UNIVERSITAS TRISAKTI

FAKULTAS TEKNOLOGI KEBUMIAN DAN ENERGI

Kampus A, Gedung D Lt.5, Jalan Kyai Tapa No.1, Jakarta 11440
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Website: www.trisakti.ac.id E-mail : ftke@trisakti.ac.id

Nomor : 343/A.2/Dek-FTKE/USAKTI/IX/2023
Lampiran : -
Perihal : Permohonan Narasumber *Training of Trainer*

Kepada Yth. Dekan
Fakultas Teknologi Mineral
Universitas Pembangunan Nasional "Veteran" Yogyakarta
Di Tempat

Dengan hormat,
Dalam rangka memenuhi Tridharma Perguruan Tinggi yaitu Pendidikan dan Pengembangan Kompetensi Dosen di lingkup FTKE Universitas Trisakti, kami bermaksud menyelenggarakan kegiatan *Training of Trainer* (ToT) dengan tema "Eksplorasi Geothermal".

Sehubungan dengan hal tersebut, bersama ini kami mengundang salah satu staff Dosen Prodi Teknik Geologi, Fakultas Teknologi Mineral, UPN "Veteran" Yogyakarta yaitu Bapak Dr. Ir. Dwi Fitri Yudiantoro, M.T., sebagai Narasumber yang sesuai dengan tema kegiatan ToT.

Adapun kegiatan tersebut akan dilaksanakan pada:

Hari/ Tanggal	: Senin & Selasa, 25-26 September 2023
Jam	: 08.00 s.d 16.00 (WIB)
Tempat	: Ruang Diponegoro, Lantai 5, Gedung D, Universitas Trisakti

Demikian permohonan ini kami sampaikan, atas perhatian dan kerjasamanya kami ucapkan terima kasih.

UNIVERSITAS TRISAKTI ☆ FAK. TEKNOLOGI KEBUMIAN dan ENERGI ☆

Jakarta, 20 September 2023
Dekan

Dr. Ir. Mohammad Burhannudinnur, M.Sc., IPU.
NIK : 1978/USAKTI

CP:
Mira Meirawaty, S.T., M.T. (081910332838)

KEMENTERIAN PENDIDIKAN, KEBUDAYAAN, RISET, DAN TEKNOLOGI
UNIVERSITAS PEMBANGUNAN NASIONAL "VETERAN" YOGYAKARTA
FAKULTAS TEKNOLOGI MINERAL
Jl. Padjajaran (SWK) 104 (Lingkar Utara) Condongcatur, Yogyakarta 55283 Telp./Fax (0274) 487813
Jl. Babarsari 2, Tambakbayan, Yogyakarta 55281 Telp. /Fax (0274) 486911
Email: ftm@upnyk.ac.id ; Home Page: http://www.ftmineral.upnyk.ac.id

SURAT TUGAS
Nomor : B /2090 / UN62.11 / ST / 2023

1. Berdasarkan surat dari Ketua Jurusan Teknik Geologi Nomor : 144 / UN62.11.01. / TU / 2023, tertanggal 24 September 2023 , Perihal Permohonan Surat Tugas.

2. Berdasarkan surat dari Universitas Trisakti Nomor : 343/A.2/Dek-FTKE/USAKTI/IX/2023 tanggal 20 September 2023, Perihal Permohonan Narasumber Trainer of Trainer

3. Sehubungan dengan hal tersebut di atas bersama ini,

Dekan Fakultas Teknologi Mineral Universitas Pembangunan Nasional UPN "Veteran" Yogyakarta, memberikan tugas kepada :

NO	NAMA	NIP/NIK	Pangkat / Gol
1	Dr. Ir. Dwi Fitri Yudiantoro, M.T.	19630225 199003 1 002	Pembina Utama Muda – IV/c

Untuk melaksanakan tugas sebagai Dosen Tamu dalam kegiatan Trainer of Trainer di Universitas Trisakti yang dilaksanakan pada :

Hari/tanggal : Senin dan Selasa / 25 – 26 September 2023
Pukul : 08.00 WIB – Selesai.
Tempat : Ruang Diponegoro, Lantai 5, Gedung D , Universitas Trisakti.

4. Surat tugas ini dibuat untuk dilaksanakan dengan penuh tanggung jawab.

Yogyakarta, 25 September 2023
Dekan

Dr.Ir. Sutarto, MT
NIP.19650301 199103 1 001

Tembusan Yth.:
Ketua Jurusan Teknik Geologi
Fakultas Teknologi Mineral
UPN "Veteran" Yogyakarta


ANALISIS
MINERAL LEMPUNG
UNTUK PANAS BUMI
Dr. Dwi Fitri Yudiantoro

GARIS BESAR PEMBAHASAN

1. METODE IDENTIFIKASI MINERAL LEMPUNG
2. TABEL MINERAL PADA CLAY DAN ASOSIASINYA (PEI YUAN CHEN)
3. MIXED LAYER CLAY

1. METODE IDENTIFIKASI MINERAL LEMPUNG

1. BULK (AIR DRY)
2. ORIENTATE
3. ETHYLEN GLYCOL
4. HEATING 550^{o}C

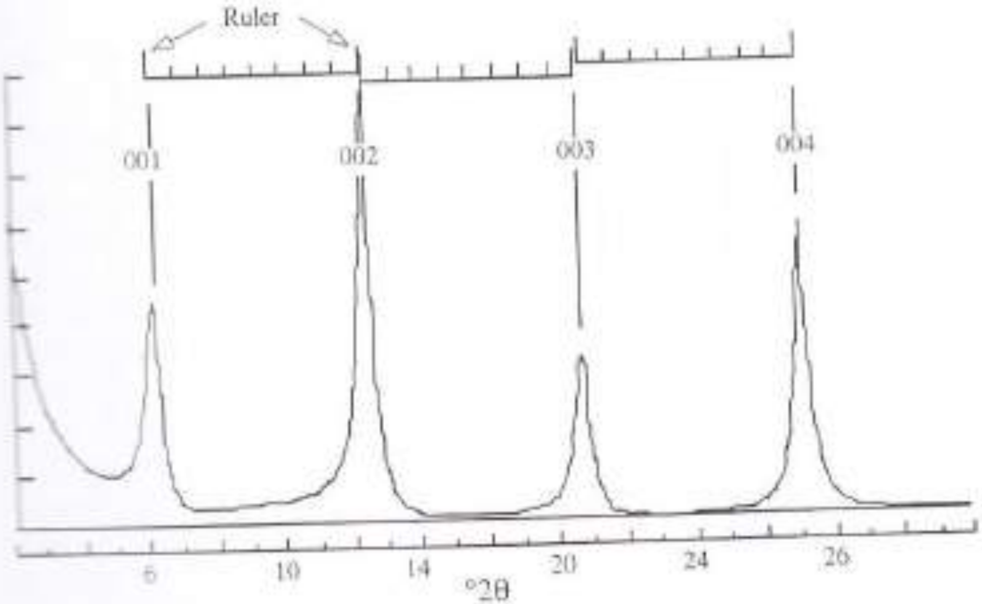


Fig. 7.1. Uniform separation of members of the 00l diffraction series for chlorite.

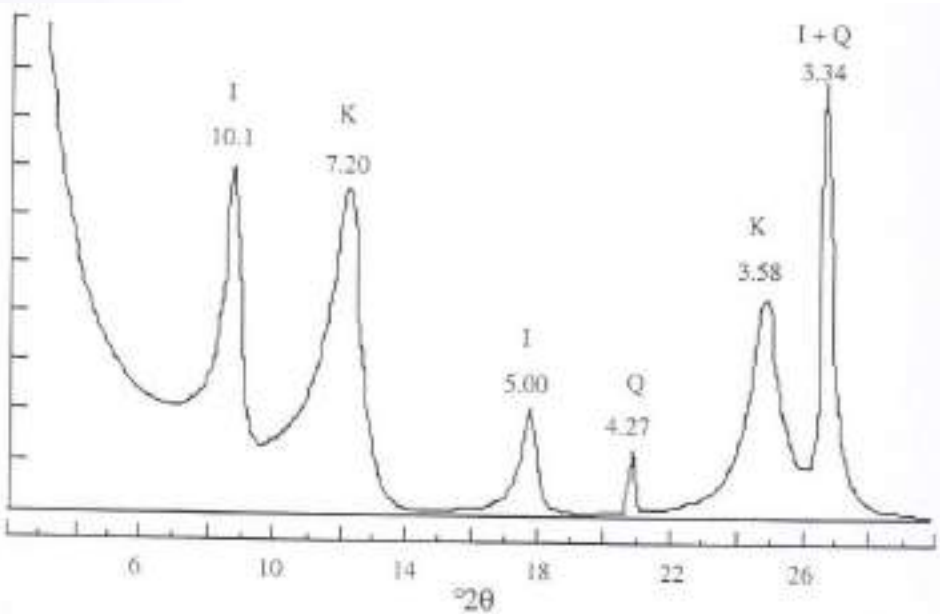


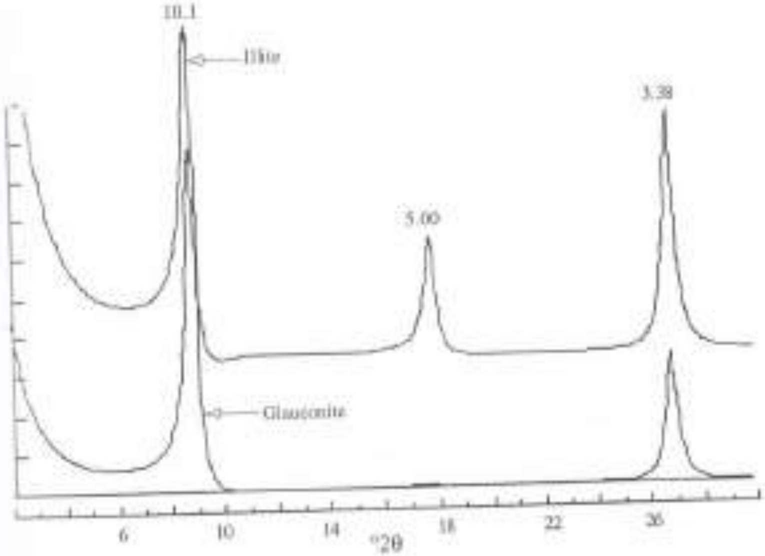
Fig. 7.2. A mixture of illite, kaolinite, and quartz.

X-Ray Diffraction and the Identification and Analysis of Clay Minerals

SECOND EDITION

DUANE M. MOORE
Illinois State Geological Survey

ROBERT C. REYNOLDS, JR.
Dartmouth College



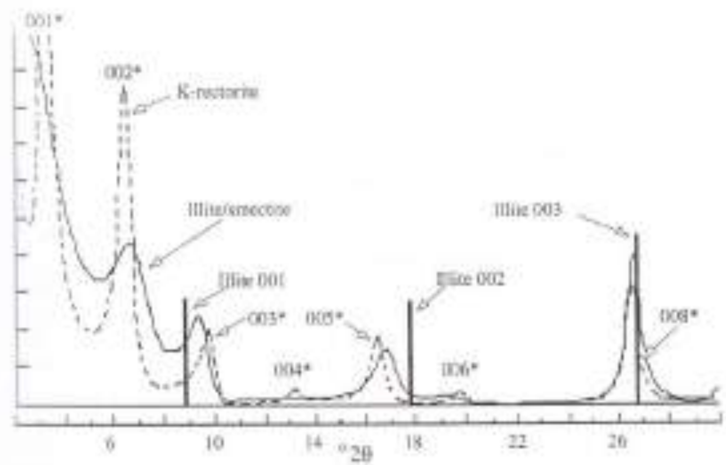
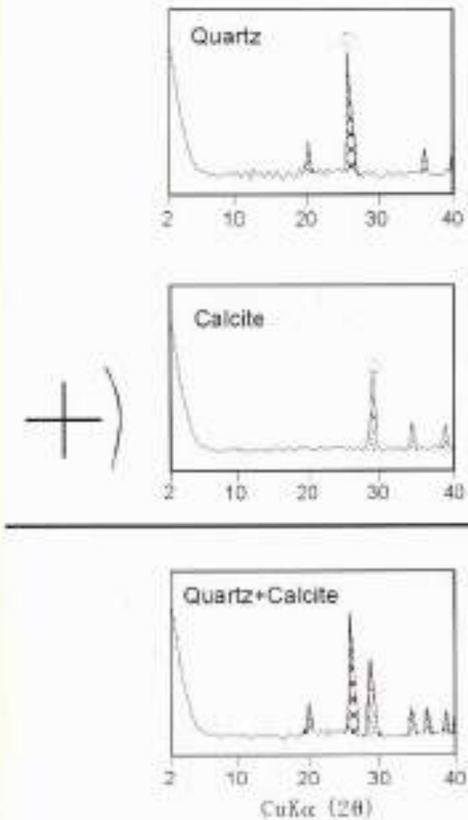


Fig. 8.2. *R*1 illite(0.7)/EG-smectite and EG-K-rectorite[*R*1 illite(0.5)/EG-smectite] and the positions of the peaks for pure illite.

岩石試料 ──► 複数の鉱物の集合体



石英試料

方解石試料

石英と方解石の混合試料

解析の方針 (Basic procedure for identification)

予想される鉱物の結晶面のピーク位置とその強度比を示した短冊を作成し，そのX線回折パターンと測定データを比較すると鉱物を同定することができる．

未同定ピークが残ったときに三強線法で鉱物同定を行なう．

注目すべきピーク位置 Important positions of peak for identification

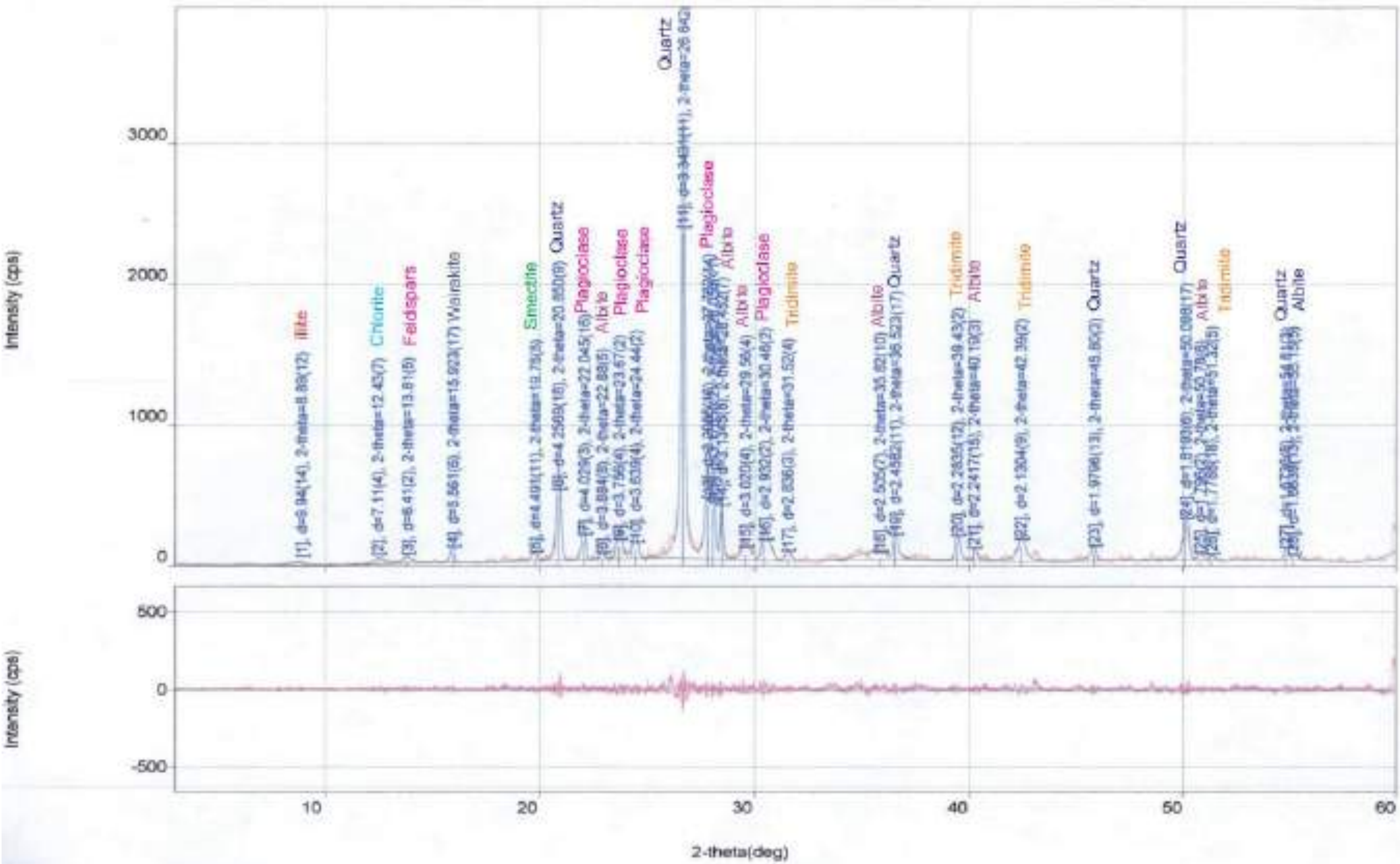
	CuKα (2θ)		CuKα (2θ)
石英 (quartz)	26.8	濁沸石 (laumontite)	9.3
斜長石 (plagioclase)	=28	方沸石 (analcime)	15.8
カリ長石 (K-feldspar)	=27	輝沸石 (heulandite)	10.0
角閃石 (hornblende)	10.2	束沸石 (stilbite)	9.8
黒雲母 (biotite)	8.7	モルデン沸石 (mordenite)	9.7
黒雲母 (muscovite)	8.9	斜プチロル沸石 (clinoptilolite, クライノタイロライト)	9.8
クリストバライト (cristobalite)	21.5 - 22.0		
モンモリロン石 (montmorillonite)	5.8	方解石 (calcite)	29.4
		苦灰石 (dolomite)	31.0
絹雲母(sericite)	8.9	重晶石 (barite)	25.8
イライト (illite)	8.9	硬石膏 (anhydrite)	25.4
緑泥石 (chlorite)	6.2	石膏 (gypsum)	11.7
カオリナイト (kaolinite)	12.3	黄鉄鉱 (pyrite)	33.1

鉱物量比のめやす (Standard for estimation of mineral abundance)

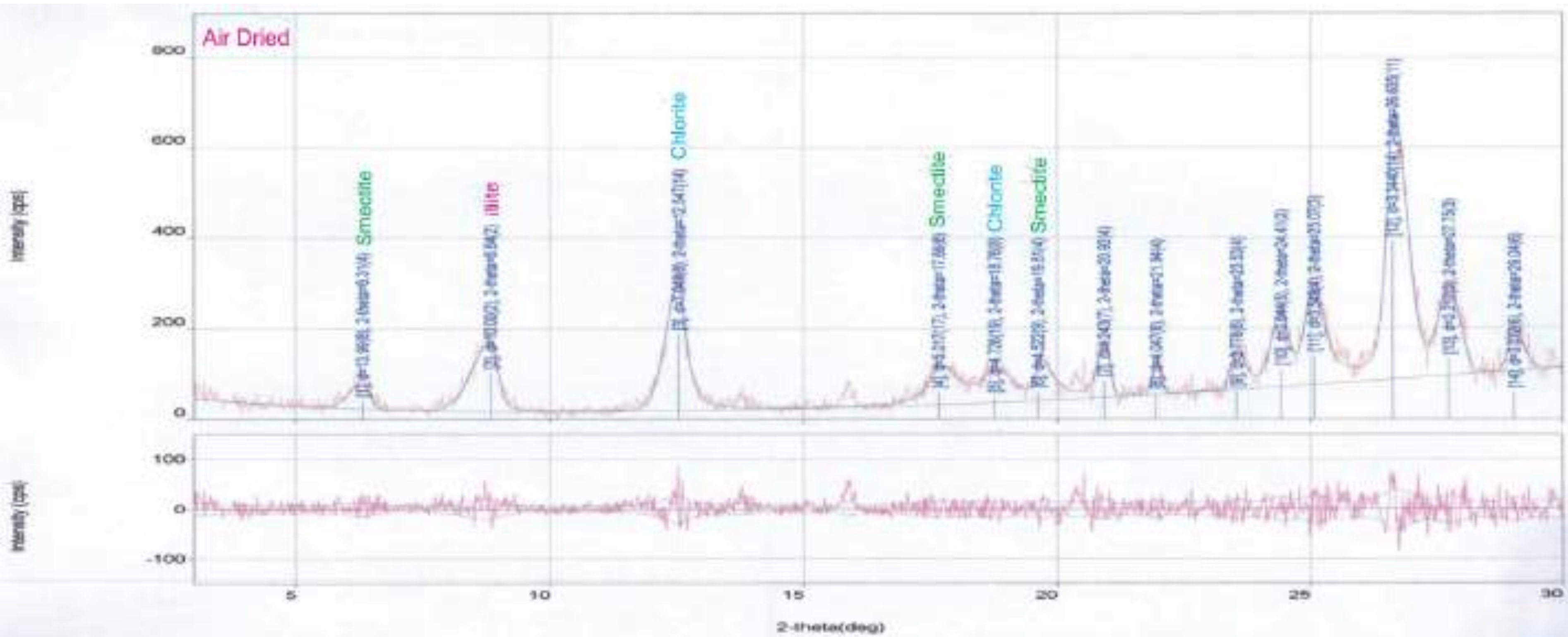
	2θ(CuKα) = 2−20°		2θ(CuKα) > 20°	
very abundant	多量（◎）	400 cps 以上	多量（◎）	800 cps 以上
abundant	中量（○）	400 − 200 cps	中量（○）	800 − 400 cps
few	少量（△）	200 cps 以下	少量（△）	400 cps 以下

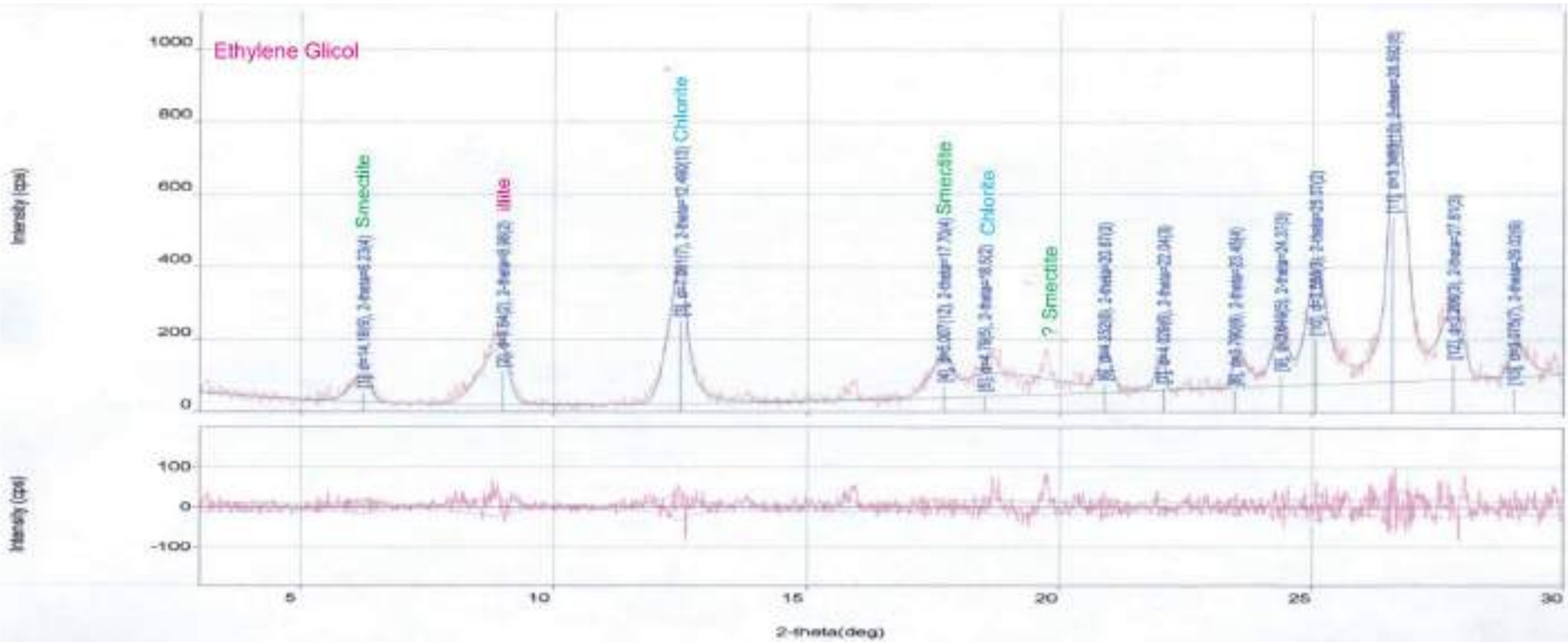
鉱物量比の比較に使用するピークの位置 (positions of peak for estimation of abundance of minerals)

	CuKα (2θ)		CuKα (2θ)
石英 (quartz)	26.8	濁沸石 (laumontite)	9.3
斜長石 (plagioclase)	≈28	方沸石 (analcime)	15.8
カリ長石 (K-feldspar)	≈27	輝沸石 (heulandite)	10.0
角閃石 (hornblende)	10.2	束沸石 (stilbite)	9.8
黒雲母 (biotite)	8.7	モルデン沸石 (mordenite)	9.7
黒雲母 (muscovite)	8.9	斜プチロル沸石 (clinoptilolite, クライノタイロライト)	9.8
クリストバライト (cristobalite)	21.5 - 22.0		
モンモリロン石 (montmorillonite)	5.8	方解石 (calcite)	29.4
		苦灰石 (dolomite)	31.0
絹雲母(sericite)	8.9	重晶石 (barite)	25.8
イライト (illite)	8.9	硬石膏 (anhydrite)	25.4
緑泥石 (chlorite)	6.2	石膏 (gypsum)	11.7
カオリナイト (kaolinite)	12.3	黄鉄鉱 (pyrite)	33.1


Intensity (cps)
2-theta(deg)
Quartz
Plagioclase
Albite
Illite
Chlorite
Feldspars
Smectite
Tridimite

Bulk


Air Dried
Smectite
Illite
Chlorite
Smectite
Chlorite
Smectite
Intensity (cps)
2-theta(deg)


Ethylene Glicol
Smectite
Illite
Chlorite
Smectite
Chlorite
? Smectite
Intensity (cps)
Intensity (cps)
2-theta(deg)
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-100
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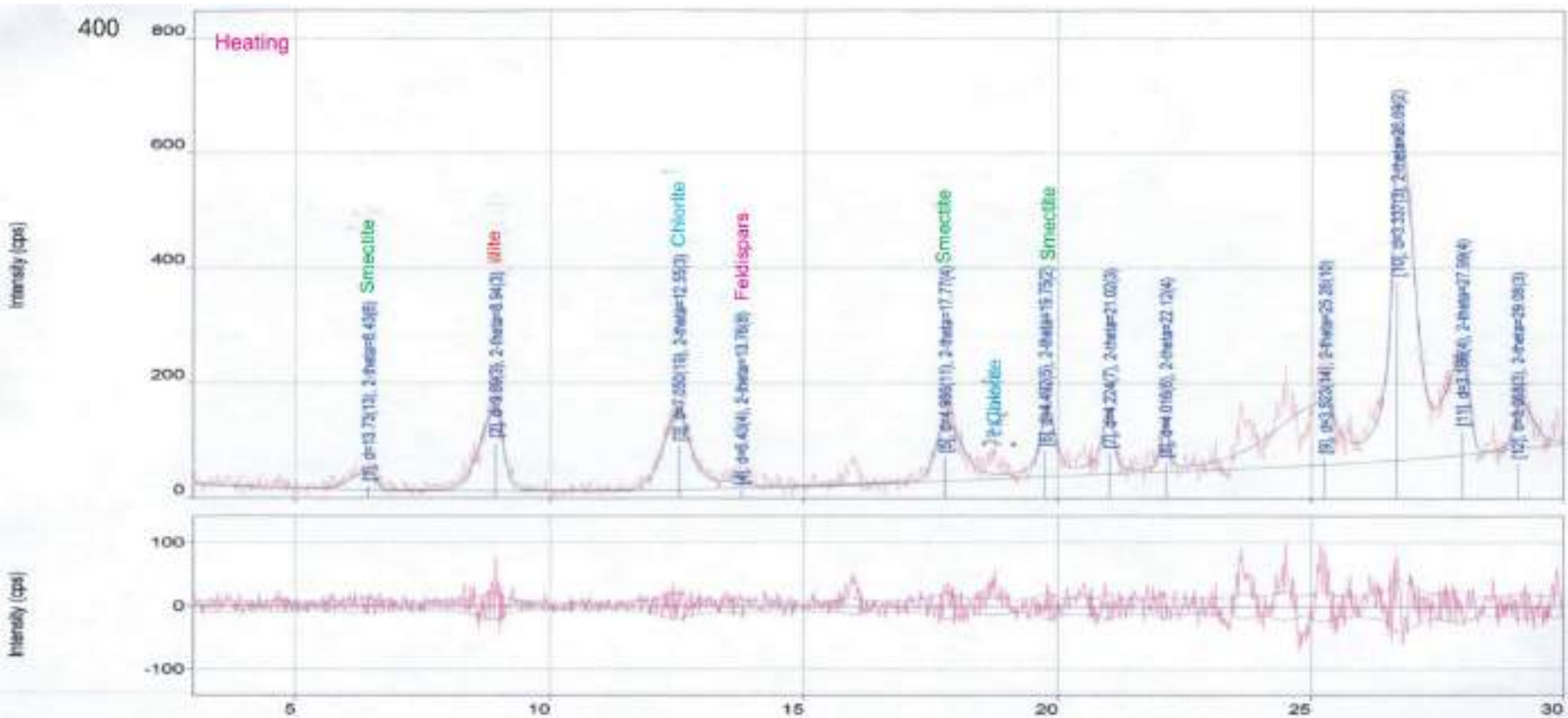
10
15
20
25
30



400
Heating
Smectite
Illite
Chlorite
Feldspars
Smectite
Smectite
Intensity (cps)
800
600
400
200
0
100
0
-100
5
10
15
20
25
30

2. TABEL MINERAL PADA CLAY DAN ASOSIASINYA (PEI YUAN CHEN)

Table of Key Lines in X-ray Powder Diffraction Patterns of Minerals in Clays and Associated Rocks

By PEI-YUAN CHEN

DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY OCCASIONAL PAPER 21

Table of Key Lines in X-ray Powder Diffraction Patterns of Minerals in Clays and Associated Rocks

Numbers in brackets indicate relative peak intensity from 1 to 10. A 2θ value without parentheses is the strongest peak (10). * indicates a mineral of the zeolite group. ** indicates a water-soluble mineral. (syn) indicates a synthetic mineral. Names connected with a hyphen, Illite-Montmorillonite for example, indicate mixed-layer minerals.

Degrees 2θ (CuKα)		d-spacing values (Å)	Mineral
2.90	5.81 17.70(2) 19.81(3) 62.17(4)	30.4 15.2 5.01 4.48 1.493	TOSUDITE (DIO-CHLORITE-MONTMORILLONITE)
2.94	6.09 12.00(3) 18.10(4) 24.31(8)	30.0 14.5 7.37 4.90 3.66	CHLORITE-SWELLING CHLORITE (= CORRENSITE)
3.04-3.12(10-2)	6.22 12.50(6) 18.76(2) 25.22(2)	29.0-28.3 14.2 7.08 4.73 2.53	CORRENSITE (CHLORITE-SWELLING 14A MINERAL)
3.21	6.96(7) 17.42(2) 19.72(2) 27.61(4)	27.5 12.7 5.09 4.50 3.23	MICA-MONTMORILLONITE, REGULAR 6:4
3.42	7.12(8) 17.91(4) 19.86(8) 28.89(5)	25.8 12.4 4.95 4.47 3.09	ILLITE-MONTMORILLONITE, REGULAR 1:1
3.53-3.68(5)	7.68-7.07 18.02(5) 26.20(5)	25.0-24.0 11.5-12.5 4.92 3.40	HYDROBIOTITE (BIOTITE-VERMICULITE)
3.57	7.12(8) 17.91(2) 25.15(4) 28.79(4)	24.70 12.4 4.95 3.54 3.10	RECTORITE=ALLEVARDITE, (PYROPHYLLITE-MONTMORILLONITE)
3.71-3.60	7.49(8) 19.63 29.57(9) 36.06(8)	23.8-24.5 11.8 4.52 3.02 2.49	ALIETTITE (TALC-SAPONITE)
4.88(8)	9.61 14.35(7) 15.88(8) 24.87(5)	18.10 9.20 6.17 5.58 3.58	COPIAPITE**
4.93	9.89(4) 25.01(5) 19.95(3) 30.29(3)	17.9 8.94 3.56 4.45 2.95	SMECTITE, GLYCEROLATED
5.19	10.46(4) 15.60(5) 26.20(5) 31.84(2)	17.00 8.45 5.68 3.40 2.81	SMECTITE, GLYCOLATED
5.73-6.31	17.70(3) 19.72(6) 29.57(4) 35.92(3)	15.4-14.0 5.01 4.50 3.02 2.50	SMECTITE, AIR-DRY
5.81(7)	2.90 11.72(2) 17.73(7) 19.81(8)	15.2 30.4 7.55 5.00 4.48	TOSUDITE
5.93	2.89 12.00(5) 18.10(9) 24.31(8)	14.9 30.5 7.37 4.90 3.66	CHLORITE-SWELLING CHLORITE
6.09-6.22	12.39(2) 19.29(3) 24.87(3) 31.38(3)	14.5-14.2 7.14 4.60 3.58 2.85	VERMICULITE, AIR-DRY
6.18-6.31(7-3)	12.46 18.80 25.15 31.72	14.3-14.0 7.10 4.72 3.54 2.82	CHLORITES
6.22(8)	12.41(7) 18.68(6) 19.63(9) 35.92(9)	14.2 7.13 4.75 4.52 2.50	SUDOITE (DIO-CHLORITE)
6.22-6.31(7-3)	3.04(3) 12.50(6) 18.80(3) 25.22(2)	14.2-14.0 29.0 7.08 4.72 3.53	CORRENSITE
6.45(5)	9.71(9) 13.39(9) 25.59 27.70	13.7 9.10 6.61 3.48 3.22	MORDENITE*
6.59	13.17(2) 19.81(9) 20.27(1) 26.52(2)	13.4 6.72 4.48 4.38 3.36	ALUNOGEN**
6.96(7)	3.21 17.42(2) 19.72(2) 27.61(2)	12.7 27.50 5.09 4.50 3.23	MICA-MONTMORILLONITE, REGULAR 6:4
7.01	10.94(5) 14.33(5) 16.75(7) 18.88(7)	12.6 8.08 6.18 5.29 4.70	HYDROBASALUMINITE

Raw data

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Operator	: Pertamina Kamojang	Date	: March-05-11 00:56:13		
Memo	:				
X-ray	: Cu / 30 kV / 15 mA				
Goniometer	: MiniFlex2 goniometer				
Attachment	: Standard sample holder				
Sample no.	: 1				
Filter	: Not used	DivSlit	: 1.25 deg.		
I.Monochro	: Not used	RecSlit	: 0.3mm		
C.Monochro	: Fixed Monochromator	SctSlit	: 1.25 deg.		
Counter	: MiniFlex2 counter	Monochro RS	: 0.8mm		
Scan mode	: Continuous	Scan speed	: 3.000 deg./min.	Sampling width	: 0.020 deg.
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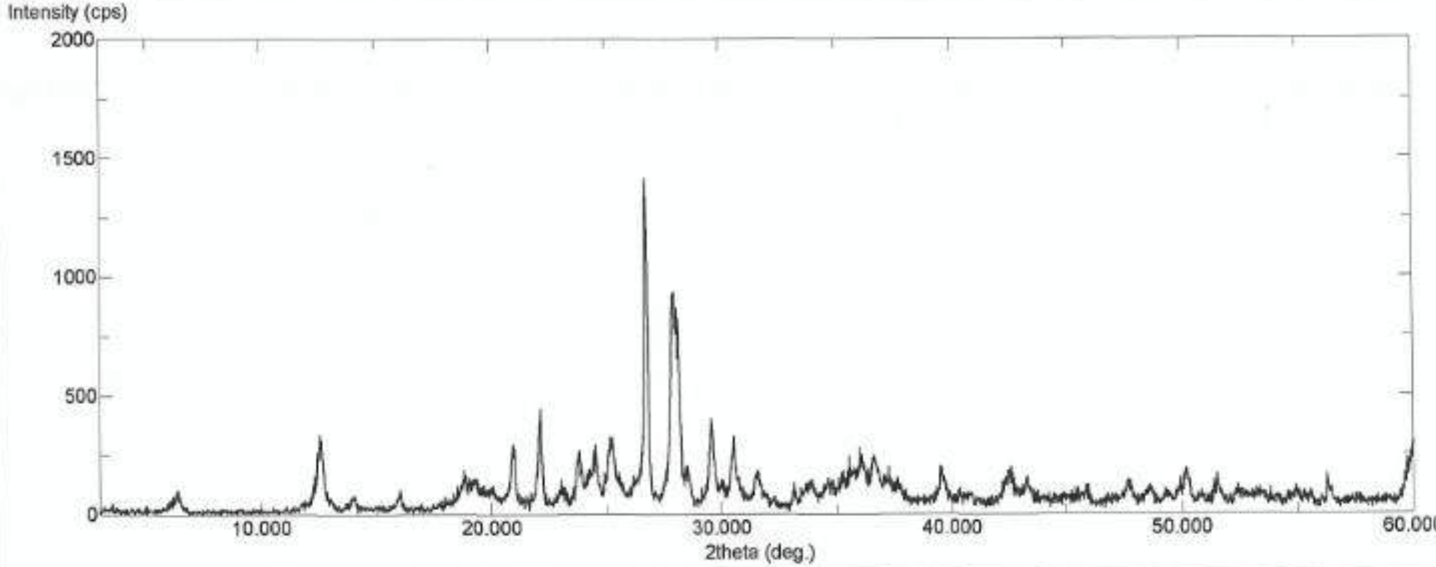
Repeat count	: 1				



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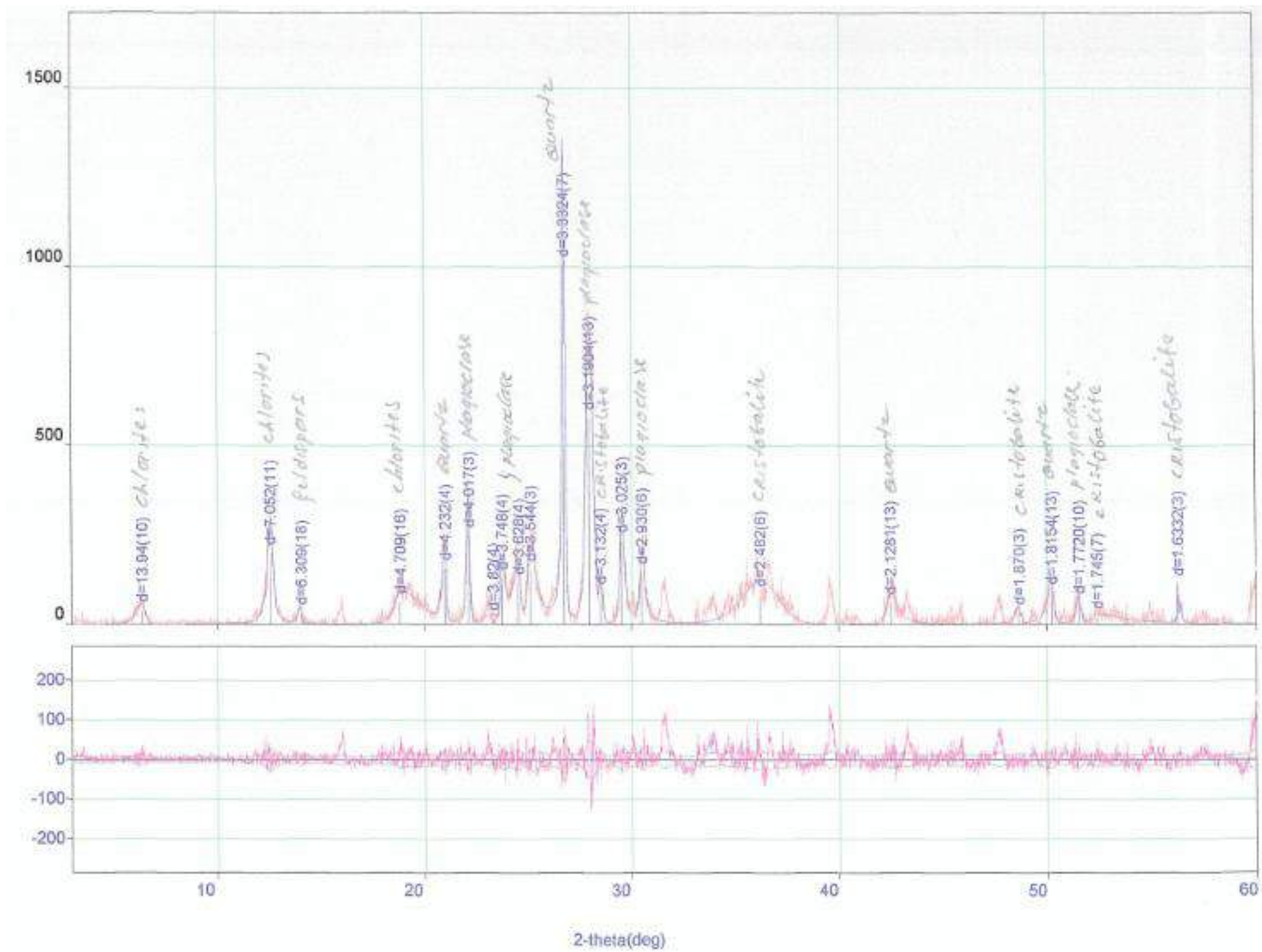
☐ 1	6.34(4)	13.94(10)	37(10)	0.55(4)	22.7(18)	1.8(7)	0.2(3)	0.0(4)	00-000-0000
☐ 2	12.542(19)	7.052(11)	200(22)	0.31(2)	96(2)	1.1(3)	1.00(17)	0.92(18)	00-000-0000
☐ 3	14.03(4)	6.309(18)	31(9)	0.22(3)	7.4(13)	4(6)	0.0(6)	0.4(13)	00-000-0000
☐ 4	18.83(6)	4.709(16)	62(12)	1.46(9)	104(8)	0.30(7)	0.40(17)	0.2(3)	00-000-0000
☐ 5	20.97(2)	4.232(4)	156(20)	0.209(17)	39(3)	3.2(15)	0.40(17)	0.2(3)	00-000-0000
☐ 6	22.113(15)	4.017(3)	247(25)	0.176(12)	52(4)	2.4(10)	0.40(17)	0.2(3)	00-000-0000
☐ 7	23.3(2)	3.82(4)	15(6)	0.7(5)	11(6)	4(7)	0.40(17)	0.2(3)	00-000-0000
☐ 8	23.72(3)	3.748(4)	130(18)	0.24(4)	45(6)	0.5(3)	0.4(2)	1.00(19)	00-000-0000
☐ 9	24.52(2)	3.628(4)	117(17)	0.38(5)	57(6)	3.9(16)	0.4(2)	1.00(19)	00-000-0000
☐ 10	25.11(2)	3.544(3)	154(20)	0.44(3)	98(5)	0.53(12)	0.4(2)	1.00(19)	00-000-0000
☒ 11	26.729(5)	3.3324(7)	1003(50)	0.151(5)	204(4)	1.55(19)	0.87(13)	0.23(10)	00-000-0000
☐ 12	27.943(12)	3.1904(13)	578(38)	0.384(9)	253(5)	0.97(12)	0.39(8)	0.00(12)	00-000-0000
☐ 13	28.48(4)	3.132(4)	90(15)	0.18(3)	19(3)	0.7(7)	0.39(8)	0.00(12)	00-000-0000
☐ 14	29.51(3)	3.025(3)	233(24)	0.20(3)	68(3)	0.7(4)	0.7(4)	1.0(3)	00-000-0000
☐ 15	30.49(6)	2.930(6)	144(19)	0.25(6)	55(4)	0.7(9)	0.9(8)	1.0(6)	00-000-0000
☐ 16	36.17(10)	2.482(6)	82(14)	2.08(9)	199(7)	1.04(19)	0.5(2)	0.0(3)	00-000-0000
☐ 17	42.44(3)	2.1281(13)	61(12)	0.58(8)	52(4)	0.6(2)	0.5(7)	1.0(4)	00-000-0000
☐ 18	48.65(9)	1.870(3)	33(9)	0.32(11)	13(3)	4(6)	0.5(9)	0(2)	00-000-0000
☐ 19	50.21(4)	1.8154(13)	88(15)	0.30(9)	42(4)	4(4)	1.00(17)	1.0(2)	00-000-0000
☐ 20	51.53(3)	1.7720(10)	62(12)	0.20(5)	16(2)	3(3)	0.8(6)	0.0(13)	00-000-0000
☐ 21	52.4(2)	1.745(7)	20(7)	1.8(4)	56(10)	0.2(2)	1.00(17)	1.0(2)	00-000-0000
☐ 22	56.283(13)	1.6332(3)	112(17)	0.070(19)	12(2)	0.6(4)	1.00(17)	1.0(2)	00-000-0000



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d=1.745(7)
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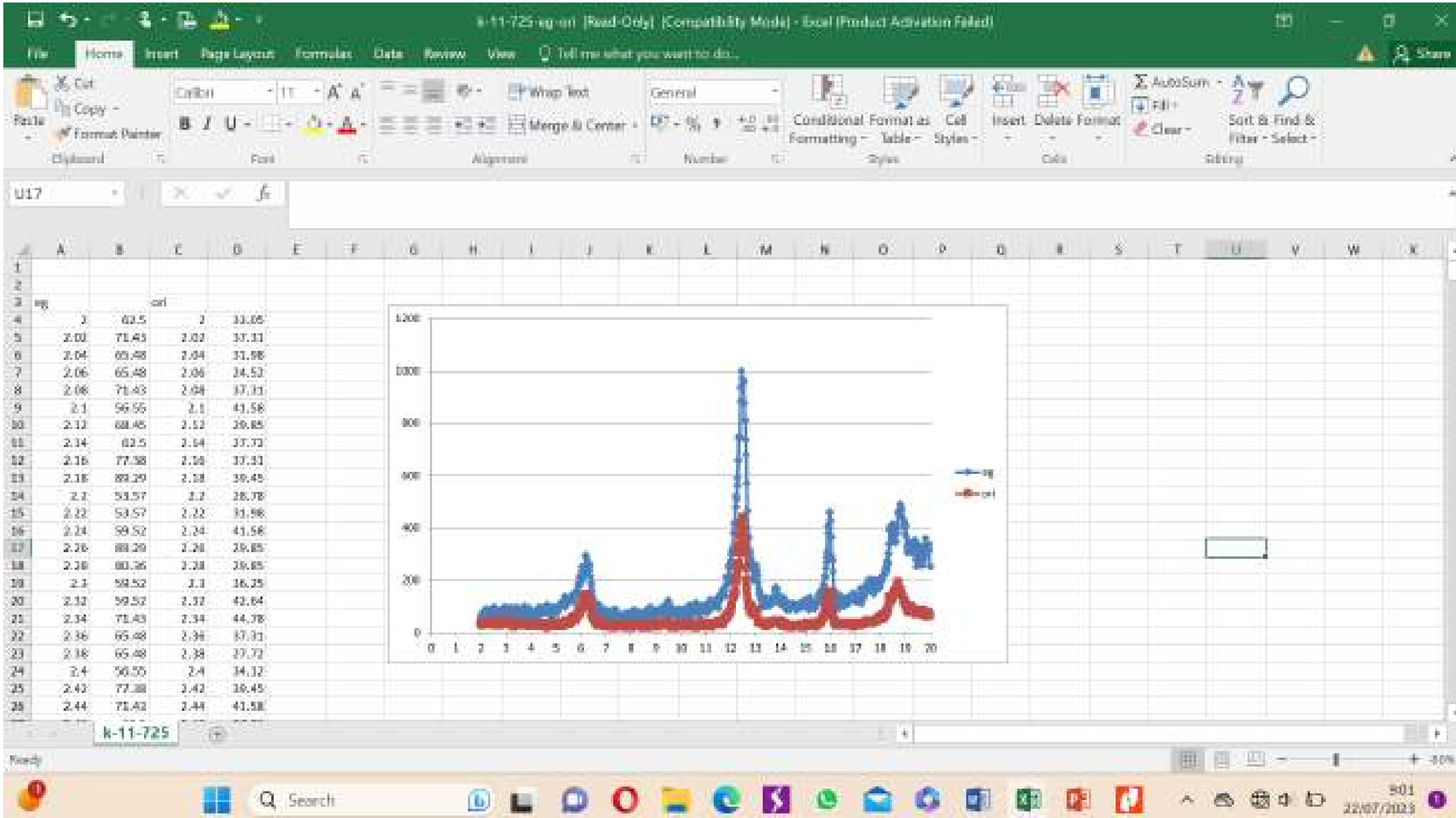
60
2-theta(deg)



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Paste
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Merge & Center
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Format as Table
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Insert
Delete
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Fill
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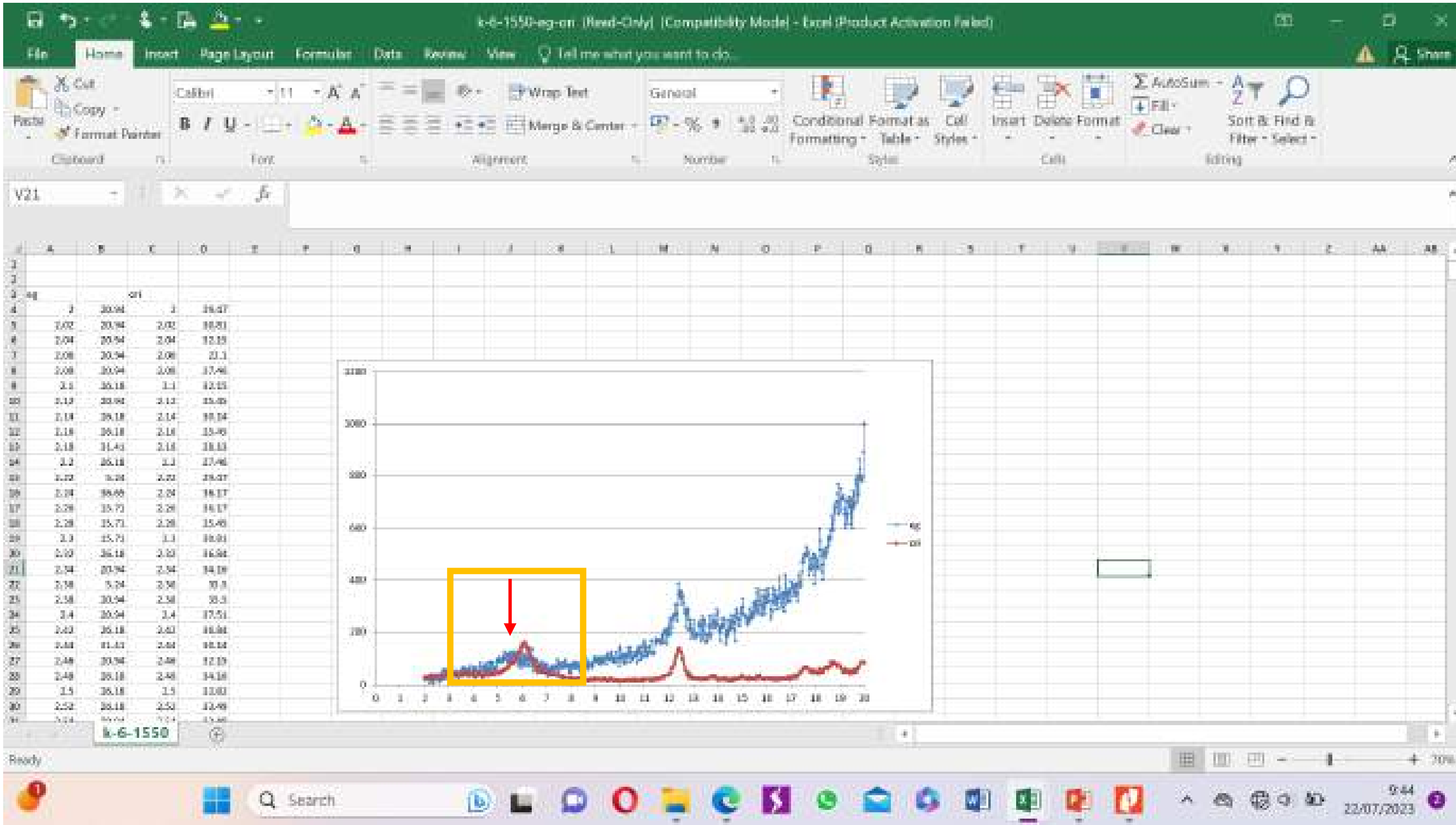
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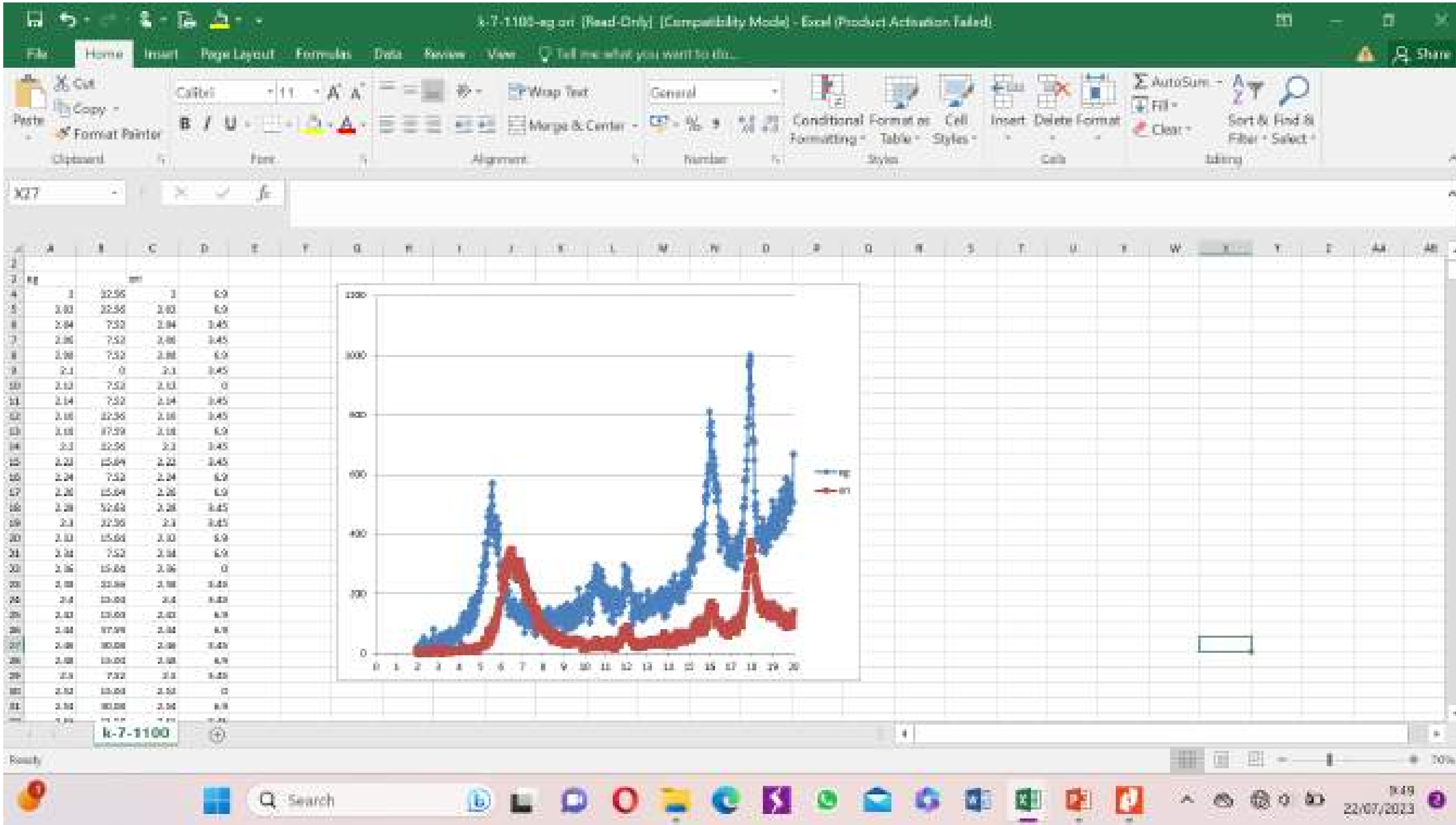

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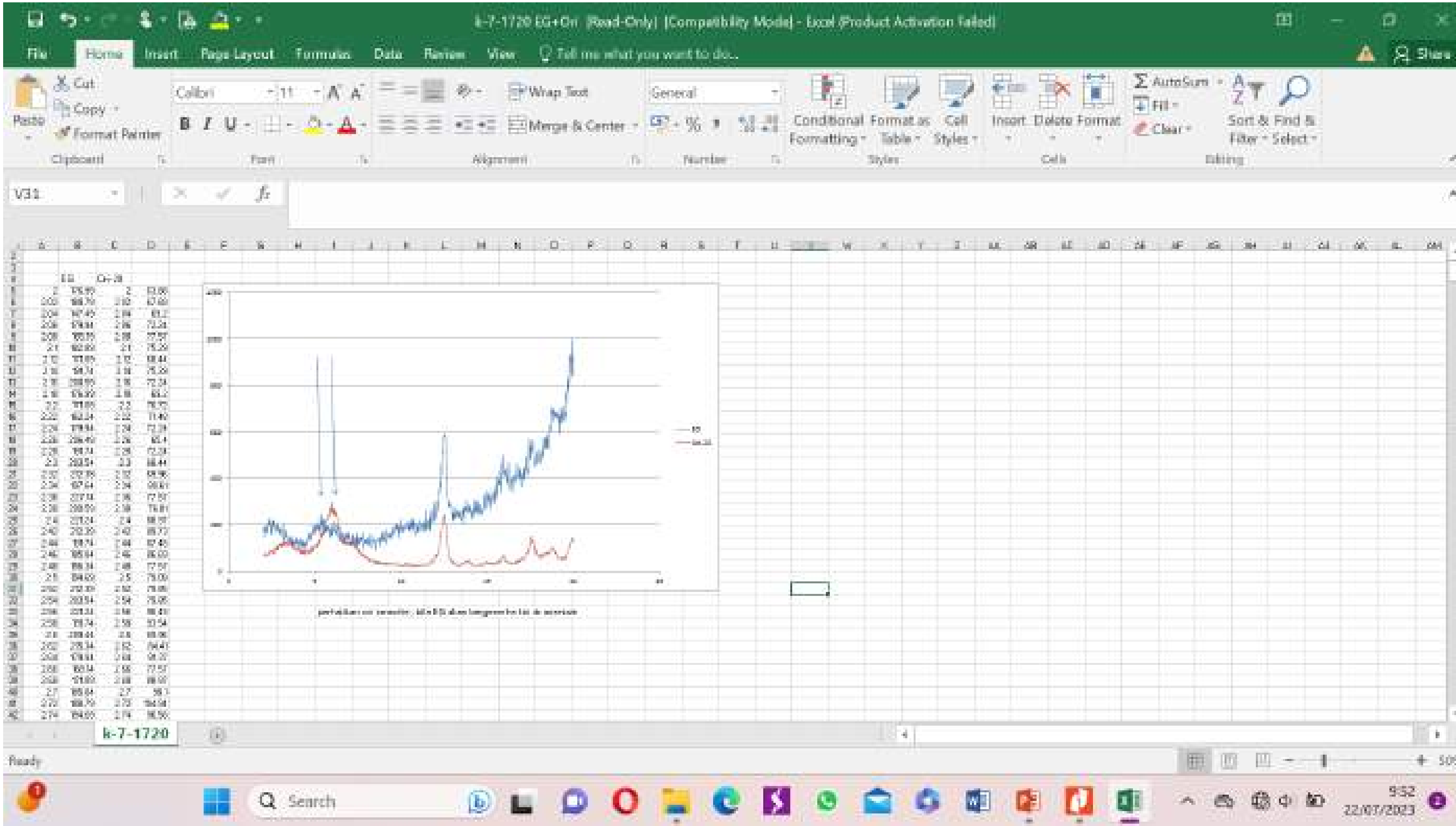

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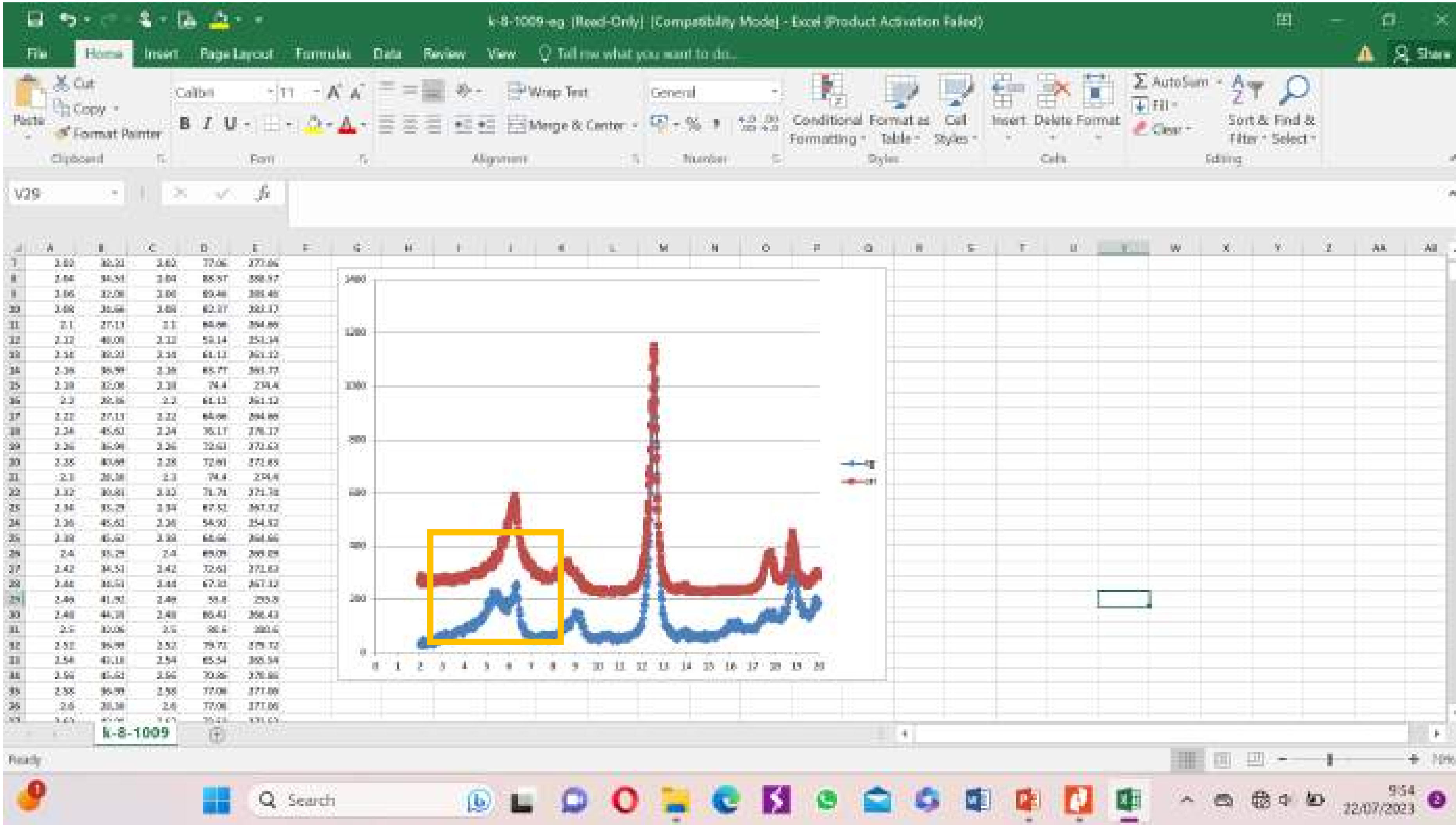
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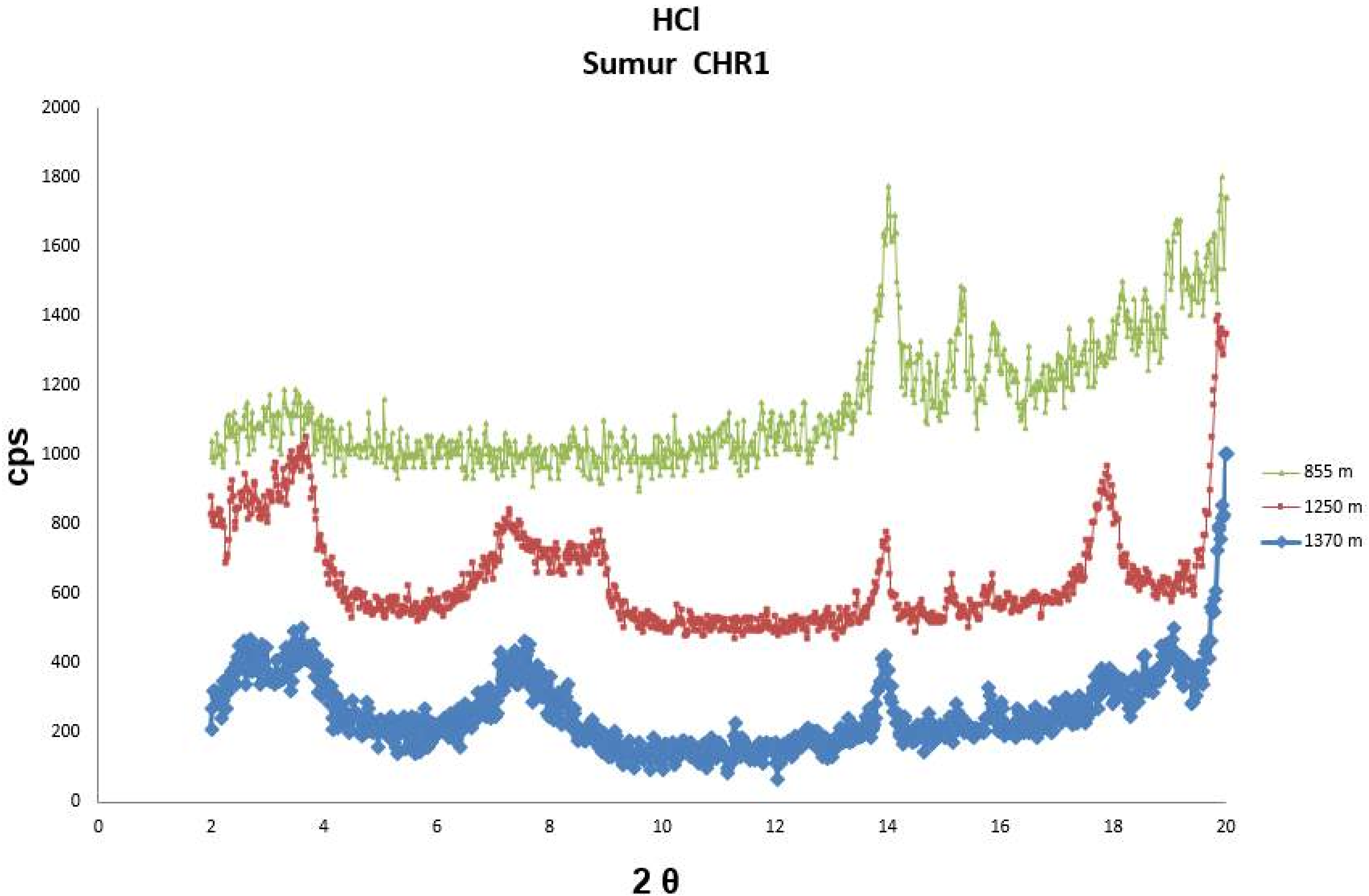
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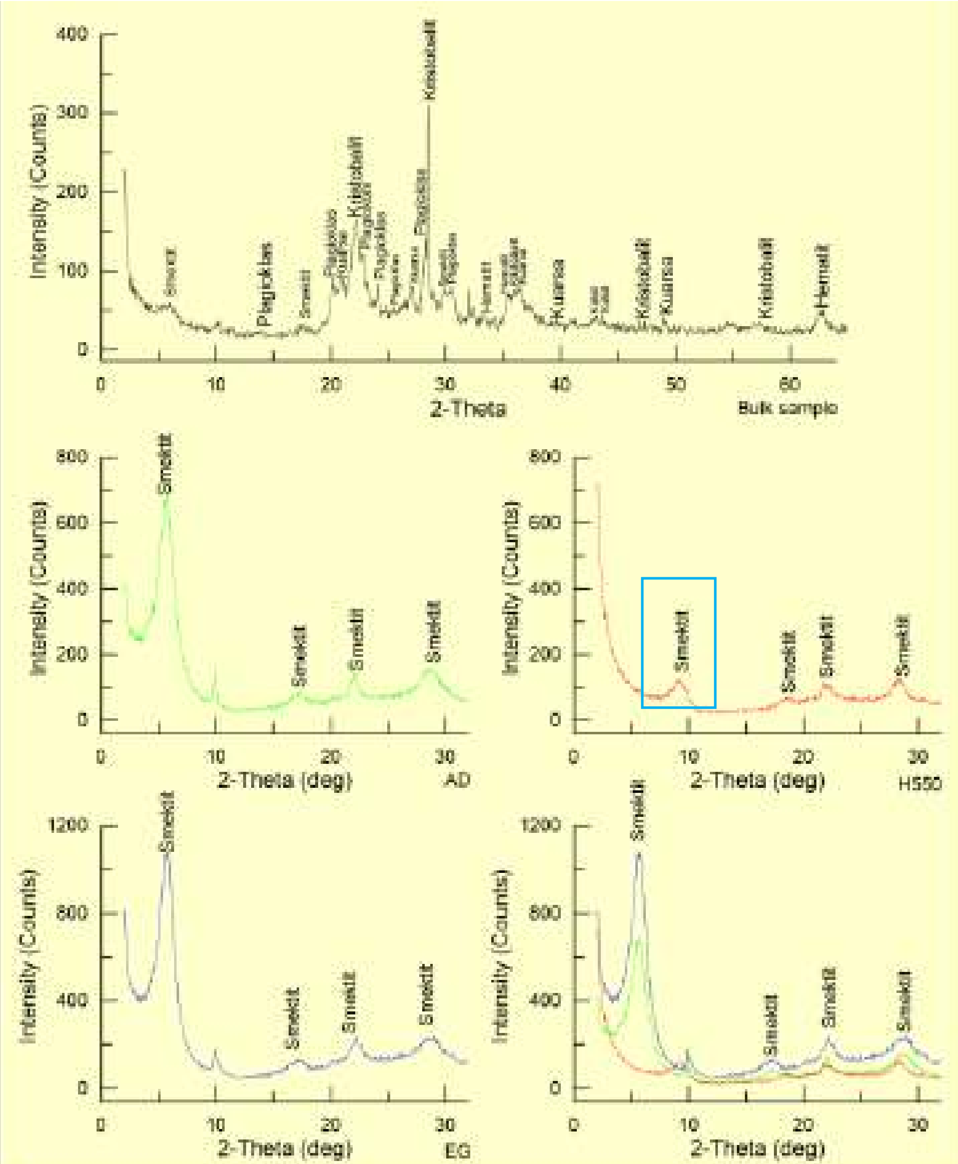


2-Theta	d(Å)	I%	Fase Mineral
5.90	14.9620	6	Smektit
17.72	5.0009	5	Smektit
29.84	2.9917	10	Smektit
22.09	4.0213	35	Kristobalit
28.41	3.1387	100	Kristobalit
36.08	2.4873	12	Kristobalit
46.90	1.9357	5	Kristobalit
57.36	1.6050	4	Kristobalit
20.90	4.2467	9	Kuarsa
26.87	3.3154	12	Kuarsa
36.46	2.4622	10	Kuarsa
39.65	2.2711	4	Kuarsa
49.10	1.8539	5	Kuarsa
13.98	6.3283	3	Plagioklas
20.12	4.4096	24	Plagioklas
22.72	3.9105	17	Plagioklas
24.06	3.6955	12	Plagioklas
25.47	3.4947	4	Plagioklas
28.13	3.1700	35	Plagioklas
30.46	2.9322	14	Plagioklas
33.28	2.6900	5	Hematit
35.52	2.5252	17	Hematit
62.50	1.4848	10	Hematit
43.10	2.0973	4	Kalsit
43.64	2.0724	6	Kalsit

Kedalaman 202 mku

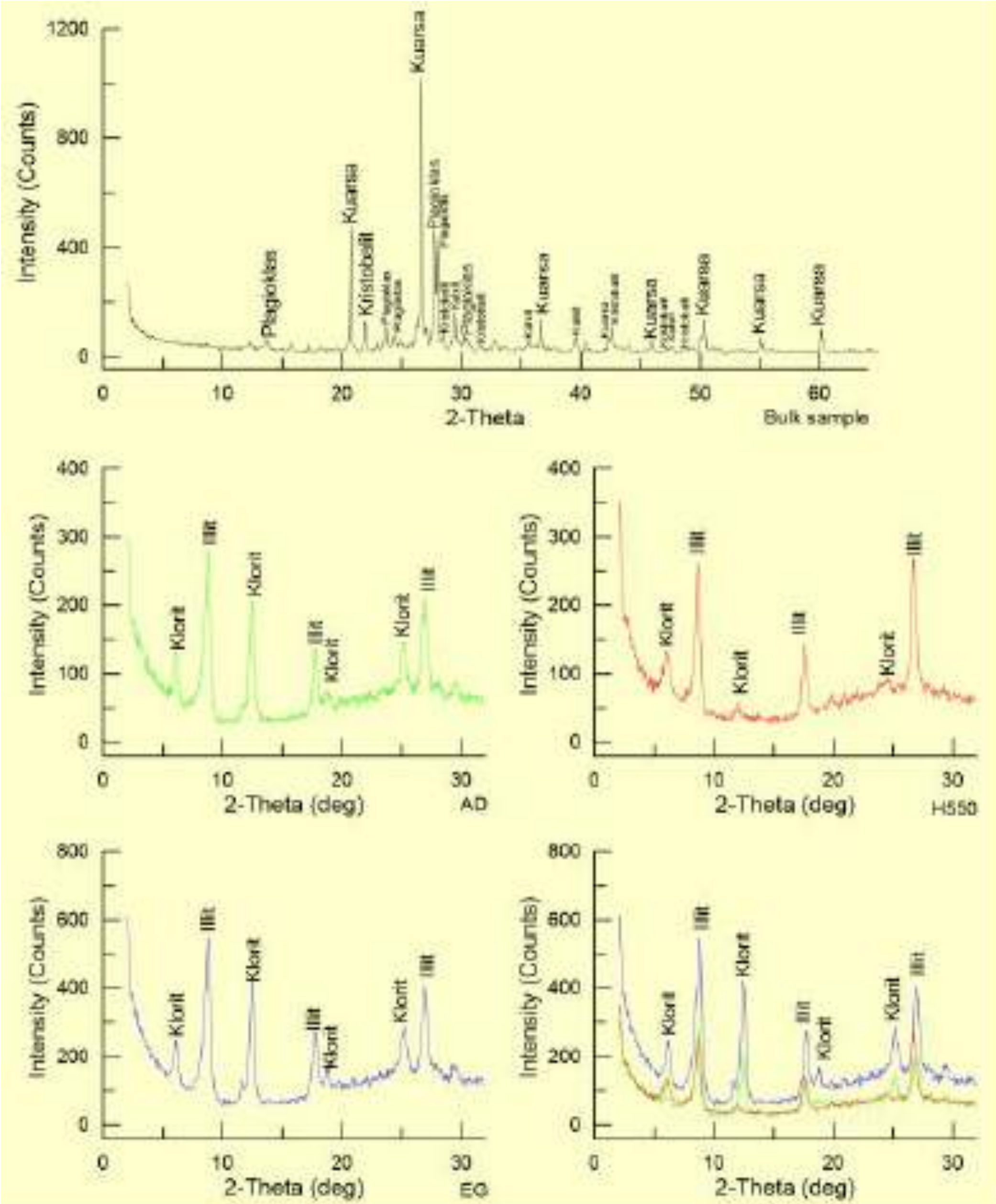
AD = ——— = *Air dried*

EG = ——— = *Ethylene Glycolated*

H550 = ——— = *Heating* 550°C

TABEL RINGKASAN PEAK ANALISIS CLAY XRD

Air Dried			*Ethylene Glycolated*			FWHM	Δ2θ (degree)	Pemanasan 550 °C			Fase Mineral
2θ *(degree)*	d (Å)	I (%)	2θ *(degree)*	d (Å)	I (%)			2θ *(degree)*	d (Å)	I (%)	
5.7200	15.4386	100	5.70	15.4910	100			8.90	9.9315	100	Smektit
17.3020	5.1211	10	17.26	5.1334	7			18.58	4.7716	40	Smektit
22.1000	4.0188	18	22.18	4.0045	15			22.30	3.9834	69	Smektit
28.9800	3.0785	13	28.90	3.0869	10			28.56	3.1227	71	Smektit

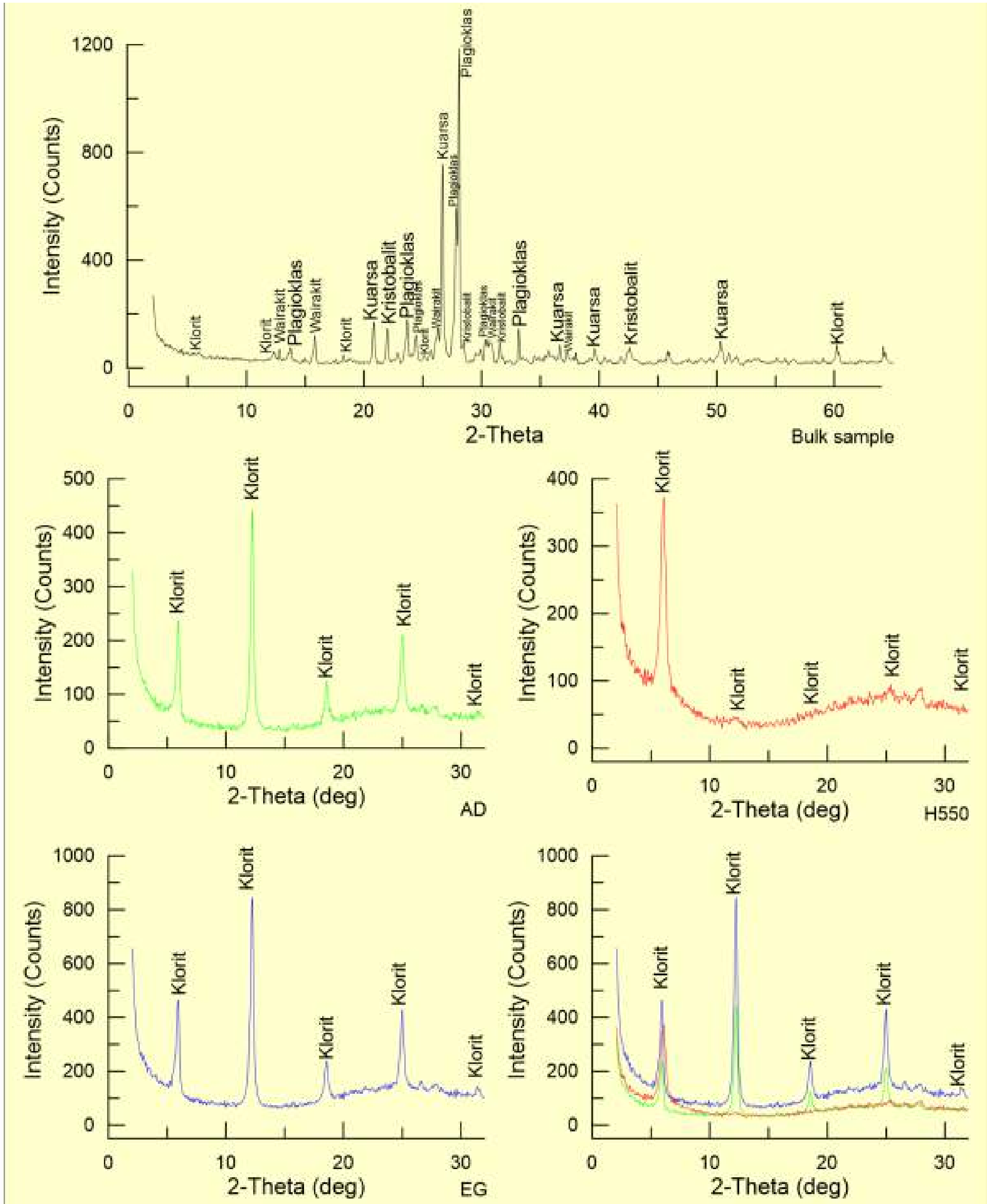


2-Theta	d(Å)	I%	Fase Mineral
21.92	4.0513	11	Kristobalit
28.46	3.1334	6	Kristobalit
31.60	2.8290	3	Kristobalit
42.56	2.1224	10	Kristobalit
47.10	1.9278	2	Kristobalit
48.62	1.8711	2	Kristobalit
20.78	4.2710	47	Kuarsa
26.62	3.3458	100	Kuarsa
36.60	2.4531	11	Kuarsa
42.30	2.1348	5	Kuarsa
45.92	1.9746	4	Kuarsa
50.00	1.8226	5	Kuarsa
50.28	1.8131	12	Kuarsa
55.08	1.6660	6	Kuarsa
60.14	1.5373	9	Kuarsa
13.66	6.4772	4	Plagioklas
23.72	3.7481	8	Plagioklas
24.40	3.6454	5	Plagioklas
27.78	3.2088	44	Plagioklas
28.04	3.1796	38	Plagioklas
30.28	2.9492	5	Plagioklas
30.50	2.9286	5	Plagioklas
29.42	3.0334	14	Kalsit
35.66	2.5157	4	Kalsit
39.56	2.2762	6	Kalsit
47.68	1.9058	3	Kalsit

Kedalaman 403 mku

TABEL RINGKASAN PEAK ANALISIS CLAY XRD

Air Dried			*Ethylene Glycolated*			FWHM	Δ2θ (degree)	Pemanasan 550 °C			Fase Mineral
2θ *(degree)*	d (Å)	I (%)	2θ *(degree)*	d (Å)	I (%)			2θ *(degree)*	d (Å)	I (%)	
6.16	14.3372	27	6.14	14.3867	25			6.08	14.5259	27	Klorit
12.46	7.0981	67	12.44	7.1094	78			12.04	7.3457	12	Klorit
18.64	4.7554	7	18.86	4.7010	11			*collapsed*			Klorit
25.14	3.5394	28	25.20	3.5310	29			24.50	3.6305	12	Klorit
31.72	2.8186	5	31.36	2.8501	4			*collapsed*			Klorit
8.74	10.1088	100	8.78	10.0631	100			8.64	10.2255	100	Illit
17.76	4.9901	34	17.76	4.9899	39			17.58	5.0407	50	Illit
26.72	3.3335	44	26.94	3.3069	56			26.70	3.3361	93	Illit



2-Theta	d(Å)	I%	Fase Mineral
5.96	14.8138	2	Klorit
12.34	7.1666	3	Klorit
18.26	4.8536	2	Klorit
25.10	3.5448	2	Klorit
60.22	1.5355	6	Klorit
22.00	4.0370	11	Kristobalit
28.48	3.1314	7	Kristobalit
31.56	2.8325	6	Kristobalit
42.62	2.1197	5	Kristobalit
20.82	4.2628	13	Kuarsa
26.66	3.3407	62	Kuarsa
36.64	2.4505	5	Kuarsa
39.60	2.2739	5	Kuarsa
50.34	1.8112	7	Kuarsa
13.74	6.4391	5	Plagioklas
23.68	3.7543	14	Plagioklas
24.44	3.6392	8	Plagioklas
27.84	3.2019	49	Plagioklas
28.08	3.1751	100	Plagioklas
30.52	2.9266	7	Plagioklas
33.16	2.6993	11	Plagioklas
12.82	6.8996	4	Wairakit
15.82	5.5971	9	Wairakit
26.30	3.3859	10	Wairakit
30.78	2.9025	6	Wairakit
37.30	2.4088	4	Wairakit

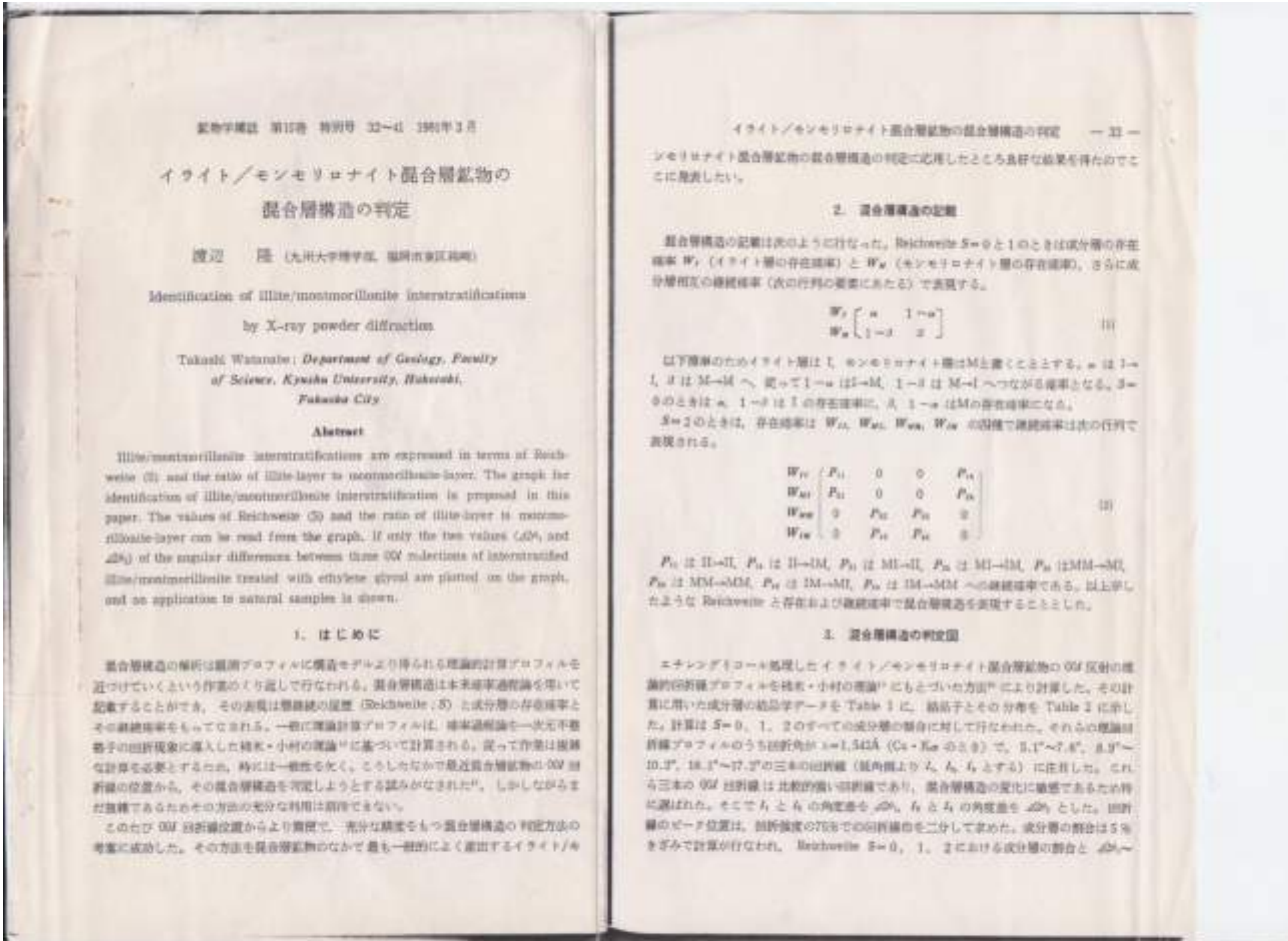
Kedalaman 799 mku

TABEL RINGKASAN PEAK ANALISIS CLAY XRD

Air Dried			*Ethylene Glycolated*			FWHM	Δ2θ (degree)	Pemanasan 550 °C			Fase Mineral
2θ *(degree)*	d (Å)	I (%)	2θ *(degree)*	d (Å)	I (%)			2θ *(degree)*	d (Å)	I (%)	
5.92	14.9153	44	5.94	14.8681	45			6.08	14.5240	100	Klorit
12.24	7.2250	100	12.24	7.2253	100			12.04	7.3438	5	Klorit
18.56	4.7767	18	18.58	4.7718	21			17.46	5.0739	4	Klorit
25.00	3.5589	35	24.98	3.5617	41			25.40	3.5036	9	Klorit
31.34	2.8519	4	31.34	2.8516	5			31.48	2.8395	3	Klorit

Kedalaman (m)	hkl	Air-dried			FWHM	Ethylene Glycolated			FWHM	Δ° 2θ	Pemanasan (550°)			Nama
		° 2θ	d (Å)	I		° 2θ	d (Å)	I			° 2θ	d (Å)	I	
151						5,08	17,3807	100	0,841					Smektit
		9,522	9,2808	45	0,183	9,54	9,2633	56,5	0,334		9,618	9,1882	26	Zeolit (Stilbit)
		19,401	4,5714	20	0,425	19,3	4,5951	25,2	0,266					Smektit
		25,061	3,5504	27,5	0,492	24,804	3,5865	20	0,538					Zeolit (Stilbit)
		28,421	3,1378	23,8	0,505									Zeolit (Stilbit)
250		8,603	10,2693	93,2	0,461	8,66	10,2022	100	0,563		8,8	10,0406	100	Ilit
		17,723	5,0003	34,1	0,356	17,645	5,0223	23,8	0,191		18	4,9241	39	Ilit
		26,72	3,3336	61,4	0,345	26,701	3,3358	58,8	0,296		26,94	3,3068	80,5	Ilit
349		5,96	14,8178	57,3	0,234	5,979	14,7696	56,7	0,227		6,119	14,4309	100	Mix Layer Khlorit/Smektit
		12,299	7,1905	100	0,258	12,301	7,1896	100	0,274					Mix Layer Khlorit/Smektit
		18,64	4,7562	32,6	0,299	18,641	4,7562	33,5	0,308					Mix Layer Khlorit/Smektit
		25,021	3,556	68,1	0,341	25,04	3,5532	70,9	0,33	12,739				Mix Layer Khlorit/Smektit
500		5,96	14,8172	38,9	0,258	5,999	14,7202	34,4	0,275		5,859	15,0709	100	Mix Layer Khlorit/Smektit
		12,3	7,1902	100	0,302	12,3	7,19	100	0,311		11,86	7,4557	32,8	Mix Layer Khlorit/Smektit
		18,679	4,7464	15,5	0,372	18,66	4,7514	16,4	0,339					Mix Layer Khlorit/Smektit
		25,04	3,5533	48,6	0,376	25,04	3,5533	48,7	0,366	12,74				Mix Layer Khlorit/Smektit
649		5,939	14,8701	33,3	0,42	5,5	16,0536	35,9	0,543		5,754	15,3456	100	Mix Layer Khlorit/Smektit
		12,319	7,1789	100	0,339	12,301	7,1897	100	0,355		11,78	7,5063	81,5	Mix Layer Khlorit/Smektit
		24,944	3,5667	38,8	0,404	25,061	3,5504	57,9	0,369	12,76				Mix Layer Khlorit/Smektit

3. MIXED LAYER CLAY


鉱物学雑誌 第15巻 特別号 32~41 1981年3月

イライト／モンモリロナイト混合層鉱物の
混合層構造の判定

渡辺 隆（九州大学理学部，福岡市東区箱崎）

Identification of illite/montmorillonite interstratifications
by X-ray powder diffraction

Takashi Watanabe: *Department of Geology, Faculty of Science, Kyushu University, Hakozaki, Fukuoka City*

Abstract

Illite/montmorillonite interstratifications are expressed in terms of Reichweite (S) and the ratio of illite-layer to montmorillonite-layer. The graph for identification of illite/montmorillonite interstratification is proposed in this paper. The values of Reichweite (S) and the ratio of illite-layer to montmorillonite-layer can be read from the graph. If only the two values (Δ2θ₁ and Δ2θ₂) of the angular differences between three 00l reflections of interstratified illite/montmorillonite treated with ethylene glycol are plotted on the graph, and an application to natural samples is shown.

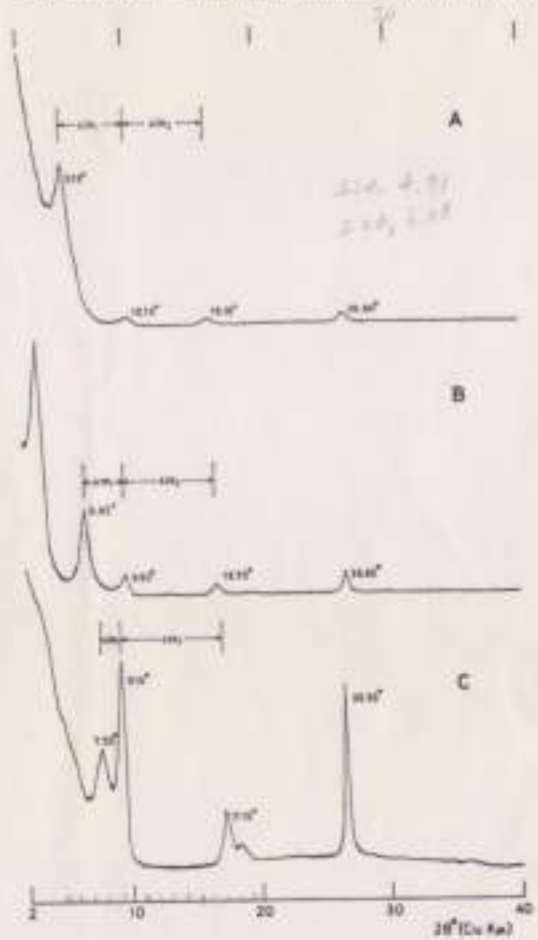
1. はじめに

イライト／モンモリロナイト混合層鉱物の混合層構造の判定 — 33 —

2. 混合層構造の記載

3. 混合層構造の判定図

Fig. 3. Examples of X-ray powder diffraction patterns of interstratified illite/montmorillonite treated with ethylene glycol, and $\Delta 2\theta_1$ and $\Delta 2\theta_2$ used for the determination of interstratification are shown.



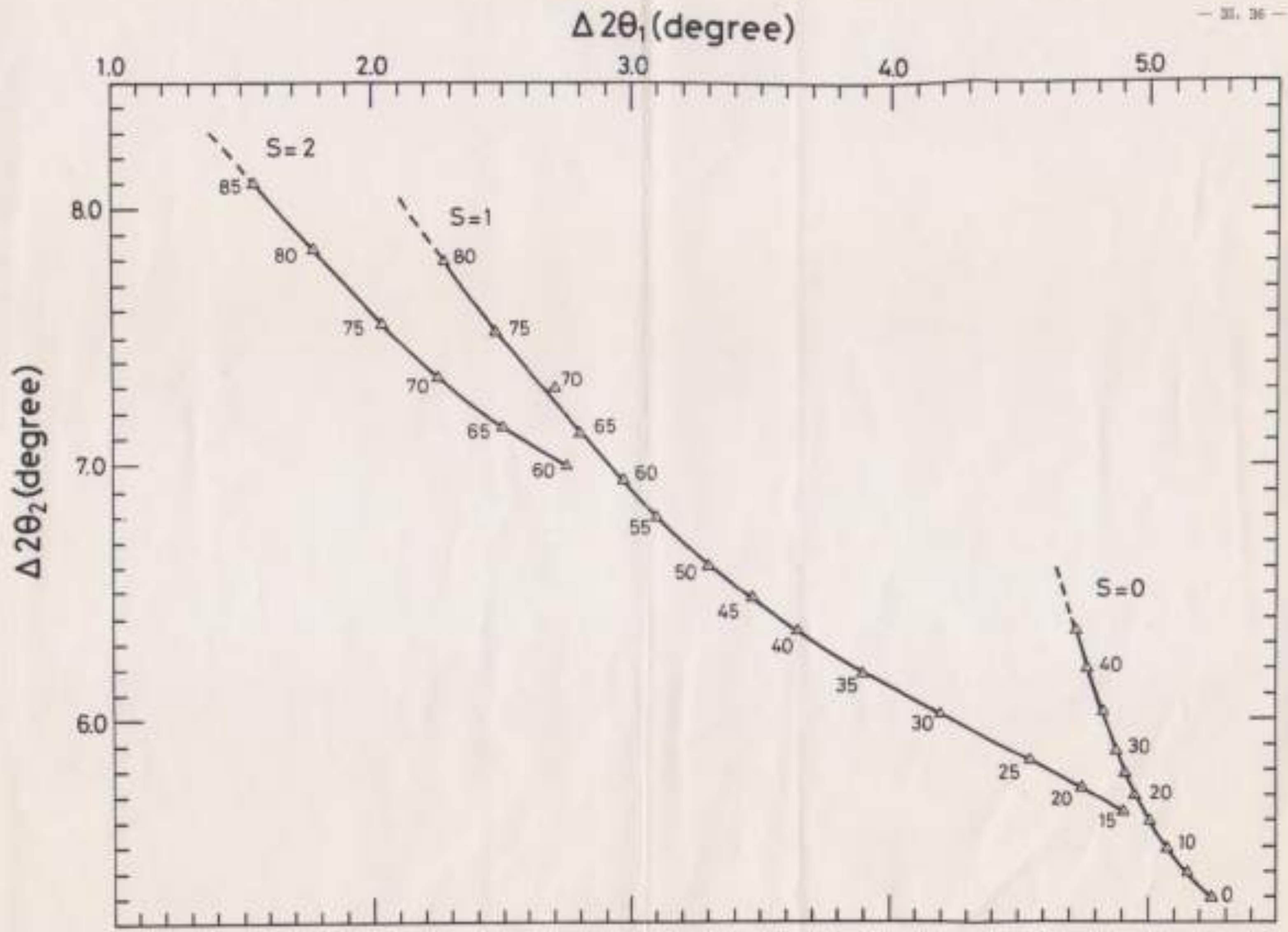


Fig. 1. The graph for identification of illite/montmorillonite interstratification. $\Delta 2\theta_1$ and $\Delta 2\theta_2$ value are the angular differences of reflections (for Cu-K_α radiation) by measuring as shown in Fig. 3. *S* means Reichweite, and the numbers along the curves show percentages of illite-layer.

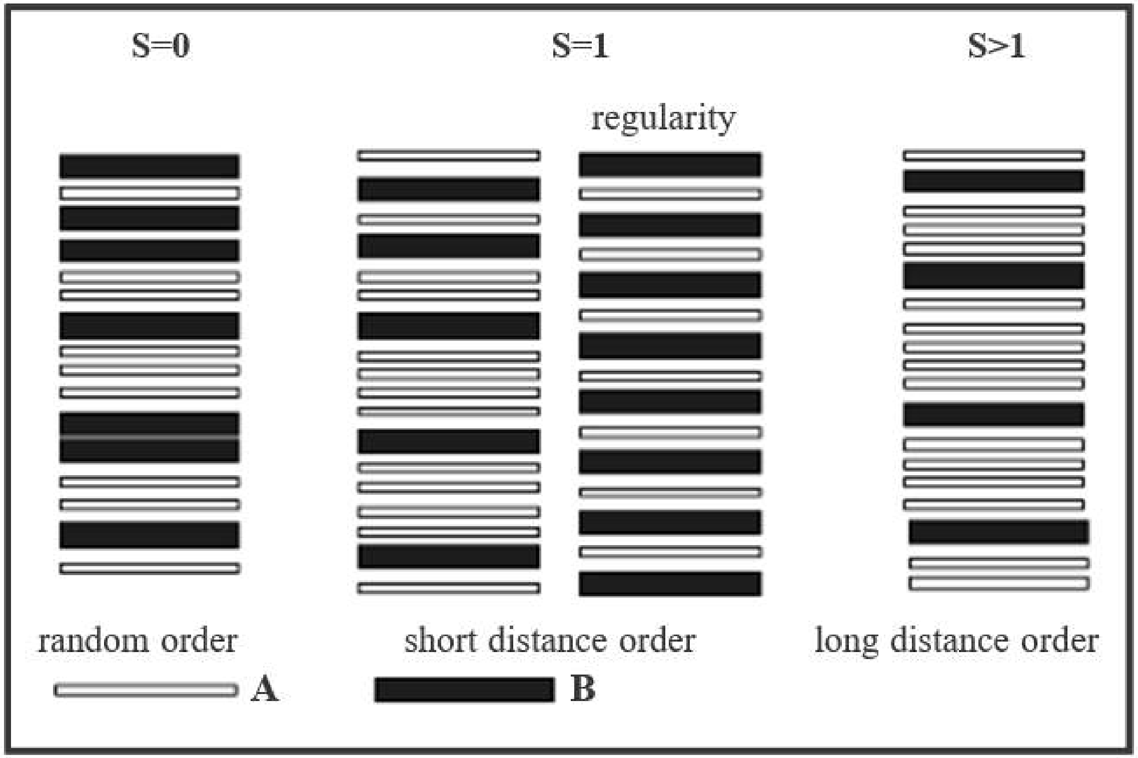
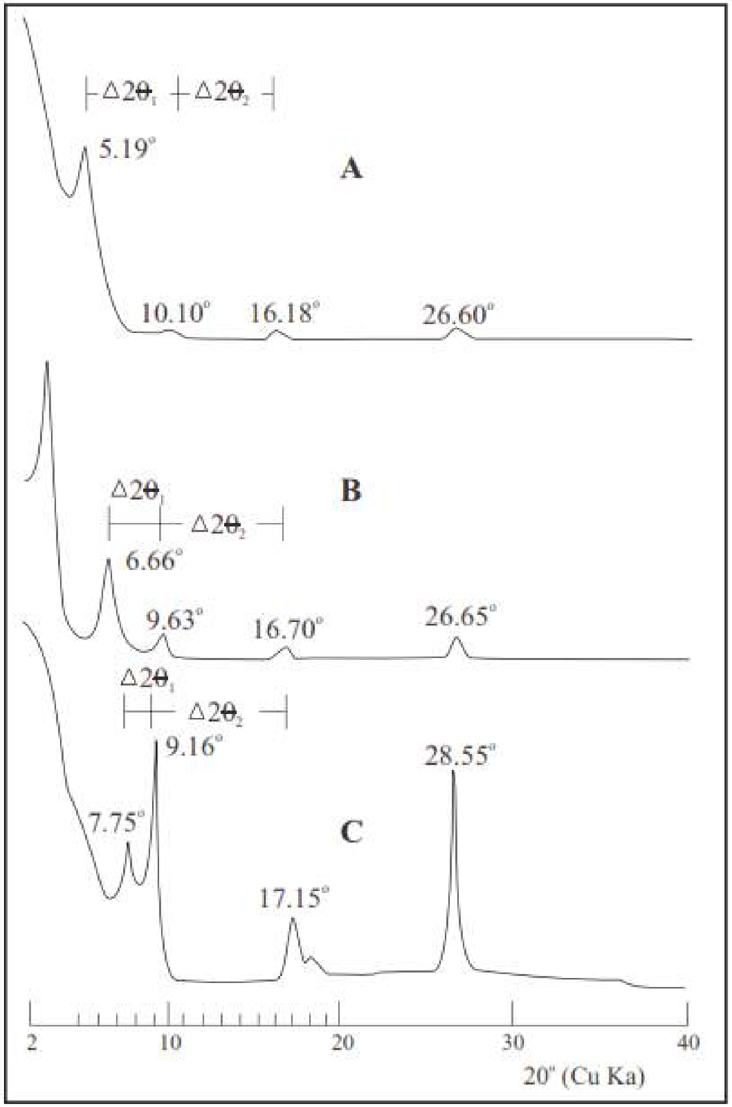


Figure 1. Schematic diagram of randomly ordered, ordered, and regularly ordered interstratifications of two types of A and B layers such as illite (10 Å) and montmorillonite (17 Å) (Meunir, 2005).

Interstratified Illite/Montmorillonite in Kamojang Geothermal Field, Indonesia (Indonesian Journal of Geology, Vol. 8 No. 4 December 2013: 177-183)



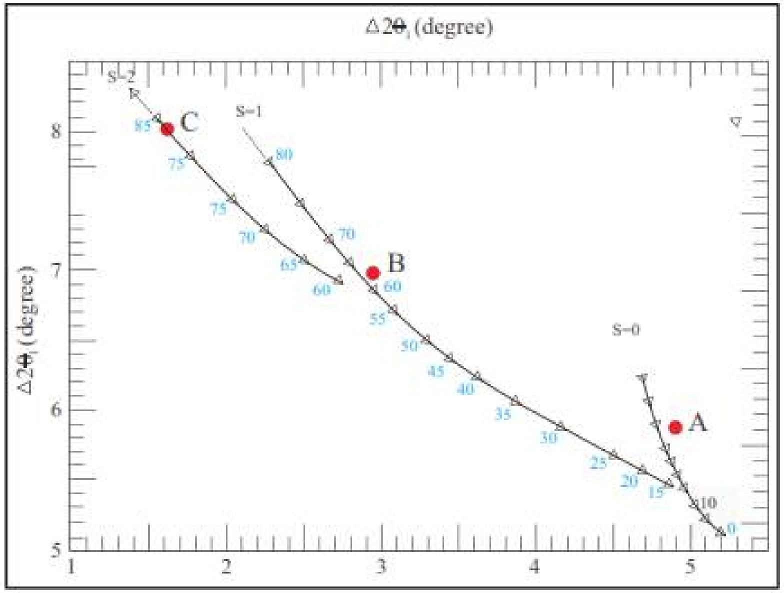


Figure 3. Diagram for identification of interstratified illite/montmorillonite. $\Delta 2\theta_1$ and $\Delta 2\theta_2$ value on the diagram represents the value of the difference in the angle of reflection (Cu Kα radiation) (Watanabe, 1981).

Result and Discussion

Variations in the composition of illite/montmorillonite

X-ray diffraction analysis using ethylene glycol to the core and samples from Wells KMJ-8, 9, 11, 13,

Table 1. Calculation Results Interstratified Illite/Montmorillonite Using Calculation Methods of Watanabe (1981) show Types Interstratified S = 0, S = 1 and % illite

Well	Depth (m)	2θ1	d(°A)	$2\theta_2$	d(°A)	$2\theta_3$	d(°A)	$\frac{2\theta_2 - 2\theta_1}{2\theta_1}$	$\frac{2\theta_3 - 2\theta_2}{2\theta_2}$	S=0	S=1	%Illite
	Core 454.8	5.50	16.04	10.60	8.37	16.30	5.42	5.10	5.70	20		20
KMJ-9	Core 609.8	5.20	17.11	10.15	8.65	16.10	5.50	4.95	5.95	30		30
	760.0	5.40	16.38	10.20	8.65	16.30	5.42	4.80	6.10	35		35
KMJ-51	363.0	5.30	16.74	10.20	8.65	16.00	5.54	4.90	5.80	25		25
KMJ-54	798.0	5.30	16.74	10.40	8.46	16.40	5.38	5.10	6.00	30		30
	306.7	6.20	14.26	9.10	9.75	16.20	5.46	2.90	7.10		65	65
KMJ-8	623.2	6.40	13.75	9.10	9.75	16.50	5.38	2.70	7.40		72	72
	638.4	6.60	13.28	9.10	9.75	16.60	5.35	2.50	7.50		72	72
KMJ-11	core 550	6.30	14.00	9.40	9.39	16.70	5.31	3.10	7.30		65	65
KMJ-13	core 666	6.00	14.81	9.40	9.39	15.90	5.85	3.40	6.50		45	45
KMJ-16	372.0	6.30	14.00	9.40	9.39	16.70	5.31	3.10	7.30		65	65
KMJ-23	657.0	6.60	13.28	9.60	9.17	16.85	5.24	3.00	7.25		65	65
KMJ-49	657.0	6.60	14.26	9.20	9.63	16.60	5.35	3.00	7.40		70	70

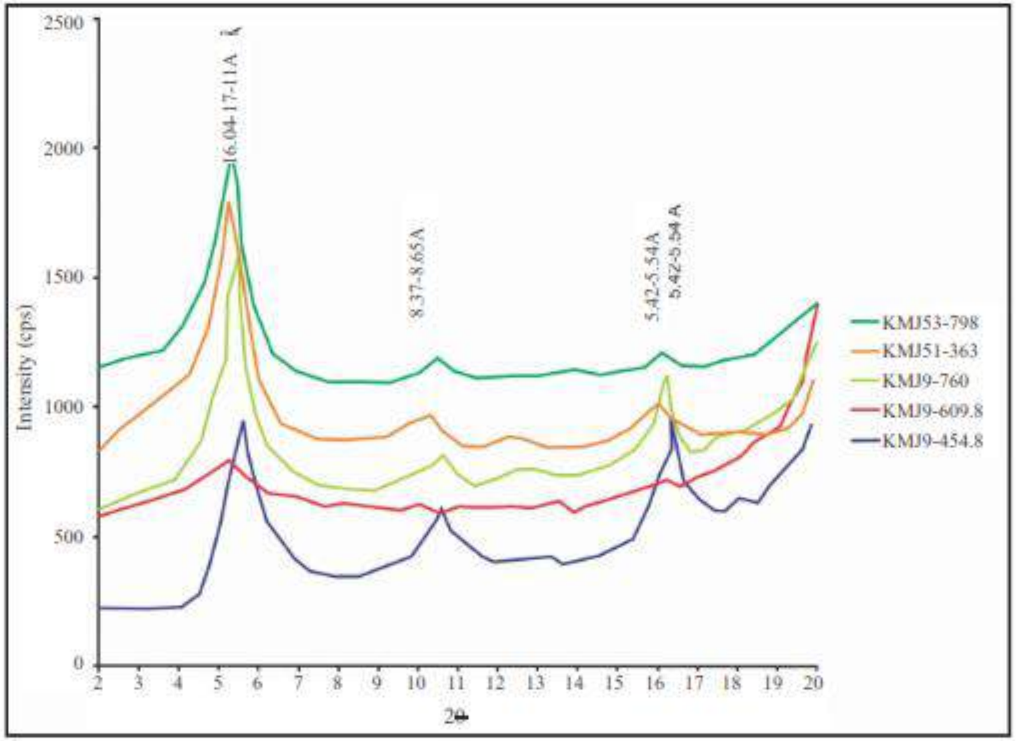


Figure 4. Results of X-ray diffraction analysis using ethylene glycol on sample KMJ-9, 51 and 54. Interstratified illite/ montmorillonite type is S= 0.

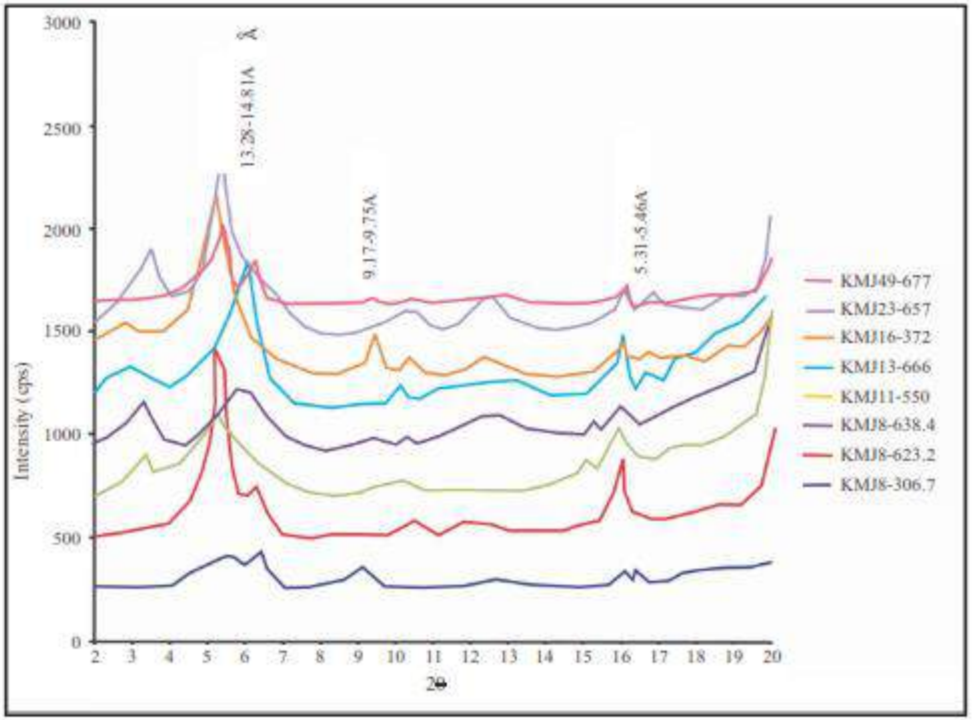
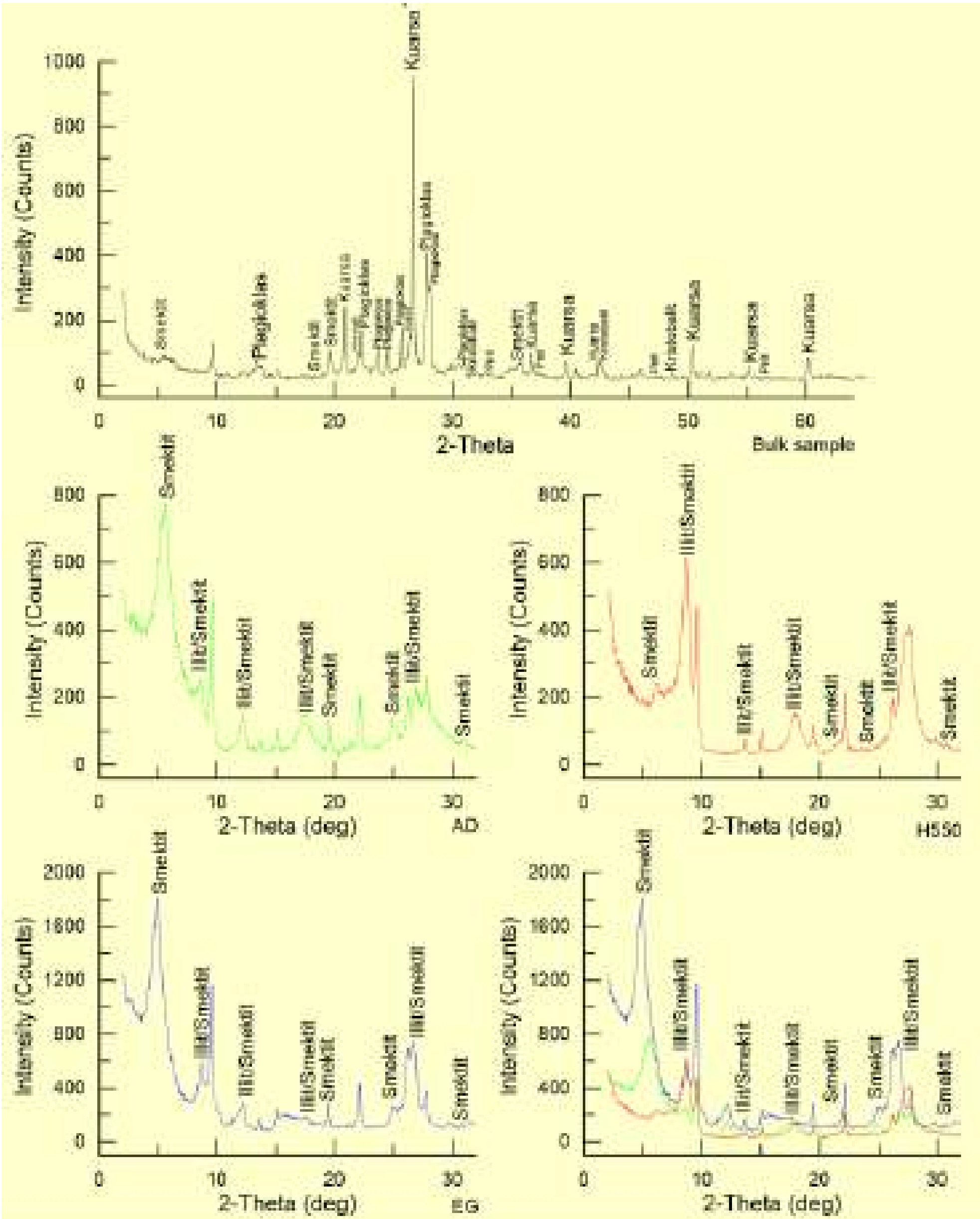


Figure 6. Results of X-ray diffraction analysis using ethylene glycol on sample of KMJ-8, 11, 13, 16, 23 and 49. Interstratified illite/montmorillonite type is S = 1.

MIXED LAYER CLAY



2-Theta	d(Å)	I%	Fase Mineral
5.46	16.1827	3	Smektit
17.49	5.0679	1	Smektit
19.60	4.5256	8	Smektit
35.82	2.5047	3	Smektit
22.02	4.0333	7	Kristobalit
31.60	2.8288	2	Kristobalit
42.62	2.1197	6	Kristobalit
48.66	1.8697	2	Kristobalit
20.84	4.2590	23	Kuarsa
26.68	3.3386	100	Kuarsa
36.64	2.4505	8	Kuarsa
39.60	2.2740	6	Kuarsa
42.36	2.1320	6	Kuarsa
50.34	1.8111	11	Kuarsa
55.10	1.6654	4	Kuarsa
60.20	1.5359	7	Kuarsa
13.36	6.6216	5	Plagioklas
13.76	6.4292	3	Plagioklas
22.24	3.9936	15	Plagioklas
23.68	3.7542	8	Plagioklas
24.44	3.6392	8	Plagioklas
25.66	3.4687	14	Plagioklas
27.84	3.2019	40	Plagioklas
28.06	3.1773	28	Plagioklas
30.98	2.8843	5	Plagioklas
33.10	2.7042	2	Pirit
37.16	2.4173	1	Pirit
47.22	1.9232	1	Pirit
56.53	1.6268	1	Pirit

Kedalaman 298 mku

TABEL RINGKASAN PEAK ANALISIS CLAY XRD

Air Dried			*Ethylene Glycolated*			FWHM	Δ2θ (degree)	Pemanasan 550 °C			Fase Mineral
2θ *(degree)*	d (Å)	I (%)	2θ *(degree)*	d (Å)	I (%)			2θ *(degree)*	d (Å)	I (%)	
5.50	16.0519	100	4.94	17.8730	100			6.24	14.1544	12	Smektit
19.50	4.5483	7	19.48	4.5535	5			21.30	4.1679	3	Smektit
24.94	3.5675	9	24.96	3.5651	3			23.62	3.7642	3	Smektit
30.84	2.8967	2	30.88	2.8935	1			30.68	2.9118	3	Smektit
8.60	10.2731	12	8.70	10.1556	9			8.66	10.2023	90	Illit/Smektit
12.18	7.2605	17	12.20	7.2490	15			13.66	6.4776	10	Illit/Smektit
17.50	5.0637	19	17.64	5.0232	2			18.16	4.8811	20	Illit/Smektit
26.26	3.3911	4	26.68	3.3384	51			26.22	3.3960	30	Illit/Smektit

MINERAL PHASE IDENTIFICATION- RIETVELD %

Abbreviation	Mineral Phase Identification	Mineral Chemical Formula	Mineral Classification	Mineral Group	1	2	3	4	5	6
					RIETVELD REFINEMENT WT%					
					NGE CUTTING 0 10m	NGE-01A 180.20m	NGE-01A 880.50m	NGE-01A 1406.15m	NGE-02 91.90m	NGE-02 597.00m
Act	Actinolite	Ca2 (Mg , Fe)5 Si8 O22 (O H)2	Silicates	Amphibole		1.0				
An	Anorthite	Ca Al2 (Si O4)2	Silicates	Plagioclase		9.2				
Andes_NaCa	Andesine	(Na , Ca)(Si , Al)4 O8	Silicates	Plagioclase	35.5	41.6		35.3	1.5	26.6
Anh	Anhydrite	Ca S O4	Sulfates	No Group		0.5	39.6	1.3	1.2	0.8
Cal	Calcite	Ca C O3	Carbonate	Calcite			2.0		2.1	
Chl	Chlorite	(Mg,Fe)5 (Al,Si)5 O10 (O H)8	Silicates	Clay		3.6	4.2	5.5	9.9	20.6
Cln	Clintonite	Al Ca3 Al3 Si O10 (O H)2	Silicates	Mica					5.1	
Crs	Cristobalite	Si O2	Silicates	Quartz	10.9					
Di	Diopside	Ca Mg (Si O3)2	Silicates	Pyroxene	7.8	16.0	1.2		2.8	
Dol	Dolomite	Ca Mg (C O3)2	Carbonate	Dolomite			1.0			
Dsp_OOH	Diaspore	Al O (O H)	Oxides/Hydroxides	Diaspore	0.7					
Gp	Gypsum	Ca S O4 . 2 H2 O	Sulfates	Gypsum	1.1					
Gth	Goethite	Fe O (O H)	Oxides/Hydroxides	Diaspore	3.5					
Hem	Hematite	Fe2 O3	Oxides/Hydroxides	Hematite	3.2					
Il_AlMgFe	Illite	(K,H3 O) (Al,Mg,Fe)2 (Si,Al)4 O10 [(OH)2,(H2O)]	Silicates	Clay	11.1		[illegible]	1.7	9.5	11.2
Ilm	Ilmenite	Fe Ti O3	Oxides/Hydroxides	Ilmenite		1.1		0.8		
Kln	Kaolinite	Al2 Si2 O5 (O H)4	Silicates	Clay	1.2				15.9	4.1
Lbd	Labradorite	(Na0.4 Ca0.6) Al1.6 Si2.4 O8	Silicates	Plagioclase	15.0	11.8		12.1		7.7
Mag	Magnetite	Fe3 O4	Oxides/Hydroxides	Spinel		3.1	2.0	4.5		2.4
Mnt	Montmorillonite	(Na , Ca)0,3 (Al , Mg)2 Si4 O10 (O H)2 . H2 O	Silicates	Clay			8.2			1.8
Mnt_CaMg2	Montmorillonite	Ca Mg2 Al Si4 (O H)2 . H2 O	Oxides/Hydroxides	Spinel		2.8			4.8	
Or	Orthoclase	K Al Si3 O8	Silicates	K Feldspar			2.8			
Py	Pyrite	Fe S2	Sulfides	Pyrite			1.1		5.0	
Qz	Quartz	Si O2	Silicates	Quartz	7.9	7.0	17.2	29.1	40.4	24.9
Rt	Rutile	Ti O2	Oxides/Hydroxides	Rutile			2.6		1.8	
Tlc	Talc	Mg3 Si4 O10 (O H)2	Silicates	Pyrophyllite-Talc		3.3		1.2		
			Total	100.0	100.0	100.0	100.0	100.0	100.0	

MINERAL CLASSIFICATION - SUM OF RIETVELD %

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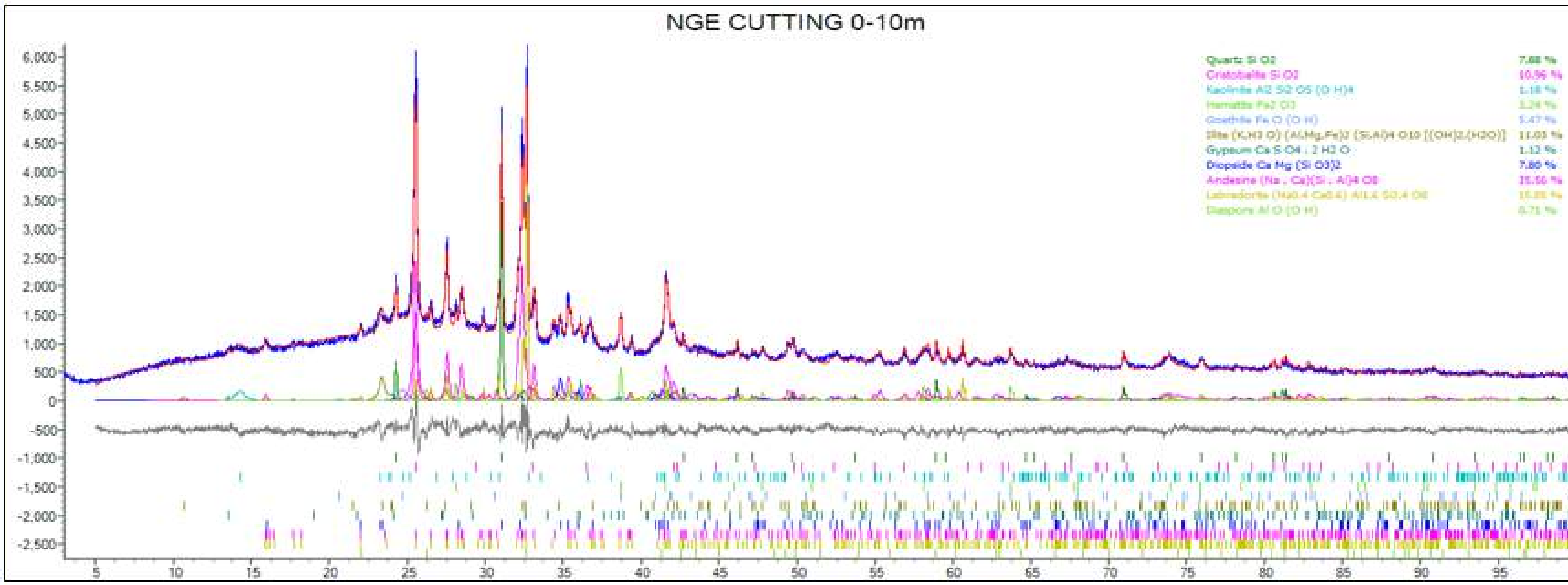
XRD Topaz Diffractrograms



TERIMAKASIH