

An Analysis of Hawaiian Basalts: A Hotspot Topic

By: Mary Bailey and Emily Jackson

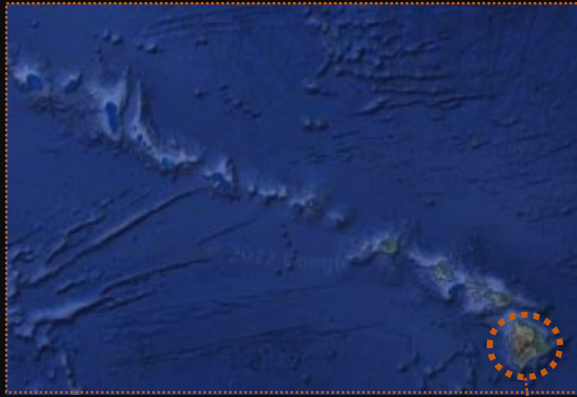
Geol 422 Term Project

Dr. Saini-Eidukat

5/3/2022



Background of the Big Island



Kilauea Iki 1959 Eruption

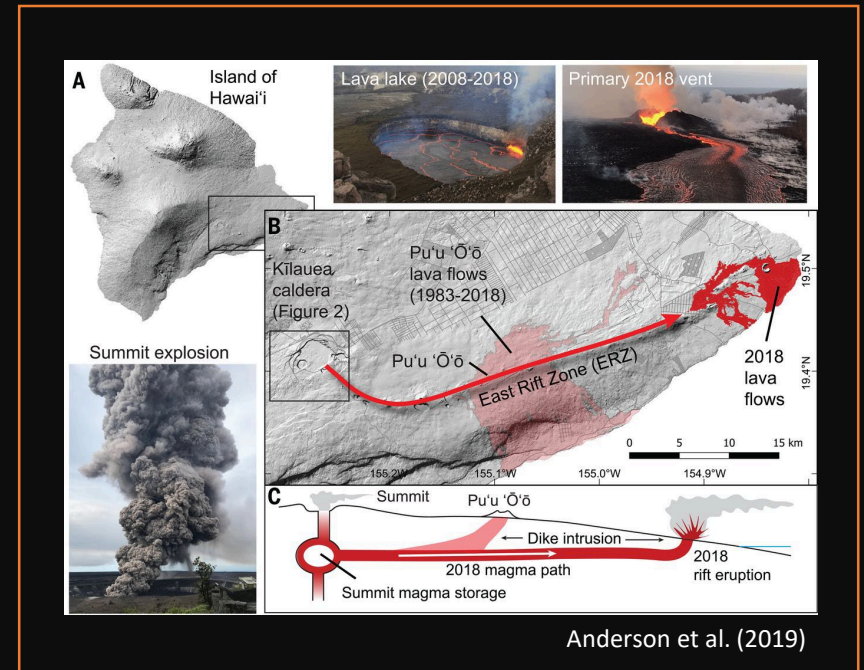
- Erupted from Nov. 14-Dec 20, 1959
- 16-17 eruption phases that lasted anywhere from 2 to 167 hours in length
- Lava lake was formed by lava pooling out of fissures along the southwestern wall.
- Eruption phases occurred as fountaining episodes that created a small cone

Mueller et al. (2019) and MacDonald and Katsura (1961)



2018 Fissure 8 Main Channel Flow

- Collapse of the Pu'u Pua'i crater located on the eastern side of the Big Island occurred on April 30, 2018.
- 24 eruptive fissures opened along a fault slip hypothesized to have been caused by a dike intrusion on May 3rd
- Fissure 8 opened May 5th and had active eruptive activity for 5 months (Anderson et al., 2019).



Guiding Question

How do the samples collected from the Kilauea Iki Crater and the Fissure 8 Main Channel compare?

- Both field areas are found along Kilauea's Eastern Rift Zone, but eruptions occurred almost 60 years apart

Work Division

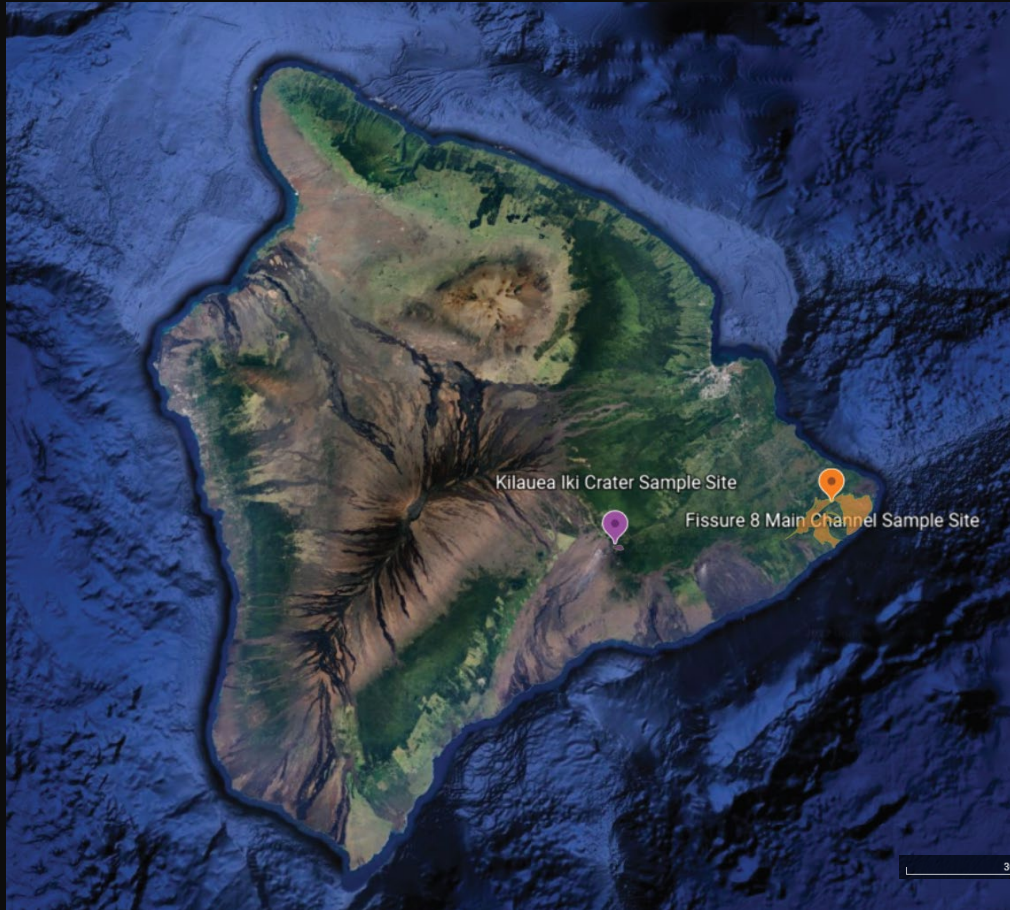
Mary:

- Fissure 8 main channel background
- Hand sample descriptions
- F8 Microscopy
- SEM

Emily:

- Kilauea Iki background
- Thin section preparation
- KI Microscopy
- CT

Sample Collection



Kilauea Iki hand sample was collected on Wednesday, 12/29/2021 9:10 am HAST
Weather: 61°, sunny with slight breeze
Lat/Lon: 19.416°, -155.255°



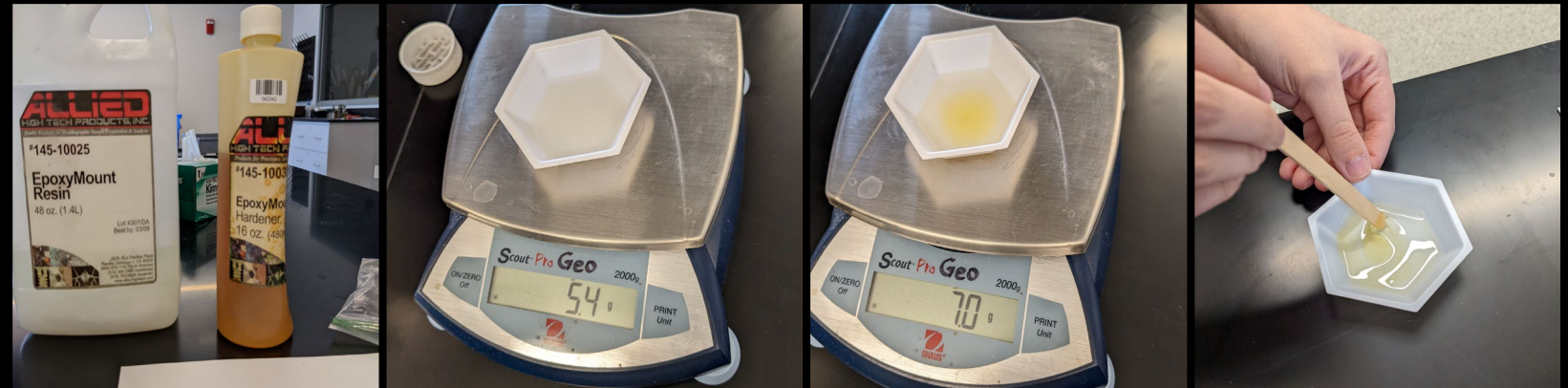
Fissure 8 hand sample was collected on Sunday, 01/09/2022 11:17 am HAST
Weather: 80°, sunny with slight breeze
Lat/Lon: 19.488°, -154.887°

Methods: Impregnation of Samples

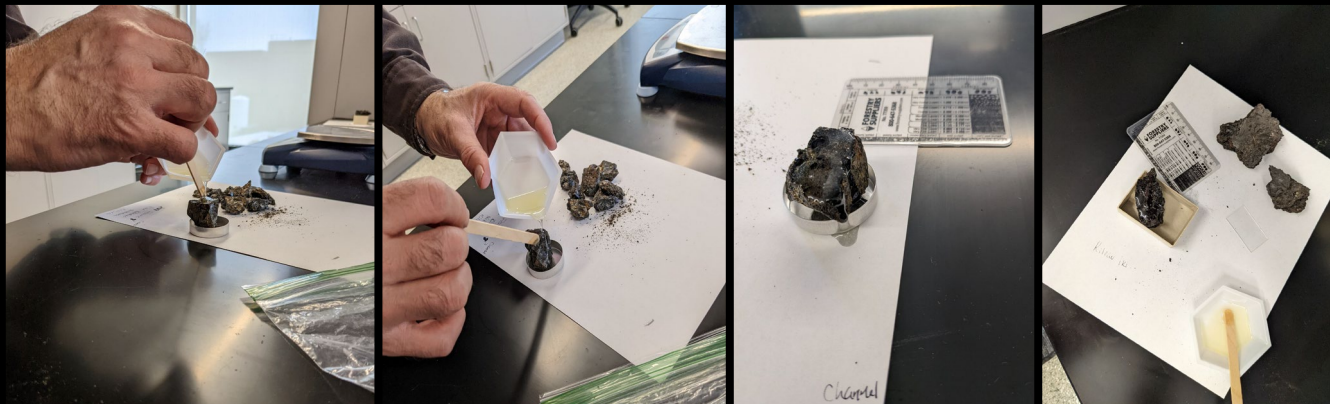
Step 1: Capture Stunning Headshots



Step 2: Mix Epoxy Resin with Hardener



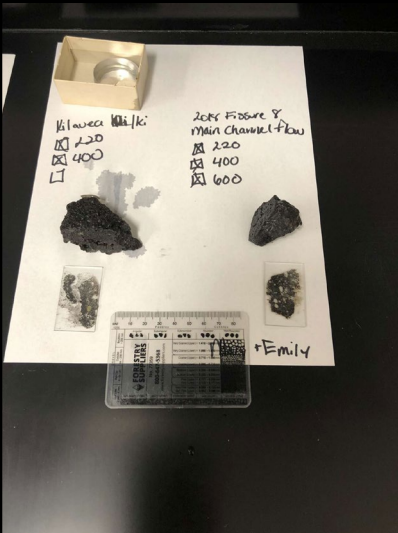
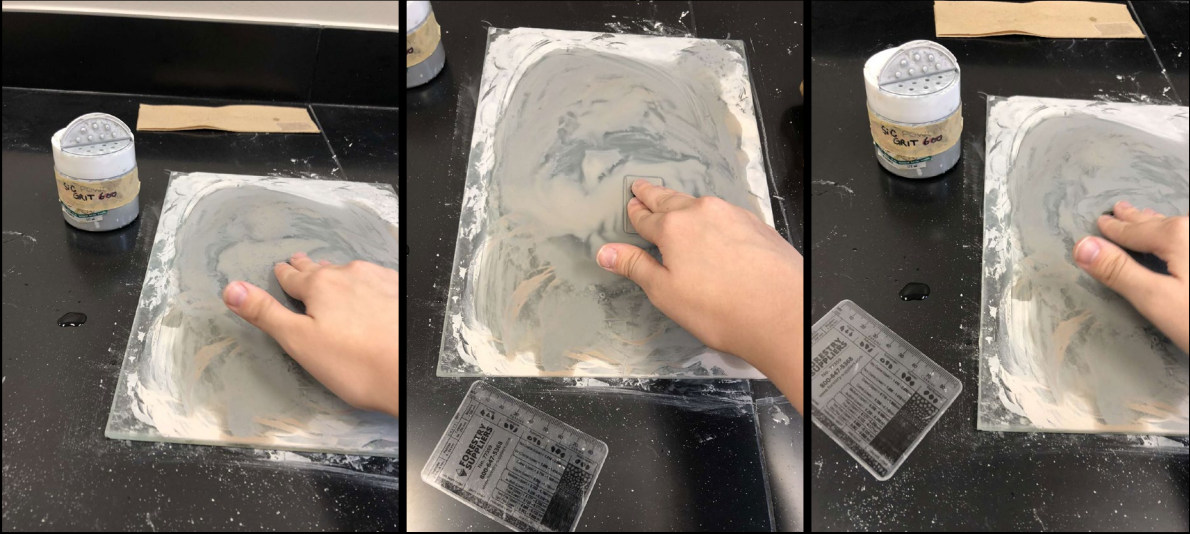
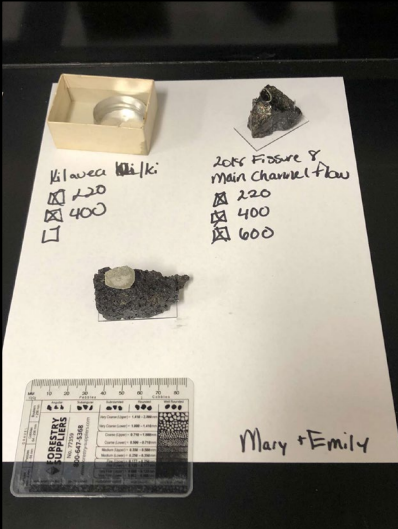
Step 3: Coat and Coat



Step 4: Vacuum



Methods: Preparing Thin Sections



Hand Sample Descriptions

Kilauea Iki

Top of sample has weathered to a grey-brown while bottom still has glassy texture with oxide residue. Middle is chocolate brown. Round to elongated vesicles ranging in <0.5 to 4 mm in size.

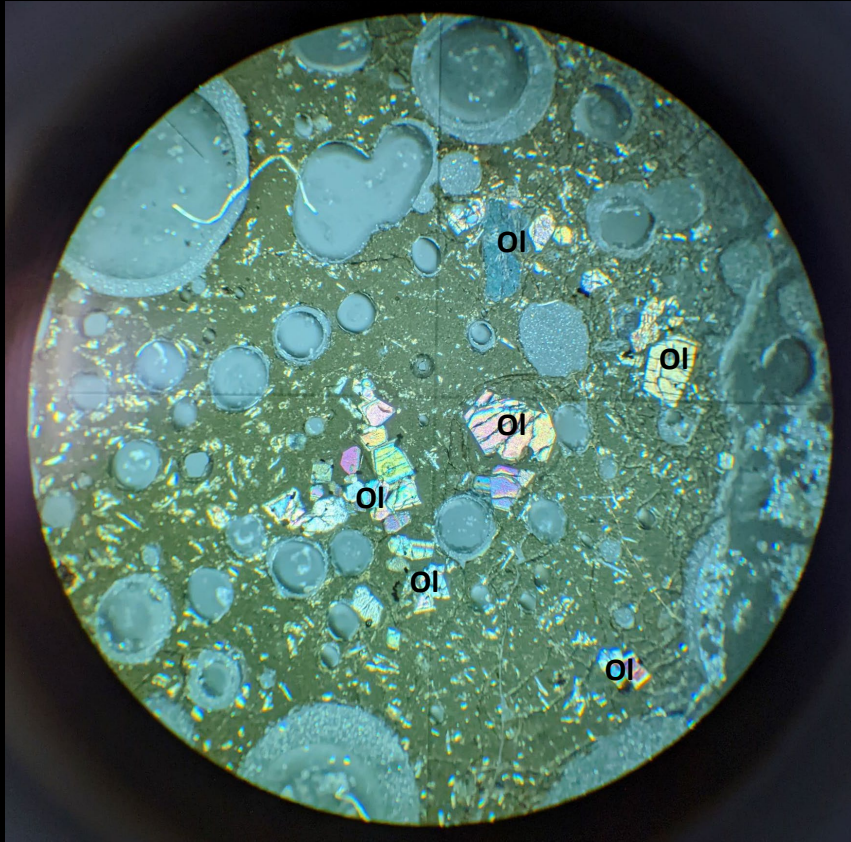
Bright green phenocrysts present in glass groundmass that are interpreted as olivine.

Fissure 8 Main Channel Flow

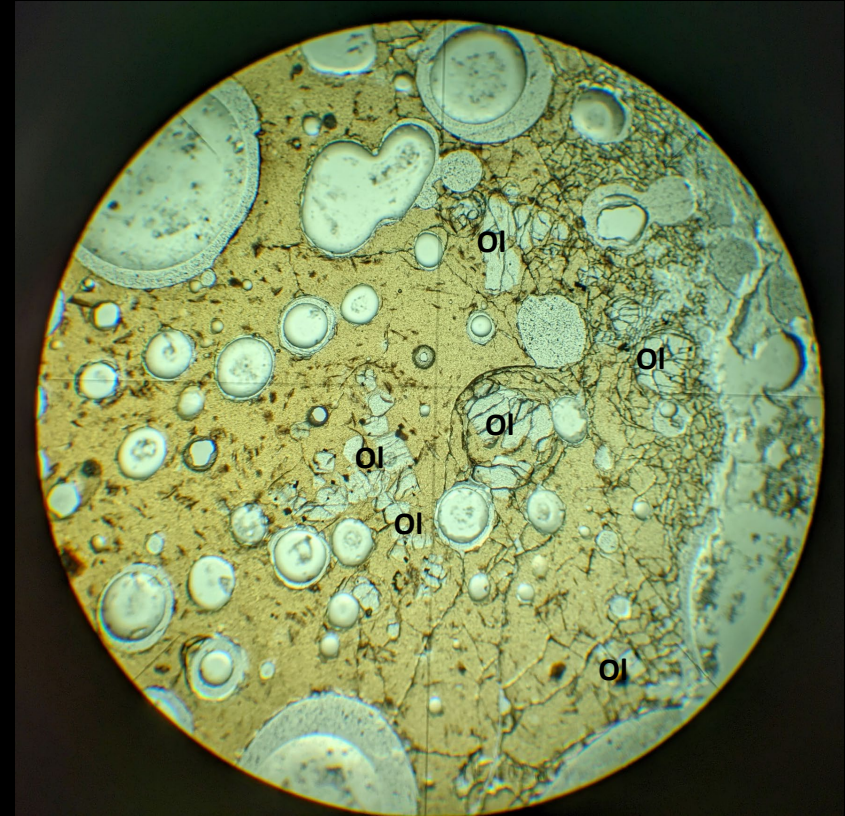
Very light samples that present very little weathering. Groundmass is very glassy and appears iridescent blue yellow and pink. Vesicles range from very small to very large (<0.5-7 mm in size). There aren't any phenocryst visible in any of the samples collected.

Fissure 8 Main Channel Basalt (Microscopy)

50% Pore Space 40% Groundmass 10% Olivine

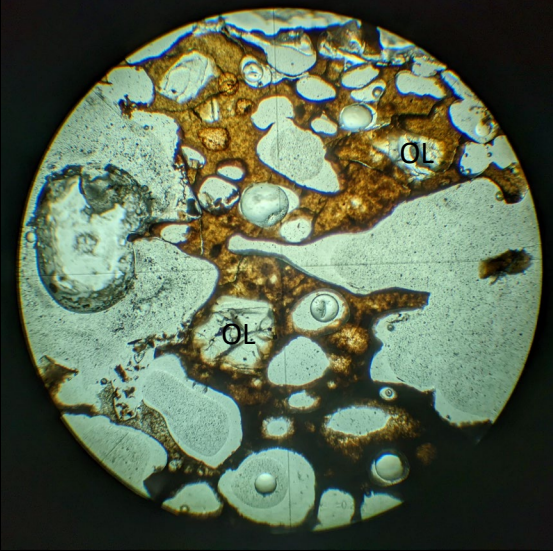


XPL

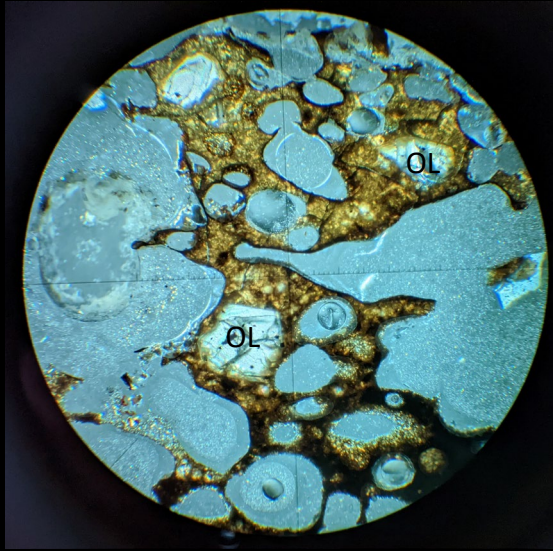


PPL

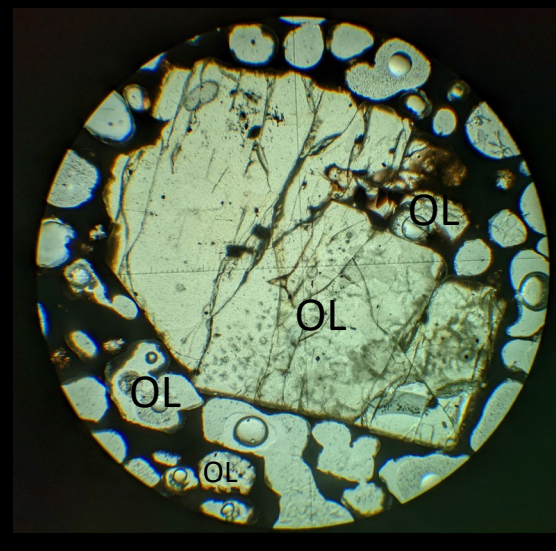
PPL



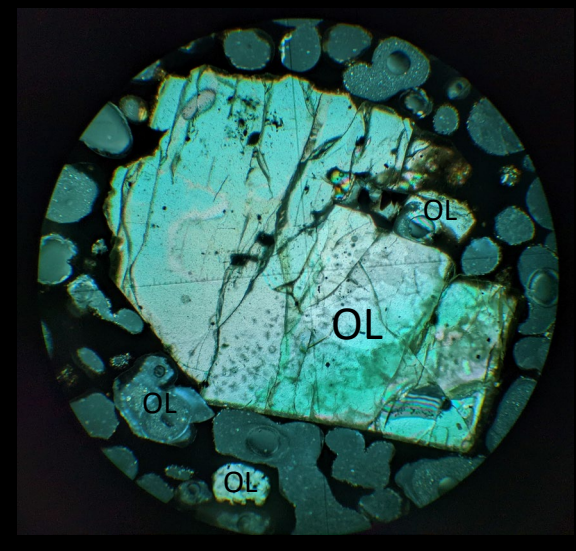
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PPL



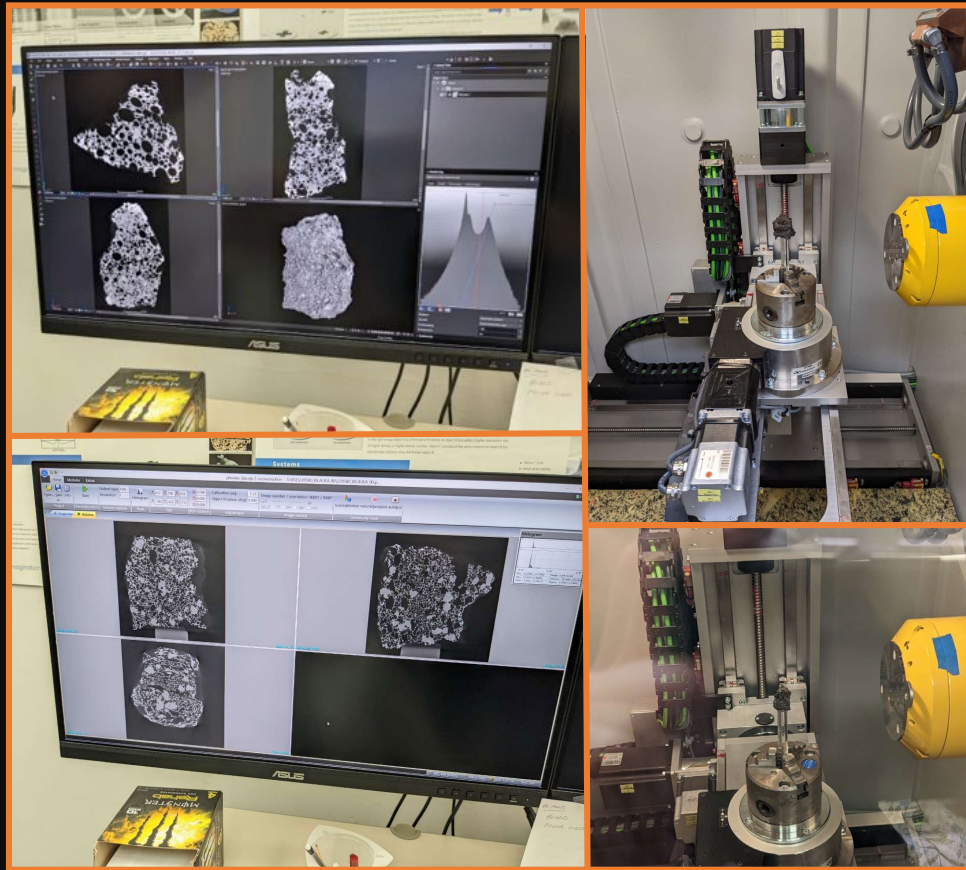
XPL



Kilauea Iki Basalt (Microscopy)

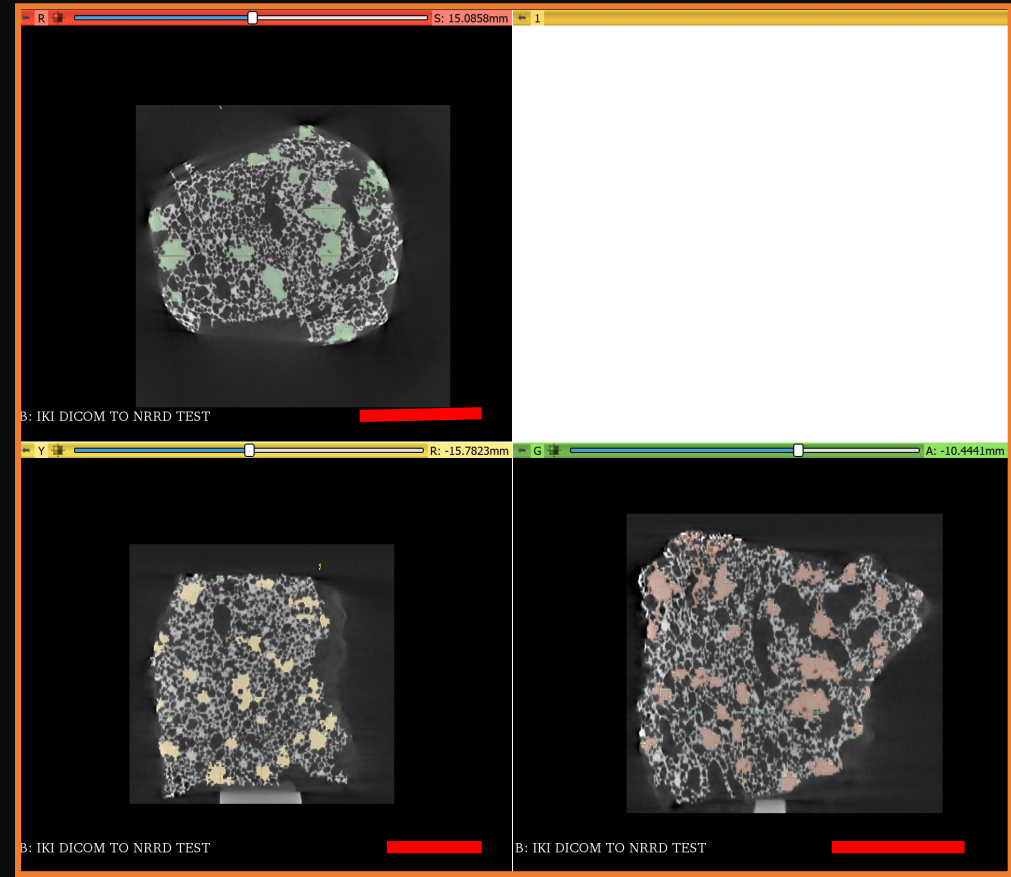
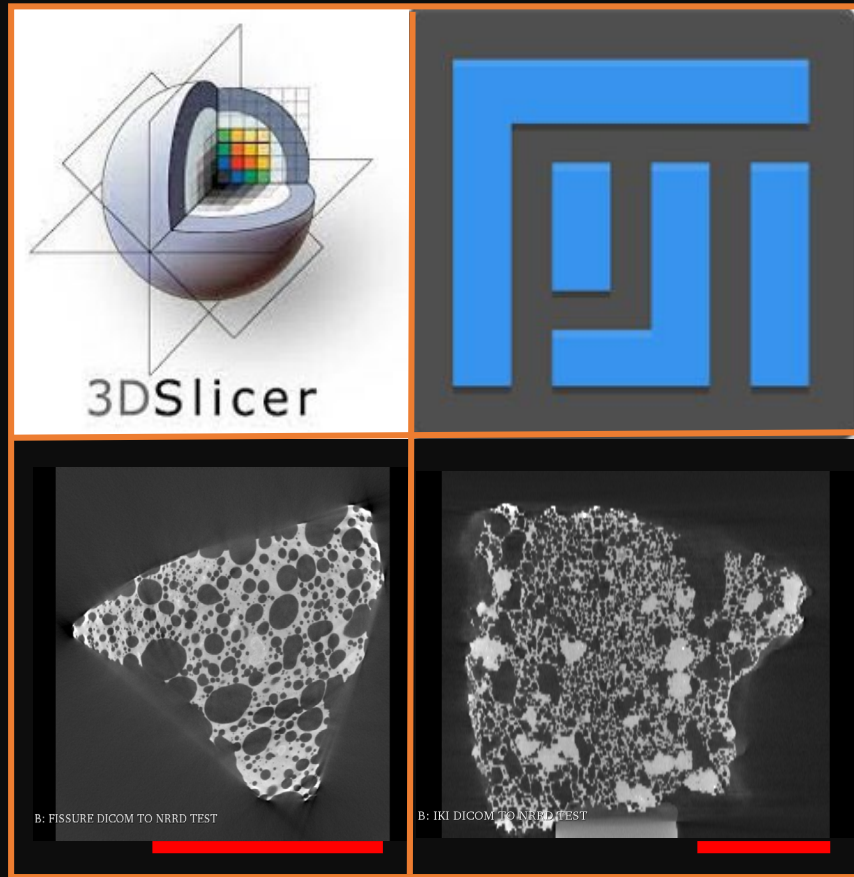
60% Pore Space 25% Groundmass 15% Olivine

Methods: Computed Tomography (CT) Analysis



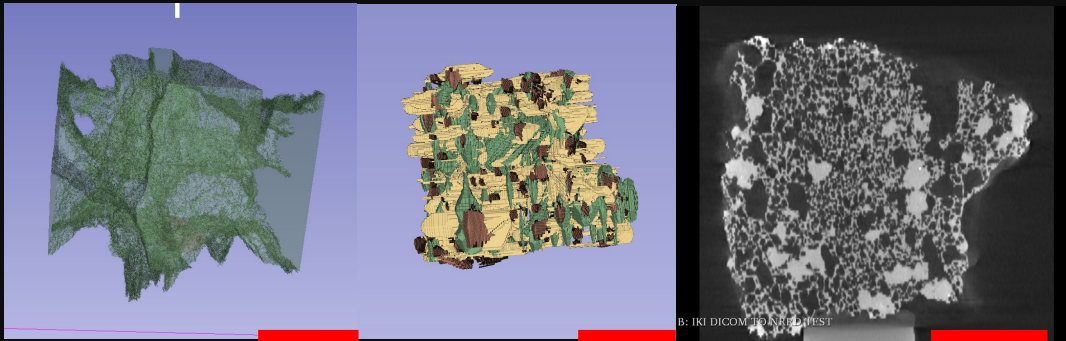
- (GE phoenix v|tome|x s CT system)
- Useful for:
 - Paleoclimate analysis
 - Geophysical analysis (Sahagian et al., 2002)

Methods: Computed Tomography (CT) Analysis



*scale bars are all 1 cm

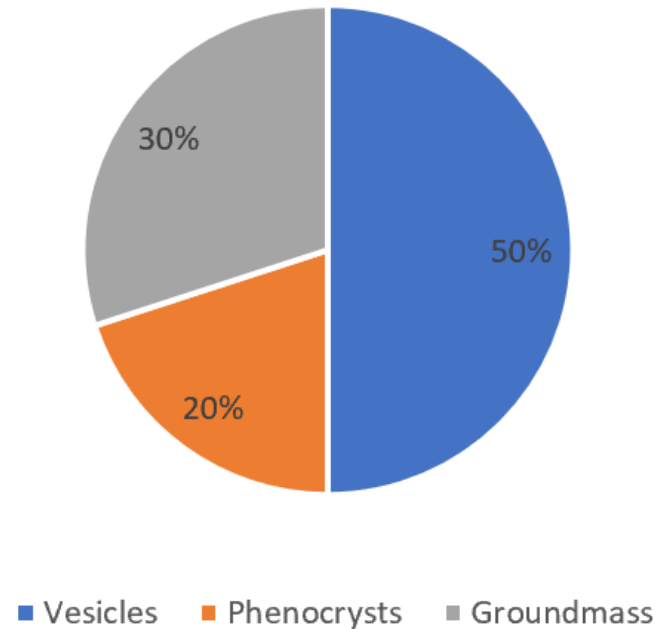
Results: Kilauea Iki Basalt



Segment Volume in cm³

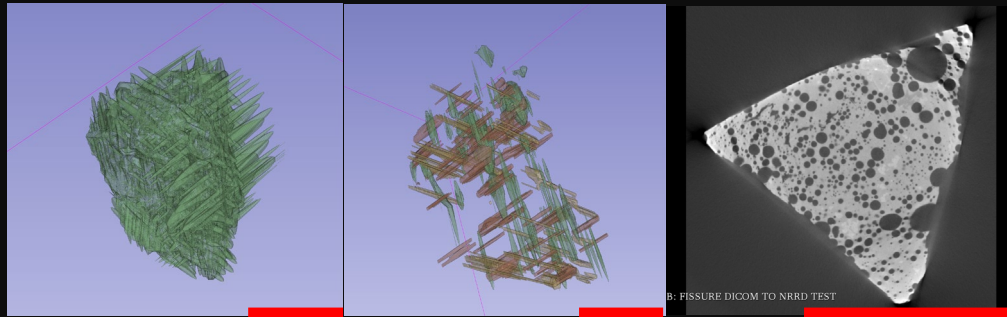
Volume Based on 3D Analysis	
Vesicles	~6.34 cm ³
Phenocrysts	~2.54 cm ³
Groundmass	~3.80 cm ³
Total	~12.68 cm ³

Segment Percent by Volume



*scale bars are all 1 cm

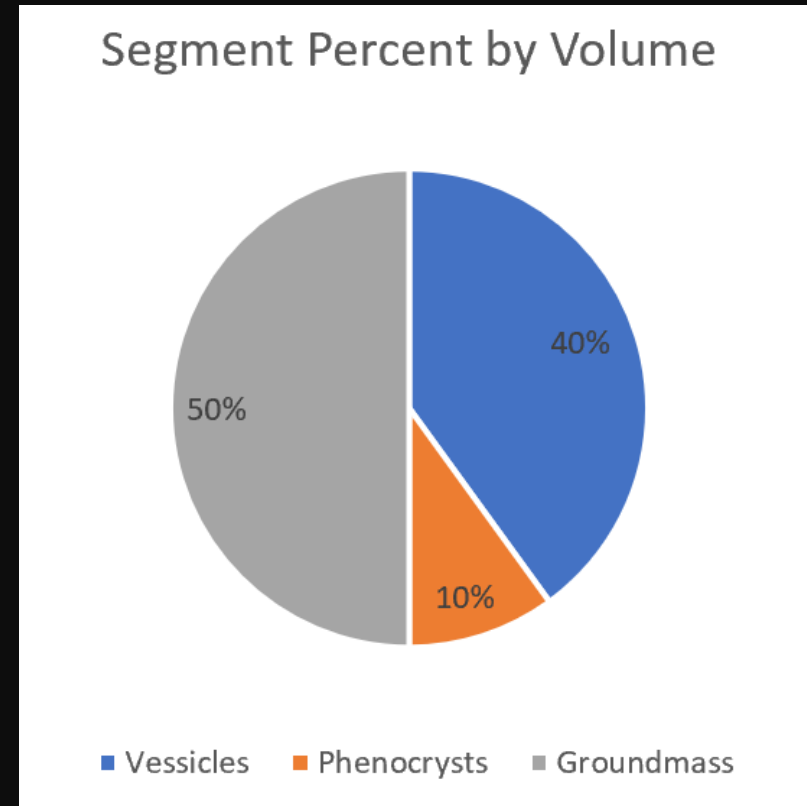
Results: Fissure 8 Channel Flow Basalt



Segment Volume in cm³

Volume Based on 3D Reconstruction	
Vesicles	~0.81 cm ³
Phenocrysts	~0.20 cm ³
Groundmass	~1.01 cm ³
Total	~2.02 cm ³

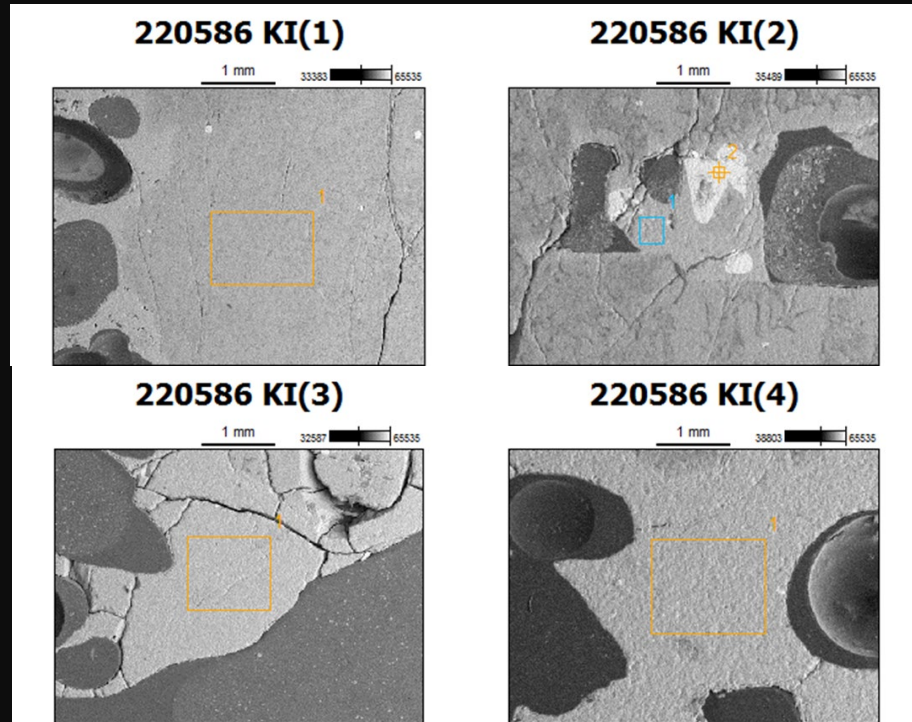
*scale bars are all 1 cm



Methods: SEM

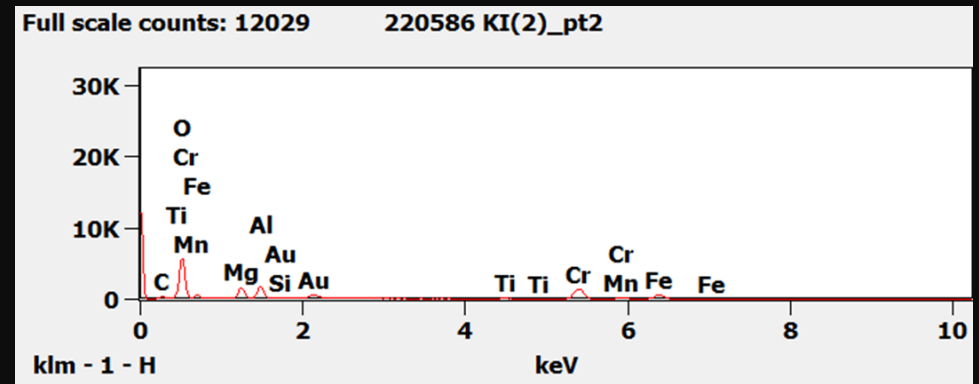
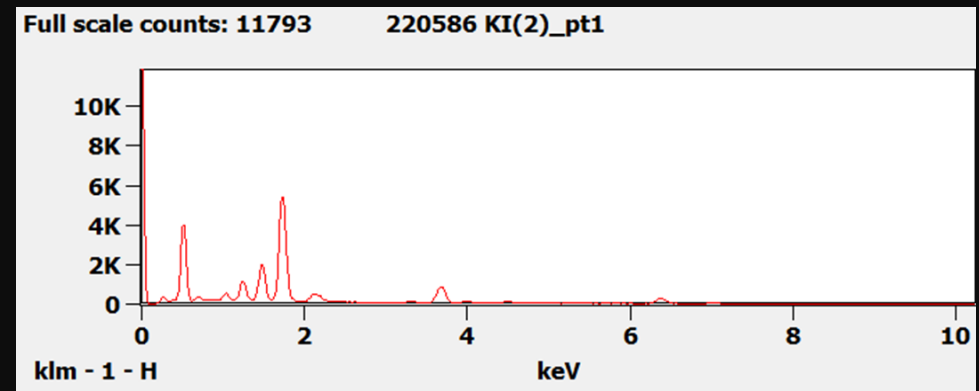
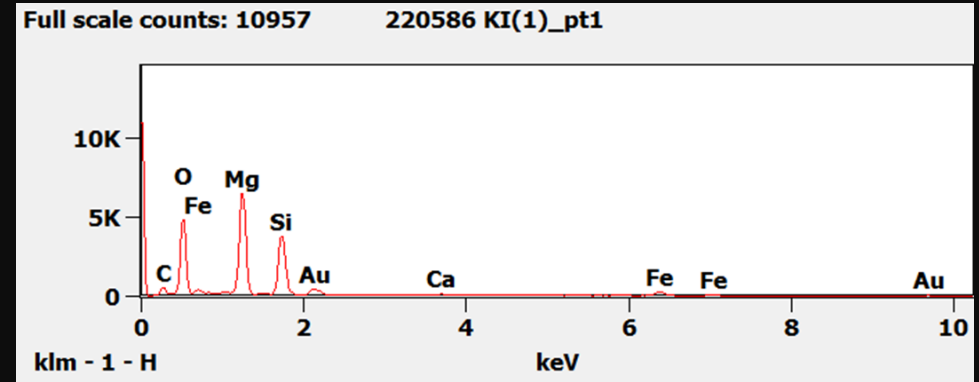


Results: Kilauea Iki Basalt

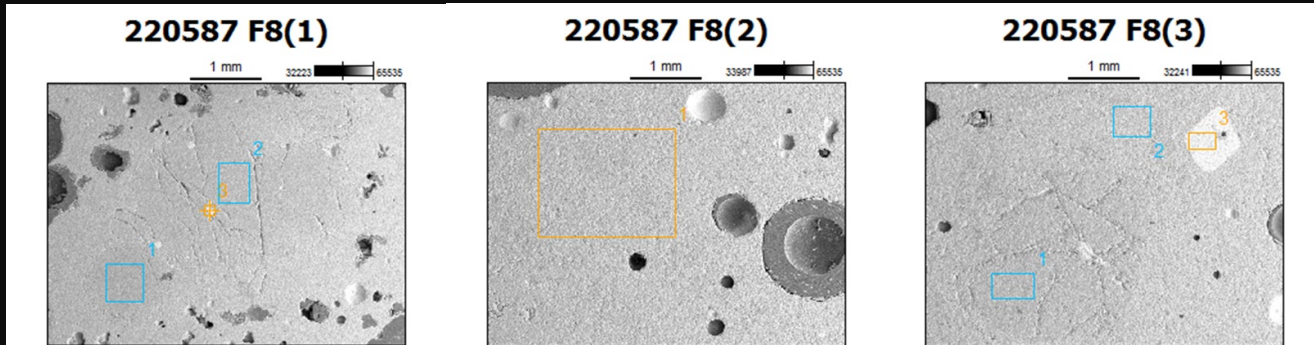


Chemical Data in wt%

	SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MnO	MgO	CaO	Na ₂ O	Cr ₂ O ₃	N ₂ O	K ₂ O	Total
KI-1	39.9	0.0	0.0	13.9	0.0	44.8	1.4	0.0	0.0	0.0	0.0	100
KI-2(p1)	48.6	2.9	12.4	12.0	0.0	6.5	11.0	2.2	0.0	3.8	0.6	100
KI-2(p2)*	1.1	2.0	14.1	25.6	0.7	12.5	0.0	0.0	44.1	0.0	0.0	100
KI-3	49.5	2.7	11.6	12.1	0.0	11.4	9.9	2.3	0.0	0.0	0.5	100
KI-4	51.6	3.0	13.2	11.3	0.0	7.5	11.0	2.2	0.0	0.0	0.5	100

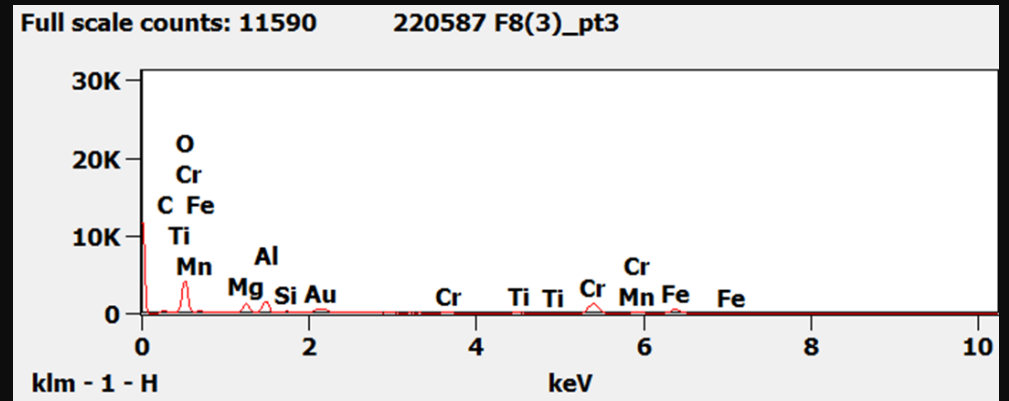
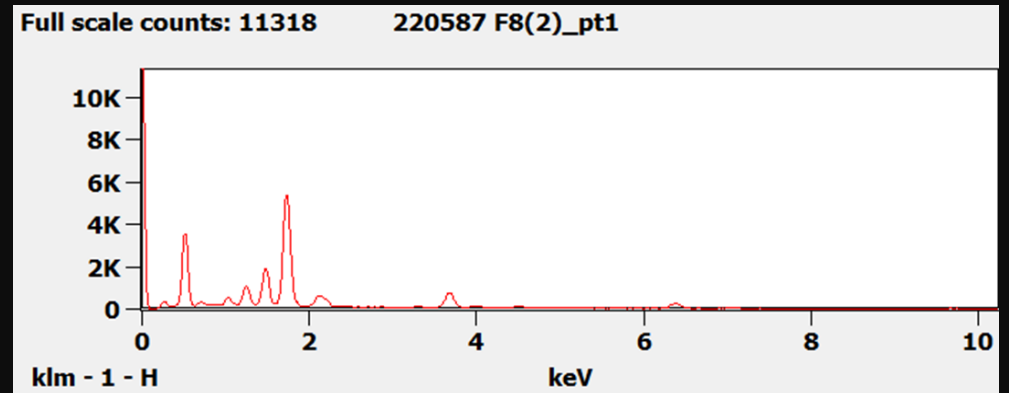
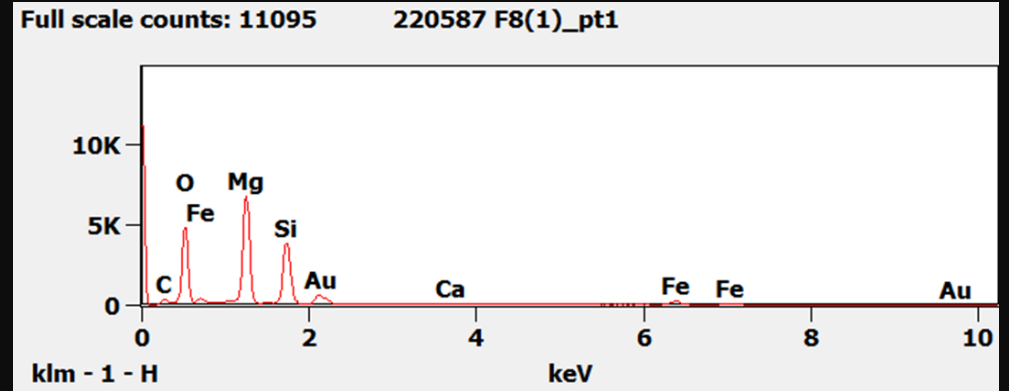


Results: Fissure 8 Main Channel Flow



Chemical Data in wt%

	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	Cr2O3	N2O	K2O	Total
F8-1(p1)	40.8	0.0	0.0	12.6	0.0	46.2	0.4	0.0	0.0	0.0	0.0	100
F8-1(p2)	41.3	0.0	0.0	11.9	0.0	46.5	0.3	0.0	0.0	0.0	0.0	100
F8-1(p3)*	0.0	1.2	13.9	22.5	0.2	12.4	0.0	0.0	49.9	0.0	0.0	100
F8-2	52.9	2.8	12.9	11.7	0.0	6.6	10.3	2.3	0.0	0.0	0.4	100
F8-3(p1)	40.5	0.0	0.0	16.4	0.0	42.3	0.8	0.0	0.0	0.0	0.0	100
F8-3(p2)	52.5	2.1	12.2	12.0	0.0	8.8	9.6	2.4	0.0	0.0	0.3	100
F8-3(p3)*	2.3	1.7	13.7	25.8	0.2	10.4	0.0	0.0	46.1	0.0	0.0	100



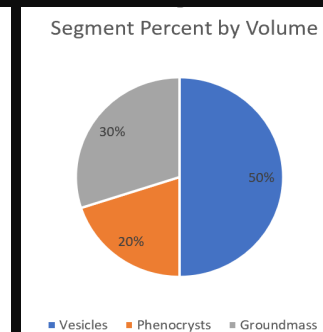
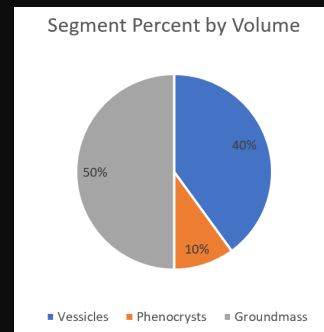
Discussion

- Samples taken collected from Kilauea Iki and Fissure 8 both had olivine phenocrysts that were determined to be forsterite which is consistent with Lynn and Swanson (2022).
- Inclusions found in both samples were chromite which Lynn and Swanson (2022) also found in their study of the 2018 fissure flow.
- Both samples were collected from eruptions with multiple events so it is unclear which event the samples are from however Sahagian et al. (2002) found that proximity to source and event timing could be determined by vesicularity percentage

Chromium	46.46 %	Cr	67.90 %	Cr ₂ O ₃
Iron	24.95 %	Fe	32.10 %	FeO
Oxygen	28.59 %	O		
	100.00 %		100.00 %	= TOTAL OXIDE

	SiO ₂	FeO	Cr ₂ O ₃	
KI-2(p2)		1.1	25.6	44.1
F8-1(p3)		0.0	22.5	49.9
F8-3(p3)		2.3	25.8	46.1

- Kilauea Iki
- Fissure 8



Conclusions

- Two samples collected from separate eruption events on Kilauea
- Microscopy, CT, and SEM to analyze samples
- Samples were deemed to be chemically similar (forsterite dominant phenocrysts and chromite inclusions)
- Samples varied physically in relation to method and location of formation
- Unable to correlate samples (using CT) to similar basalts from literature due to method of collection and number of samples



Acknowledgements

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References

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