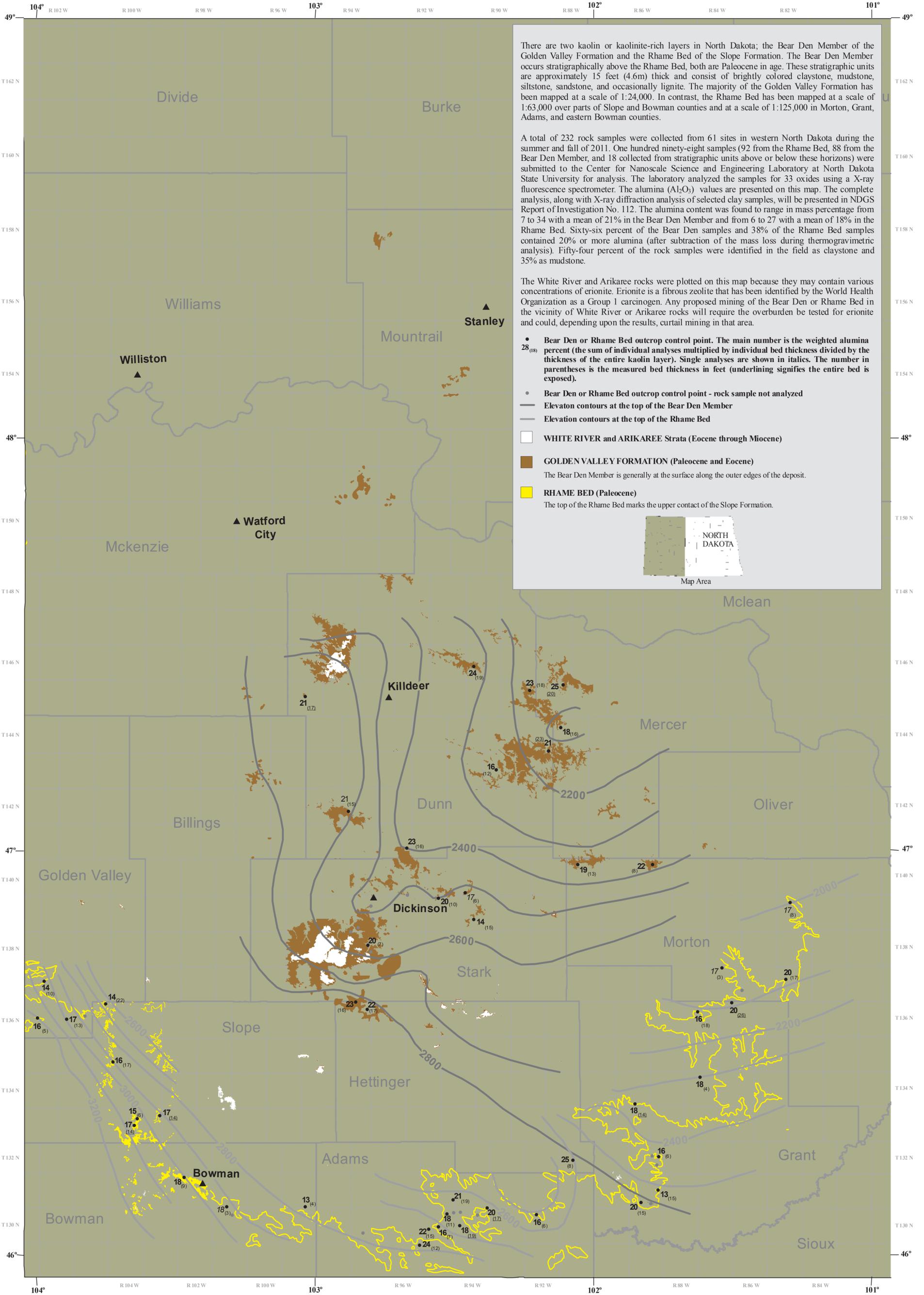


Alumina Content of the Bear Den Member and the Rhame Bed in North Dakota

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There are two kaolin or kaolinite-rich layers in North Dakota; the Bear Den Member of the Golden Valley Formation and the Rhame Bed of the Slope Formation. The Bear Den Member occurs stratigraphically above the Rhame Bed, both are Paleocene in age. These stratigraphic units are approximately 15 feet (4.6m) thick and consist of brightly colored claystone, mudstone, siltstone, sandstone, and occasionally lignite. The majority of the Golden Valley Formation has been mapped at a scale of 1:24,000. In contrast, the Rhame Bed has been mapped at a scale of 1:63,000 over parts of Slope and Bowman counties and at a scale of 1:125,000 in Morton, Grant, Adams, and eastern Bowman counties.

A total of 232 rock samples were collected from 61 sites in western North Dakota during the summer and fall of 2011. One hundred ninety-eight samples (92 from the Rhame Bed, 88 from the Bear Den Member, and 18 collected from stratigraphic units above or below these horizons) were submitted to the Center for Nanoscale Science and Engineering Laboratory at North Dakota State University for analysis. The laboratory analyzed the samples for 33 oxides using a X-ray fluorescence spectrometer. The alumina (Al₂O₃) values are presented on this map. The complete analysis, along with X-ray diffraction analysis of selected clay samples, will be presented in NDGS Report of Investigation No. 112. The alumina content was found to range in mass percentage from 7 to 34 with a mean of 21% in the Bear Den Member and from 6 to 27 with a mean of 18% in the Rhame Bed. Sixty-six percent of the Bear Den samples and 38% of the Rhame Bed samples contained 20% or more alumina (after subtraction of the mass loss during thermogravimetric analysis). Fifty-four percent of the rock samples were identified in the field as claystone and 35% as mudstone.

The White River and Arikaree rocks were plotted on this map because they may contain various concentrations of erionite. Erionite is a fibrous zeolite that has been identified by the World Health Organization as a Group 1 carcinogen. Any proposed mining of the Bear Den or Rhame Bed in the vicinity of White River or Arikaree rocks will require the overburden be tested for erionite and could, depending upon the results, curtail mining in that area.

- **Bear Den or Rhame Bed outcrop control point.** The main number is the weighted alumina percent (the sum of individual analyses multiplied by individual bed thickness divided by the thickness of the entire kaolin layer). Single analyses are shown in italics. The number in parentheses is the measured bed thickness in feet (underlining signifies the entire bed is exposed).
- **Bear Den or Rhame Bed outcrop control point - rock sample not analyzed**
- **Elevation contours at the top of the Bear Den Member**
- **Elevation contours at the top of the Rhame Bed**
- **WHITE RIVER and ARIKAREE Strata (Eocene through Miocene)**
- **GOLDEN VALLEY FORMATION (Paleocene and Eocene)**
The Bear Den Member is generally at the surface along the outer edges of the deposit.
- **RHAME BED (Paleocene)**
The top of the Rhame Bed marks the upper contact of the Slope Formation.



Scale 1:500,000
0 3 6 9 12 Miles