DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

WATER-RESOURCES INVESTIGATIONS 82-4027

INTRODUCTION

In 1978 the U.S. Geological Survey began a 4-year study of aquifers in the northern Great Plains. The purpose of this map, which is a product of that study, is to show the altitude of the top of the Judith River Formation. Other maps show the total thickness (Feltis, 1982a), cumulative thickness of sandstone (Feltis, 1982b), and potentiometric surface of water (Levings, 1982) in the Judith River Formation. These maps are part of a series that describes the geology and potentiometric surface of selected rock units of Jurassic or younger age in the plains area of Montana.

SOURCE OF DATA

Most geologic data used to compile the map have been obtained from records of oil and gas exploration wells on file in offices of the Montana Department of Natural Resources and Conservation and the U.S. Geological Survey. The data were derived from interpretation of geophysical logs of oil or gas test wells. One site per township was the optimum density of data selected for map compilation; however, geophysical logs were not available for all townships.

JUDITH RIVER FORMATION

The Upper Cretaceous Judith River Formation consists of eastward-pointing wedges of nonmarine, regressive-shoreline, and shallow-water marine strata that are enclosed by the westward-pointing wedges of Claggett and Bearpaw Shales. The source material for the Judith River Formation and other Cretaceous formations was mostly from a north-trending cordilleran highland in western Wyoming and Montana. The stratigraphy and geologic history of the Judith River Formation are described by Gill and Cobban (1973), who show by stratigraphic diagrams and strandline maps the relationship of the formation to other Cretaceous rocks and the position and direction of strandline movement.

In the Crazy Mountains basin of south-central Montana, the Judith River sediments interfinger with continental sediments of the Cokedale Formation of the Livingston Group. The Cokedale Formation is the westward nonmarine equivalent of the Claggett Shale and part of the Judith River Formation of central Montana, or to part of the Two Medicine Formation of northwestern Montana (Roberts, 1972, p. C45). The Two Medicine Formation crops out on the west flank of the Sweetgrass arch in the northwest part of the study area. The Two Medicine also consists mostly of continental sediments and is equivalent to the Eagle Sandstone, Claggett Shale, and Judith River Formation of the area east of the Sweetgrass arch (Mudge, 1972, p. A73).

Contours were not extended into the Bearpaw Mountains and adjacent areas encompassed by the wide dashed line on the map in north-central Montana. In these areas, continuity of the Judith River Formation has been disturbed by large-scale gravity slides away from the Bearpaw Mountains and by extensive thrust faulting and rifting, tilting, and collapse of the rocks in the slide sheets. These geologic features are described by Reeves (1925) and Hearn (1976). No attempt was made to extend contours into the Crazy Mountains basin in the southwestern part of the area or on the west flank of the Sweetgrass arch because of the complexity of the interfingering sediments of the marine sequence of central Montana with the continental sediments from the west.

STRUCTURAL FEATURES

The map shows the range in altitude and the configuration of several structural features. The Williston basin and Blood Creek syncline in the northeastern part of the area are separated from the Powder River basin to the south by the Miles City arch. In central Montana the Bowdoin dome, part of the structure within the Big Snowy anticlinorium, and the Bull Mountains basin are shown.

REFERENCES CITED

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Gill, J. R., and Cobban, W. A., 1973, Stratigraphy and geologic history of the Montana Group and equivalent rocks, Montana, Wyoming, and North and South Dakota: U.S. Geological Survey Professional Paper 776, 37 p.

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Levings, G. W., 1982, Potentiometric-surface map of water in the Judith River Formation in the northern Great Plains area of Montana: U.S. Geological Survey Open-File Report 82-562, scale 1:1,000,000.

Mudge, M. R., 1972, Pre-Quaternary rocks in the Sun River Canyon area, northwestern Montana: U.S. Geological Survey Professional Paper 663-A, p. A1-A142.

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Roberts, A. E., 1972, Cretaceous and early Tertiary depositional and tectonic history of the Livingston area, southwestern Montana: U.S. Geological Survey Professional Paper 526-C, p. C1-C120.

Ross, C. P., Andrews, D. A., and Witkind, I. J., 1955, Geologic map of Montana: U.S. Geological Survey, scale 1:500,000, 2 sheets.

METRIC CONVERSION TABLE

The following factors can be used to convert inch-pound units in this report to the International System of units (SI):

Multiply inch-pound unit	By	To obtain SI unit
foot	0.3048	meter
mile	1.609	kilometer

National Geodetic Vertical Datum of 1929: A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level.

EXPLANATION

- CRETACEOUS and TERTIARY — LIVINGSTON GROUP AND LOWER PART OF THE FORT UNION FORMATION--Includes the Cokedale Formation, which is equivalent to the Claggett Shale and part of the Judith River Formation in central Montana
- CRETACEOUS — TWO MEDICINE FORMATION--Equivalent to the Eagle Sandstone, Claggett Shale, and Judith River Formation on the east flank of the Sweetgrass arch
- JUDITH RIVER FORMATION--Pattern shows general area of outcrop
- CONTACT--Dashed where concealed by alluvium or terrace deposits
- INFERRED CONTACT--The Judith River Formation has not been recognized in the Black Hills uplift, although an interval on geophysical logs indicates that an equivalent of the Judith River Formation is present in this area
- THRUST FAULT--Sawteeth on upper plate
- NORMAL FAULT--Approximately located. U, upthrown side; D, downthrown side
- FAULT ZONE OR LINEAMENT--Arrows, where shown, indicate relative horizontal movment
- 3000 — STRUCTURE CONTOUR--Shows altitude of the top of the Judith River Formation. Hachures indicate depression contour. Contour intervals 250 and 500 feet. National Geodetic Vertical Datum of 1929
- CONTROL POINT--Location of oil or gas test well
- BOUNDARY OF COMPLEX GEOLOGIC STRUCTURE--Encloses general area of gravity slides, thrust faults, and associated structural features that greatly distort the configuration of the top of the Judith River Formation in the vicinity of the Bearpaw Mountains

Study area
MONT. N. DAK. S. DAK. WYO. NEBR.
Approximate boundary of northern Great Plains

Base from U.S. Geological Survey
State base map, 1968

Scale 1:1 000 000
0 10 20 30 40 MILES
0 10 20 30 40 KILOMETERS

Geologic contacts from Ross, Andrews, and Witkind (1955). Structural features from Dobbin and Erdmann (1955)

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1983

MAP SHOWING ALTITUDE OF THE TOP OF THE JUDITH RIVER FORMATION, MONTANA

by
R. D. Feltis
1982

Helena, Montana