

基隆火山群安山岩礦物化學之初步研究

The preliminary study of mineral chemistry in the Chilung Volcano Group

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Outline

1. Geological background
2. Previous research
3. Research motivation
4. Methods
5. Results and discussion
6. Conclusion
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8. Acknowledgement



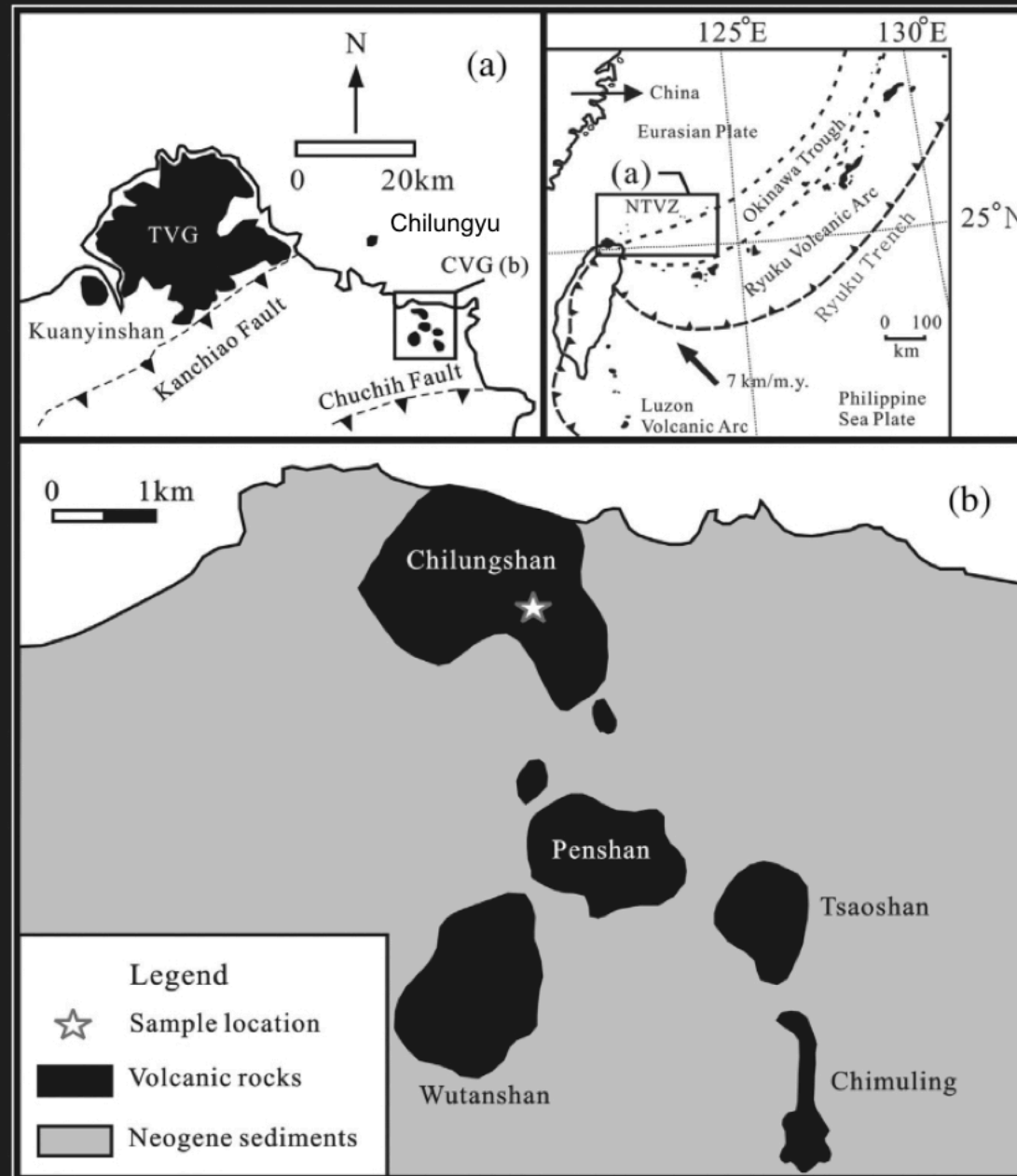
Chilungshan



Chilungyu

Tectonic setting of Taiwan and Chilung Volcano group

Modified after Lai et al. (2014)



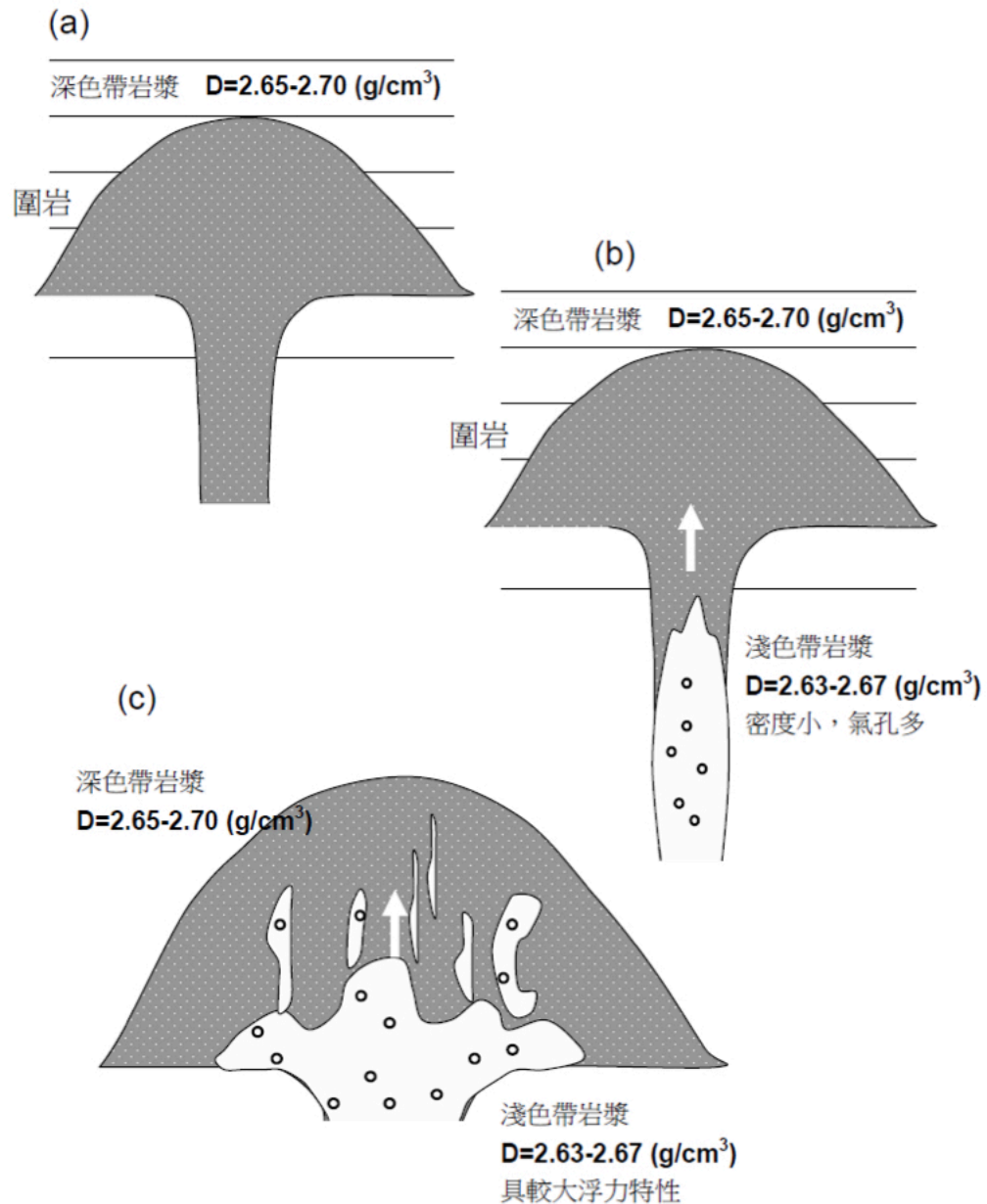
Tectonic Setting of Taiwan and CVG

Geological Background — Dating of CVG

Dating Method	K-Ar	Fission Track Dating (FTD)	Ar-Ar	Zircon U-Pb
Chilungshan	Juang and Chen (1989): 0.81-1.7Ma	1.Chen et al. (1993): 0.88-1.40 Ma 2.Liu et al. (1986) & Liu (1987): 1.1±0.1Ma	Lee (1998) 1.26±0.01Ma	1. Gao et al. (2010): 1.17±0.02 Ma 2. Wan et al. (2012) 1.04±0.06 Ma 3. Shao et al. (2014) 1.11±0.05Ma
Chilungyu	Juang and Chen (1989): 1.02±0.05 Ma	Chen et al. (1993): 0.37±0.09~0.28±0.04 Ma		Chu et al. (2018): 0.41±0.03 Ma

- ▶ Chilungshan: 0.81~1.40 Ma
- ▶ Chilungyu: 0.28~1.02 Ma
- ▶ Chilungyu is younger than Chilungshan

Magma mingling model in Chilungshan



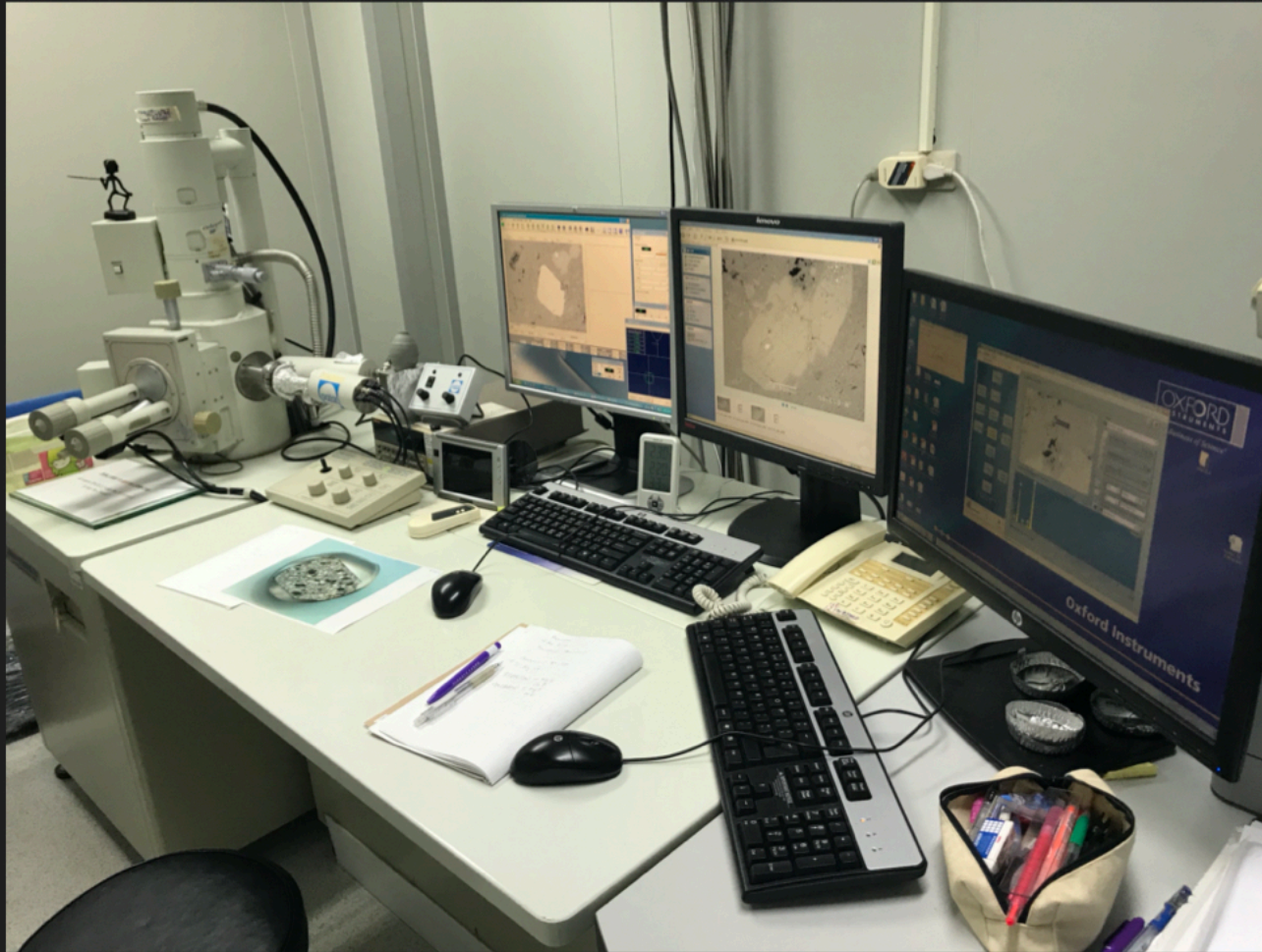
Chang (2006)

1. Magma in darker band: higher density; more alkaline
2. Magma in lighter band: lower density; more acidic; more gas holes
3. Magma in lighter band has higher buoyancy to float upward
4. Large viscosity difference → magma mingling occur

Research motivation

- ▶ In this study, we try to use mineral chemistry to study the phenocryst of CVG.
- ▶ Mineral composition analyses were obtained on polished thin sections from these two locations.
- ▶ The selected minerals are clinopyroxene, orthopyroxene, plagioclase and hornblende.

Mineral chemistry analyses

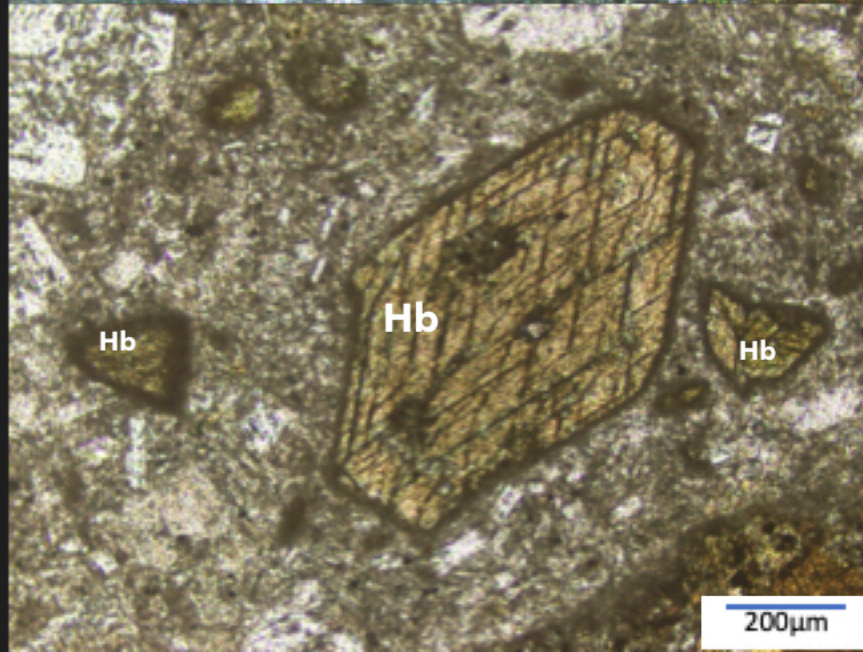
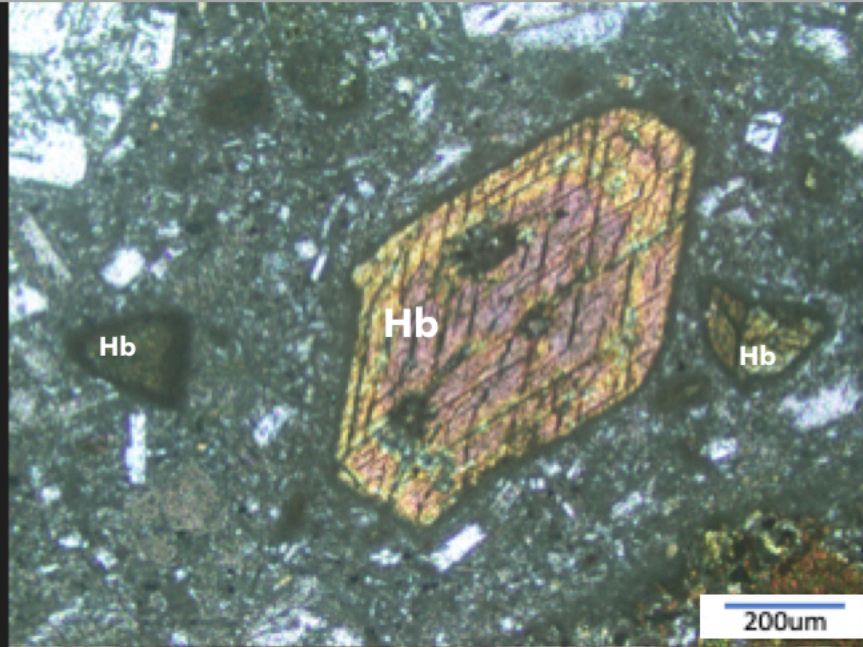


Scanning Electron Microprobe (SEM, JEOL JSM-63060LV) fitting with an Energy Dispersive Spectrometer (EDS, Oxford Instruments INCA-300)



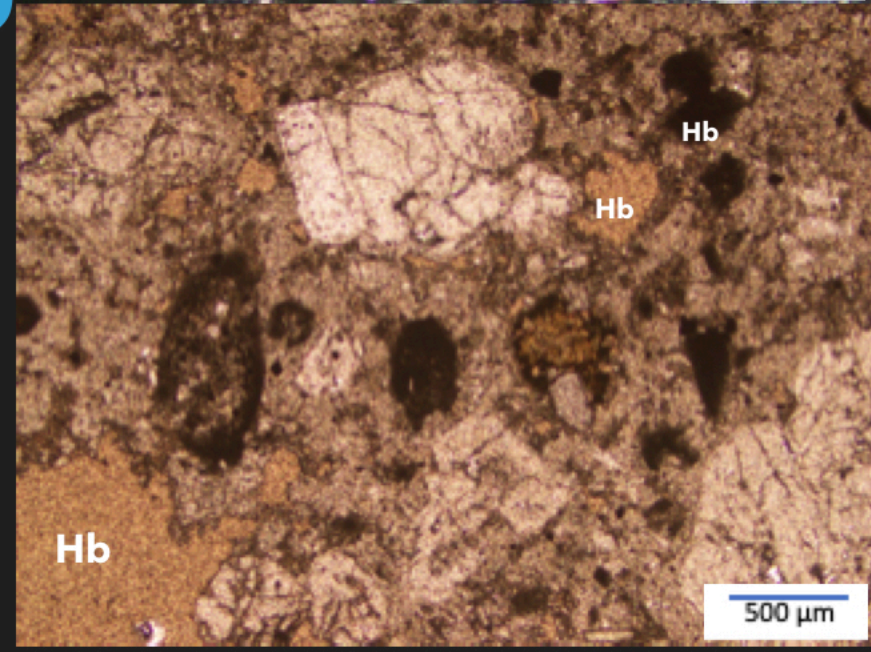
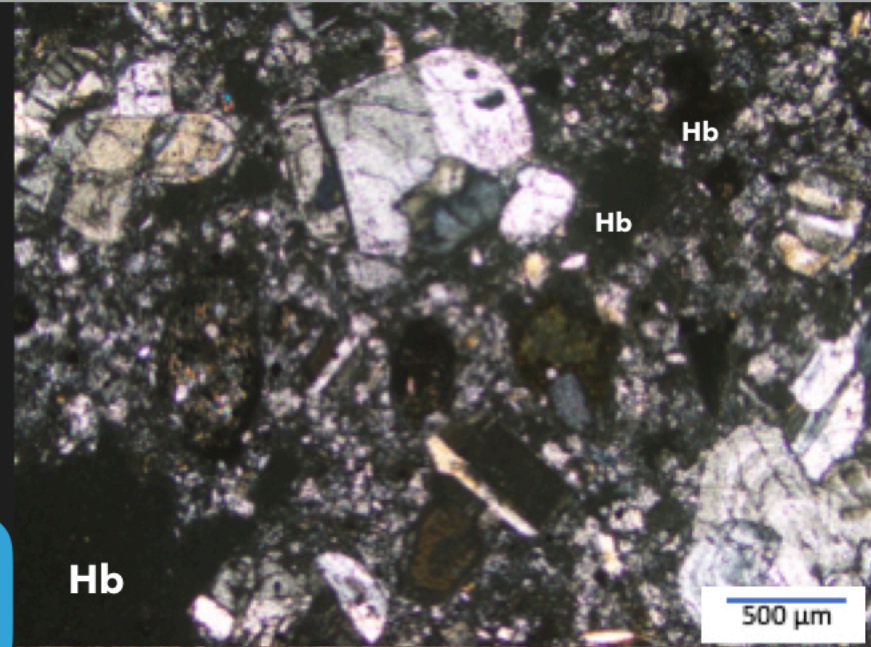
Electronic Microprobe Analyzer (EMPA, JEOL EPMA JXA-8900R)

Thin Section of Chilungshan

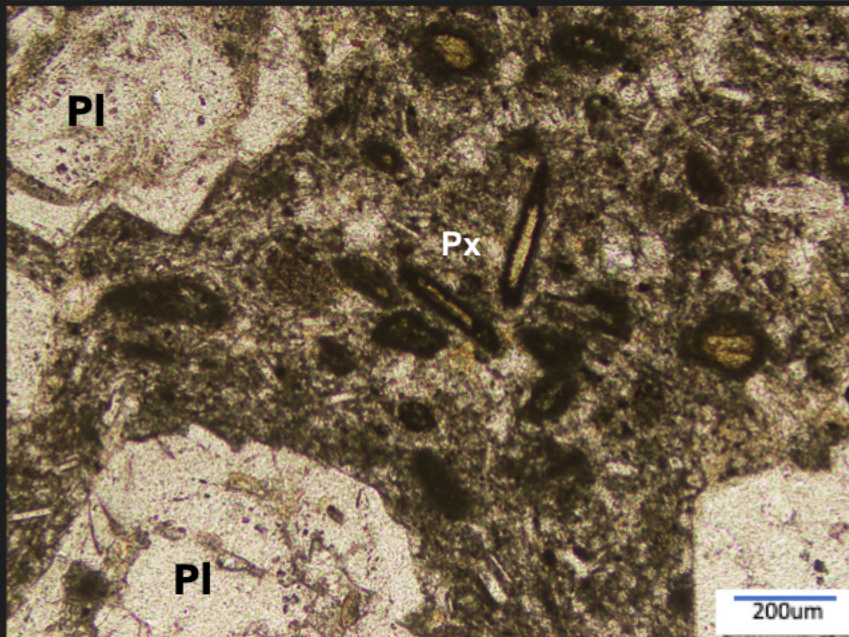
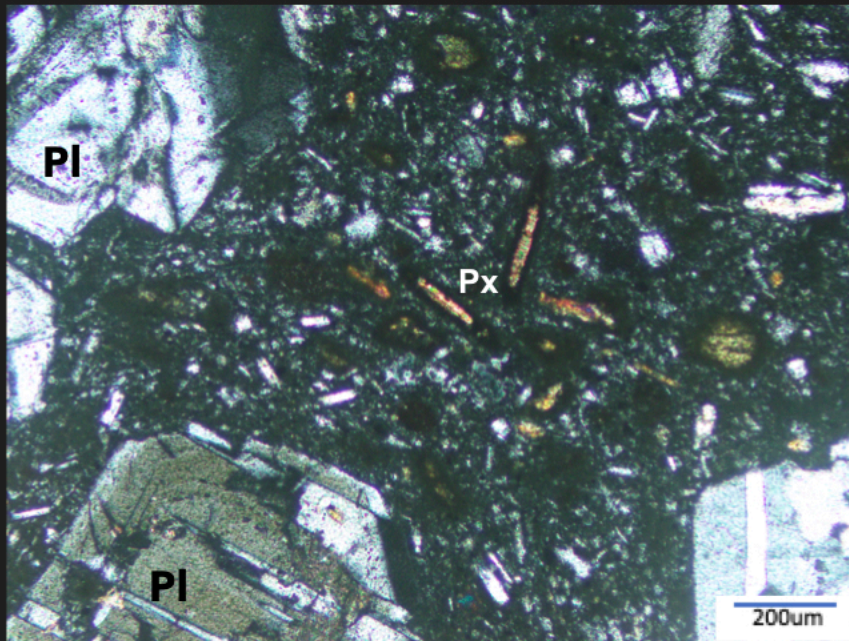


Hornblende

Thin Section of Chilungyu

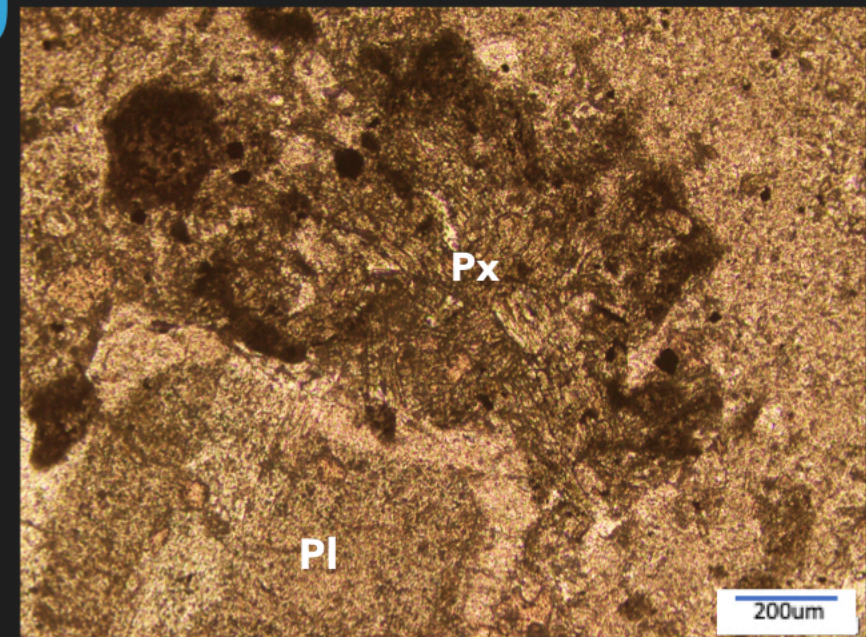
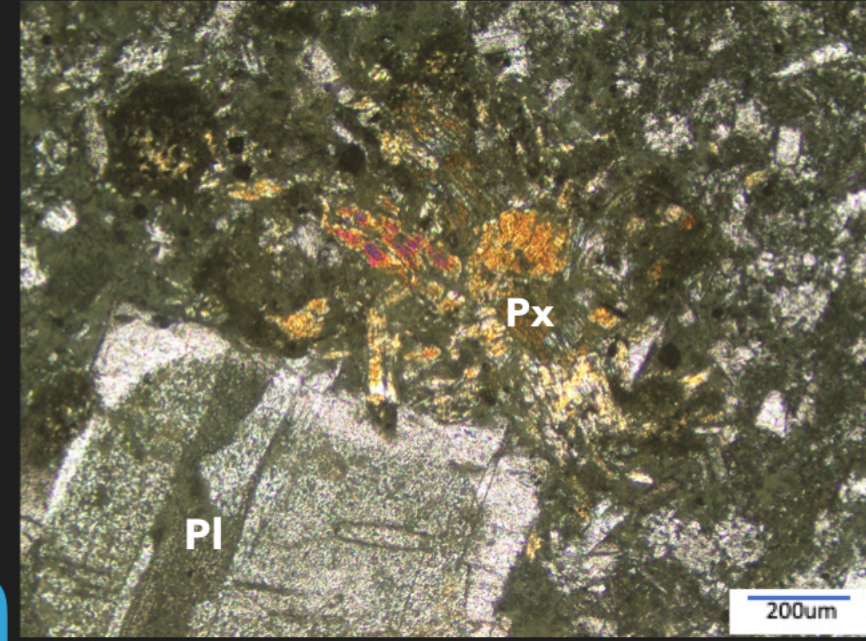


Thin Section of Chilungshan

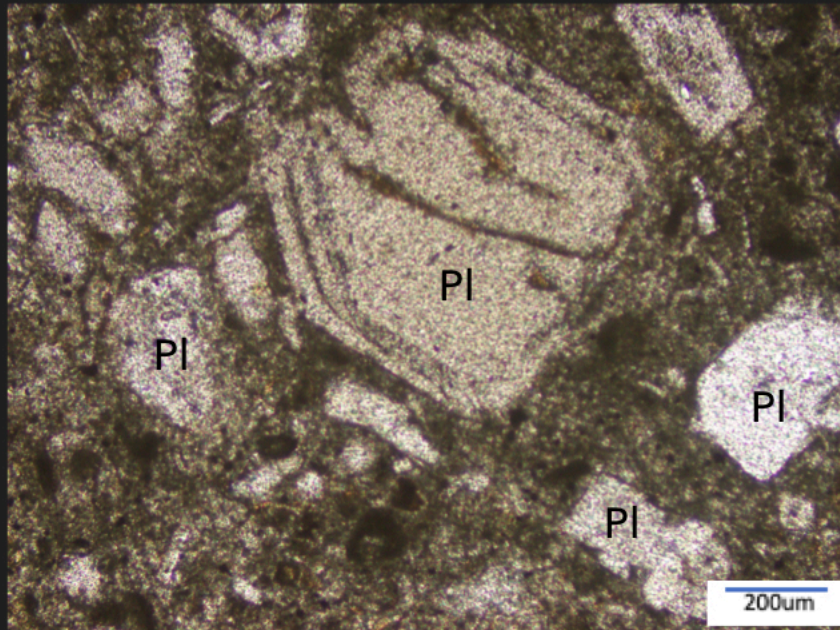
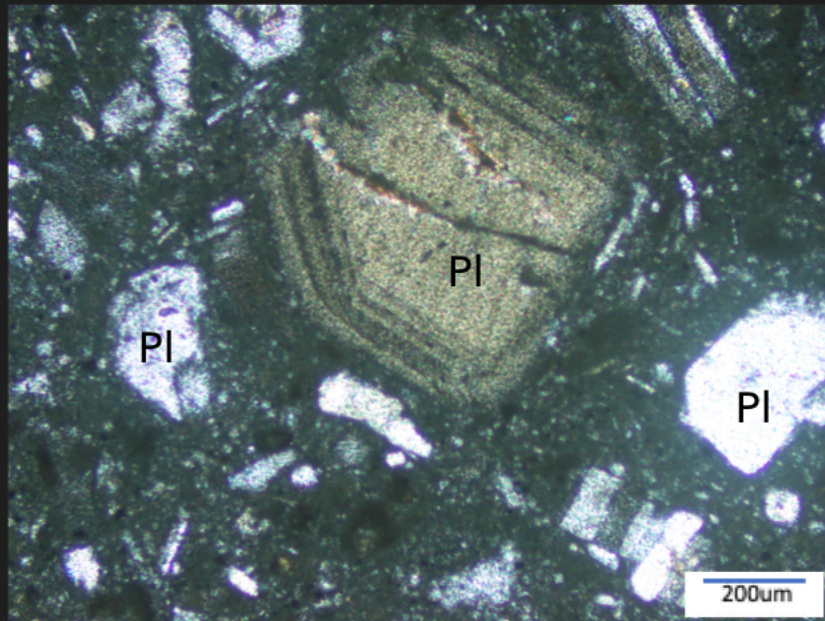


Pyroxene

Thin Section of Chilungyu

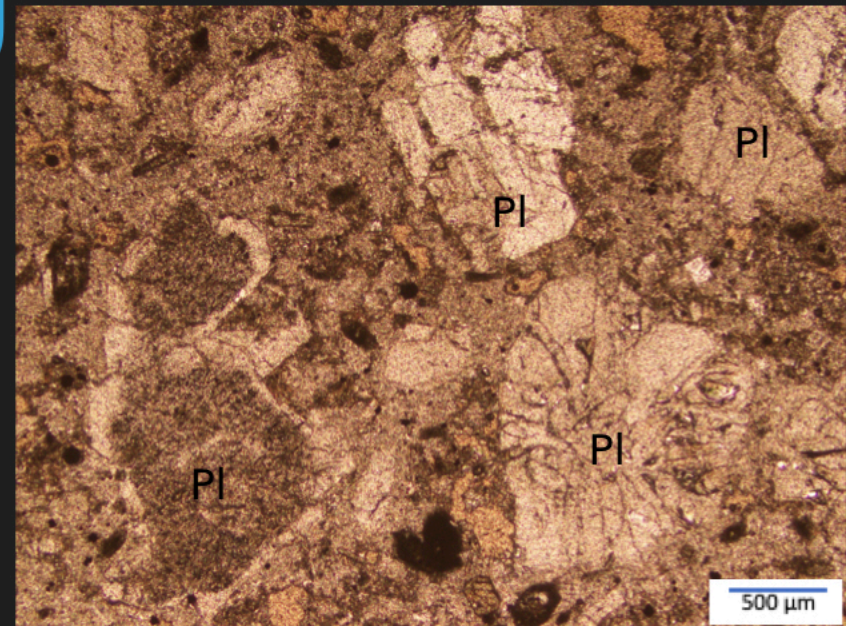
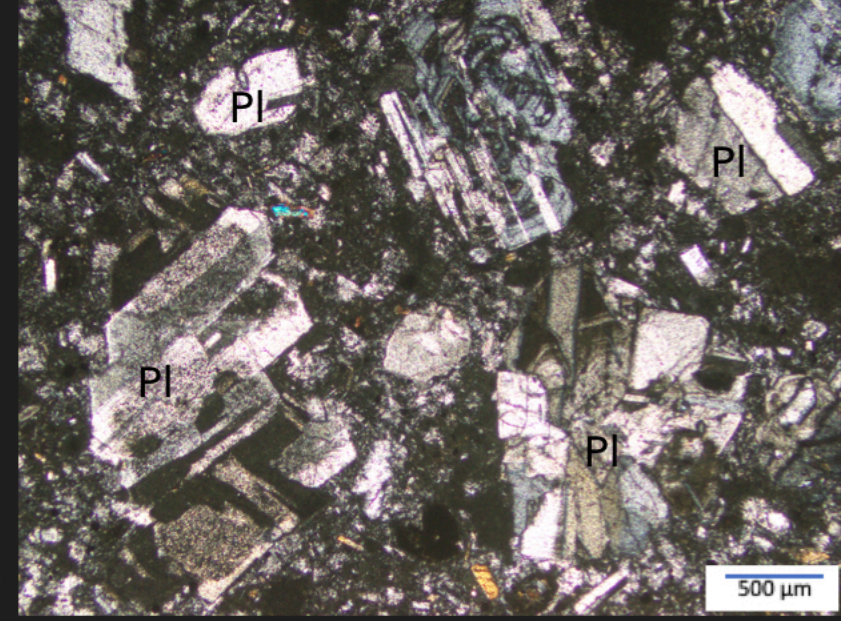


Thin Section of Chilungshan



Plagioclase

Thin Section of Chilungyu

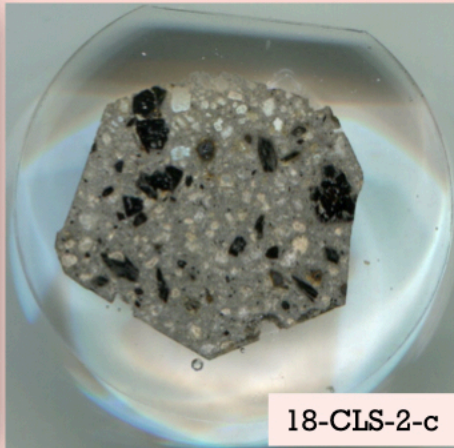
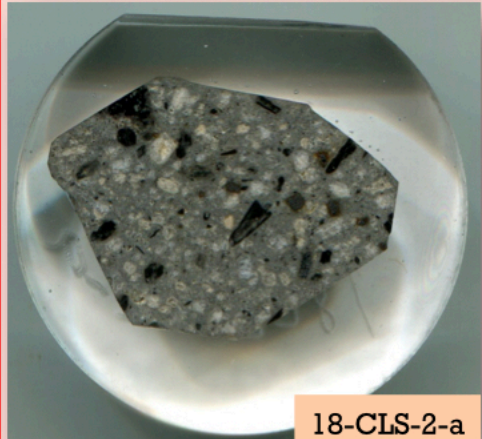
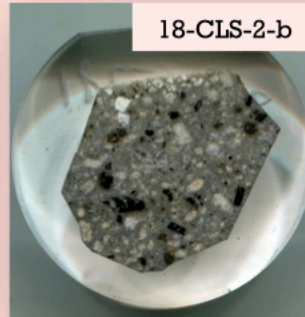
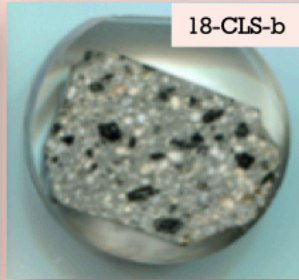
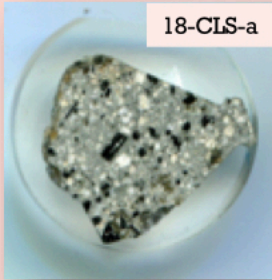


Polished Sections

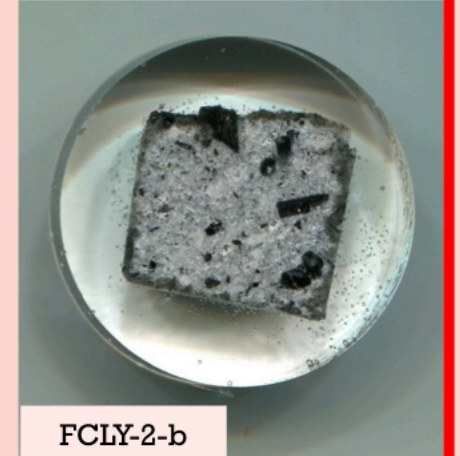
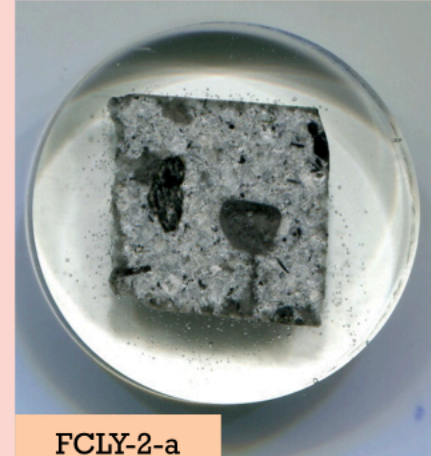
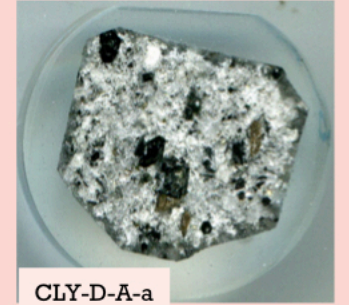
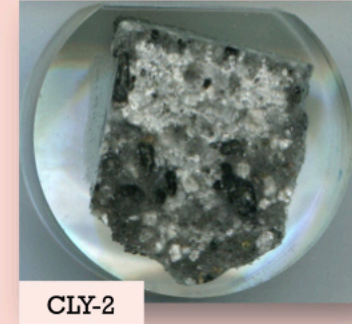
2.5 cm x 2.5 cm

Polished
Section

Chilungshan

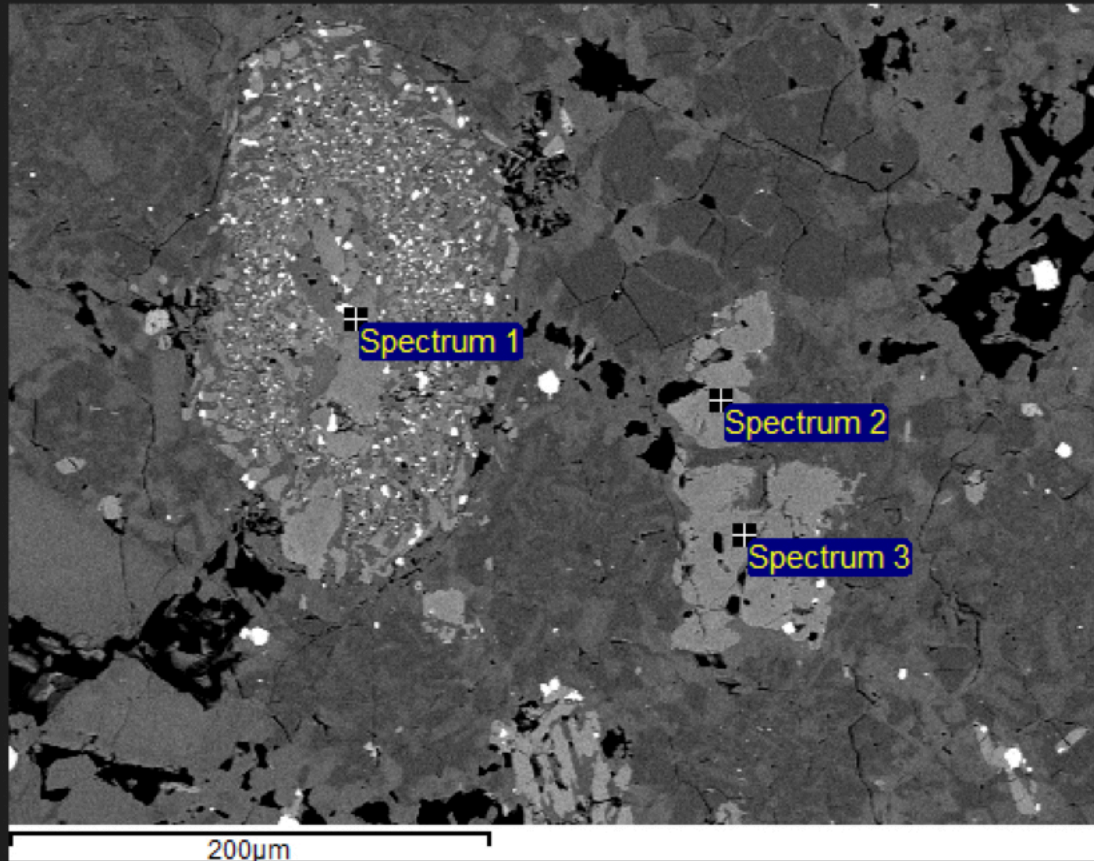


Chilungyu

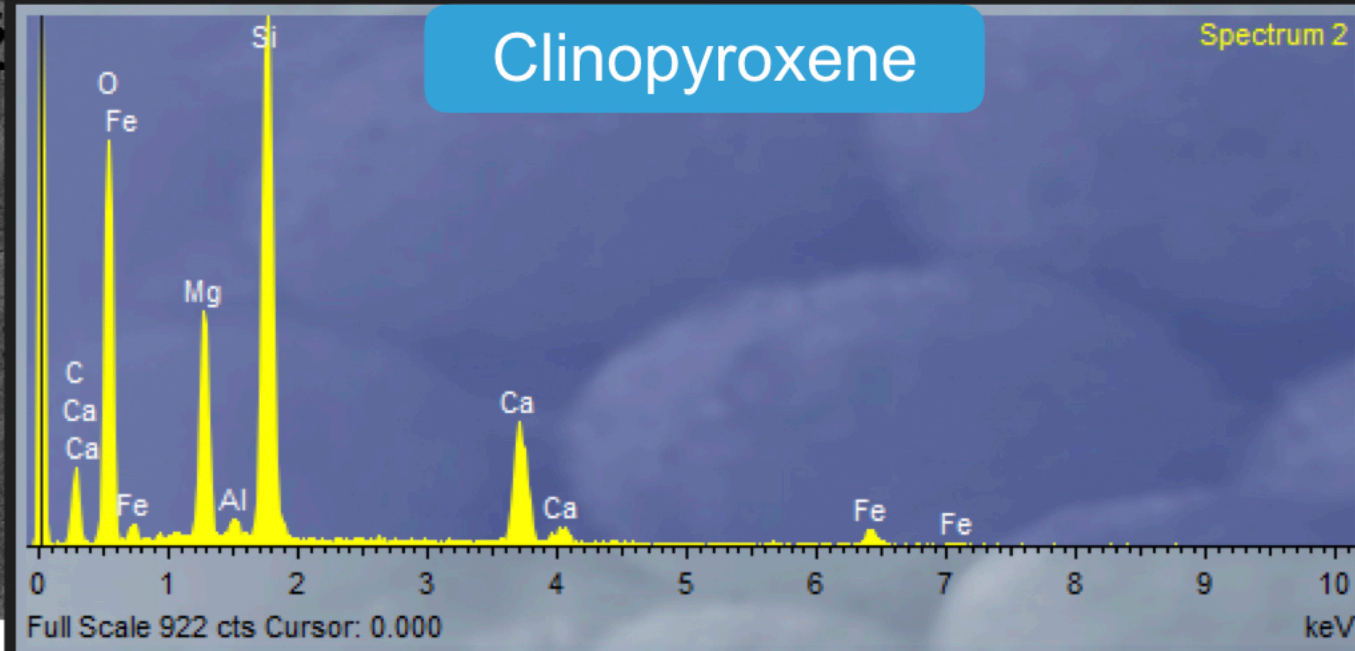


SEM-EDS Results

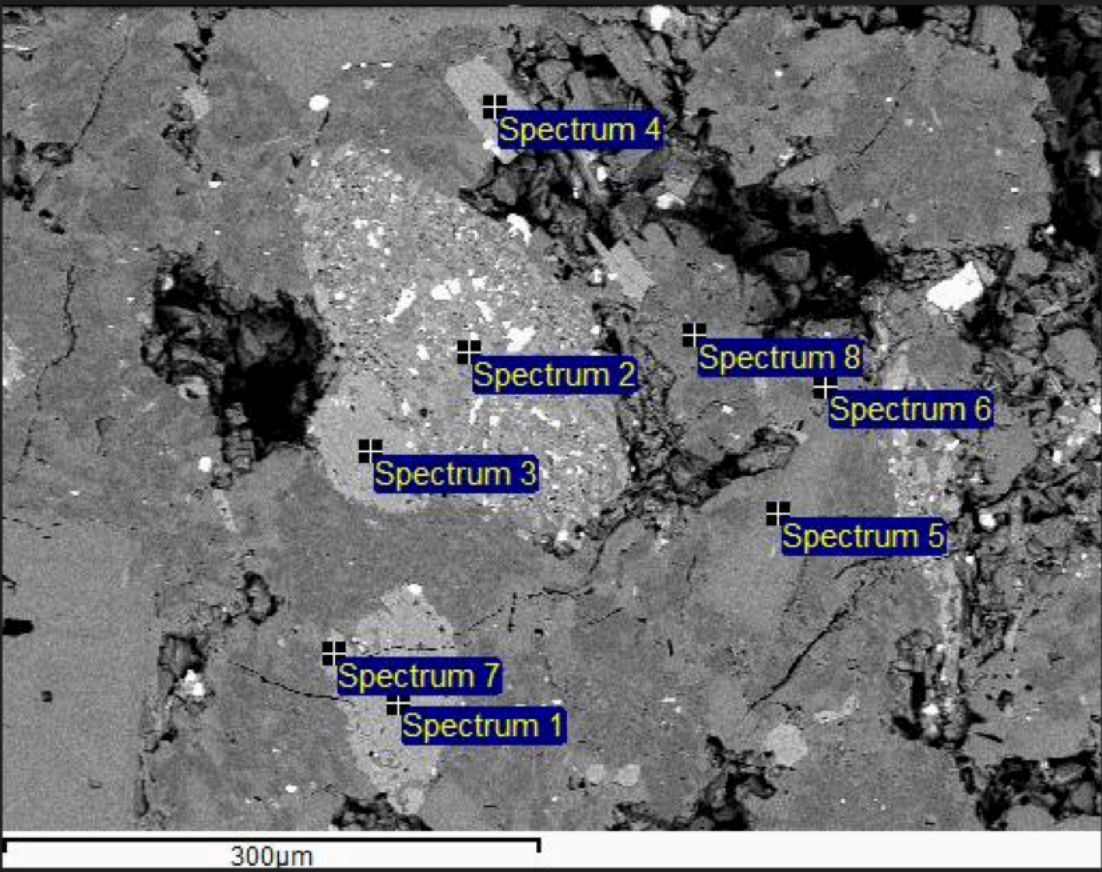
To determine the respective minerals through the peak of major elements



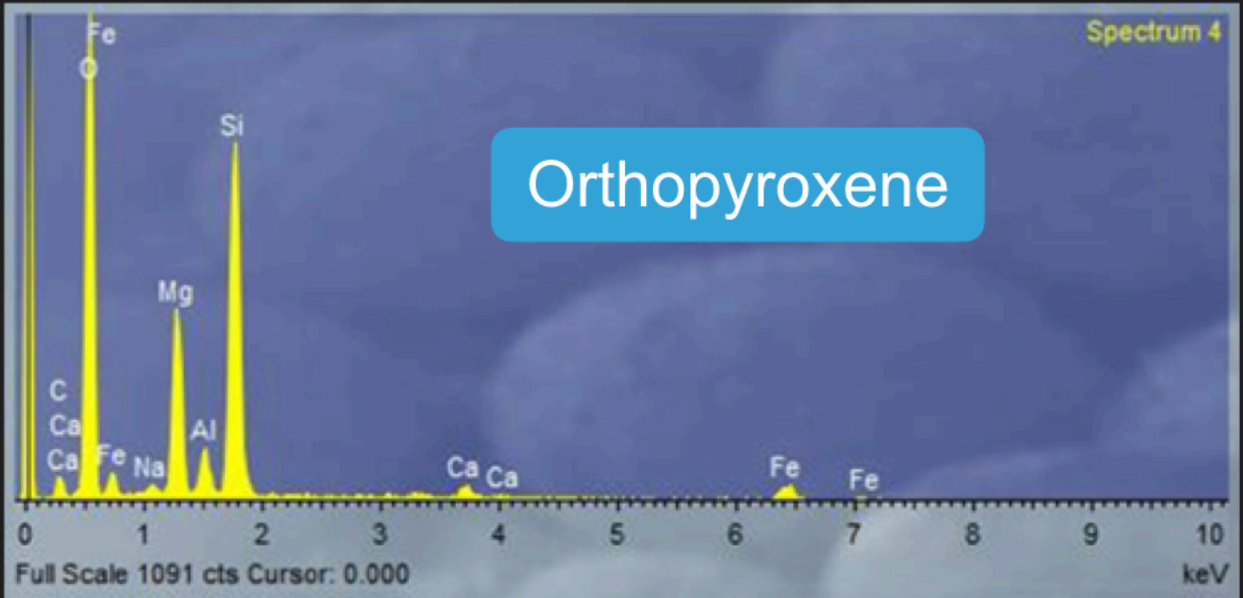
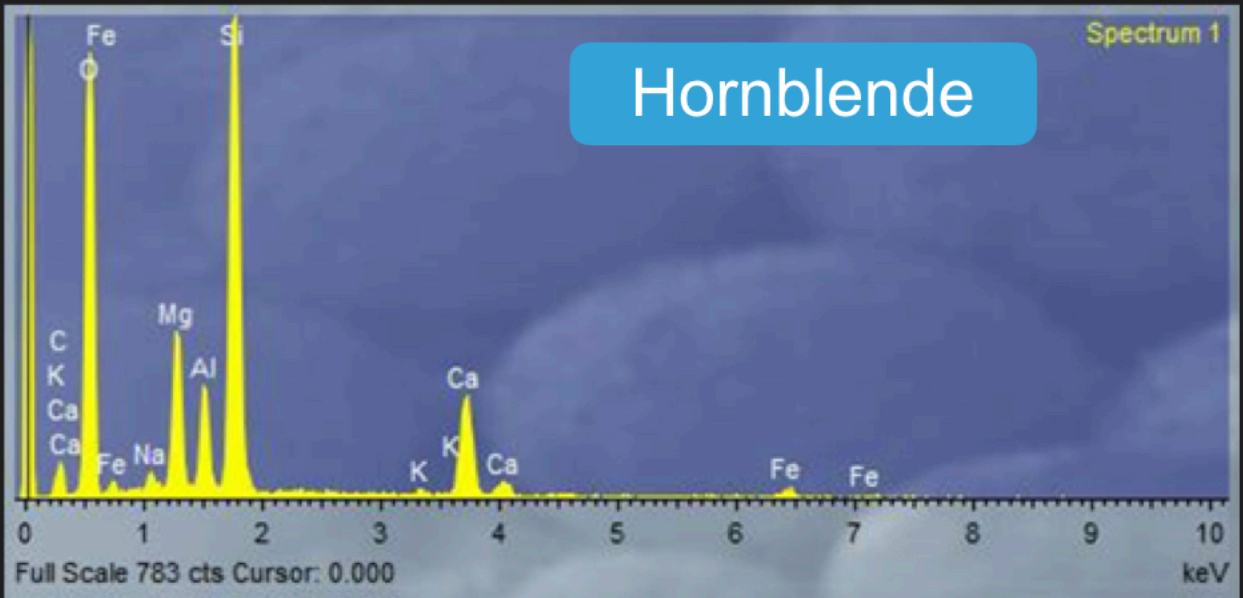
FCLY-2-a_area0 x230B



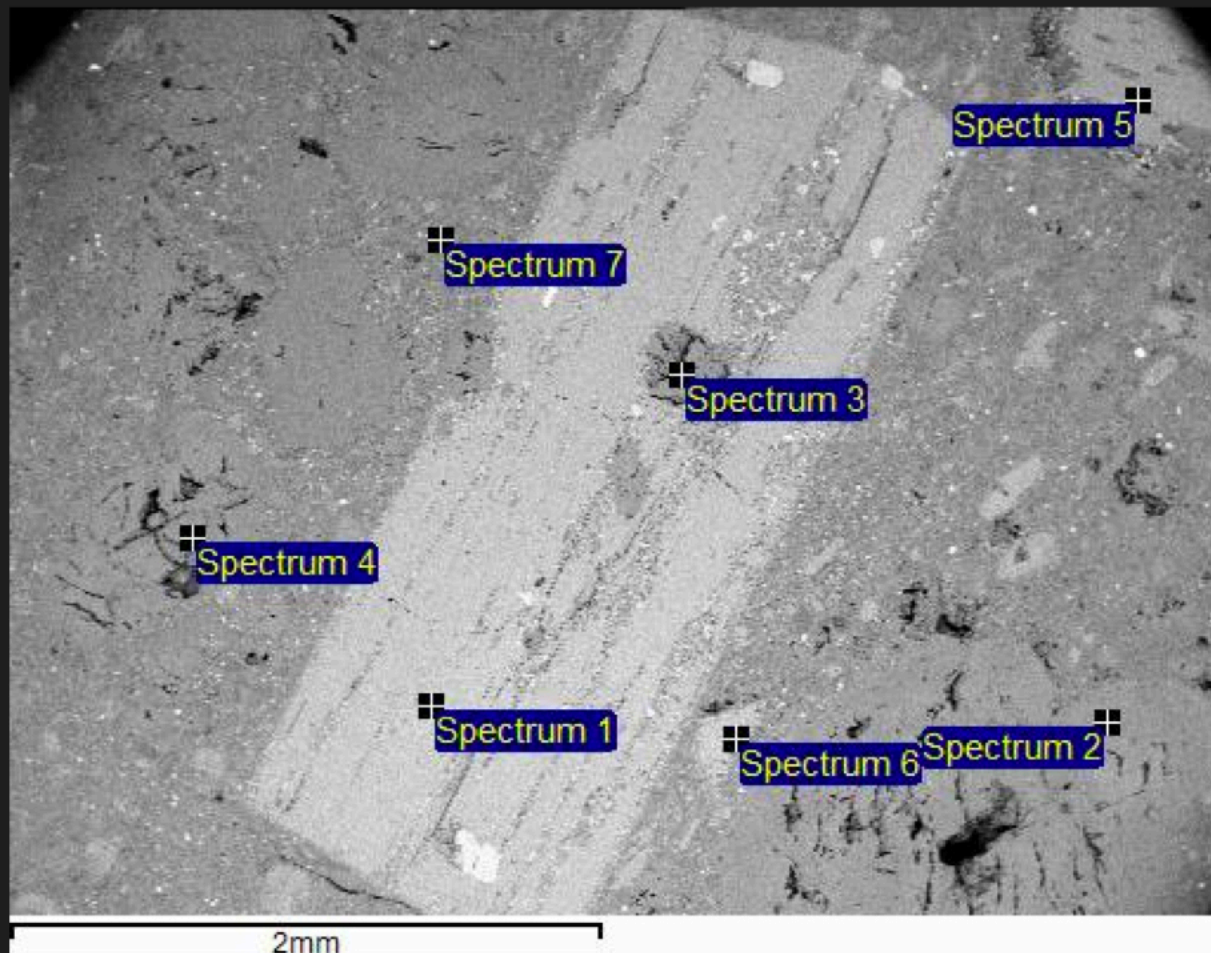
SEM-EDS Results



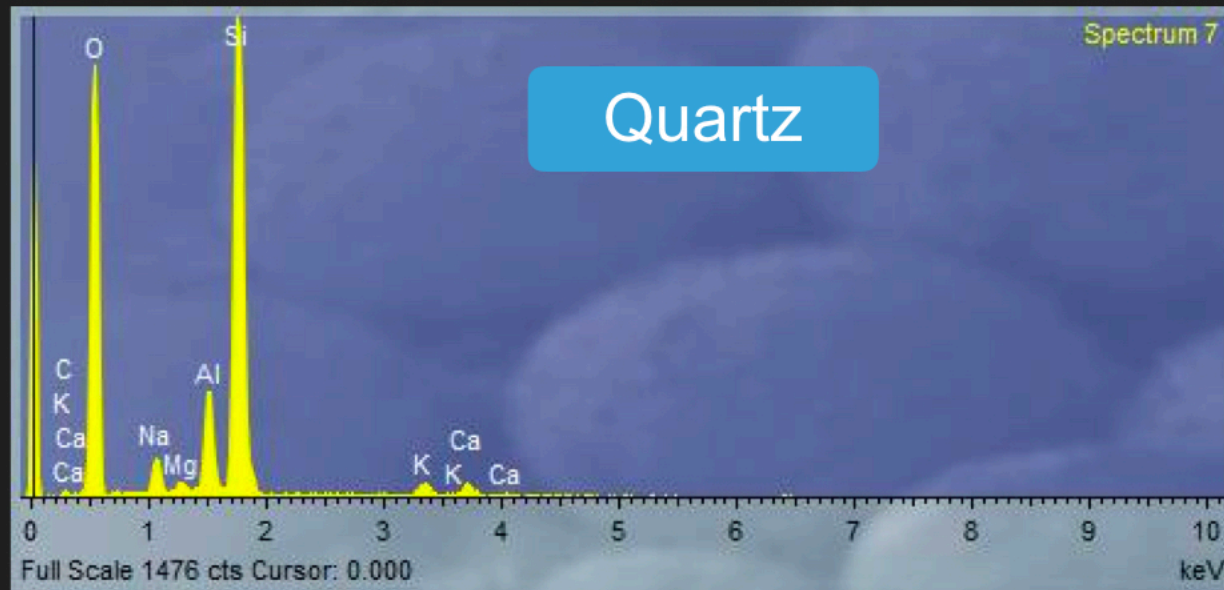
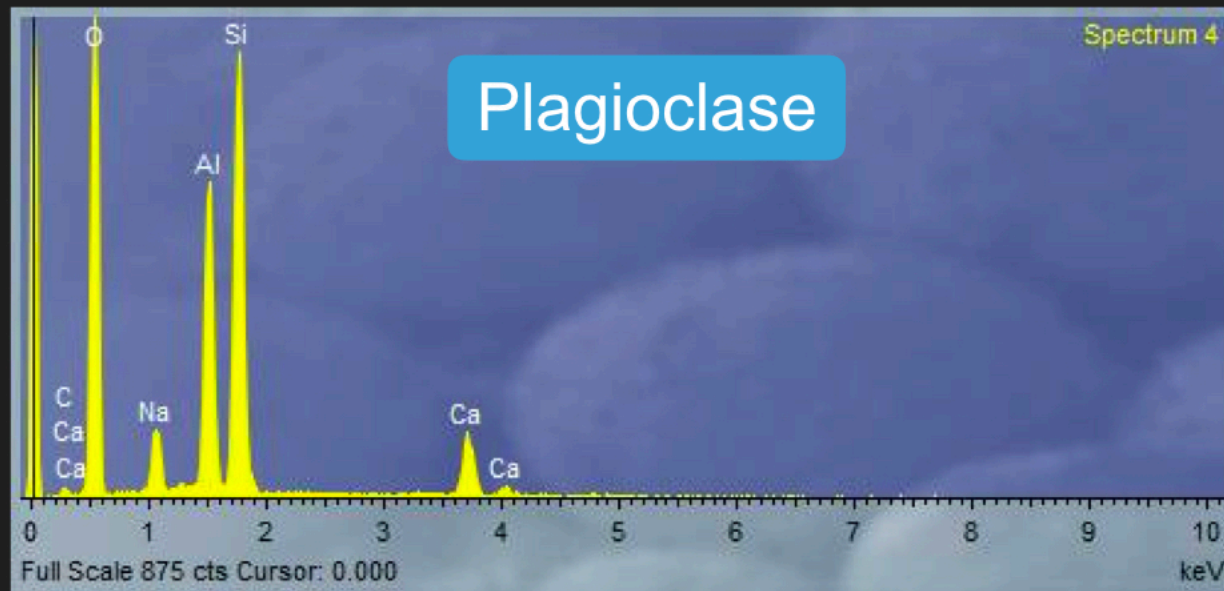
FCLY-2-a_area3 x200B



SEM-EDS Results



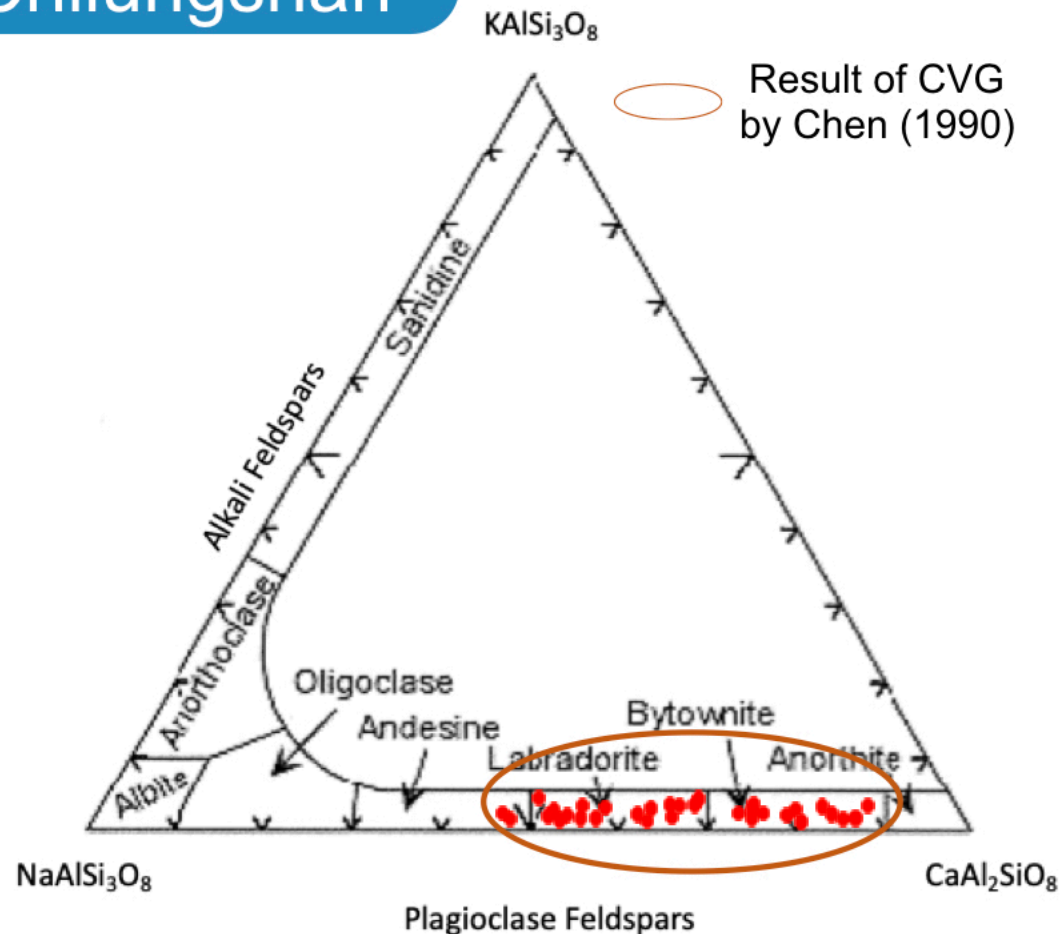
18CLS-2-a_area0 x40B



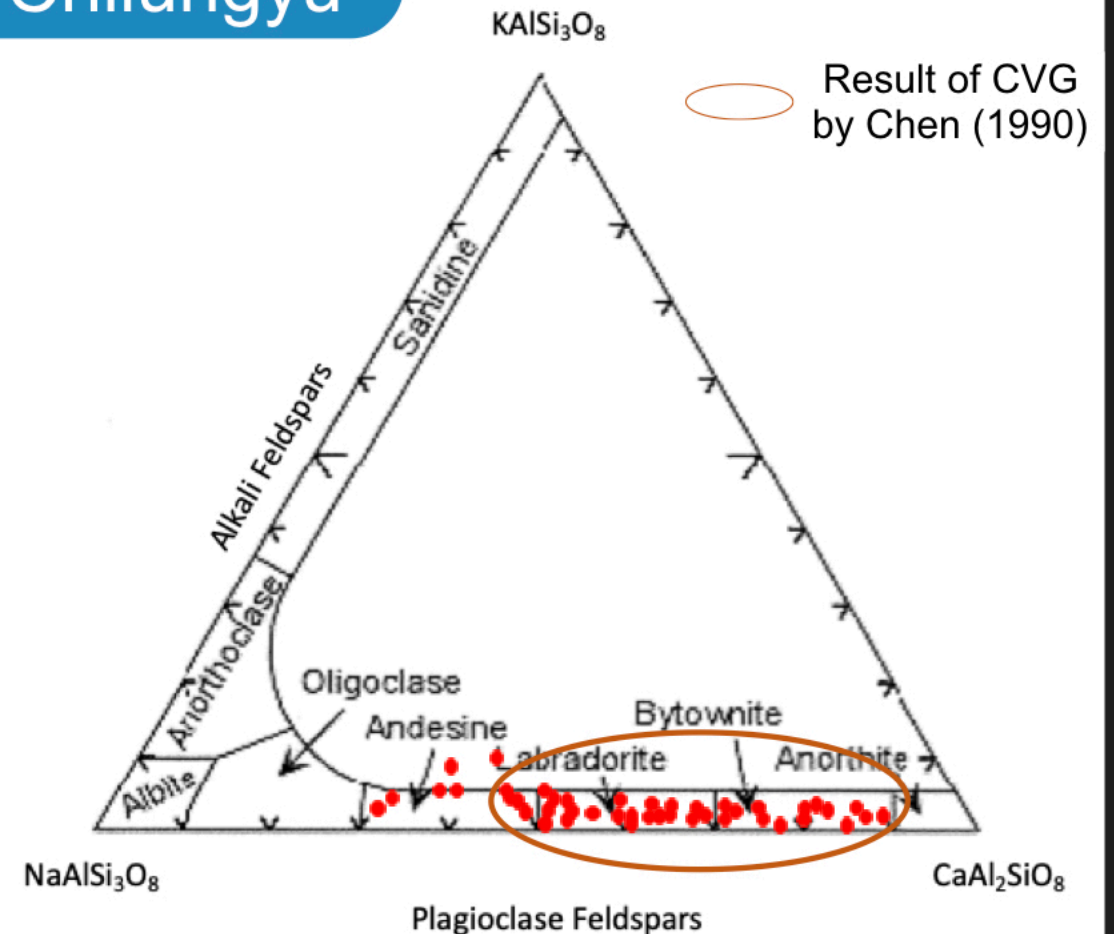
Classification of Plagioclase

Location	Analyzed	Corrected
Chilungshan	n= 351	n= 43
Chilungyu	n= 424	n= 72

Chilungshan



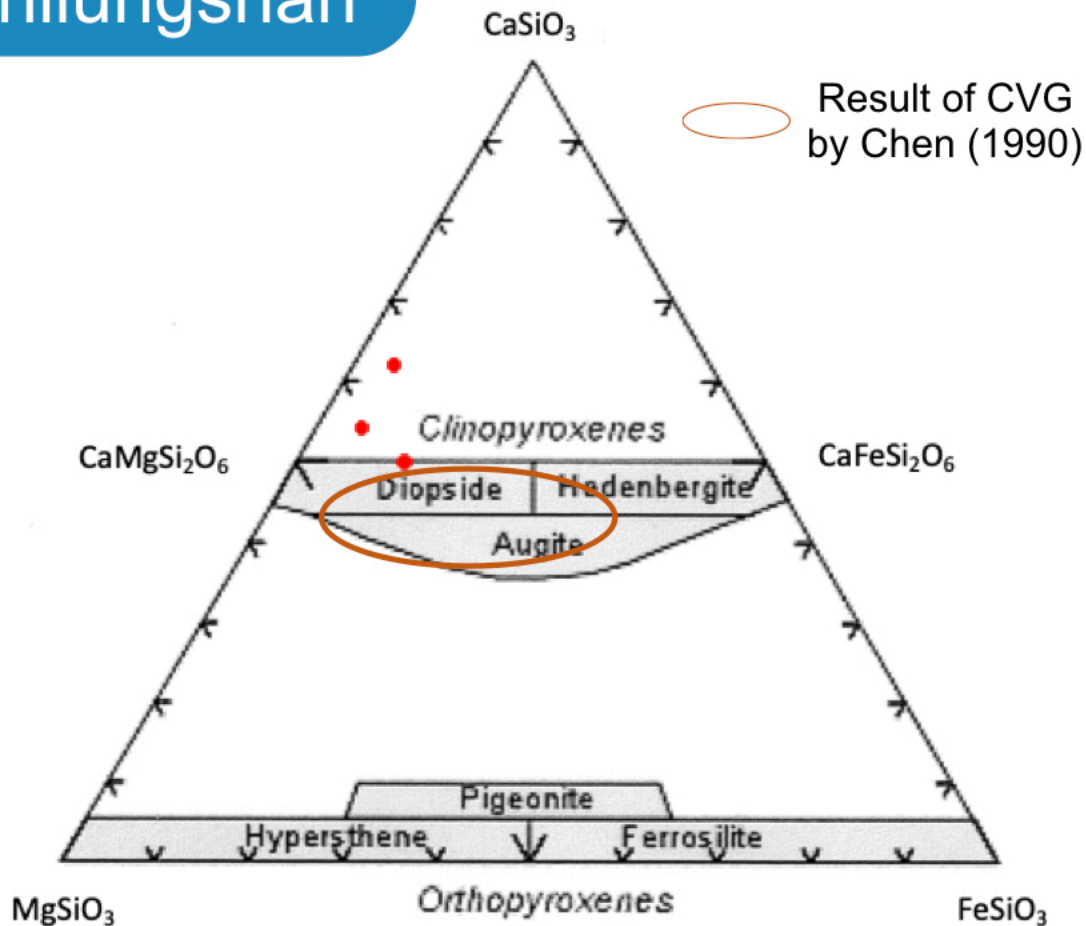
Chilungyu



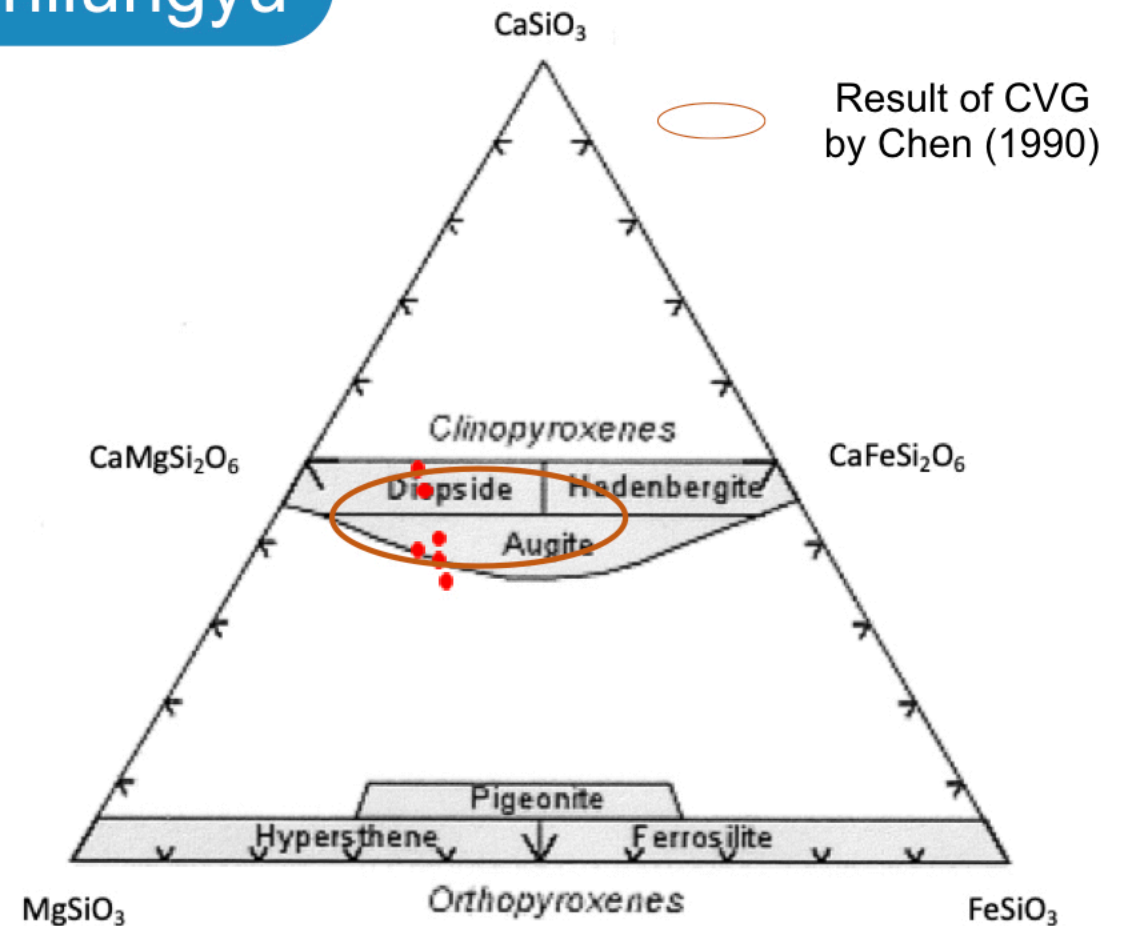
Classification of Clinopyroxene

Location	Analyzed	Corrected
Chilungshan	n= 134	n= 3
Chilungyu	n= 90	n= 6

Chilungshan



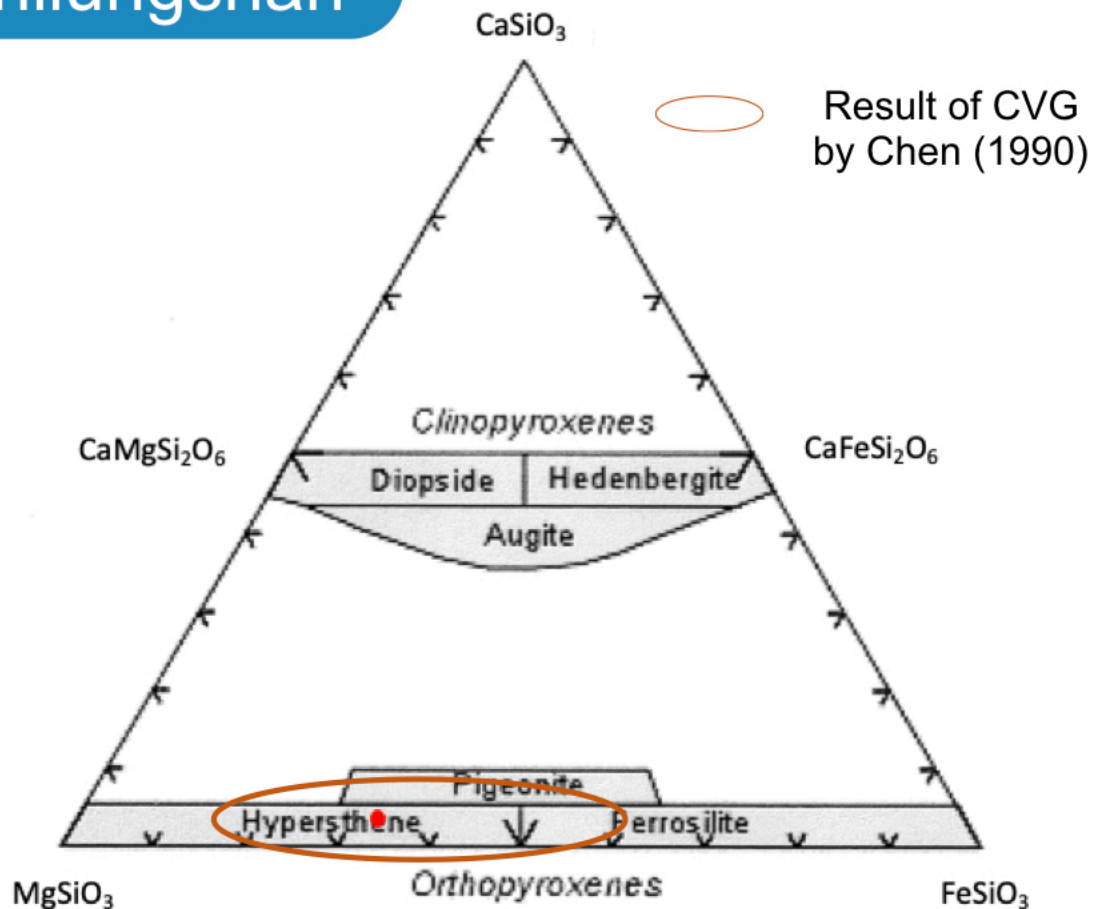
Chilungyu



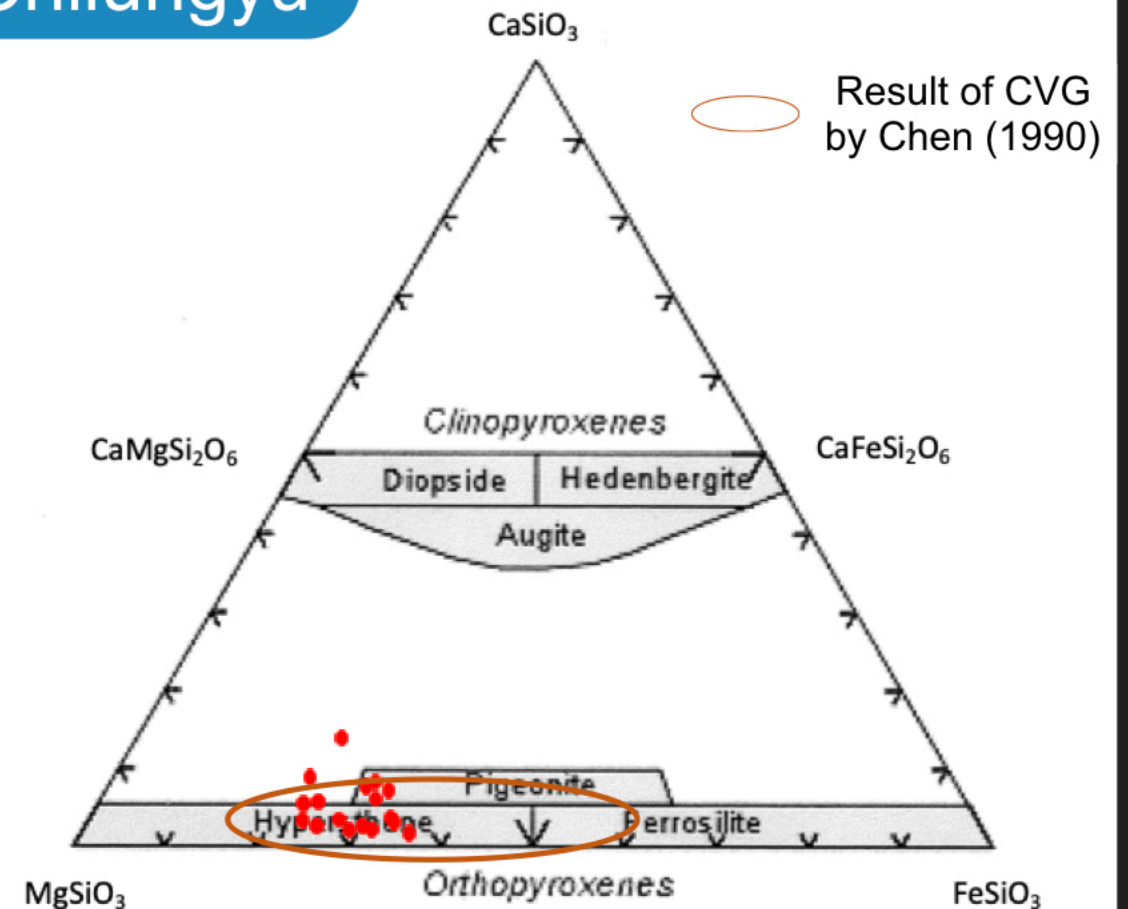
Classification of Orthopyroxene

Location	Analyzed	Corrected
Chilungshan	n= 66	n= 1
Chilungyu	n= 199	n= 20

Chilungshan



Chilungyu



EMPA Results and discussion — Magma mixing?

Location	FCLY-2-A	FCLY-2-B
Spot	Area5_21	Area4_17
Location of spot	Core	Core
Fo mole (%)	79.2	78.0

🔍 Magma mixing in Chilungyu?

🔍 Olivine + Quartz?

EMPA Results and discussion — Magma mixing?

Hornblende

Data	Analyzed		Corrected
Chilungshan	n= 384		n= 168
Sample	18CLS-2-A		18CLS-2-A
Spot	area6_9		area6_11
Location of spot	Core		Rim
Wo mole (%)	27.3		29.1
Sample	18CLS-2-A		18CLS-2-A
Spot	area10_13		area10_15
Location of spot	Core		Rim
Wo mole (%)	27.6		29.5
Sample	18CLS-2-C	18CLS-2-C	18CLS-2-C
Spot	area6_25	area6_26	area6_28
Location of spot	Core	Core	Rim
Wo mole (%)	28.9	28.4	28.2
Sample	18CLS-2-C	18CLS-2-C	18CLS-2-C
Spot	area7_14	area7_15	area7_16
Location of spot	Core	Rim	Rim
Wo mole (%)	27.3	28.6	27.7

Data	Analyzed		Corrected
Chilungyu	n= 110		n= 25
Sample	FCLY-2-A		FCLY-2-A
Spot	area4_14		area4_15
Location of spot	Core		Rim
Wo mole (%)	24.5		44.6
Sample	FCLY-2-B		FCLY-2-B
Spot	area9_90		area9_91
Location of spot	Core		Rim
Wo mole (%)	30.7		14.0
Sample	FCLY-2-B		FCLY-2-B
Spot	area9_90		area9_91
Location of spot	Core		Rim
Wo mole (%)	30.7		14.0
Sample	18CLS-2-	18CLS-2-C	18CLS-2-C
Spot	area7_14	area7_15	area7_16
Location of spot	Core	Rim	Rim
Wo mole (%)	27.3	28.6	27.7

EMPA Results and discussion — Magma mixing?

Plagioclase

Data		Analyzed		Corrected	
Chilungshan		n= 351		n= 43	
Sample	18CLS-2-a	18CLS-2-a	18CLS-2-a	18CLS-2-a	18CLS-2-a
Spot	area2_9	area0_11	Area7_34	Area7_35	
Location of spot	Core	Rim	Core	Rim	
An mole (%)	68.7	51.0	78.1	55.5	
Sample	18CLS-2-a	18CLS-2-a	18CLS-2-c	18CLS-2-c	
Spot	area13_1	area13_3	area1_21	area1_23	
Location of spot	Core	Rim	Core	Rim	
An mole (%)	78.0	55.6	65.0	58.5	
Sample	18CLS-2-c	18CLS-2-c	18CLS-2-c	18CLS-2-c	18CLS-2-c
Spot	area7_5	area7_7	area7_9	area7_10	area7_12
Location of spot	Core	Rim	Core	Core	Rim
An mole (%)	67.4	46.4	75.0	68.4	53.2

Data		Analyzed		Corrected	
Chilungyu		n= 424		n= 72	
Sample	FCLY-2-B	FCLY-2-B	FCLY-2-B	FCLY-2-B	FCLY-2-B
Spot	area0_29	area0_31	Area3_5	Area3_6	Area3_7
Location of spot	Core	Rim	Core	Core	Rim
An mole (%)	56.1	60.8	51.2	52.0	61.6
Sample	FCLY-2-B	FCLY-2-B	FCLY-2-B	FCLY-2-B	FCLY-2-B
Spot	Area3_108	Area3_109	Area3_110	area9_62	area9_64
Location of spot	Core	Core	Rim	Core	Rim
An mole (%)	79.8	53.5	59.9	66.6	55.0
Sample	FCLY-2-B	FCLY-2-B	FCLY-2-B	FCLY-2-B	FCLY-2-B
Spot	area9_65	area9_66	area9_68	Area9_78	Area9_80
Location of spot	Core	Core	Rim	Core	Rim
An mole (%)	79.7	67.2	54.5	83.6	62.4

Conclusion

- ▶ According to our results of mineral chemistry,
 - ▶ Plagioclase in Chilungshan and Chilungyu are belonged to **labradorite** and **bytownite**, and some **andesine** can also be found in Chilungyu.
 - ▶ **Hypersthene** and **diopside** can be found in both areas, however, **augite** only exist in Chilungyu
- ▶ Some **olivine** existed abnormally in Chilungyu's sample, and this occurrence might as a result of magma mixing. However, we find no olivine in the thin section.
- ▶ There is no obviously different chemical composition between core and rim in all phenocrysts. Therefore, magma mixing might be unusual in CVG.

Reference

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- ▶ 臺灣之火成岩，陳正宏，經濟部中央地質調查所，1990

Acknowledgement

- ▶ Teacher Advisor:
- ▶ Professor Lai Yu-Ming
- ▶ Analysis of EMPA & SEM-EDS results:
- ▶ Yoshiyuki Iizuka, Masako USUKI, Wang Yu-Shiang
- ▶ Sample Preparation:
- ▶ Hsia Wen-yu, Lee Dung-Han, Yang Chih-Yuan, Ho Chi-En