



Internship at the Instituto Geofísico del Ecuador (IGEPN)

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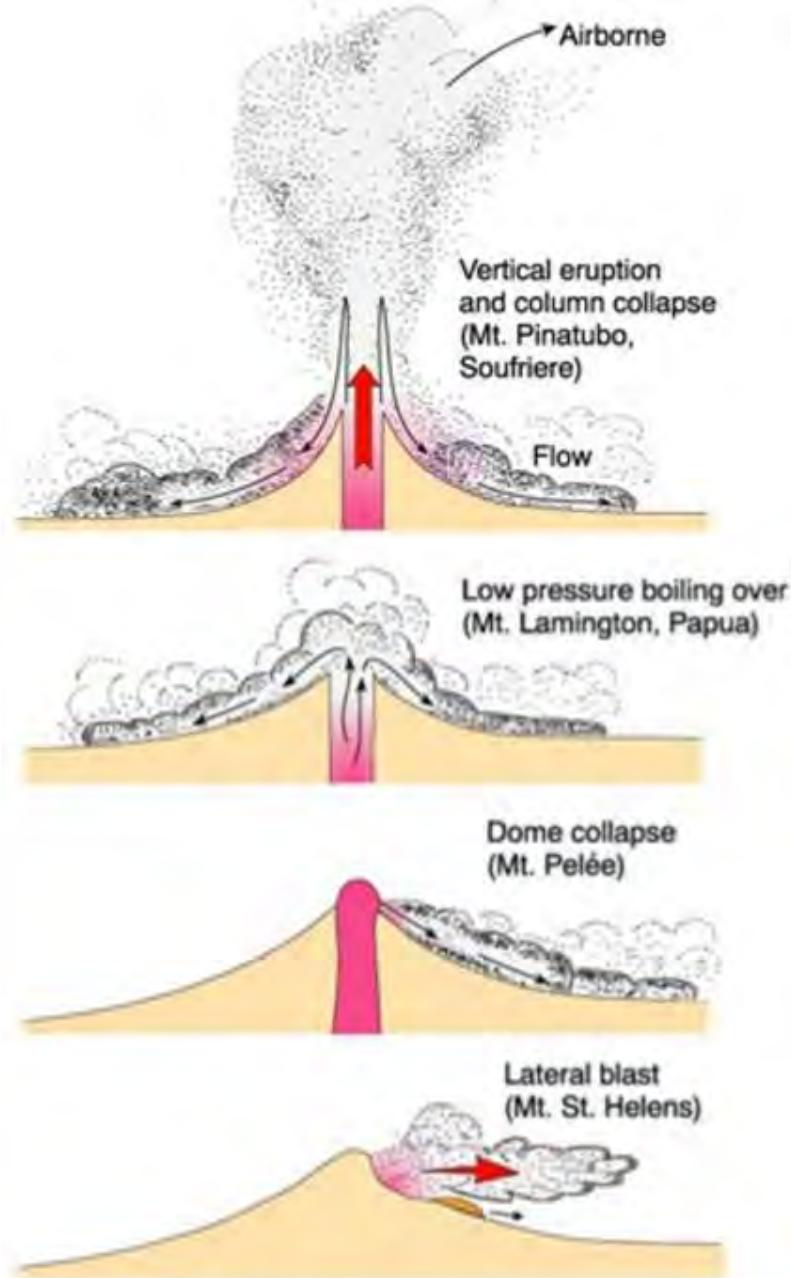
Pyroclastic Density Currents

- Gravity-driven rapidly moving mixtures of hot volcanic particles and gas that flow across the ground.
- Composed of dense basal granular layer with an overlying dilute ash cloud
- Temperature: up to ~600–800 ° C
- Velocity: 50-200km/h
- Volume: <1km³ - thousands of km³, may extend over 100 km from their source

Druitt (1998), & Roche (2013)

PDC Eruptions

- Eruption column collapse
 - pumice-rich ignimbrite
- Upwelling and overflow with no eruption column
 - pumice-poor ignimbrite
- Lava dome/flow collapse
 - “block and ash flow”
- *Lateral blast*



Project Objective

- Search for a correlation between the particle density and the grainsize distribution of a specific sample with its deposit density.
- Validate a new method implemented by F. Vásconez to estimate the deposit density.

Our Deposits



Volcanic Complex Pululahua



Tungurahua

- 781 – 11 kaBP: effusive dome formation and BAFs
- ~2,485 – ~2,240aBP: series of explosive events.
Pumice Flows and surge

Andrade, D. (2002)

- PDC deposits from ravines Palmahurco (scoria flow, 2014) and Chontapamba (surge, 2006)

García, J. (2016)

“Gigantic cone” (modified by Váscone, 2015)



$$volume_{deposit} = 23,593 * (\# \text{ plastic balls}) - 0,7497 \quad (cm^3)$$

“Gigantic cone” (modified by Vásconez, 2015)

$$\rho_{deposit} =$$



mass



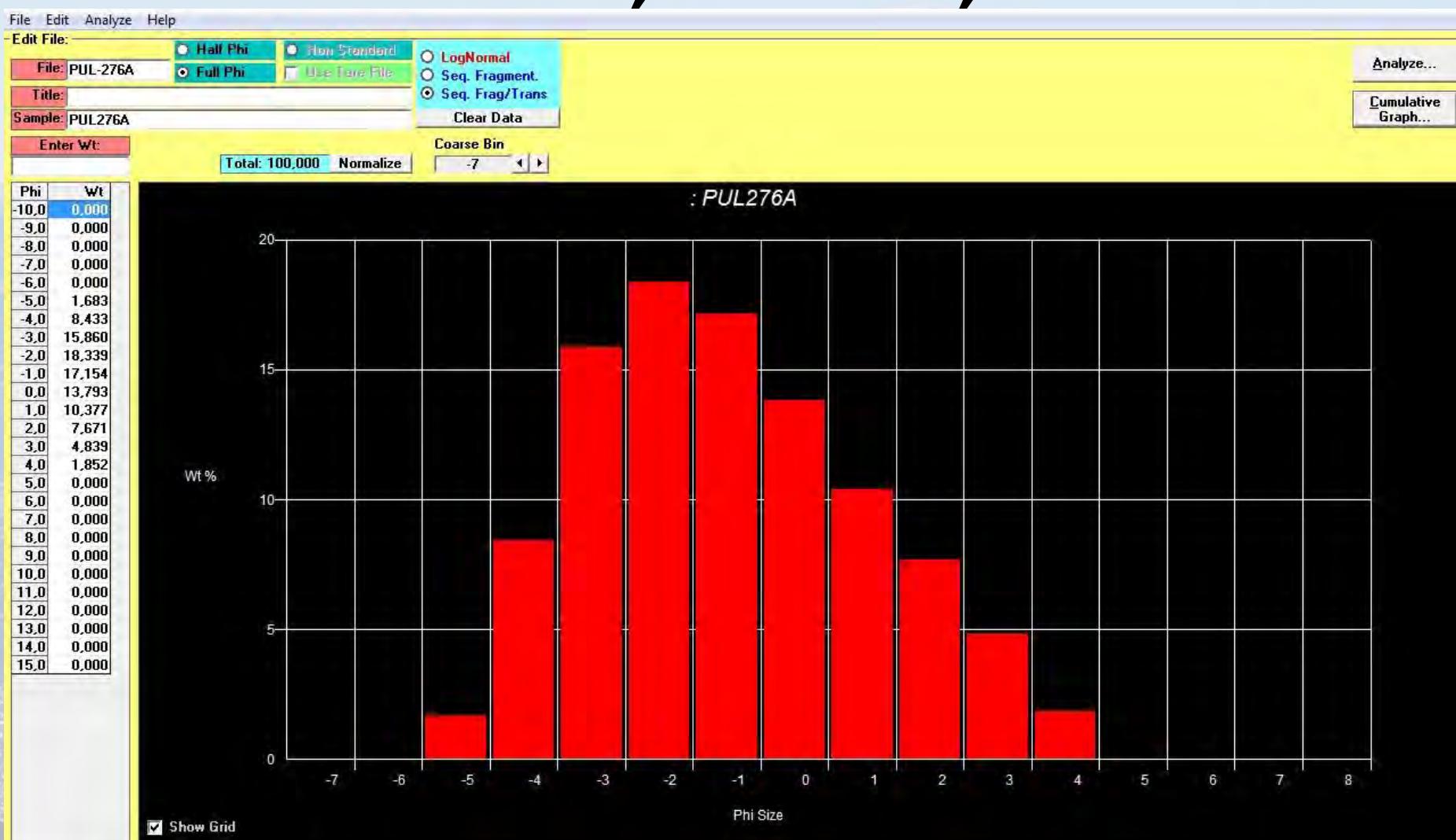
volume

Dividing and Sieving



METHODS

Grain size distribution analysis: KWare SFT, Wohletz, 2013.



METHODS

Paraffin-method



$$|\vec{E}| = |\vec{P}| = \text{mass}_{\text{fluid}} * g = (\rho_{\text{fluid}} * \text{volume}_{\text{fluid}}) * g$$
$$\text{mass}_{\text{displaced water}} = \text{volume}_{\text{clast}}$$

METHODS

Statistical analysis: pyroclast density and porosity: Bernard et al., 2015

RStudio

File Edit Code View Plots Session Build Debug Tools Help

Project: (None)

stats_DIEGO.R * stats_DIEGO.R * stats.R *

Source on Save Run Source

```
1 #DESCRIPTION:
2
3 #ARGUMENTS:
4 # file: A csv file containing mass, volume, density, and porosity of volcanic dep
5 #sep: The columns of the csv file can be separated with commas (","), semicolons
6 #header: The default value is TRUE, this means that each column has its own header.
7 #run: It is the number of random runs that will be performed to compute the sam
8 #probs: The random runs are divide in quantiles. The probs vector gives the perce
9 #pq: Quantile of 95% (0.95) for the random runs.
10 #pe: Closest sample size for errors of 1% and 5% (0.01,0.05)
11 #breaks: Intervals used to compute the histograms. The default vector spans from 0
12 #minmax: If this argument is TRUE the plotting limits in the x-axis are given
13 # by the minimum and maximum porosity values of the field data.
14 #plot: The default value is TRUE. All the plots are shown in the screen.
15 #pdf: The default value is TRUE. All the plots are printed into pdf files.
16 #txt: The default value is TRUE. A txt file is written into the disk with the resu
17 #Example for running: 1.- source("stats.R")
18 # 2.- results<-stats("fielddata.csv")
19 results <- function(file,sep=",",run=1000,header=TRUE,probs=seq(0,100,5)/100,pq=0.95,v
20 <-
```

1:1 (Top Level) R Script

Console C:/Users/Anais/Desktop/Geo/Tables/R/TUNG/

```
> source("stats_DIEGO.R")
> results<-stats("TUNG-JG-007B.csv")
```

item	value
1	n 1.290000e+02
2	minm 1.850000e+00
3	maxm 3.991900e+02
4	Fam 1.938798e+01
5	tm 2.501050e+03
6	minv 1.530000e+00
7	maxv 1.477600e+02
8	fav 8.115194e+00
9	tv 1.046860e+03
10	minrho 8.000000e-01
11	maxrho 2.790000e+00
12	stdrho 5.117073e-01
13	farho 2.192946e+00

Environment History

To Console To Source

```
results<-stats("TUNG-JG-002D.csv")
source("stats_DIEGO.R")
results<-stats("TUNG-JG-002c.csv")
source("stats_DIEGO.R")
results<-stats("TUNG-JG-007A.csv")
source("stats_DIEGO.R")
results<-stats("TUNG-JG-007B.csv")
source("stats_DIEGO.R")
results<-stats("TUNG-JG-007B.csv")
source("stats_DIEGO.R")
results<-stats("TUNG-JG-007B.csv")
```

Files Plots Packages Help Viewer

Zoom Export Clear All

Abundance Histogram Comparison: Porosity; n= 129

Abundance (%)

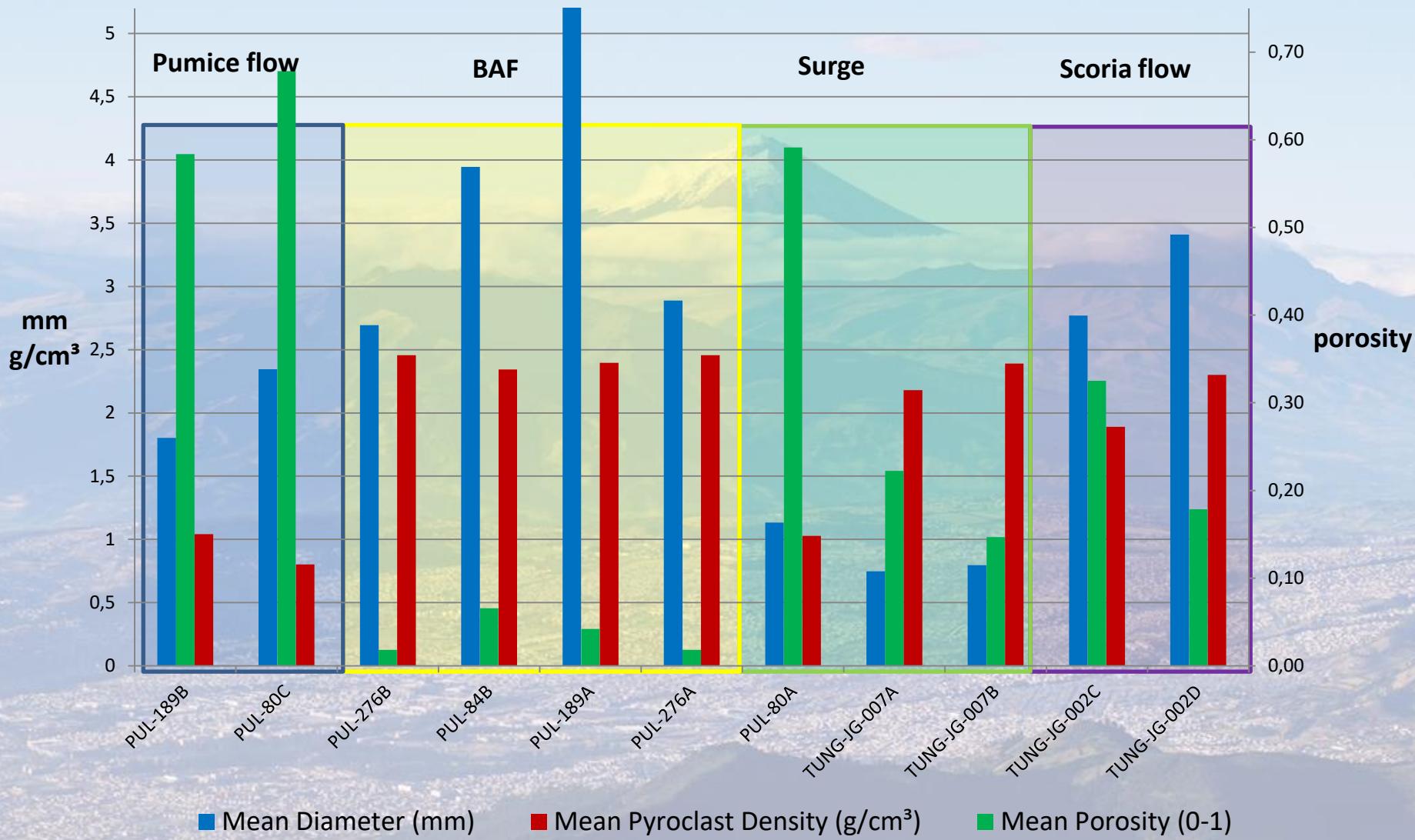
Porosity

Weighted by volume

Frequency

Porosity Range	Weighted by volume (%)	Frequency (%)
0.00-0.05	42	28
0.05-0.10	8	12
0.10-0.15	18	10
0.15-0.20	10	8
0.20-0.25	5	5
0.25-0.30	2	3
0.30-0.35	5	10
0.35-0.40	3	7
0.40-0.45	2	6
0.45-0.50	1	4
0.50-0.55	0	2
0.55-0.60	0	1
0.60-0.65	1	2
0.65-0.70	0	1
0.70-0.75	0	1

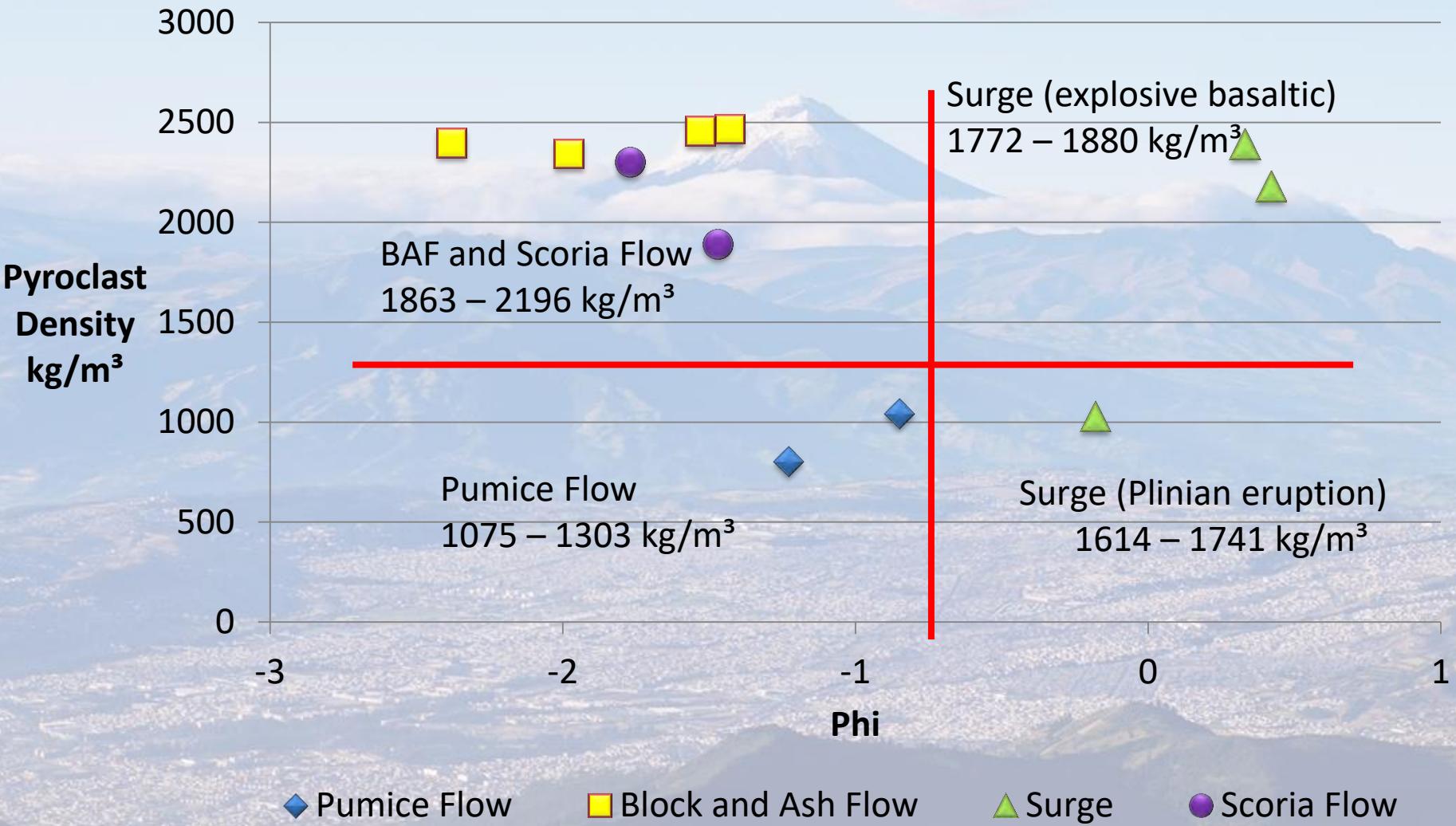
Mean comparisson: granulometry, pyroclast density and porosity



Conclusion/Summary

	Grainsize mm[ϕ]	Pyroclast density (-4 ϕ) kg/m ³	Porosity (0-1)	Deposit density kg/m ³
Pumice Flow	1,8[-0,85] – 2,35[-1,23]	802 – 1041	0,58 – 0,68	1075 – 1303
BAF	2,7[-1,43] – 5,21[-2,38]	2343 – 2467	0,02 – 0,07	1863 – 2196
Surge (explosive Basalitic)	0,74[0,42] – 0,8[0,33]	2179 – 2390	0,15 – 0,22	1772 – 1880
Surge (Plinian eruption)	0,46[1,12] – 1,13[-0,18]	1027	0,59	1614 – 1741
Scoria Flow	2,77[-1,47] – 3,41[-1,77]	1890 – 2300	0,18 – 0,33	1863 – 2026

Pyroclast Density (-4 ϕ) vs. Mean Diameter



CONCLUSION

“Try to summarize what you did and explain one important way that the experience built on your previous studies or contributes to your future plans.”

– R. Plumley



