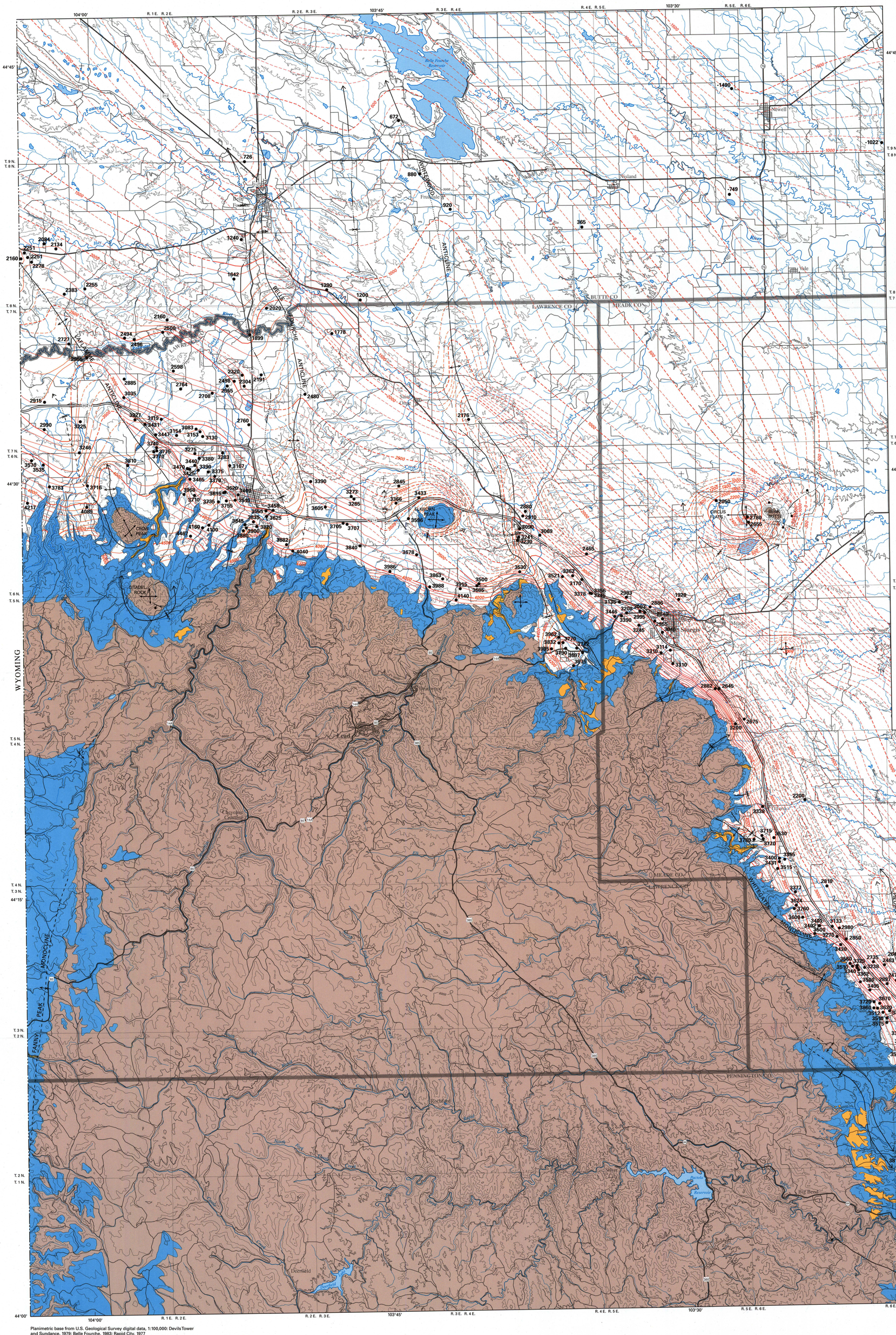
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
SOUTH DAKOTA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
AND THE WEST DAKOTA WATER DEVELOPMENT DISTRICT

HYDROLOGIC INVESTIGATIONS ATLAS HA-744-C
Northern part of area —SHEET 1 OF 2
Carter, J.M., and Redden, J.A., 1999, Altitude of the Top of the Minnelusa Formation in the Black Hills Area, South Dakota



Planimetric base from U.S. Geological Survey digital data, 1:100,000: Devils Tower and Sundance, 1979; Belle Fourche, 1983; Rapid City, 1977
Topographic base modified from U.S. Geological Survey digital data, 1:24,000, from maps dated 1950-84
Universal Transverse Mercator projection
Zone 13
North American Horizontal Datum 1927

INTRODUCTION

This map is a product of the Black Hills Hydrology Study, which was initiated in 1990 to assess the quantity, quality, and distribution of surface water and ground water in the Black Hills area of South Dakota (Driscoll, 1992). This long-term study is a cooperative effort between the U.S. Geological Survey (USGS), the South Dakota Department of Environment and Natural Resources, and the West Dakota Water Development District, which represents various local and county cooperators. This map is part of a series of 1:100,000-scale maps for the study. The maps include a hydrogeologic map, structure-contour maps (altitudes of the tops of formations) for five formations that contain major aquifers in the study area, and potentiometric maps for these five major aquifers (the Inyan Kara, Minnekahta, Minnelusa, Madison, and Deadwood aquifers).

The study area consists of the topographically defined Black Hills and adjacent areas located in western South Dakota. The Black Hills area is an elongated, dome-shaped feature, about 125 miles long and 60 miles wide, which was uplifted during the Laramide orogeny (Feldman and Heimlich, 1980). The oldest geologic units in the study area are Precambrian metamorphic and igneous rocks, which are exposed in the central core of the Black Hills. Surrounding the Precambrian core is a layered series of sedimentary rocks including limestones, sandstones, and shales that are exposed in roughly concentric rings around the uplifted flanks of the Black Hills. The bedrock sedimentary units typically dip away from the uplifted Black Hills at angles that approach or exceed 10 degrees near the outcrops, and decrease with distance from the uplift. Many of the sedimentary units contain aquifers, both within and beyond the study area. Recharge to these aquifers occurs from infiltration of precipitation upon the outcrops and, in some cases, from infiltration of streamflow (Hortness and Driscoll, 1998). Artesian conditions generally exist within these aquifers where an upper confining layer is present. Flowing wells and artesian springs that originate from confined aquifers are common around the periphery of the Black Hills.

The purpose of this map is to show the altitude of the top (structure contours) of the Minnelusa Formation within the area of the Black Hills Hydrology Study. The depth to the top of the Minnelusa Formation can be estimated at a specific site by subtracting the altitude of the top of the formation from the topographic elevation. However, caution is urged in determining the depth to the top of the formation in areas on the map where the contours are approximately located.

SOURCES OF DATA

The outcrops shown on the map are from Strobel and others (1999), and the geologic features are modified from Redden (1994) and Strobel and others (1999). The data points shown on this map were compiled from interpretation of drillers' logs and geophysical logs of water wells and oil, gas, and water test holes, and from information stored in the ground-water database of the USGS National Water Information System. Many of the site locations were field verified during the study. The altitudes of subsurface contacts were data compiled by J. Paul Gries (South Dakota School of Mines and Technology), the South Dakota Geological Survey, and the USGS. In some areas, data were either unavailable or insufficient to adequately determine the depth to the top of the Minnelusa Formation, even though information about deeper formations was available and was used for other maps of this series. Additional information for the wells and test holes used for this map are presented in Carter (1999). In areas where no wells penetrated the Minnelusa Formation, the altitude of the top of the formation was estimated based on the structure contours of the shallower Inyan Kara Group (Carter and Redden, 1999a) and Minnekahta Limestone (Carter and Redden, 1999b). The structure contours in these areas probably are less accurate than in areas nearer the outcrop of the Minnelusa Formation.

DESCRIPTION OF THE MINNELUSA FORMATION

The Pennsylvanian- and Permian-age Minnelusa Formation consists mostly of yellow to red cross-stratified sandstone, limestone, dolomite, and shale (Strobel and others, 1999). In addition to sandstone and dolomite, the lower part of the formation consists of shale and anhydrite (DeWitt and others, 1986). The upper part of the Minnelusa Formation also may contain anhydrite, which generally has been leached to form collapsed breccias in and near the outcrop (Braddock, 1963). The thickness of the Minnelusa Formation within the study area increases from north to south and ranges from 375 feet near Belle Fourche to 1,175 feet near Edgemont. Along the northeastern part of the central Black Hills, there is little anhydrite in the subsurface. Hence, the decreased thickness in this area is due to a change in the depositional environment. On the south and southwest side of the study area, there is a considerable increase in thickness of clastic units as well as a thick section of anhydrite. In the southern Black Hills, the Minnelusa Formation thins in areas very close to the upper contact due to leaching of anhydrite.

The Minnelusa Formation is overlain by the Permian-age Opeche Shale and unconformably overlies the Mississippian-age Madison Limestone. The lower contact of the Minnelusa Formation is irregular due to deposition over the karst surface of the Madison Limestone. As a result, the lowermost lithologies of the Minnelusa Formation may vary considerably.

ALTITUDE OF THE TOP OF THE MINNELUSA FORMATION

The Minnelusa Formation generally dips away from the core of the Black Hills. The dip of the top of the Minnelusa Formation generally is steepest near the outcrop, where it can exceed 20 degrees, and gradually decreases with increasing distance from the outcrop to less than 1 degree near the study area boundary. The altitude of the top ranges from 5,000 feet above sea level (based on the National Geodetic Vertical Datum of 1929) in the southwest part of the study area to 1,500 feet below sea level in the northeastern part.

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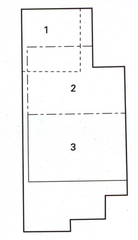
INDEX TO STRUCTURE MAPPING



Structure contours modified from:
1. Peter and others (1987)
2. Peter and others (1988)
3. Peter and others (1991)

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—2000

SCALE 1:100,000
2 1 0 2 4 6 8 10 MILES
2 1 0 2 4 6 8 10 KILOMETERS
LAND SURFACE CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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Altitude of the Top of the Minnelusa Formation in the Black Hills Area, South Dakota

By
Janet M. Carter and Jack A. Redden

1999

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