Textural investigations of pyroclastic products from the June 3rd 2018 eruption of Volcán de Fuego, Guatemala

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Introduction

The June 3rd, 2018, eruption of Fuego volcano (Guatemala) produced a complex sequence of small-volume pyroclastic density currents (PDCs) that inundated all sectors around the volcano and propagated >12 km on the southeastern flank, deposited ~50 million m^3 of pyroclastic material.

The eruptive stratigraphy shows evidence of a sub-Plinian phase associated with tephra fallout and one PDC unit followed by at least seven stacked, massive flow units deposited by rapid stepwise aggradation of successive block-and-ash flow (BAF) pulses in the Las Lajas barranca on the southeastern flank.

Eruption Timeline

3:00 - Increase in seismic activity

6:00 - Strong summit explosions began

10:00 - First series of PDCs descended the Seca, Sanra Teresa, and Ceniza barrancas

11:30 - 13:30 - Explosivity became sustained

13:10 - **Explosivity peaked with a 16-19 km high sub-Plinian eruption column**. During this phase, PDCs were seen traveling toward La Reunion golf resort in the Las Lajas barranca.

14:20 - The first PDC reached the bridge of the RN-14 road that crosses the eastern Las Lajas channel.

15:00 - 15:30 - **Peak PDC activity**

15:05 - First PDC pulse occured

15:09 - First PDC pulse impacted the Las Lajas bridge, overflowing into the RN-14 road.

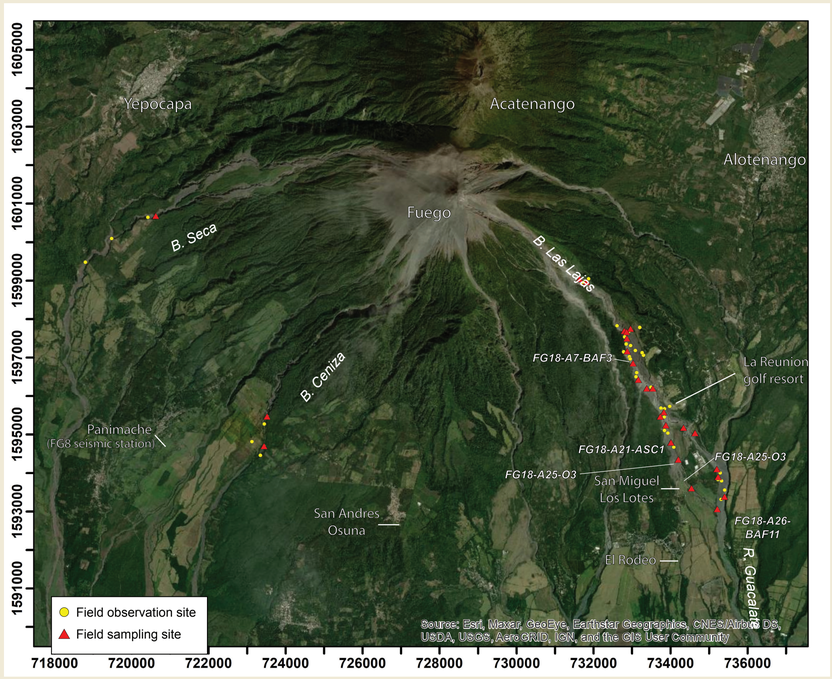
15:09 - 15:12 - Another PDC pulse arrived at the bridge, overflowed the highway and continued along the RN-14 road.

15:12 - 15:16 - Third PDC pulse recorded by seismic station.

15:18 - PDC seen at the entrance of El Rodeo village overflowing toward San Miguel de Los Lotes. Moments later, several PDC pulses led to the destruction of the northwestern part of the San Miguel de Los Lotes village.

16:30 - PDC activity ceased.

Sampling Map



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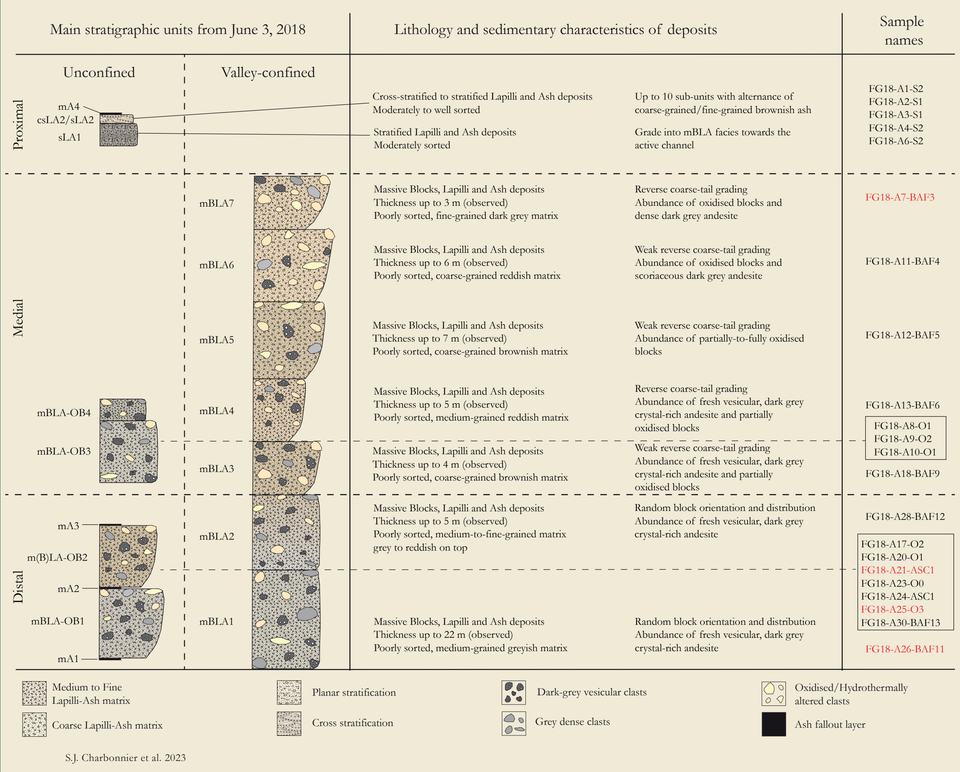
About 40 samples were collected in August 2018 along the path of the June 2018 PCs in the Las Lajas barranca, including tephra fallout, pyroclastic surge and block-and-ash flow deposits. The preliminary results shown here focus only on sample analyses performed on pyroclastic surge deposits and block-and-ash flow deposits.

Samples investigated in this study are labeled on sampling map (left).

Objectives:
Compare the characteristics of the sub-Plinian and PDC phases

This study investigates textural and geochemical changes throughout the June 3rd eruptive sequence. Using component analyses, juvenile clasts (scoria and glass) from each eruptive unit were selected for major and trace element analyses, bulk density calculation, and for quantification of vesicularity.



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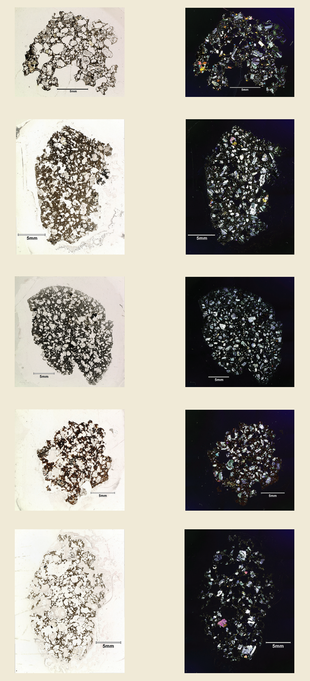
Petrographic Thin Sections



A7_BAF3b
Brown scoria

A21_ASC1C
Black scoria

A25_O3
Dark gray scoria

A25_O3k
Brown scoria

A26_BAF11
Dark gray scoria

Images taken using a Keyence VHX-7000 digital microscope at x20 magnification

Methods: Determination of vesicularity using FOAMS (Shea et al. 2010)

Image Acquistion

Examples of unprocessed SEM images from sample A7_BAF3b

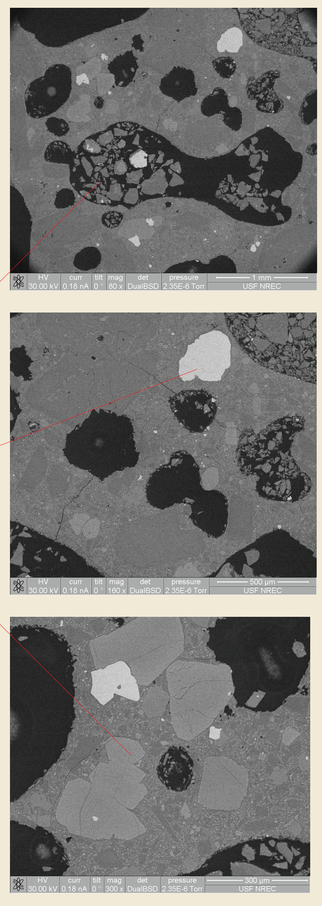
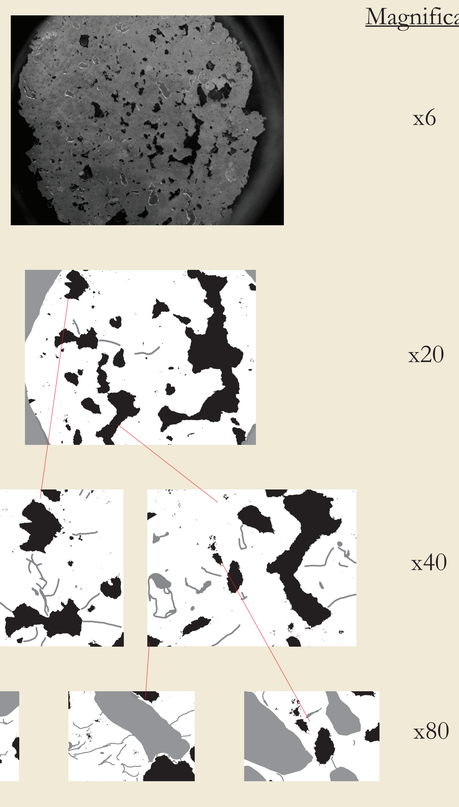


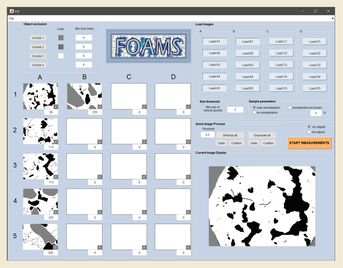
Image Processing

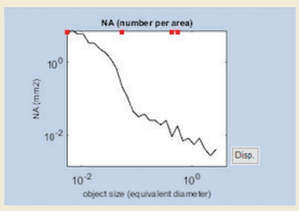
Adobe Photoshop is used to process.

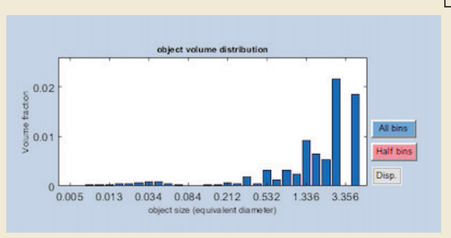
- Images must be converted from RGB to grayscale.
- Vesicles are filled in completely black
- Crystal phases and groundmass are filled in white or gray



Results







Sample	Type	Envelope Density (gr/cm^3)	Lab-derived Vesicularity	FOAMS zone#_run#	Objects Measured	2D integrated vesicularity
A7_BAF3b	brown scoria	1.83	32.9			
				zone1_run1	205	30.2
				zone2_run1	344	23.9
						Average: 27.05%
A21_ASC1C	black scoria	2.15	23.5			
				zones1,2_run1	228	3.8
				zones1,2_run2	133	6.1
				zones2,3_run1	107	6.1
						Average: 5.3%
A25_O3	dark gray scoria					
				zones1,2_run1	688	7.8
				zones1,3_run1	721	9.1
						Average: 8.5%
A25_O3k	brown scoria	2.09	23.5			
				zones1,3_run1	212	13.1
				zones2,3_run2	526	9
						Average: 11.1%
A26_BAF11	dark gray scoria					
				zones1,2_run1	298	**Average: 12.1%**

Next Steps

- Process more samples from both sub-Plinian and PDC units using FOAMS
- Use Confort 15 to model decompression rates of both eruption phases
- Whole rock geochemistry

References

- Charbonnier, S.J., Garin, F., Rodriguez, L., Ayala, K., Cancel, S., Escobar-Wolf, R., Chigna, G., Chun-Quinillo, C., Gonzalez, D., Chigna, W., Chun-Quinillo, K., Merida, R., Juarez, F.,Calder, E., 2023. Unravelling the dynamics and hazards of the June 3rd, 2018, pyroclastic density currents at Fuego volcano (Guatemala). J. Volcanol. Geotherm. Res. 436. https://doi.org/10.1016/j.jvolgeores.2023.107791
- Shea, T., Houghton, B., Gurioli, L., Cashman, K., Hammer, J., Hobden, B., 2010. Textural studies of vesicles in volcanic rocks: An integrated methodology. J. Volcanol. Geotherm. Res. 190, 271 - 289. https://doi.org/10.1016/j.jvolgeores.2009.12.003

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