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Geology & Ground Water, Cheyenne County, Nebraska

Robert F. Diffendal Jr.
University of Nebraska - Lincoln, rdiffendal1@unl.edu

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Geology

R.F. Diffendal, Jr., research geologist, Conservation and Survey Division, University of Nebraska, helped prepare this section.

The oldest rock unit exposed in Cheyenne County is the upper part of the Brule Formation, which is the youngest formation of the White River Group of the Oligocene epoch (33-29 million years old). Surface

outcrops, road cuts, and railroad cuts through the Brule Formation occur along the sides of valleys along Lodgepole Creek from just east of Sidney westward to the vicinity of Brownson, along the valley sides of Sidney Draw and its tributaries, and along the sides of an unnamed drainageway northwest of Colton. Test drilling and drilling for wells along the floor of Lodgepole Creek have revealed that the alluvial (stream) deposits from the Deuel-Cheyenne County line in the east to the Point of Rocks in the west are also underlain by the Brule Formation.

Much of the Brule Formation is brown to pink siltstone. The silt-sized grains are dominantly made up of volcanic debris erupted from volcanoes that were active in the Rocky Mountains of Colorado, the Great Basin of Nevada and adjoining states, and possibly other areas during the period of Brule deposition. The volcanic debris was transported to Cheyenne County by wind and deposited as an extensive thick blanket of volcanic ash fragments (glass shards and glass mantled crystals). While most of the Brule siltstones are made up of impure volcanic ash, some strata in the Brule Formation are made up of very pure volcanic ash and may be several feet thick.

Some changes occurred in the Brule Formation after its deposition. Clay minerals were deposited in pore spaces between the silt and sand grains. These minerals form cement that bonds the grains together, producing the siltstone. Fractures developed in the Brule siltstones after cementation occurred. The spacing of these fractures varies within the formation and may be related to the weathering of the near-surface layers of the silts during periods when deposition ceased. Calcium carbonate cemented siltstone concretions also formed in some parts of the Brule Formation, probably as a result of changes in included water chemistry or soil-forming processes.

The Ash Hollow Formation of the Ogallala Group is directly above the Brule Formation in the county. This formation is of Miocene age (10.5-5 million years old). It was deposited on the stream eroded surface of the Brule Formation, mainly by rivers draining out of the Rocky Mountains in Wyoming and northern Colorado. The sediments and rocks of the Ash Hollow Formation include sand and gravel, conglomerates, sands, sandstones, silts, siltstones, and diatomites. These kinds of deposits graded laterally and vertically into one another, just as similar deposits of rivers grade into one another today. Streams transported and deposited sediments of the Ash Hollow Formation directly alongside the higher spots where soils were forming on previously deposited sediments. Through time these streams filled their channels with sediments eroded from the granites and other rocks of the Rocky Mountains and then shifted their positions, cut new channels, and filled these in turn.

In contrast to the tremendous volcanic ash deposits that formed the Brule Formation, the volcanic ash deposits of the Ash Hollow Formation are rarely more than 10 feet thick and generally extend over areas of less than 1 square mile. These ash deposits occur in gullies, swales, ponds, and stream channels that must have been topographically low at the time that the ash was deposited. Ash Hollow ash deposits generally have admixtures of non-volcanic sediments and often appear to have been washed off the surrounding land surfaces into the low spots.

The Ash Hollow Formation is typified by hard calcium carbonate or silica-cemented layers of sandstone or siltstone that form gray ledges that are as much as several feet thick and are separated from one another by softer materials. These so-called "mortar beds" are thought to be remnants of soils formed in the higher areas adjacent to streams during the deposition of the formation. Fossil root structures, "seeds," and other plant fossils in these ledges support this idea.

Material that is younger than that in the Ash Hollow Formation in the county includes unconsolidated windblown silt (loess) and sand covering parts of the uplands on either side of Lodgepole Creek and Sidney Draw, stream deposits (alluvium) beneath valley floors and terraces along the sides of valleys, and slope deposits (colluvium) along the sides of valleys. All of these deposits appear to be relatively young, with most of them less than 20,000 years old.

Strata inclined at angles as much as 9 degrees in the area northwest of Colton and along Rush Creek in the northeastern part of the county indicate that some of the Ash Hollow and older rocks of the county have been deformed by folding or faulting. This deformation may have been responsible for the distribution of ground water and hydrocarbons in some parts of the county.

Ground Water

R.F. Diffendal, Jr., research geologist, Conservation and Survey Division, University of Nebraska, helped prepare this section.

The Brule Formation, which underlies all of Cheyenne County, generally yields only small amounts of water to wells. Large initial yields often followed by rapid declines during pumping may come from wells in fractured parts of the Brule Formation. Wells along the eroded valley sides and on the floors of the valley of Lodgepole Creek and Sidney Draw may be supplied by water from this aquifer.

The Ash Hollow Formation (Ogallala Group) underlies the tablelands and the sides of valleys along Lodgepole Creek and Sidney Draw and also underlies

the valley floor of Lodgepole Creek west of Point of Rocks. Records of test drilling and drilling for irrigation wells indicate that the formation varies from 0 to more than 500 feet in thickness in the county and is thickest in the northern half of the county.

The Ash Hollow Formation is completely saturated below the water table. The saturated thickness where the formation occurs is known to be from less than 35 to more than 290 feet from one part of the county to another. Potential yields to wells vary from little or no yield to more than 1,000 gallons per minute, depending on the thickness of the formation and the kinds of sediments and rocks encountered.

Unconsolidated silts, sands, and pebbles of Quaternary age (younger than 2.8 million years old) are important sources of ground water in the valleys. Municipal supplies for some farms, ranches, villages, and towns along Lodgepole Creek come from these units at least in part.

Municipalities in the county obtain their water from one or more of these three geologic units. Sidney obtains most or all of its water from fractured zones in the Brule Formation. Potter, Gurley, and Dalton obtain water from the Ash Hollow Formation. Lodgepole's water supply comes from Quaternary alluvium.

New wells drilled for irrigation and municipal and industrial supplies are recorded annually. In 1983 the cumulative total of registered irrigation wells in the county was 444, of which 222 used center-pivot systems for water distribution. Most of these wells are in the northern half of the county and along Lodgepole and Cottonwood Creeks and along Sidney Draw. A cumulative total of 31 municipal wells and 13 industrial wells had been drilled in Cheyenne County through 1983.

The supply of ground water is adequate for the needs of most domestic and livestock users in the county. Reliable supplies are most difficult to obtain from areas where the Brule Formation is near the surface. The depth to water varies greatly across the county. The water table occurs at less than 10 feet beneath the surface in areas on the floor of Lodgepole Creek, while it is more than 300 feet beneath the surface of the tablelands at many places.

Water quality throughout the county is generally good. The water ranges from hard to very hard but otherwise is low in mineralization.

Contamination of water supplies is a potential problem. Chemicals introduced during agricultural activities, human and animal wastes that have been improperly disposed, leaking fuel storage tanks, and commercial and household chemicals that have been carelessly discarded are possible sources of contamination. Water supplies should be checked periodically to determine if a problem is developing, particularly in areas where the sources just mentioned are present.