Magmatic processes prior to the 1400-BP, caldera-forming eruption of Rabaul, Papua New Guinea

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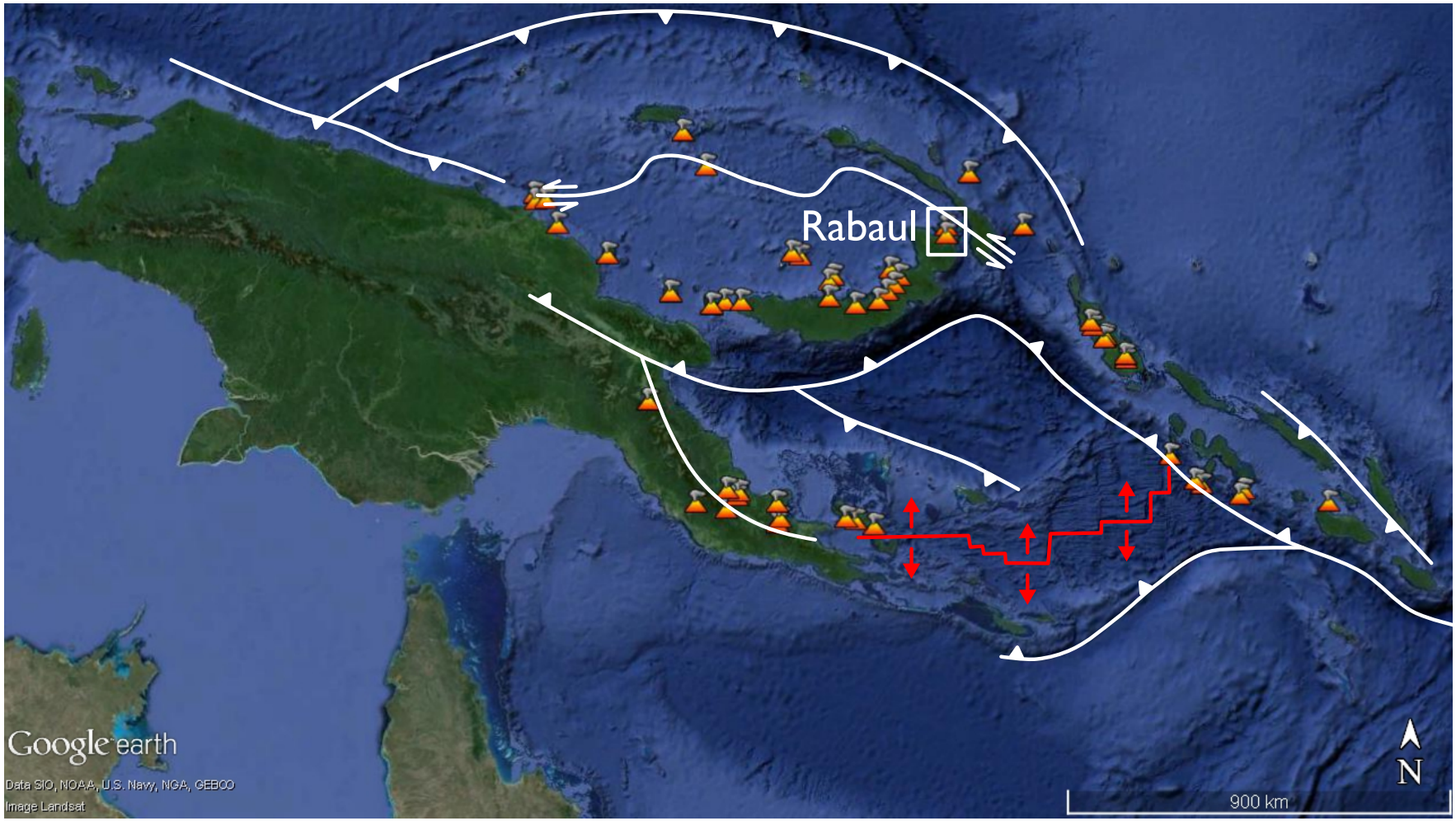
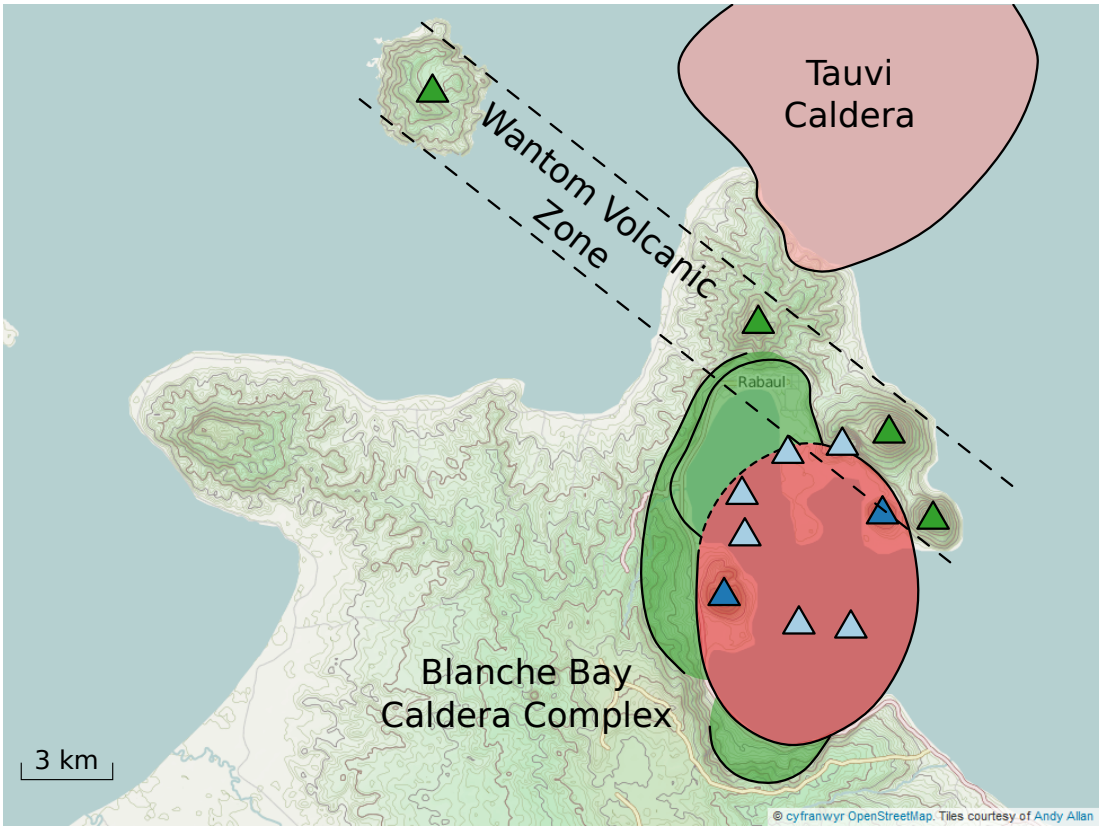
Volcanism is due to subduction at the New Britain Trench



Volcanic history of Rabaul



1994–
Current phase of activity

∼750 years BP
Oldest dated
post-caldera rocks

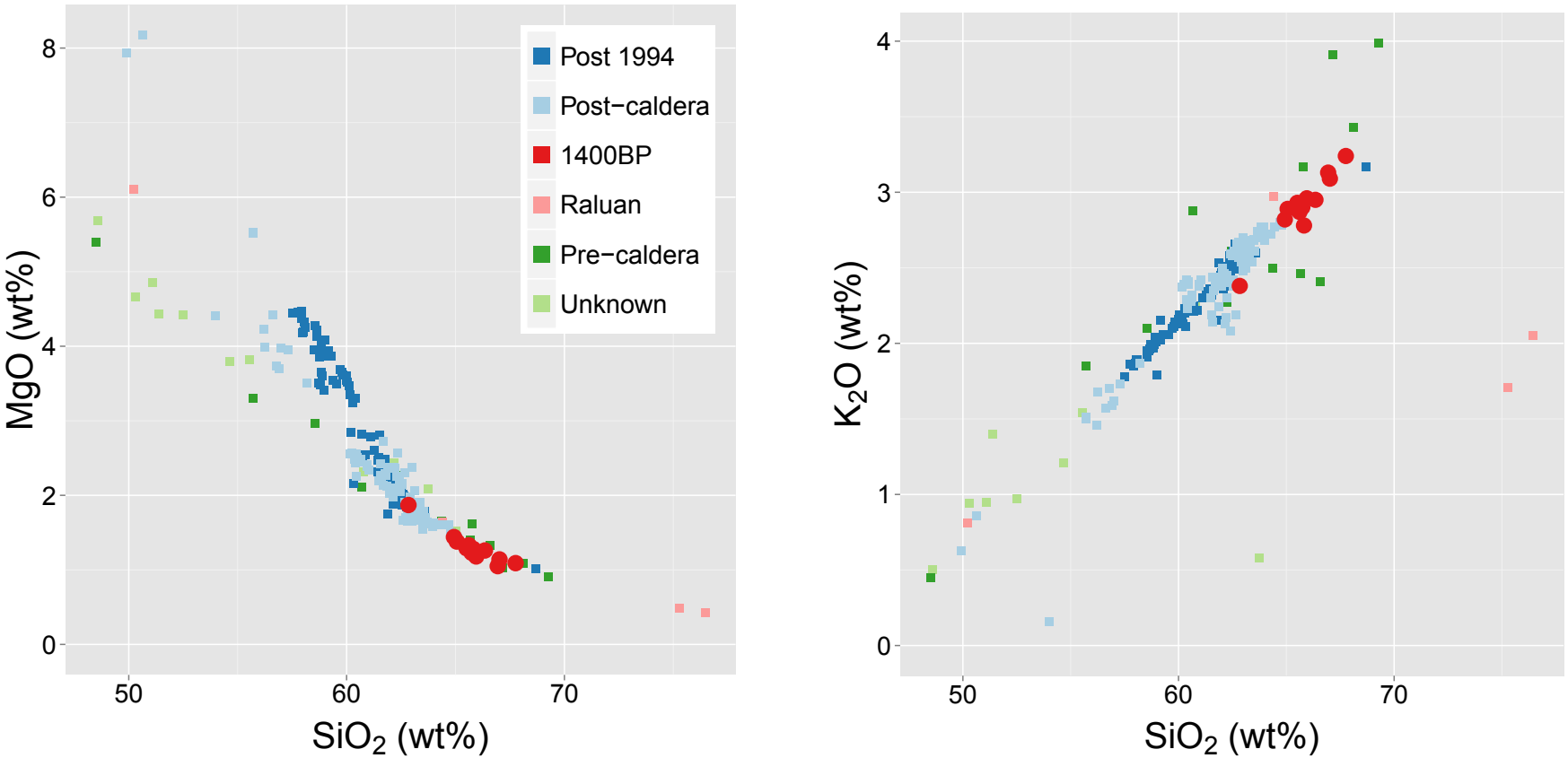
$1,376 \pm 34$ years BP
"1400 BP" Ignimbrite

∼7,000 years BP
Raluan Ignimbrite

1,200–7ka
Pre-caldera

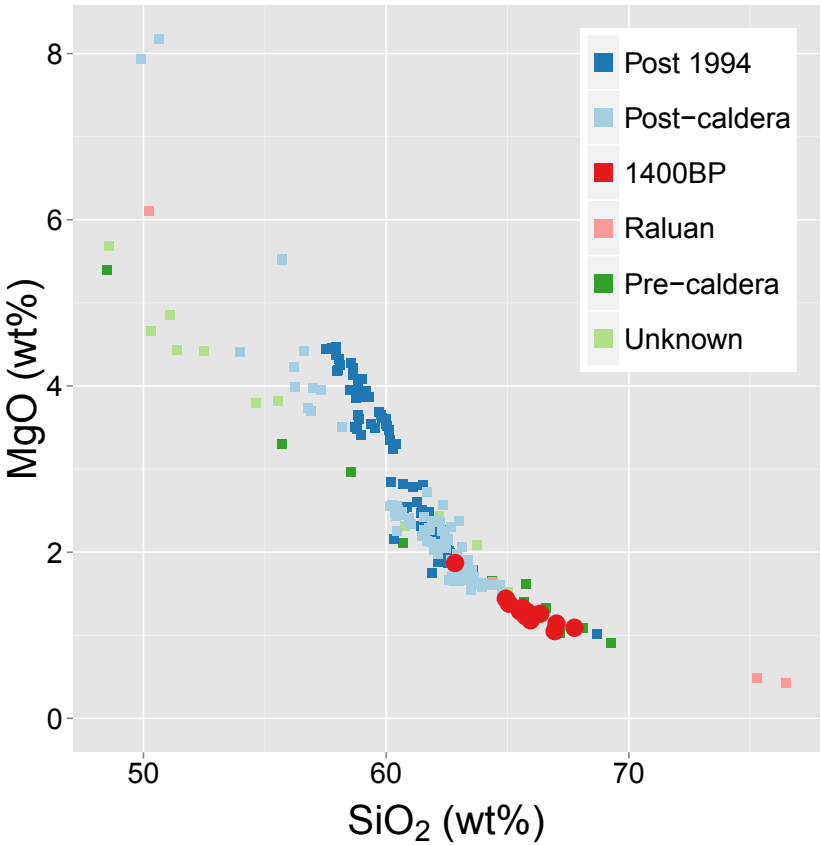
After Johnson et al. (2010)

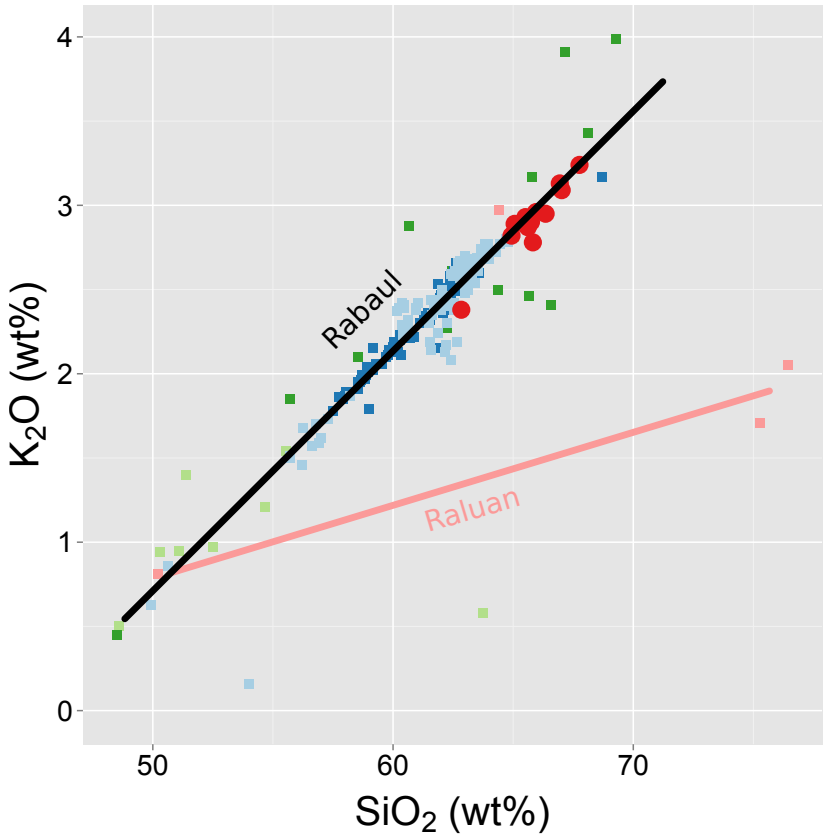
1400 BP magma plots along Rabaul trend



1400 BP: Our data; all other eruptions: Heming and Carmichael (1973), Wood et al. (1995), Patia (2004), Cunningham et al. (2009)

1400 BP magma plots along Rabaul trend





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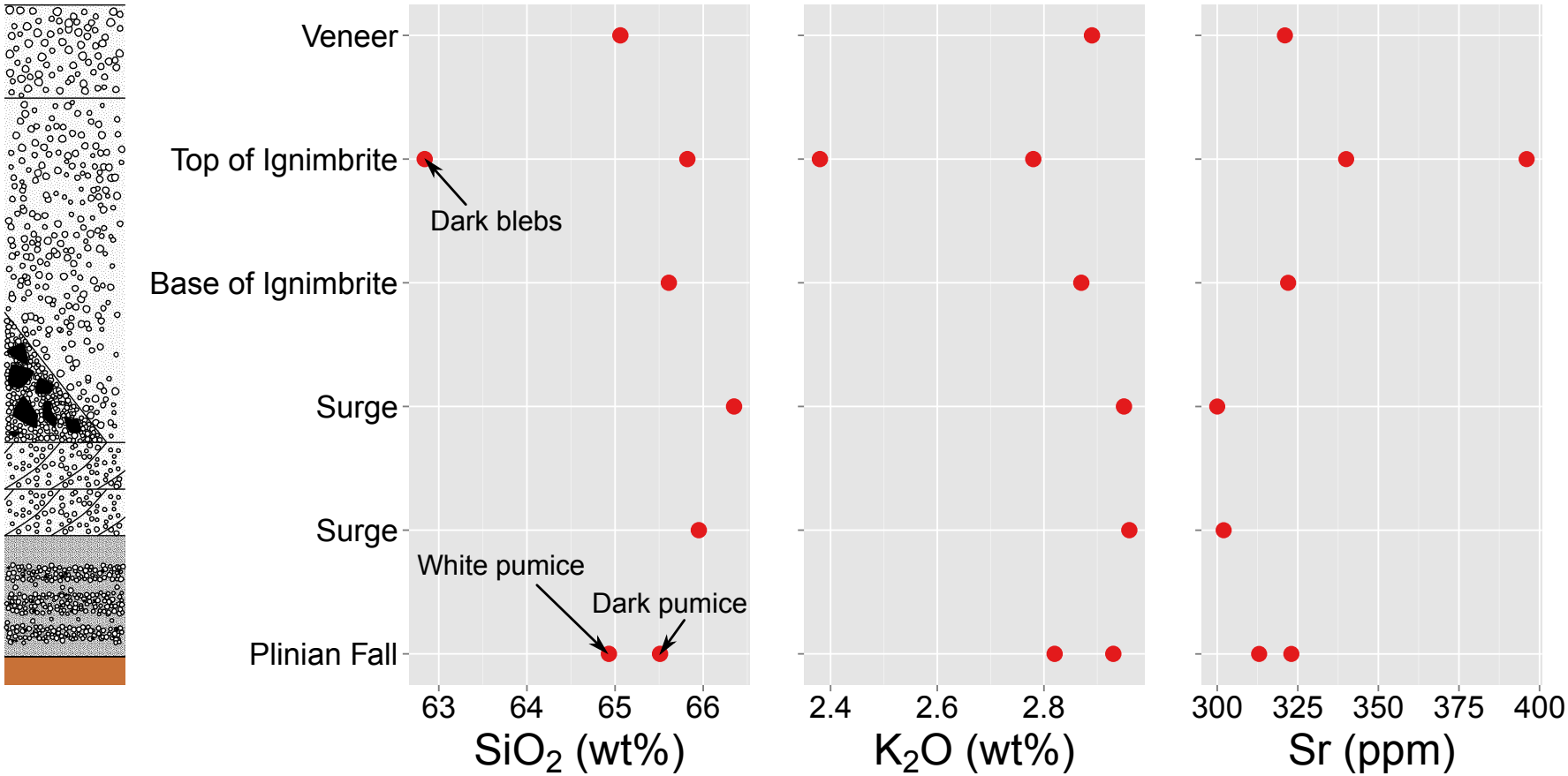
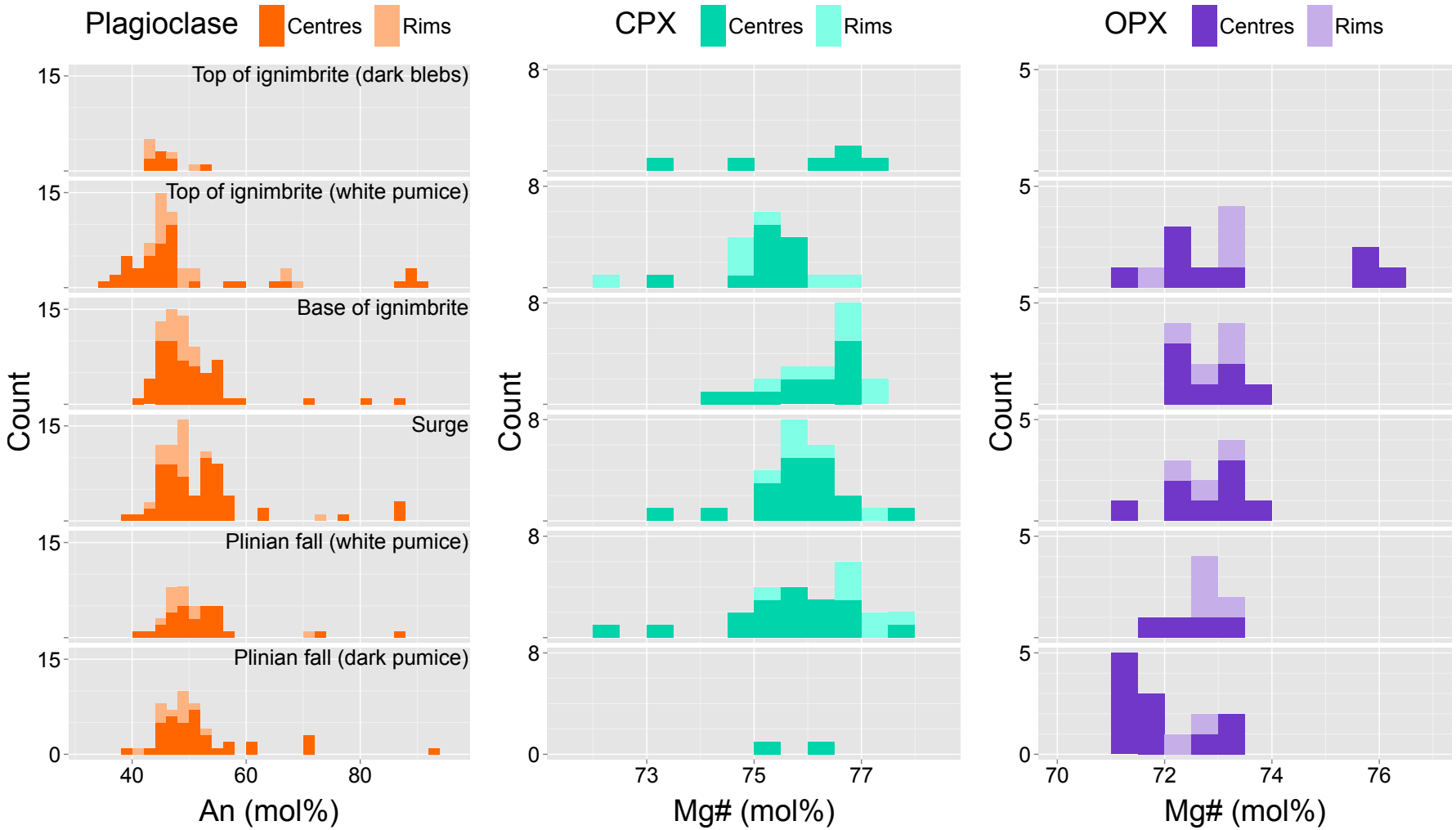
The 1400 BP magma appears homogeneous

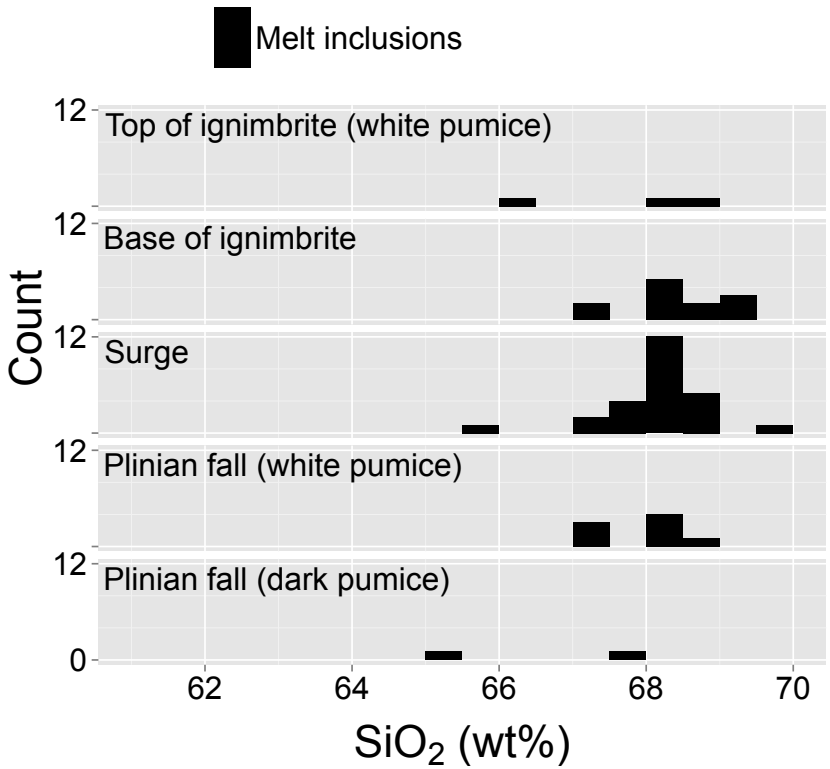
There are dark, less-evolved blebs at top of the ignimbrite
A recharge magma injected into base of chamber shortly before eruption?

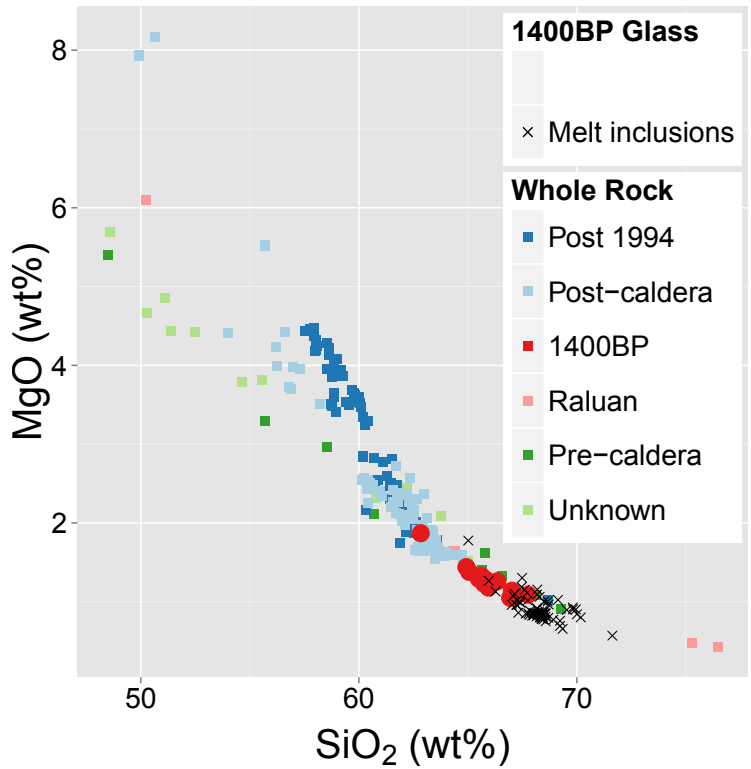


No sign of recharge in mineral chemistry



Only one population of melt inclusions...





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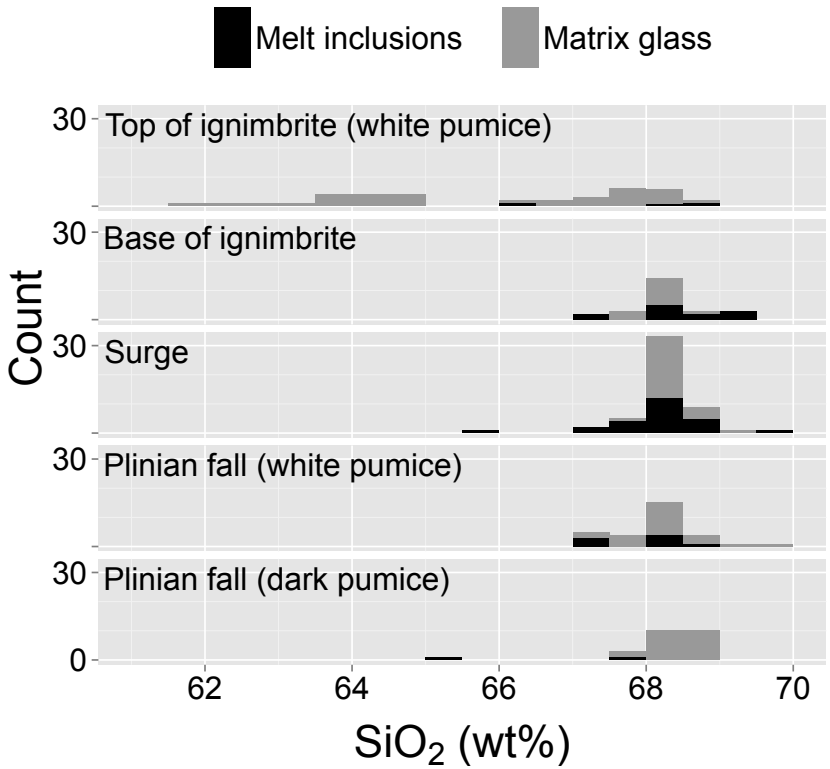
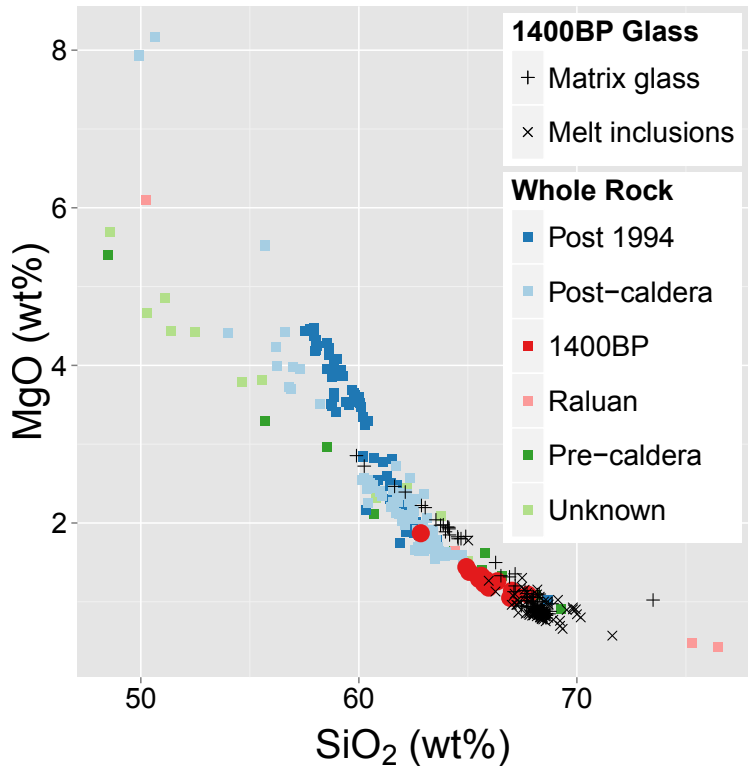
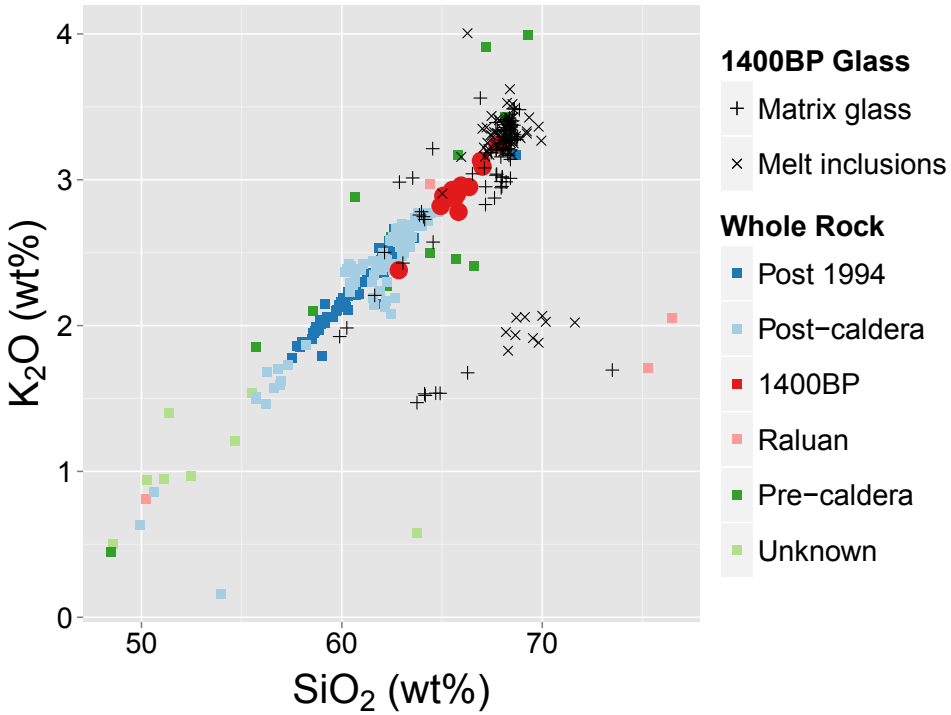




...but matrix glass from the top of the ignimbrite shows greater spread—mixing

Interaction with remnant Raluan magma?



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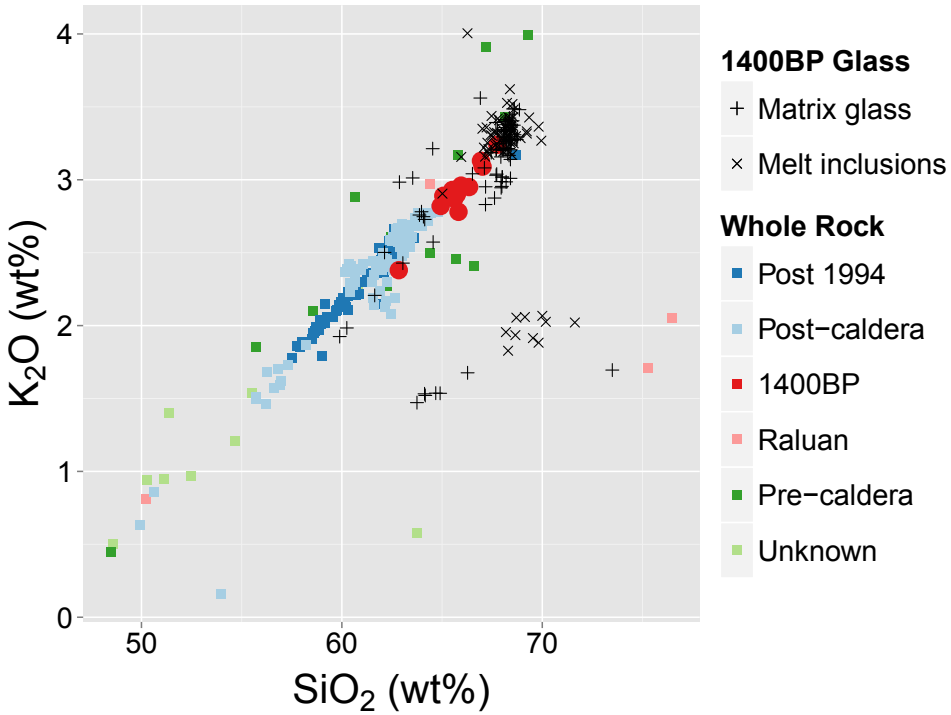
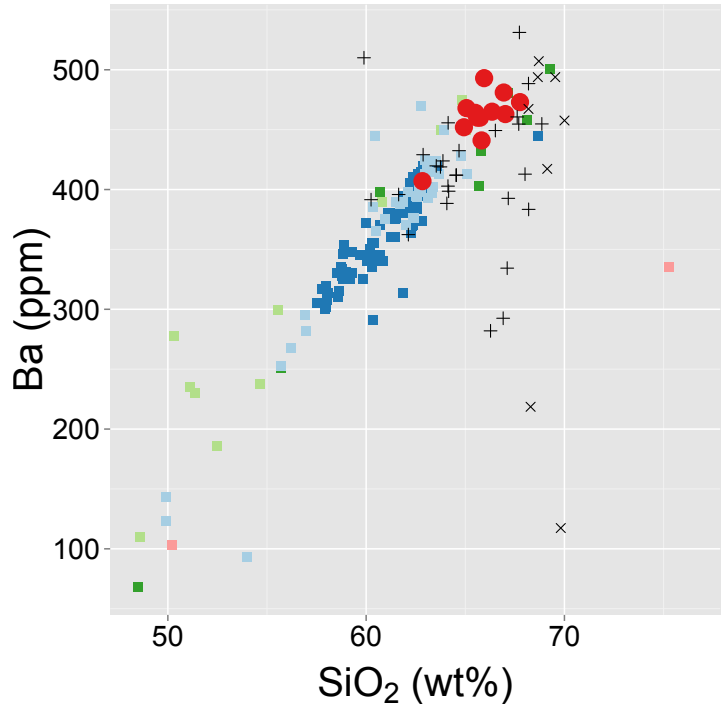
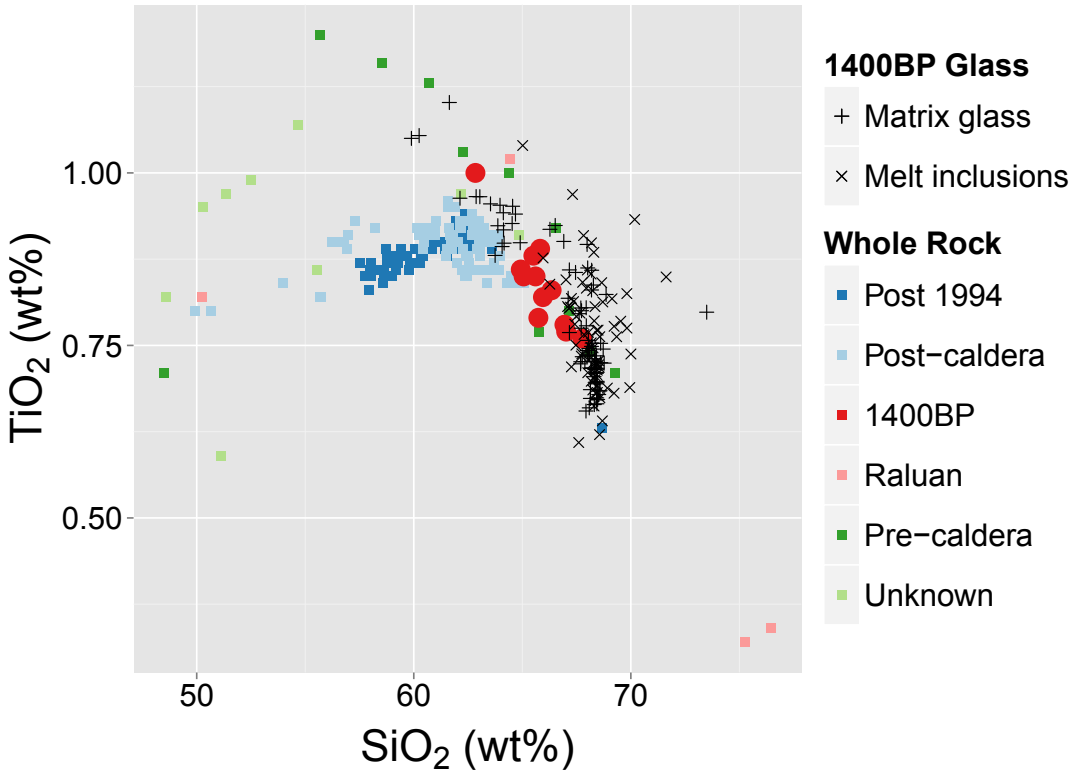




No! Matrix glasses have high incompatible trace element concentrations (Ba, Zr, Hf, Rb, La)

Composition of the recharge magma for the 1400 BP and post-caldera magmas



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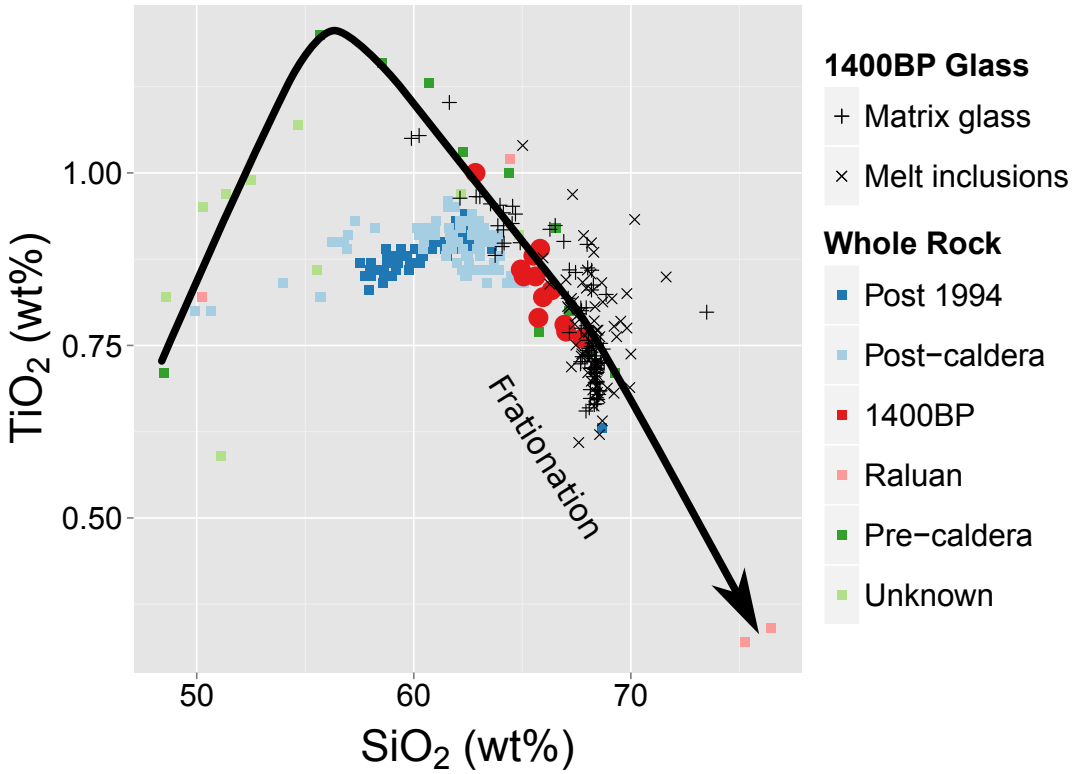

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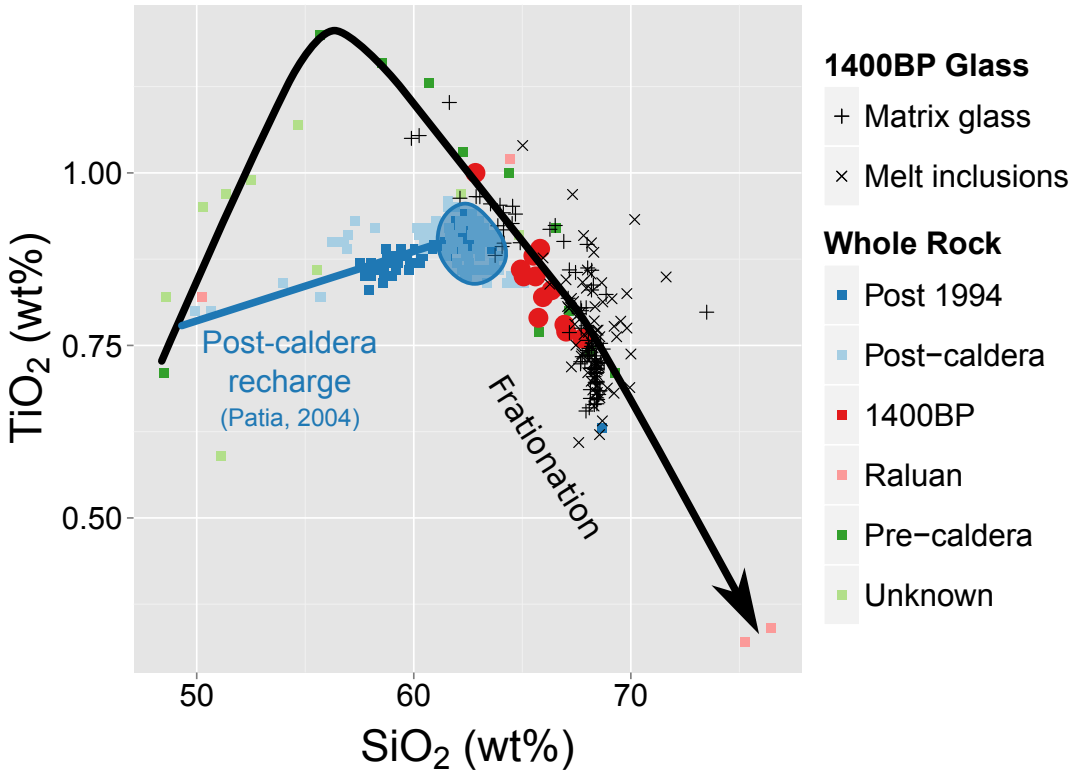
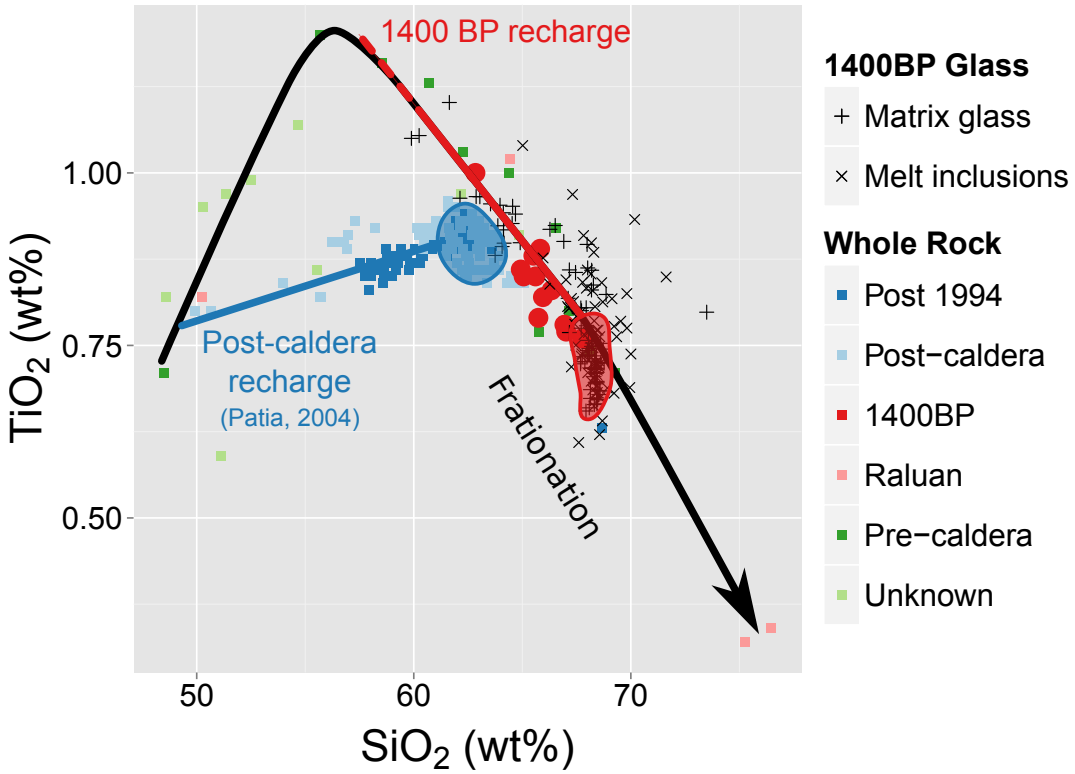


Post-caldera recharge: $\sim$50 wt% SiO_2

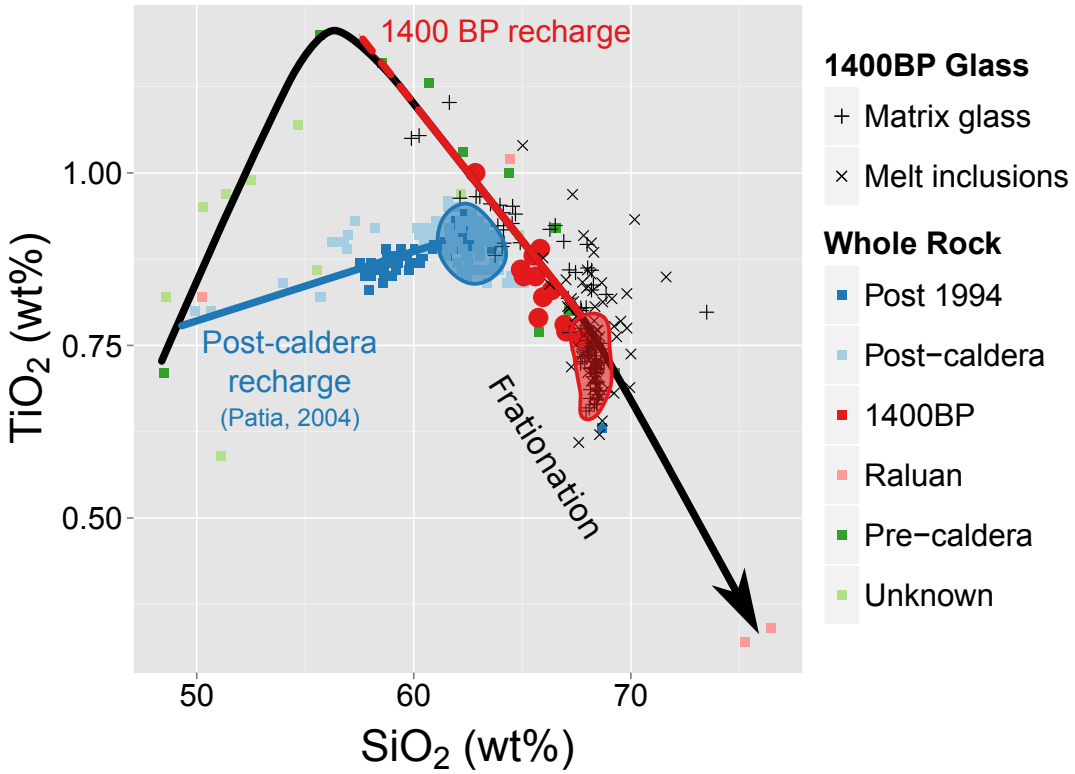
Composition of the recharge magma for the 1400 BP and post-caldera magmas



Post-caldera recharge: $\sim$50 wt% SiO_2

1400 BP recharge: $\sim$57–60 wt% SiO_2

Composition of the recharge magma for the 1400 BP and post-caldera magmas



Post-caldera recharge: ∼50 wt% SiO_2

1400 BP recharge: ∼57–60 wt% SiO_2

Possible interpretations:

1. More evolved recharge causes a more evolved reservoir to form
2. The presence of a more evolved reservoir prevents basaltic recharge from entering the shallow system

Conclusions

1. The 1400 BP eruption did not remobilise Raluan magma
2. The 1400 BP magma chamber was recharged with a more evolved magma to that which is currently being input into the plumbing system
3. This implies the plumbing system changed after the 1400 BP eruption

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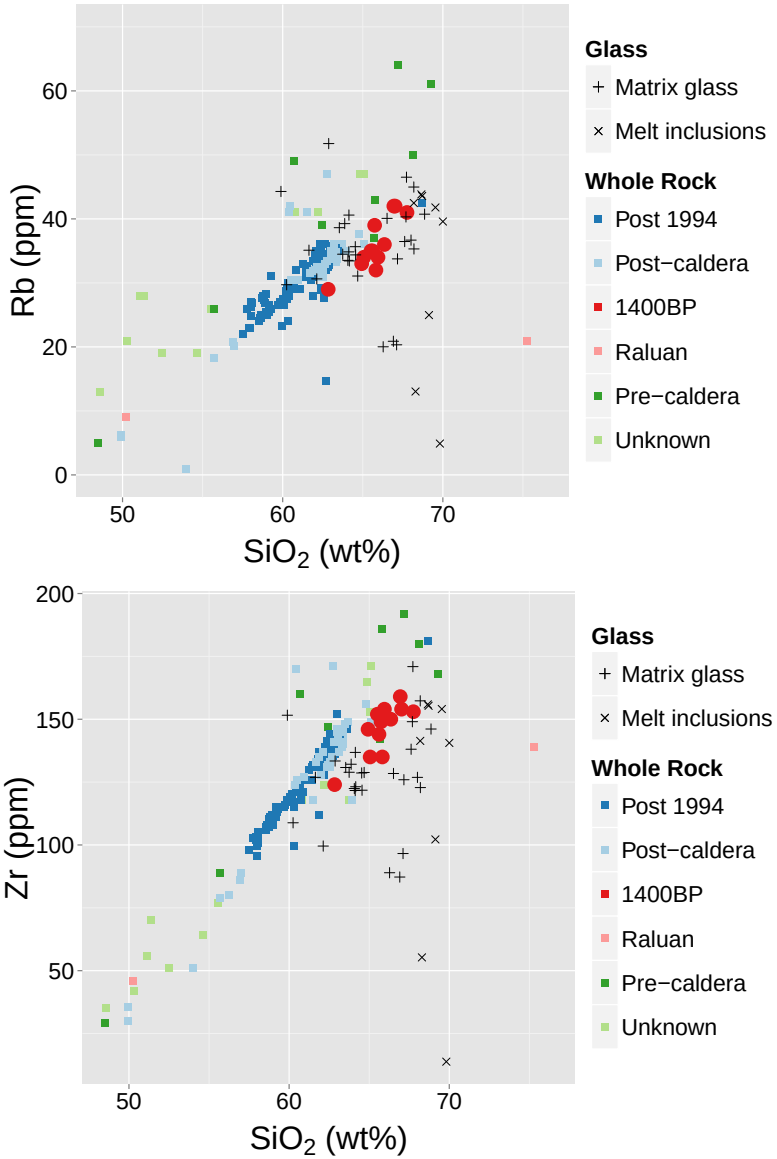
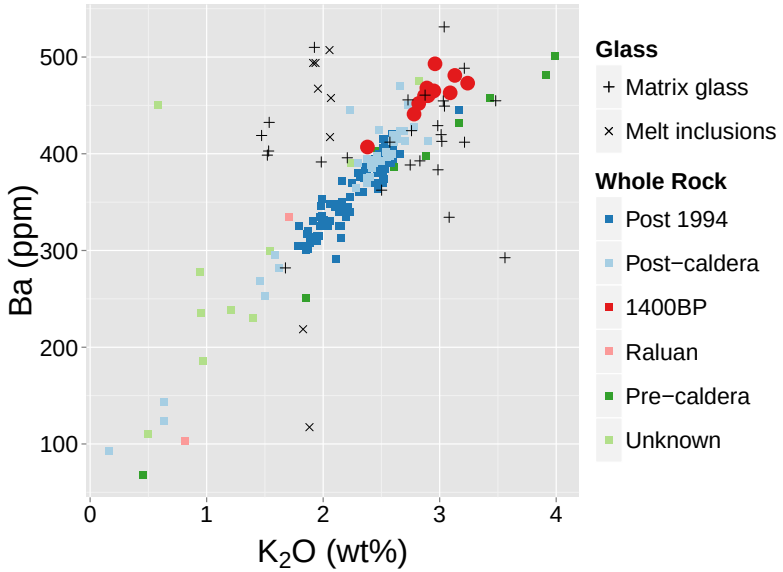
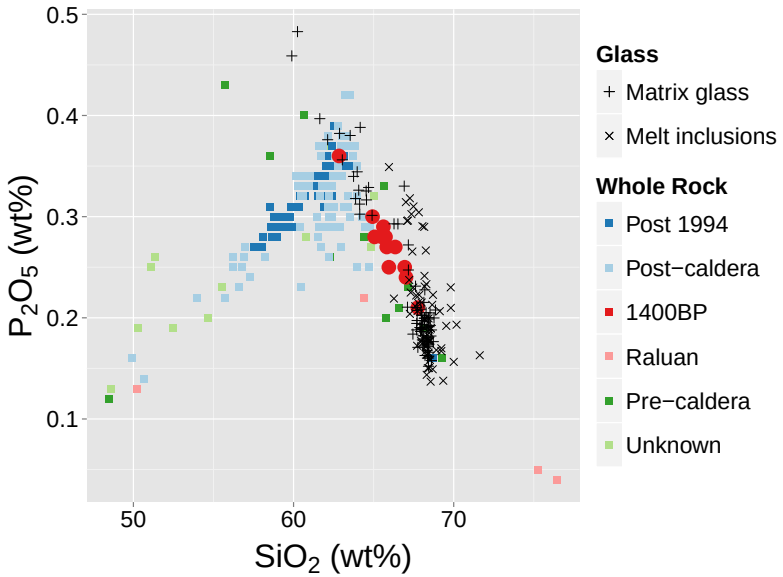
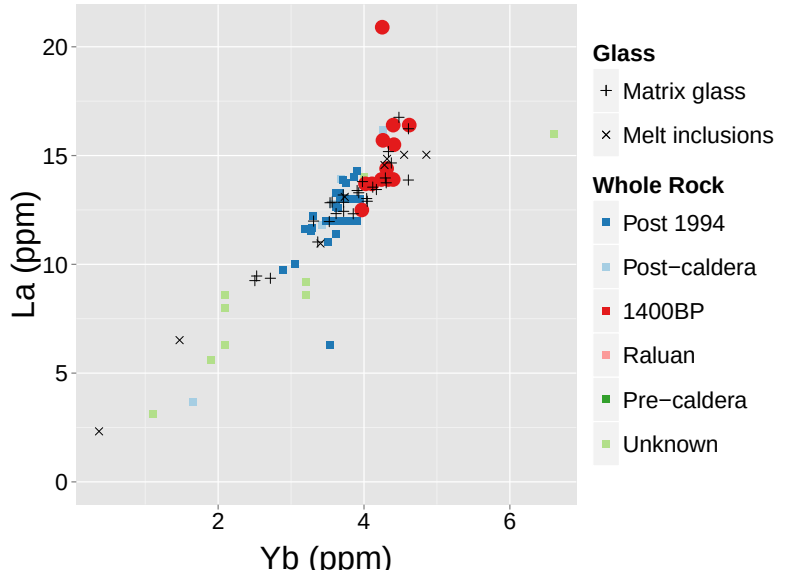
Thank you!

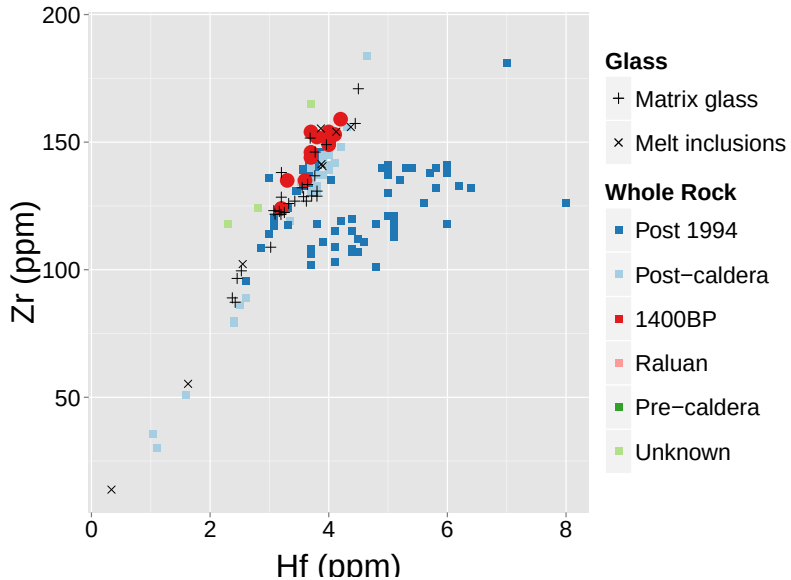
Questions? Email: gfabbro@ntu.edu.sg


Rb (ppm)
60
40
20
0
50
60
70
SiO2 (wt%)
Glass
Matrix glass
Melt inclusions
Whole Rock
Post 1994
Post−caldera
1400BP
Raluan
Pre−caldera
Unknown
Zr (ppm)
200
150
100
50
50
60
70
SiO2 (wt%)
Glass
Matrix glass
Melt inclusions
Whole Rock
Post 1994
Post−caldera
1400BP
Raluan
Pre−caldera
Unknown


Ba (ppm)
500
400
300
200
100
0
1
2
3
4
K2O (wt%)
Glass
Matrix glass
Melt inclusions
Whole Rock
Post 1994
Post−caldera
1400BP
Raluan
Pre−caldera
Unknown


P2O5 (wt%)
0.5
0.4
0.3
0.2
0.1
50
60
70
SiO2 (wt%)
Glass
Matrix glass
Melt inclusions
Whole Rock
Post 1994
Post−caldera
1400BP
Raluan
Pre−caldera
Unknown


La (ppm)
Yb (ppm)
0
5
10
15
20
2
4
6
Glass
Matrix glass
Melt inclusions
Whole Rock
Post 1994
Post−caldera
1400BP
Raluan
Pre−caldera
Unknown


Zr (ppm)
Hf (ppm)
50
100
150
200
0
2
4
6
8
Glass
Matrix glass
Melt inclusions
Whole Rock
Post 1994
Post−caldera
1400BP
Raluan
Pre−caldera
Unknown