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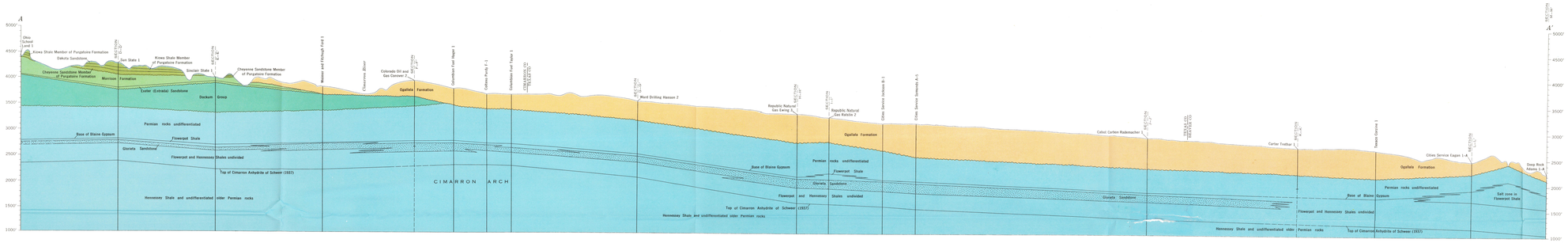

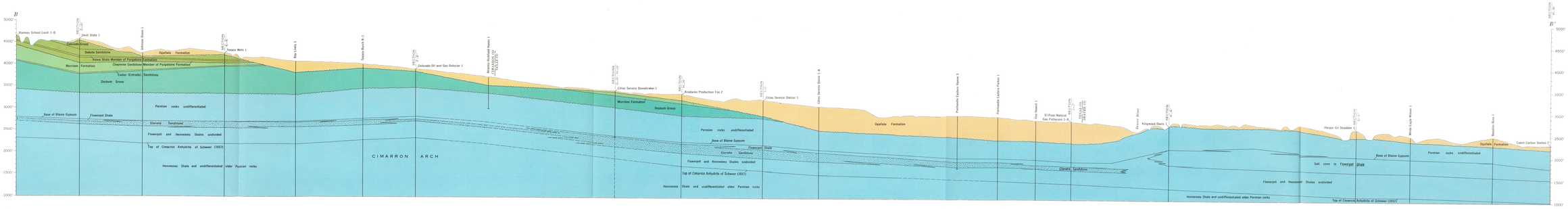

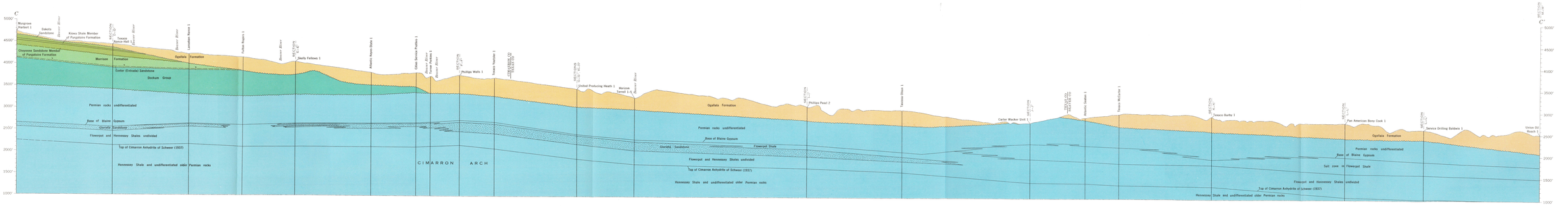

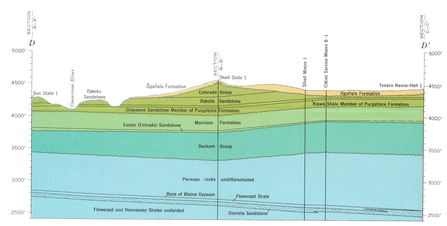

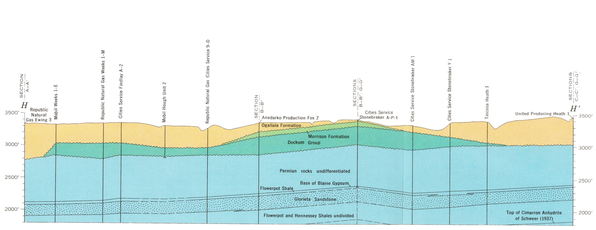

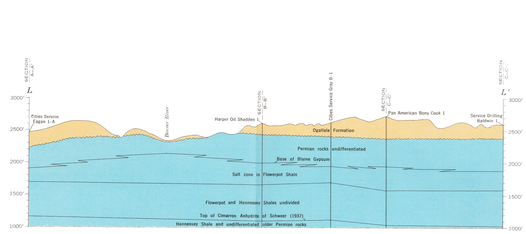

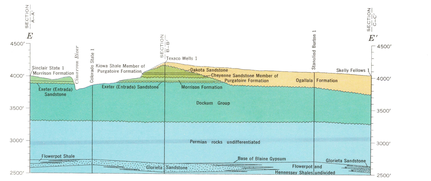

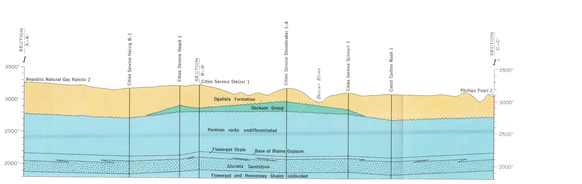

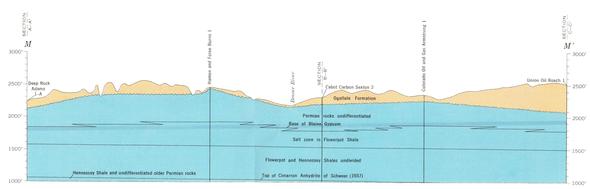

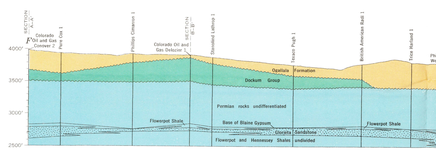

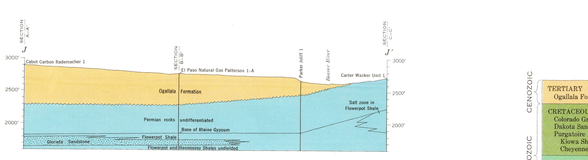

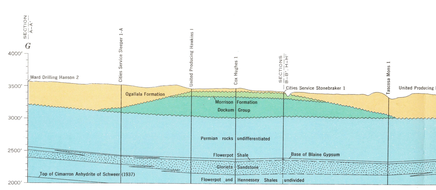

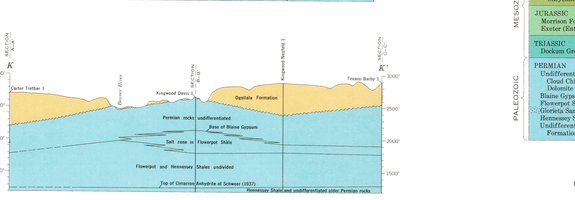

EXPLANATION

CENOZOIC

TERTIARY
- Ogallala Formation

MESOZOIC

CRETACEOUS
- Colorado Group
- Dakota Sandstone
- Purgatoire Formation
  - Kiowa Shale Member
  - Cheyenne Sandstone Member

JURASSIC
- Morrison Formation
- Exeter (Entrada) Sandstone

TRIASSIC
- Dockum Group

PALEOZOIC

PERMIAN
- Undifferentiated—may include Dog Creek Shale, Whitehorse Group, Cloud Chief Formation, and Quartermaster Formation. Alibates Dolomite Lentil occurs in upper part of Quartermaster Formation.
- Blaine Gypsum
- Flowerpot Shale
- Glorieta Sandstone
- Hennessey Shale—includes Cimarron Anhydrite
- Undifferentiated older Permian—mostly units of the Wellington Formation. May include upper part of Chase Group

Conformable contact between formations
Dashed where inferred

Unconformable contact between formations
Dashed where inferred

5 0 5 10 15 20 MILES

5 0 5 10 15 20 KILOMETERS

VERTICAL EXAGGERATION × 26.4
DATUM IS MEAN SEA LEVEL

GEOLOGIC SECTIONS

The sections are based on subsurface geologic information obtained from 129 electric logs, 48 commercial sample logs of oil and gas tests, and 34 drillers' logs of water wells or test holes. For some oil and gas tests a commercial sample log and an electric log were available; for others, only one of the three types of logs was obtainable. Most of the sample and drillers' logs were for wells in Cimarron County. The large vertical exaggeration on the geologic sections was necessary to show stratigraphic relations and formation thicknesses in the desired detail.

HYDROLOGY

Rocks of Permian age.—The undifferentiated older Permian rocks, Hennessey Shale and Flowerpot Shale are not important sources of ground water because of low transmissivity, unconomical depth, and poor water quality.

Water samples from the Glorieta Sandstone have not been analyzed chemically by the U.S. Geological Survey. However, oil company records of analyses of water from the Glorieta in three wells in Texas County show that chloride concentrations range from about 10,000 to 30,000 mg/l (milligrams per liter) and that dissolved-solids concentrations are about 63,000 mg/l. These analyses indicate that water in the Glorieta Sandstone in the Oklahoma Panhandle is highly mineralized and, therefore, is not chemically suitable for ordinary use without desalting. Oil- and gas-field brines have been disposed into the Glorieta for a number of years and locally may have further degraded the quality of the water.

Permian rocks less than 500 feet below the surface in Beaver County may be a source of water for stock and domestic use in localities where water from other aquifers is unavailable. This water has high concentrations, 5,000 mg/l or more, of dissolved minerals, and well yields are small, about 10 gpm (gallons per minute) or less. Water in these rocks is under artesian pressure and may flow from some wells.

Although the base of fresh water in the Oklahoma Panhandle has not been mapped in detail, a few chemical analyses of water samples and interpretation of electric logs of many oil and gas tests in the area indicate that water of poor quality generally may be expected in rocks of Permian age and in younger rocks at depths greater than 1,200 feet below land surface. Salt and gypsum mainly are responsible for the poor water quality in rocks of Permian age. Water in these rocks generally is of a sodium chloride or calcium sulfate type, but locally may be a mixture of both types. Water in the Permian and older rocks contains dissolved solids in excess of 1,000 mg/l and generally is unsatisfactory for most uses without treatment or dilution. Leaching of evaporites from outcrops of Permian rocks results in a marked increase in the concentration of dissolved solids in the surface waters of Beaver County.

Rocks of Triassic age.—The lower unit of the Dockum in the Oklahoma Panhandle is equivalent approximately to the Santa Rosa Sandstone aquifer of the Dockum Group in New Mexico and parts of the Texas Panhandle. The Dockum Group is a source of irrigation water in southeastern Baca County, Colo. (Richards and others, 1968, p. 5), where maximum well yields of as much as 2,500 gpm (gallons per minute) are reported. Although aquifer-test data are not available for the lower unit of the Dockum in the Oklahoma Panhandle, physical properties such as grain size and rock thickness are favorable, and the unit is the most extensive potential aquifer of pre-Tertiary age in the area. Well depths necessary to reach the base of the Dockum in the Oklahoma Panhandle range from a few hundred feet in eastern Texas County to 1,200 feet in western Cimarron County. Water from this unit is under artesian pressure and may flow from a well.

Water produced from wells in rocks of Triassic age varies widely in chemical quality; in some areas the water contains more than 1,000 mg/l dissolved solids, and may require dilution to be acceptable for some uses.

Rocks of Jurassic age.—The Exeter (Entrada) Sandstone is relatively thin; otherwise, the size of the sand grains and degree of sorting indicate that the Exeter (Entrada) may be a source of small amounts, 20 gpm or less, of ground water where the chemical quality of water is acceptable. Water from the Exeter (Entrada) is under artesian pressure and may flow from a well.

The Morrison Formation is not an important source of fresh ground water in Oklahoma because of low transmissivity and water quality unacceptable for some uses.

Water from wells in rocks of Jurassic age varies widely in chemical quality; in many areas the water contains more than 1,000 mg/l dissolved solids, may have large concentrations of sodium, potassium, bicarbonate, and sulfate, and may require dilution to be acceptable for some uses.

Rocks of Cretaceous age.—The Cheyenne and Dakota yield water for irrigation, public supply, and domestic and stock use in Cimarron County, and in adjacent areas of Kansas, Colorado, New Mexico, and Texas. In Baca County, Colo., an estimated 75 percent of the irrigation wells obtain all or part of their water from the Dakota Sandstone (U.S. Geological Survey, 1967, p. 16, 21). Irrigation development from rocks of Cretaceous age in Cimarron County currently is limited to a relatively small area in the southwestern part of the county. In many places these Cretaceous sandstones furnish part of the supply for many multiple-screen wells that also obtain water from the overlying Ogallala.

Although yields of wells producing from only the Cheyenne or the Dakota have not been determined in Cimarron County, these rocks are geologically similar to the same units in adjacent areas where they are important aquifers. Yields from the Cheyenne vary widely because of the lithology of the unit; in some areas in Oklahoma where the sandstone is moderately well cemented, yields generally are 10 to 20 gpm or less, but in localities in Colorado where the sandstone is poorly cemented, yields up to 3,000 gpm have been reported. The average measured yield in Baca and southern Prowers Counties, Colo., is 500 gpm (Richards and others, 1968, p. 5), and in Grant and Stanton Counties, Kans., yields as much as 600 gpm are possible where the Cheyenne is predominantly sandstone (Fader and others, 1964, p. 18). Wells tapping the Dakota Sandstone alone generally yield less than 100 gpm in Oklahoma, although yields as large as 500 gpm have been measured in southeastern Colorado.

Water in the Cheyenne is under artesian pressure and may flow from a well. Water in the Dakota Sandstone is unconfined where the formation crops out and where the overlying Ogallala Formation is mostly sandstone and gravel. Where the Ogallala contains shale or clay beds or where rocks of the Colorado Group overlie the Dakota, water in the Dakota is under artesian pressure and may flow from a well.

The Kiowa Shale Member and rocks of the Colorado Group are not important sources of ground water in the Oklahoma Panhandle area mostly because of low transmissivity.

Water in the Cheyenne generally is of good quality and is suitable for irrigation and other uses. In most places it is of the calcium bicarbonate type. The quality of water in the Dakota may differ from one locality to another, but generally is of the calcium bicarbonate type and is acceptable for most uses. In some areas, however, the concentration of iron and fluoride may be high, 0.3 mg/l or more (iron) and 1.7 mg/l or more fluoride; in others the sodium content may be excessive, more than 50–60 percent sodium. Some treatment may be necessary for domestic use. Because much of the water from the Dakota used for irrigation is pumped from multiple-screen wells, dilution by better quality water reduces the adverse effect of poor quality water from the Dakota.

CONCLUSIONS

This preliminary study indicates that the lower unit of the Dockum Group is an undeveloped source of fresh ground water over most of Cimarron County and parts of Texas County as far east as Guymon. The Exeter (Entrada) Sandstone and sandstone of the Morrison Formation may be an additonal source of ground water in the western half of Cimarron County. Although the Cheyenne and Dakota currently yield water for irrigation to multiple-screen wells in the southwestern part of Cimarron County, their area of potential production of fresh ground water is considerably more extensive.

Detailed studies, including collection and interpretation of more comprehensive data on the following subjects, should be made:

1. Regional stratigraphy of the Dockum Group and the Exeter (Entrada), Cheyenne, and Dakota.
2. Configuration of the base of fresh water.
3. Amount of water in storage and transmissivity for each of the four units cited.
4. Additional data on water quality for each unit.
5. Additional well samples and electric logs for better control in establishing subsurface limits of the middle part of the Permian to Tertiary rock units.

See sheet 1 for geologic maps

PRELIMINARY INVESTIGATIONS OF THE HYDROGEOLOGY OF THE PERMIAN TO TERTIARY ROCKS OF THE OKLAHOMA PANHANDLE

By
Robert B. Morton

1973

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1973—G73080