

Chemical Analysis of the Igneous Intrusion at Bridal Veil Falls

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NDSU Petrology Geology 422

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Igneous Intrusion at Bridal Veil Falls

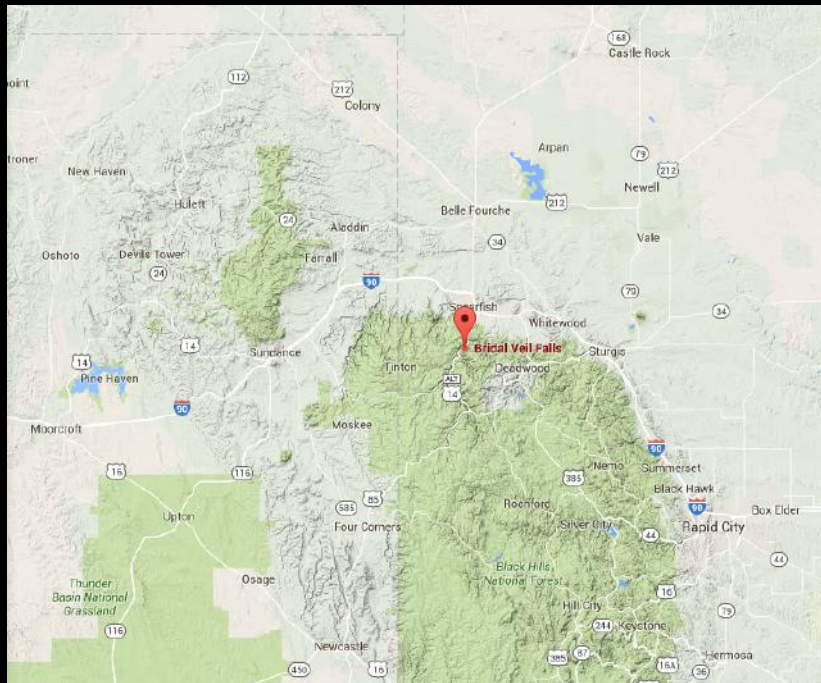


Photograph by Brady Folkestad



https://www.google.com/maps/@44.4176226,-103.8810965,3a,64.4y,296.18h,92.91t/data=!3m6!1e1!3m4!1s1DjK_v6kbDiTbAog_0tLw!2e0!7i133!2!8i6656!6m1!1e1

Locality



- Located in western South Dakota almost on the South Dakota and Wyoming border
- In the Spearfish Canyon
- Northwest of Deadwood and South of Spearfish, SD
- Coordinates $44^{\circ}25'3.33''\text{N}$
 $103^{\circ}52'51.63''\text{W}$

<https://www.google.com/maps/place/Bridal+Veil+Falls/@44.4761905,-104.2193391,9.5z/data=!4m1!1m4!3m3!1s0x5332bd1e0e8caf5:0xcdac2afa7d49a5f8!2sBridal+Veil+Falls!3b1!3m1!1s0x5332bd1e0e8caf5:0xcdac2afa7d49a5f8!5m1!1e4>

Background of Sedimentary Rocks at Bridal Veil Falls, SD

- Late Cambrian to Early Ordovician (497 to 480 Ma)
- Rests upon an unconformity of Precambrian metamorphic rock
- Consists mainly of conglomerate and sandstones
- Deposited by an ancient sea

Background of the Igneous Intrusion at Bridal Veil Falls, SD

- Occurred ~40 to ~60 Ma (K-Ar dating method)
- Underlies the Deadwood formation
- Some describe the rock as a phonolite porphyry, some describe it as a nepheline syenite
- There are many other intrusions similar

(Basset, 1961)



<https://sites.google.com/site/geologyofpearfishcanyon/bridal-veil-falls>

Guiding Question/Goal

- Create XRF and SEM data to support or rebuttal previous ideas.
- What should the rock be identified as?

Hand Sample

- Fine-grained, gray-green and white mottled with a phaneritic texture
- Some biotite present
- Collected at a road cut on the opposite side of the falls



Photograph by Brady Folkestad

Methods: XRF (X-Ray Fluorescence)

Preparations

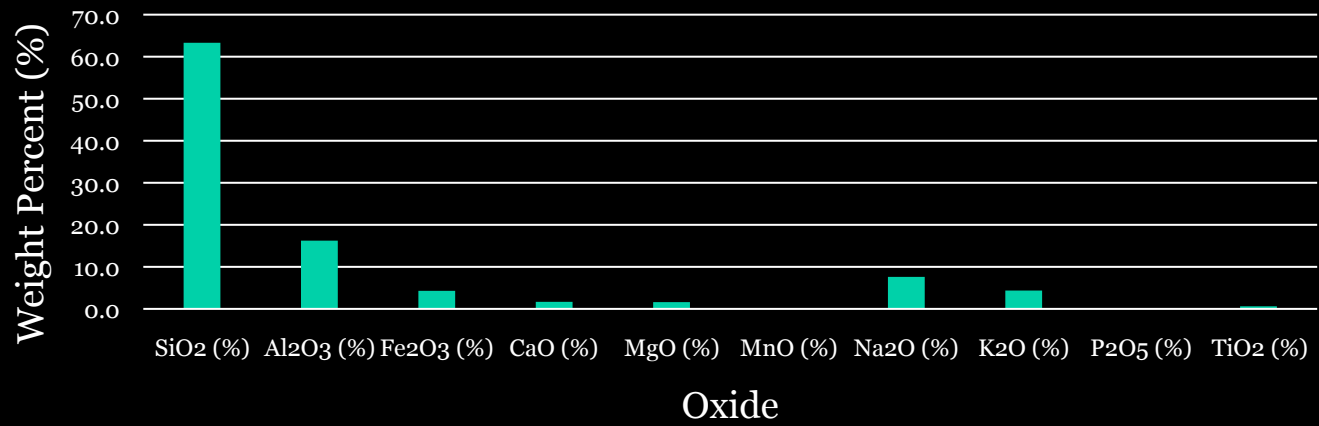
- Crushed sample
- Added 10mL of vertel to 30 grams of the crushed sample, then powdered the sample (using a TM Swing Mill)
- Used polyvinyl in alcohol solution to cement the powder
- Pressed powder into disk at 15 tonnes for 1.5 minutes
- Ran Sample through XRF machine



Photograph by Brady Folkestad

XRF Results

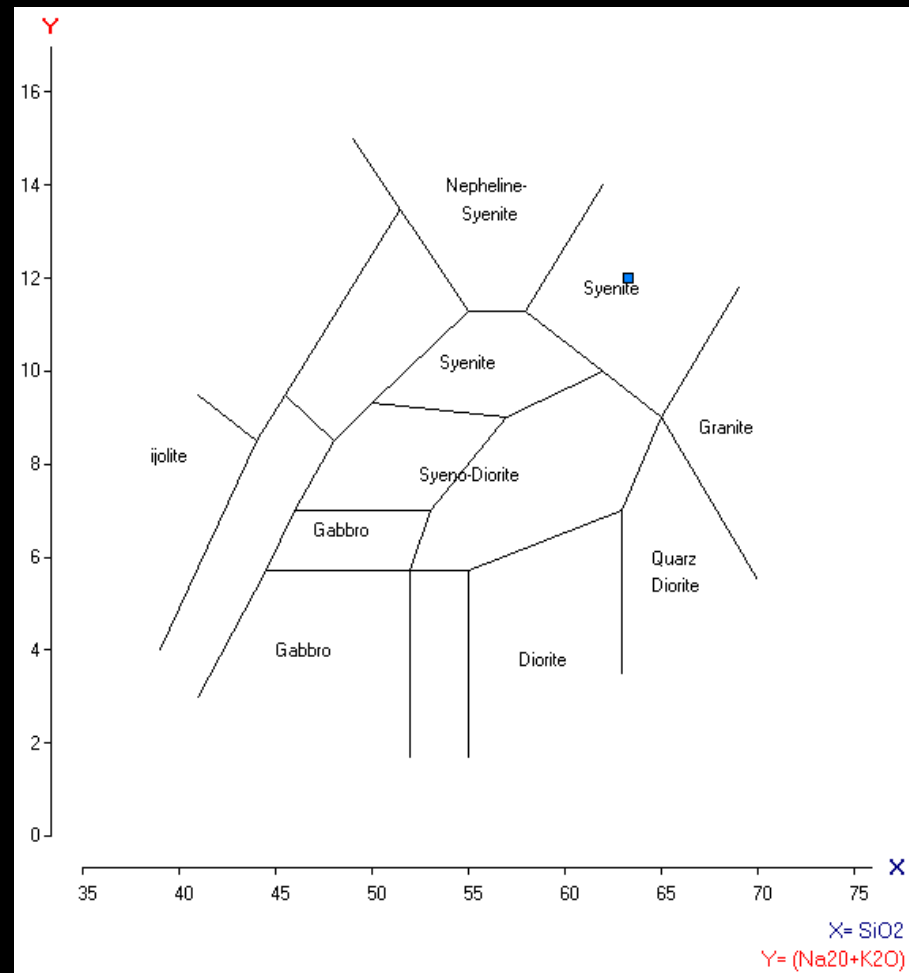
Weight Percent of Oxides



SiO2 (%)	Al2O3 (%)	Fe2O3 (%)	CaO (%)	MgO (%)	MnO (%)	Na2O (%)	K2O (%)	P2O5 (%)	TiO2 (%)
63.3	16.2	4.3	1.7	1.6	0.1	7.6	4.4	0.2	0.6

XRF Results

- TAS diagram plotted using PetroGraph
- Cox-Bell-Pank methods



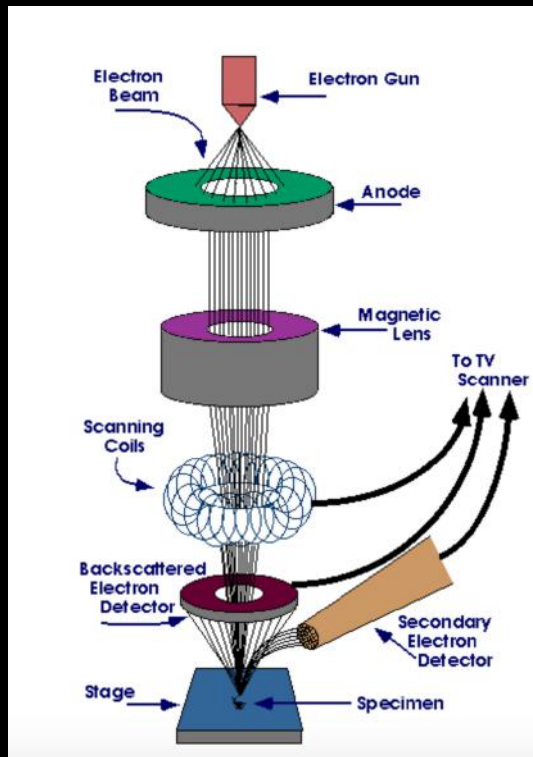
Thin Section for SEM

- Sample was already prepared for SEM



Photograph by Brady Folkestad

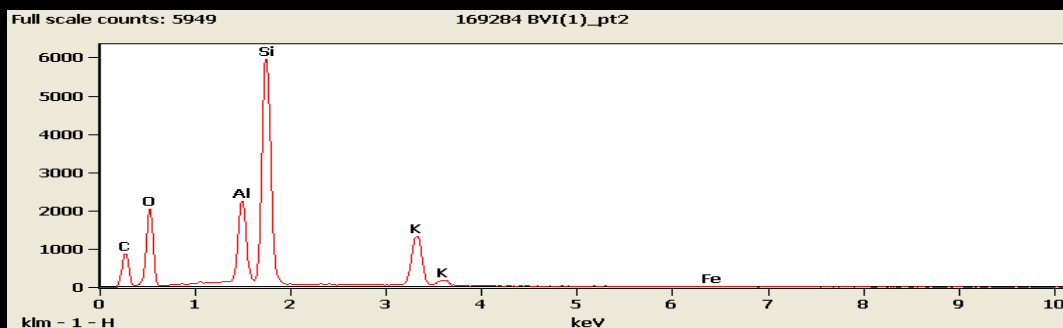
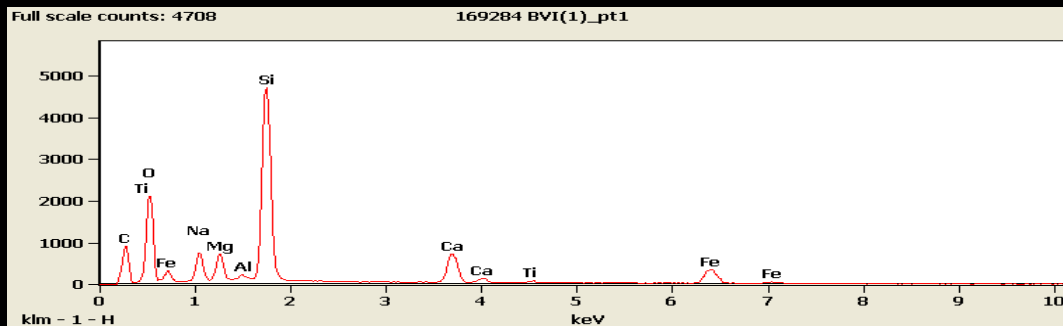
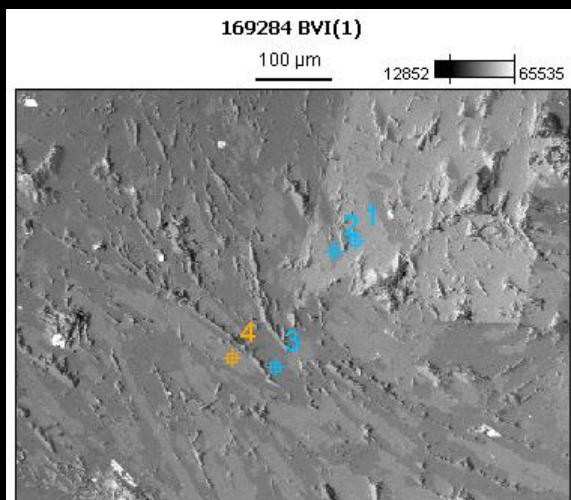
Methods: SEM (Scanning Electron Microscope)



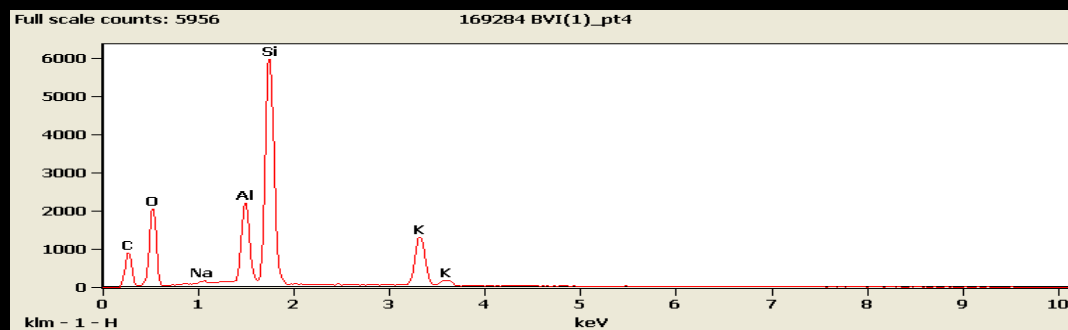
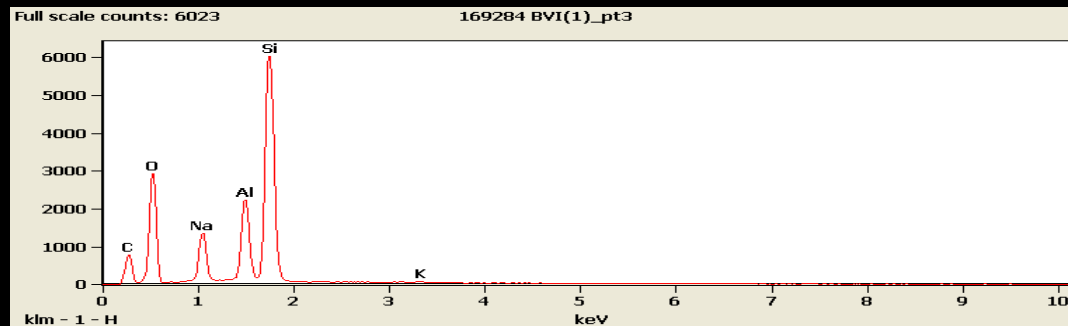
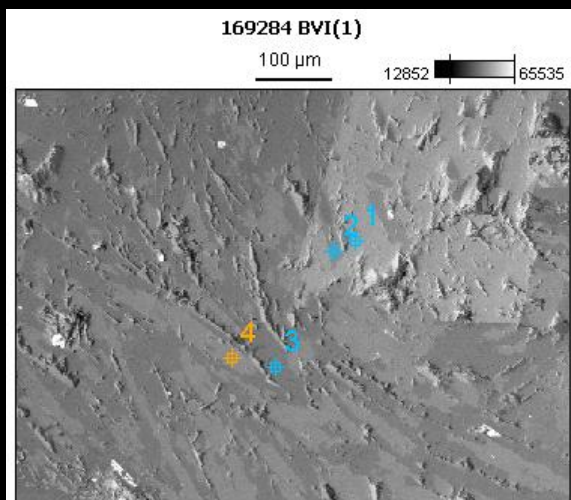
https://www.ndsu.edu/em_lab/instrumentation/jeojsm_6490lv/

<http://1.bp.blogspot.com/-kjXMtQPfKtw/VWMRyjOEPCI/AAAAAAAAADrk/2PoxQ2plZQY/s1600/Screen%2BShot%2B2015-05-25%25%2Bat%2B8.12.12%2Bpm.png>

SEM Results



SEM Results



SEM Mineral Identification

		Na ₂ O	MgO	Al ₂ O ₃	SiO ₂	K ₂ O	CaO	TiO ₂	Fe ₂ O ₃
169284 BVI (1)_pt1	---	7.61	5.19	0.70	51.87		11.59	1.52	21.52
169284 BVI (1)_pt2	---			18.10	64.53	16.63			0.74
169284 BVI (1)_pt3	---	13.31		18.65	67.83	0.21			
169284 BVI (1)_pt4	---	0.68		17.86	65.64	15.83			

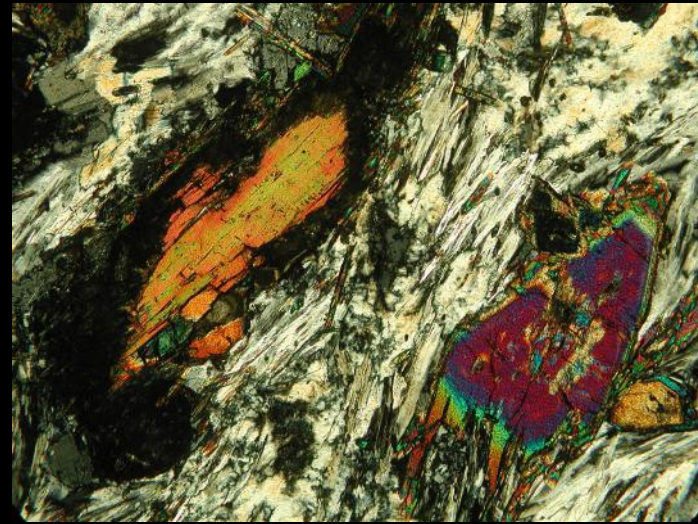
- BVI-1
 - Aegirine-augite (Na,Ca)(Fe³⁺,Fe²⁺,Mg,Al)Si₂O₆
- BVI-2
 - Orthoclase KAlSi₃O₈
- BVI-3
 - Albite NaAlSi₃O₈
- BVI-4
 - Orthoclase KAlSi₃O₈

Thin Section



Photograph by Brady Folkestad

FOV 2mm
10X zoom



Alkali feldspar laths, hornblende
(surrounded by Aegirine-augite), Aegirine-
augite

Conclusion

- The minerals identified fit into an alkali rich system
- The rock seems to be a syenite
 - Could be due to deuteritic reaction
- More samples need to be taken from different areas of the intrusion.
- More XRF and SEM data collection for comparison

Acknowledgments

I'd like to thank Dr. Saini-Eidukat for all of his help with the project, as well as the folks that helped me operate the SEM machine.

References

- Basset, W.A., 1961, Potassium-argon age of Devil's Tower, Wyoming, *Science*, v. 134, p. 1373
- Kirchner, J.G., 1971, The Petrography and Petrology of the phonolite Porphyry Intrusions of the Northern Black Hills, South Dakota, p. 87-172