

## Major element geochemistry and first zircon U-Pb age dates of Precambrian basement rocks in eastern North Dakota

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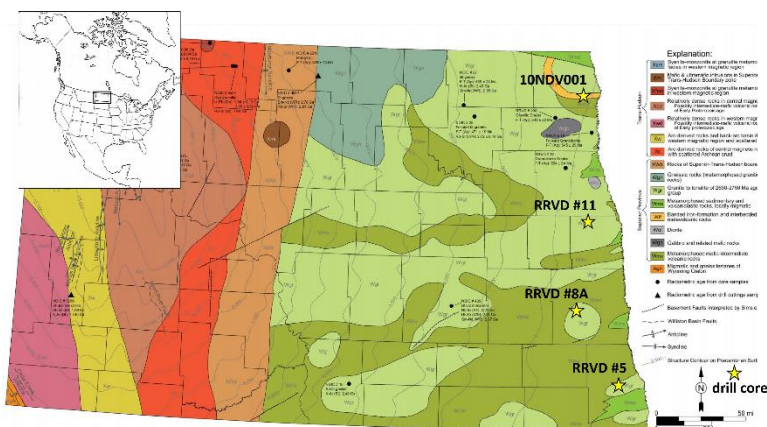
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We are re-examining cores of the 1977 Red River Valley Drilling Project (Moore, 1978). Other previous work includes study of the paleoweathered horizon on the Precambrian bedrock (Kelley, 1980), Klasner and King (1986), Sims et al. (1991) and various ILSG abstracts. We sampled the Precambrian portions of three of these cores (RRVD #5, #8, #11) from eastern North Dakota, and a core cut by Kennecott Exploration Company in 2010 (10NDV001; Nesheim, 2013) (Fig. 1; Table 1). Samples were analyzed at Washington State University (WSU) for U-Pb zircon age dates. Kelley (1980) reported major element analyses and new analyses were carried out at WSU and North Dakota State University using XRF (Table 2).



**Figure 1.** Precambrian geology map of North Dakota after Nesheim (2012) and Sims et al. (1991), with location map and core locations (stars) for this study

**Table 1.** Summary of samples, lithology, and zircon age dates

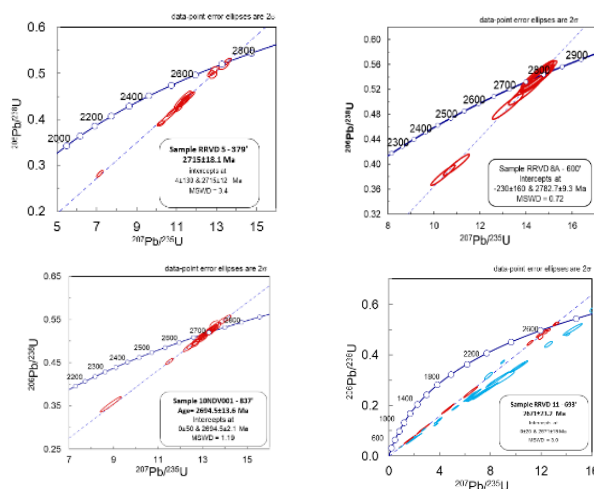
| Core / depth     | Lat / Long | lithology                                     | Zircon age (MSWD)                         |
|------------------|------------|---|---|
| RRVD 5           | 46.225514  | Fine to medium grained quartz monzonite       | 2715.0 +/- 18.1 Ma (3.4)                  |
| 379 ft (115.5 m) | -96.932504 |   |   |
| RRVD 8A          | 46.897502  | Fine to medium grained chlorite gneiss        | 2782.7±9.3 Ma (0.72)                      |
| 600 ft (182.9 m) | -97.370662 |   |   |
| RRVD 11          | 47.614926  | Medium grained biotite granitoid              | 2 populations: younger 2671±23.2 Ma (3.0) |
| 693 ft (211.2 m) | -97.291738 |   |   |
| 10NDV001         | 48.61706   | Medium grained magnetite-rich granitic gneiss | 2694.5±13.6 Ma (1.19)                     |
| 837 ft (255.1 m) | -97.316902 |   |   |

**Table 2.** Whole rock major element analyses

| wt. %                          | 1     | 2     | 3     | 4     |
|--------------------------------|-------|-------|-------|-------|
| SiO <sub>2</sub>               | 74.00 | 68.91 | 64.30 | 65.80 |
| TiO <sub>2</sub>               | 0.16  | 0.18  | 0.13  | 0.42  |
| Al <sub>2</sub> O <sub>3</sub> | 13.7  | 10.43 | 17.40 | 15.20 |
| Fe <sub>2</sub> O <sub>3</sub> | 1.36  |       | 2.04  | 4.67  |
| FeO                            |       | 1.65  |       |       |
| MnO                            | 0.01  | 0.31  | 0.02  | 0.10  |
| MgO                            | 0.04  | 0.44  | 0.71  | 0.00  |
| CaO                            | 1.49  | 4.60  | 0.91  | 1.65  |
| Na <sub>2</sub> O              | 4.60  | 0.87  | 8.16  | 6.00  |
| K <sub>2</sub> O               | 4.22  | 6.82  | 5.96  | 5.90  |
| P <sub>2</sub> O <sub>5</sub>  | 0.09  | 0.03  | 0.06  | 0.05  |
| SO <sub>3</sub>                |       | 0.04  |       |       |
| LOI                            |       | 5.44  |       |       |
| sum                            | 99.67 | 99.72 | 99.68 | 99.79 |

1: RRVD 5-383.5"; 2: RRVD 8A-602';

3: RRVD 11-695'; 4: 10NDV001-836'



**Figure 2.** U-Pb concordia diagrams for zircons from the Precambrian core samples with weighted mean <sup>207</sup>Pb/<sup>206</sup>Pb ages. Error ellipses represent 2SE uncertainties. Open ellipses with thick grey lines depict outlier U-Pb zircon analyses removed from final age determinations.

The analyzed rocks contain 64-74 wt.% SiO<sub>2</sub>, with RRVD 11-695' showing high total alkalis (Na<sub>2</sub>O+K<sub>2</sub>O = 14.12 wt. %). All show Neoproterozoic zircon ages (2.7–2.8 Ga) with the granitoids showing slightly younger ages than the gneisses (Table 1; Fig. 2). Sample RRVD 11-693 appears to be a 2 component rock with two zircon populations. These chemical results and measured ages are consistent with those measured in other areas of the Superior Craton (cf. Li et al., 2020).

## REFERENCES:

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