

An investigation into the Ferrar Dolerites, Dry Valleys Antarctica

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Petrology 422

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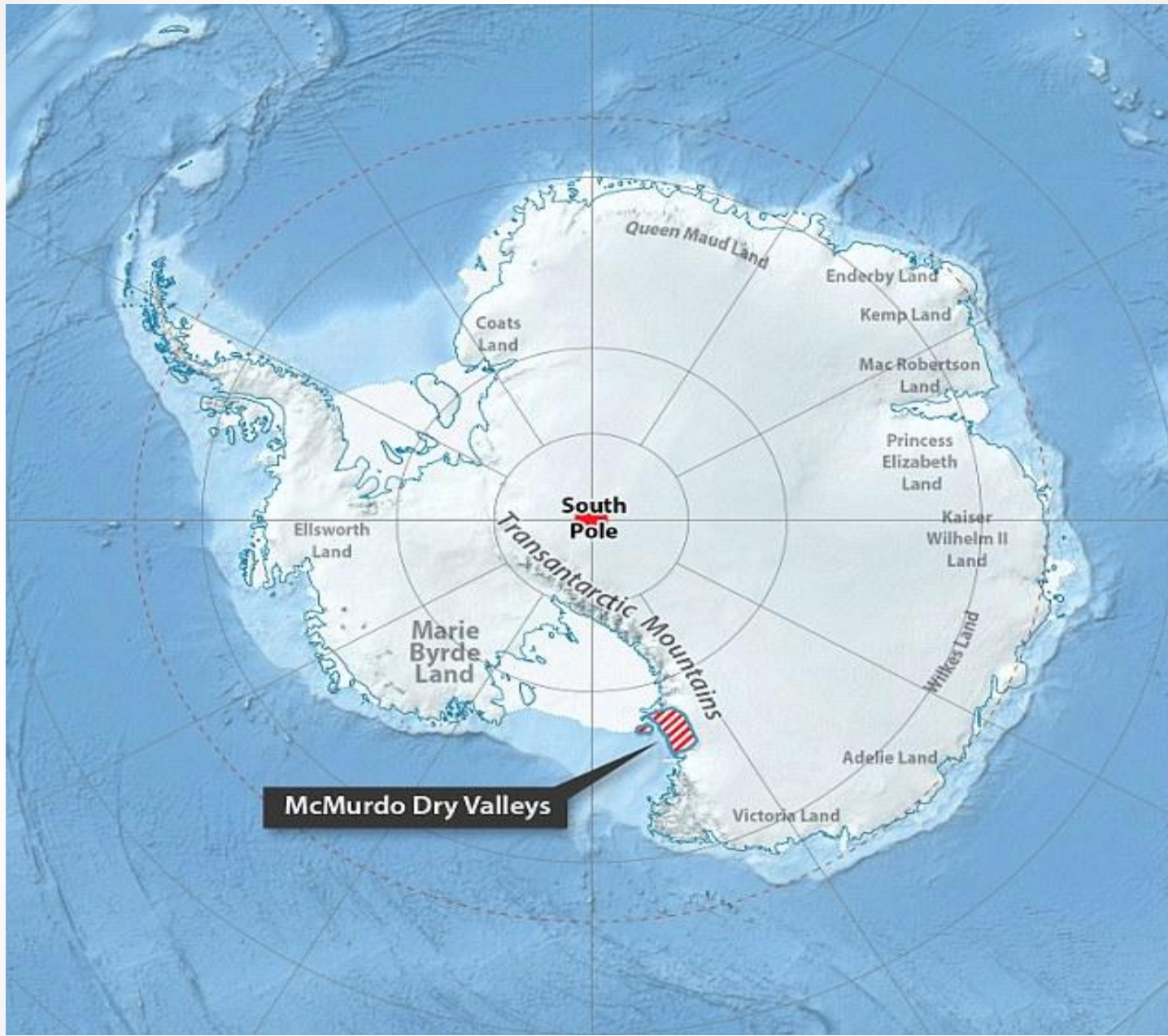
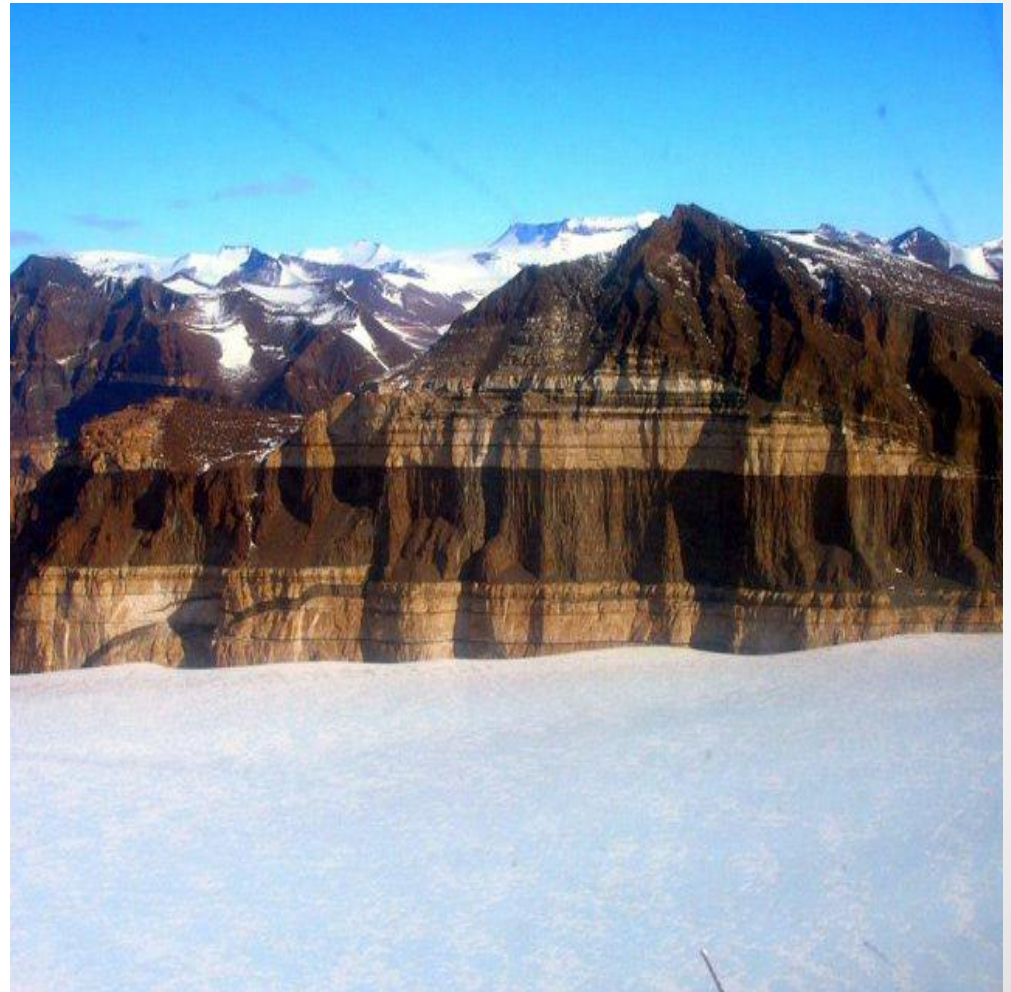


Image from: http://i.dailymail.co.uk/i/pix/2015/04/28/17/281BDFE100000578-3059337-image-a-124_1430236826419.jpg

Ferrar Dolerite

- Jurassic Age ~184 Ma
- Ferrar Large Igneous Province
 - Extends more than 4000 km
 - From the Weddell Sea to SE Australia
 - Interpreted as a failed rift
- 4 major sills
 - Basement
 - Peneplain
 - Beacon/Aasgard
 - Mt. Fleming



Samples

Pivot Peak



- SW Edge of Dry Valleys
- Nunatak
 - Exposed ridge not covered in snow
- From striated outcrop
- Tough to know if high or low sill
- Sample Collected by Dr. Adam Lewis

Samples

ALX-05-85



- Western side of Friis Hills.
- Not found from bedrock, but bedrock exposed
- Middle Sill
- Sample collected by Dr. Adam Lewis

Samples

ASX-10-11A



- Eastern edge of Friis Hills
- Not bedrock, bedrock was found only few feet away
- Found 6km away from ALX-05-85
- Sample collected by Alex Smith

Samples

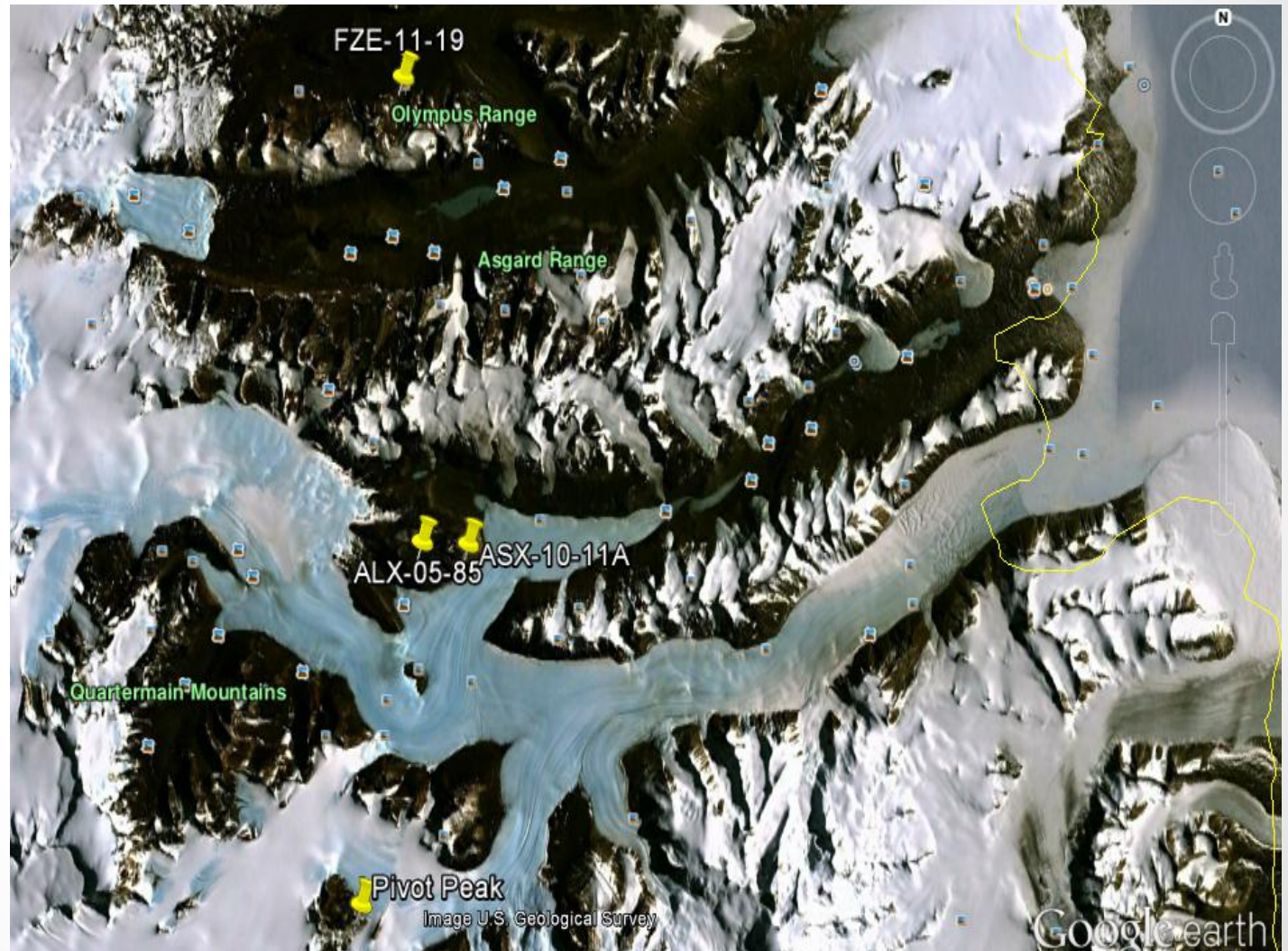
FZE-11-19



- From Olympus range
- ~10 km from bull pass
 - Some believe Bull pass to be source of sills
- Middle Sill
- Collected by Felix Zamora.

Map of Samples

- Pivot Peak to ALX-05-85
 - ~25.7 km
- Pivot Peak to FZE-11-19
 - ~58 km
- ALX-05-85 to FZE-11-19
 - ~33 km
- ALX-05-85 to ASX-10-11A
 - ~6 km



Thin Section

- Creating 2 thin sections to compare mineralogy
- Methods
 - Cut up rock into a blank
 - Polished the gluing slide
 - Epoxy
 - Cut slide with petro-thin
 - Polished to 30 microns
 - Used Leica Microscope



Photos By: Kevin McKenzie ●

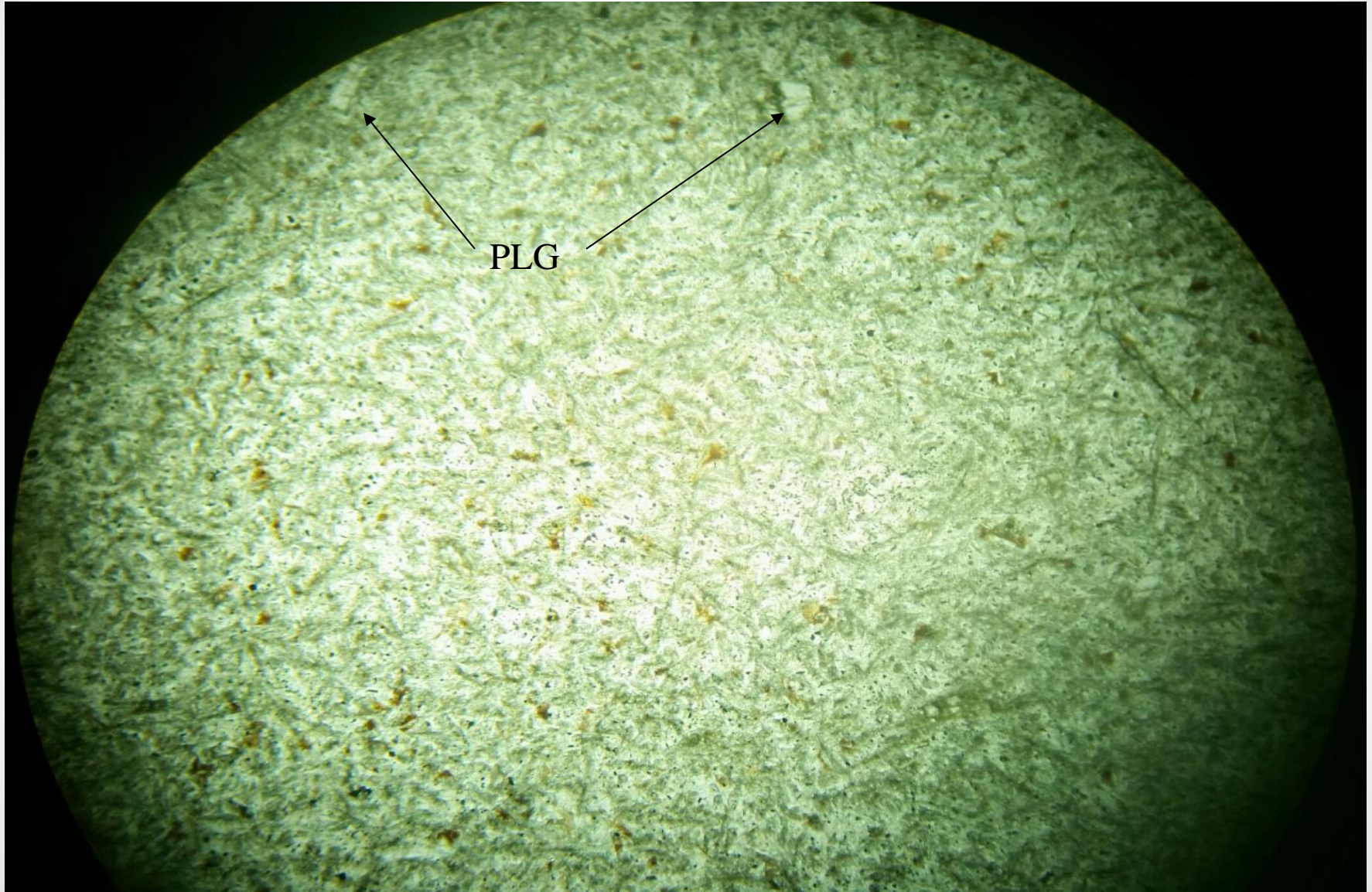
Thin Sections Pivot Peak 1



• Scale - 2 mm XP

Photos By: Kevin McKenzie ●

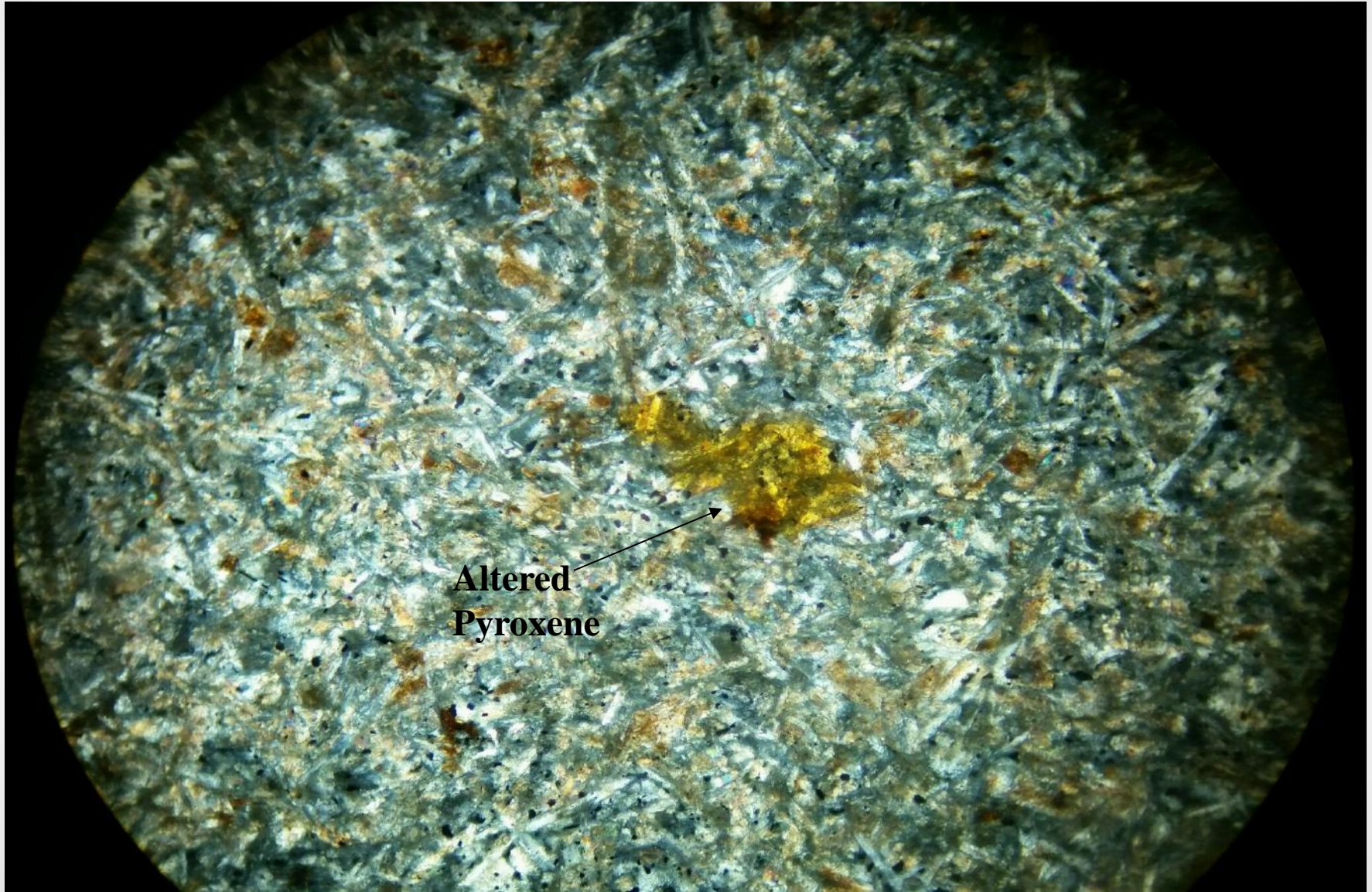
Thin Sections Pivot Peak 1



• Scale - 2 mm PPL

Photos By: Kevin McKenzie •

Thin Sections Pivot Peak 2

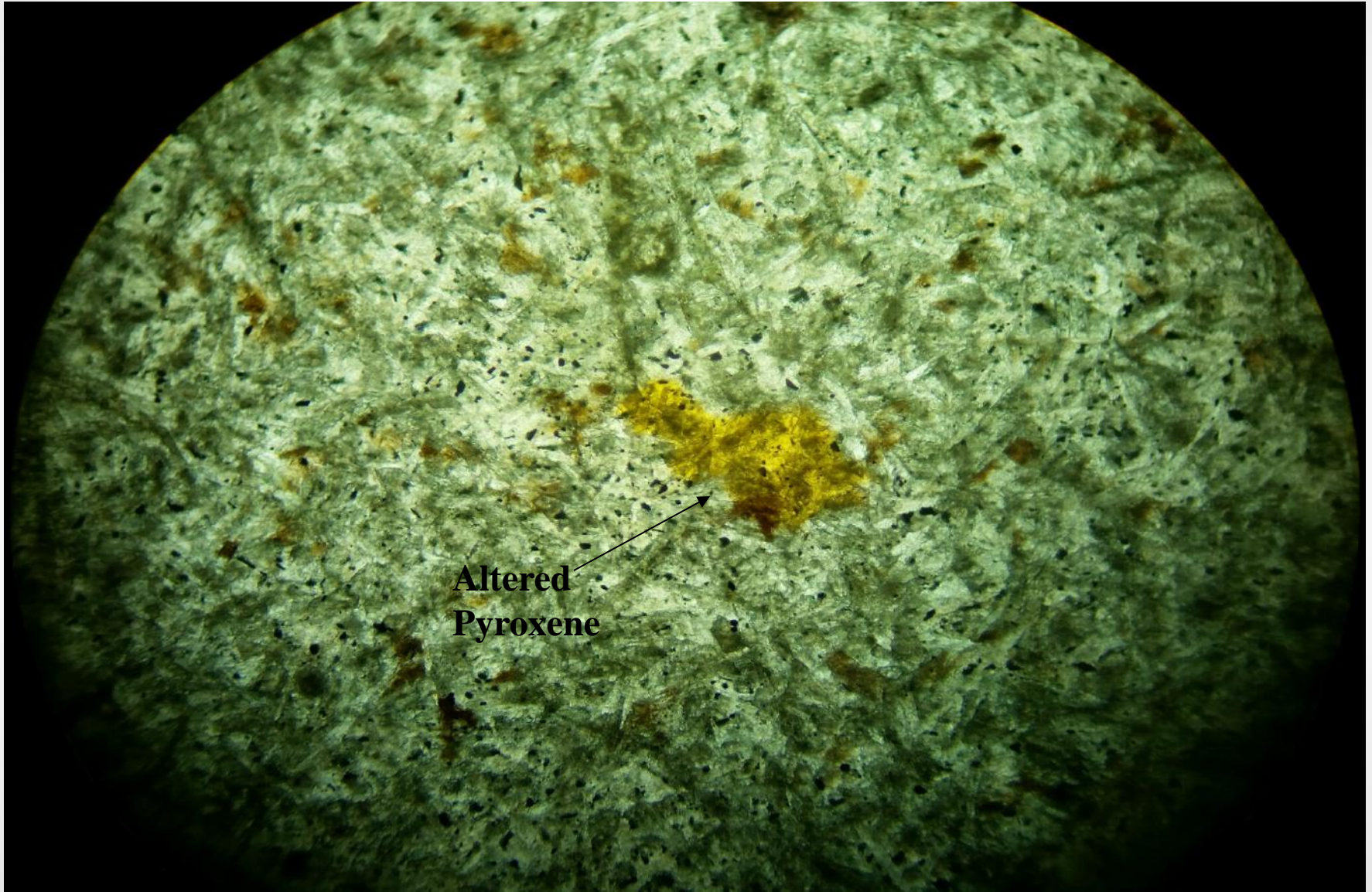


Altered
Pyroxene

• Scale - 2 mm XP

Photos By: Kevin McKenzie ●

Thin Sections Pivot Peak 2



• Scale - 2 mm PPL

Photos By: Kevin McKenzie •

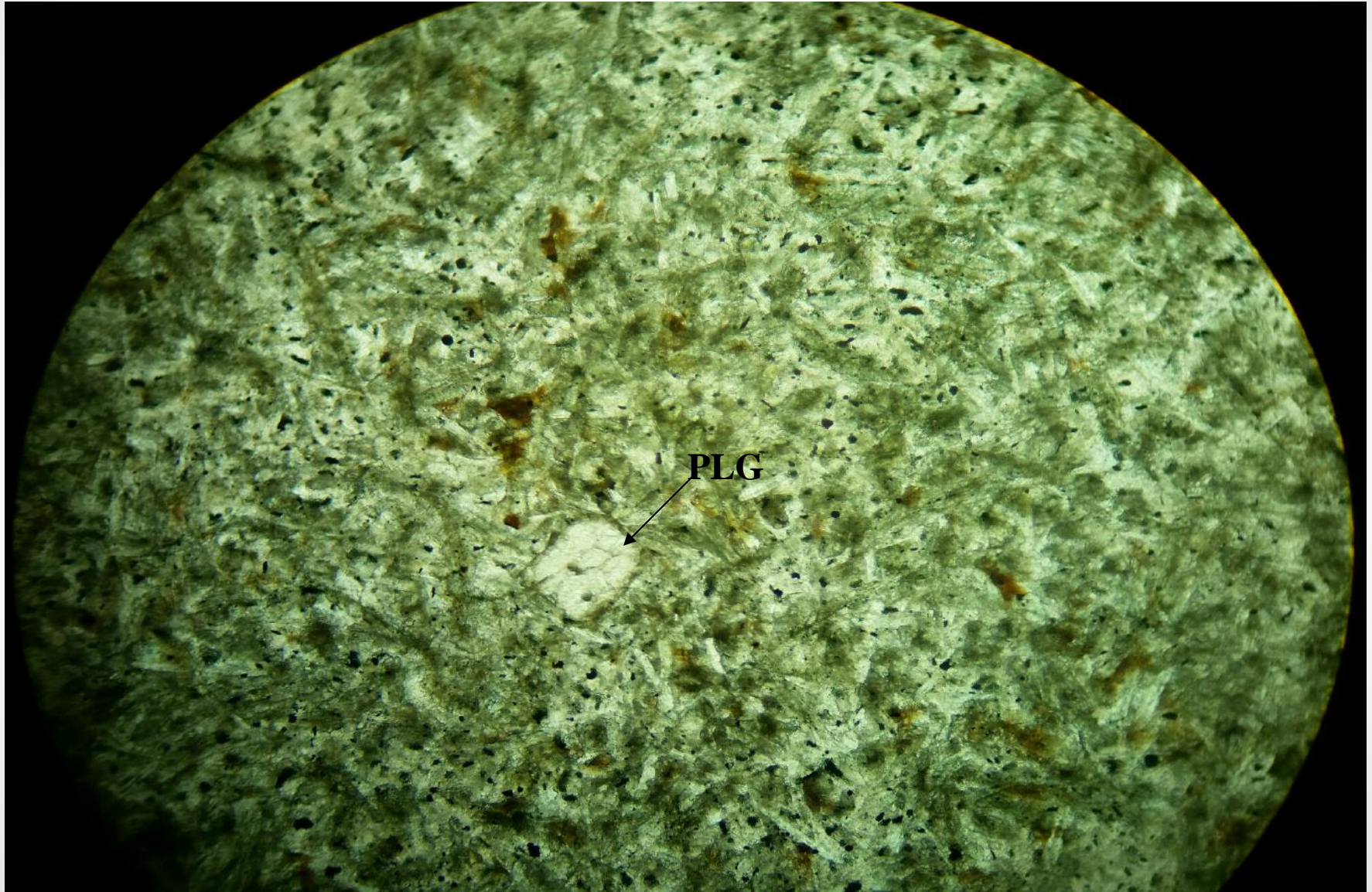
Thin Sections Pivot Peak 3



• Scale - 2 mm XP

Photos By: Kevin McKenzie •

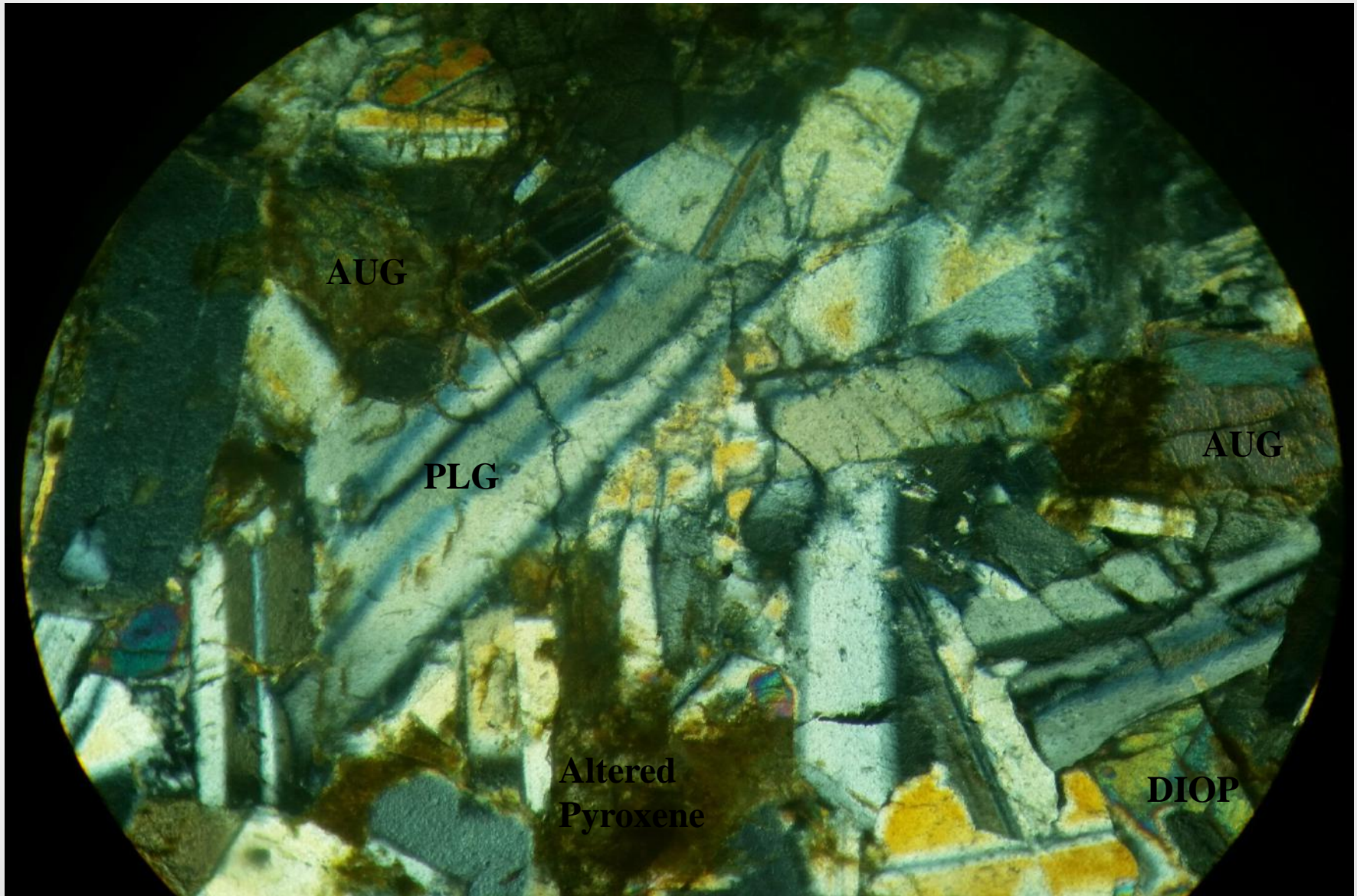
Thin Sections Pivot Peak 3



• Scale - 2 mm PPL

Photos By: Kevin McKenzie •

Thin Sections Friis Hills 1

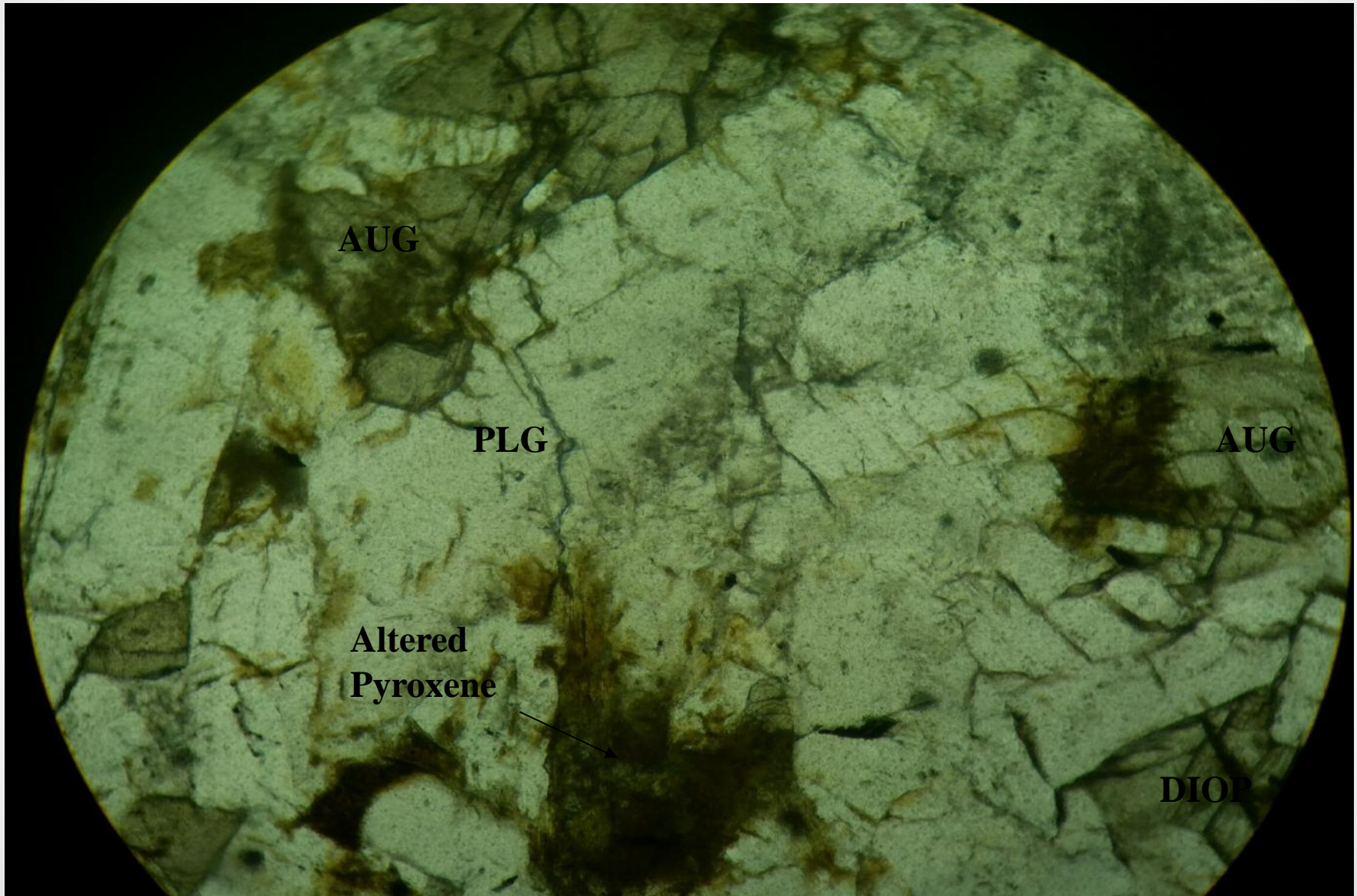


• Scale - 2 mm XP

ALX-10-11A

Photos By: Kevin McKenzie •

Thin Sections Friis Hills 1

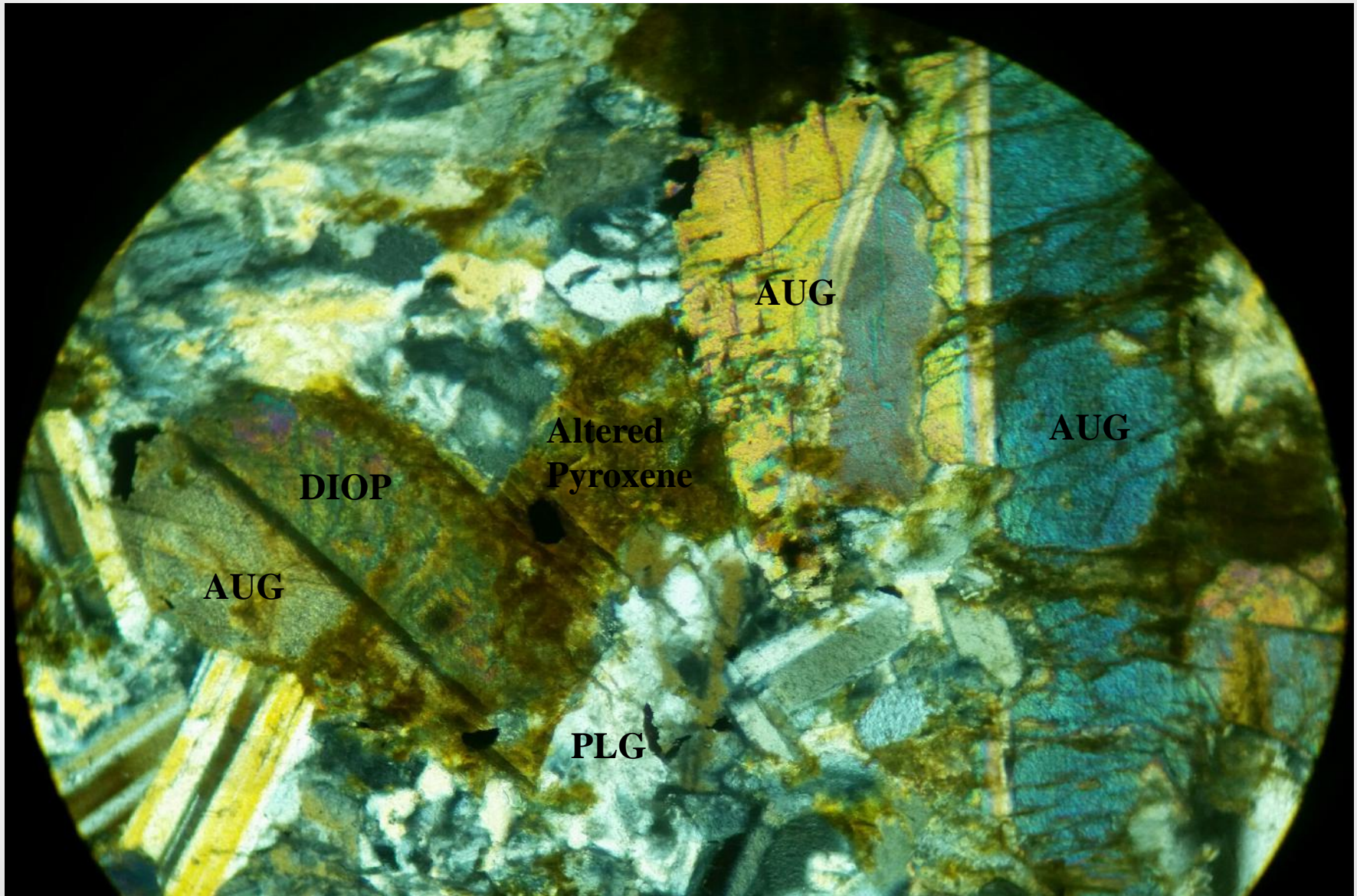


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ALX-10-11A

Photos By: Kevin McKenzie •

Thin Sections Friis Hills 2

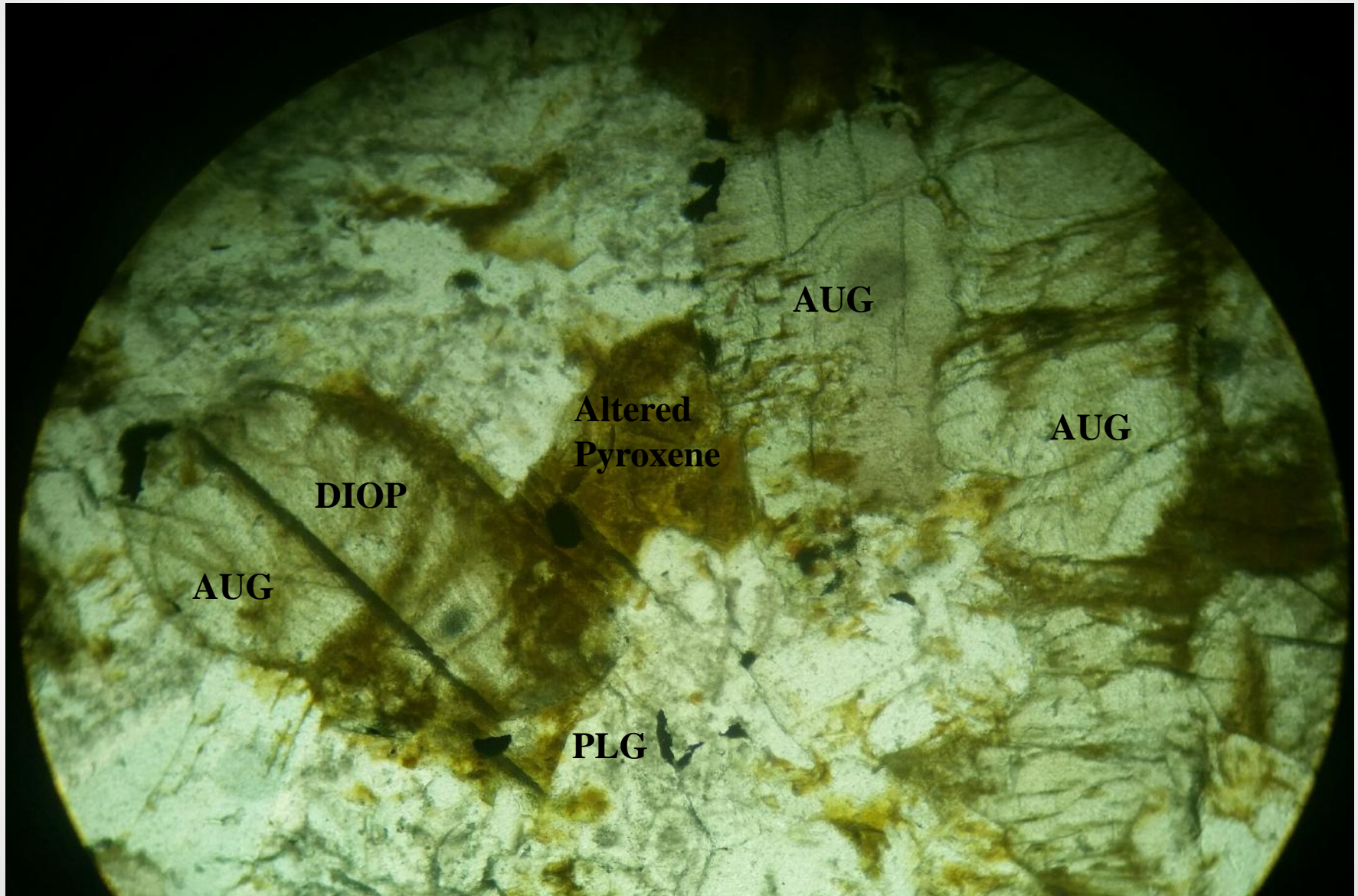


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ALX-10-11A

Photos By: Kevin McKenzie •

Thin Sections Friis Hills 2

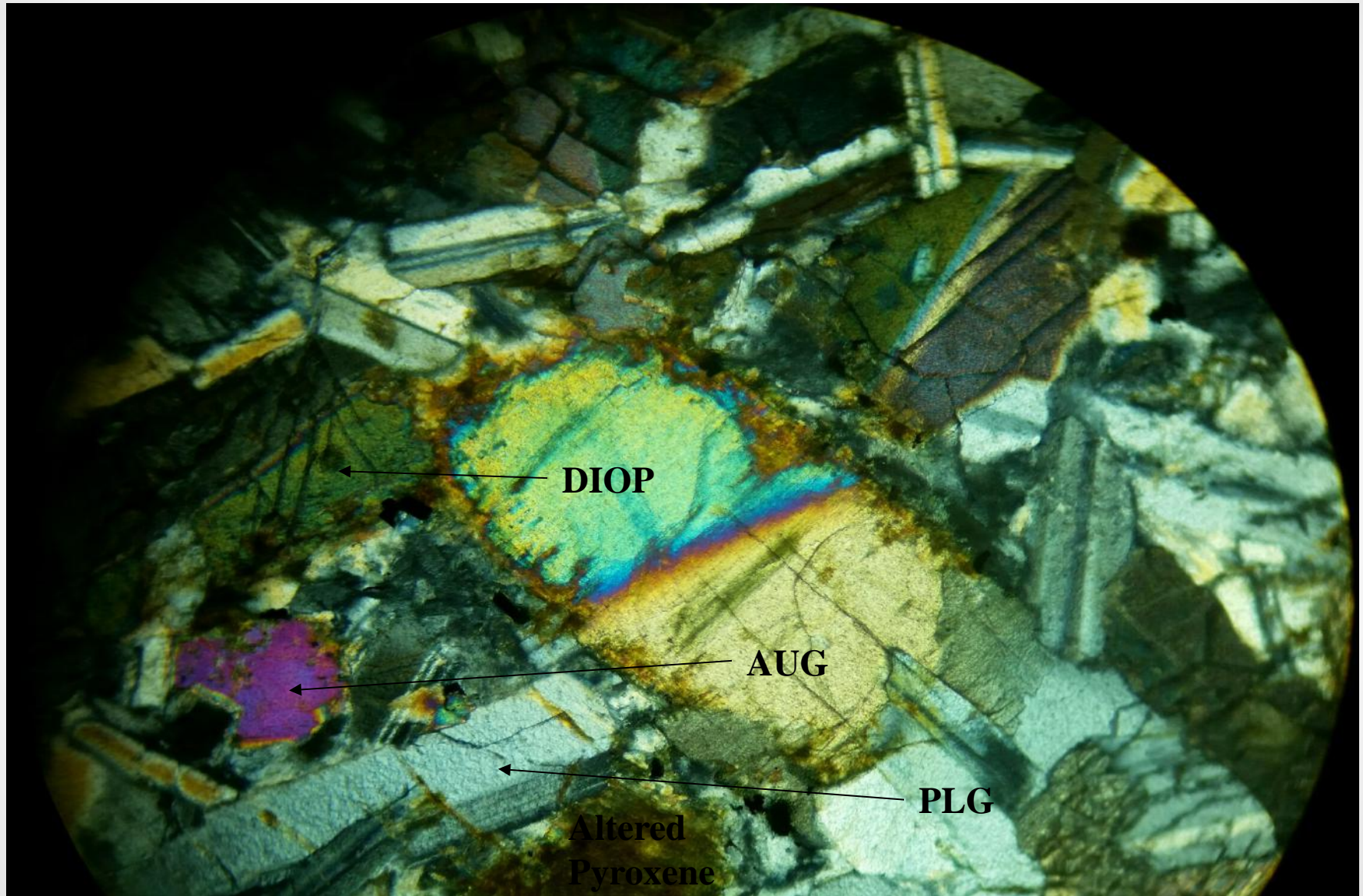


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ALX-10-11A

Photos By: Kevin McKenzie •

Thin Sections Friis Hills 3

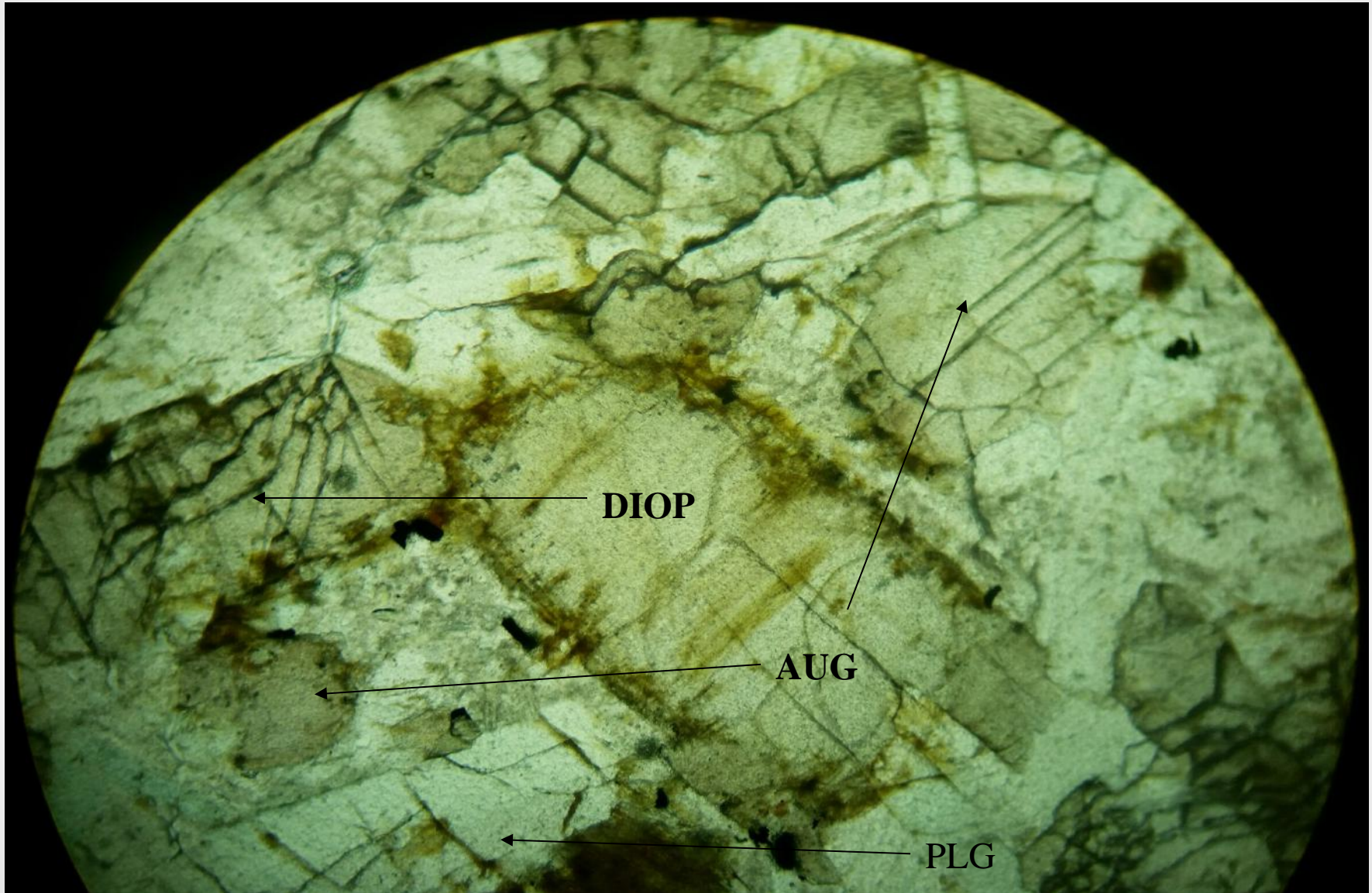


• Scale - 2 mm XP

ALX-10-11A

Photos By: Kevin McKenzie ●

Thin Sections Friis Hills 3



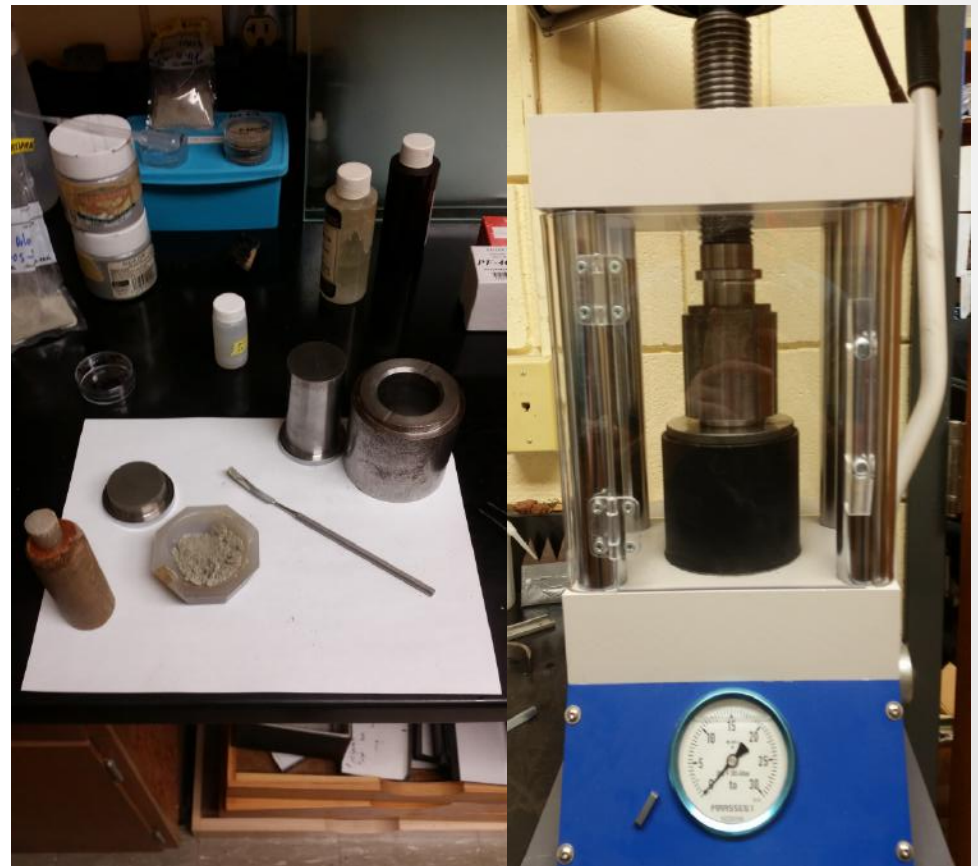
• Scale - 2 mm PPL

ALX-10-11A

Photos By: Kevin McKenzie •

XRF

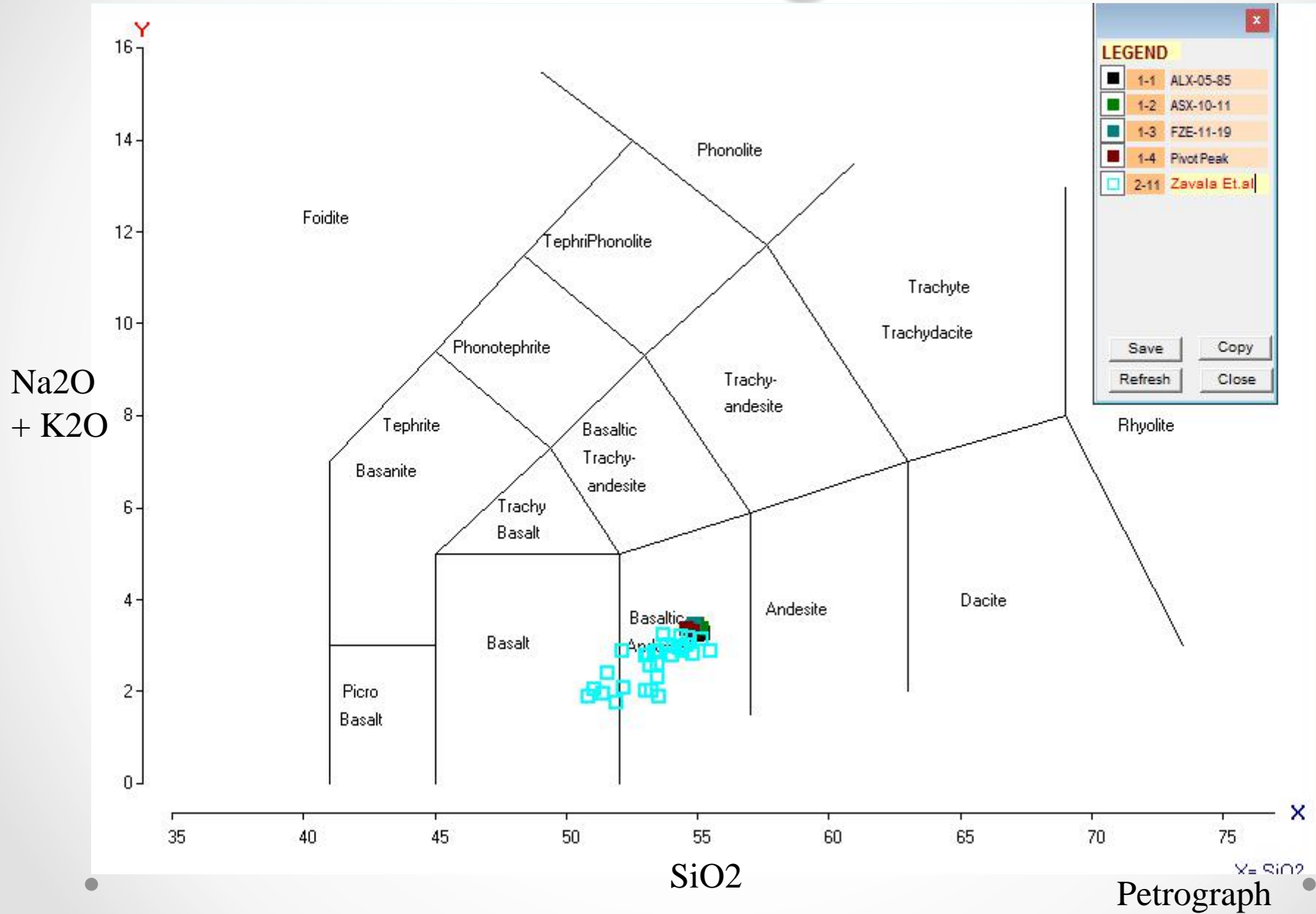
- Comparing chemical composition to investigate a variance among the samples
- Pellet Methods
 - Crush rock into small pellets
 - Using a Puckmill to grind ~30 grams into powder
 - ~5 grams powder – 8 drops propyl vinyl
 - ~2 more grams with 2 more drops
 - Hydraulic press for 90 seconds
 - Dry Sample for 5 minutes
 - Load samples into XRF



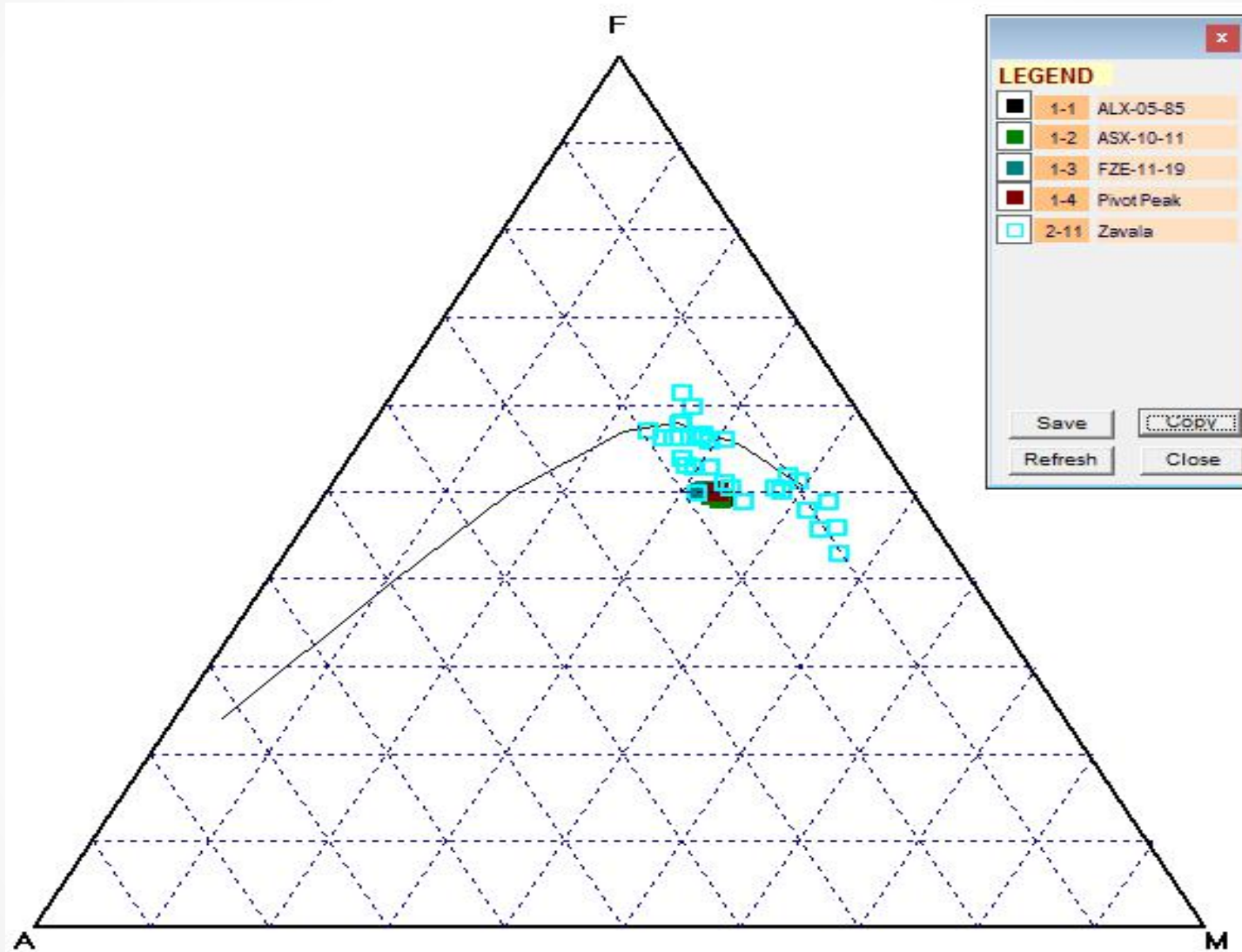
XRF

1		ALX-05-85	ALX-05-85	ASX-10-11	ASX-10-11	FZE-11-19	FZE-11-9	PIVOT PEAK	PIVOT PEAK
2	SiO ₂	55.19	54.98	55.01	55.18	54.83	54.90	54.62	54.80
3	Al ₂ O ₃	14.26	14.11	13.65	13.71	14.65	14.67	14.17	14.20
4	Fe ₂ O ₃	9.42	9.69	9.70	9.56	9.50	9.44	9.75	9.69
5	MgO	10.44	10.67	10.79	10.73	10.68	10.66	10.71	10.69
6	MnO	6.49	6.34	6.48	6.60	6.03	5.96	6.51	6.41
7	CaO	0.13	0.13	0.14	0.13	0.14	0.14	0.14	0.14
8	Na ₂ O	2.35	2.26	2.48	2.37	2.38	2.44	2.41	2.41
9	K ₂ O	0.90	0.98	0.99	0.98	1.00	1.01	0.93	0.89
10	P ₂ O ₅	0.15	0.15	0.14	0.13	0.13	0.13	0.11	0.12
11	TiO ₂	0.68	0.69	0.61	0.61	0.65	0.65	0.64	0.64

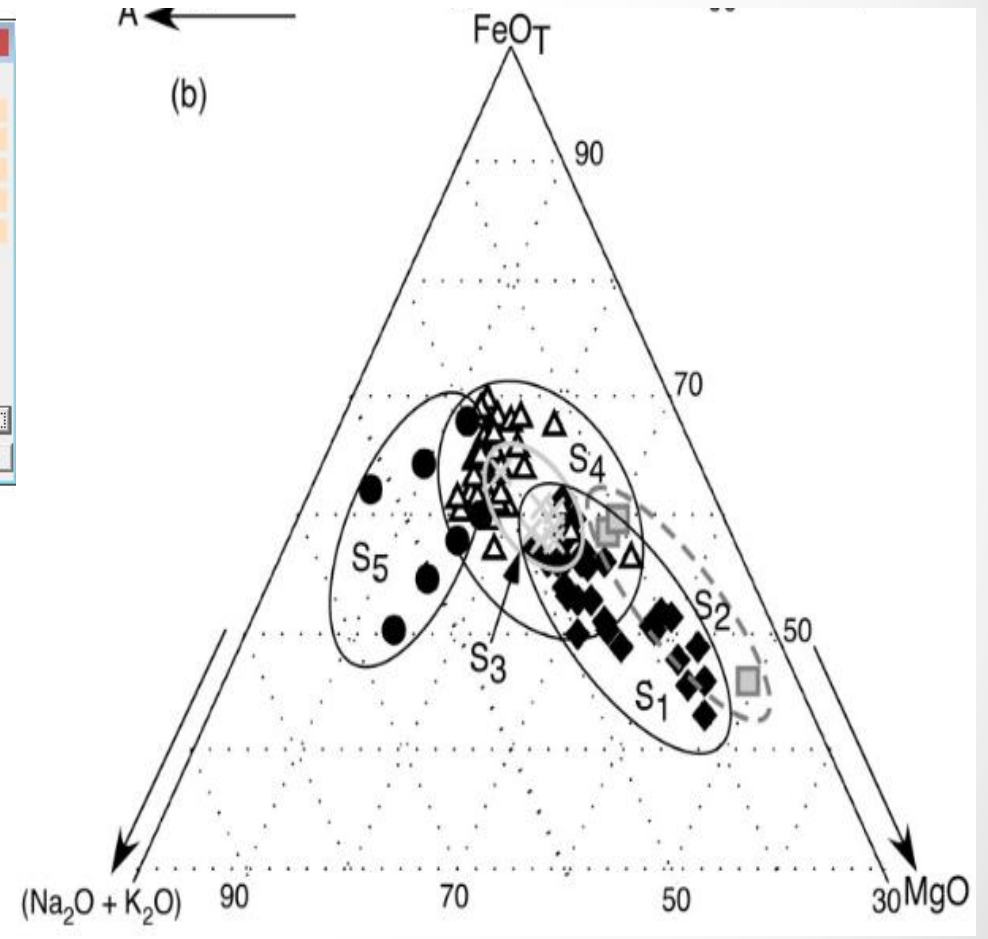
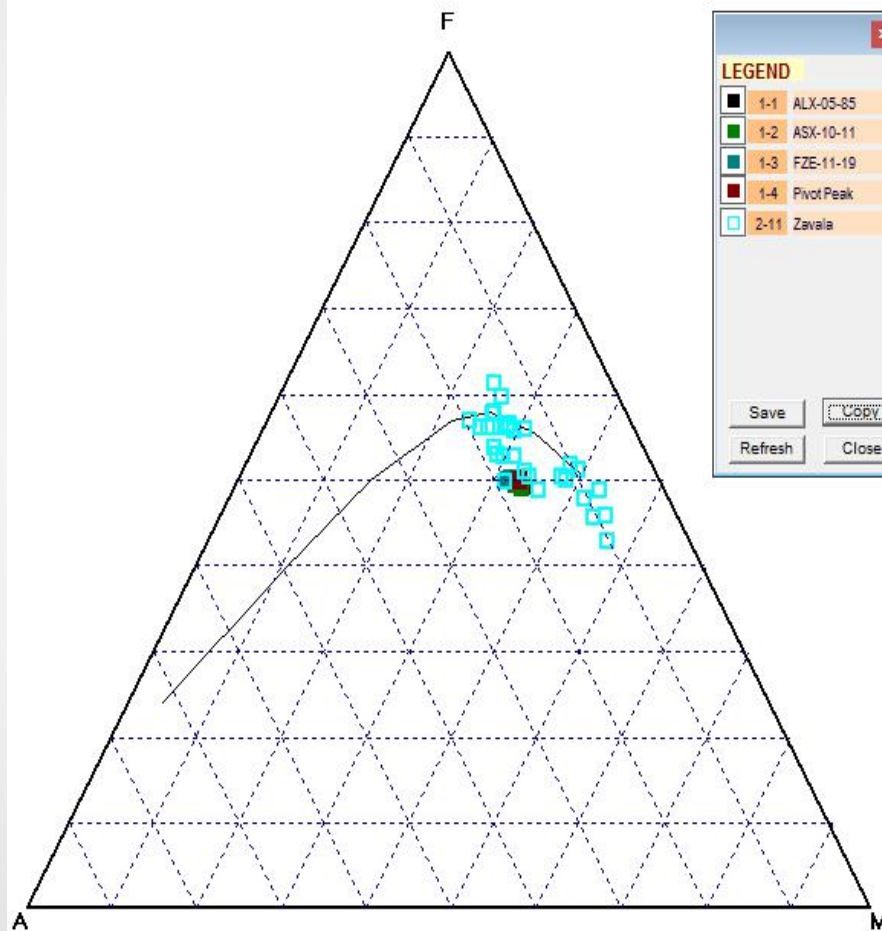
TAS Diagram



Igneous AFM Diagram



XRF



• Petrograph

Zavala, et al. (2011)

XRF

Fig.2: (FeOtot/MgO) vs SiO2 (Right mouse click for option - Double click to change)

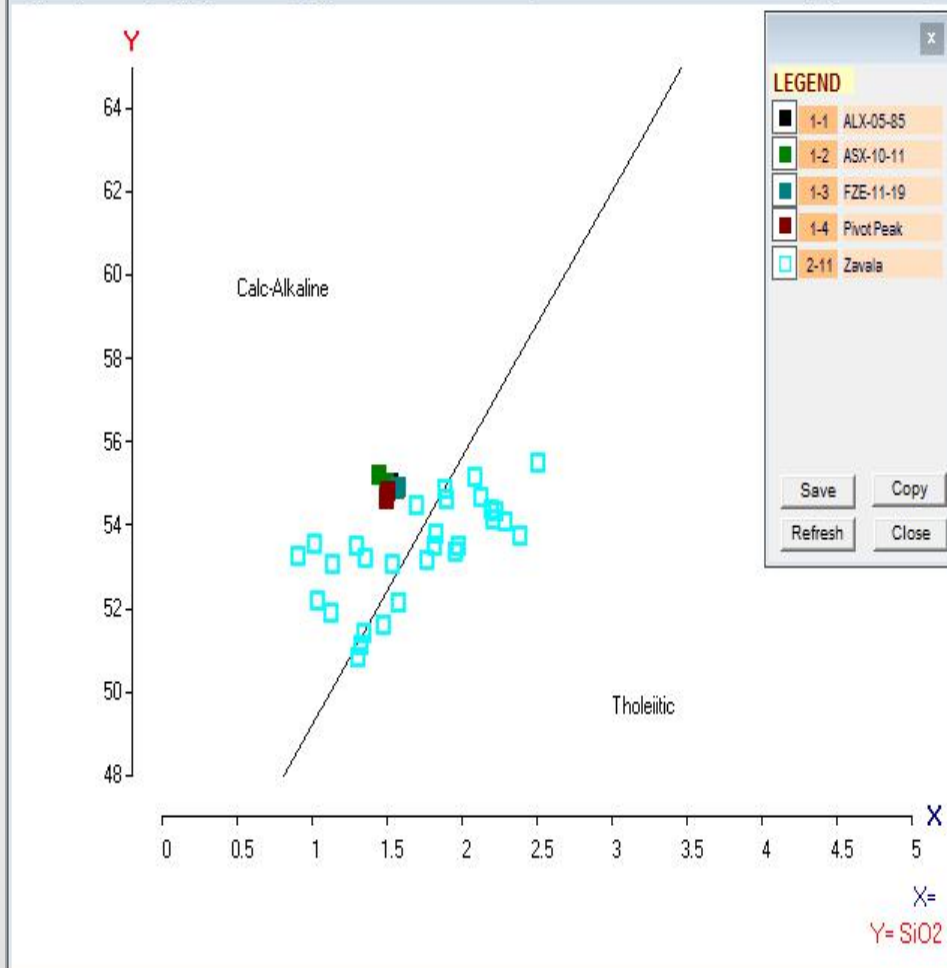
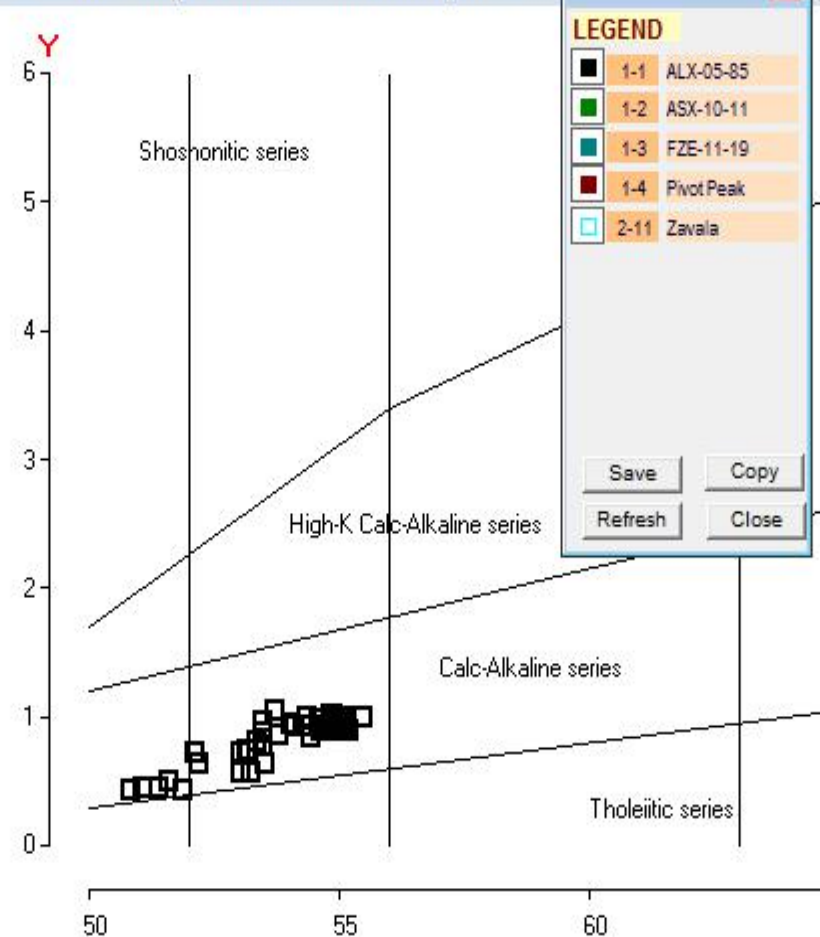
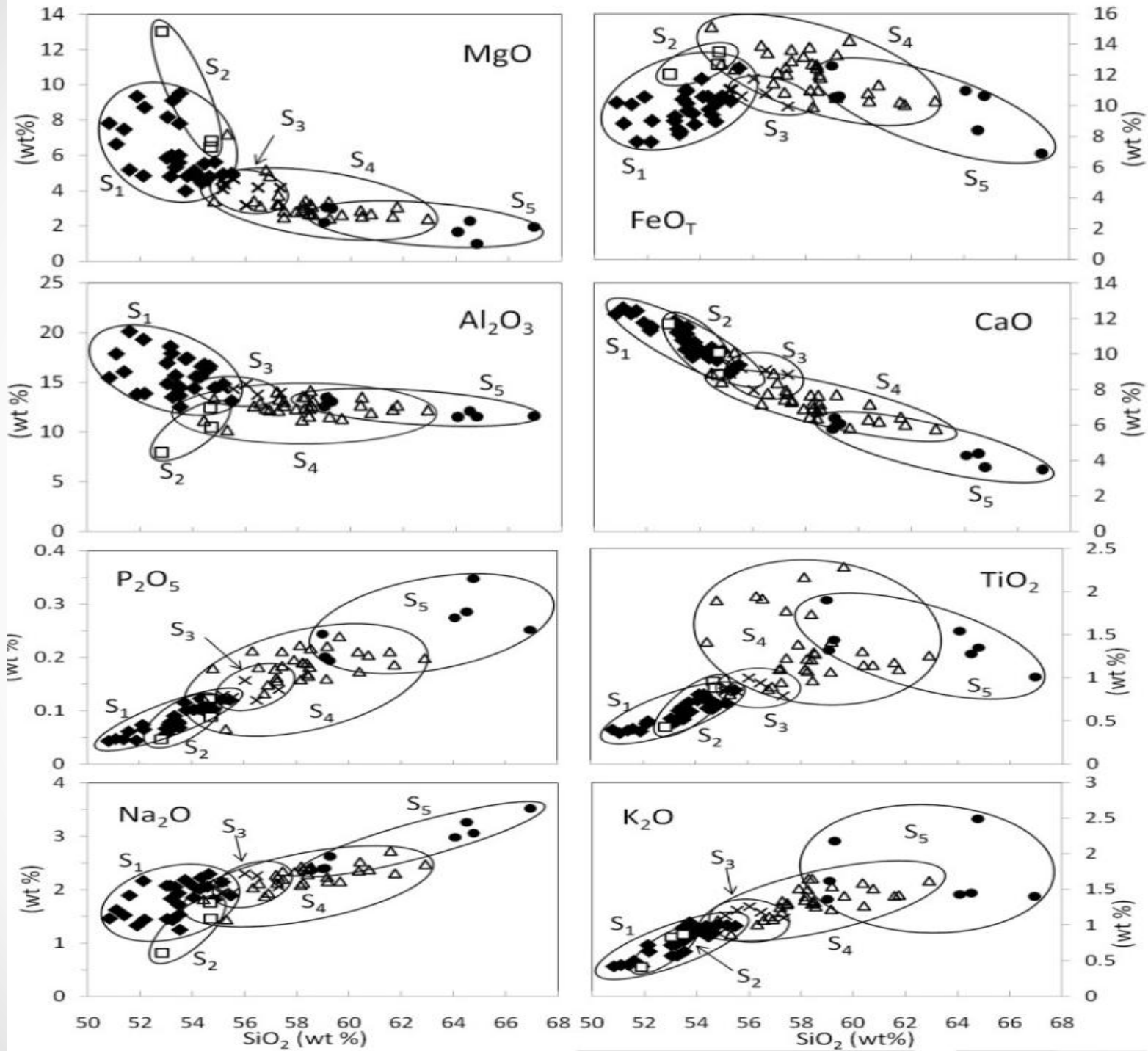


Fig.1: SiO2 vs K2O (Right mouse click for option - D





MgO Harker Diagram

Zavala, et al. (2011)

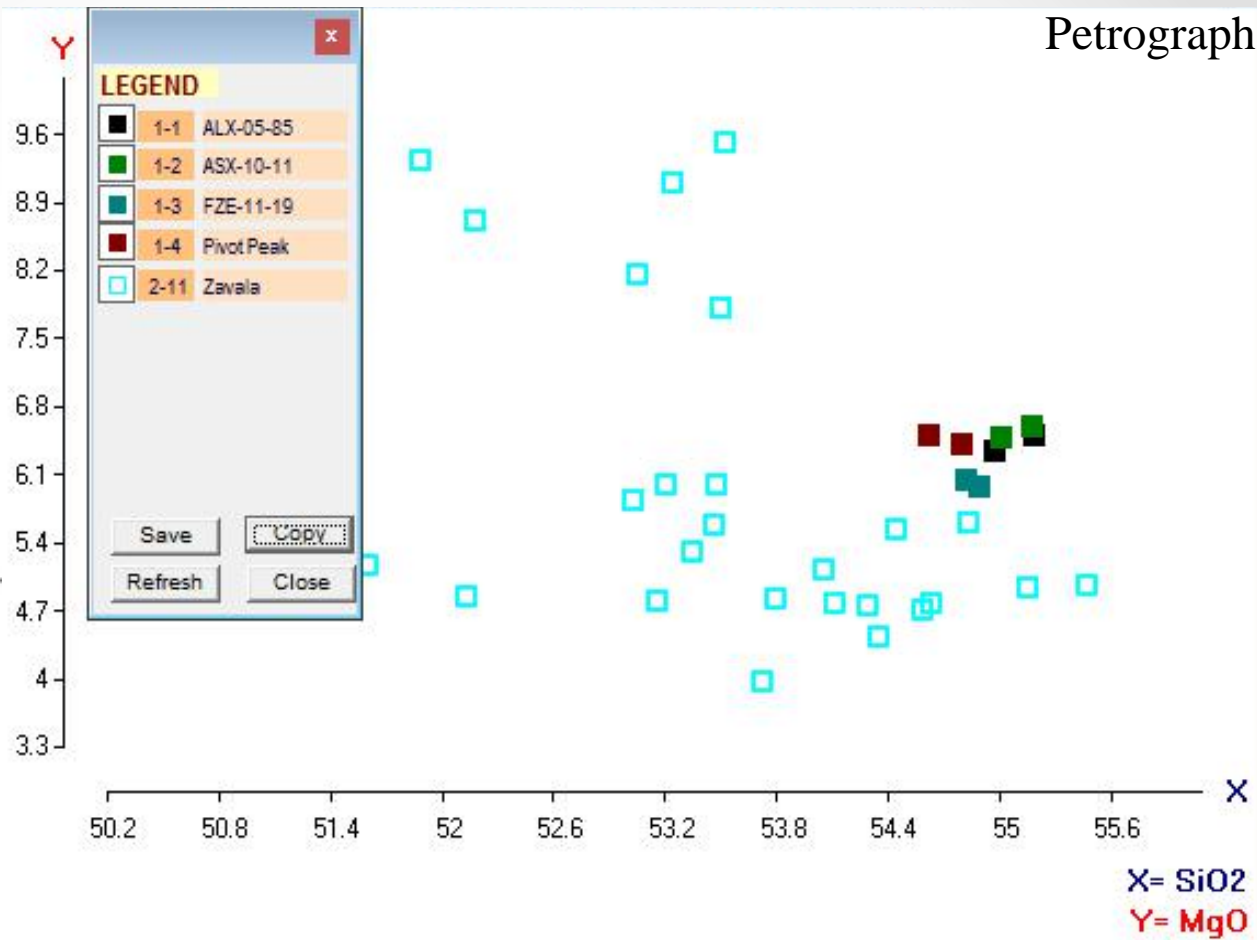
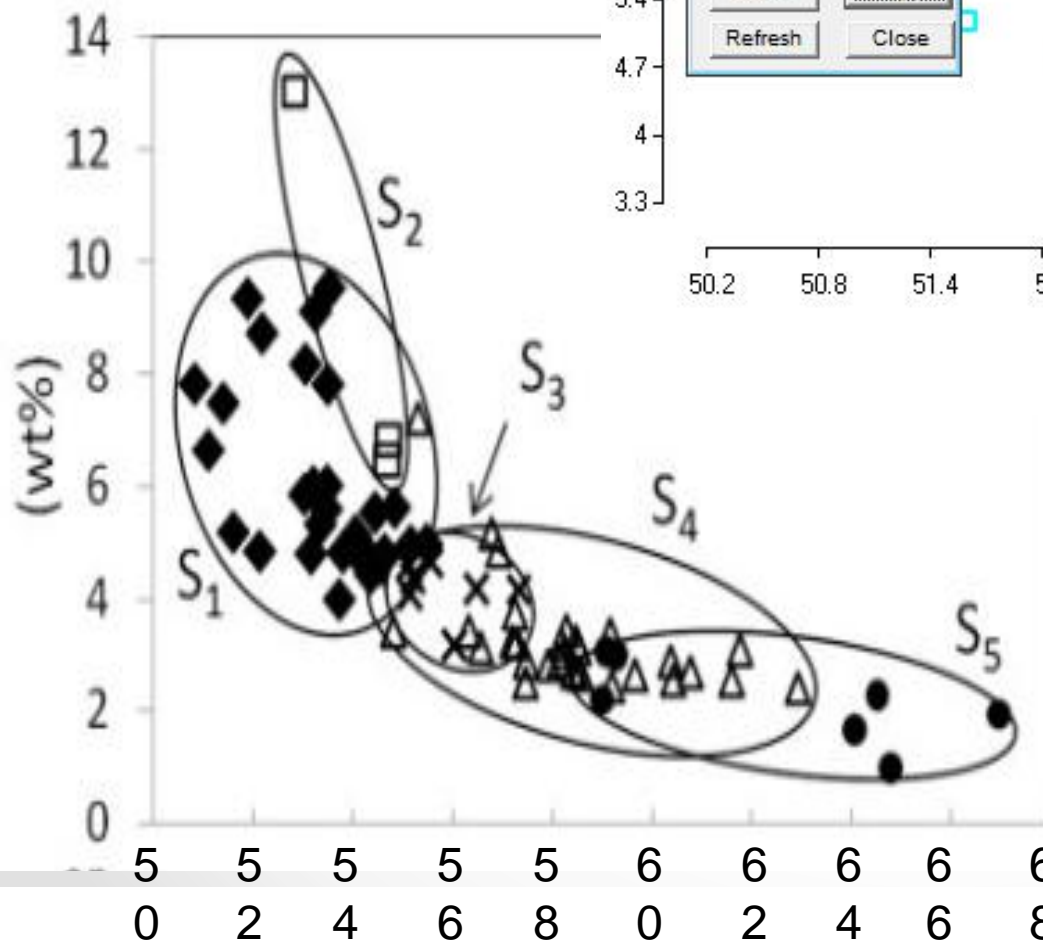


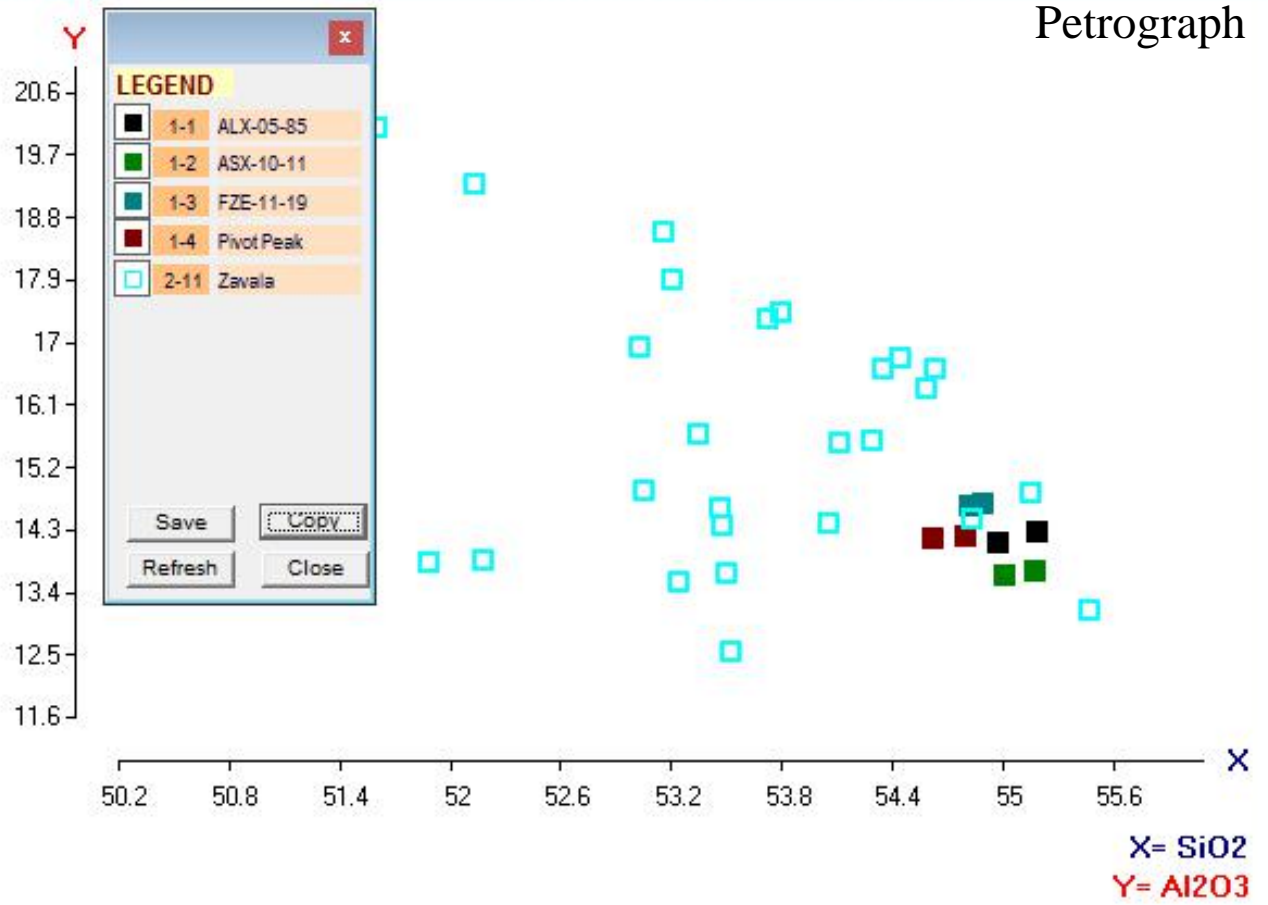
Table 4: Definitions of segregation groups

Group	MML	Plagioclase	Augite	Pigeonite
S ₁	+	+	+	+
S ₂	+	-	+	+
S ₃	+	+	+	-
S ₄	+	-	+	-
S ₅	+	-	-	-

MML (melts modeled liquids); +, added; -, subtracted.

Al₂O₃ Harker Diagram

Petrograph



Zavala, et al. (2011)

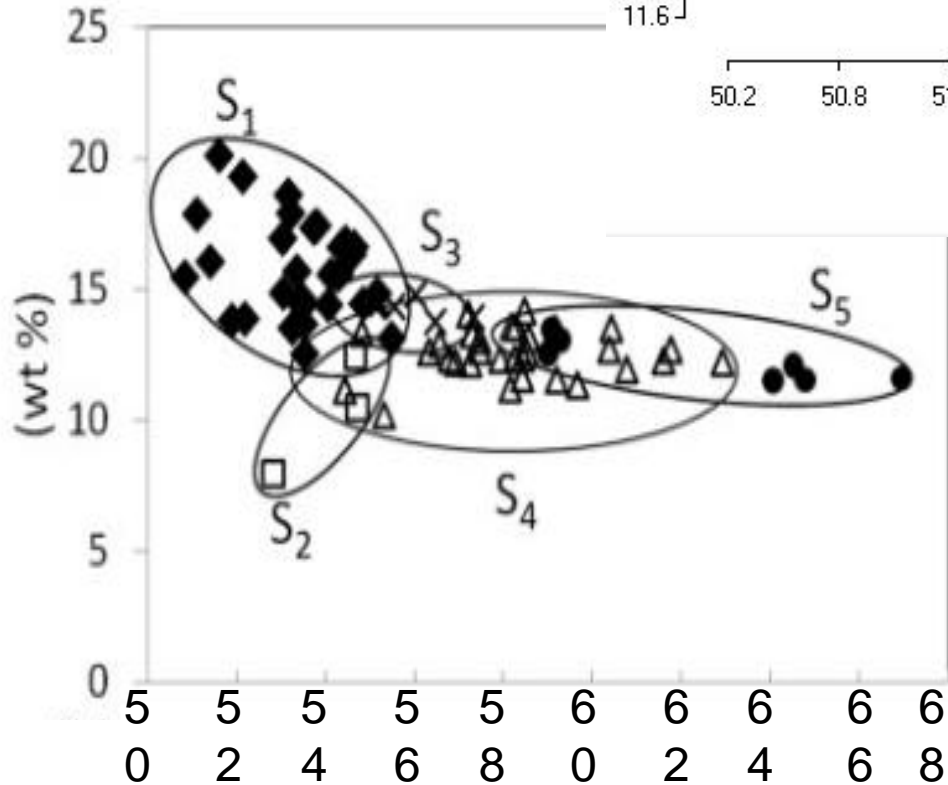
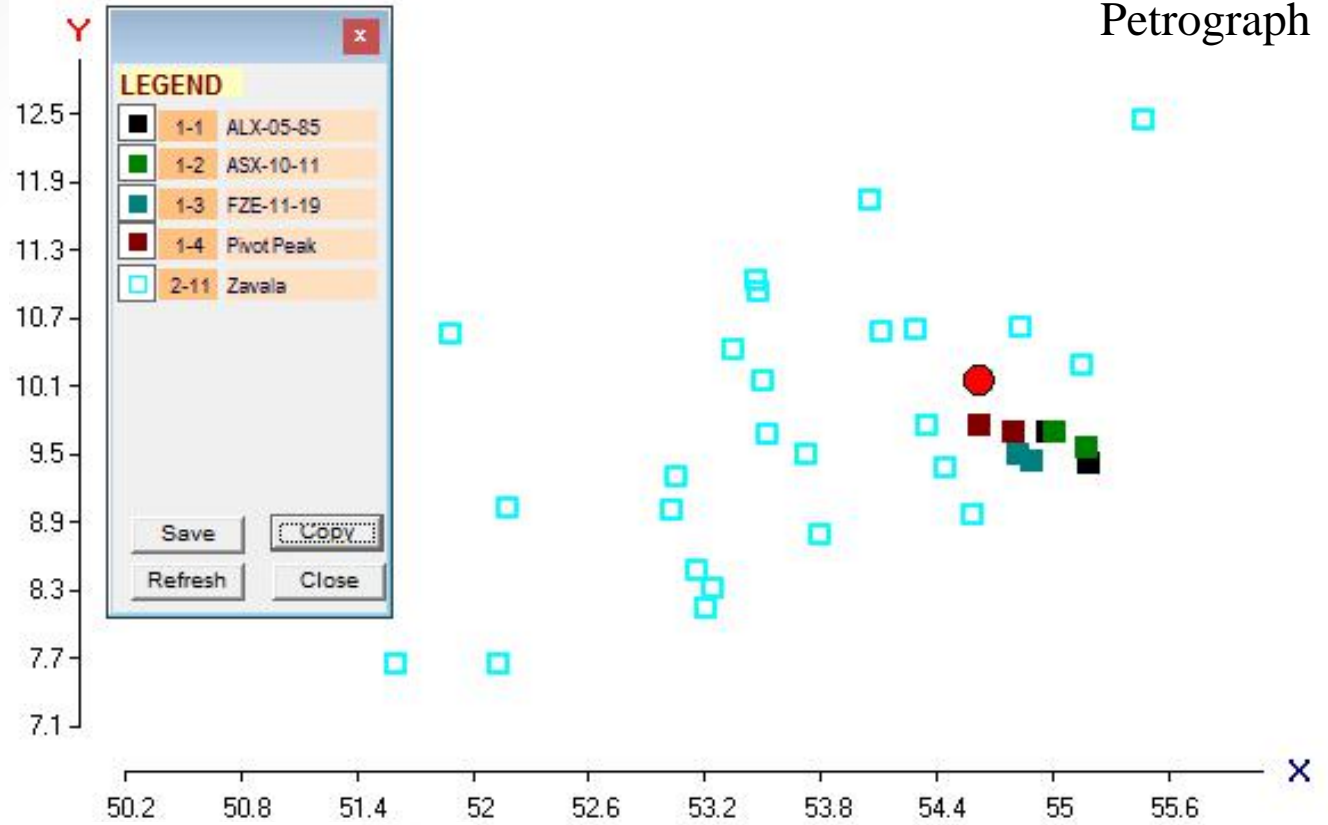


Table 4: Definitions of segregation groups

Group	MML	Plagioclase	Augite	Pigeonite
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S ₂	+	-	+	+
S ₃	+	+	+	-
S ₄	+	-	+	-
S ₅	+	-	-	-

MML (melts modeled liquids); +, added; -, subtracted.

Fe₂O₃ Harker Diagram



Zavala, et al. (2011)

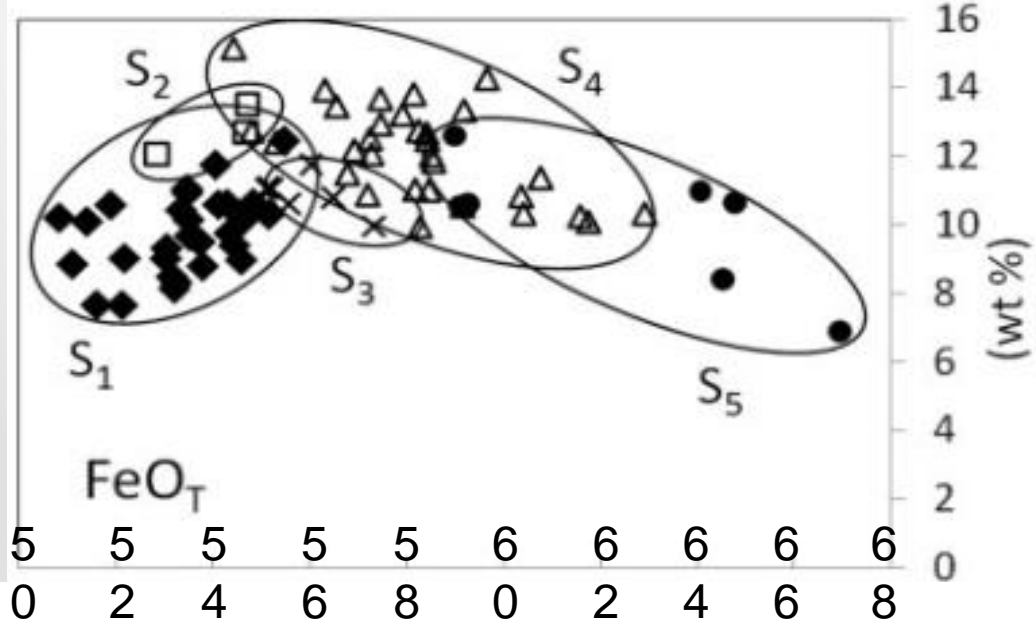
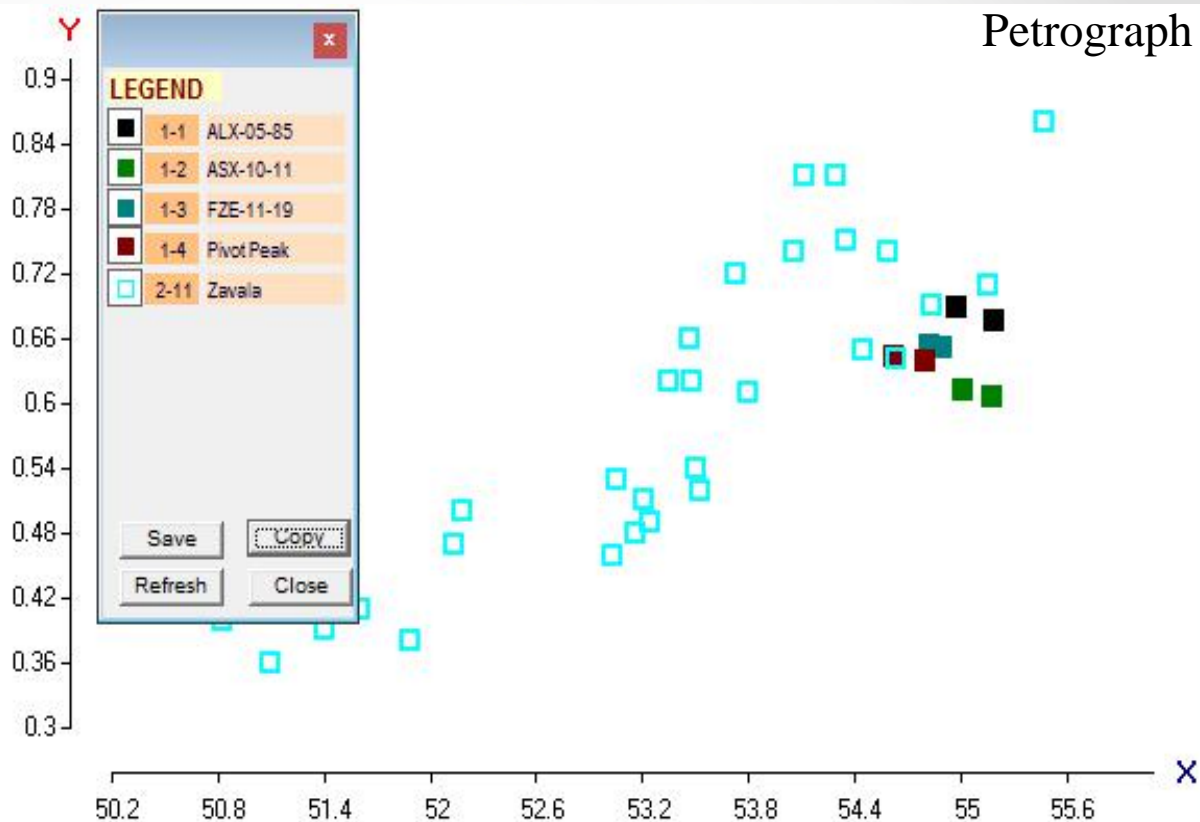


Table 4: Definitions of segregation groups

Group	MML	Plagioclase	Augite	Pigeonite
S ₁	+	+	+	+
S ₂	+	-	+	+
S ₃	+	+	+	-
S ₄	+	-	+	-
S ₅	+	-	-	-

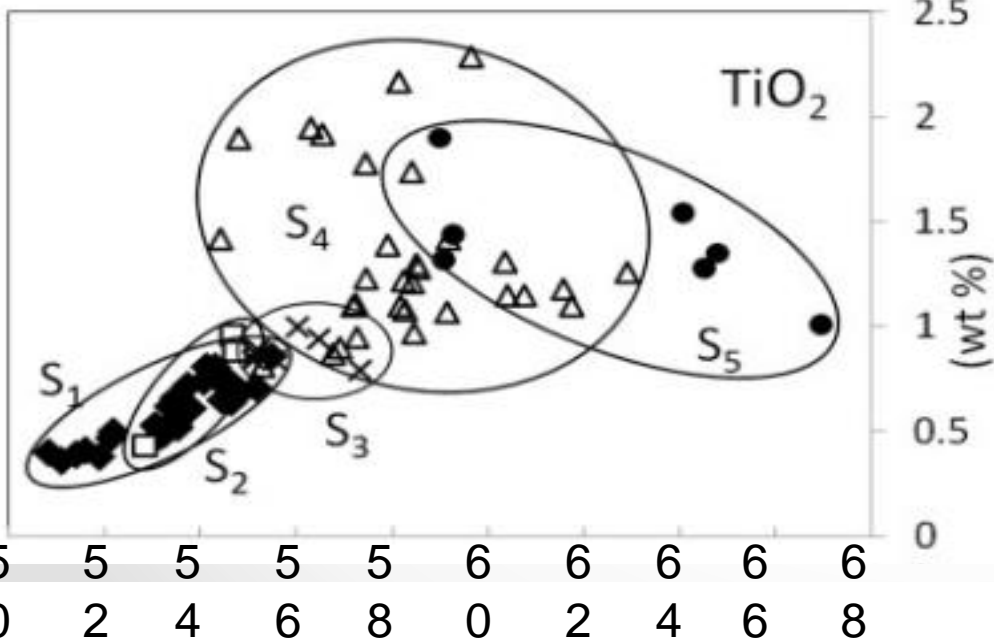
MML (melts modeled liquids); +, added; -, subtracted.

TiO₂ Harker Diagram



Petrograph

Zavala, et al. (2011)



X= SiO₂
Y= TiO₂

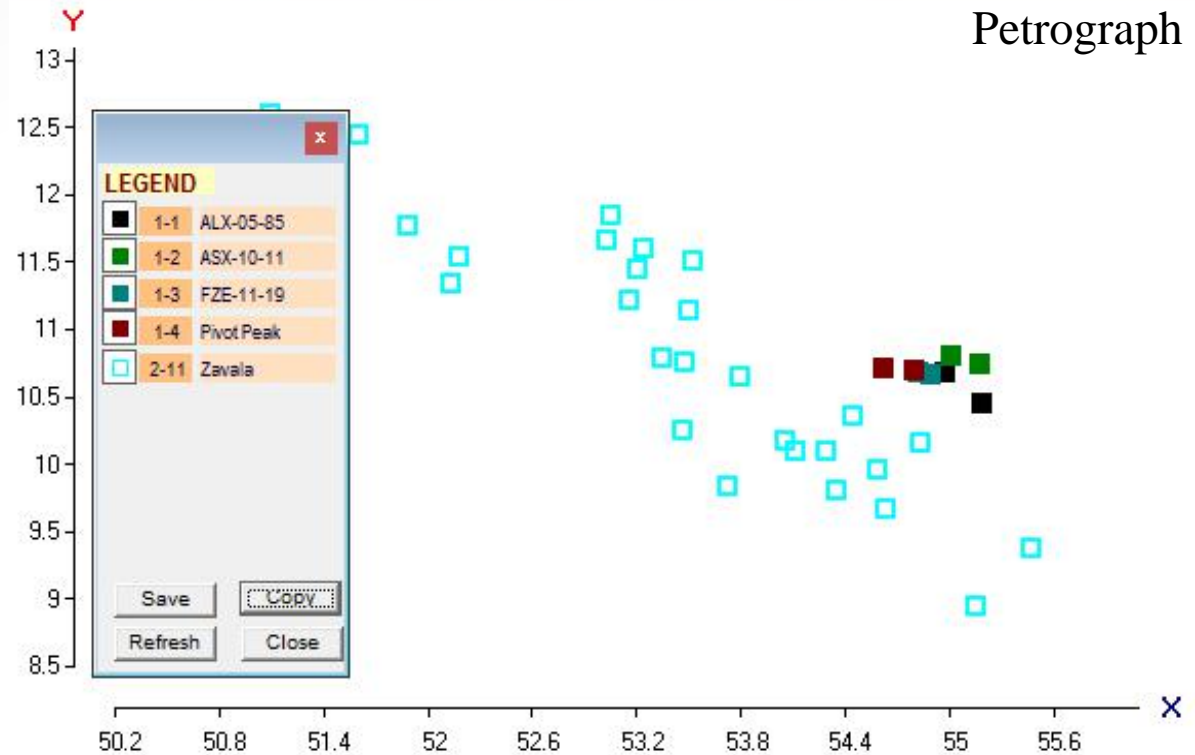
Table 4: Definitions of segregation groups

Group	MML	Plagioclase	Augite	Pigeonite
S ₁	+	+	+	+
S ₂	+	-	+	+
S ₃	+	+	+	-
S ₄	+	-	+	-
S ₅	+	-	-	-

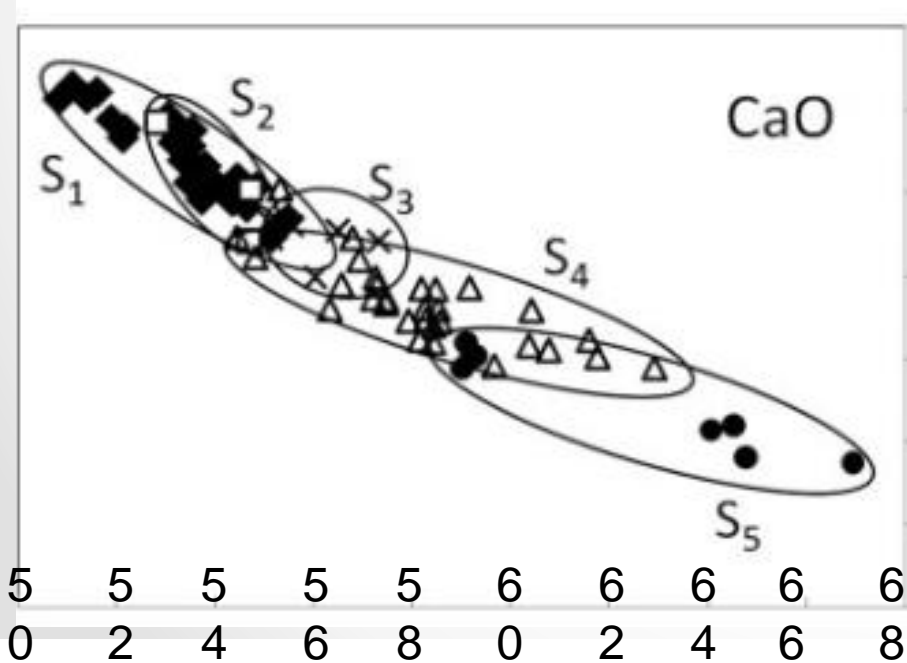
MML (melts modeled liquids); +, added; -, subtracted.

CaO Harker Diagram

Petrograph



Zavala, et al. (2011)



X= SiO2
Y= CaO

Table 4: Definitions of segregation groups

Group	MML	Plagioclase	Augite	Pigeonite
S ₁	+	+	+	+
S ₂	+	-	+	+
S ₃	+	+	+	-
S ₄	+	-	+	-
S ₅	+	-	-	-

MML (melts modeled liquids); +, added; -, subtracted.

K₂O Harker Diagram

Zavala, et al. (2011)

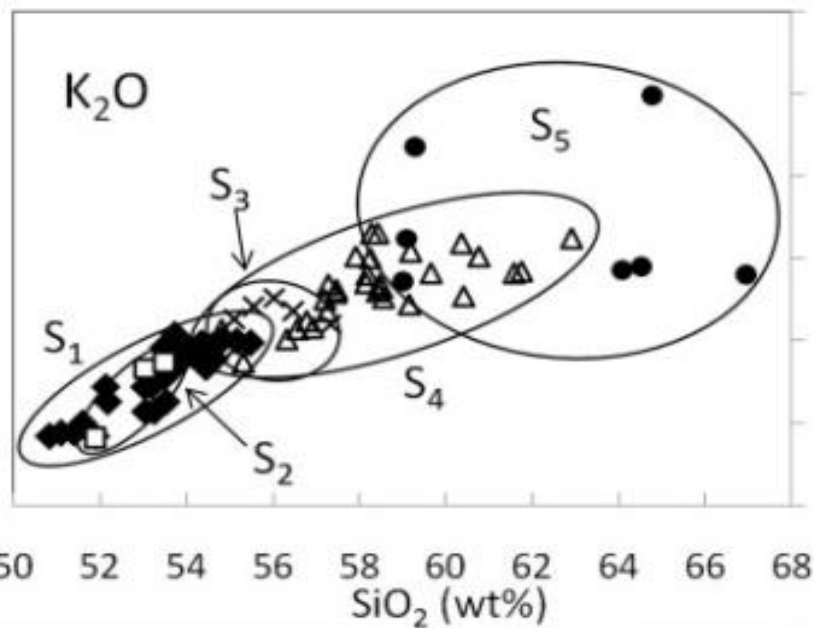
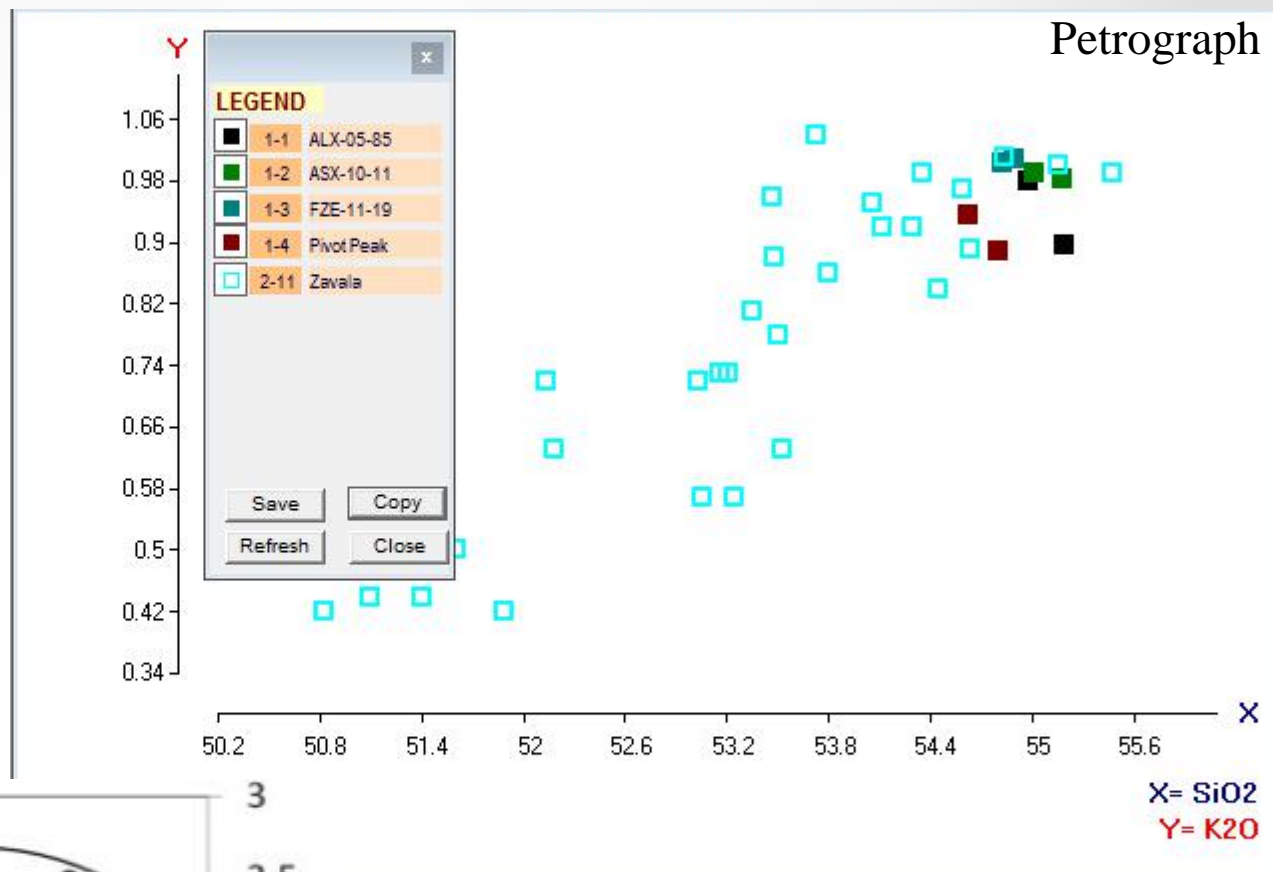
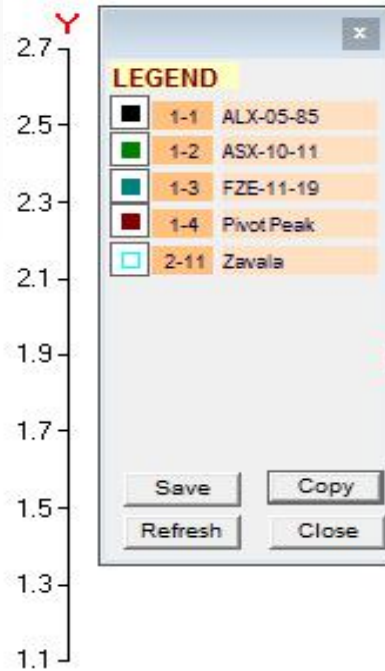


Table 4: Definitions of segregation groups

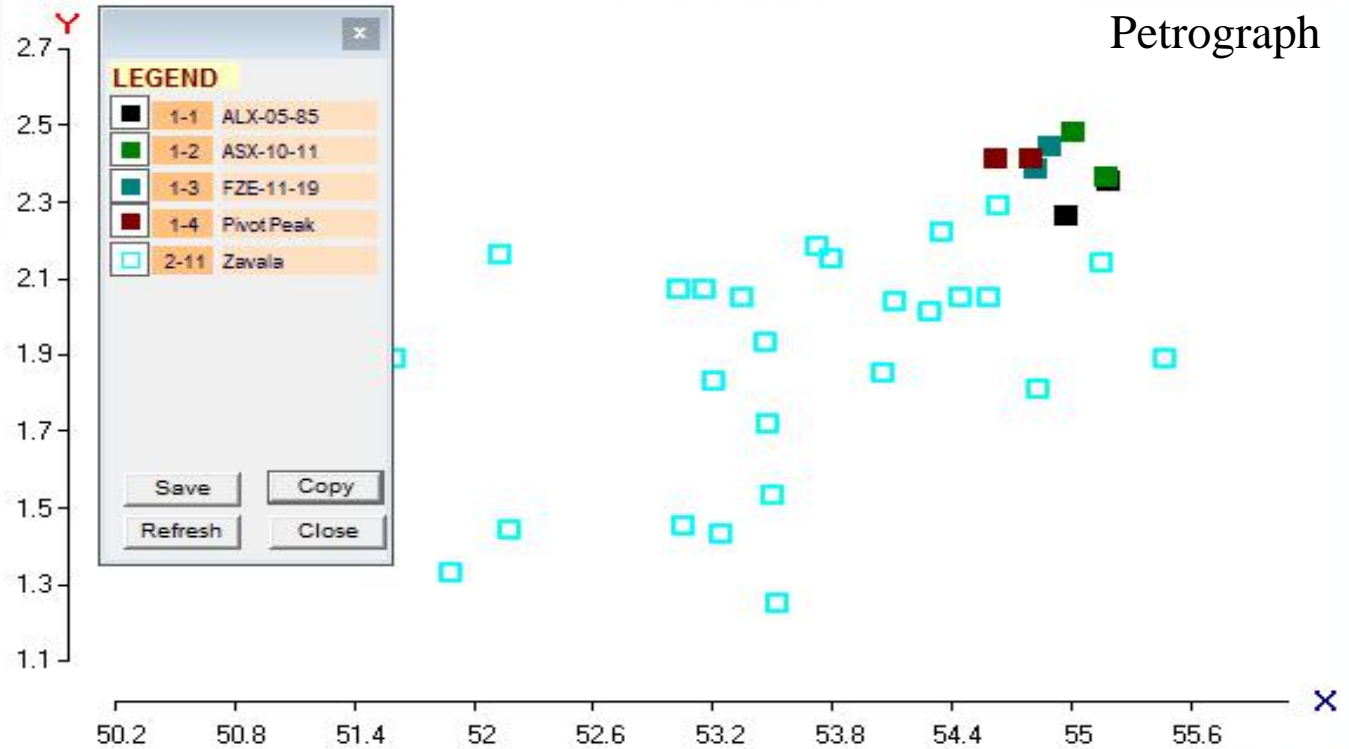
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S ₂	+	-	+	+
S ₃	+	+	+	-
S ₄	+	-	+	-
S ₅	+	-	-	-

MML (melts modeled liquids); +, added; -, subtracted.

Na₂O Harker Diagram



Petrograph



Zavala, et al. (2011)

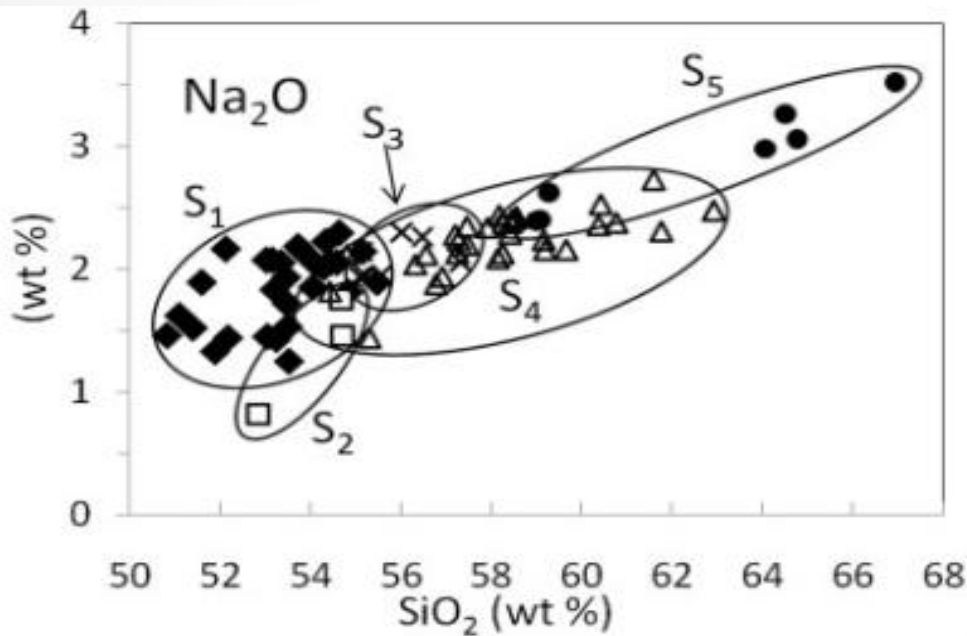
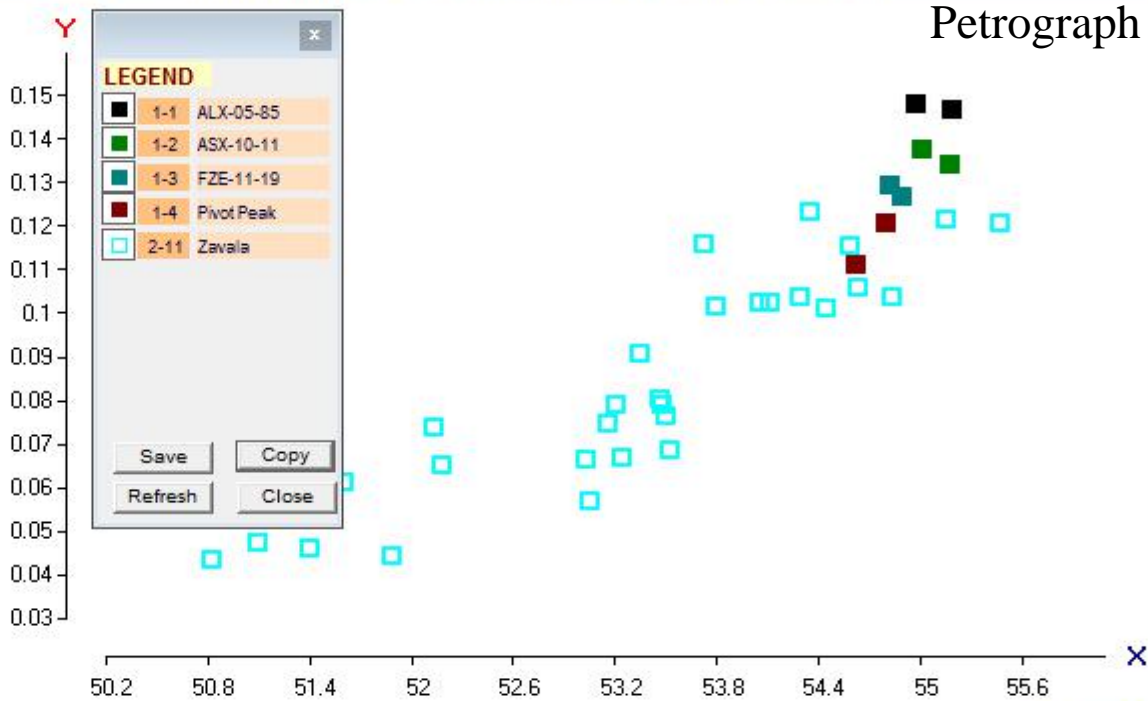


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S ₂	+	-	+	+
S ₃	+	+	+	-
S ₄	+	-	+	-
S ₅	+	-	-	-

MML (melts modeled liquids); +, added; -, subtracted.

P₂O₅ Harker Diagram



Zavala, et al. (2011)

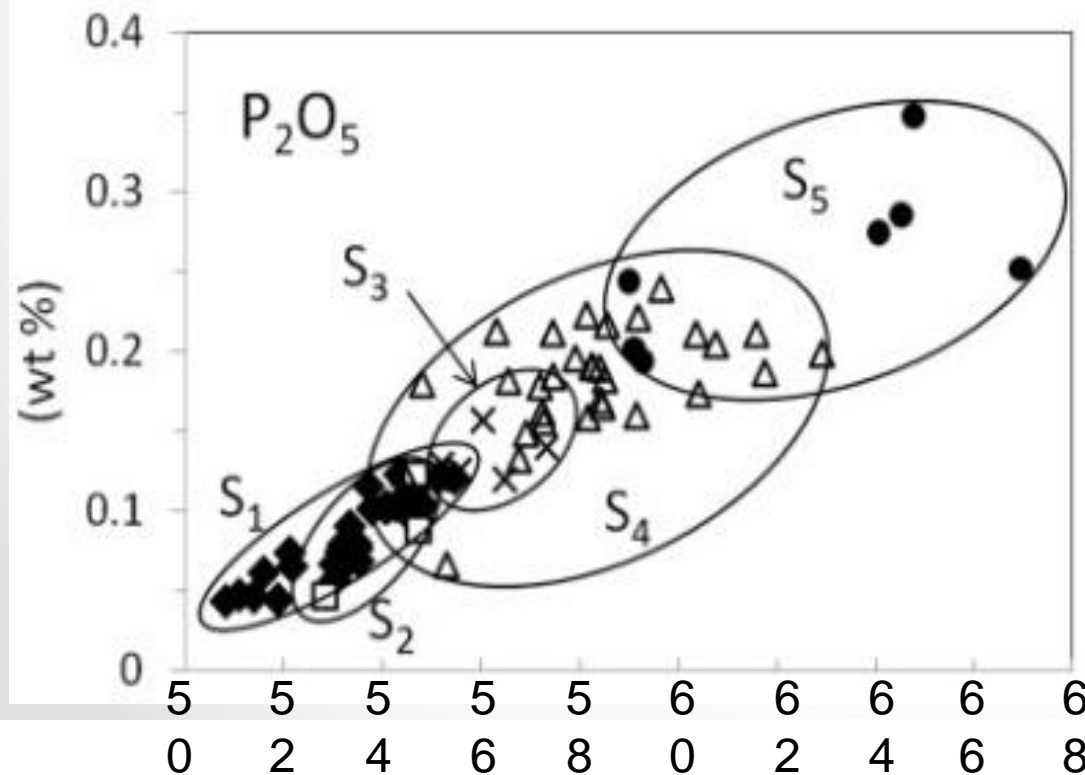


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S ₂	+	-	+	+
S ₃	+	+	+	-
S ₄	+	-	+	-
S ₅	+	-	-	-

MML (melts modeled liquids); +, added; -, subtracted.

Conclusion

- Investigating 4 samples from Ferrar Dolerites
 - Spans a total of ~60 km
- Mineralogy
 - Grain Size
 - Slight variation in oxides
 - Pyroxenes
- XRF
 - Variance is undetectable
 - All points sampled fall with each other
- Interpretation
 - Likely to be from same sill stack
 - Likely to be from same source
- New ways to expand on Research
 - REE and trace element analysis
 - Compare rocks from different sills
 - XRD to help compare the mineralogy in fine grained samples

Acknowledgements

Dr. Adam Lewis for the rock samples.

Dr. Adam Lewis and Dr. Alan Ashworth for the use of their lab and the puckmill

Dr. David Hopkins for the use of his lab and the petrothin

Dr. Bernhardt Saini-Eidukat for the use of his lab, the XRF and the water saw

