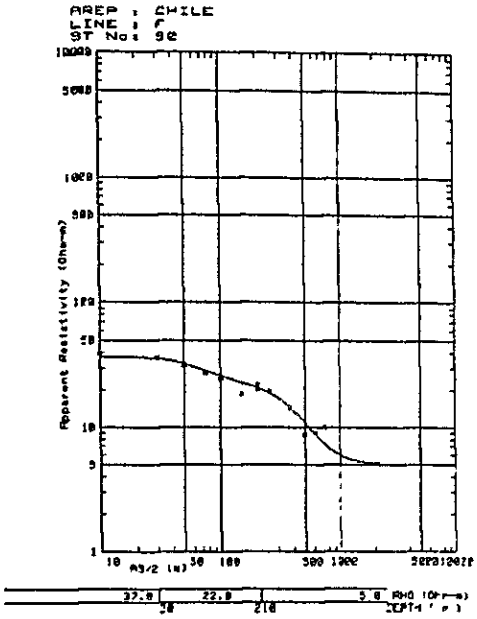

AREA : CHILE
LINE : F
ST No: 48

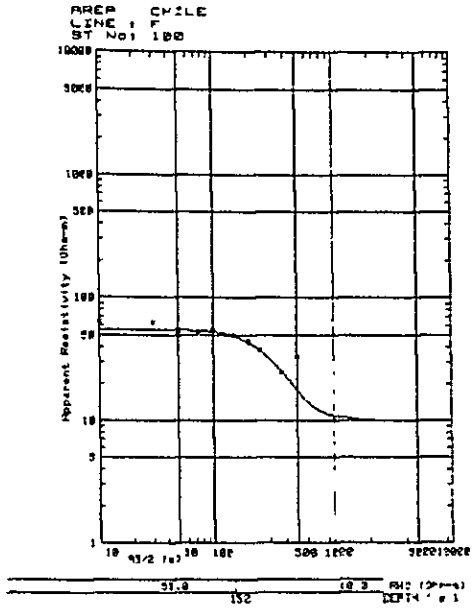

AREA : CHILE
LINE : F
ST No: 80
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

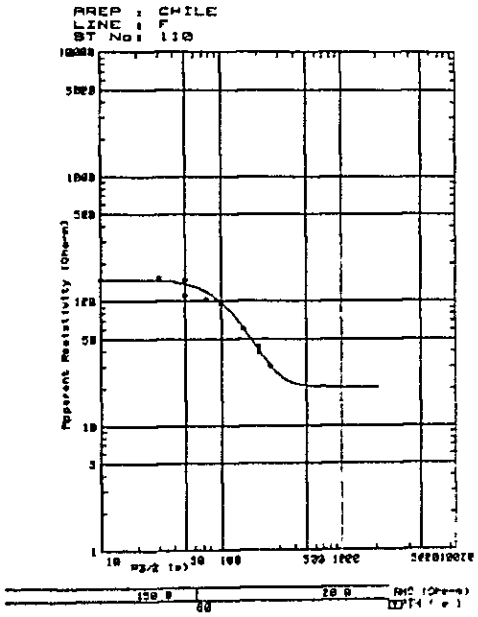

AREA : CHILE
LINE : F
ST No: 60
Apparent Resistivity (Ohm-m)
RHO (Ohm-m)


AREA : CHILE
LINE : F
ST No: 70
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)

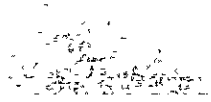

AREA : CHILE
LINE : F
ST No: 60
Apparent Resistivity (Ohm-m)
AB/2 (m)
RHO (Ohm-m)
DEPTH (m)


AREA : CHILE
LINE : F
ST No: 90


AREA : CHILE
LINE : F
ST No: 100


AREA : CHILE
LINE : F
ST No: 110

X-RAY DIFFRACTION



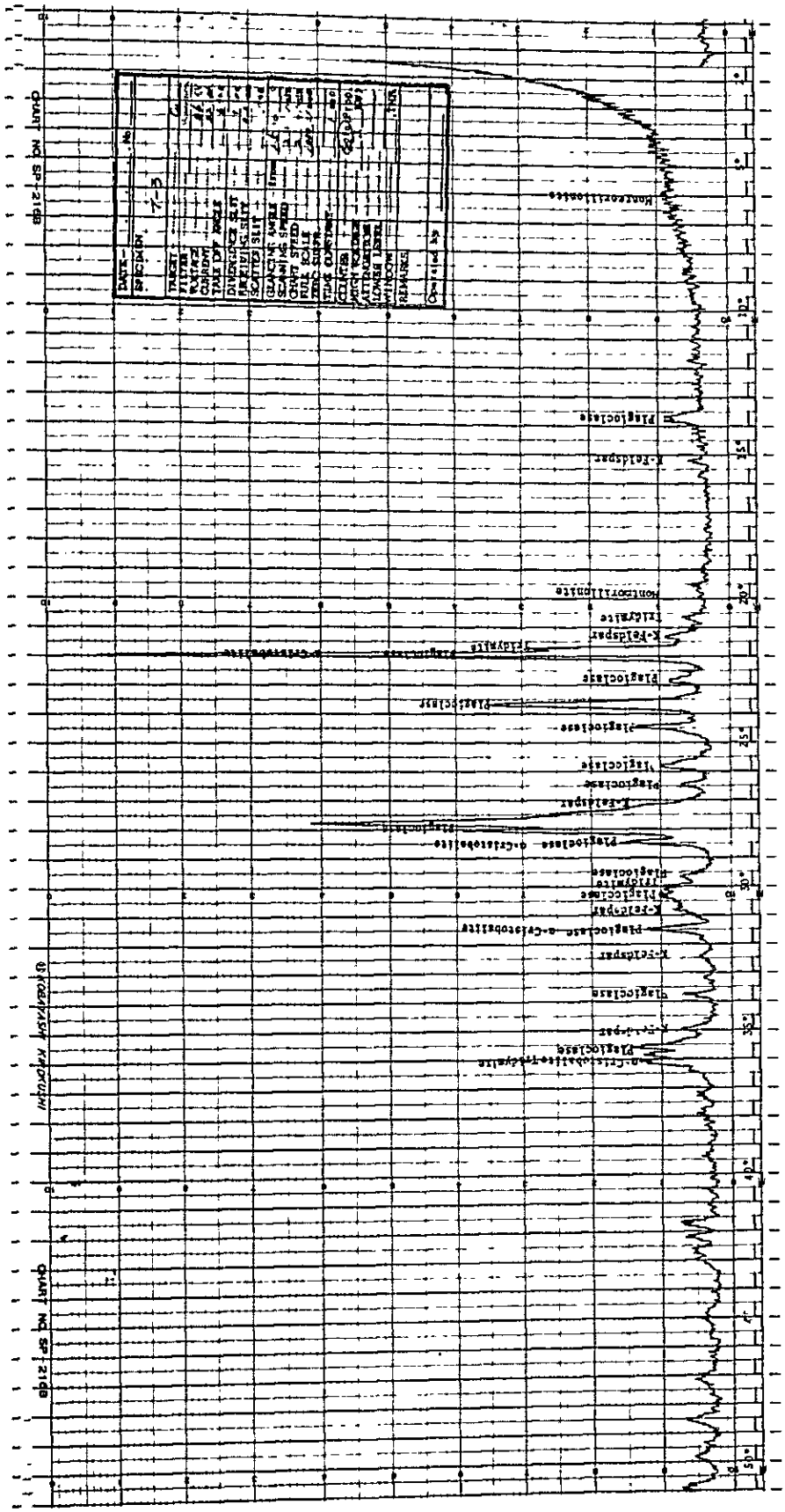
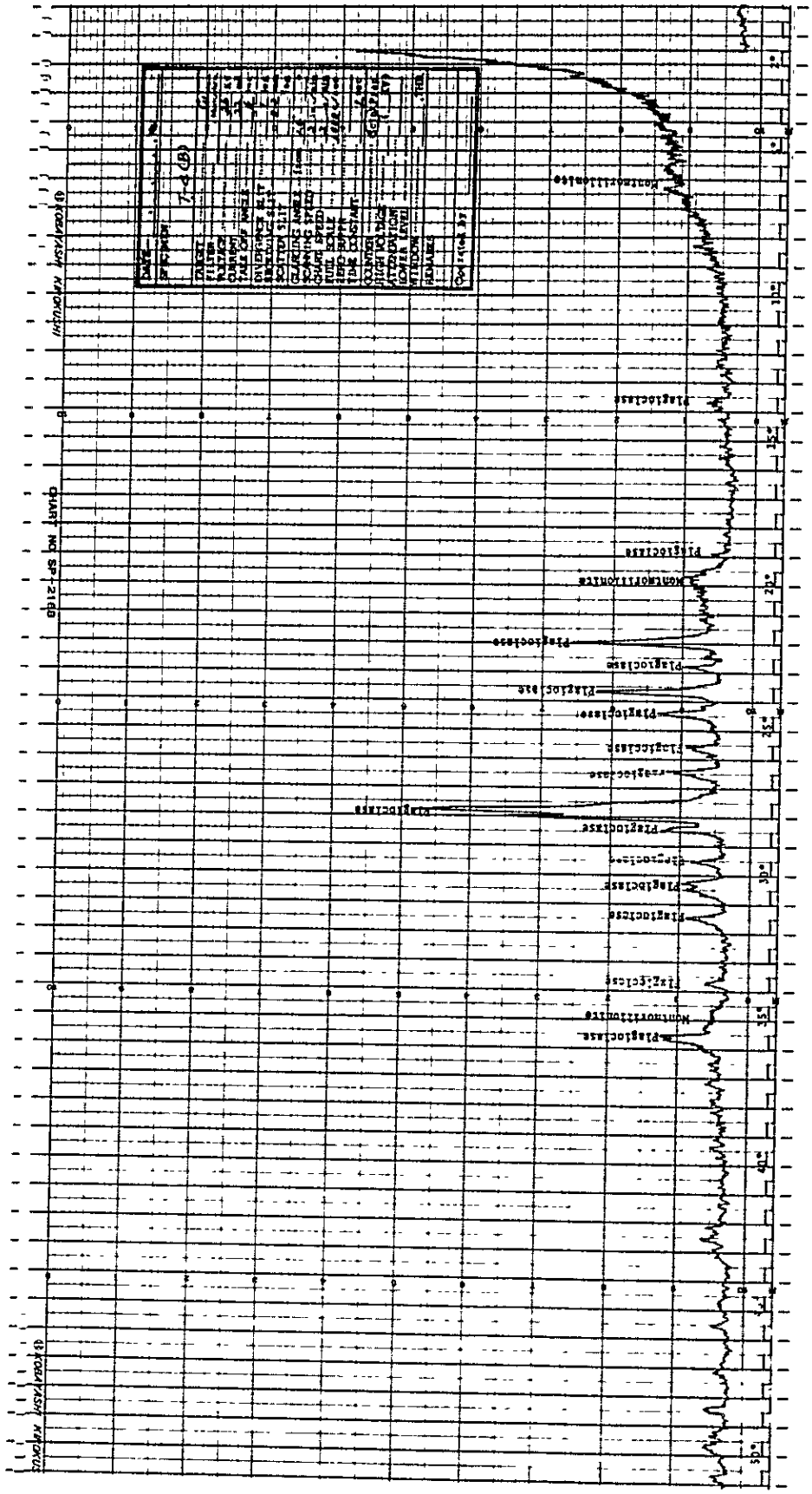
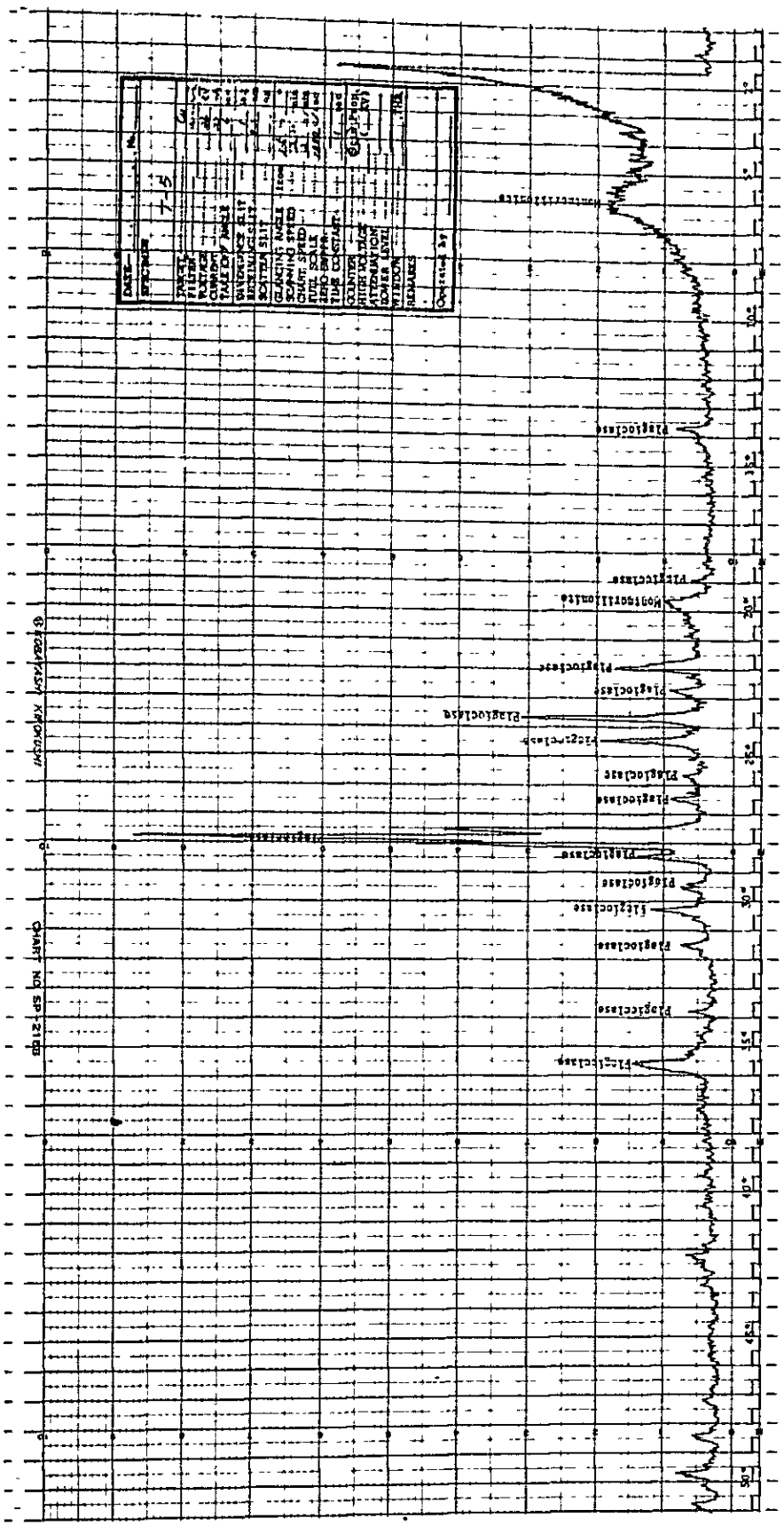
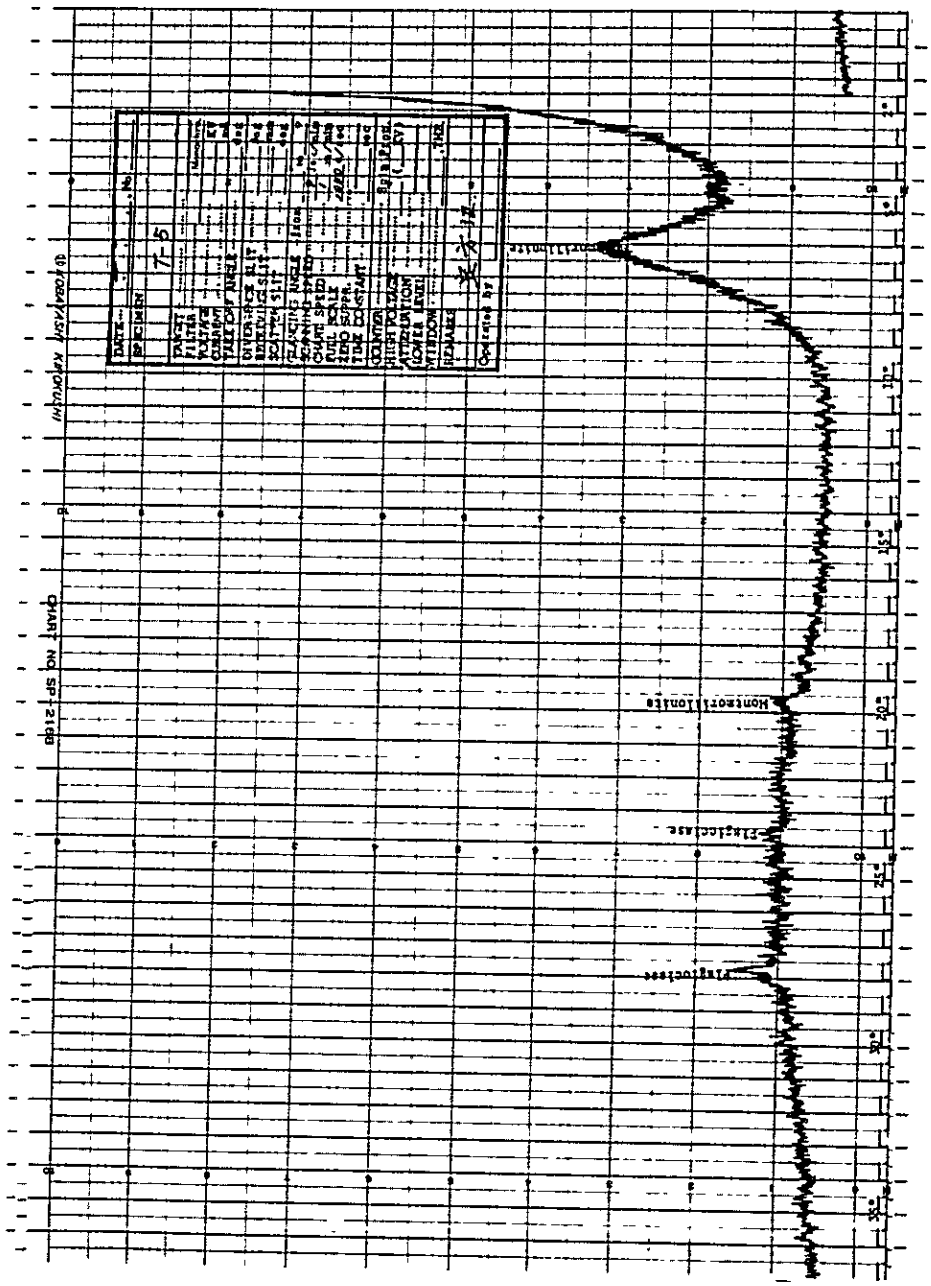


CHART NO SP-2108
Montmorillonite
Plagioclase
K-feldspar
Montmorillonite
Talc/Mica
K-feldspar
Talc/Mica
Plagioclase
Plagioclase
Plagioclase
Talc/Mica
Plagioclase
K-feldspar
Plagioclase
Talc/Mica
Plagioclase
K-feldspar
Plagioclase
Plagioclase
Plagioclase
CHART NO SP-2108


Plagioclase
Montmorillonite
Plagioclase
Montmorillonite
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Montmorillonite
Plagioclase


DATE
SPECIMEN 7-5
TARGET Cu
FILTER
VOLTAGE
CURRENT
TAKE OFF ANGLE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
GLANCING ANGLE
SCANNING SPEED
CHART SPEED
FULL SCALE
ZERO SUPPR.
TIME CONSTANT
COUNTER
HIGH VOLTAGE
ATTENUATION
LOWER LEVEL
WINDOW
REMARKS
Operated by
Montmorillonite
Plagioclase
Montmorillonite
5°
10°
15°
20°
25°
30°
35°
40°
45°
50°
KOBAYASHI KIROKUSHI
CHART NO SP-21BB


Montmorillonite
Kaolinite
Montmorillonite

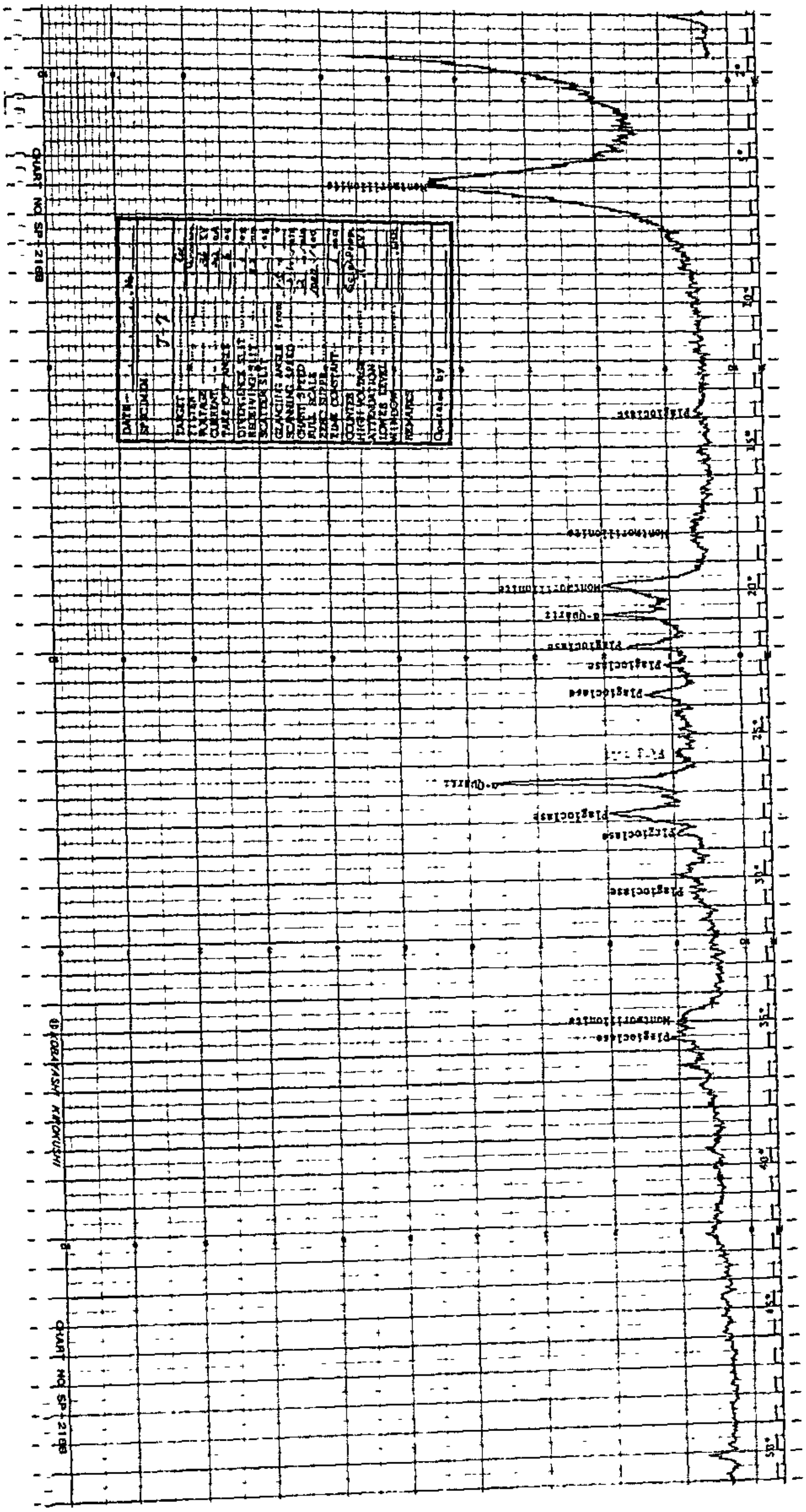
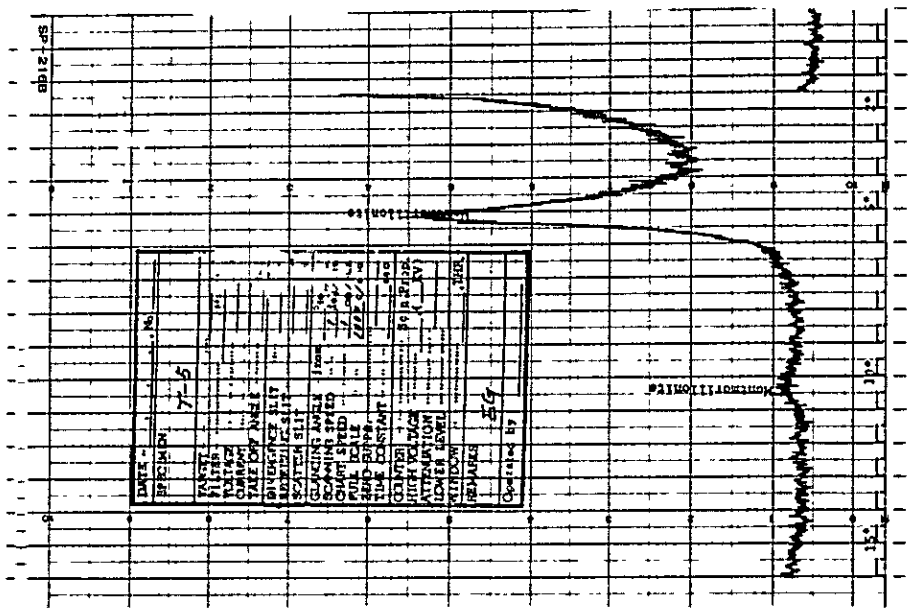
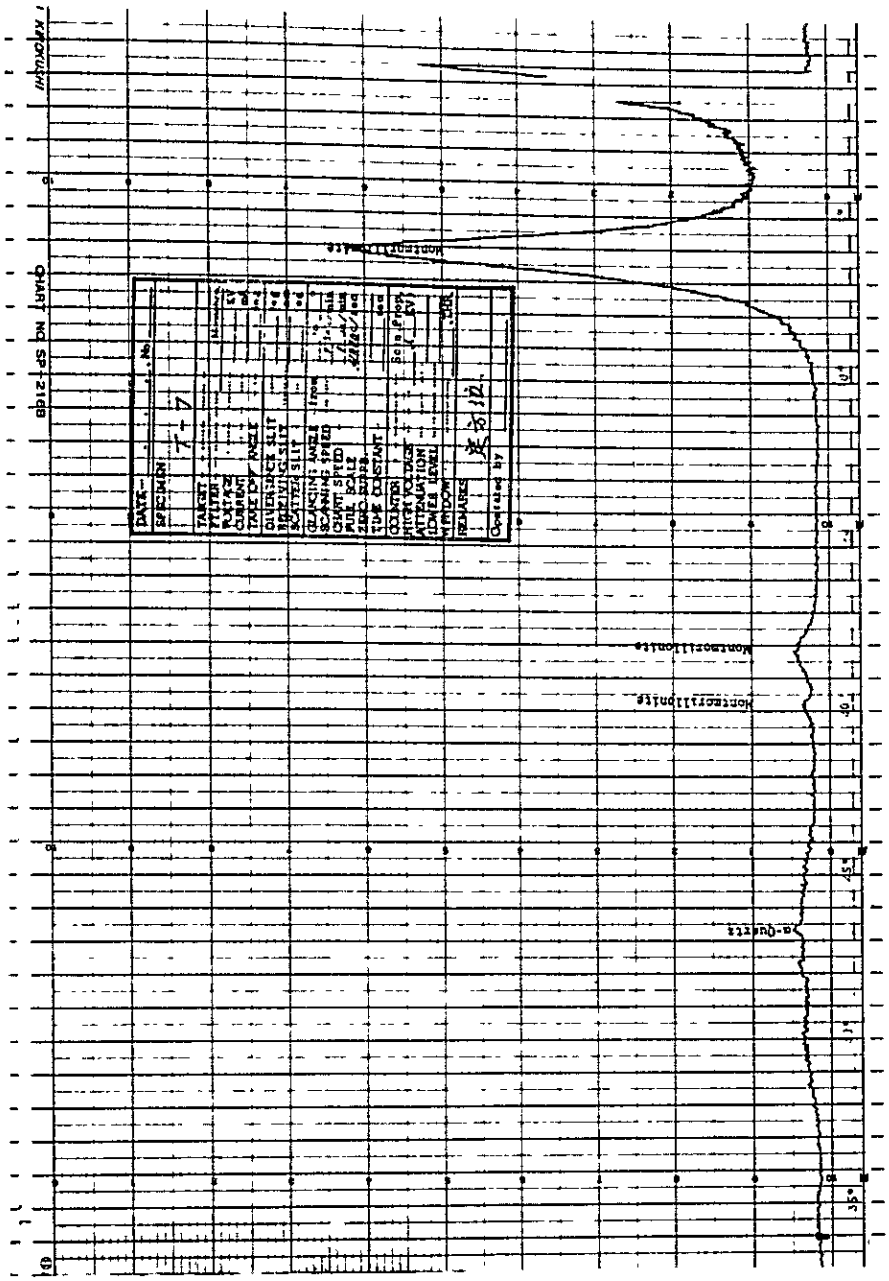


CHART NO. SP-216B
KOBAYASHI KIROKUSHI
DATE
SPECIMEN
TARGET
FILTER
VOLTAGE
CURRENT
TAKE-OFF ANGLE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
SCANNING ANGLE
SCANNING SPEED
CHART SPEED
FULL SCALE
ZERO SUPPR.
TIME CONSTANT
COUNTER
HIGH VOLTAGE
ATTENUATION
LOWER LEVEL
WINDOW
REMARKS
Operated by
Montmorillonite
Plagioclase
Montmorillonite
Montmorillonite
α-Quartz
Plagioclase
Plagioclase
Plagioclase
α-Quartz
Plagioclase
Plagioclase
Plagioclase
Montmorillonite
Plagioclase
5°
10°
15°
20°
25°
30°
35°
40°
45°
50°


Montmorillonite
Montmorillonite
DATE
SPECIMEN
TARGET
FILTER
VOLTAGE
CURRENT
TAKE OFF ANGLE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
SCANNING ANGLE
SCANNING SPEED
CHART SPEED
FULL SCALE
ZERO SUPPR.
TIME CONSTANT
COUNTER
HIGH TENSION
DISCRIMINATION
LOWER LEVEL
WINDOW
REMARKS
Operated by


Montmorillonite
Montmorillonite
Montmorillonite
α-Quartz
DATE
SPECIMEN
TARGET
FILTER
KV
MA
TAKE OFF ANGLE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
GRAPH SPEED
TIME CONSTANT
COUNTER
HIGH VOLTAGE
ATTENUATION
REMARKS
Operated by

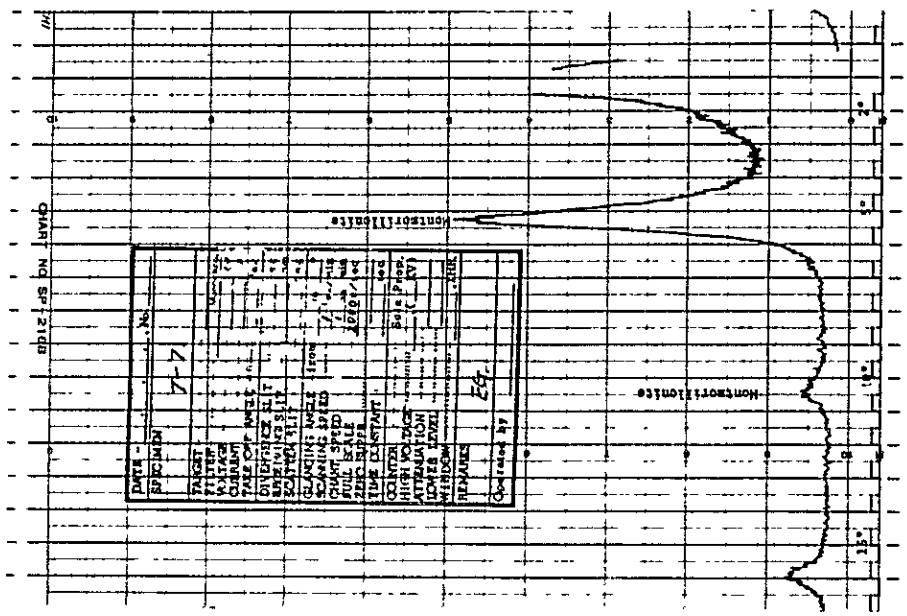
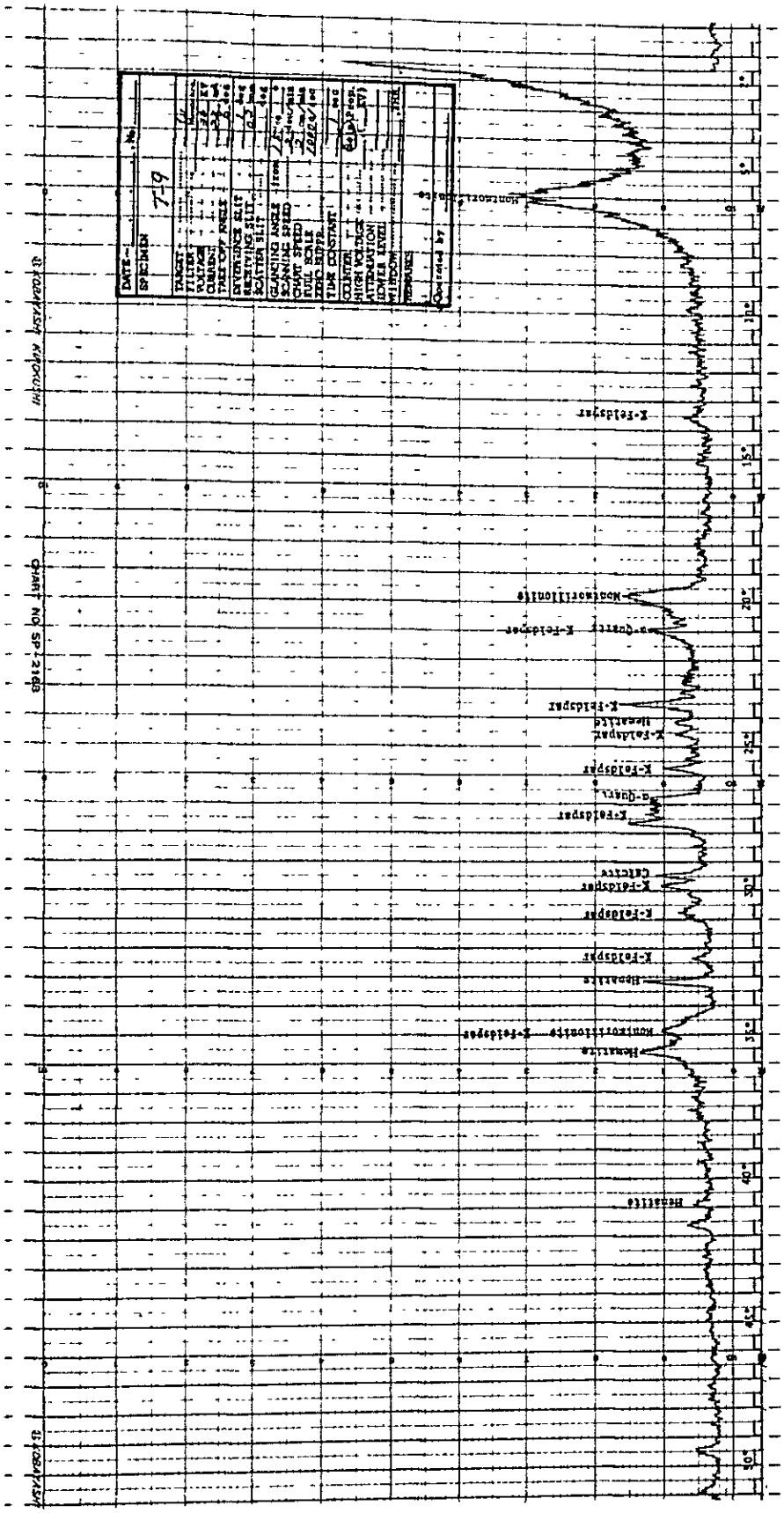
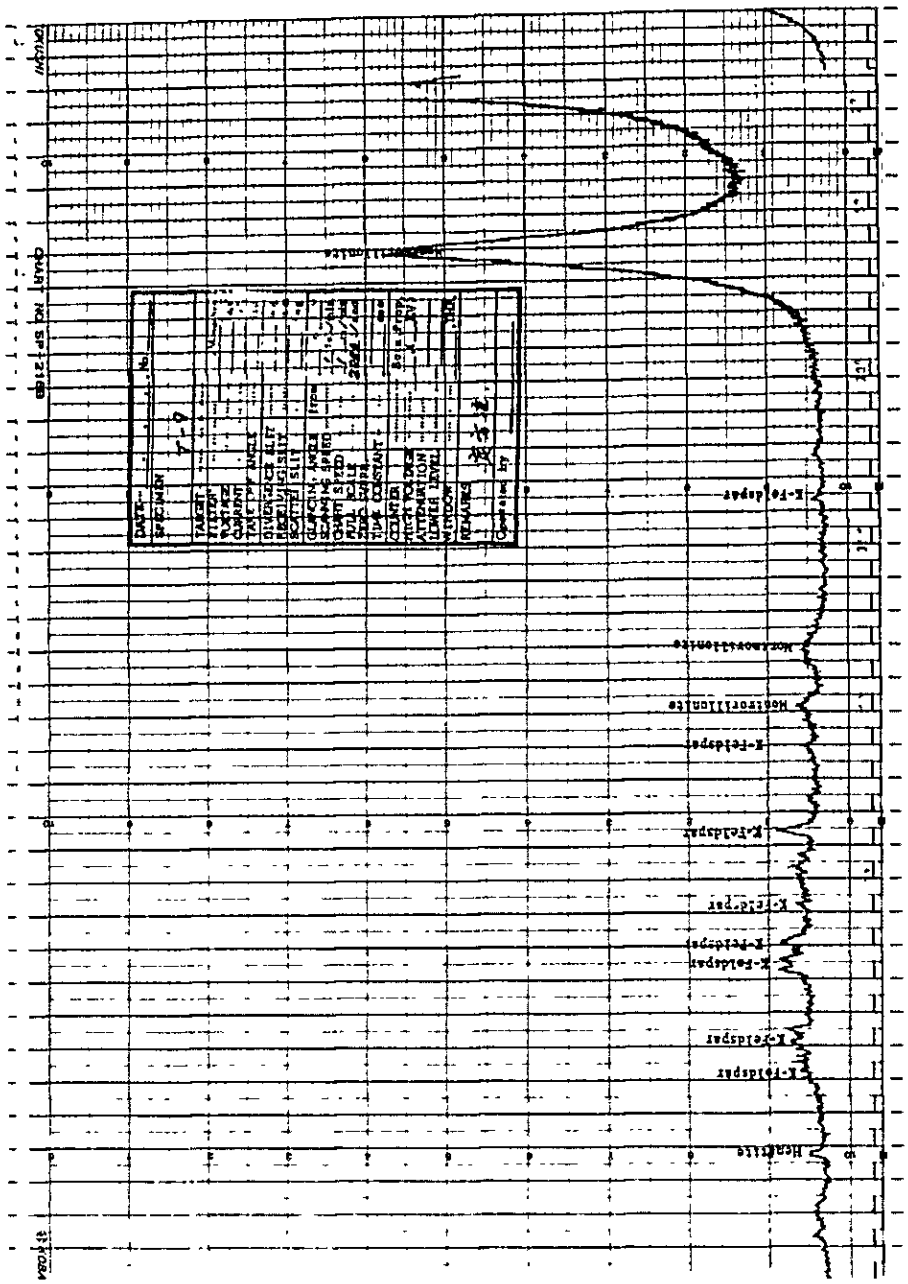


CHART NO SP 2108
Horizontal scale
Horizontal scale
DATE -
SPECIMEN
No.
TARGET
FILTER
VOLTAGE
CURRENT
TAKE-OFF ANGLE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
GUNNING WIDTH
SCANNING SPEED
CHART SPEED
FULL SCALE
ZERO SUPPR.
TIME CONSTANT
COUNTER
HIGH VOLTAGE
ATTENUATION
LOWER LEVEL
WINDOW
REMARKS
Operated by


DATE
SPECIMEN
7-19
Montmorillonite
K-feldspar
Montmorillonite
K-feldspar
α-Quartz
K-feldspar
K-feldspar
K-feldspar
α-Quartz
K-feldspar
K-feldspar
Calcite
K-feldspar
K-feldspar
Hematite
Montmorillonite
K-feldspar
Hematite
Hematite
10°
15°
20°
25°
30°
35°
40°
45°


Hematite
K-feldspar
K-feldspar
K-feldspar
K-feldspar
K-feldspar
K-feldspar
K-feldspar
Montmorillonite
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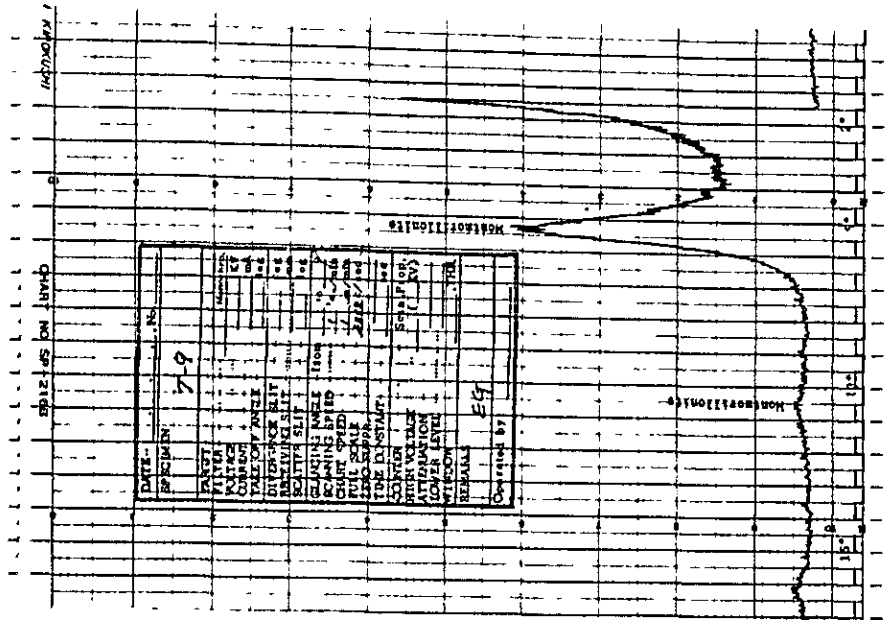
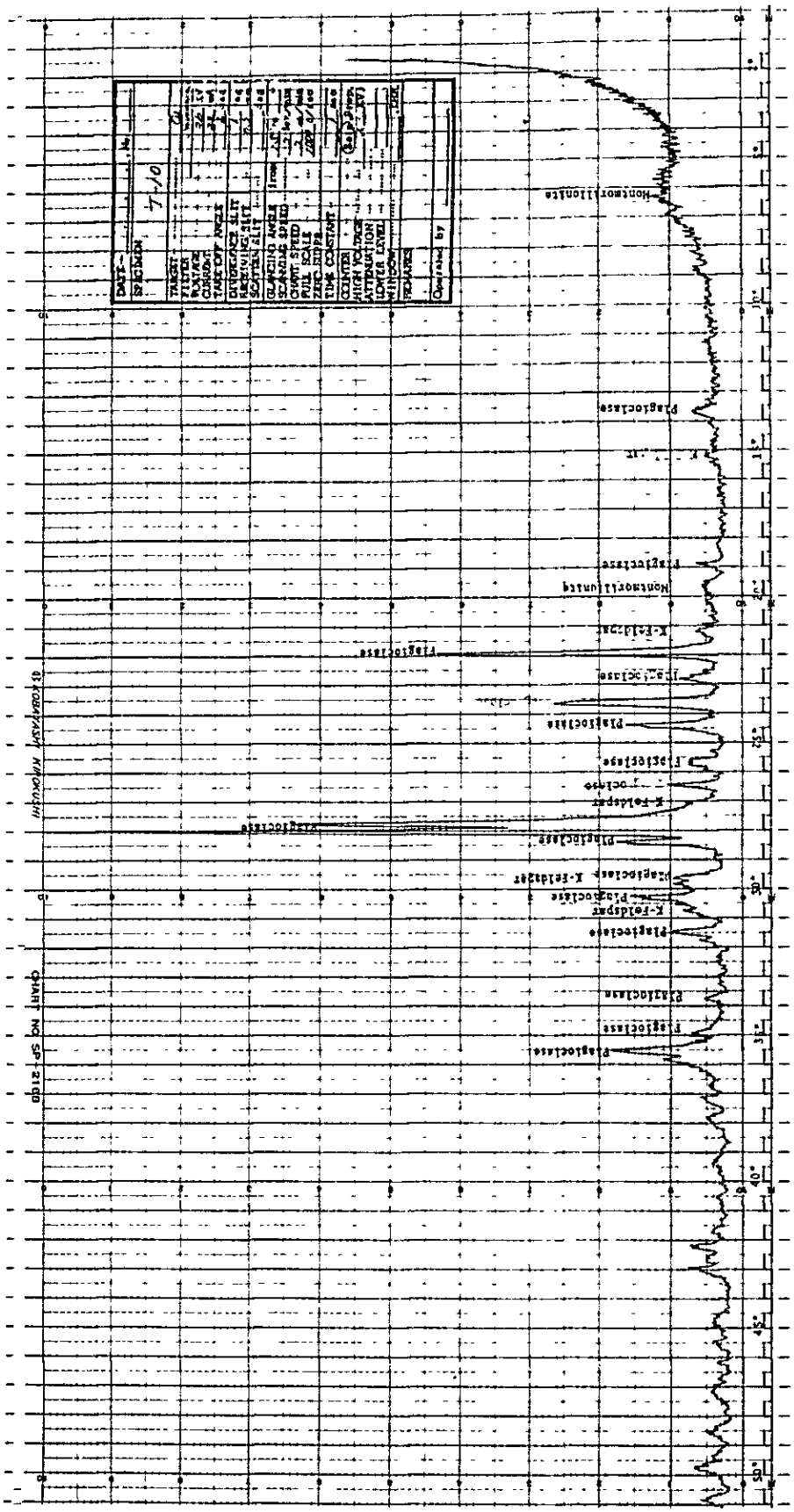
K-feldspar
K-feldspar


Horizontal
Vertical
Horizontal
Vertical
DATE
SPECIMEN
TARGET
FILTER
COLLIMATOR
TAKE-OFF ANGLE
DIFFRACTION SLIT
RECEIVING SLIT
SCATTER SLIT
GONIOMETER SPEED
CHART SPEED
FULL SCALE
TIME CONSTANT
COUNTER
DETECTOR VOLTAGE
ATTENUATION
LOWER LEVEL
WINDOW
REMARKS
Operator


DATE
SPECIMEN
T-10
TARGET
FILTER
VOLTAGE
CURRENT
TAKE OFF ANGLE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
GLANCING ANGLE
SCANNING SPEED
CHART SPEED
FULL SCALE
ZERO SUPP.
TIME CONSTANT
COUNTER
HIGH VOLTAGE
ATTENUATION
LOWER LEVEL
WINDOW
REMARKS
Operated by
Montmorillonite
Plagioclase
Plagioclase
Montmorillonite
K-Feldspar
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
K-Feldspar
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Plagioclase K-Feldspar
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Plagioclase
Plagioclase
Plagioclase
5°
10°
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25°
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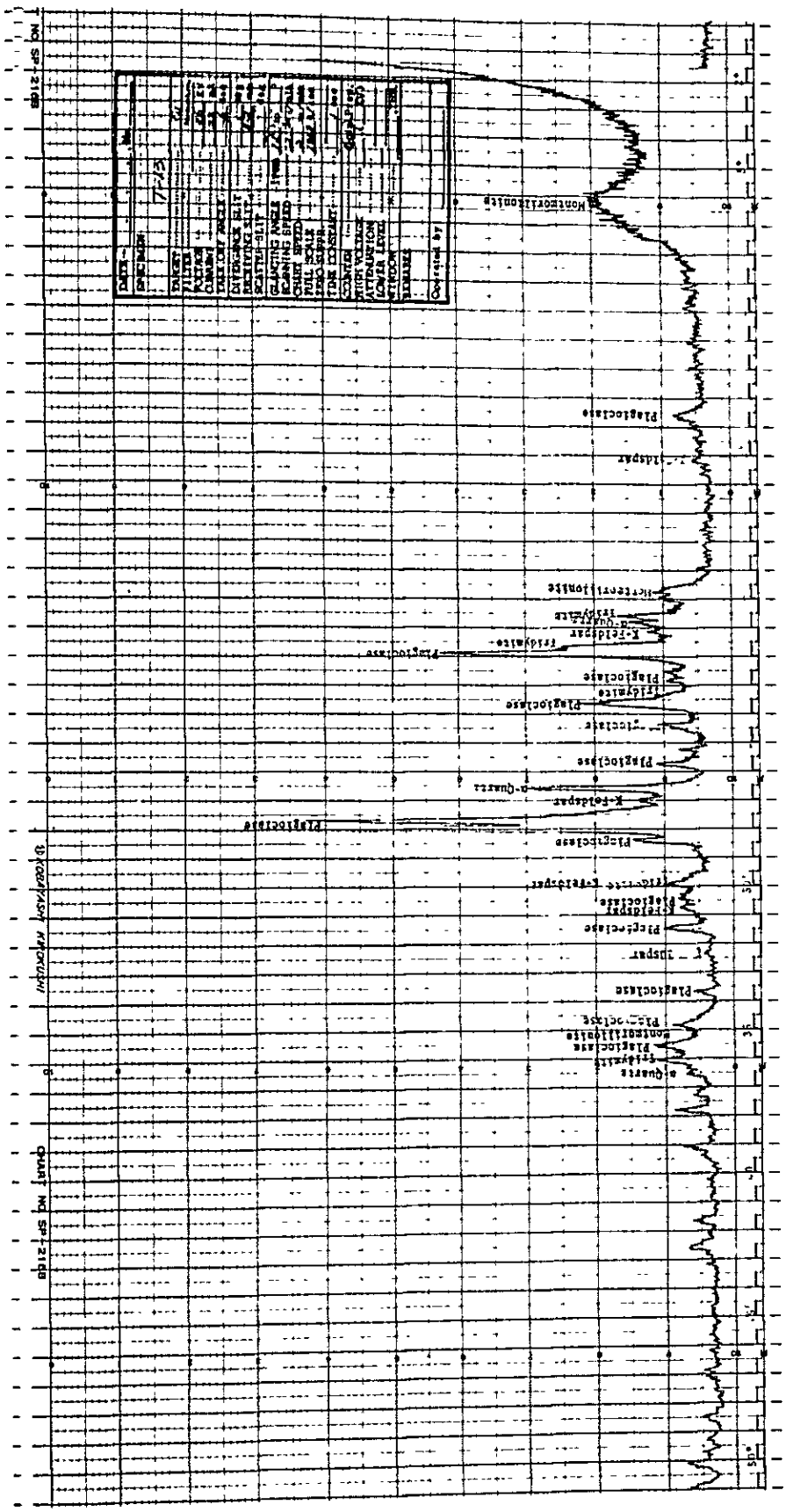
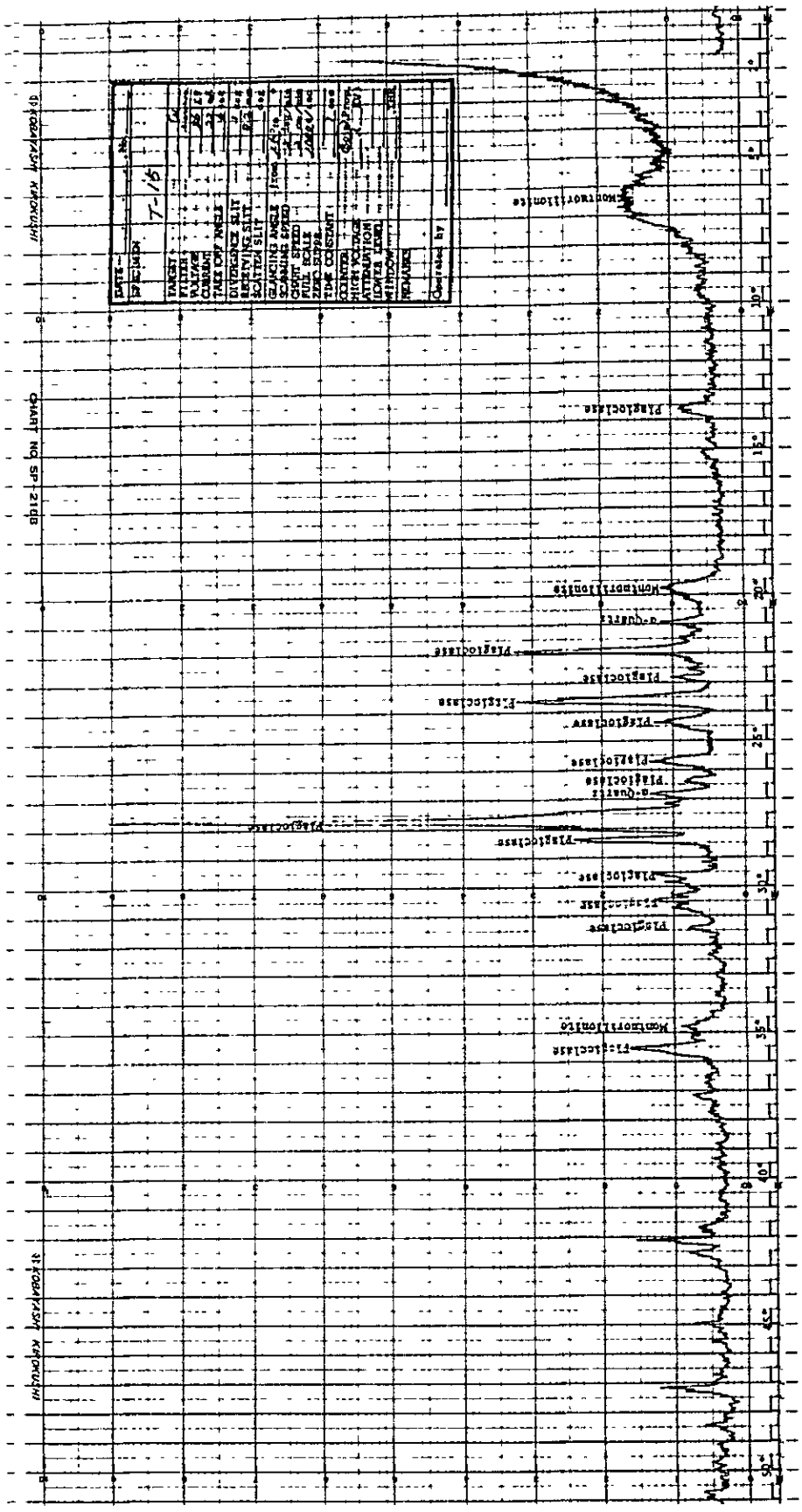
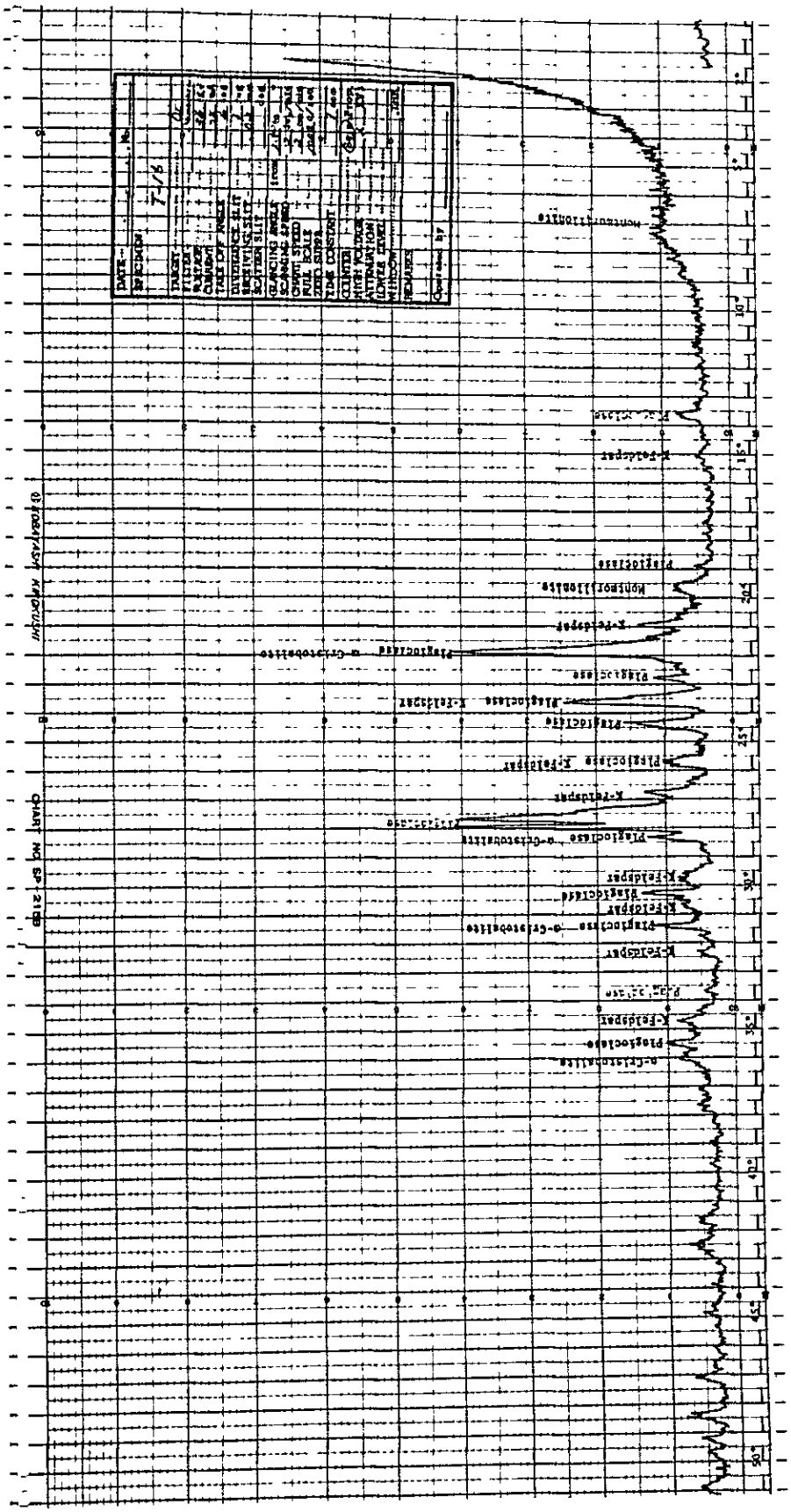
35°
40°
45°
50°
KOBAYASHI KIKOUSHI
CHART NO SP-2100


NO SP-216B
DATE
SPECIMEN T-13
TARGET Cu
FILTER
VOLTAGE
CURRENT
TAKE OFF ANGLE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
GLANCING ANGLE
SCANNING SPEED
CHART SPEED
FULL SCALE
ZERO SUPPR
TIME CONSTANT
COUNTER
HIGH VOLTAGE
ATTENUATION
LOWER LEVEL
WINDOW
REMARKS
Operated by
Montmorillonite
Plagioclase
K-feldspar
Montmorillonite
Tridymite
α-Quartz
K-feldspar
Tridymite
Plagioclase
Plagioclase
Tridymite
Plagioclase
Plagioclase
Plagioclase
K-feldspar
α-Quartz
Plagioclase
Plagioclase
Tridymite K-feldspar
Plagioclase
K-feldspar
Plagioclase
K-feldspar
Plagioclase
Plagioclase
Montmorillonite
Plagioclase
Tridymite
α-Quartz
KOBAYASHI KIROKUSHI
CHART NO SP-216B


Montmorillonite
Plagioclase
Montmorillonite
α-Quartz
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
α-Quartz
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Montmorillonite
Plagioclase
Montmorillonite



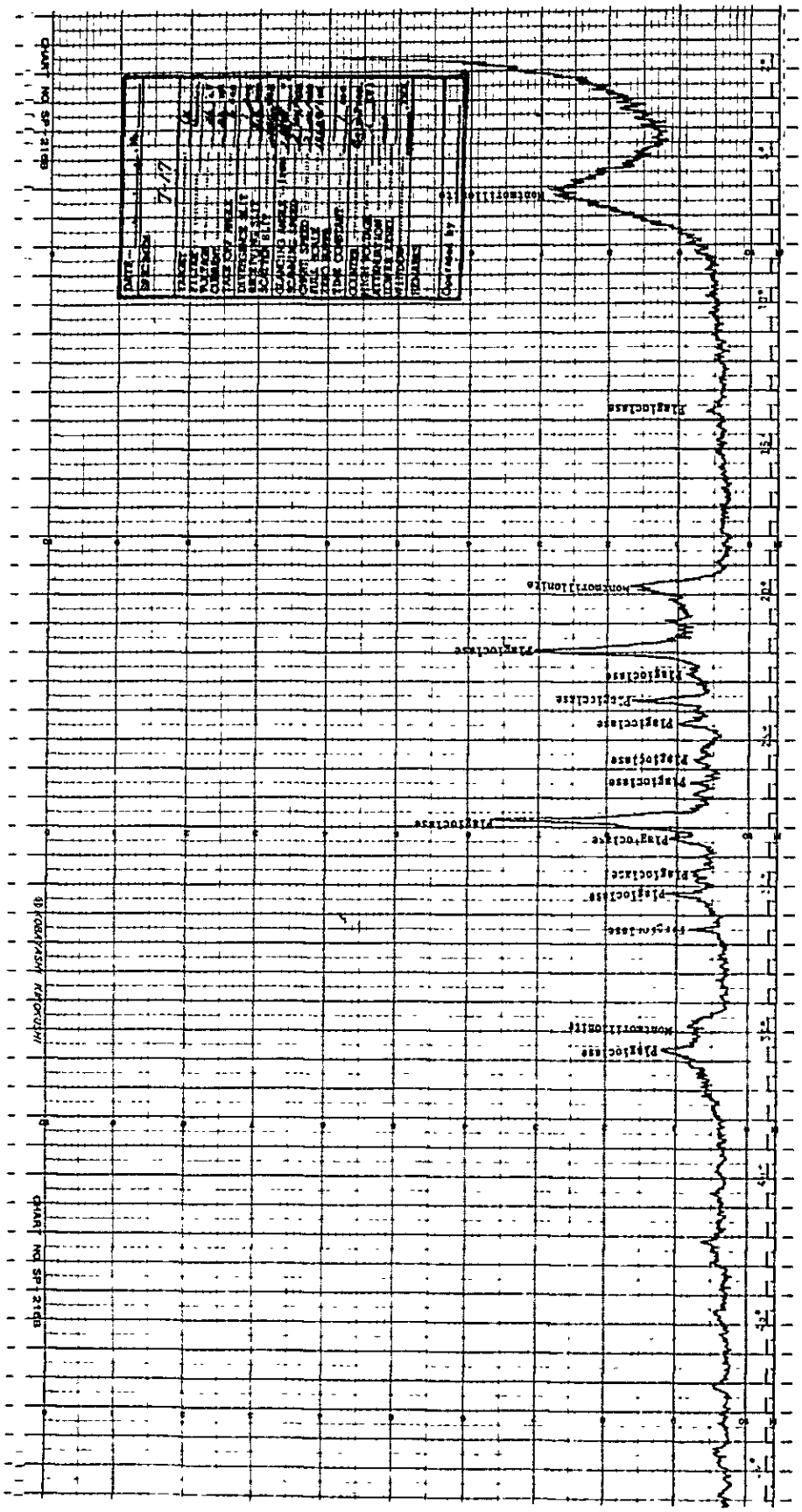
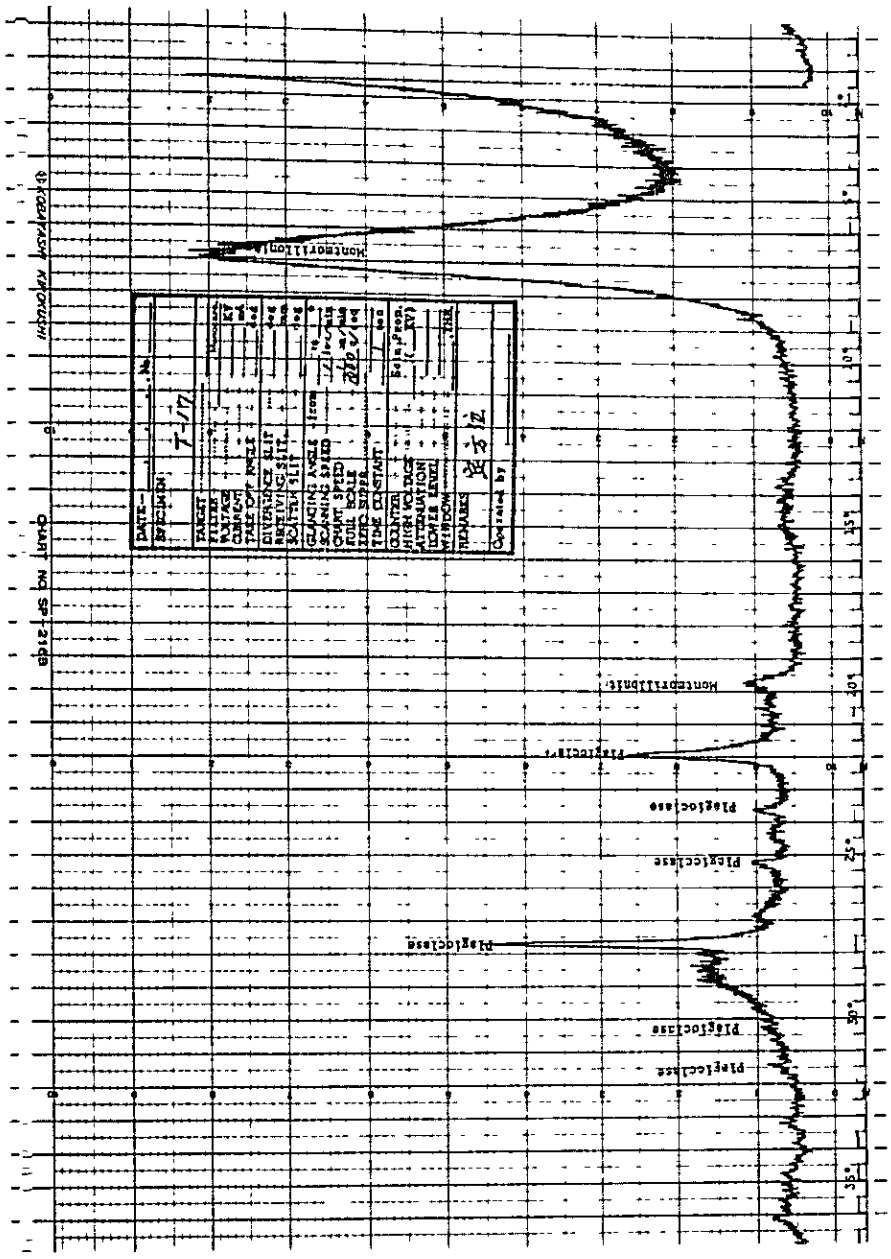
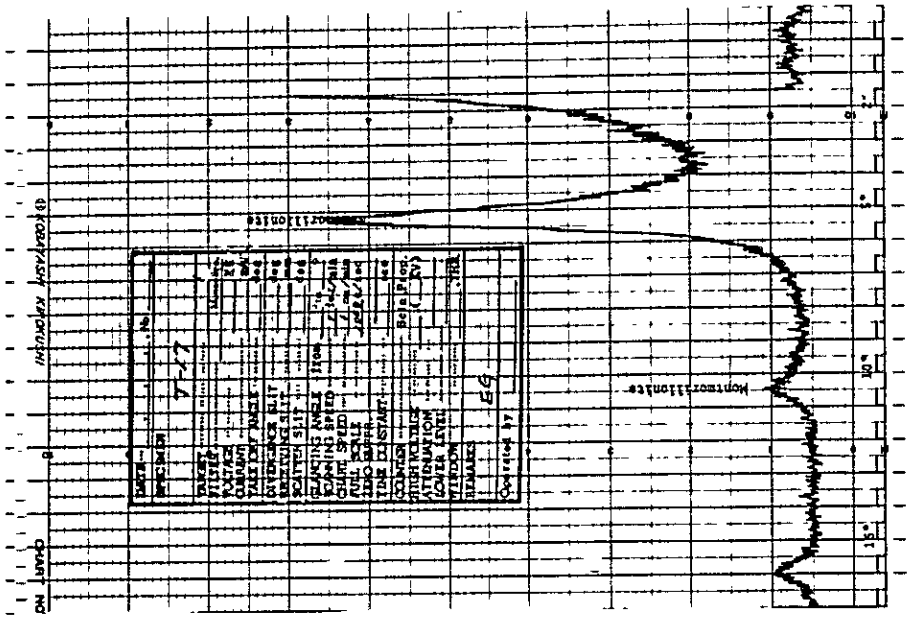
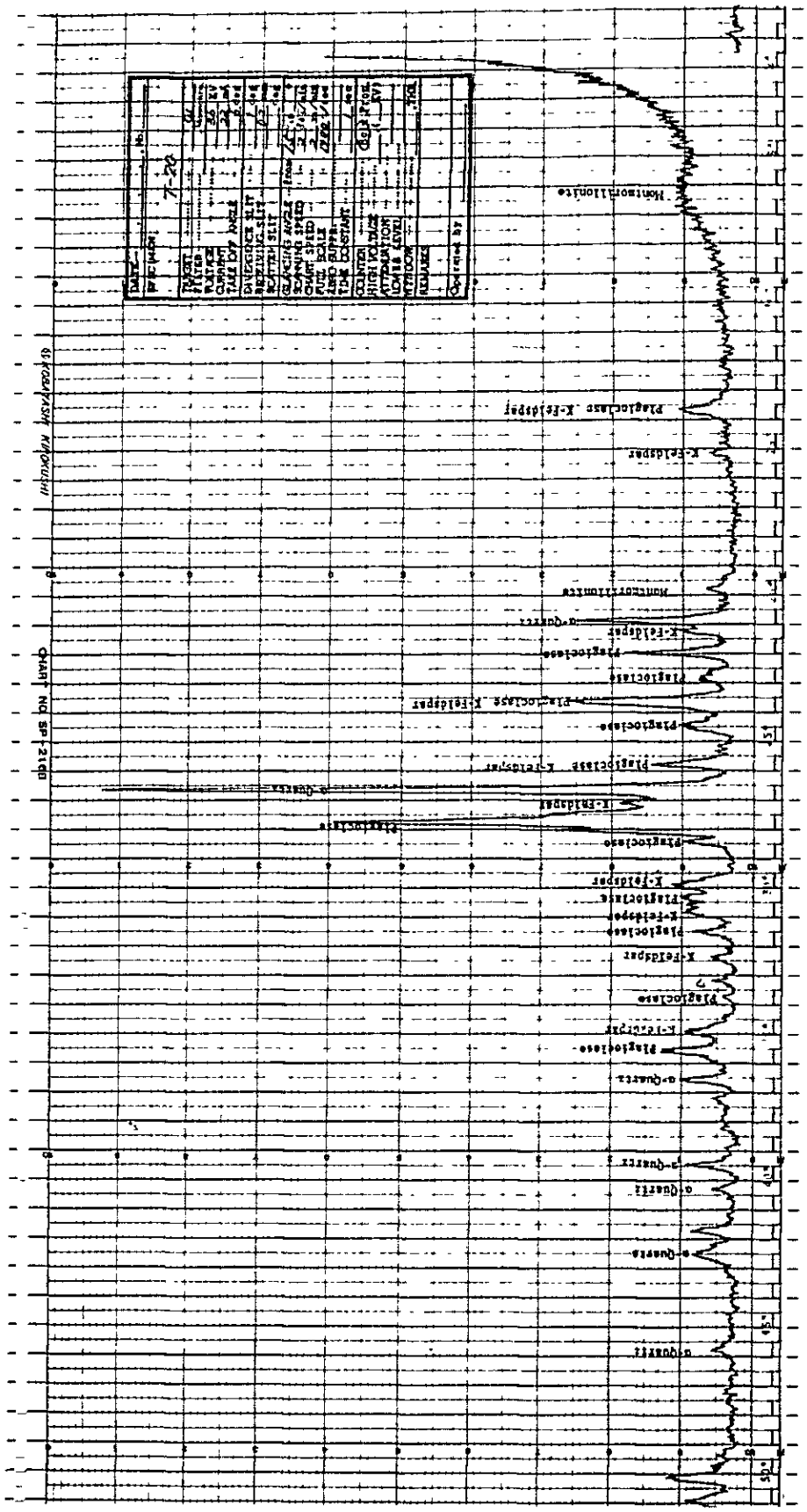


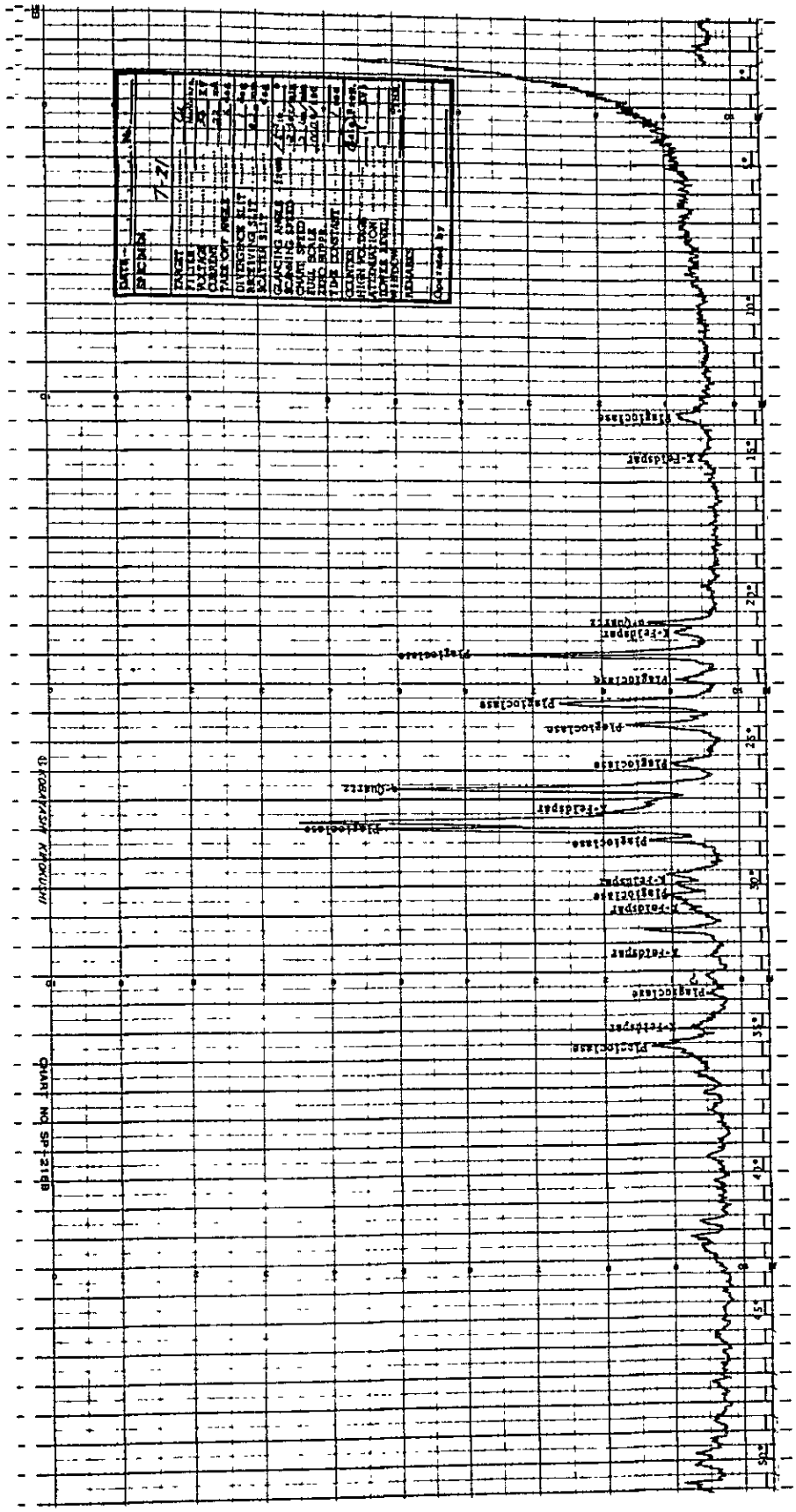
CHART NO SP-216B
KOBAYASHI KIKOKUSHI
CHART NO SP-216B
DATE
SPECIMEN
T-17
TARGET
FILTER
VOLTAGE
CURRENT
TAKE OFF ANGLE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
GLANCING ANGLE
SCANNING SPEED
CHART SPEED
FULL SCALE
ZERO SUPPR.
TIME CONSTANT
COUNTER
HIGH VOLTAGE
ATTENUATION
LOWER LEVEL
WINDOW
REMARKS
Operated by
Montmorillonite
Plagioclase
Montmorillonite
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Montmorillonite
Plagioclase
5°
10°
15°
20°
25°
30°
35°
40°
45°
50°

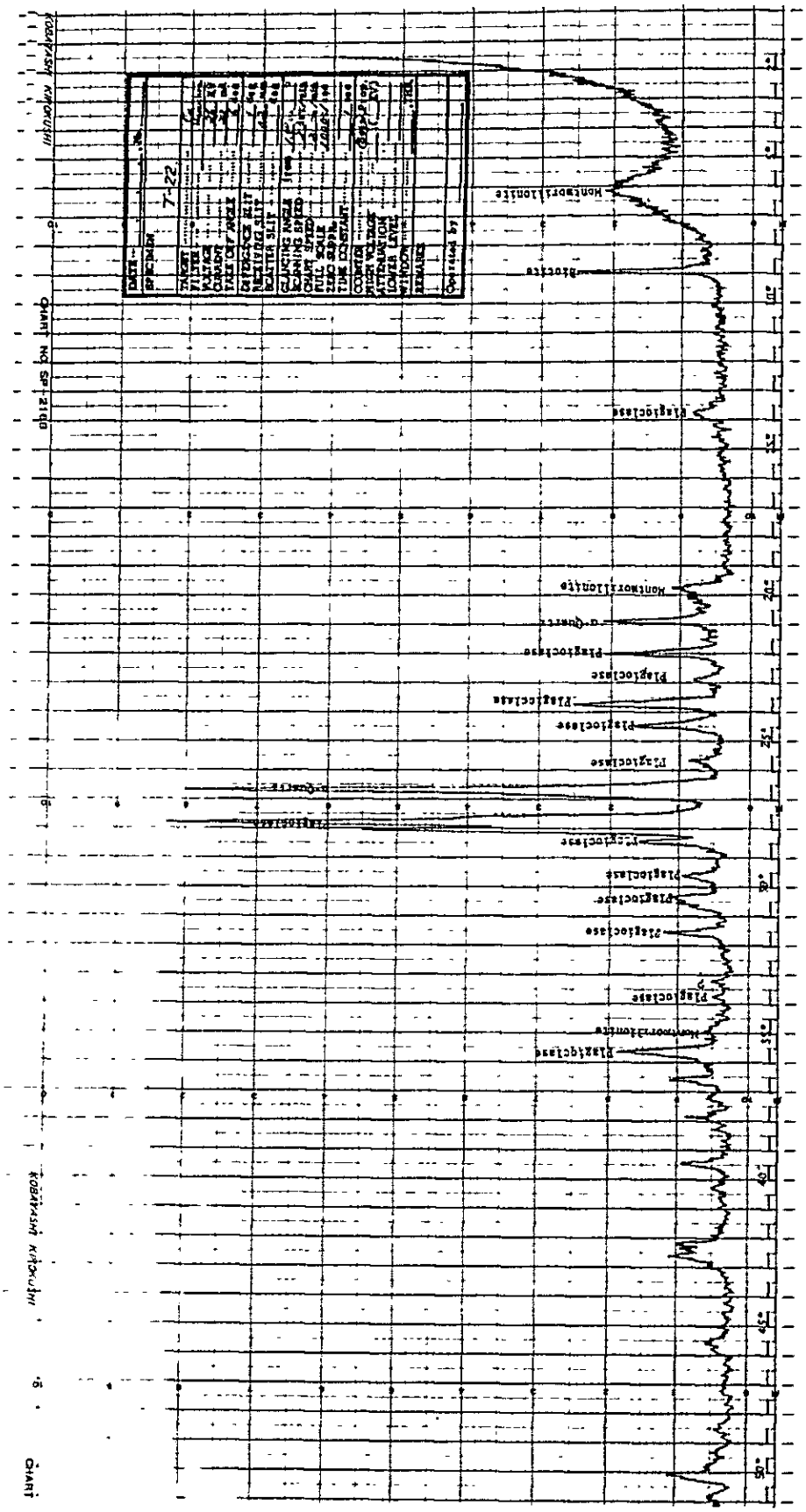

Montmorillonite
Montmorillonite
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
10°
15°
20°
25°
30°
35°

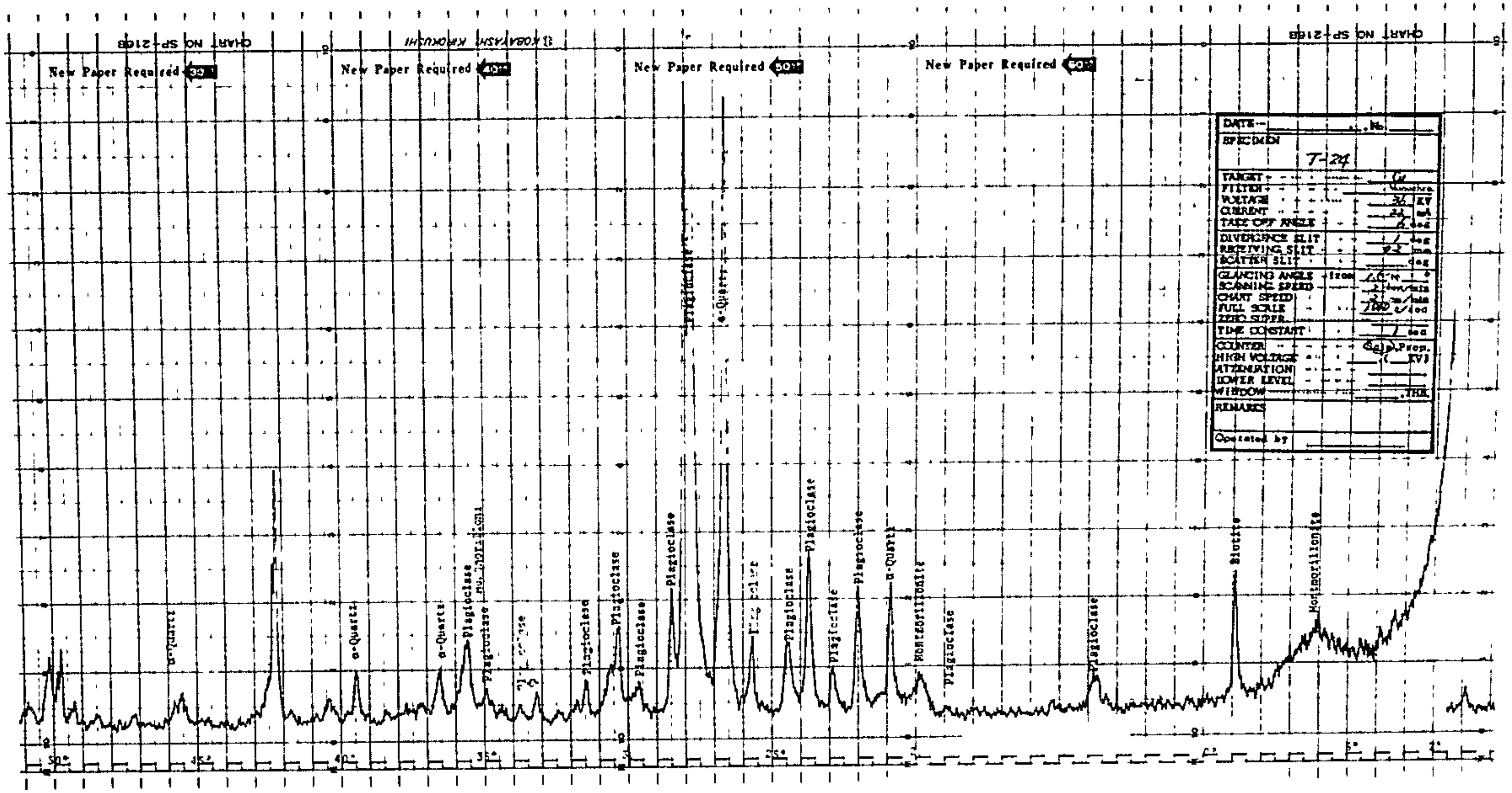

Montmorillonite
Montmorillonite
10°
16°

Montmorillonite
Plagioclase
Montmorillonite
α-quartz
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Montmorillonite
α-quartz

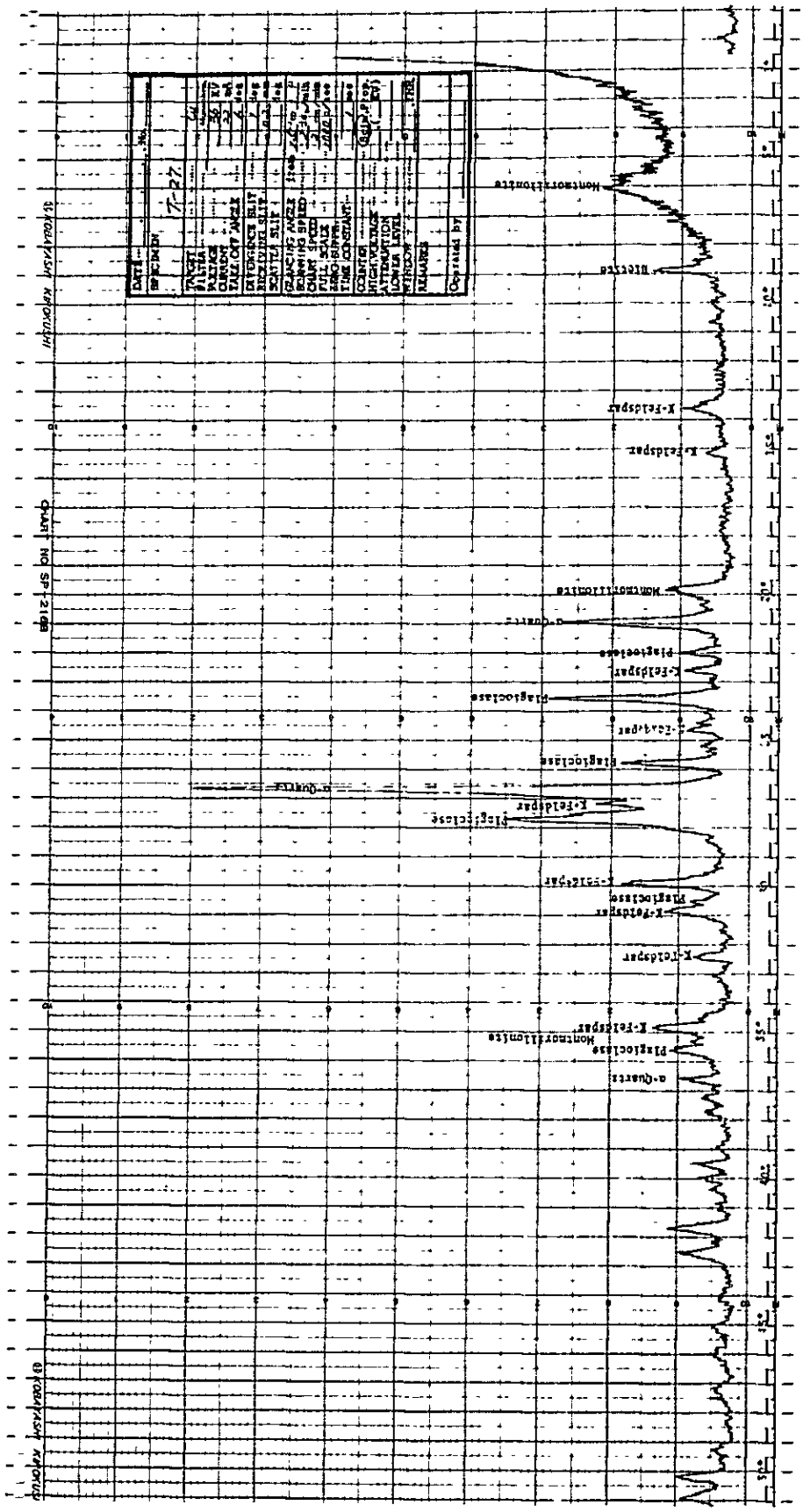

T-20
Cu
30 KV
KOBAYASHI KIROKUSHI
CHART NO. SP-2100
Montmorillonite
Plagioclase K-Feldspar
K-Feldspar
Montmorillonite
α-Quartz
K-Feldspar
Plagioclase
Plagioclase
Plagioclase K-Feldspar
Plagioclase
Plagioclase K-Feldspar
α-Quartz
K-Feldspar
Plagioclase
Plagioclase
K-Feldspar
Plagioclase
K-Feldspar
Plagioclase
K-Feldspar
?
Plagioclase
K-Feldspar
Plagioclase
α-Quartz
α-Quartz
α-Quartz
α-Quartz
α-Quartz
15°
45°
50°

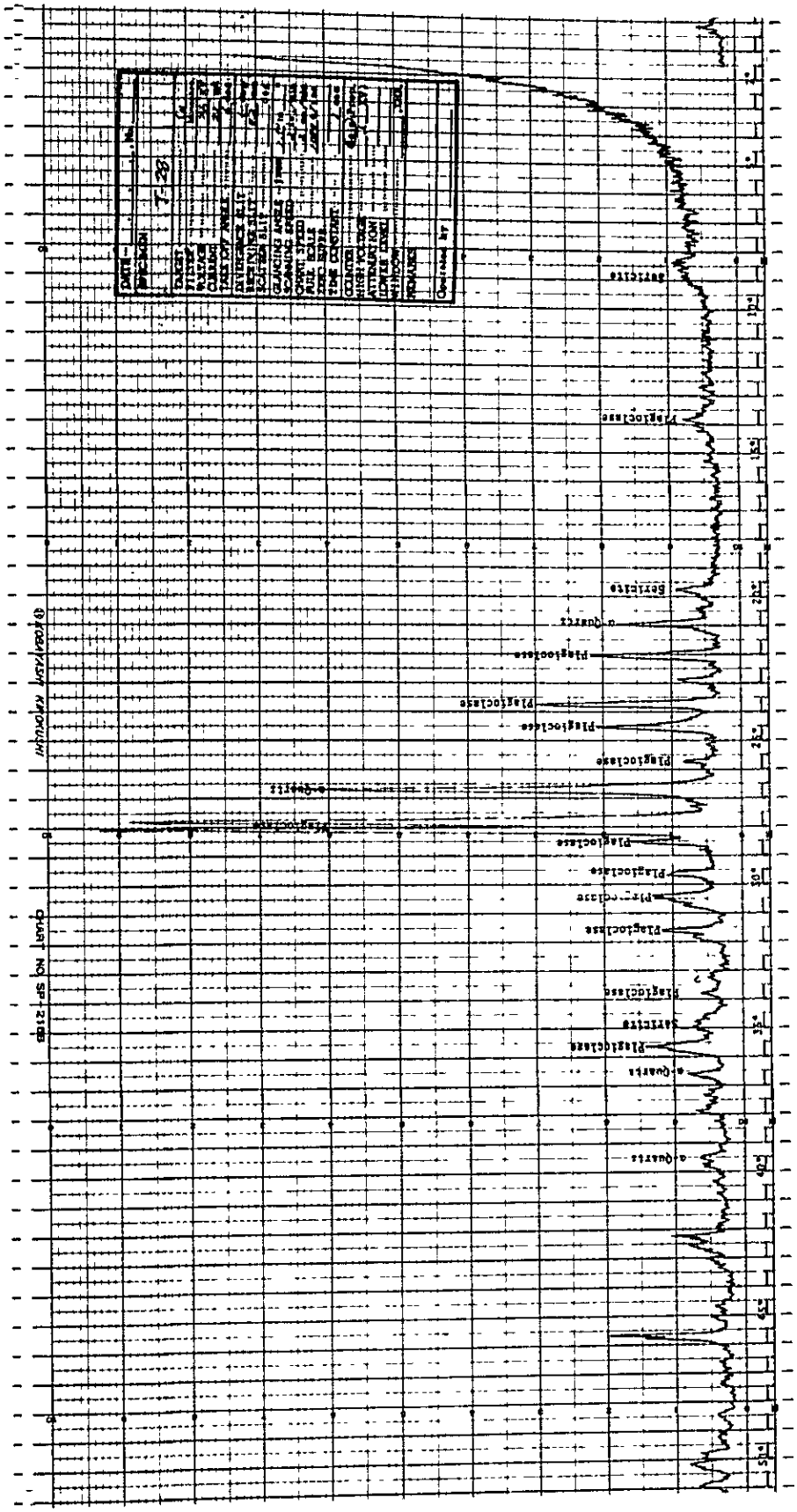
 DATE
No.
SPECIMEN 7-21
TARGET Cu
FILTER
VOLTAGE
CURRENT
TAKE OFF ANGLE
DIVERGENCE SLIT
RECEIVING SLIT
SCATTER SLIT
GLANCING ANGLE
SCANNING SPEED
CHART SPEED
FULL SCALE
ZERO SUPPR.
TIME CONSTANT
COUNTER
HIGH VOLTAGE
ATTENUATION
LOWER LEVEL
WINDOW
REMARKS
Operated by
5°
10°
15°
20°
25°
30°
35°
40°
45°
50°
Plagioclase
K-Feldspar
α-Quartz
K-Feldspar
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
α-Quartz
K-Feldspar
Plagioclase
Plagioclase
K-Feldspar
Plagioclase
K-Feldspar
K-Feldspar
Plagioclase
K-Feldspar
Plagioclase
KOBAYASHI KIROKUSHI
CHART NO SP-216B

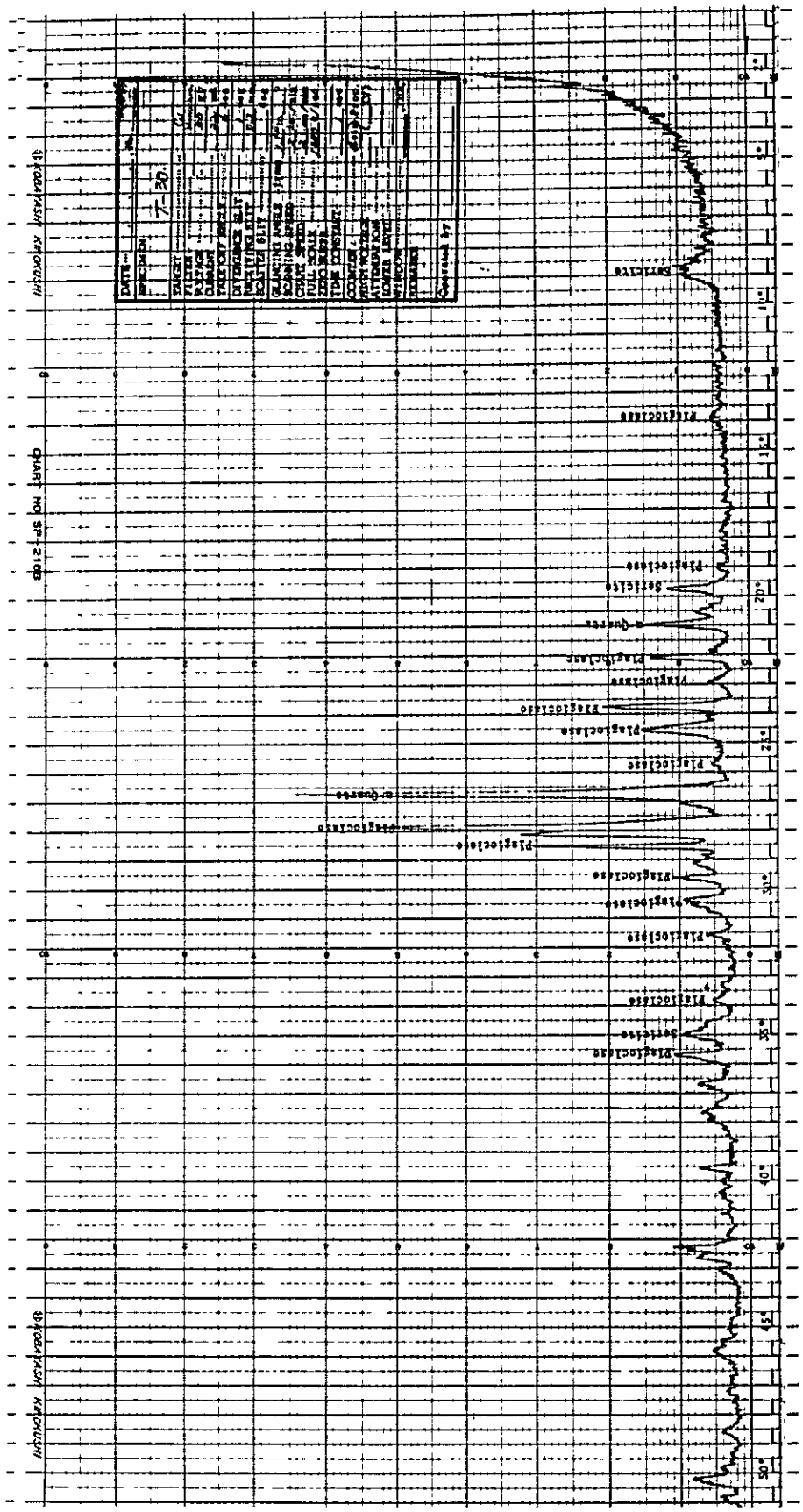

KOBAYASHI KIMOKUSHI
CHART NO SP-2140
Hornblendite
Plagioclase
Hornblendite
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Hornblendite
Plagioclase
KOBAYASHI KIMOKUSHI
CHART

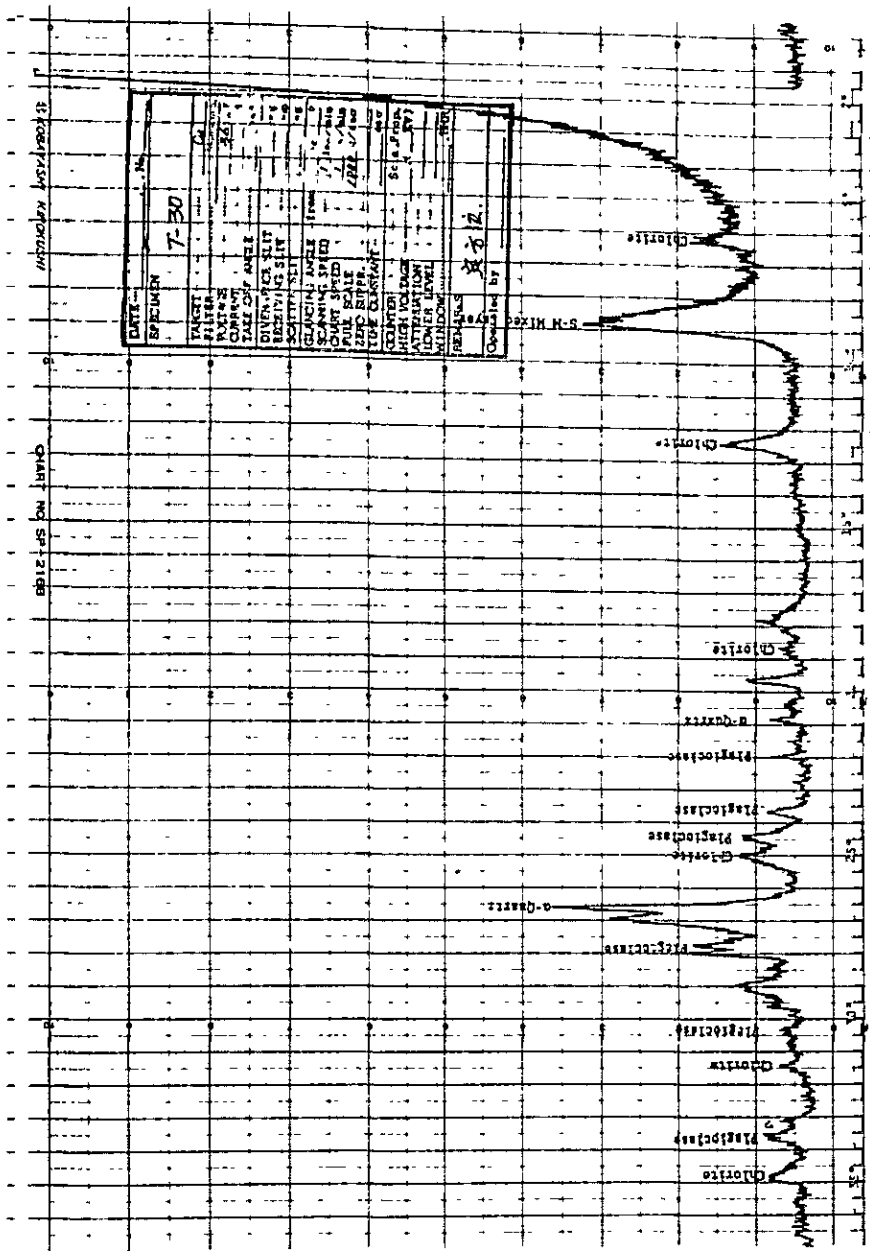


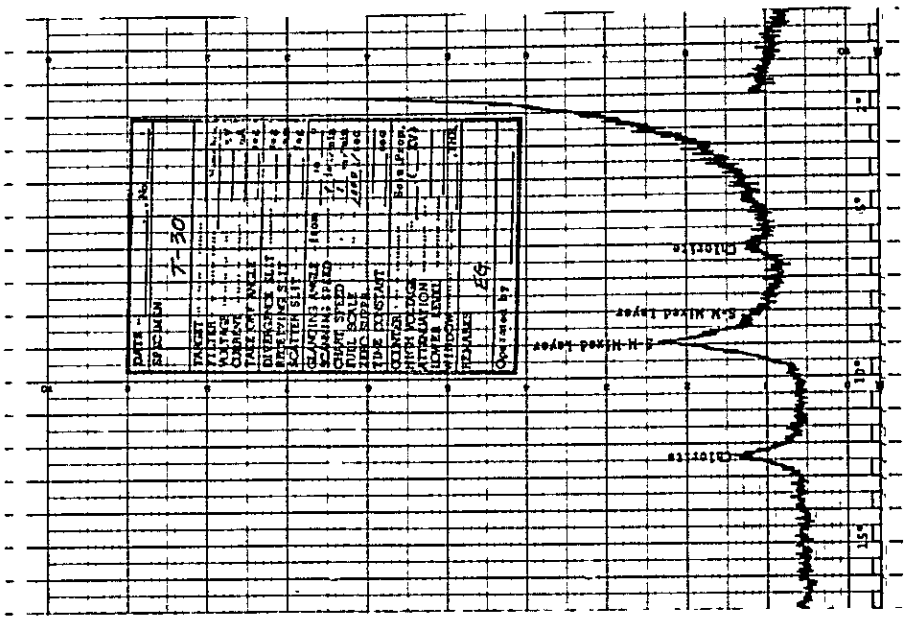
DATE ________ No. ________
SPECIMEN T-24
TARGET Cu
FILTER Ni monochro
VOLTAGE 30 KV
CURRENT 20 mA
TAKE OFF ANGLE 6 deg
DIVERGENCE SLIT 1 deg
RECEIVING SLIT 0.3 mm
SCATTER SLIT ____ deg
GLANCING ANGLE from 60° to ____°
SCANNING SPEED 2 deg/min
CHART SPEED 2 cm/min
FULL SCALE 1000 c/sec
ZERO SUPPR. ________
TIME CONSTANT 1 sec
COUNTER Scin. Prop.
HIGH VOLTAGE ____ (____KV)
ATTENUATION ________
LOWER LEVEL ________
WINDOW ________ THR.
REMARKS
Operated by ________

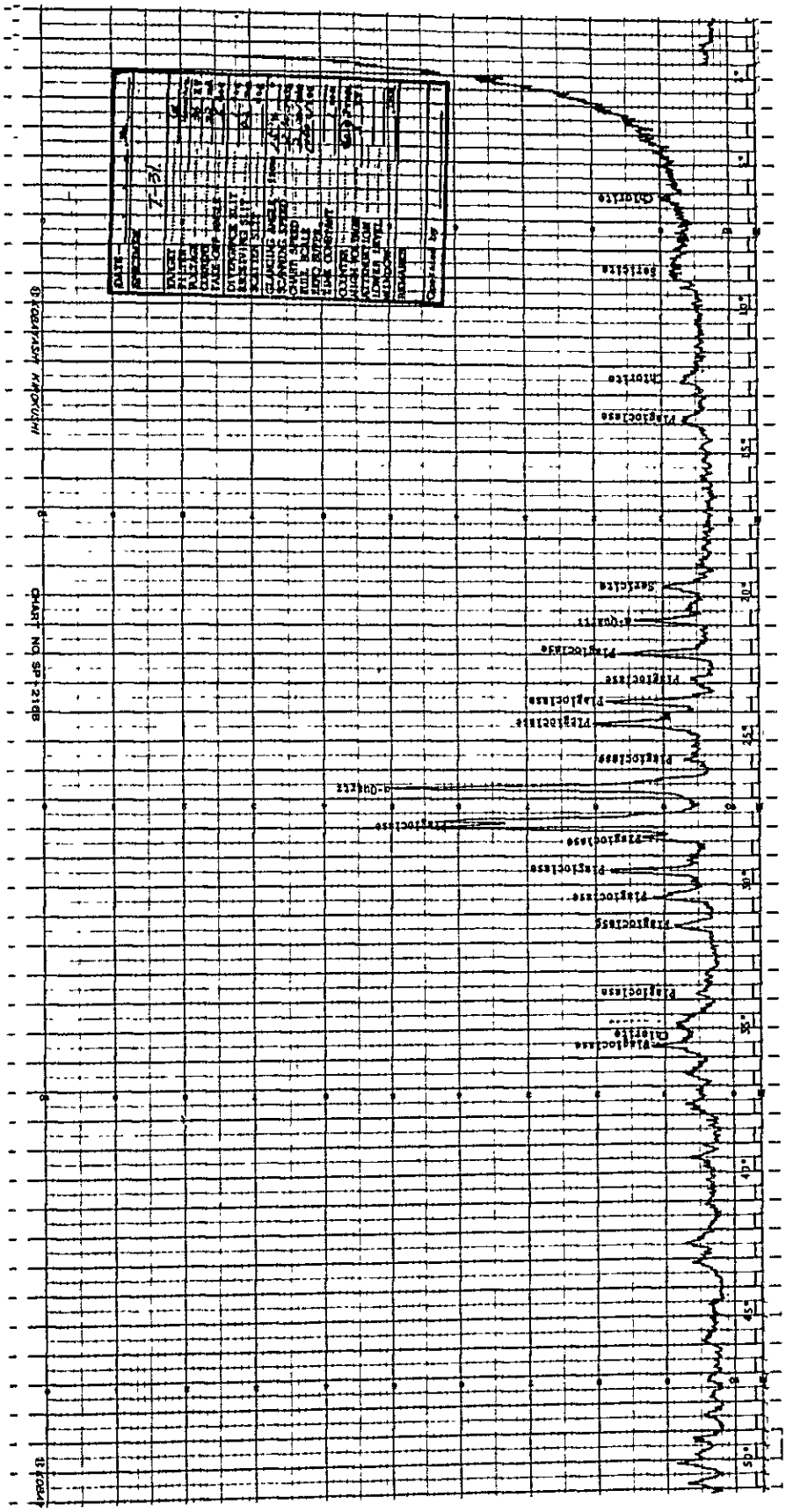

KOBAYASHI KIROKUSHI
CHART NO SP-2108
DATE
SPECIMEN T-27
TARGET Cu
FILTER
VOLTAGE 30 KV
CURRENT 22 mA
TAKE OFF ANGLE
DIVERGENCE SLIT 1 deg
RECEIVING SLIT
SCATTER SLIT 1 deg
GRANCING ANGLE
RUNNING SPEED
CHART SPEED
FULL SCALE
ZERO SUPPR.
TIME CONSTANT
COUNTER
HIGH VOLTAGE
ATTENUATION
LOWER LEVEL
WINDOW
REMARKS
Operated by
Montmorillonite
Biotite
K-Feldspar
K-Feldspar
Montmorillonite
α-Quartz
Plagioclase
K-Feldspar
Plagioclase
K-Feldspar
Plagioclase
α-Quartz
K-Feldspar
Plagioclase
K-Feldspar
Plagioclase
K-Feldspar
K-Feldspar
K-Feldspar
Montmorillonite
Plagioclase
α-Quartz
5°
10°
15°
20°
25°
30°
35°
40°
45°
50°

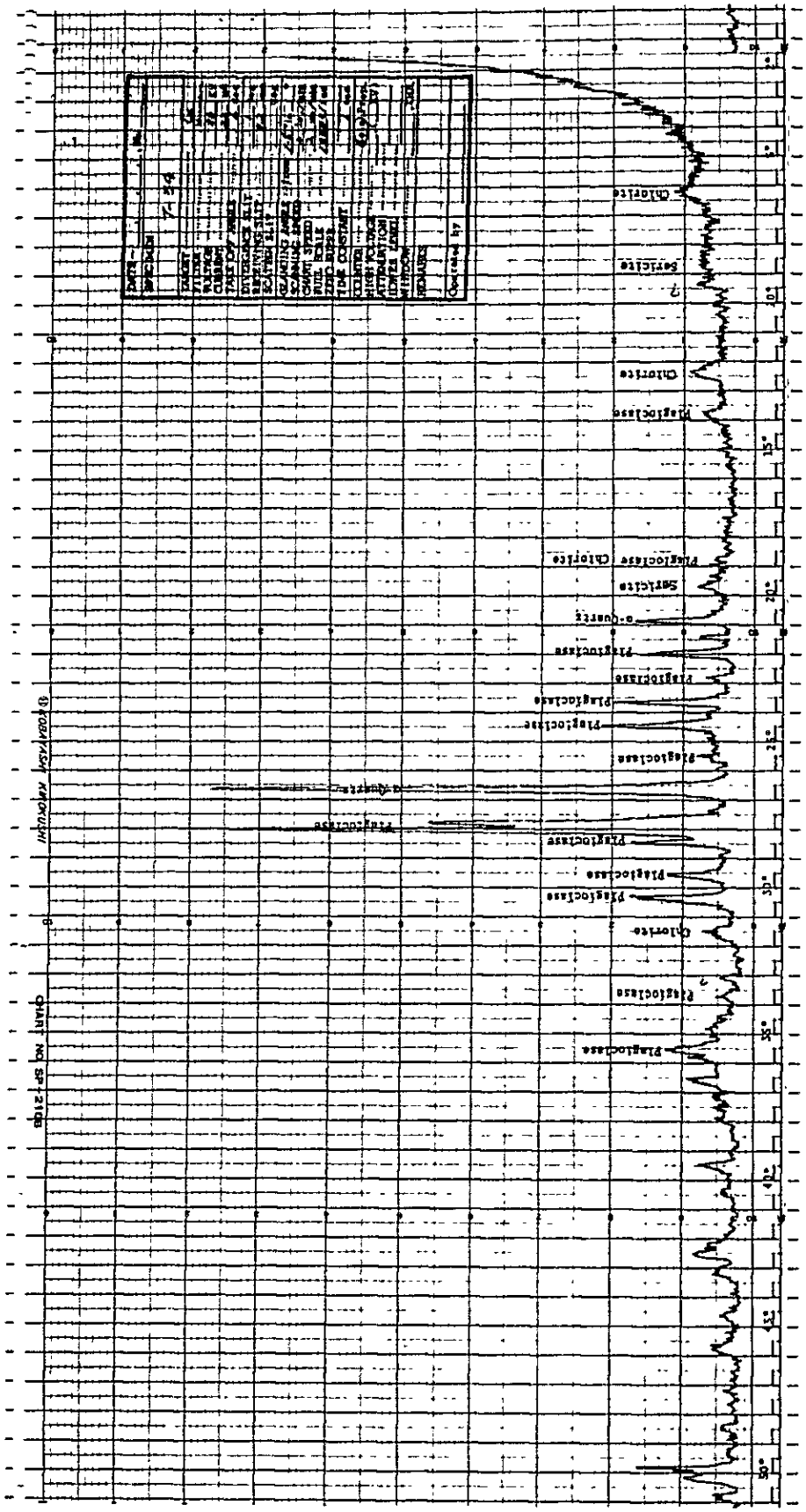

T-28
Sericite
Plagioclase
Sericite
α-Quartz
Plagioclase
Plagioclase
Plagioclase
Plagioclase
α-Quartz
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Sericite
Plagioclase
α-Quartz
α-Quartz
5°
10°
15°
20°
25°
30°
35°
40°
45°
50°
KOBAYASHI KAPDUSHI
CHART NO SP-2108


KOBAYASHI KAKOUSHI
CHART NO SP-2168
KOBAYASHI KAKOUSHI


Chlorite
S-N Mixed
Chlorite
Chlorite
Plagioclase
α-Quartz
Plagioclase
Plagioclase
Chlorite
Plagioclase
Chlorite

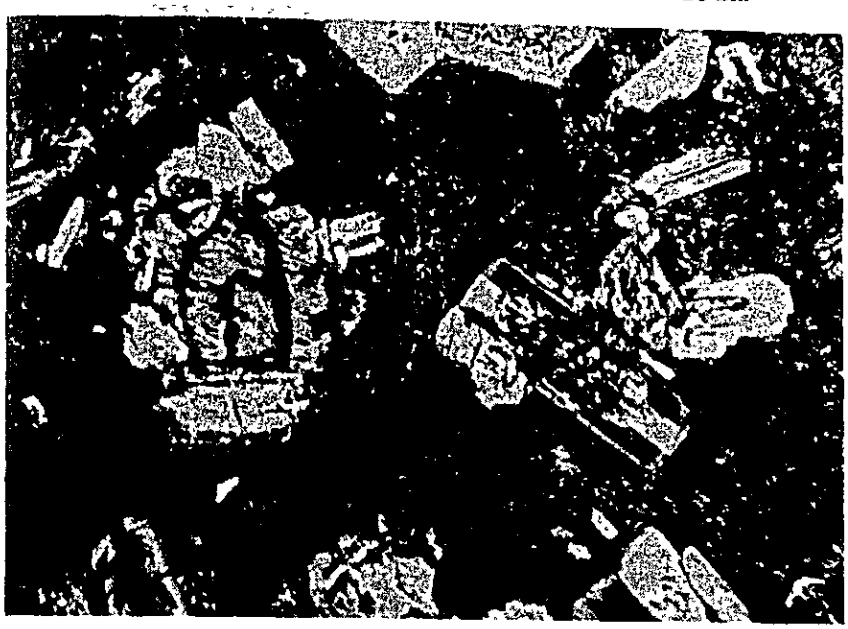

T-30
Diorite
S.W. Mixed layer
N. Mixed layer
Diorite
Diorite
5°
10°
15°




Chlorite
Sericite
Chlorite
Plagioclase
Plagioclase Chlorite
Sericite
Quartz
Plagioclase
Plagioclase
Plagioclase
Plagioclase
Quartz
Plagioclase
Plagioclase
Plagioclase
Chlorite
Plagioclase
Plagioclase
CHART NO. SP-210B

MICROSCOPIC PHOTOGRAPHS

Sample No. T-3 , 186m to 192m



Two pyroxene andesite

x 40

Open nicols

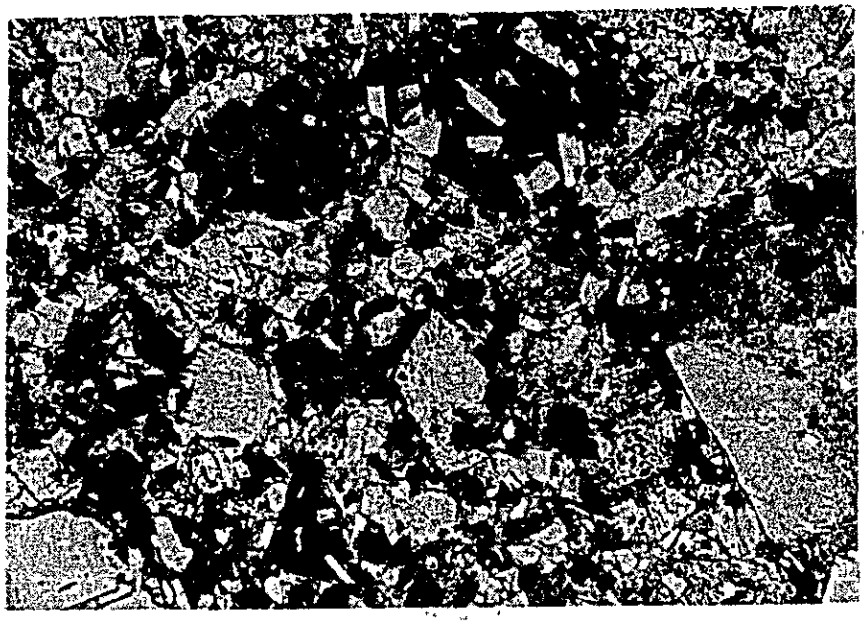
x 40

Cross nicols

Microscopic observation

: Weakly altered(montmorillonite) hyperthen, left phenocryst,and plagioclase, right pheno.

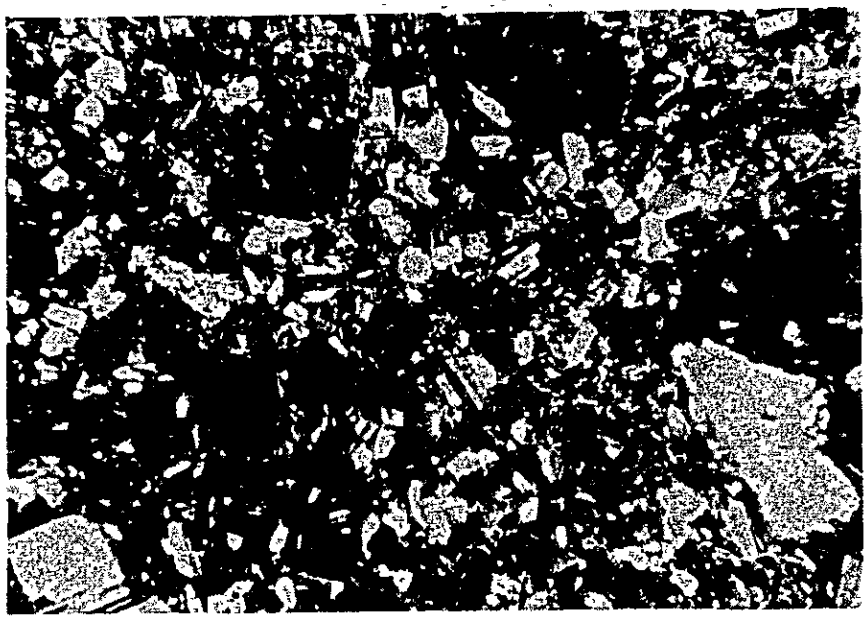
Sample No. T-4 , 215m to 221m



Andesitic coarse grained tuff

x 40

Open nicols



x 40

Cross nicols

Microscopic observation

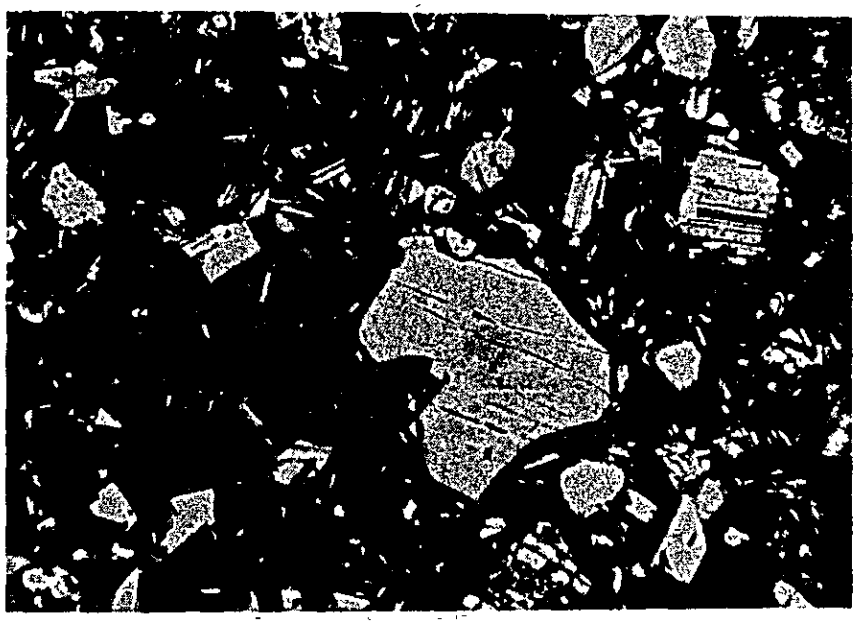
: Pyroclastics consist of fragments of plagioclase and mafic crystal , glass and rock.
Matrix is consist of secondary montmorillonite.

Sample No. T-5 , 243m to 247m

Andesitic coarse grained tuff

x 40

Open nicols



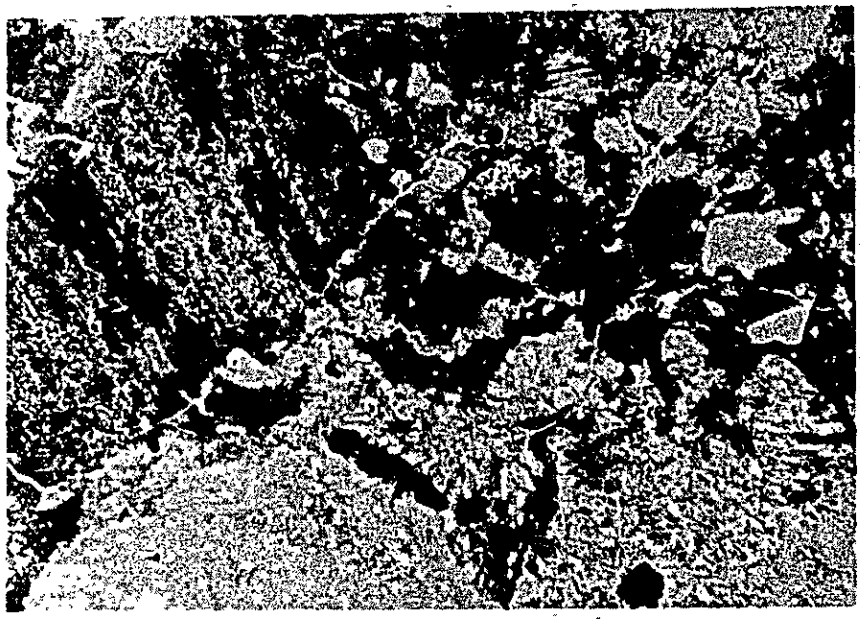
x 40

Cross nicols

Microscopic observation

: Pyroclastics containing large amounts of andesite breccia , glass fragments and crystal fragments of plagioclase , pyroxene and biotite.
Weak alteration of montmorillonite is recognized.

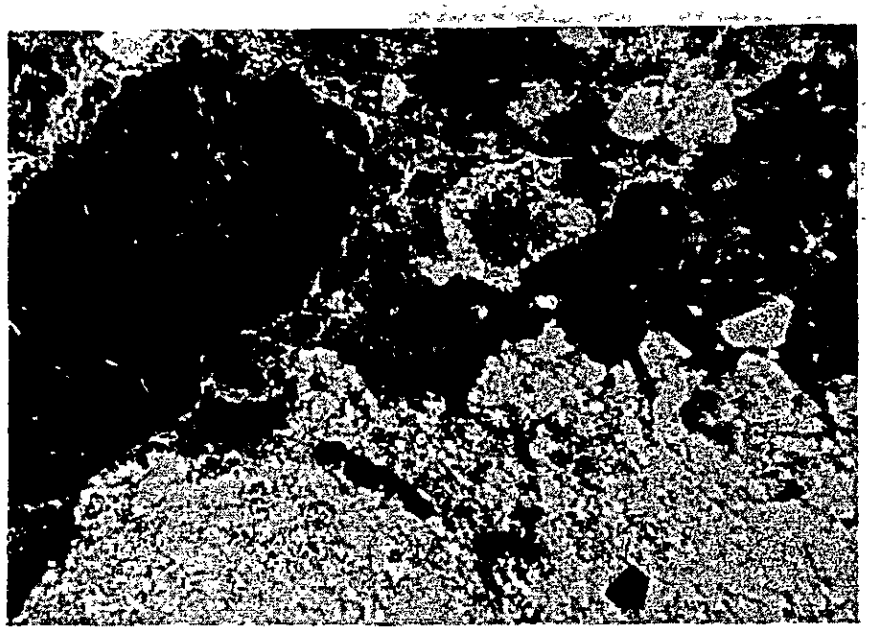
Sample No. T-7 , 315m to 320m



Andesitic coarse grained tuff

x 40

Open nicols



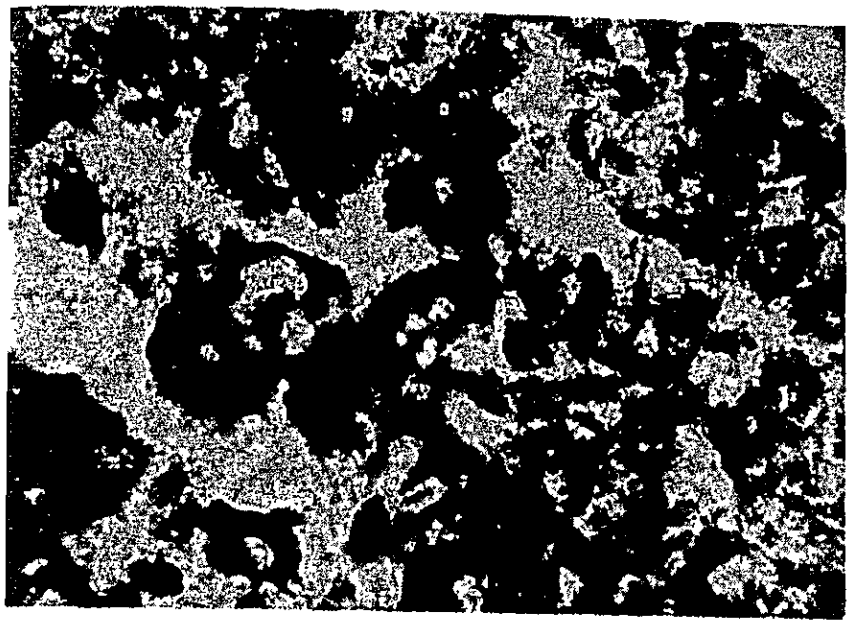
x 40

Cross nicols

Microscopic observation

: Plagioclase is main constituent crystal fragment and besides of it a small amount of quartz , K-feldspar are observed.
Pyroxene andesite and rhyolitic or dacitic rocks (left) are included.

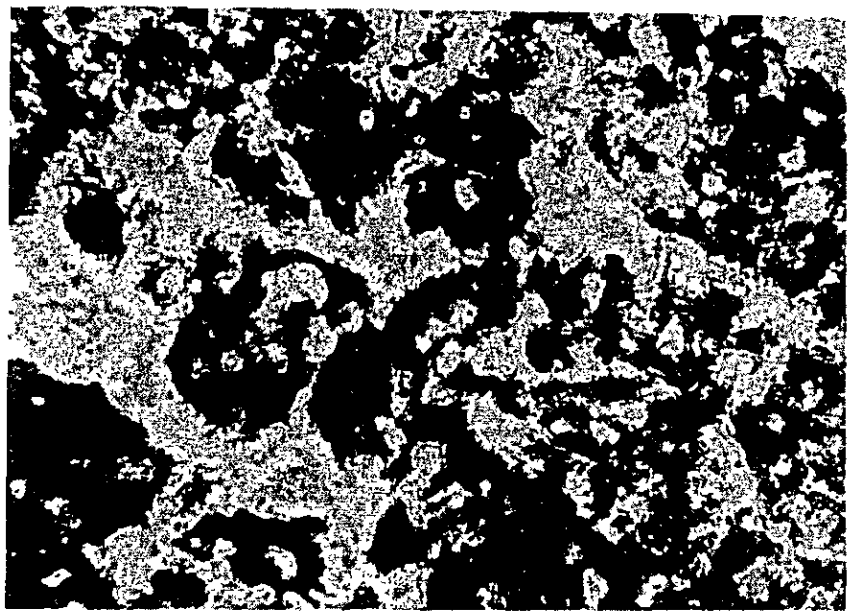
Sample No. T-9 , 368m to 373m



Fine grained tuff ?

x 130

Open nicols



x 130

Cross nicols

Microscopic observation

: The rock is consist of fine grained opaque mineral (hematite ?) , clay mineral and calcite.

Sample No. T-10 , 402m to 404m

Pyroxene andesite

x 40

Open nicols

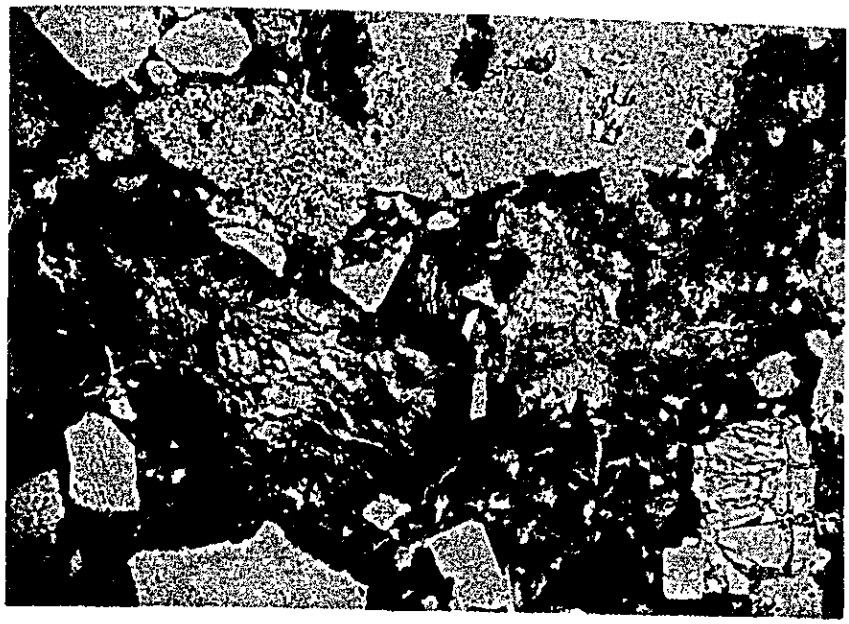
x 40

Cross nicols

Microscopic observation

: Pyroxene andesite characterized by the orientated arrangement of feldspar in the groundmass. Montmorillonite is observed along the crack and the clearvage of phenocrysts.

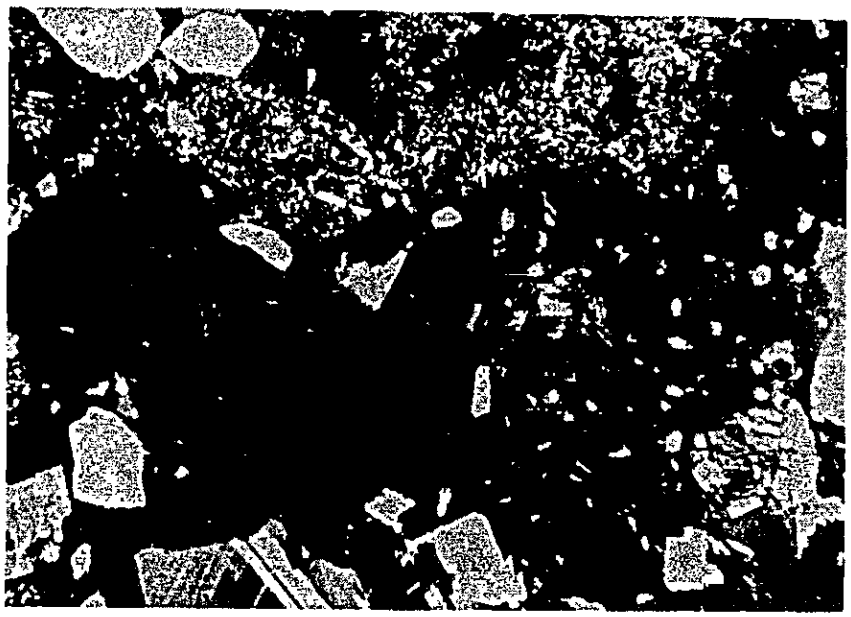
Sample No. T-13 , 489m to 492m



Dacitic lapilli tuff

x 40

Open nicols



x 40

Cross nicols

Microscopic observation

: The lapilli tuff is characterized to contain a large amount of pumice. Breccia included is andesitic rock , and crystal flakes are plagioclase, opaque mineral and small amount of biotite. Pumice , glass and mafic mineral are completely altered to montmorillonite.

Sample No. T-15 , 550m to 552m

Andesite

x 40

Open nicols

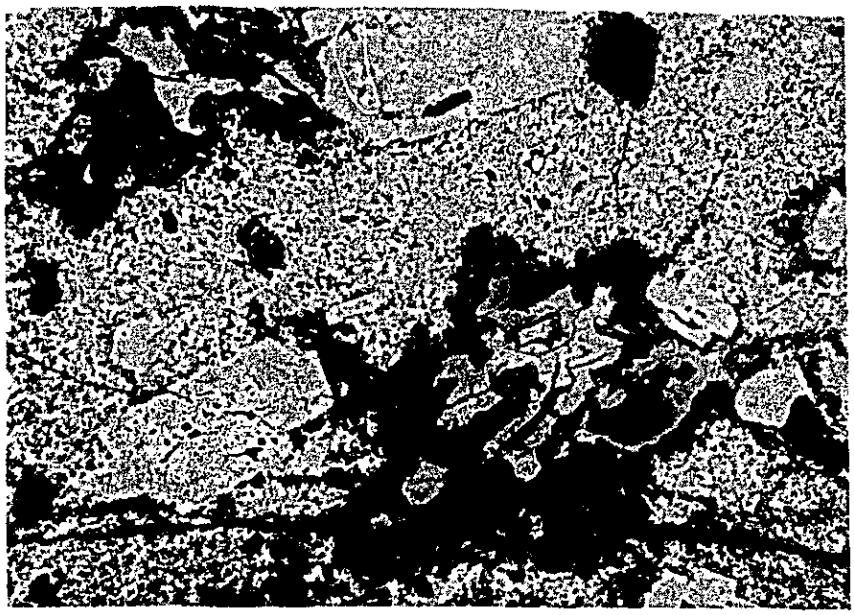
x 40

Cross nicols

Microscopic observation

: Andesite breccia included in the formation. Mafic mineral and groundmass are completely altered to montmorillonite.

Sample No. T-16 , 580m to 583m



Lapilli tuff

x 40

Open nicols

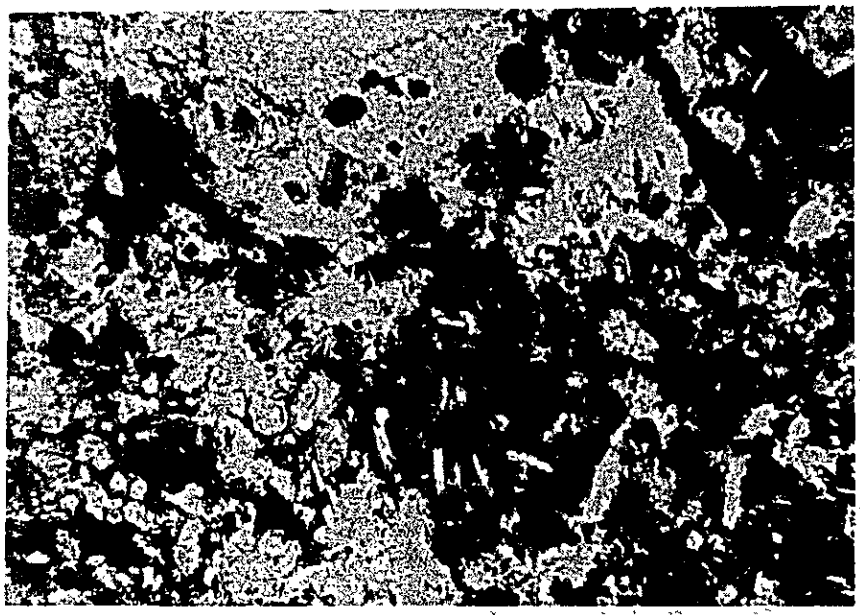
x 40

Cross nicols

Microscopic observation

: Mafic mineral and groundmass are strongly altered to montmorillonite.

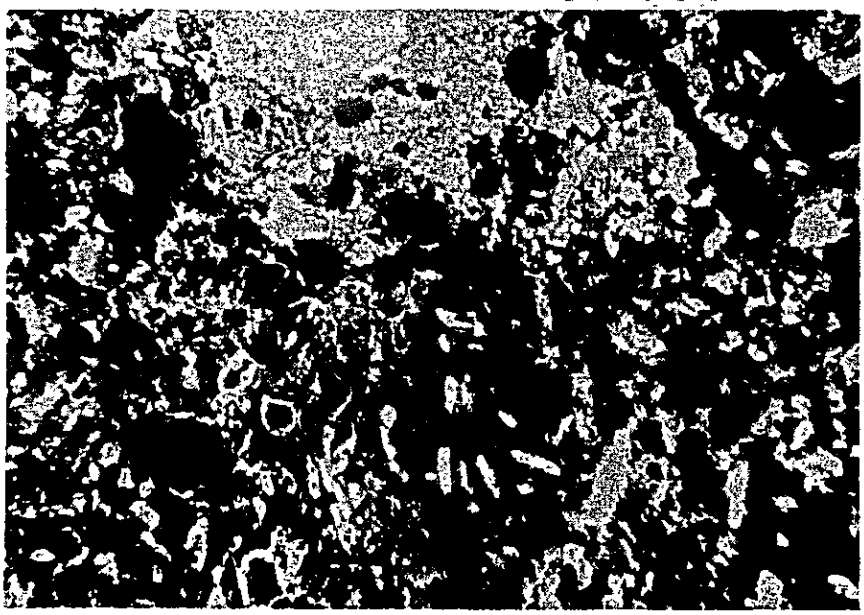
Sample No. T-17 , 611m to 614m



Lapilli tuff

x 40

Open nicols



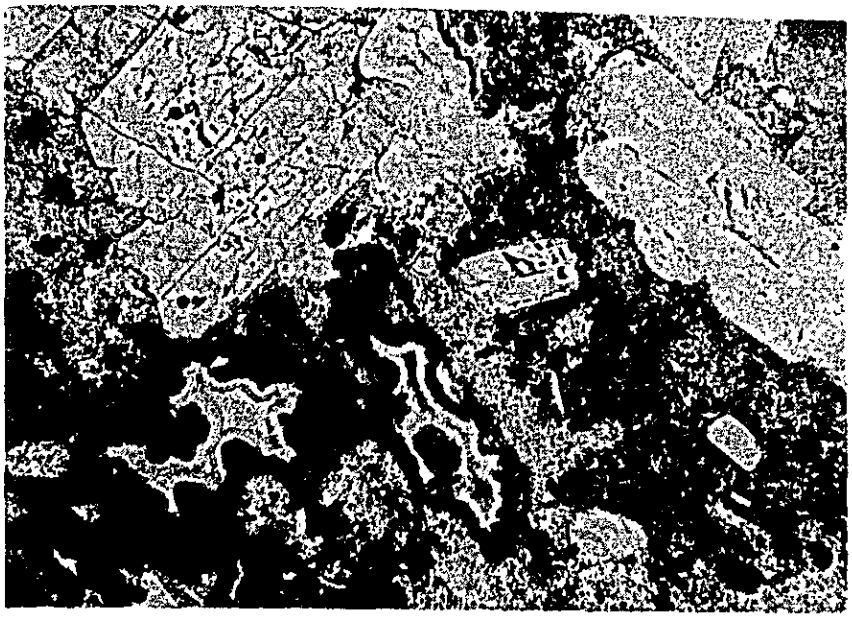
x 40

Cross nicols

Microscopic observation

: Strongly altered pyroclastic rock.
Large amounts of montmorillonite and limonite are observed in the groundmass.

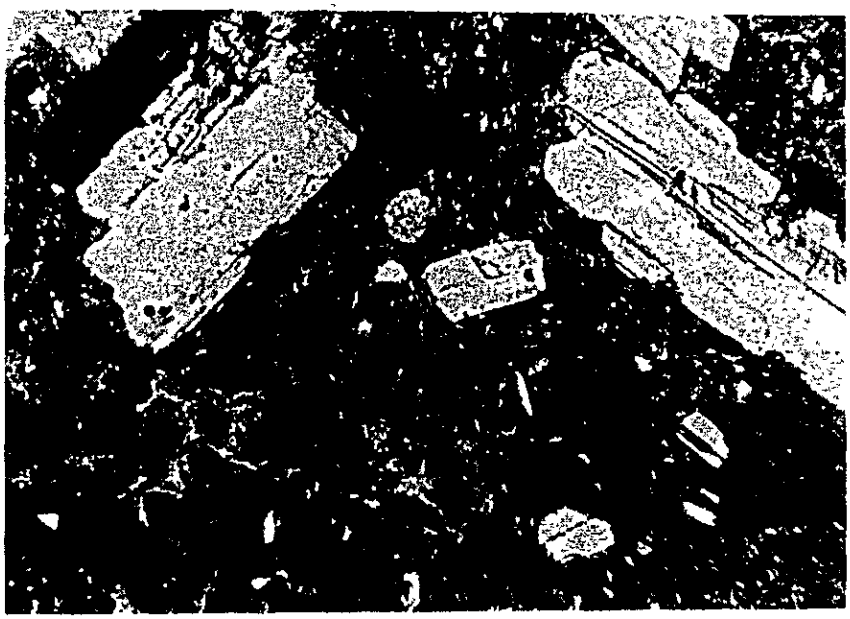
Sample No. T-18 , 641m to 643m



Lapilli tuff

x 40

Open nicols



x 40

Cross nicols

Microscopic observation

: Pyroclastics rock consist of andesite , characterized by flow structure , and dacite. All of mafic mineral and groundmass are altered to montmorillonite and to silica mineral assemblage.

Sample No. T-20 , 702m to 704m

Andesite

x 40

Open nicols

x 40

Cross nicols

Microscopic observation

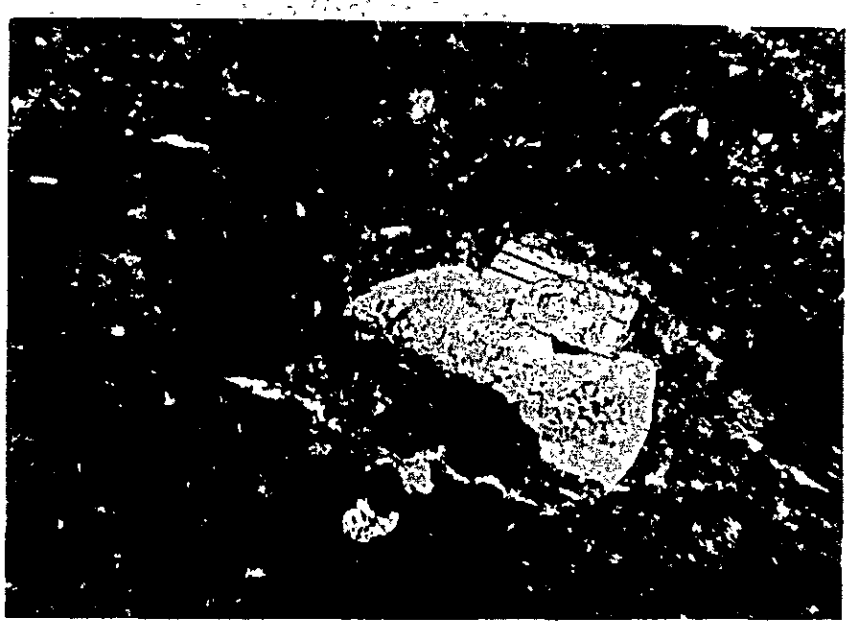
: As a phenocryst plagioclase can be confirmed , and other mafic minerals are altered to montmorillonite. Groundmass consists of plagioclase , secondary fine grained quartz , montmorillonite. The vein consist of montmorillonite and fine grained secondary quartz.

Sample No. T-21 , 733m to 735m

Andesite

x 40

Open nicols



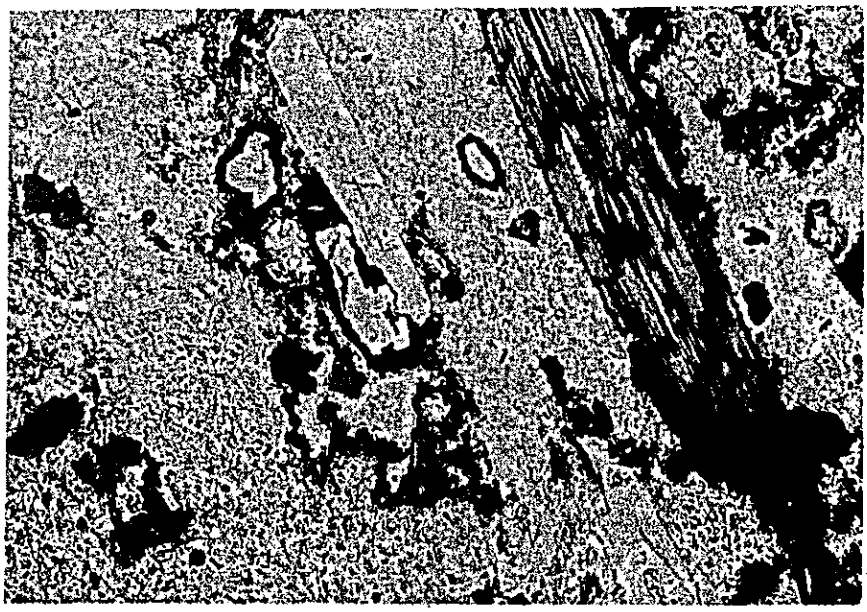
x 40

Cross nicols

Microscopic observation

: The rock is characterized by fine grained andesite with few phenocryst of plagioclase showing flow structure. Groundmass consists of plagioclase , K-feldspar and opaque mineral. Mafic mineral and groundmass are altered to montmorillonite , calcite and other secondary minerals.
Secondary quartz veinlet is rarely observed.

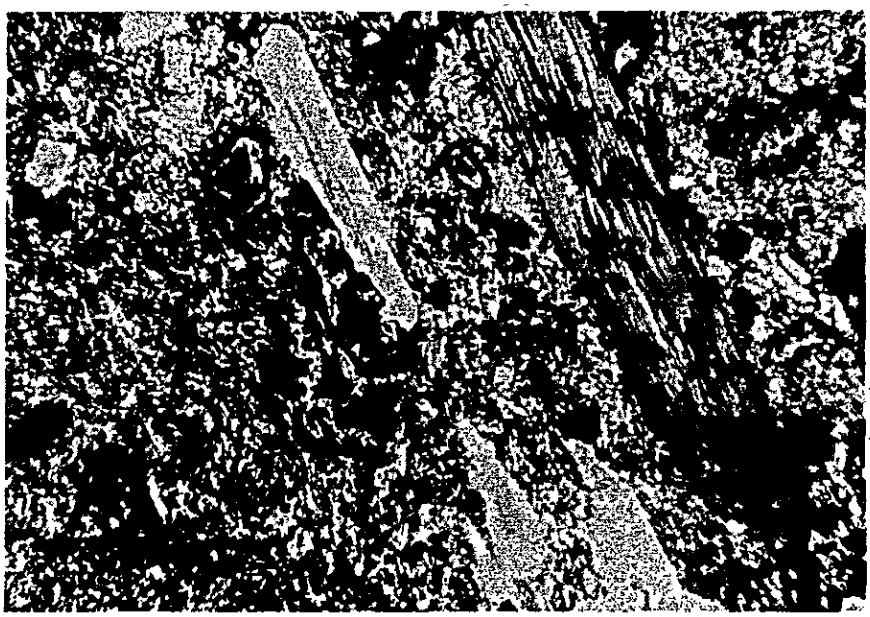
Sample No. T-22 , 763m to 765m



Strongly welded tuff or Dacite

x 40

Open nicols



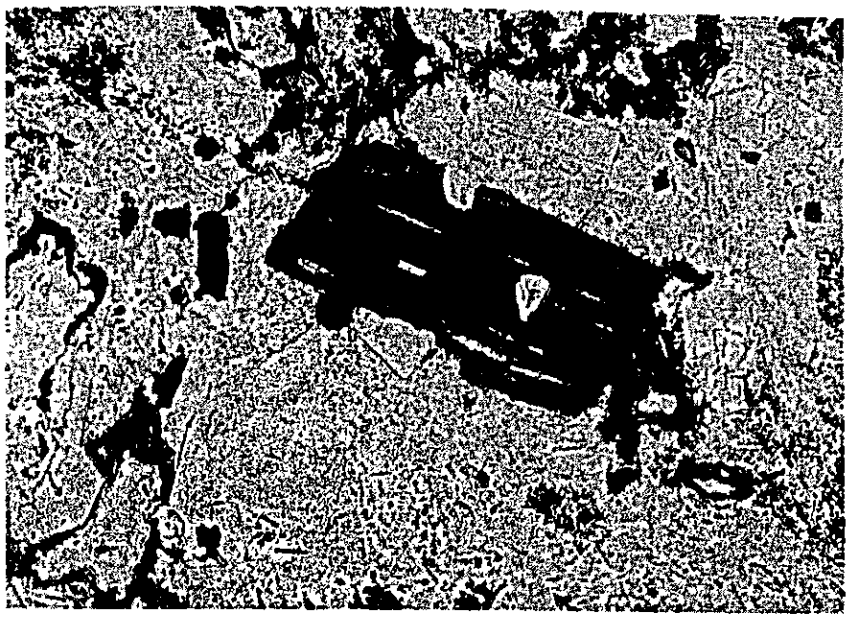
x 40

Cross nicols

Microscopic observation

: The rock is characterized by flow texture. Phenocrysts are composed of plagioclase ,biotite and hornblende , and its groundmass consists of plagioclase , quartz and K-feldspar. Groundmass and mafic mineral are strongly altered to montmorillonite and secondary quartz.

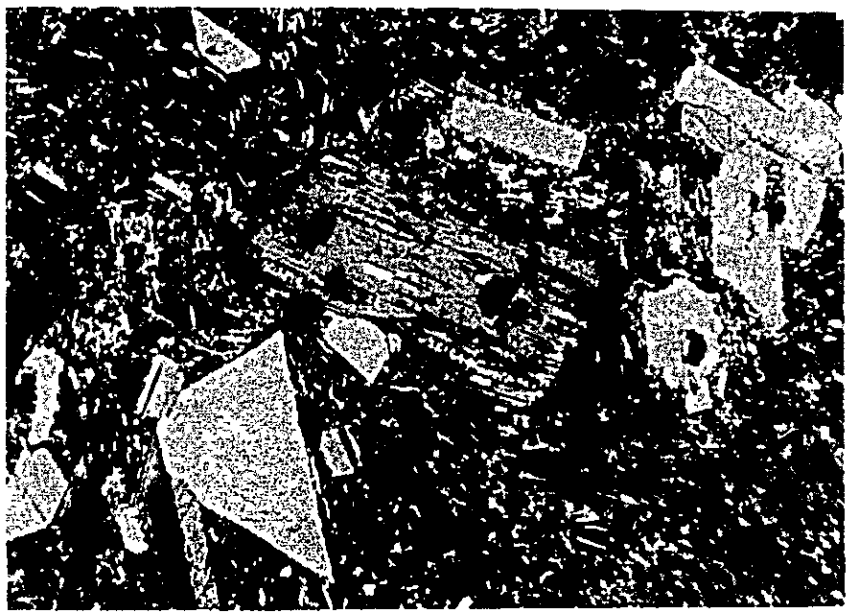
Sample No. T-24 , 812m to 814m



Strongly welded tuff or Dacite

x 40

Open nicols



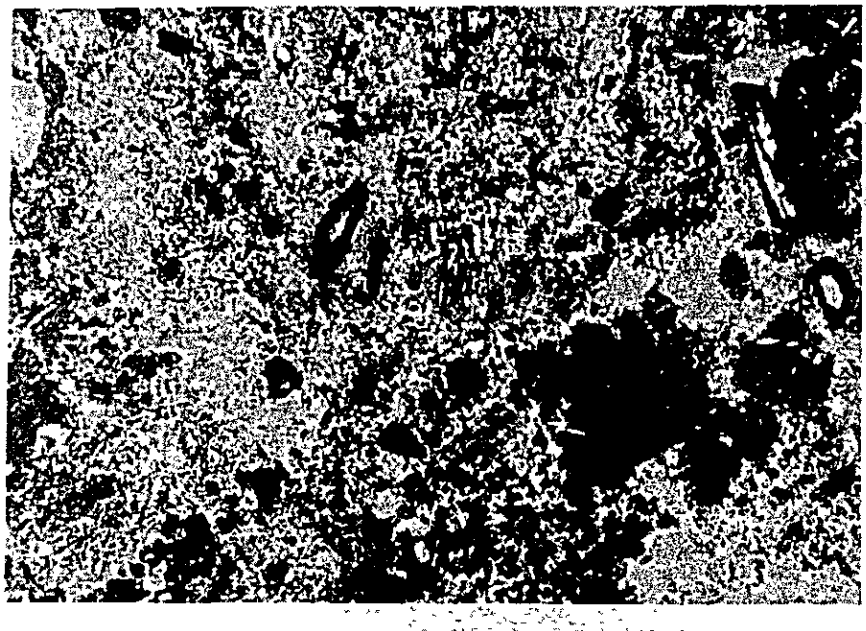
x 40

Cross nicols

Microscopic observation

: The texture and rock forming minerals are same to Sample No. T-22.

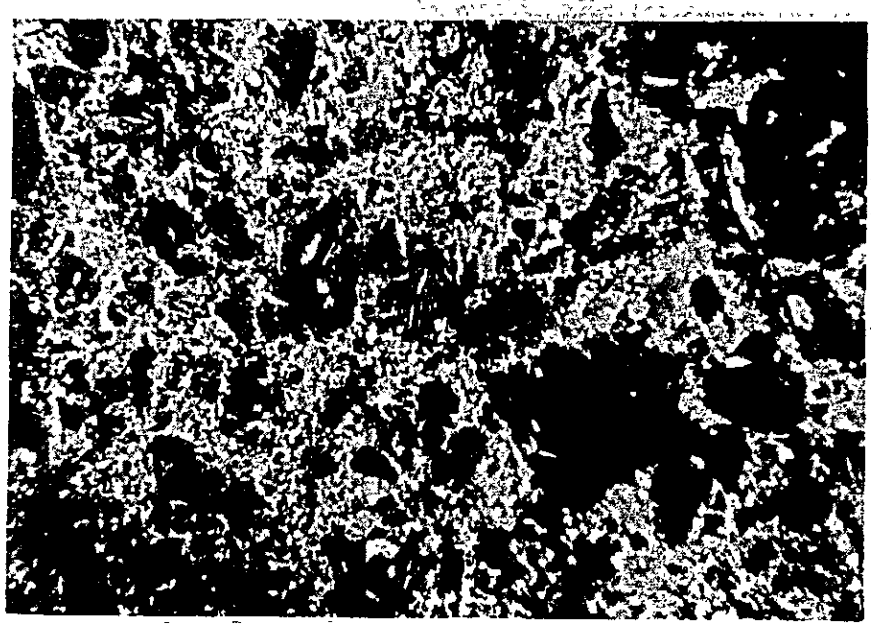
Sample No. T-27 , 904m to 908m



Dacitic tuff

x 40

Open nicols



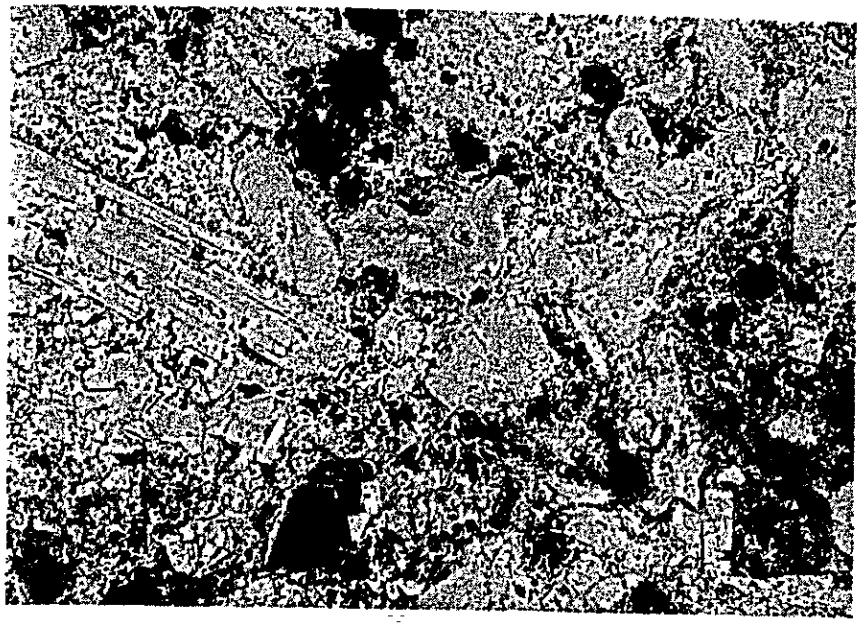
x 40

Cross nicols

Microscopic observation

: Phenocrysts are same to Sample No. T-22 , and its texture is clastic.
Groundmass is strongly altered to montmorillonite and also mafic mineral is altered montmorillonite spot with opasite rim.

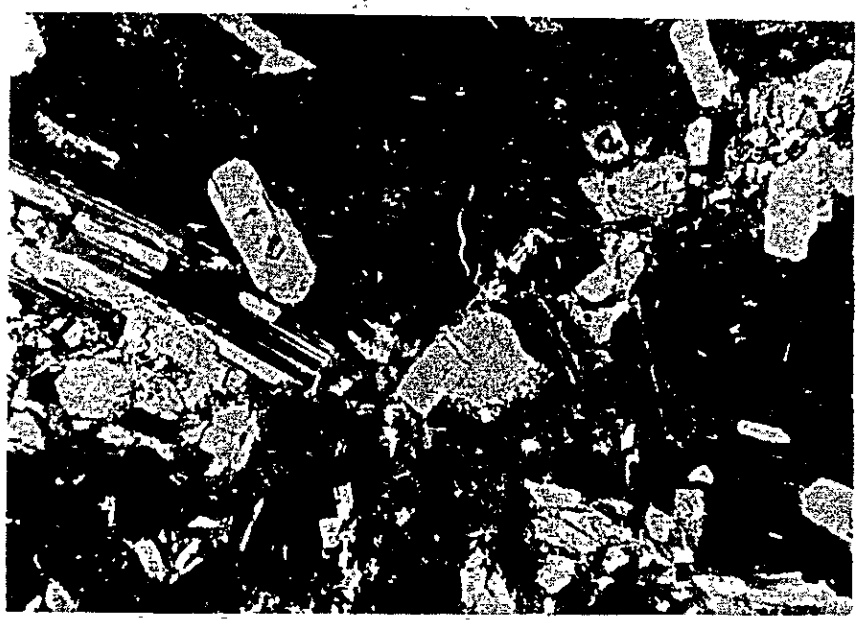
Sample No. T-28 , 935m to 937m



Coarse grained
andesite tuff

x 40

Open nicols



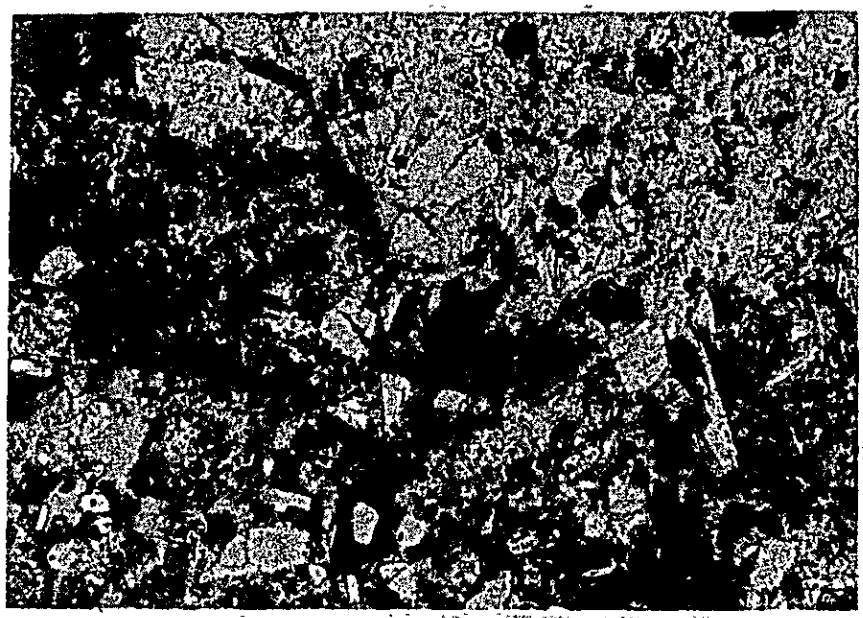
x 40

Cross nicols

Microscopic observation

: Andesitic tuff consist of andesite fragment , plagioclase and opaque mineral.
Groundmass is strongly altered to chlorite calcite and fine grained secondary quartz.

Sample No. T-30 , 996m to 996.3m



Coarse grained andesitic tuff

x 40

Open nicols

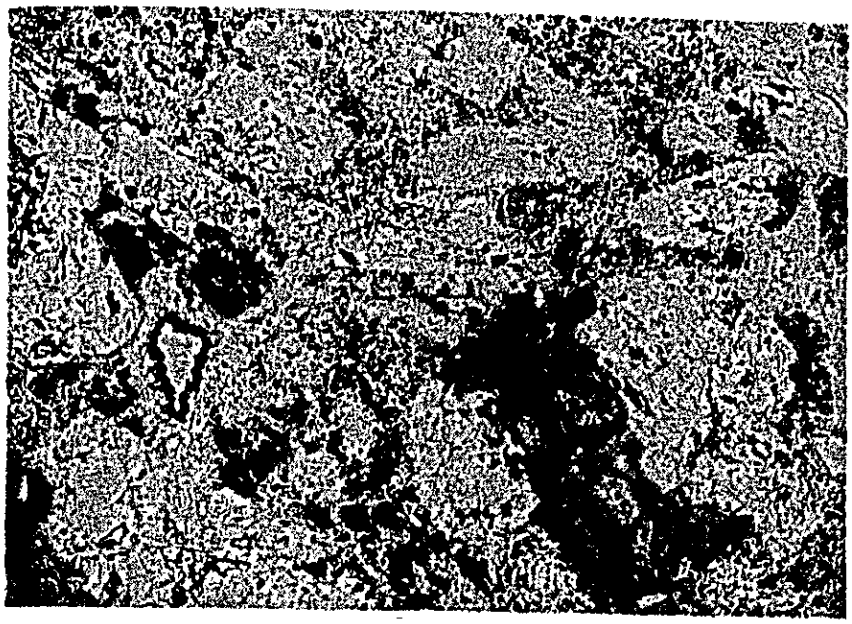
x 40

Cross nicols

Microscopic observation

: Breccia included , texture and alteration are same to Sample No. T-28.

Sample No. T-31 , 1039m to 1041m



Pyroxene andesite

x 40

Open nicols

x 40

Cross nicols

Microscopic observation

: The rock consist of plagioclase , augite and opaque mineral as its phenocryst , and its groundmass is composed of plagioclase , secondary quartz , clay minerals and opaque. Groundmass and mafic minerals are altered to chlorite , and , especially , epidote is recognized in plagioclase phenocryst.

Sample No. T-34 , 1154m to 1157m

Andesite

x 40

Open nicols

x 40

Cross nicols

Microscopic observation

: The texture , phenocryst mineral , and alteration are same to Sample No. T-31.

TEMPERATURE AND PRESSURE LOGGING CONDITION

Temperature and Pressure Logging Condition

Logging No.	I	II		III		
	Temperature	Temperature 1	Temperature 2	Temperature 1	Temperature 2	Temperature 3
Logging Curve No	①	②	③	④	⑤	⑥
Date	21/Oct/1980 Tue.	1/Nov/1980 Sat	2/Nov/1980 Sun	15/Nov/1980 Sat	15/Nov/1980 Sat	16/Nov/1980 Sun
Weather	Fine	Fine	Cloudy	Fine	Fine	Fine
Temperature (℃)	13 0	10 0	12 0	12.5	5 0	13 0
Atmosphere (mb)	600 0	600 0	599 0	598 0	602.0	599.0
Equipment	KTB 10004	KTB 10004	KTB 10004	KTB 10004	KTB 10004	KTB 10004
Drilling depth (m)	463 0	653 0	653 0	814 5	814.5	814.5
Logging depth (m)	300 0	652 0	652 0	800.0	800 0	800 0
Standing time (h)	144 05	4 30	23 40	7:30	16 30	31·00
Final circulation	15/Oct/1980 12 00	1/Nov/1980 10 00	1/Nov/1980 10 00	15/Nov/1980 2 00	15/Nov/1980 2 00	15/Nov/1980 2 00
Logging from	12·05	14 20	9 20	9 23	18 10	9 00
" till	13 03	15 33	11 04	11·02	19 49	10 34
" Final	13.15	16 35	11 40	11:34	20 18	10 58
Water level (-m)	73.0	0	7 0	0	0	0
Water level temp. (°C)	No data	No data	No data	No data	N 18.0	25.0
Bottom temp. (°C)	No data	67 4	111 2	114.5	132.8	142 6
Maximum temp (°C)	60.3	67 4	111 2	114.5	132 8	142.6
and its depth (-m)	300 0	652.0	652 0	800 0	800 0	800 0
Stationary point Thermometer Max Temp. (°C)	60 0	63.0	112.0	118 0	132 0	142.0
Well diameter and its depth (inch, -m)	8 3/4 463 0	8 3/4 653 0	8 3/4 653.0	6 1/8 814 5	6 1/8 814.5	6 1/8 814.5
Casing pipe and its depth (inch, -m)	9 5/8 312 0	9 5/8 312 0	9 5/8 312.0	7 651.5	7 651 5	7 651.5
Slit pipe and its depth (inch, -m)	–	–	–	–	–	–
Circulation Water and its density	Bentonite mud 1.06	Bentonite mud 1 07	Bentonite mud 1 07	Bentonite mud 1 07	Bentonite mud 1.07	Bentonite mud 1.07
Remarks						

Temperature and Pressure Logging Condition

Logging No	IV				
	Temperature 1	Temperature 2	Temperature 3	Temperature 4	Temperature 5
Logging Curve No	⑦	⑧	⑨	⑩	⑪
Date	27/Nov/1980 Tue	28/Nov/1980 Fri.	29/Nov/1980 Sat.	30/Nov/1980 Sun	1/Dec/1980 Mon.
Weather	Fine	Fine	Fine	Fine	Fine
Temperature (°C)	4 0	16 0	15.0	16.0	13.0
Atmosphere (mb)	603.0	599 0	600 0	601.0	600.0
Equipment	KTB 10004	KTB 10004	KTB 10004	KTB 10004	KTB 10004
Drilling depth (m)	1,157 0	1,157.0	1,157.0	1,157.0	1,157.0
Logging depth (m)	1,150 0	1,150.0	1,150 0	1,150 0	1,150 0
Standing time (h)	10 20	23 00	48 00	72·00	
Final circulation	27/Nov/1980 9 00	27/Nov/1980 9 00	27/Nov/1980 9 00	27/Nov/1980 9 00	27/Nov/1980 9 00
Logging from	19 20	9 00	8.57	8.56	9.00
" till	21 20	11.21	11.16	11 33	11.35
" Final	22 05	12:04	11 55	12 08	12 13
Water level (-m)	0	0	0.5	1.5	2.0
Water level temp. (°C)	14.0	19.0	19 0	20 0	22 0
Bottom temp (°C)	146.1	158.9	165.5	168.8	170.5
Maximum temp (°C) and its depth (-m)	146.1 1,150 0	158.9 1,150.0	165.5 1,150.0	169.3 1,150.0	170.5 1,150 0
Stationary point Thermometer Max. Temp (°C)	144.0	154.0	164.0	167.5	169.0
Well diameter and its depth (inch, -m)	6 1/8 1,157	6 1/8 1,157	6 1/8 1,157	6 1/8 1,157	6 1/8 1,157
Casing pipe and its depth (inch, -m)	7, 651.5	7, 651.5	7, 651.5	7, 651.5	7, 651.5
Slit pipe and its depth (inch, -m)	5, 648 0~1,157.0	5, 648.0~1,157.0	5, 648 0~1,157.0	5, 648.0~1,157.0	5, 648.0~1,157.0
Circulation Water and its density	Cool water –	Cool water –	Cool water –	Cool water –	Cool water –
Remarks					

Temperature and Pressure Logging Condition

Logging No	V			
	Pressure 1	Pressure 2	Pressure 3	Temperature 1
Logging Curve No	P 1 , 2 , 3	P 4 , 5 , 6	P 7	⑫
Date	1/Dec/1980 Sun	1/Dec/1980 Sun	4/Dec/1980 Tue	4/Dec/1980 Tue.
Weather	Fine	Fine	Fine	Fine
Temperature (°C)	16 0	16 0	15 0	15 0
Atmosphere (mb)	602	602	599	599
Equipment	KPG 10201	KPG 10201	KPG 7727	KTB 10004
Drilling depth (m)	1,157	1,157	1,157	1,157
Logging depth (m)	200	200	500	1,150
Standing time (h)	–	–	–	after injection
Final circulation	–	–	–	–
Logging from	15 50	15 50	10 10	15 00
" till	16 08	16 08	10 45	16 38
" Final	21·15	21 15	14 00	17.35
Water level (-m)	–	–	–	–
Water level temp (°C)	–	–	–	–
Bottom temp (°C)	–	–	–	166.8
Maximum temp. (°C)	–	–	–	166.8
and its depth (-m)	–	–	–	1,150
Stationary point Thermometer Max. Temp (°C)	–	–	–	165
Well diameter and its depth (Inch, -m)	6 1/8 1,157	6 1/8 1,157	6 1/8 1,157	6 1/8 1,157
Casing pipe and its depth (inch, -m)	7, 651.5	7, 651.5	7, 651.5	7, 651.5
Slit pipe and its depth (inch, -m)	5, 648~1,157	5, 648~1,157	5, 648~1,157	5, 648~1,157
Circulation water and its density	Cool water –	Cool water –	Cool water –	Cool water –
Remarks				

CALCULATION OF ANALIZED RESERVOIR TEMPERATURE

Calculation of Analized Reservoir Temperature (II 1, 2 Curve No.②,③)

Depth (m)	Cooling time (t)	Standing time (θ)	(t + θ)	θ / (t + θ)	Measured Temp. (°C)
100	A) Drilling Date 2/Sep/1980 3:00 B) Final circulation 1/Nov/1980 10:00 C) Hours from A till B 1447 h	1) 4.5 2) 24.0	1) 1451.5 2) 1471.0	1) 0.0031 2) 0.0163	1) 48.0 2) 44.7
200	A) Drilling Date 10/Sep/1980 11:00 B) Final circulation 1/Nov/1980 10:00 C) Hours from A till B 1247 h	1) 4.9 2) 24.3	1) 1251.9 2) 1271.3	1) 0.0039 2) 0.0191	1) 50.7 2) 51.1
300	A) Drilling Data 14/Sep/1980 15:00 B) Final circulation 1/Nov/1980 10:00 C) Hours from A till B 1147 h	1) 5.0 2) 24.5	1) 1152.0 2) 1171.5	1) 0.0043 2) 0.0209	1) 51.8 2) 56.3
400	A) Drilling Date 13/Oct/1980 4:00 B) Final circulation 1/Nov/1980 10:00 C) Hours from A till B 462 h	1) 5.2 2) 24.8	1) 467.2 2) 486.8	1) 0.0111 2) 0.0509	1) 54.4 2) 59.7
500	A) Drilling Date 27/Oct/1980 12:00 B) Final circulation 1/Nov/1980 10:00 C) Hours from A till B 118 h	1) 5.3 2) 25.0	1) 123.3 2) 143.0	1) 0.0430 2) 0.1748	1) 57.8 2) 77.2
600	A) Drilling Date 30/Oct/1980 9:00 B) Final circulation 1/Nov/1980 10:00 C) Hours from A till B 49 h	1) 5.4 2) 25.8	1) 54.4 2) 74.8	1) 0.0993 2) 0.3449	1) 59.8 2) 93.9

Calculation of Analized Reservoir Temperature (III. 1 ~ 3, Curve No.④~⑥)

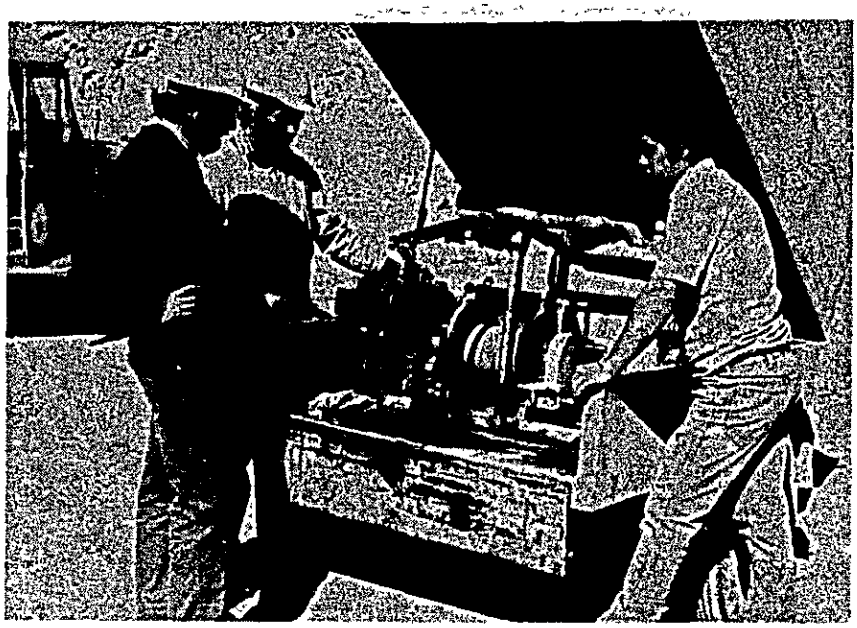
Depth(m)	Cooling time (t)	Standing time (θ)	(t + θ)	θ/(t + θ)	Measured Temp. (°C)
100	A) Drilling Date 2/Sep/1980 3:00 B) Final circulation 15/Nov/1980 2:00 C) Hours from A till B 2447.0 h	1) 7.6 2) 16.3 3) 31.4	1) 2454.6 2) 2463.3 3) 2478.4	1) 0.0031 2) 0.0066 3) 0.0127	1) 44.4 2) 45.5 3) 43.9
200	A) Drilling Date 10/Sep/1980 11:00 B) Final circulation 15/Nov/1980 2:00 C) Hours from A till B 1575.0 h	1) 7.7 2) 16.5 3) 31.6	1) 1582.7 2) 1591.5 3) 1606.6	1) 0.0048 2) 0.0104 3) 0.0197	1) 51.9 2) 54.6 3) 53.5
300	A) Drilling Date 14/Sep/1980 15:00 B) Final circulation 15/Nov/1980 2:00 C) Hours from A till B 1475.0 h	1) 7.9 2) 16.7 3) 31.8	1) 1482.9 2) 1491.7 3) 1506.8	1) 0.0053 2) 0.0112 3) 0.0314	1) 57.3 2) 60.3 3) 59.1
400	A) Drilling Date 13/Oct/1980 4:00 B) Final circulation 15/Nov/1980 2:00 C) Hours from A till B 790.0 h	1) 8.2 2) 16.8 3) 31.9	1) 798.2 2) 806.8 3) 821.9	1) 0.0103 2) 0.0208 3) 0.0388	1) 64.3 2) 69.3 3) 71.0
500	A) Drilling Date 27/Oct/1980 12:00 B) Final circulation 15/Nov/1980 2:00 C) Hours from A till B 446.0 h	1) 8.4 2) 16.9 3) 32.1	1) 454.4 2) 462.9 3) 478.1	1) 0.0185 2) 0.0365 3) 0.0671	1) 72.1 2) 78.1 3) 82.7
600	A) Drilling Date 30/Oct/1980 9:00 B) Final circulation 15/Nov/1980 2:00 C) Hours from A till B 377.0 h	1) 8.6 2) 17.3 3) 32.3	1) 385.6 2) 394.3 3) 409.3	1) 0.0223 2) 0.0439 3) 0.0789	1) 77.7 2) 88.8 3) 93.4
700	A) Drilling Date 10/Nov/1980 5:00 B) Final circulation 15/Nov/1980 2:00 C) Hours from A till B 117.0 h	1) 8.8 2) 17.5 3) 32.5	1) 125.8 2) 134.5 3) 149.5	1) 0.0700 2) 0.1301 3) 0.2174	1) 90.5 2) 103.1 3) 109.4
800	A) Drilling Date 14/Nov/1980 15:00 B) Final circulation 15/Nov/1980 2:00 C) Hours from A till B 11.0 h	1) 9.0 2) 17.8 3) 32.7	1) 20.0 2) 28.8 3) 43.7	1) 0.4500 2) 0.6180 3) 0.7483	1) 114.5 2) 132.5 3) 142.6

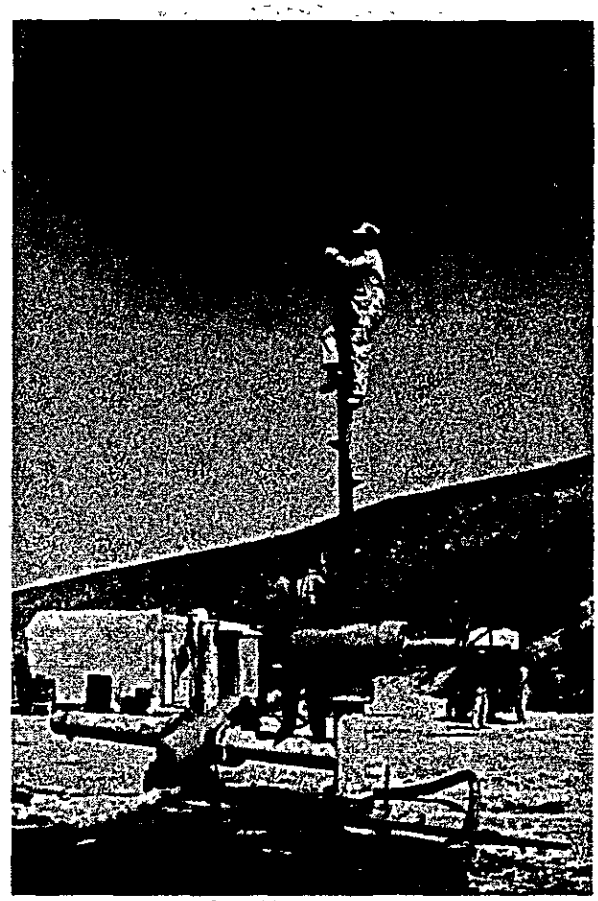
Calculation of Analized Reservoir Temperature (IV 1 ~ 5, Curve No⑦~①)

Depth (m)	Cooling time (t)	Standing Time (θ)	(t+θ)	θ/(t+θ)	Measured Temp (°C)
100	A) Drilling Date 2/Sep/1980 3 00 B) Final circulation 27/Nov/1980 9 00 C) Hours from A till B 2070 h	1) 10.6 2) 23.2 3) 48 1 4) 72 1 5) 96 3	1) 2,080 65 2) 2,093.2 3) 2,118 1 4) 2,142 1 5) 2,166 2	1) 0 0051 2) 0 0111 3) 0 0227 4) 0 0337 5) 0 0445	1) 49.2 2) 44 3 3) 43.8 4) 44 0 5) 46 6
200	A) Drilling Date 10/Sep/1980 11 00 B) Final circulation 27/Nov/1980 9 00 C) Hours from A till B 1870 h	1) 10 8 2) 23 4 3) 48 3 4) 72.3 5) 96 4	1) 1,880 8 2) 1,893 4 3) 1,918 3 4) 1,942.3 5) 1,966 4	1) 0 0057 2) 0 0124 3) 0 0252 4) 0 0372 5) 0.0490	1) 57.3 2) 57.6 3) 56.3 4) 57 0 5) 56 9
300	A) Drilling Date 14/Sep/1980 15 00 B) Final circulation 27/Nov/1980 9 00 C) Hours from A till B 1770 h	1) 11.0 2) 23 6 3) 48.5 4) 72 5 5) 96 6	1) 1,781.0 2) 1,793.6 3) 1,818.5 4) 1,842.5 5) 1,866 6	1) 0 0062 2) 0 0132 3) 0 0267 4) 0 0393 5) 0 0518	1) 65 4 2) 67 9 3) 64 8 4) 66 4 5) 66 9
400	A) Drilling Date 13/Oct/1980 4 00 B) Final circulation 27/Nov/1980 9 00 C) Hours from A till B 1085 h	1) 11 1 2) 23 8 3) 48 7 4) 72 7 5) 96.9	1) 1,096 1 2) 1,108 8 3) 1,133 7 4) 1,157 7 5) 1,181.9	1) 0 0101 2) 0.0215 3) 0 0430 4) 0 0628 5) 0 0820	1) 77 1 2) 78.3 3) 77 7 4) 79 8 5) 81 8
500	A) Drilling Date 27/Oct/1980 12 00 B) Final circulation 27/Nov/1980 9 00 C) Hours from A till B 741 h	1) 11.3 2) 24 0 3) 48 9 4) 72 9 5) 97 1	1) 752.3 2) 765 0 3) 789 9 4) 813 9 5) 838 1	1) 0 0150 2) 0 0314 3) 0 0619 4) 0 0896 5) 0 1159	1) 86.9 2) 89 1 3) 90 8 4) 93.3 5) 94.8
600	A) Drilling Date 30/Oct/1980 9 00 B) Final circulation 27/Nov/1980 9 00 C) Hours from A till B 672 h	1) 11 4 2) 24.2 3) 49 1 4) 73 1 5) 97.3	1) 683 4 2) 696 2 3) 721 1 4) 745 1 5) 769.3	1) 0 0167 2) 0 0348 3) 0 0681 4) 0 0981 5) 0 1265	1) 94 9 2) 99 6 3)102 3 4)106.3 5)108 3
700	A) Drilling Date 10/Nov/1980 5 00 B) Final circulation 27/Nov/1980 9.00 C) Hours from A till B 412 h	1) 11 6 2) 24 4 3) 49.3 4) 73.3 5) 97.5	1) 423 6 2) 436 4 3) 461.3 4) 485.3 5) 509.5	1) 0 0274 2) 0 0559 3) 0 1069 4) 0 1510 5) 0 1914	1)105 1 2)111 7 3)117 2 4)120 6 5)124 4
800	A) Drilling Date 14/Nov/1980 15.00 B) Final circulation 27/Nov/1980 9.00 C) Hours from A till B 306 h	1) 11 7 2) 24.6 3) 49.5 4) 73.5 5) 97.8	1) 317.7 2) 330.6 3) 355 5 4) 379 5 5) 463.8	1) 0 0368 2) 0 0744 3) 0 1392 4) 0 1937 5) 0 2422	1)112.6 2)121 4 3)127 7 4)131 7 5)136 6
900	A) Drilling Date 19/Nov/1980 4 00 B) Final circulation 27/Nov/1980 9 00 C) Hours from A till B 197 h	1) 11 9 2) 24.8 3) 49.7 4) 73 8 5) 98 0	1) 208 9 2) 221.8 3) 246 7 4) 270 8 5) 295 0	1) 0 0570 2) 0.1118 3) 0 2015 4) 0 2725 5) 0 3322	1)120 1 2)130.7 3)138 5 4)143 2 5)146 3
1,000	A) Drilling Date 22/Nov/1980 2 00 B) Final circulation 27/Nov/1980 9 00 C) Hours from A till B 127 h	1) 12 0 2) 25 0 3) 49.9 4) 74 1 5) 98.2	1) 139 0 2) 152 0 3) 176.9 4) 201 1 5) 225 2	1) 0 0863 2) 0 1645 3) 0 2821 4) 0.3685 5) 0 4361	1)127.9 2)139.5 3)147 1 4)152 1 5)155.8
1,100	A) Drilling Date 24/Nov/1980 20 00 B) Final circulation 27/Nov/1980 9 00 C) Hours from A till B 61 h	1) 12.2 2) 25.2 3) 50 1 4) 74 4 5) 98 4	1) 73.2 2) 86.2 3) 111 1 4) 135.4 5) 159 4	1) 0 1667 2) 0 2923 3) 0 4509 4) 0 5495 5) 0.6173	1)138 6 2)151.5 3)159.2 4)163 2 5)167 2
1,150	A) Drilling Date 26/Nov/1980 14 00 B) Final circulation 27/Nov/1980 9 00 C) Hours from A till B 19h	1) 12.3 2) 25.4 3) 50 3 4) 74 5 5) 94 6	1) 31.3 2) 44 4 3) 69 3 4) 93 5 5) 113.6	1) 0.3930 2) 0 5721 3) 0 7258 4) 0 7968 5) 0 8327	1)146 1 2)158 9 3)165.5 4)169.3 5)171.5

PHOTOGRAPHS

Geological survey





Logging survey