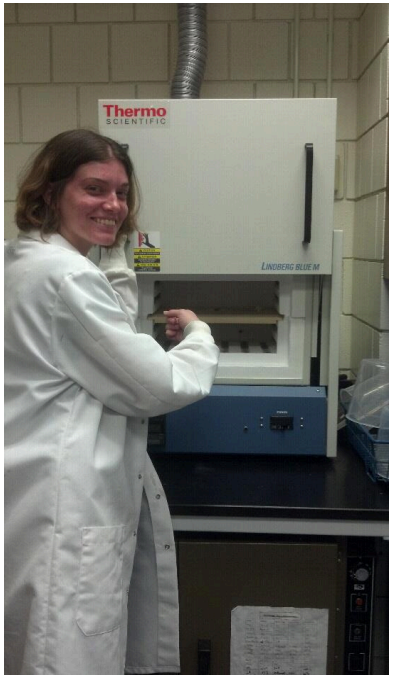
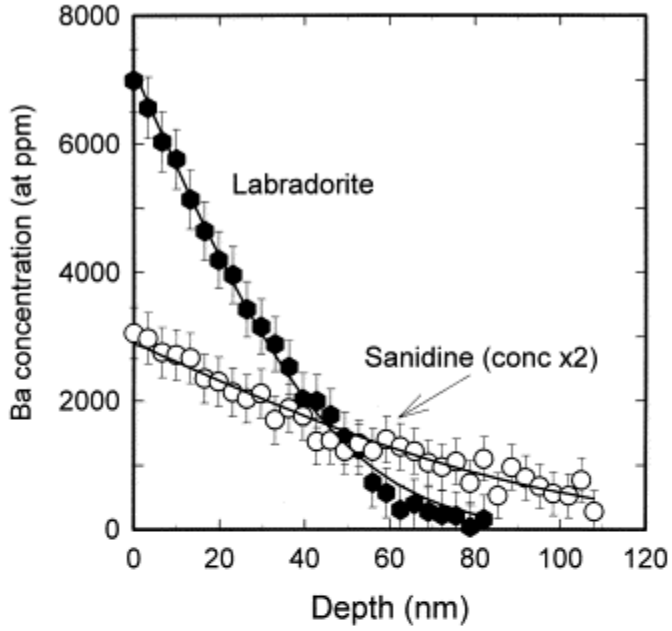
Diffusion of Barium in Feldspar

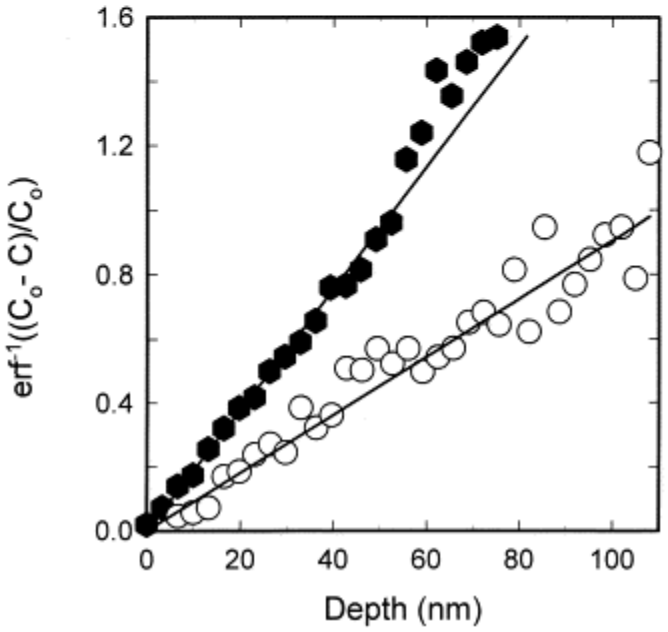
Sara Evanoff and Kilynn Sandberg
Petrology
NDSU Geology 422
May 3, 2012



Previous Work

- D.J. Cherniak (2010)
  - Observing Barium, Strontium, and Lead Isotopes
  - Sources of diffusing were BaO, SiO2, and Al2O3 mixed with grounded feldspar
  - Melted samples in a 1 atm furnace
  - Fick's second law
  - Erf^{-1} $((C_o-C_{(x,t)})/C_o)$
  - $(4Dt)^{-1/2}$

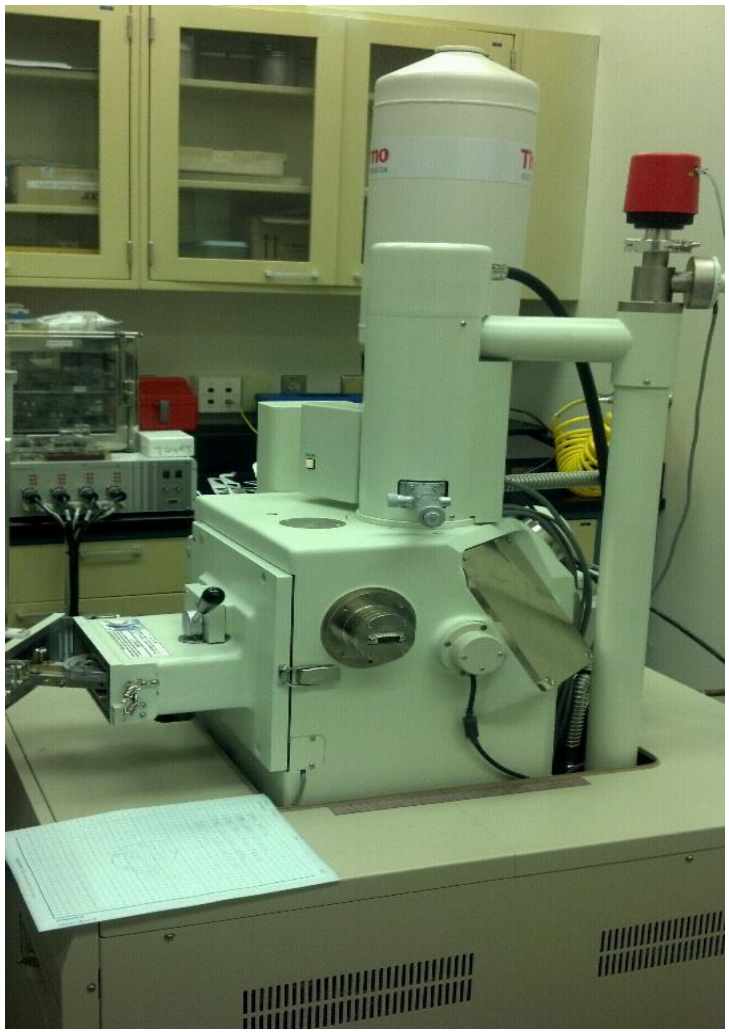




Hypothesis

During the melting and recrystallization process the Barium will migrate into the feldspar

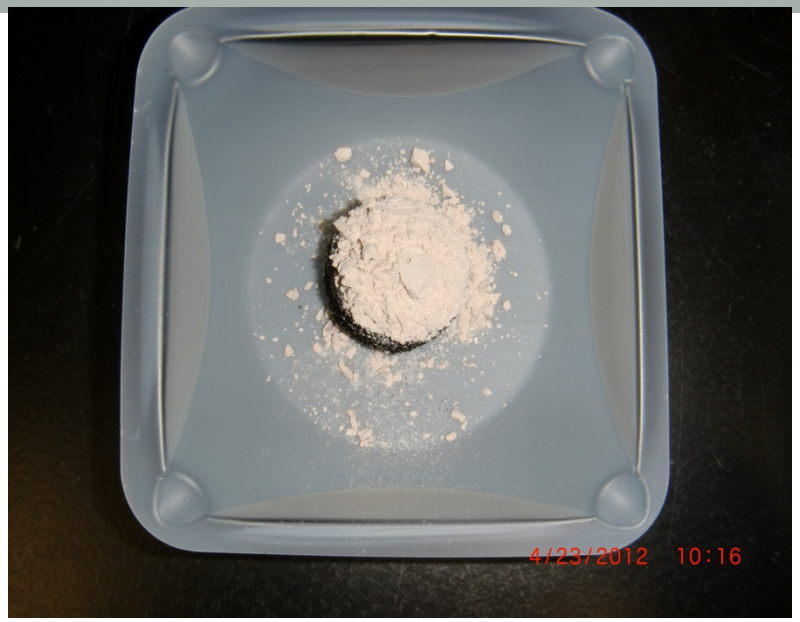
Equipment



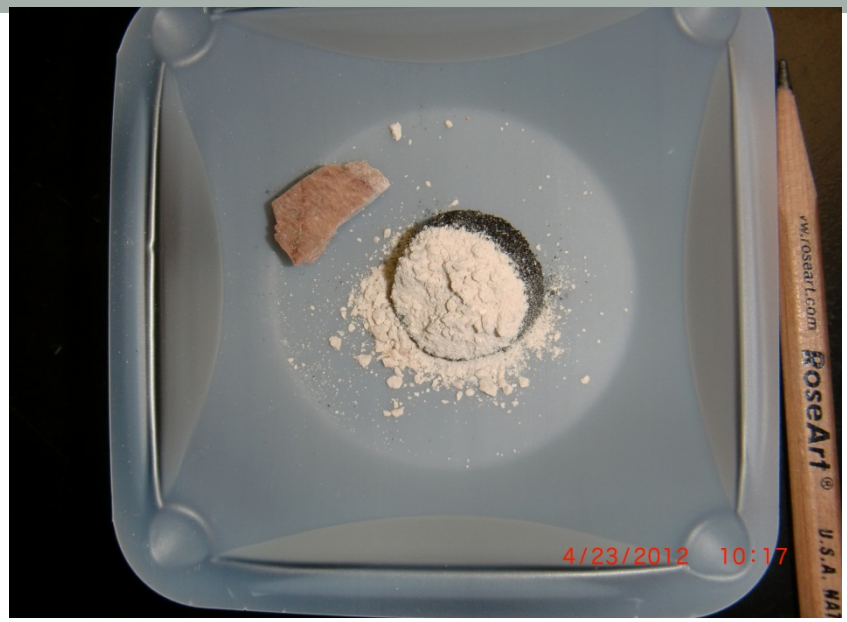
Trial 1

- Temperature: 770 degrees Celsius
- Time length: 7 hours

Crucible	Rhyolite (g)	Feldspar (g)	Barium hydroxide (g)
1	5.00	0.00	0.00
2	5.00	2.36	0.00
3	5.00	0.77 and 0.78	1.00



Rhyolite



Rhyolite and Feldspar

Feldspar, Barium, and Rhyolite

Trial 2

- Temperature: 850 degrees Celsius
- Time Length: 20 hours

Crucible	Rhyolite (g)	Feldspar (g)	Barium Hydroxide (g)
1	5.00	0.00	0.00
2	5.00	2.56	0.00
3	5.00	0.77 and 0.78	1.00

Trial 3

- Temperature: 850 degrees Celsius
- Time Length: 7 hours

Crucible	Rhyolite (g)	Flux (g)
1	4.00	1.00


CENTIMETRE
Institute on Lake Superior Geology
www.lakesuperiorgeology.org
INCH

Trial 4

- Temperature: 650 degrees Celsius
- Time Length: 2 hours

Crucible	Rhyolite (g)	Flux (g)	Feldspar (g)	Barium Hydroxide (g)
1	4.00	1.00	0.00	1.00
2	4.00	1.00	2.54	1.00

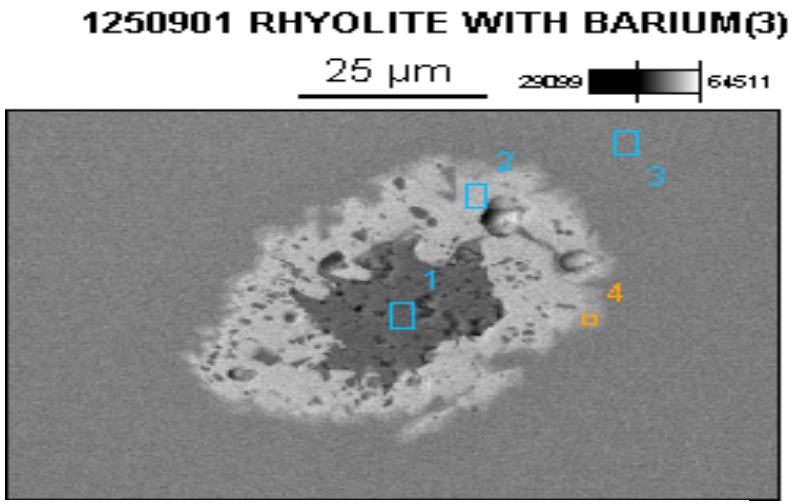
Trial 5

- Temperature: 850 degrees Celsius
- Time Length: 2 hours

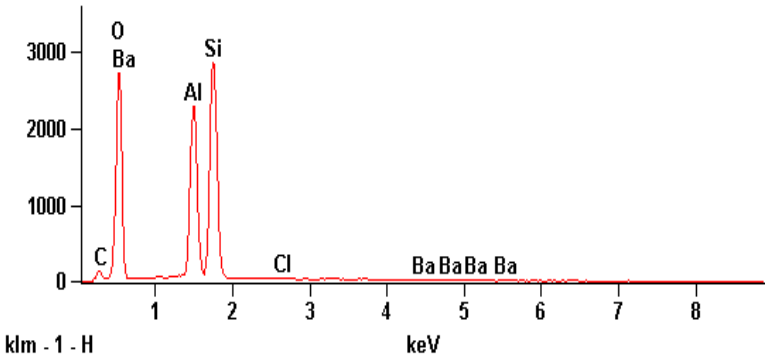
Crucible	Rhyolite (g)	Flux (g)	Feldspar (g)	Barium Hydroxide (g)
1	4.00	1.00	0.00	1.00
2	4.00	1.00	2.54	1.00

Rhyolite and Barium

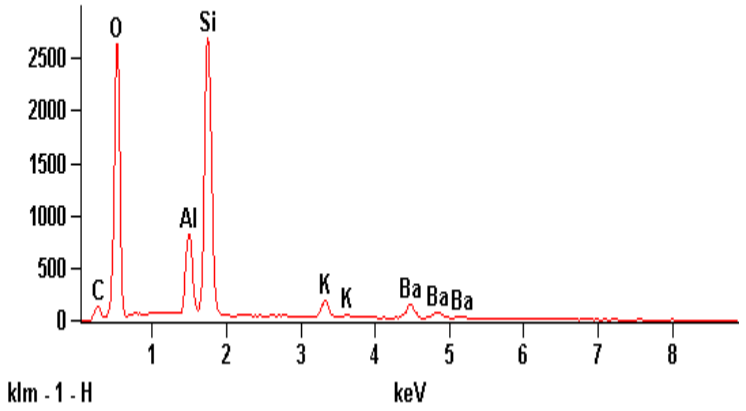
Rhyolite, Feldspar, and Barium



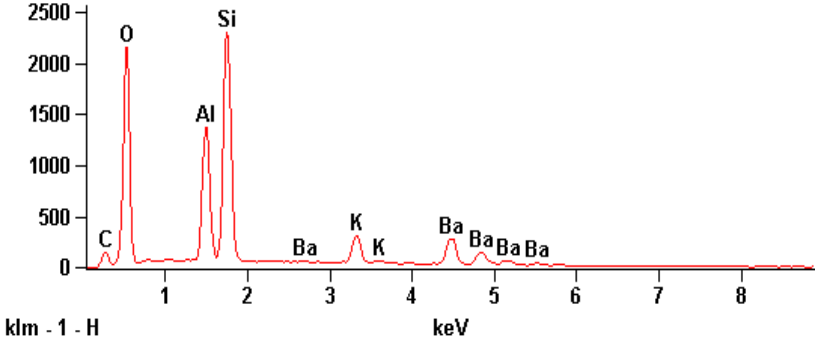
1250901 RHYOLITE WITH BARIUM(3)_pt1



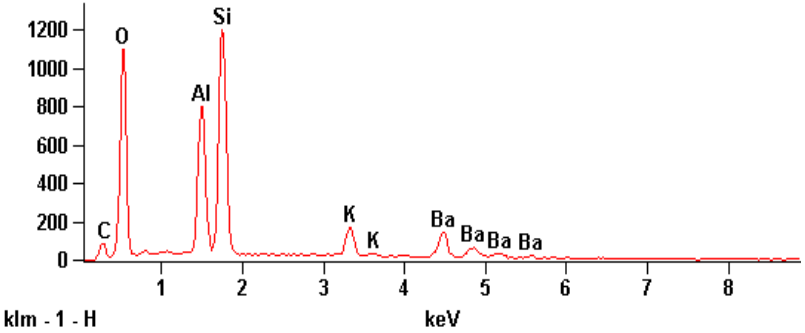
1250901 RHYOLITE WITH BARIUM(3)_pt3



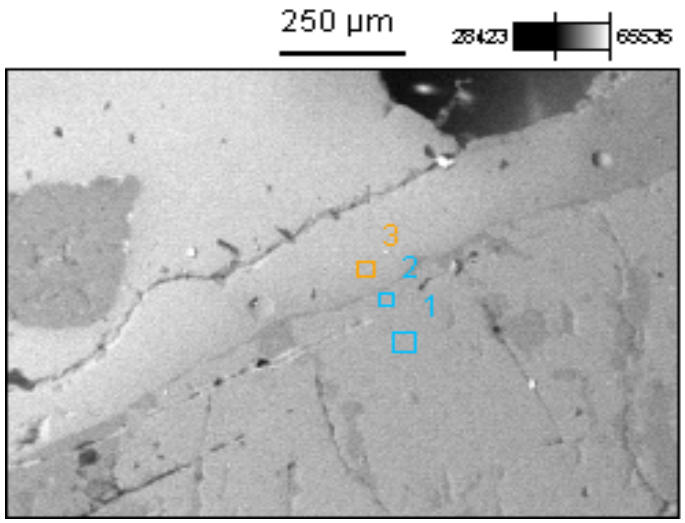
1250901 RHYOLITE WITH BARIUM(3)_pt2



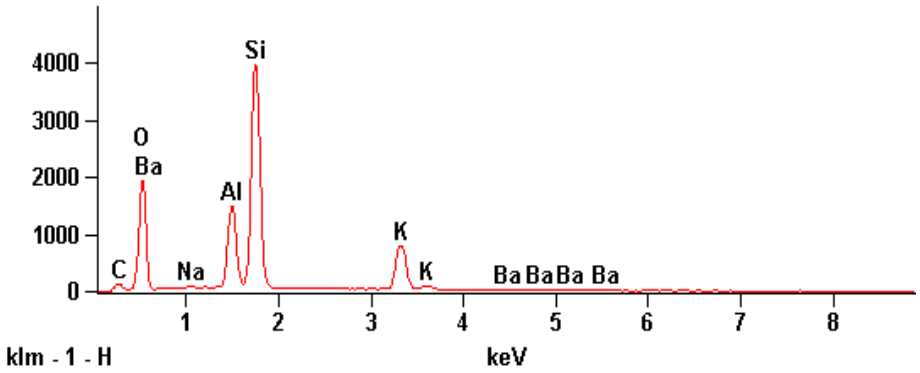
1250901 RHYOLITE WITH BARIUM(3)_pt4



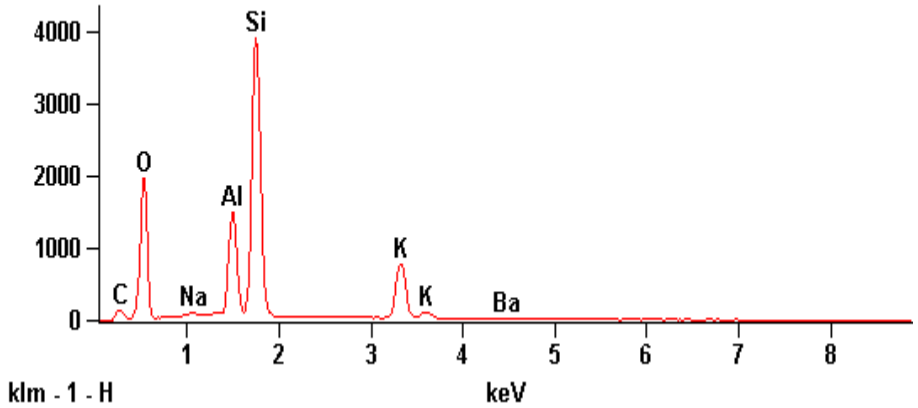
125092 RHYOLITE BARIUM FELDSPAR(1)



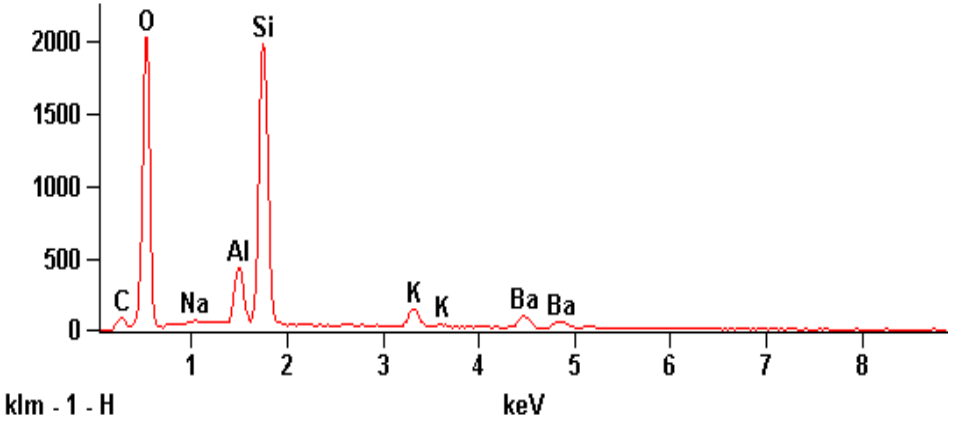
125092 RHYOLITE BARIUM FELDSPAR(1)_pt1



125092 RHYOLITE BARIUM FELDSPAR(1)_pt2

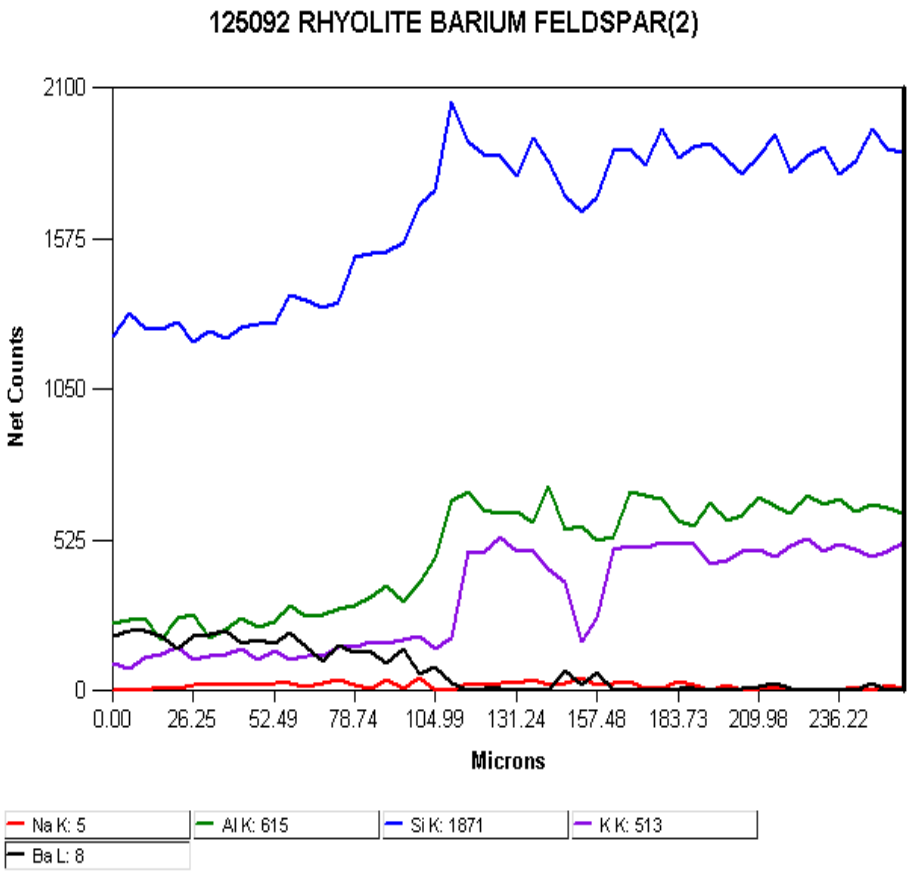


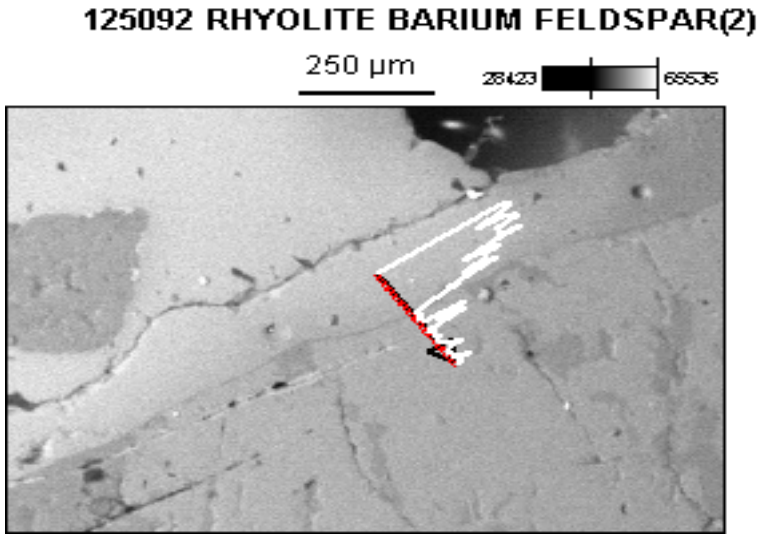
125092 RHYOLITE BARIUM FELDSPAR(1)_pt3



Line Point Scan

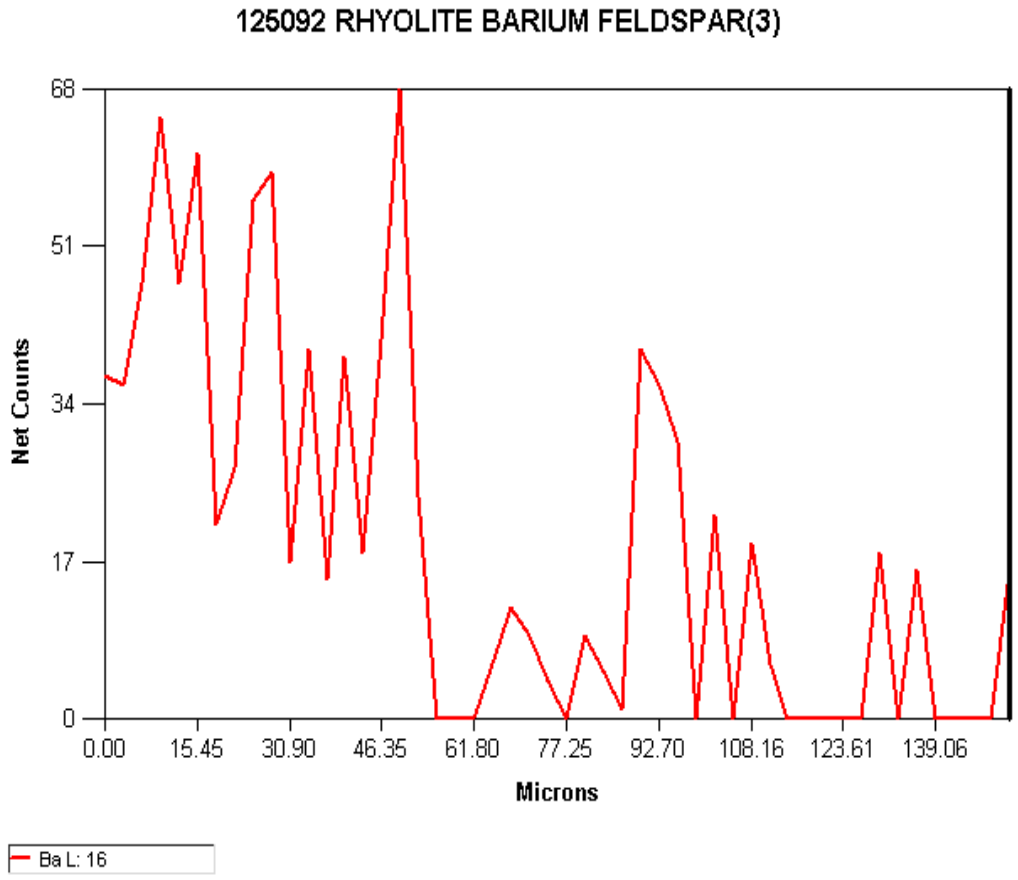
- Is a series of 50 points along a line that is specifically placed. The SEM then scans each of the 50 points for various elements.

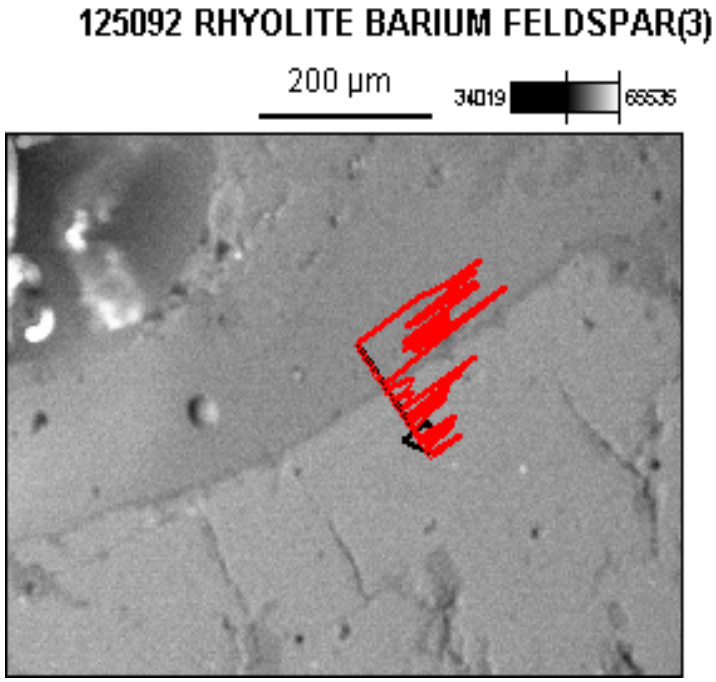




Accelerating Voltage: 15.0 kV

Magnification: 170





Accelerating Voltage: 15.0 kV

Magnification: 100

Results

- There was a Barium in the rhyolite crystals and the glass
- There was some Ba diffusion within the Feldspar phenocryst about 30.9 microns
- Diffusion Coefficient
  - $K_D = C_s/C_L = 1.91/25.77 = 0.074$ wt% (Winter, 2010 figure 9.3)

Conclusion

- The best possible way to melt the rhyolite is at 850 degrees Celsius for 2 hours with the addition of flux, using a graphite crucible
- The barium is greater in the rhyolite crystals than in the glass
- During the melting and recrystallization process the Barium will migrate into the feldspar, given more time the diffusion might be more

References

- Cherniak D.J. (2010) Cation Diffusion in Feldspar. *Diffusion in Minerals and Melts.* Vol 72. pp 699-700
- Cherniak D.J. (2002) Ba Diffusion in Feldspar *Geochimica Acta*. Vol 66, No. 9, pp 1641-1650
- Winter John D. (2010) *Principles of Igneous and Metamorphic Petrology*. Second Edition. pp 383, 659-660
- Zhang Y. (2010) Diffusion in Minerals and Melts: Theoretical Background. *Diffusion in Minerals and Melts.* Vol 72. pp 2-14,16, 43-46

Thank you!

Water Ecology Lab and Dr. Eidukat