

Base from U.S. Geological Survey 1:250,000 series: Woodward Quadrangle, 1965, revised 1971. Scale 1:250,000. Contour interval 100 feet with supplementary contours at 50 foot intervals. Datum: Mean Sea Level.

FIGURE 1: GEOLOGIC MAP

INTRODUCTION

Urbanization, economic growth, and improved standards of living in rural areas of Oklahoma require ever-increasing amounts of water. Basic information on the availability and usability of water is needed in many parts of the State by planners and individual water users for development of this vital resource. Recognizing the need for such information on a regional basis, the Oklahoma Geological Survey requested the U.S. Geological Survey to make reconnaissance appraisals of the water resources, with special emphasis on ground water, in selected areas of the State. The Woodward Quadrangle, which includes about 7,800 square miles in northwestern Oklahoma, was selected for appraisal because of the need for information on the distribution and hydrologic characteristics of the various aquifers, surface-water resources, and chemical quality of both ground and surface waters.

Information used to appraise the water resources of the Woodward Quadrangle was obtained from field investigations, U.S. Geological Survey reports and files, State and other Federal agencies, and private industries. The Oklahoma Water Resources Board, Oklahoma State Department of Health, Farmers Home Administration, U.S. Soil Conservation Service, city officials, representatives of rural water districts, and many farmers and ranchers provided information on the area's water resources.

For readers interested in using the metric system, the English units used in this report can be converted to metric units by the following conversion factors:

| From                                       | Multiply by         | To obtain                           |
|--|---------------------|-------------------------------------|
| Unit: Abbreviation:                        | Unit: Abbreviation: |                                     |
| Inch (in)                                  | 2.54                | Centimeter (cm)                     |
| Foot (ft)                                  | 0.3048              | Meter (m)                           |
| Mile (mi)                                  | 1.609               | Kilometer (km)                      |
| Square mile (sq mi)                        | 2.590               | Square kilometer (km <sup>2</sup> ) |
| Acre                                       | 4047                | Square meters (m <sup>2</sup> )     |
| Gallon (gal)                               | 3.78543             | Liter (l)                           |
| Cubic feet per second (ft <sup>3</sup> /s) | 28.32               | Liters per second (l/s)             |

GEOLOGIC AND TOPOGRAPHIC SETTING

The Woodward Quadrangle is in the Central Lowland and Great Plains provinces of the Interior Plains and is part of the Arkansas River drainage basin. Except for scattered, small outliers of rocks of Cretaceous age, the area is underlain by Permian bedrock (fig. 1) with reported dips ranging from 4 to 30 feet per mile and averaging 17 feet per mile south-southwest. Deposits of Tertiary and Quaternary age are nearly horizontal. No significant structural anomalies are known; however, sinkhole development, caused by ground water dissolving and removing bedded salt or gypsum, has resulted in minor localized folding in most rocks.

SOURCES OF GEOLOGIC MAPPING

The sources of information used to compile the geologic map of the Clinton Quadrangle are listed below; the area included in each source is shown in figure 2.

- Alexander, W. B., 1965, Areal geology of southern Dewey County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 42 p.
- Birchum, J. M., 1963, Areal geology of northwest Dewey County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 33 p.

- Fay, R. O., 1962, Geology and mineral resources of Blaine County, Oklahoma: Oklahoma Geological Survey Bulletin 89, 258 p.
- 1965, Geology and mineral resources of Woods County, Oklahoma: Oklahoma Geological Survey Bulletin 106, 189 p.
- 1972, Unpublished field maps: Oklahoma Geological Survey.
- Hamilton, William, Jr., 1962, Areal geology of Fairview area, Major County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 73 p.
- Jeary, G. L., 1961, Areal Geology of western Major County, Oklahoma: University of Oklahoma unpublished M.S. thesis, 130 p.
- Kitts, D. B., 1965, Geology of the Cenozoic rocks of Ellis County, Oklahoma: Oklahoma Geological Survey Circular 69, 30 p.
- Lovett, F. D., 1960, Areal geology of the Quartermaster area, Roger Mills and Ellis Counties, Oklahoma: University of Oklahoma unpublished M.S. thesis, 81 p.
- Miser, H. D., and others, 1954, Geologic map of Oklahoma: Oklahoma Geological Survey and U.S. Geological Survey, scale 1:500,000.
- Myers, A. J., 1959, Geology of Harper County, Oklahoma: Oklahoma Geological Survey Bulletin 80, 108 p.
- 1970, Unpublished manuscript maps: Oklahoma Geological Survey.

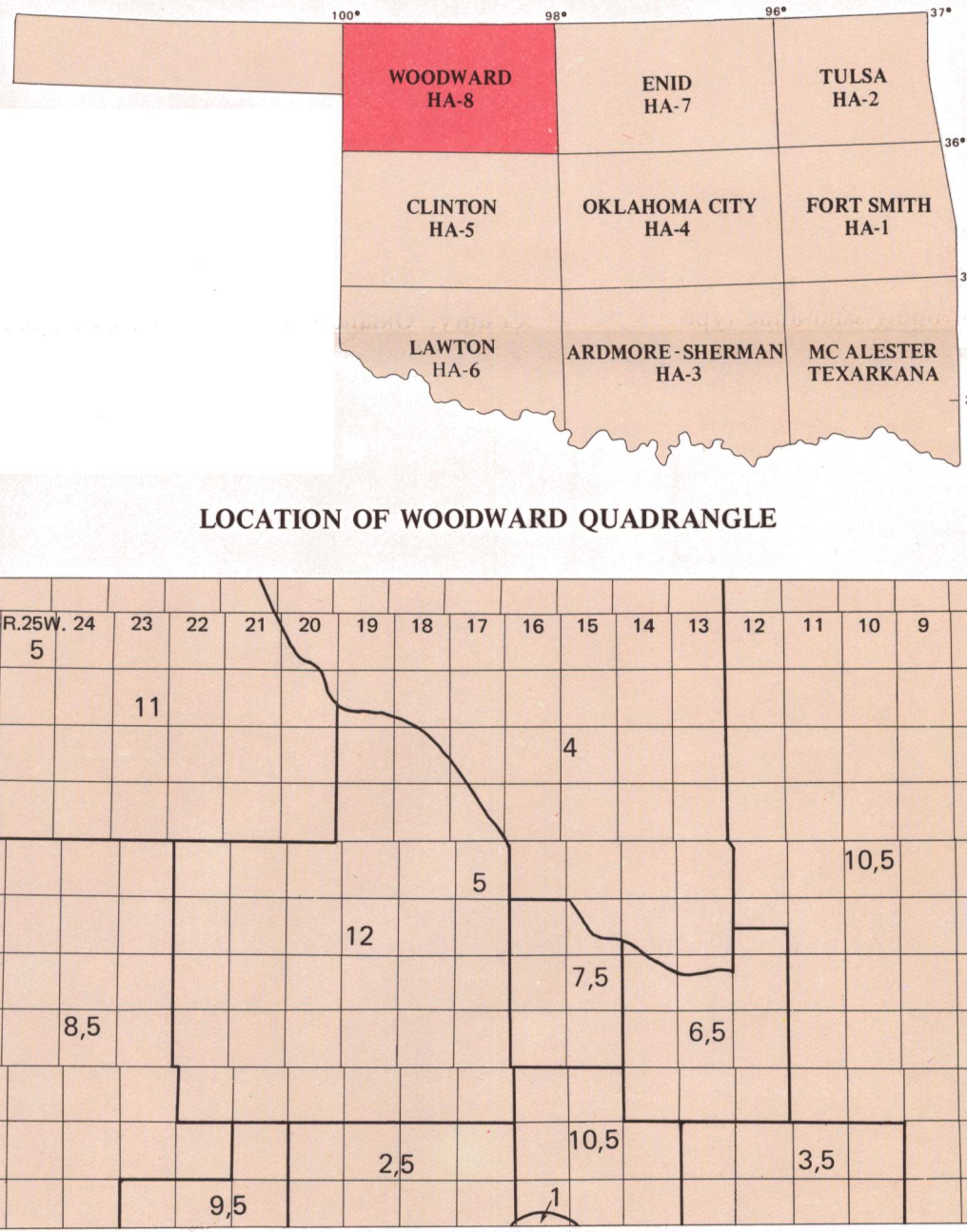


FIGURE 2: INDEX TO GEOLOGIC MAPPING

EXPLANATION

The stratigraphic nomenclature and age determinations used herein are those accepted by the Oklahoma Geological Survey and do not necessarily agree with those of the U.S. Geological Survey.

- ALLUVIUM: Lenticular and interfingering deposits of gravel, sand, silt, and clay. Generally light-tan to gray. Thickness along major streams ranges up to 100 feet and probably averages 40 feet; along minor streams the thickness ranges up to 45 feet and probably averages 20 feet.
- OGALLALA FORMATION: Gravel, sand, silt, clay, caliche, and limestone, locally cemented with calcium carbonate. Generally light-tan to gray to white. Thickness ranges up to 400 feet and probably averages 150 feet.
- KIOWA FORMATION: Gray and yellow shale and limestone, with many *Texigryphaea* shells locally. At base is 5 to 10 feet of greenish-gray sandstone in places. Thickness ranges up to 140 feet with top eroded.

- DOXEY FORMATION: Red-brown shale and siltstone, with greenish-gray calcareous siltstone at base. Exposed thickness is 30 feet, with top eroded.
- CLOUD CHIEF FORMATION: Red-brown and greenish-gray shale and siltstone with some orange-brown fine-grained sandstone and siltstone. At base are two or more thin, pink to maroon to greenish-gray dolomite beds and (or) gypsum beds (*Moccasin Creek Bed*), eroding into a mappable escarpment. About 25 feet above the base is a white to light-gray dolomite (*Day Creek Bed*) not mapped. Thickness ranges up to 160 feet, with top eroded in many places.
- RUSH SPRINGS FORMATION: Orange-brown fine-grained sandstone, commonly cross-bedded, with some interbedded red-brown shale, silty shale, and gypsum beds. In southern part of area, about 30 feet below top is a thin massive gypsum bed (*Weatherford* or *One Horse Bed*), not mapped here but mapped by Miser and others (1954) as basal Cloud Chief. About 100 feet lower is another thin gypsum (*Old Crow Bed*), not mapped here but mapped by Miser and others (1954) as top of Marlow. Thickness is about 150 feet in southern part and 90 feet near Kansas border, with top eroded in many places.
- MARLOW FORMATION: Orange-brown fine-grained sandstone and siltstone, with some interbedded red-brown shale and silty shale in upper part and some thin gypsum beds at base, about 35 feet above base, and at top. The upper two gypsum and (or) dolomite beds are generally pink to maroon and less than 1 foot thick; they may erode into mappable escarpments about 20 feet apart, being named *Emanuel Bed* at top (mapped) and *Relay Creek Bed* 15 to 20 feet below the top (not mapped). In places the basal Marlow is a greenish-gray medium-grained sandstone. In Woods and Woodward Counties, the *Doe Creek Lentil* (Pmd) is a coarse-grained calcareous sandstone with algal clumps and invertebrate fossils, ranging up to 70 feet thick from the base of the Marlow to the Relay Creek Bed, cropping out in a narrow band of high hills striking northeast. Thickness is about 120 feet, with top eroded at many places.
- DOG CREEK SHALE: Red-brown shale and silty shale, with gypsum, dolomite, and orange-brown sandstone. In upper part are many thin, dense light-gray dolomite beds, the basal one of which is named *Southard Bed* (unmapped); in lower part is much salt-spar gypsum with a greenish-gray dolomite at top termed *Wagona Bed* (unmapped). Thickness ranges from 30 feet or less at Kansas border to 100 feet in southern part of area.
- BLAINE FORMATION: Alternating cyclic sequence of 3 or 4 massive gypsum beds with red-brown shales, generally with a named dolomite at the base of each gypsum bed and a greenish-gray shale at the base of each dolomite. The named unmapped sequence is (ascending) *Cedar Springs Dolomite*, *Medicine Lodge Gypsum*, shale, *Maggie Dolomite*, *Nescatunga Gypsum*, shale, *Altona Dolomite*, *Shiner Gypsum*, shale, and *Haskew Gypsum* at top. Thickness ranges up to 90 feet, with the shales being thinner northward.
- FLOWERPOT SHALE AND CHICKASHA FORMATION: Red-brown silty shale with some thin gypsum and dolomite beds in upper 50 feet and fine-grained sandstones in upper part to north. The middle and upper parts contain 50 feet or more of rock salt in the immediate subsurface, giving origin to the Ferguson Salt Plain in Blaine County and the Big and Little Salt Plains in Woods and Harper Counties on the Cimarron River. Thickness ranges from 180 feet in north part to 430 feet in south part. The *Chickasha Formation* (Pc) is a deltaic tongue of red-brown to greenish-gray to orange-brown cross-bedded mudstone conglomerate, siltstone, shale, and fine-grained sandstone, about 30 feet thick, in the middle of the Flowerpot, pinching out northward.
- CEDAR HILLS SANDSTONE: Orange-brown to greenish-gray fine-grained sandstone and siltstone, with some red-brown shale. Thickness ranges up to 180 feet, with more sandstone to the north and more shale to the south.
- BISON FORMATION: Mostly orange-brown to greenish-gray fine-grained sandstone. Thickness ranges up to 120 feet.
- SALT PLAINS FORMATION: Orange-brown fine-grained sandstone and siltstone, with a greenish-gray sandstone in middle 30 feet (*Crisfield Sandstone Member*) unmapped. Thickness ranges up to 160 feet.
- KINGMAN FORMATION: Orange-brown to greenish-gray fine-grained sandstone and siltstone, with some red-brown shale. Thickness is about 70 feet.
- FAIRMONT SHALE: Red-brown blocky shale with some greenish-gray calcitic siltstones. Thickness ranges up to 160 feet.

RECONNAISSANCE OF THE WATER RESOURCES OF THE WOODWARD QUADRANGLE, NORTHWESTERN OKLAHOMA

By  
Robert B. Morton  
U.S. Geological Survey  
1980