# Comparison of Chalky Buttes Porphyry and Porphyry Near Forsyth

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# Outline

- Introduction

  -Chalky Buttes Member

  -Forsyth Cobble
- Backround
  - Prior research
- Methods

  -XRF, SEM, Microscopy
- Results
- Conclusion

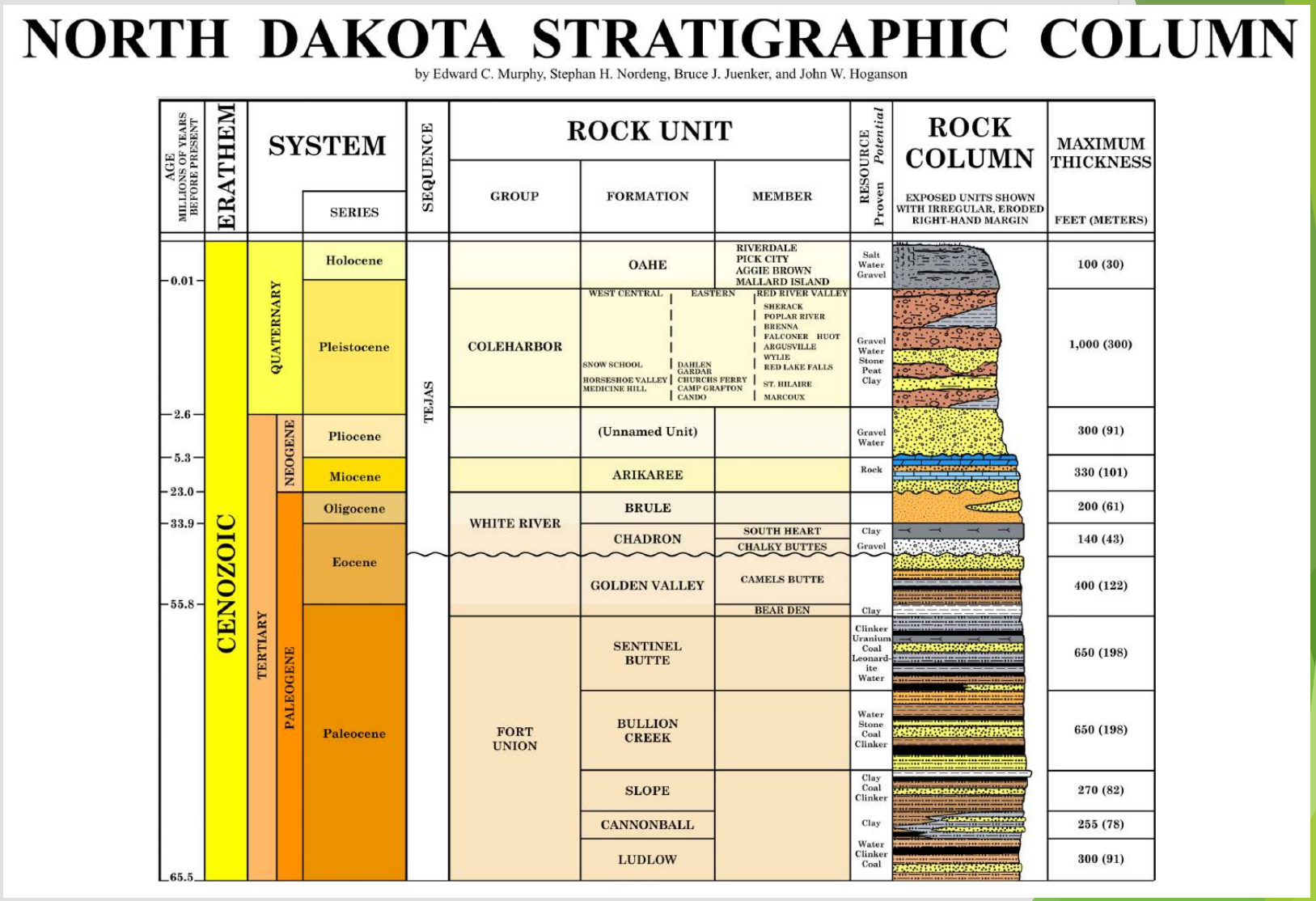
# Introduction


From: google maps

# Introduction to Chalky Buttes Fm.

- Part of the Chadron Formation
- In the White River Group
- Late Eocene in Age
- Consists of many cobbles including quartzite, sandstone, mudstones, petrified wood, and volcanic porphyry
- Cobbles were deposited by fluvial forces

# Introduction to Chalky Buttes Formation



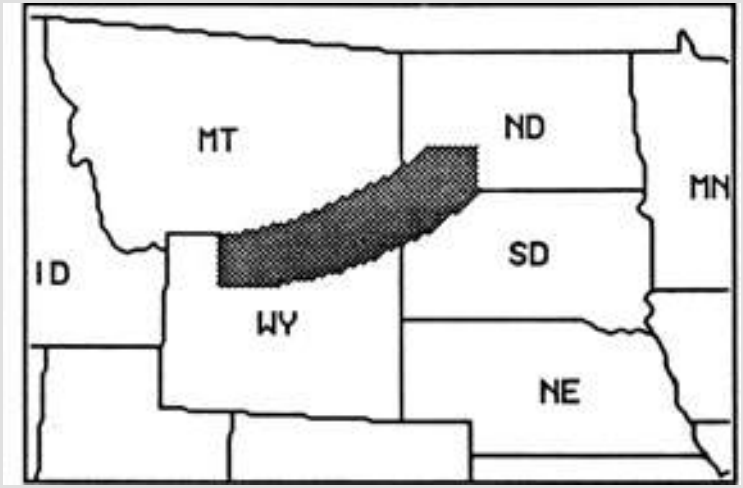

From: nd.gov

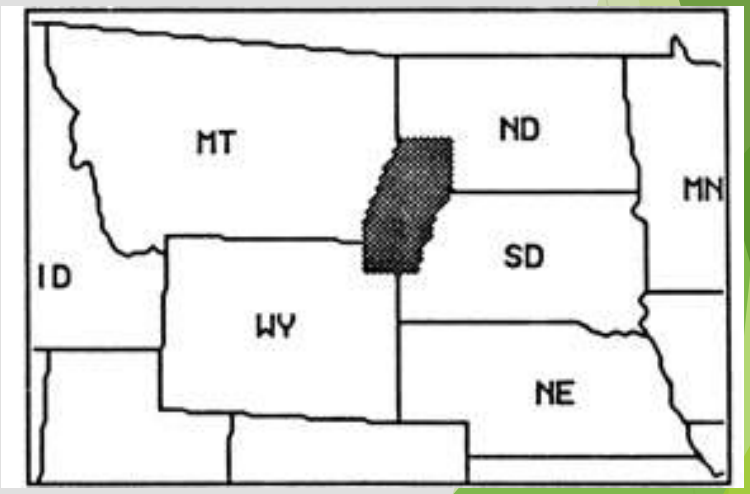
# Introduction to the Forsyth Cobble

- Found in the Yellowstone River by NDSU Alumnus Levi Moxness
- Have been labeled as Flaxville Cobbles, although they are not in the Flaxville Formation, located in Northeastern Montana (Leckie, D. 2006).
- Source of the Cobbles in the Yellowstone River is believed to be the Absaroka Mountains

# Background

- Source of the Chalky Buttes cobbles is unknown
- Two main hypotheses are debated
  - Transport from the Absaroka-Beartooth region of Wyoming and Montana
  - Transport from the northern Black Hills




Photos from: Clausen, 1986

# What do We Want to Know?

- We want to determine if the cobbles have a similar composition
- If the cobbles are similar it is possible they could be from the same source

# Methods

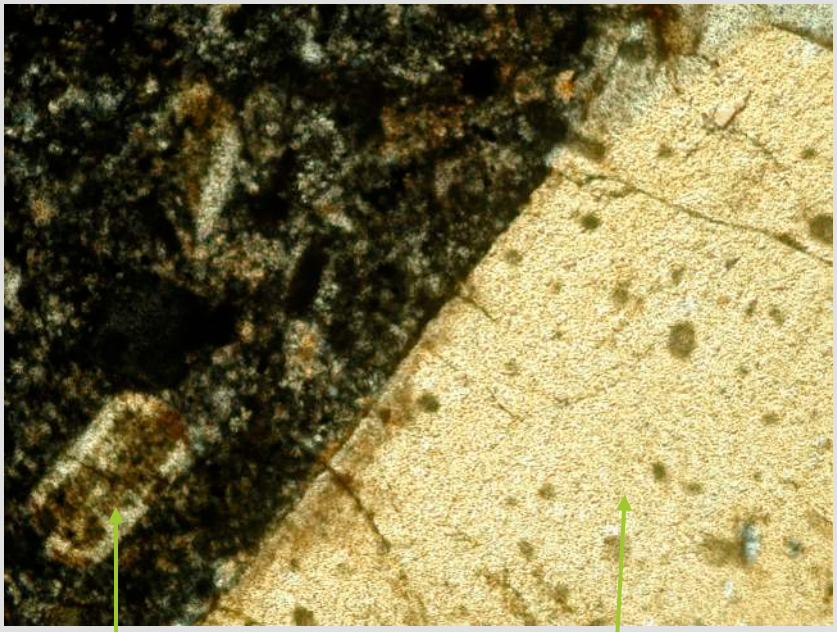
- Microscopy
  - Cut samples, high precision saw, made thin sections, sanded them down to proper thickness (30 microns)
- XRF
  - Crushed samples, made them into powder, constructed pellets
- SEM
  - Cut samples, polished, then carbon coated them

# Microscopy

- Samples appeared similar
- Both contained K-spar phenocrysts, and many smaller grains surrounding them
- Phenocrysts indicate a period of slow cooling then finished cooling quickly, indicated by the smaller grains
- Some Plagioclase is also present, but the grains are primarily K-spar

# Microscopy

Yellowstone River



Scale: 1.3 mm

Smaller Grains

Phenocryst

Chalky Buttes

Phenocryst

# Methods in Action


# XRF Data

- Conducted XRF analysis on two similar looking porphyries from the Chalky Buttes Member and one belonging to the “Forsyth Cobble” found in the Yellowstone River

# XRF Results

| Formula | AA-84-CB | Stat. erro | LLD = lower limit of detection | Formula | LM-12060 | Stat. erro | LLD |
|---|---|---|---|---|---|---|---|
| SiO2 | 68.43% | 0.05% | 152.3 PPM | SiO2 | 67.01% | 0.05% | 147.3 PPM |
| Al2O3 | 15.72% | 0.18% | 407.7 PPM | Al2O3 | 15.46% | 0.19% | 384.8 PPM |
| Fe2O3 | 0.49% | 0.20% | 10.8 PPM | Fe2O3 | 1.31% | 0.13% | 13.4 PPM |
| CaO | 1.03% | 0.54% | 205.2 PPM | CaO | 1.32% | 0.52% | 216.3 PPM |
| MgO | 0.33% | 1.32% | 379.8 PPM | MgO | 0.23% | 1.38% | 358.3 PPM |
| MnO | 0.02% | | 8.6 PPM | MnO | 0.09% | 0.72% | 10.2 PPM |
| Na2O | 1.60% | 2.49% | 627.0 PPM | Na2O | 1.82% | 2.25% | 599.4 PPM |
| K2O | 11.97% | 0.18% | 234.5 PPM | K2O | 12.30% | 0.19% | 234.6 PPM |
| P2O5 | 0.01% | | 67.2 PPM | P2O5 | 0.02% | | 65.6 PPM |
| TiO2 | 0.11% | | 39.7 PPM | TiO2 | 0.16% | | 42.6 PPM |
| | 99.71% | | | | 99.70% | | |

(K,Na)(Si,Al)4O8

Molecular Weight = 274.30 gm

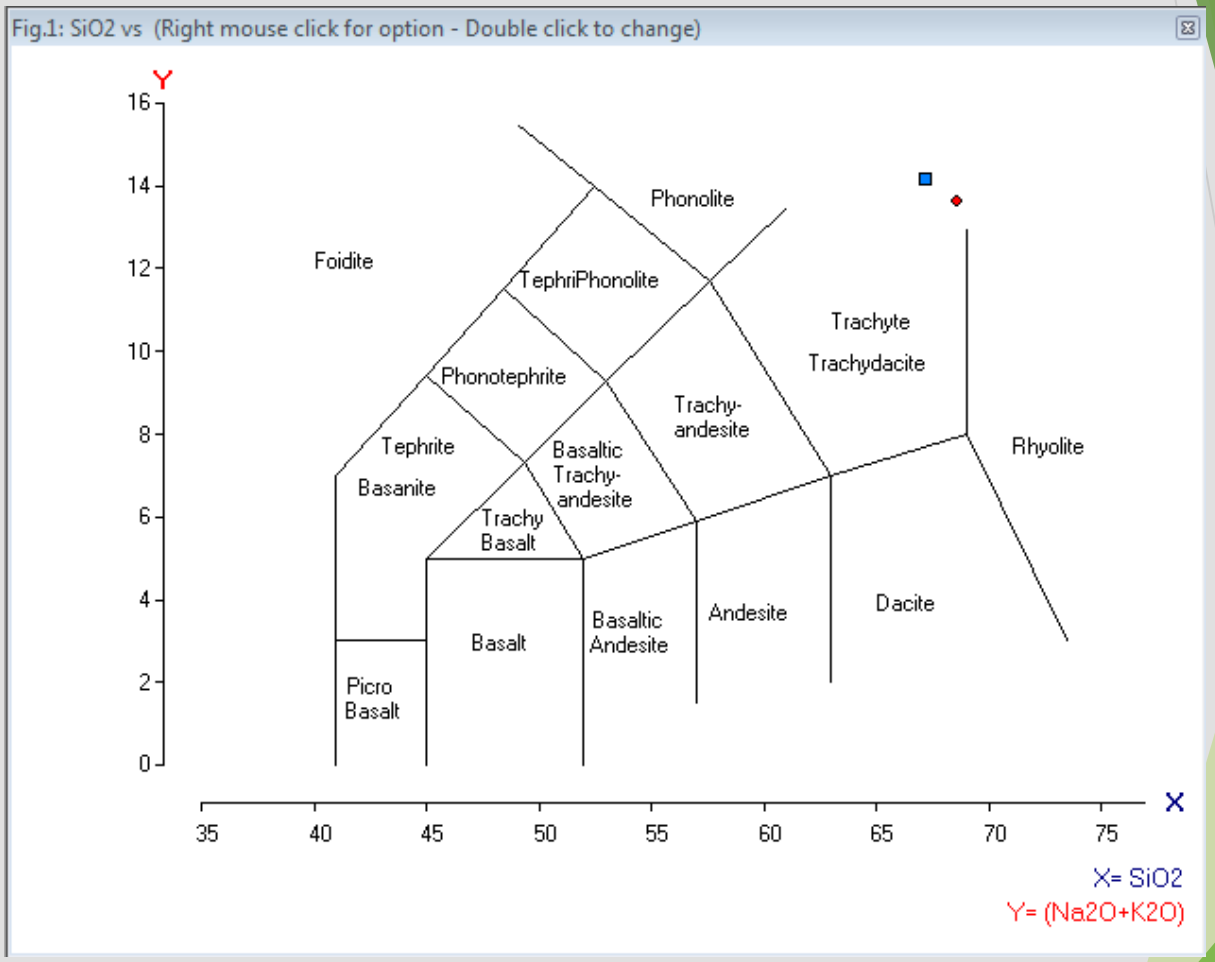
| | | | | |
|---|---|---|---|---|
| Potassium | 10.69 % | K | 12.88 % | $K_2O$ |
| Sodium | 2.10 % | Na | 2.82 % | $Na_2O$ |
| Aluminum | 9.84 % | Al | 18.59 % | $Al_2O_3$ |
| Silicon | 30.72 % | Si | 65.71 % | $SiO_2$ |
| Oxygen | 46.66 % | O | | |
| | 100.00 % | | 100.00 % | = TOTAL OXIDE |

$K_{0.75}Na_{0.25}AlSi_3O_8$

Sanidine

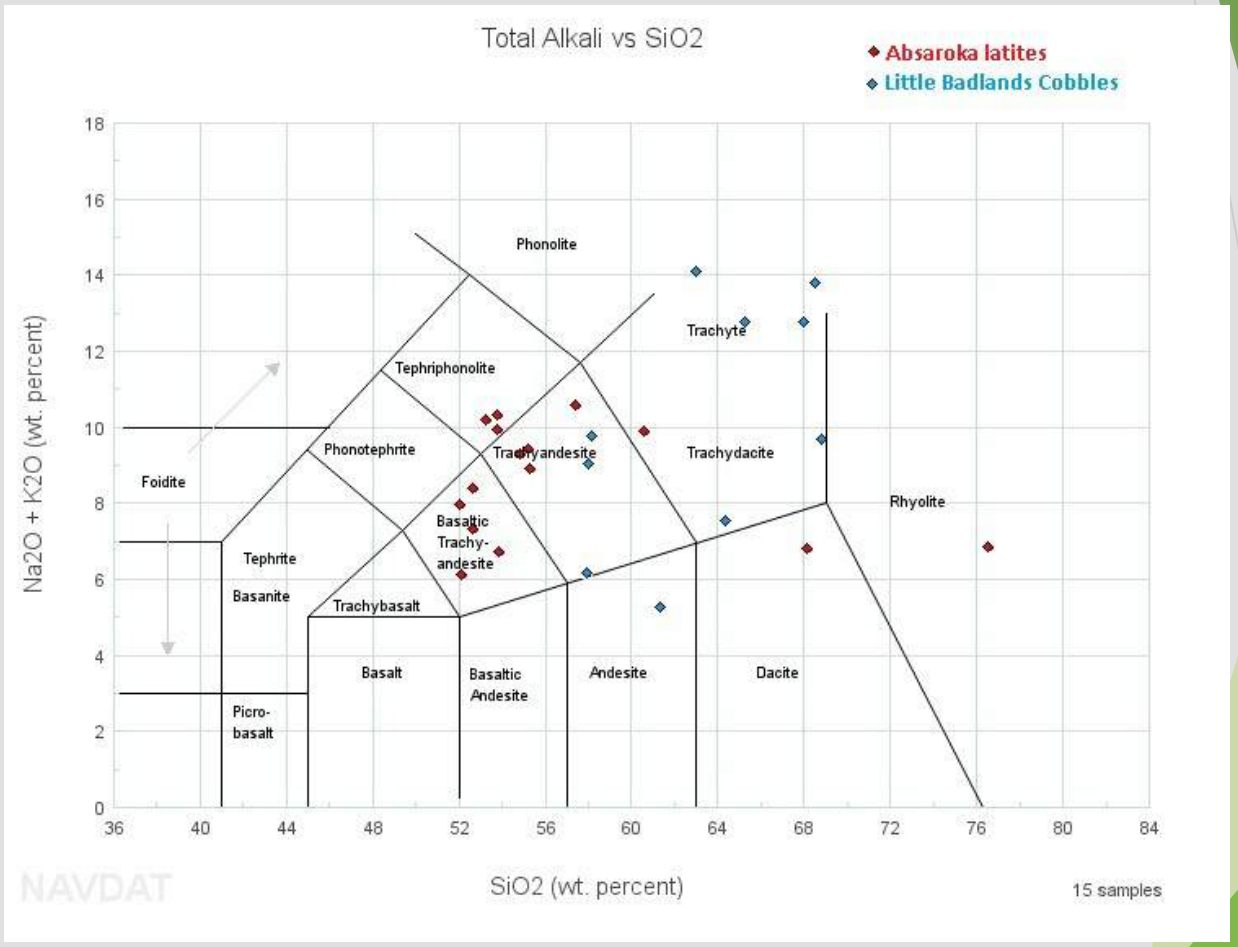
From: Webmineral.com

# TAS Diagram



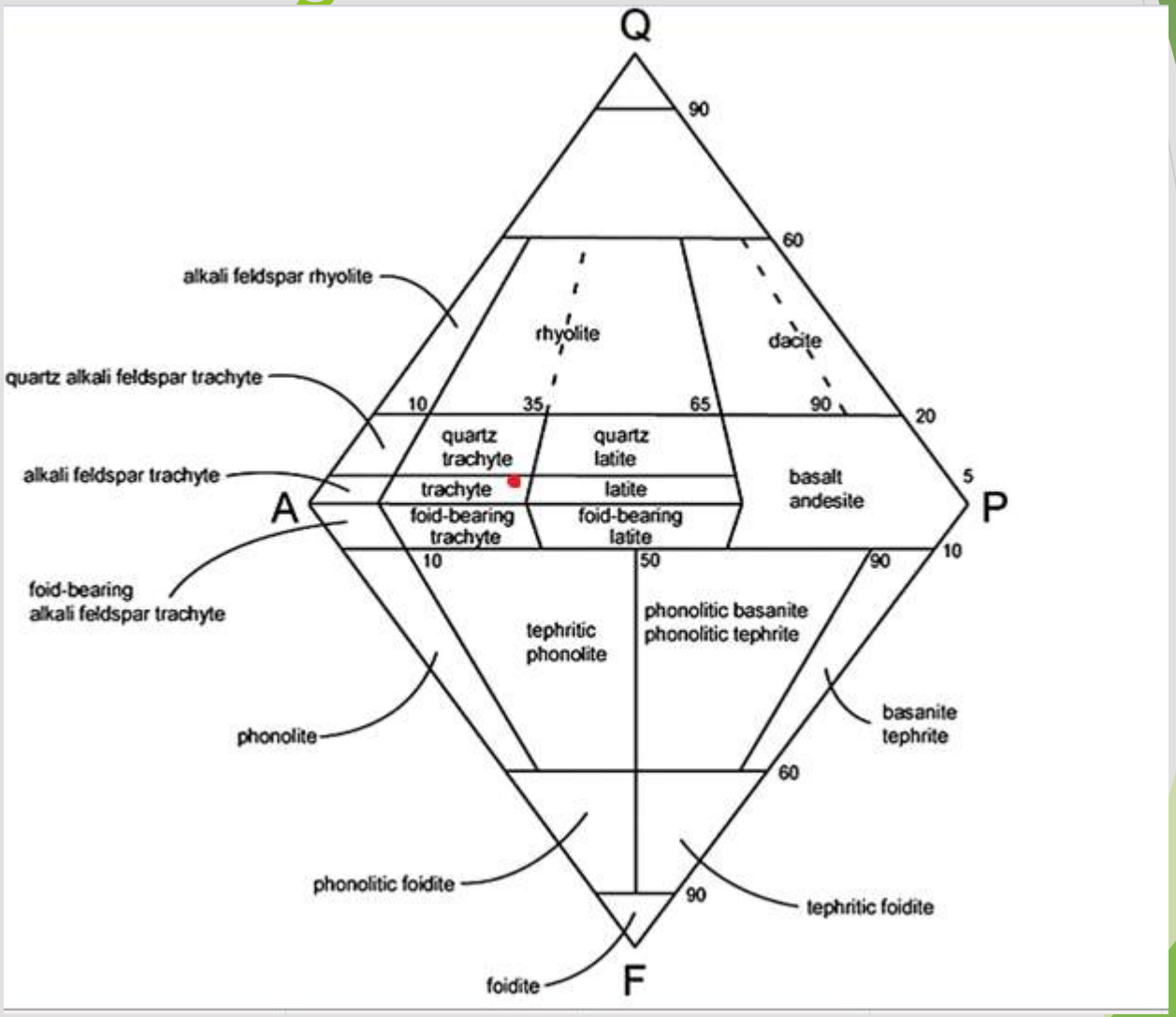

Red- Chalky Buttes Blue- Forsyth

# Data From Previous Research

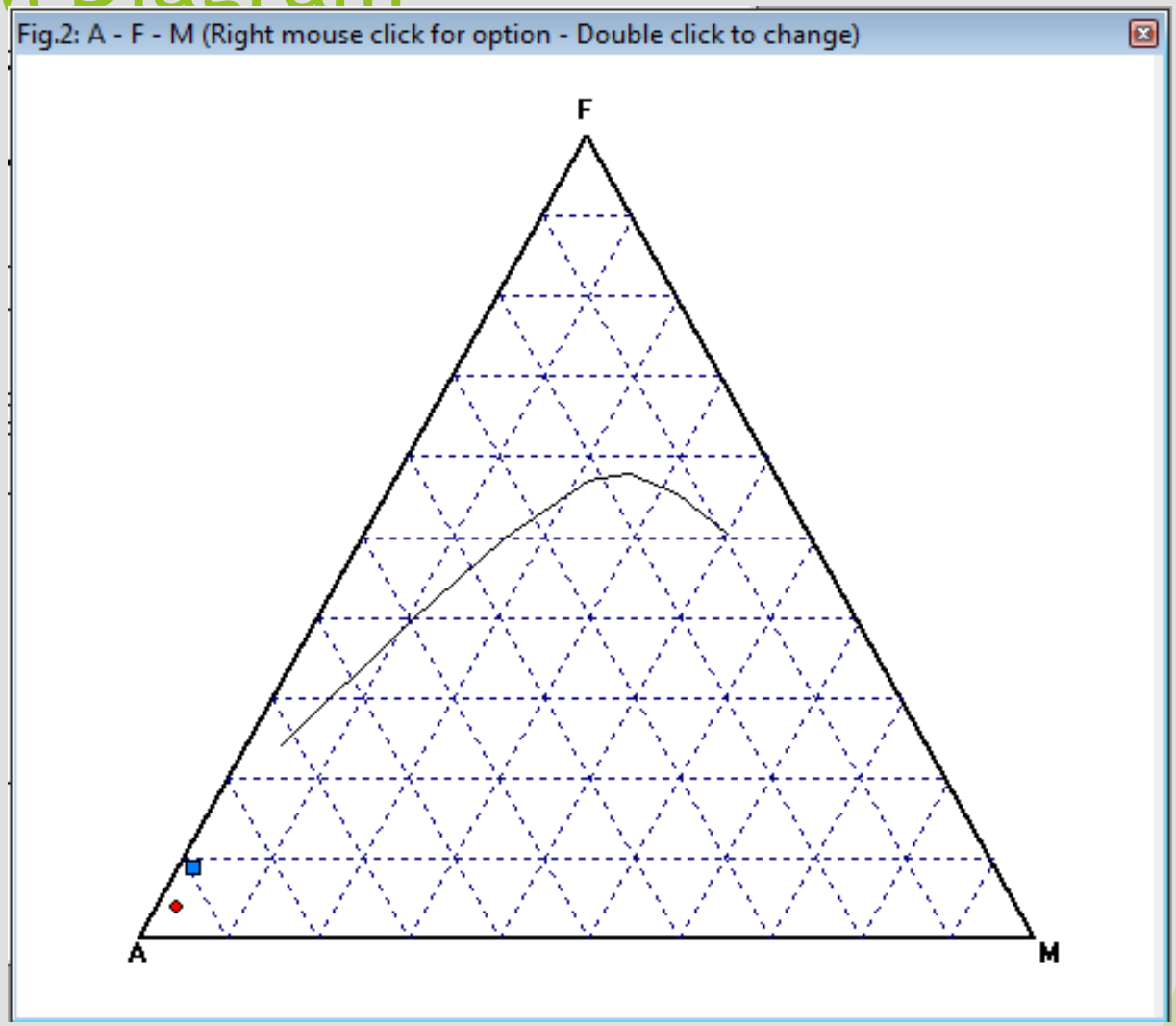



Taken from: Moxness, Levi, 2012

# QAPF Triangle



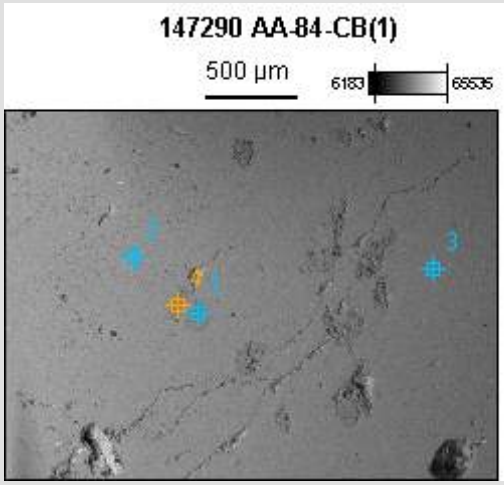
# AFM Diagram

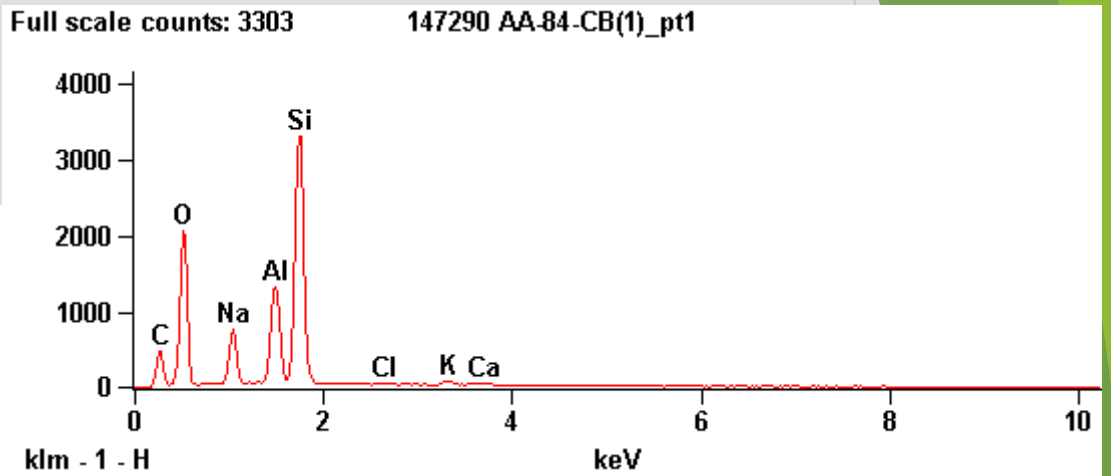


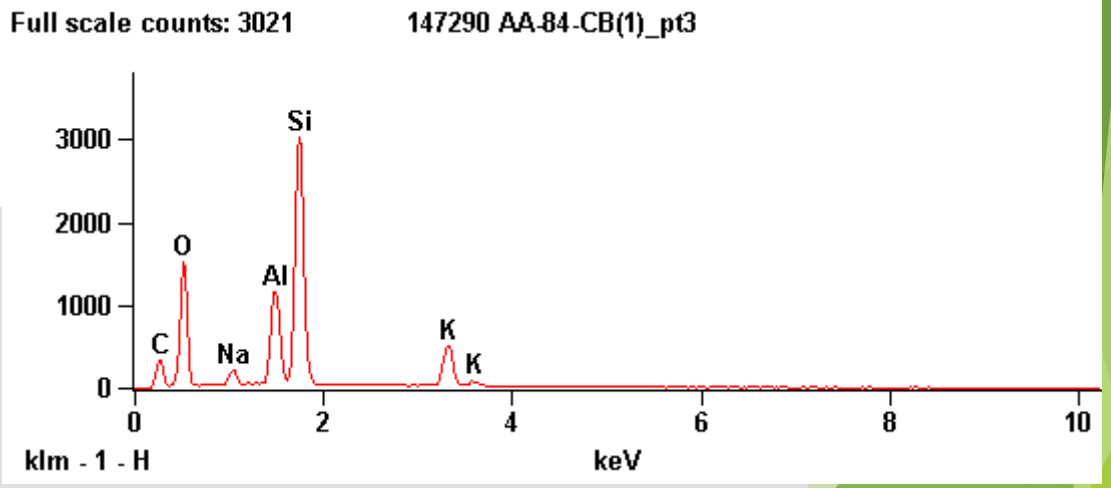

Red- Chalky Buttes
Blue- Forsyth

# SEM Results (AA-84-CB)

(Chalky Buttes)

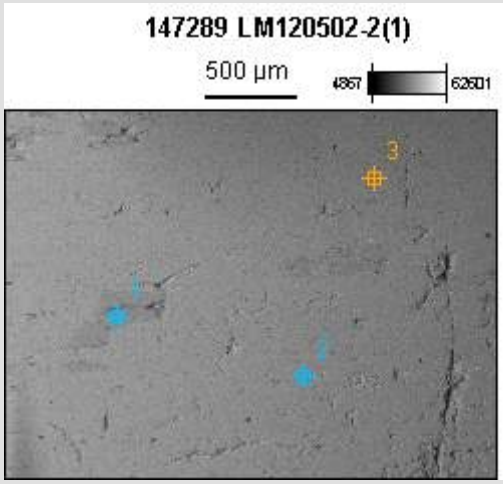


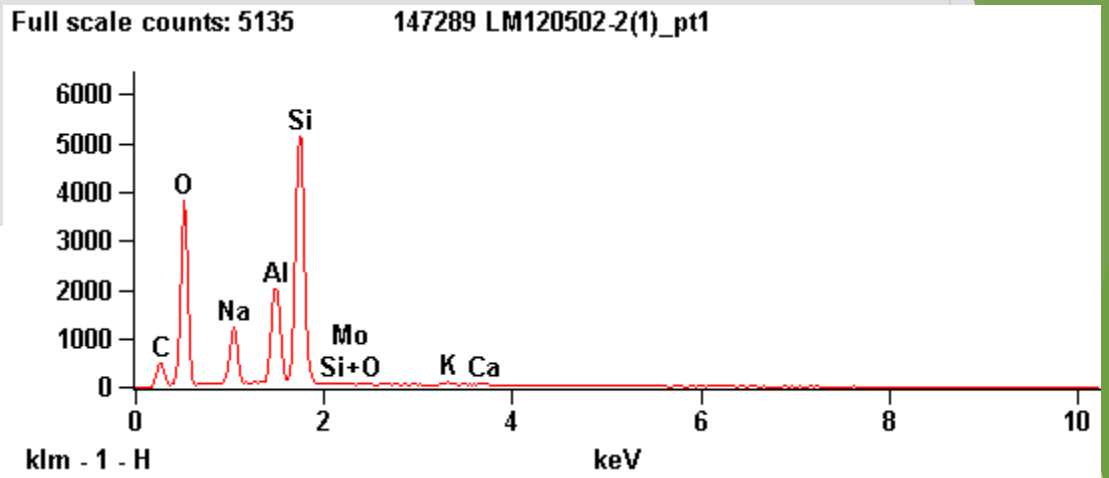



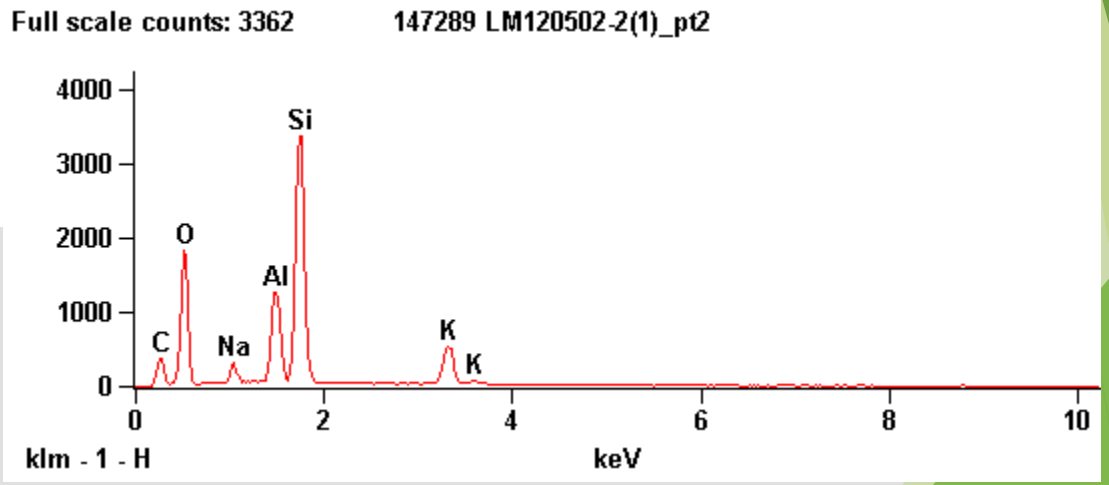



# SEM Results (LM-120602-2)

(Yellowstone River)



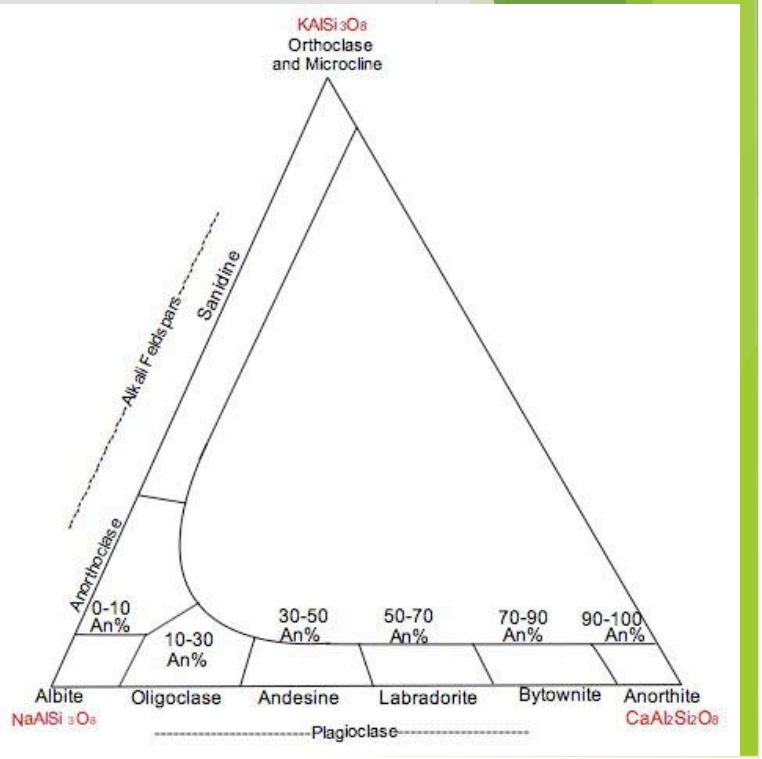
# SEM Results Comparison

| | Basis of 8 Oxygens | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Si | 2.90 | 2.99 | 2.97 | 2.90 | 3.02 | 2.97 | 4.00 | 2.75 | 2.50 | 2.98 | 2.36 |
| | Al | 1.03 | 0.99 | 1.04 | 1.04 | 0.95 | 1.01 | 0.00 | 1.53 | 1.85 | 1.01 | 2.07 |
| | MgO | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.04 | 0.00 | 0.02 |
| | Fe2O3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 |
| Totals | | 3.93 | 3.99 | 4.00 | 3.94 | 3.97 | 3.98 | 4.00 | 4.57 | 4.40 | 3.99 | 4.46 |
| | | | | | | | | | | | | |
| | Na | 1.11 | 0.34 | 0.32 | 1.07 | 0.00 | 0.38 | 0.00 | 0.00 | 0.00 | 0.40 | 0.06 |
| | K | 0.07 | 0.70 | 0.70 | 0.07 | 1.06 | 0.71 | 0.00 | 0.25 | 0.44 | 0.66 | 0.28 |
| | Ca | 0.07 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 |
| Totals | | 1.24 | 1.04 | 1.02 | 1.21 | 1.06 | 1.09 | 0.00 | 0.33 | 0.44 | 1.07 | 0.34 |
| Monty | | | | | | | | | | | | |

| | Basis of 8 Oxygens | | | | | |
|---|---|---|---|---|---|---|
| | Si | 2.91 | 3.00 | 3.00 | 2.95 | 2.98 | 2.98 |
| | Al | 1.02 | 0.99 | 0.97 | 1.01 | 0.99 | 0.99 |
| | **Totals** | 3.94 | 3.98 | 3.98 | 3.96 | 3.97 | 3.98 |
| | | | | | | | |
| | Na | 1.15 | 0.38 | 0.45 | 1.09 | 0.44 | 0.38 |
| | K | 0.05 | 0.68 | 0.61 | 0.09 | 0.66 | 0.70 |
| | Ca | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Totals** | 1.24 | 1.06 | 1.06 | 1.18 | 1.10 | 1.09 |
| | Wilcox | | | | | | |

# SEM Results Comparison

- Both contained Alkali feldspar, most likely Sanidine
- Within the Sanidine there was also Albite
- Commonly form together



# Results

- Microscopy, XRF, and SEM data are all quite similar
- Not perfect, but we would not expect them to be
- Could make the argument that they come from the same source

# Conclusions

- It is possible they come from the same source material
- Can not say for sure
- The Yellowstone cobble could have simply been reworked by the Yellowstone River
- It does help to rule out the Black Hills as a source
- Further research needed

# Further Research

- Age dating on the cobbles using Zircon crystals
- These are just two cobbles, need to compare many more

# Sources


- Clausen, E. 1986. Origin of Quartz Latite Porphyry Cobbles found at base of White River Group Sediments in Southwestern North Dakota. NDGS 1986 Fieldtrip Guidebook. pp. 41-45.
- Leckie, D. A., 2006. Tertiary fluvial gravels and evolution of the Western Canadian Prairie Landscape. Elsevier, Amsterdam.
- Moxness, L. 2012. Provenance of cobbles from the Chalky Buttes Member of the Chadron Formation, southwestern North Dakota. (unpublished)
- Web Mineral. Sanidine Mineral Data. webmineral.com


ARE THERE
ANY QUESTIONS?
DIYLOL.COM