North Dakota Geological Survey
100K Series: Dksn - u

Uranium
Dickinson 100K Sheet, North Dakota

Grassy Butte	Killdeer	Hazen
Belfield		Glen Ullin
Bowman	Mott	Elgin

Adjoining 100K Maps

12°
1981 Magnetic North Declination at Center of Sheet

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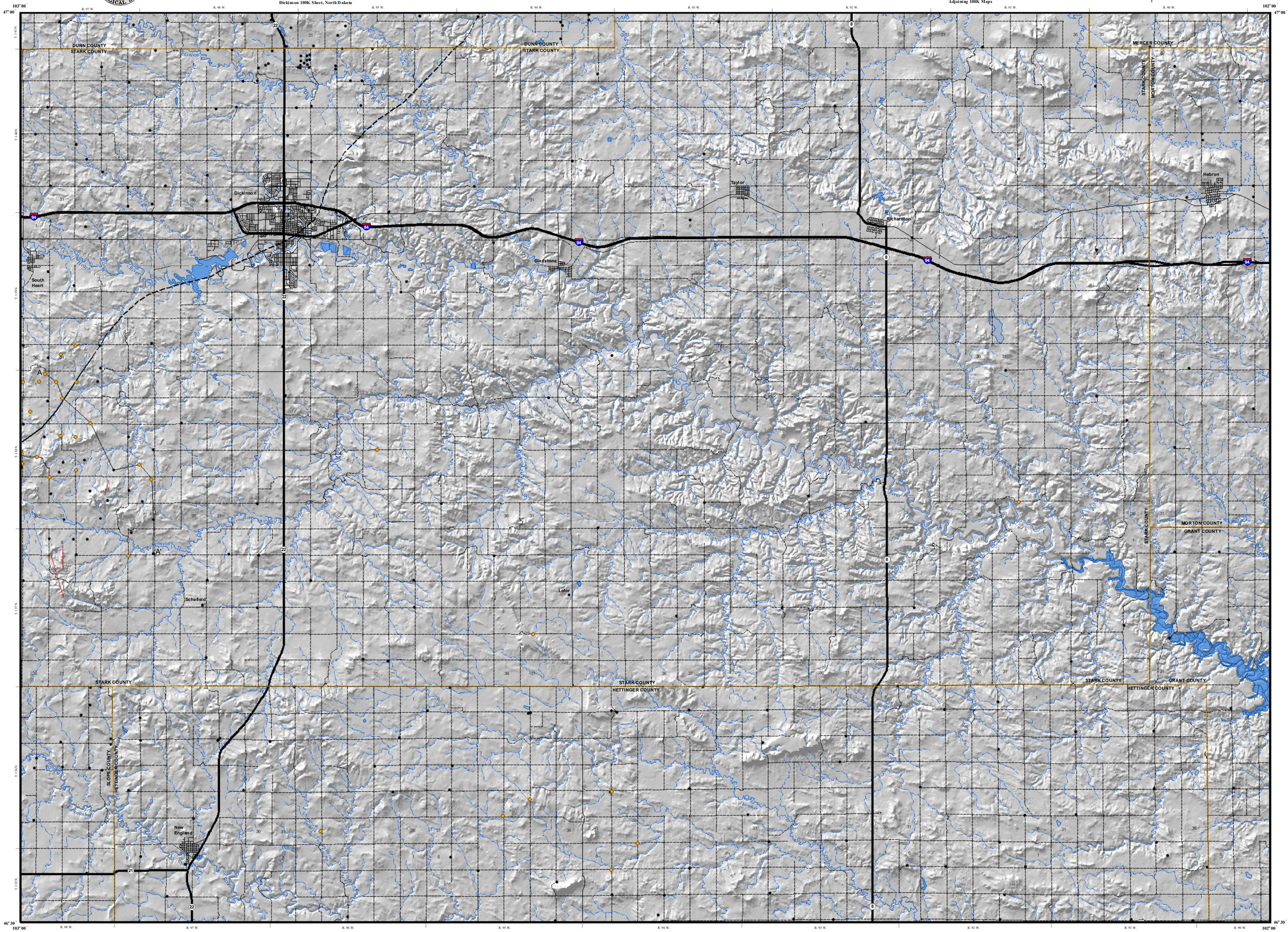


Edward C. Murphy
2006

Rocks exposed at the surface of the Dickinson 100K sheet are primarily 60 million year old sandstones, siltstones, claystones, mudstones, and lignites of the Sentinel Butte Formation (Paleocene). The Golden Valley Formation is present in some upland settings and rocks of the White River Group (Chadron and Brule Formations) and Arikaree Formation are preserved in the Little Badlands southwest of Dickinson and as caprock on the major buttes in the area. The Golden Valley Formation (Paleocene to Eocene) consists of alternating beds of sandstone, siltstone, claystone, mudstone, and lignite. The Golden Valley is split into two members; the lower member is Paleocene in age and consists primarily of kaolinitic-rich claystones and mudstones. The upper member is Eocene in age and lithologically similar to the underlying Sentinel Butte Formation. Lithologies of the Chadron Formation (Eocene) include conglomerate, claystone, and marlstone. The Brule Formation (Oligocene) contains beige colored sandstones, siltstones, and mudstones. The Arikaree Formation (Oligocene and Miocene) consists of green to gray colored sandstones and conglomerates. The White River Group is a few tens of feet thick where it caps buttes within this sheet. In the Little Badlands, the White River Group is approximately 250 feet thick and the Arikaree rocks are a maximum of 40 feet thick (Murphy et al., 1993). The Fort Union Group has a maximum thickness of approximately 1,500 feet in this area (Murphy, 2006).

A northeast trending syncline is present in the Little Badlands. First noted by Denson and Gill (1965) the axis can be plotted on a structure map of the lower member (Bear Den) of the Golden Valley Formation and traced northeast of Dickinson (Biek and Murphy, 1997). Additional structure has been noted further east of Dickinson in the Taylor area (Murphy, 2005).

The volcanic-rich White River and Arikaree strata are the likely source rocks for uranium when it is present in this area (Denson and Gill, 1965). Over millions of years, groundwater has leached uranium from this strata and deposited it in the underlying carbonaceous rocks and occasionally sandstones within the Golden Valley Formation and Fort Union Group. According to this model, uranium should be concentrated in the stratigraphically highest lignite.

The North Dakota Geological Survey's database for the Dickinson Sheet contains exploration holes and monitoring wells that have electric logs to the surface. These electric logs are typically suites of gamma, resistivity, density, and to a lesser degree spontaneous potential or sp. The gamma probe passively measures the natural radioactivity in the borehole. Zones or horizons of increased radioactivity are recognizable as spikes on gamma logs. All gamma logs in this database were examined for radioactive spikes or indicators of increased radioactivity on the log traces. Background radioactivity in the Fort Union strata ranges from 20 to 60 gamma counts per second (gcps). The values of most gamma spikes or deflections in this area were less than 150 gamma counts per second.

Gamma spikes were primarily concentrated in the vicinity of the Little Badlands (T138N, R97 & 98W). The zones of increased radioactivity in this area generally occur at or beneath the base of the White River Group or in the first carbonaceous layer below the base of that unconformable contact. The highest gamma value (425 gcps) was found at the base of the White River Group in T138N, R97W, section 22. In addition to this stratigraphic horizon, elevated counts were also detected in carbonaceous layers (typically thin lignites) and sandstones more than 200 feet beneath the base of the White River Group.

References

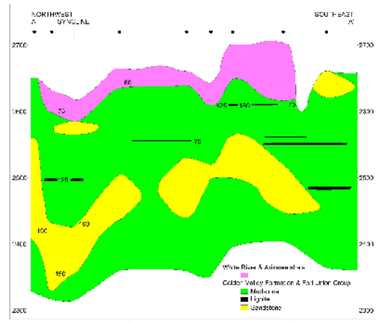
Biek, R.F., Murphy, E.C., 1997, Dickinson geology: a guide to the geology, mineral resources, and geologic hazards of the Dickinson area: North Dakota Geological Survey Geologic Investigations No. 1, 76 p.

Denson, N.M., and Gill, J.R., 1965, Uranium-bearing lignite and carbonaceous shale in the southwestern part of the Williston Basin – a regional study: United States Geological Survey Professional Paper 463, 75 p.

Murphy, E.C., 2005, The surface geology of the Taylor Quadrangle: North Dakota Geological Survey 24k map series Ts16 - sg, 1:24,000 scale.

Murphy, E.C., 2006, The lignite resources of North Dakota: North Dakota Geological Survey Report of Investigation No. 104, 141 p.

Murphy, E.C., Hoganson, J.W., and Forsman, N.F., 1993, The Chadron, Brule, and Arikaree Formations in North Dakota; the buttes of southwestern North Dakota: North Dakota Geological Survey Report of Investigation No. 96, 144 p.



A cross-section through White River, Golden Valley, and Fort Union strata in the Little Badlands, Stark County. The numbers within the diagram are the gamma counts per second (gcps) on gamma spikes measured from the shale line of the gamma log. The gcps are plotted to the right of the corresponding borehole and at the stratigraphic position they were detected.

Geologic Symbols

- Geophysical logs that contain one or more gamma spikes, indicating the presence of Uranium.
- Geophysical logs that do not contain gamma spikes. Data points include coal exploration and subsurface mineral drill holes, oil and gas wells, and ND State Water Commission drill holes.

Axis of Syncline
Axis of Syncline - Approximated
Lineaments
A —— A' Cross-Section

Other Features

Water
Water - Intermittent
Water - Inundated
River/Stream - Perennial
River/Stream - Intermittent
County Boundary
Interstate Highway
State Highway
Paved Road
Unpaved Road
Section Corners

Scale 1:100,000

0 1 2 3 4
Miles

Mercator Projection 1927 North American Datum
Standard parallel 46° 30' Central meridian 102° 30'
USGS NED Shaded Relief - Vertical Exaggeration 9 x

Cartographic Compilation: Elroy L. Kadrmas