# Petrology and Geochemistry of Precambrian basement rocks in Walsh County, North Dakota

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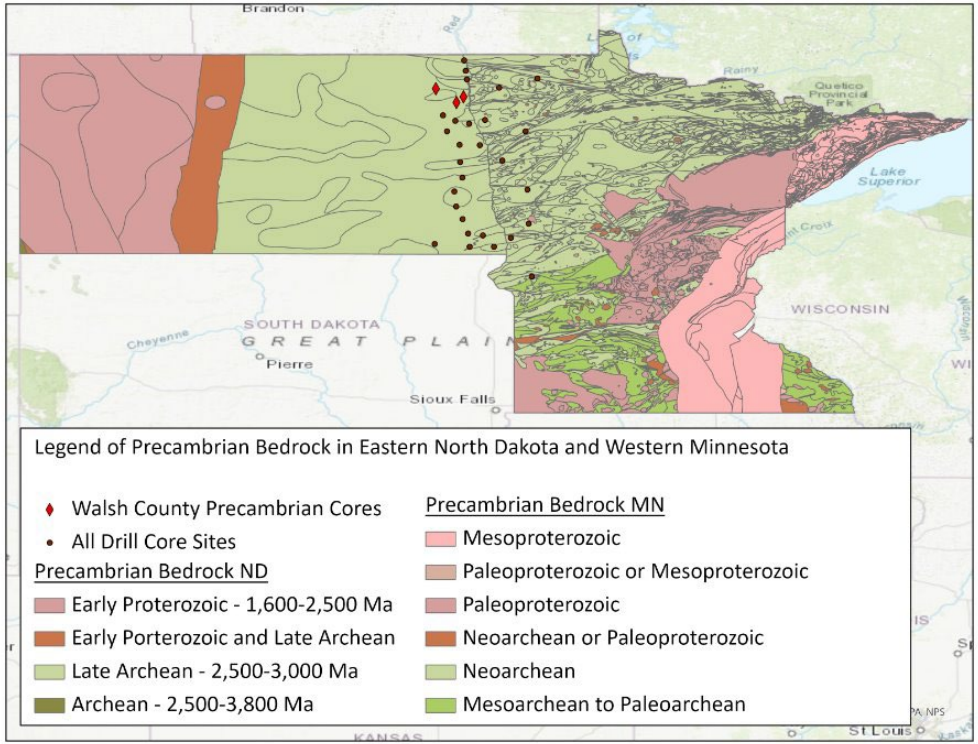
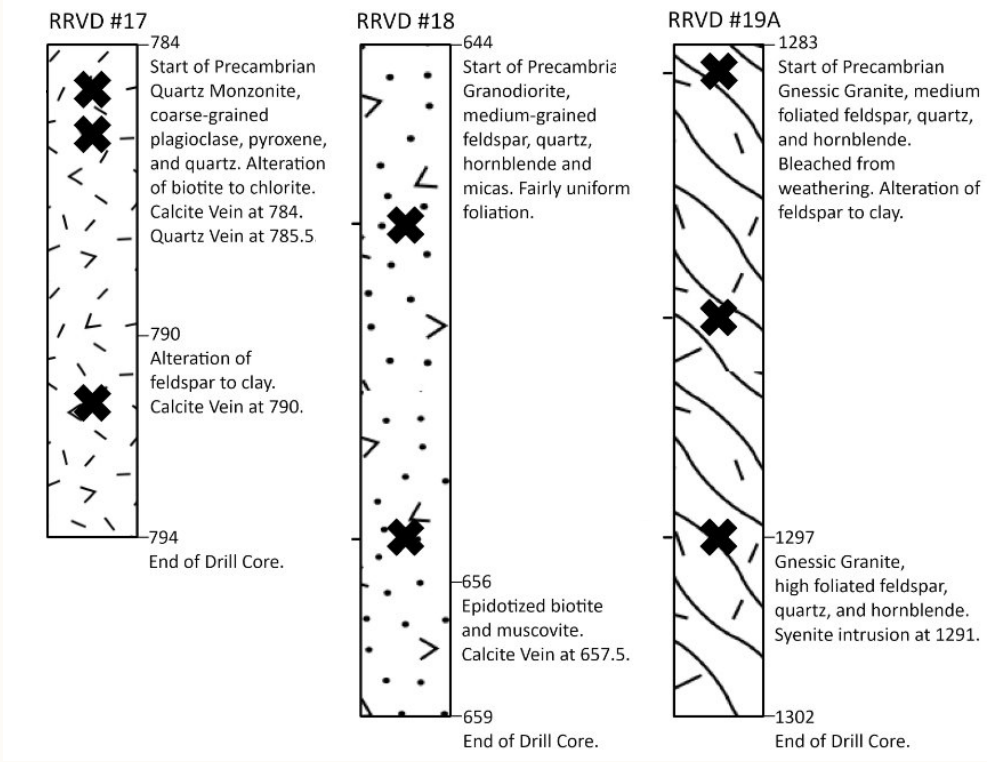
# Basemap of Core Sites




- In 1977, 32 drill cores were taken to see Uranium Potential
- Studying cores #17, #18, and #19A
  - Precambrian & in Walsh County

**Figure 1:** Location map of Eastern North Dakota and Western Minnesota. Era of Precambrian Bedrock is outlined. Red River Valley Drill Cores are outlined.

# Lithology of Core

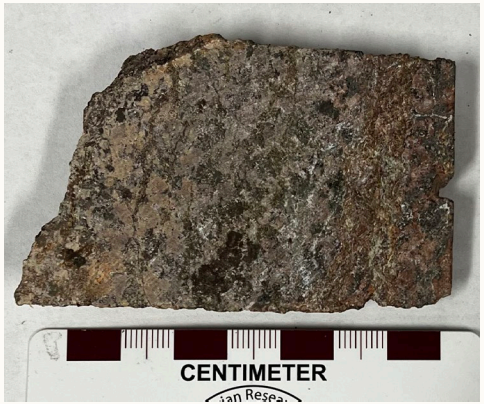



- Insights from Moore Report and Optical Observations

**Figure 2:** Stratigraphic column of RRVD drill core Precambrian layers. Black Xs indicate sample locations. Numbers to the left correspond to the XRF analysis in Table 1. Data taken from Moore (1979) and optical observations.

# Drill Core Photos #17

#17 – 791



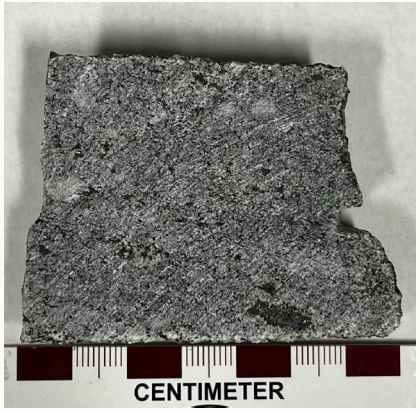


#17 – 784.5

#17 – 785

# Drill Core Photos #18

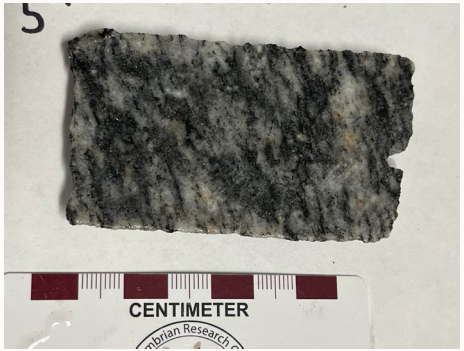

#18 – 648.5

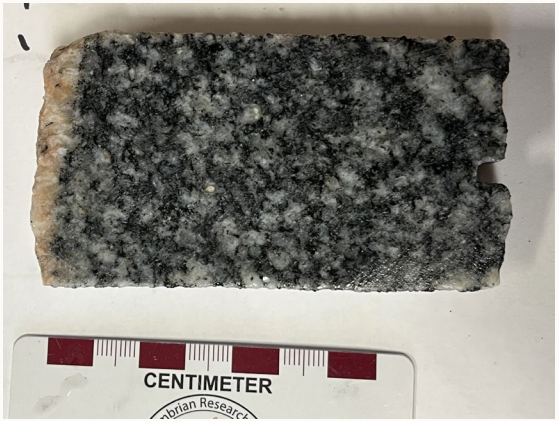



#18 – 655.5

# Drill Core Photos #19A

#19A– 1296.5




#19A– 1291

#19A– 1284.5

# Methods

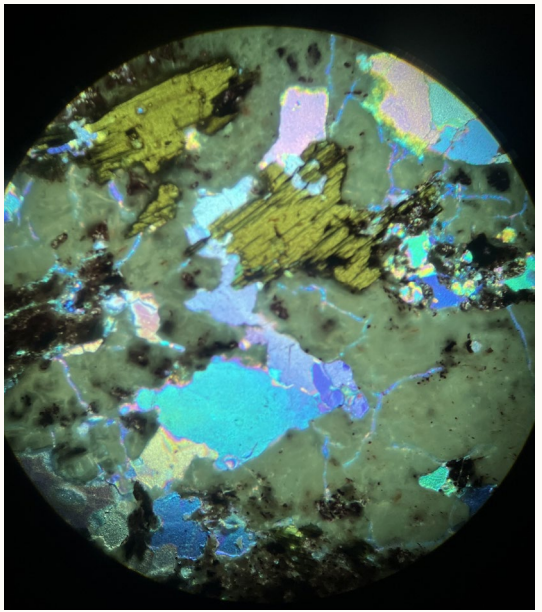
- Optical Observations
  - Hand sample analysis
  - Creating thin sections

- X-Ray Diffraction (XRD)
  - X-Rays transmits the sample
  - Measures 2 theta as the angle from the detector changes
  - Measures intensity at various 2 thetas

- X-Ray Fluorescence (XRF)
  - X-Rays transmits the sample and excites atoms
  - Measures energy transfer from dislodged atom

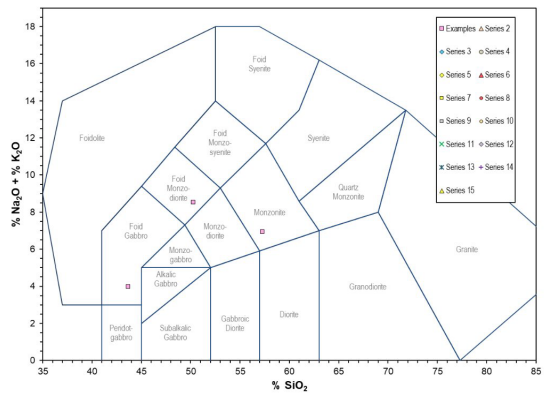
# RRVD#17 Optical Observations

- RRVD #1-7785
- RRVD #1-7784.5
  - Biotite
  - Quartz
- RRVD #1-7791



# RRVD#17 XRD and XRF

- Prominent Minerals:
  - RRVD #17785 Quartz, Calcite, Kaolinite, Anorthite, & Muscovite
  - RRVD #17784.5 Calcite, Quartz, Kaolinite, & Periclase
  - RRVD #17791 Quartz, Sanidine, & Calcite



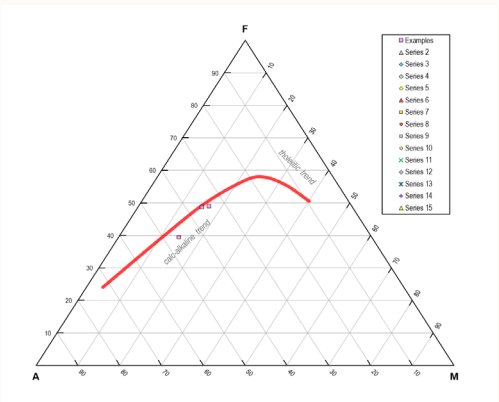



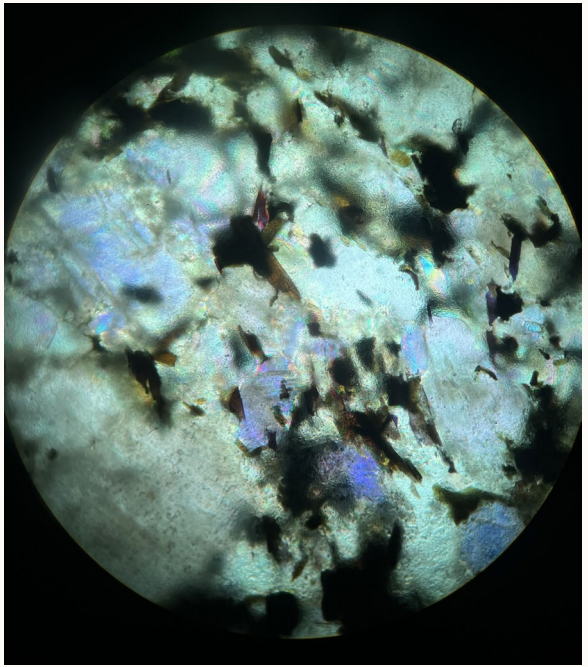

**Figure 3:** Classification diagrams for samples from RRVD#17.

| wt% | 1 | 2 | 3 |
|---|---|---|---|
| $SiO_2$ | 59.1 | 43.6 | 50.1 |
| $TiO_2$ | 0.58 | 1.1 | 0.452 |
| $Al_2O_3$ | 23.6 | 20.7 | 13 |
| $Fe_2O_3$ | 6.77 | 6.32 | 12.8 |
| MnO | 0.07 | 0.166 | 0.146 |
| MgO | 2.25 | 1.97 | 3.64 |
| CaO | 3.44 | 21.9 | 10.9 |
| $Na_2O$ | 5.32 | N.D. | N.D. |
| $K_2O$ | 1.84 | 3.97 | 8.51 |
| $P_2O_5$ | 0.20 | 0.133 | 0.108 |
| Total | 103.1 | 99.85 | 99.66 |

**Table 1**: 1: RRVD #17785, 2:RRVD #17784.5 3:RRVD #17791
Chemical data from NDSU XRF analysis.

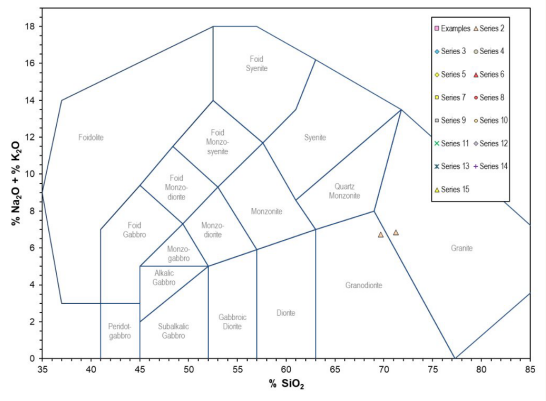
# RRVD#18 Optical Observations

- RRVD #18645.5
  - Quartz
- RRVD #18655.5



# RRVD#18 XRD and XRF

- Prominent Minerals:
  - RRVD #18-645.5 Quartz, Albite, Anorthoclase, Biotite, & Microcline
  - RRVD #18-655.5 Quartz, Albite, & Anorthoclase



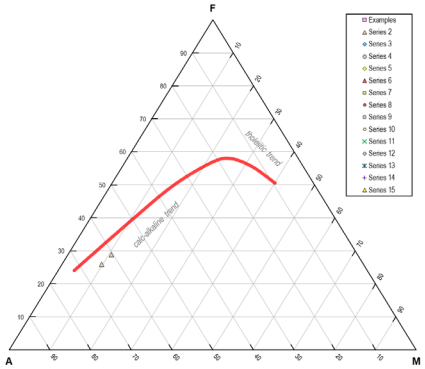



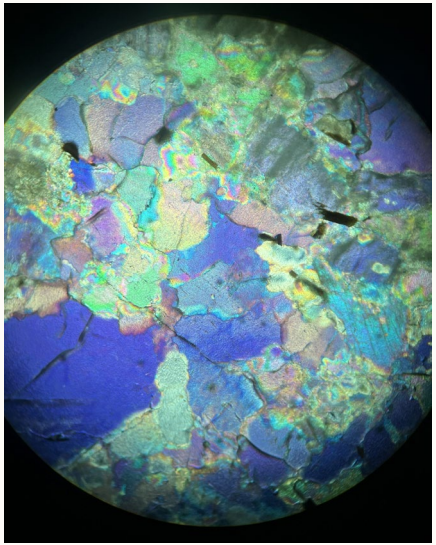

**Figure 3:** Classification diagrams for samples from RRVD#18.

| wt% | 4 | 5 |
|---|---|---|
| $SiO_2$ | 69.2 | 71 |
| $TiO_2$ | 0.39 | 0.32 |
| $Al_2O_3$ | 14.7 | 13.8 |
| $Fe_2O_3$ | 3.55 | 3.06 |
| MnO | 0.05 | 0.04 |
| MgO | 1.19 | 1.04 |
| CaO | 3.83 | 3.44 |
| $Na_2O$ | 5.23 | 5.51 |
| $K_2O$ | 1.46 | 1.32 |
| $P_2O_5$ | 0.15 | 0.13 |
| Total | 99.75 | 99.66 |

**Table 2:** 4: RRVD #18-645.5, 5: RRVD #18-655.5 Chemical data from NDSU XRF analysis.

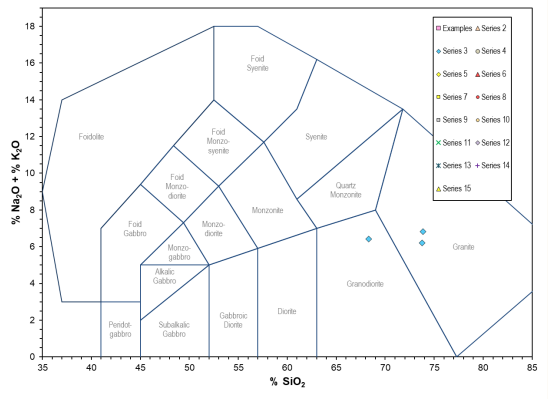
# RRVD#19A Optical Observations

- RRVD #19A284.5
- RRVD #19A291
- RRVD #19A296.5



# RRVD#19A XRD and XRF

- Prominent Minerals:
  - RRVD #19A1284.5 Microcline, Kaolinite, Quartz
  - RRVD #19A1291 Quartz, Anorthite, Albite, Augite
  - RRVD #19A1296.5 Anorthite, Microcline, Augite



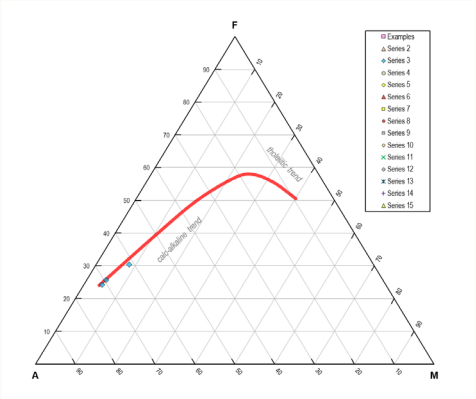




**Figure 3:** Classification diagrams for samples from RRVD#19A.

| wt% | 6 | 7 | 8 |
|---|---|---|---|
| $SiO_2$ | 68.2 | 73.5 | 73.6 |
| $TiO_2$ | 0.31 | 0.21 | 0.22 |
| $Al_2O_3$ | 20.4 | 13.5 | 13.1 |
| $Fe_2O_3$ | 3.53 | 2.54 | 2.57 |
| MnO | 0.03 | 0.03 | 0.03 |
| MgO | 0.87 | 0.44 | 0.44 |
| CaO | N.D. | 3.12 | 2.8 |
| $Na_2O$ | N.D. | 4.82 | 4.32 |
| $K_2O$ | 6.4 | 1.36 | 2.47 |
| $P_2O_5$ | 0.07 | 0.09 | 0.07 |
| Total | 99.81 | 99.61 | 99.62 |

**Table 1:** 6: RRVD #19A1284.5, 7: RRVD #19A-1291, 8: RRVD #19A1296.5. Chemical data from NDSU XRF analysis.

# Relation to Superior Province

- The Superior Province (Archean)
  - Covers parts of Canada, MN, WI, and MI
- Drill cores fall in the Western Superior Province
- Western Wabigoon
  - Volcanic rocks, tonalite plutons, and metasedimentary rocks.
  - Minnesota River Valley terranes
  - Plutonic (mostly) granitic rocks.

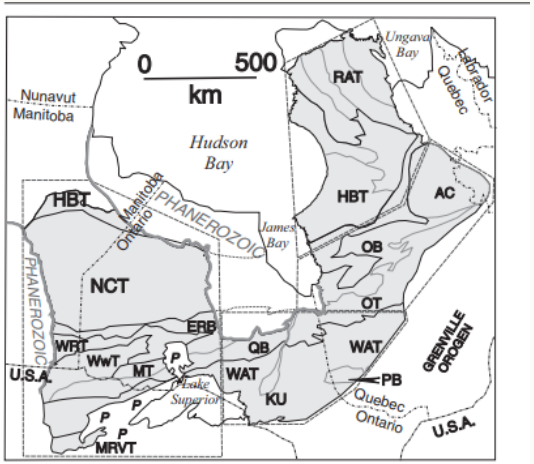



**Figure 4.** Subprovinces and broad structural trends of the Superior Province, ( Percival et al., 2012)

# Relation to Superior Province

- Follow closely RRVD #18 and RRVD #19A
- Collisions with neighboring terranes
  - Possible cause for metamorphic deformation or upheaval to the surface
- No concrete answers, but give us an idea of processes and relations to know terranes.

# Thanks!

Thank You to Dr. Bernhardt Saini - Eidukat and Cristian Pereira for your help and assistance!

## Any Questions?