DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

WATER-RESOURCES INVESTIGATIONS 82-4034

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 Eagle Sandstone. Other maps show the total thickness (Feltis, 1982a) and the cumulative thickness of sandstone (Feltis, 1982b) in the combined Eagle Sandstone and Telegraph Creek Formation, and the potentiometric surface of water in the Eagle Sandstone and equivalent units (Levings, 1982). 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.

EAGLE SANDSTONE

The Upper Cretaceous Eagle Sandstone is an eastward-pointing wedge of nonmarine, regressive-shoreline, and shallow-water marine strata. The Eagle generally consists of the basal Virgelle Sandstone Member, a middle shale, and an upper sandstone unit. The underlying Upper Cretaceous Telegraph Creek Formation is a sequence of shallow-water marine shale, siltstone, and fine-grained sandstone that is transitional between shale of the Colorado Group and the Eagle. Overlying the Eagle is a westward-pointing wedge of the Claggett Shale. The source material for the Eagle Sandstone and other Cretaceous formations was mostly from a north-trending cordilleran highland in western Wyoming and Montana. The stratigraphy and geologic history of the Eagle Sandstone and Telegraph Creek 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.

The Eagle Sandstone of central Montana grades into a sandy shale in east-central Montana. Johnson and Smith (1964, p. 40) report this gradation from sec. 17, T. 15 N., R. 30 E., southeastward to sec. 22, T. 14 N., R. 31 E., where "***both the upper and lower members grade laterally into sandy shale and cannot readily be identified; in this area also, the Eagle Sandstone and underlying Telegraph Creek Formation cannot be differentiated." Similar descriptions of this lateral gradation are given by Knechtel (1959, p. 743) for the Little Rocky Mountains area and Richards (1955, p. 58) for the Little Bighorn River area in south-central Montana. In eastern Montana, the top of the Eagle Sandstone was picked on geophysical logs at the base of the Ardmore Bentonite Bed of the Claggett Shale.

In central Montana the Upper Cretaceous marine sandstone and shale sequence of rocks grades laterally and interfingers with continental deposits from the west. On the west side of the Sweetgrass arch, the Eagle is represented only by the Virgelle Sandstone Member. The middle and upper members of the Eagle, as known east of the Sweetgrass arch, are equivalent to part of the continental deposits of the Two Medicine Formation west of the arch (Mudge, 1972, p. A73-A74). In the western part of the Crazy Mountains basin the Eagle Sandstone is gradationally overlain by the Cokedale Formation of the Livingston Group (Roberts, 1972, p. C31) and in the eastern part of the basin the Eagle is overlain by the Claggett Shale, which contains numerous beds of sandstone. Because of the complexity of the stratigraphy, with interfingering of sandstone beds of the Cokedale, Claggett, and Eagle Formations, the contours were not extended across the Crazy Mountains basin.

Contours also were not extended into the Bearpaw Mountains and adjacent areas encompassed by the dashed line in the north-central part of the map. The continuity of the Eagle Sandstone was disturbed by large-scale gravity slides away from the Bearpaw Mountains and by the extensive thrust faults and rifting, tilting, and collapse of the rocks that occurred in the slide sheet. These geologic features are described by Reeves (1925) and Hearn (1976) but are not shown in detail on the State geologic map (Ross and others, 1955). However, the State geologic map shows areas of thrust faults south of the mountains.

STRUCTURAL FEATURES

The map shows the range in altitude and the configuration of several structural features. The Williston and Powder River basins of eastern Montana are separated by the Miles City arch and Cedar Creek anticline. In central Montana the map shows the Hogeland basin, Bowdoin dome, Blood Creek syncline, the eastern part of the Big Snowy anticlinorium, and the Bull Mountains and Wheatland basins. Part of the west flank of the Sweetgrass arch, east side of Crazy Mountains basin, and north end of Big Horn basin are also shown. These and other structural features are shown on the map by Dobbin and Erdmann (1955).

REFERENCES CITED

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Reeves, Frank, 1925, Geology and possible oil and gas resources of the faulted area south of the Bearpaw Mountains, Montana, Part 2 of Contributions to economic geology: U.S. Geological Survey Bulletin 751-C, p. 71-114.

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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

EAGLE SANDSTONE--Includes Virgelle Sandstone Member, but not the underlying Telegraph Creek Formation. Pattern shows general area of outcrop

VIRGELLE SANDSTONE MEMBER OF EAGLE SANDSTONE--Pattern shows general area of outcrop west of the Sweetgrass arch where the middle and upper members of the Eagle Sandstone are equivalent to part of the Two Medicine Formation

CONTACT--Dashed where concealed by alluvium or terrace deposits. In the southeast corner of the State, the top of the Eagle-Telegraph Creek interval has not been mapped, although it can be identified on geophysical logs. Therefore, the contact in that area is the base of the Telegraph Creek or the top of the underlying Niobrara Formation as shown on the State geologic map (Ross and others, 1955). In the south-central part of the State, in the vicinity of the Little Bighorn River, the dashed line represents the top of the Eagle-Telegraph Creek interval where it cannot be differentiated from the overlying rock unit

THRUST FAULT--Sawteeth on upper plate

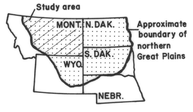
NORMAL FAULT--Approximately located. U, upthrown side; D, downthrown side

FAULT ZONE, LINEAMENT, OR TREND--Arrows, where shown, indicate relative horizontal movement

-500- STRUCTURE CONTOUR--Shows altitude of the top of the Eagle Sandstone. Hachures indicate depression contour. Contour intervals 500 and 1,000 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 Eagle Sandstone in the vicinity of the Bearpaw Mountains



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)

MAP SHOWING ALTITUDE OF THE TOP OF THE EAGLE SANDSTONE, MONTANA

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Helena, Montana

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