Permian Stratigraphy of Blaine County, Oklahoma—a Preliminary Report[1]

ROBERT O. FAY, Oklahoma Geological Survey
and University of Oklahoma, Norman

Blaine County is in the central part of northwestern Oklahoma, on the northeast flank of the Anadarko basin, and it covers an area of approximately 950 square miles. Permian strata, 1,200 feet thick, chiefly of the El Reno and Whitehorse groups, comprise all the pre-Pleistocene deposits exposed at the surface of the county. With the exception of the youngest beds, all the rocks dip 14 feet per mile southwest. The strike changes from north-northwest in the northern part of the county to west-northwest in the southern part.

Most of the formations consist of red-brown shales, siltstones, and sandstones that are interbedded with thin persistent beds of dolomite and gypsum. Within the county, type localities have been established for the Relay Creek dolomites, the Blaine formation, and three members of the Blaine (Alabaster gypsum, Magpie dolomite, and Altona dolomite). In a forthcoming publication, names will be applied in Blaine County to three

[1] Publication authorized by the Director, Oklahoma Geological Survey

persistent dolomite beds, two in the Dog Creek shale and one at the base of the Blaine formation.

Cloud Chief formation

The youngest bedrock of Blaine County is in the Cloud Chief formation, of which the lower 134 feet is exposed in hills northwest of Eagle City. Here the Cloud Chief consists of sandstone with four interstratified dolomite beds one to four feet thick. The basal dolomite is possibly equivalent to the Weatherford dolomite, and the other dolomite beds are respectively 35 feet, 105 feet, and 130 feet above the base. Other similar dolomites are present in Custer and Washita Counties, but their correlation is not yet established.

Whitehorse group

This group consists of fine-grained sandstone with subordinate shale, distributed in the Rush Springs sandstone above and the Marlow formation below. The thickness of the group in northwestern Blaine County is 260 feet.

Rush Springs sandstone. The top of this formation is the base of the Weatherford dolomite and the base is the Upper Relay Creek dolomite. The Rush Springs sandstone is approximately 150 feet thick near Eagle City and 290 feet thick near Thomas, in Custer County. It is a massive, fine- to coarse-grained sandstone, composed of subangular to subrounded quartz grains with ferruginous and calcareous cement. Cross-bedding is prominent in the upper 20 feet and in many other parts of the formation.

Marlow formation and Relay Creek dolomites. The top of the Marlow is placed at the top of the Upper Relay Creek dolomite, and the basal bed is a greenish-white coarse-grained sandstone 6 inches to 4 feet thick. This formation is predominantly an orange-brown sandstone and siltstone to the south but the basal half is shale or silty shale to the north (see figure 1). The thickness is 102 feet in the southern part of Blaine County, 110 feet in the central part, and 102 feet in the northern part. It is 65 feet thick in Kansas (Green, 1939). The Relay Creek dolomites are named from an area of buttes 3 miles northwest of Greenfield, south of Relay Creek, in central Blaine County. At this locality the Upper Relay Creek dolomite is 9 inches thick and the Lower Relay Creek dolomite is 4 feet thick. They are separated by 28 feet of sandstone. Both dolomite beds and the sandstone between them are abnormally thick. A third dolomite as much as one foot thick occurs 4 to 7 feet beneath the Lower Relay Creek dolomite, but it cannot be found outside this general area.

The Relay Creek dolomites are widely distributed in Blaine County and surrounding areas. They are normally speckled black and maroon, are ¼-2 inches thick, and separated by 20-24 feet of sandstone. At some localities a similar bed occurs about 5 feet below the Upper Relay Creek dolomite, and a definite 2-inch pink shale is found about 6 feet above the Lower Relay Creek dolomite in north-central Blaine County. The lower shale and siltstone division thins to almost nothing to the south and thickens to 50 feet to the north, where gypsum nodules occur. There is a sharp contrast between the basal greenish white to orange-brown Marlow sandstone and the red-brown Dog Creek shale below. Structure contours drawn on the Relay Creek dolomites roughly follow the Marlow and Altona contours, thus indicating that there is no angular unconformity at the base of the Marlow. Structure contours drawn on the Relay Creek dolomites are more closely spaced in the southwest than in the central part of the county, showing steepening of dip toward the axis of the Anadarko basin.

El Reno group

In Blaine County the El Reno group consists mainly of red-brown shale and evaporite beds of gypsum, anhydrite, and dolomite, divided into the Dog Creek shale, Blaine formation, and Flowerpot shale (descending). The contact of the Flowerpot shale with the underlying Cedar Hills formation is indefinite, but measurements made from a bed tentatively chosen as the base yield a thickness of 700 feet for the El Reno group.

Dog Creek shale. This red-brown shale is 170 feet thick in northern Grady County, 180 feet in Blaine County, and only 30 feet thick at the type locality in central Barber County, Kansas (Norton, 1939, fig. 16). The base of the Dog Creek shale is drawn at the top of the Shimer gypsum, or at the underlying Altona dolomite where the Shimer is absent. In Blaine County there are two mappable dolomite members, respectively 100 feet and 50 feet above the base in the southern part of the county. The upper member, a 3-inch gray-brown dense dolomite, can be traced through Blaine County with a constant interval of about 90 feet between it and the Marlow. Northwest, in southwest Major County, this interval is about 40 feet. The lower member is a 3- to 4-foot argillaceous greenish white dolomite that can be traced from northern Canadian County, where it is 50 feet above the Altona dolomite, to Kansas, where it is about 12 feet above the Altona (Norton, 1939, fig. 16). This is definite proof that the northward thinning of the lower part of the Dog Creek to one-fourth its normal thickness is the result of deposition. Therefore, there is no need to assume that lateral gradation or an unconformity exists at the Marlow-Dog Creek boundary, but rather that a change from shale to sand deposition took place in the same body of water. To the south, in Grady County, the formation grades laterally into mudstone conglomerates and siltstones of the Chickasha formation.

Blaine formation. In central Blaine County, at the type locality along Salt Creek Canyon, there are three massive gypsums, each with a dolomite at its base and each separated by red-brown and gray-green shales. In descending order they are the Shimer gypsum with Altona dolomite at base, Nescatunga gypsum with Magpie dolomite at base, and Medicine Lodge gypsum with unnamed dolomite at base. The gypsum beds are respectively 21, 15, and 7 feet thick, and the Altona and Magpie are generally 1 foot thick. The town of Ferguson was located 3 miles east of here and the name Ferguson was applied to this basal gypsum, but this bed has been traced into the Medicine Lodge area of Kansas, confirming the conclusion of Evans (1931), that the Ferguson is identical to Medicine Lodge. Therefore, the name Ferguson is not used in this paper. The total thickness of this formation is 90 feet in the southern part of Blaine County and 75 feet in the northern part. It is 40 feet thick in Kansas (Norton, 1939, fig. 16). All gypsum units gradually thin and pinch out southward in northern Canadian County with additional thickening of the intervening shale units. Farther south in Grady County, this formation grades into the Chickasha mudstone conglomerates and siltstones with only the Altona dolomite and Magpie dolomite remaining. In this area a one-foot gypsum named Pocasset is about 5 feet above the Altona dolomite and is therefore equivalent to the Shimer gypsum. In northern Canadian County and southern Blaine County another gypsum lens appears halfway between the Nescatunga gypsum and the Medicine Lodge gypsum. This is named the Alabaster and is 0-3 feet thick. To the north, all gypsum units thicken (except for the Alabaster, which pinches out), attain a maximum thickness in Major County and Woodward County, and then thin toward Kansas where the upper two are absent and the lower one remains 30 feet thick. The intervening shales thin northward until only 10 feet remains between the Altona dolomite and the top of the 30-foot ledge of Medicine Lodge gypsum (with intervening Nescatunga gypsum and Magpie dolomite miss-

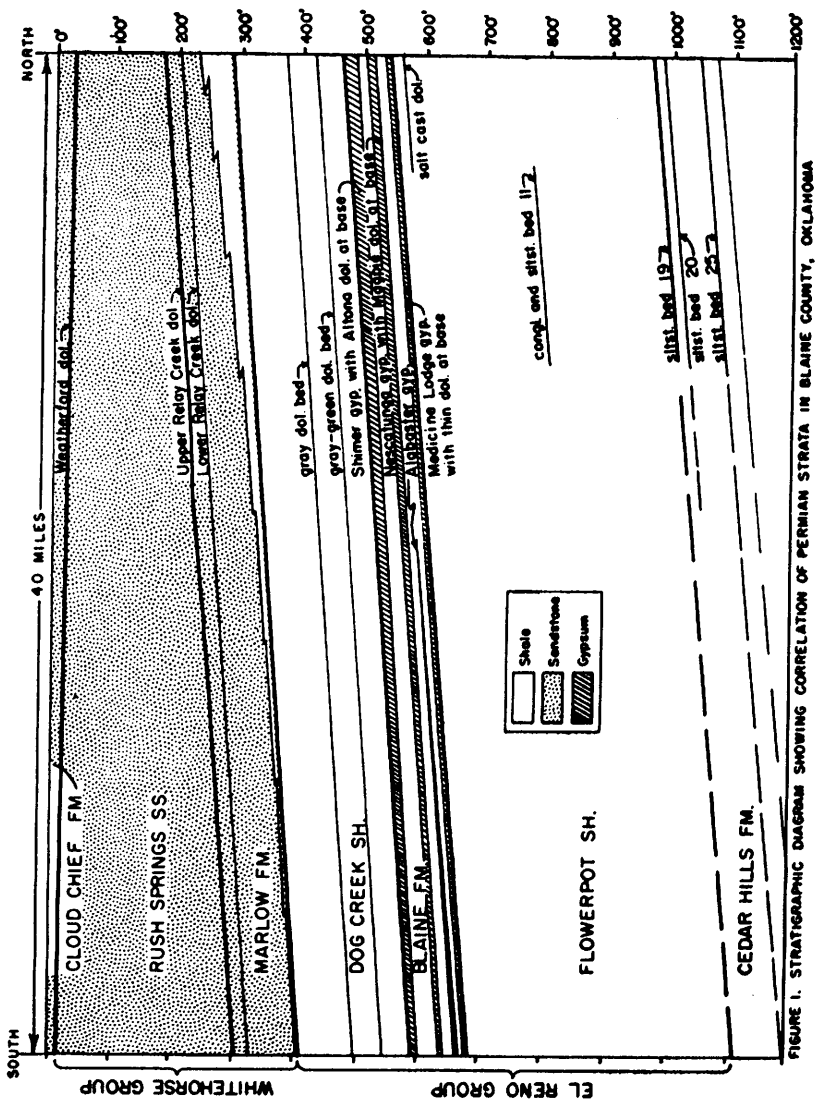

FIGURE 1. STRATIGRAPHIC DIAGRAM SHOWING CORRELATION OF PERMIAN STRATA IN BLAINE COUNTY, OKLAHOMA

ing). In Harper County and surrounding area, a gypsum one to 4 feet thick occurs about 6 feet above the top of the Shimer gypsum and has been named the Haskew. It does not occur in Blaine County and it has not been found in southern Major County.

Flowerpot shale. The total thickness of this red-brown shale is 430 feet in Blaine County, and if equivalent beds have been used, it is only 170-190 feet thick at the type locality in Kansas (Norton, 1939). In the upper part, in northern Blaine County, there is a one- to 2-inch salt-cast dolomite that occurs 21 feet below the Medicine Lodge gypsum and this is used for purposes of correlation (see figure 1). In northern Woodward County, the interval has lessened to about 10 feet, thus indicating that the rate of depositional thinning to the north is about double. A prominent 2-foot gray-green and orange-brown siltstone occurs about 12 feet below the dolomite. In southern Major County this unit thickens to 6 feet and contains a 2-foot gypsum in the middle. Farther north, the gypsum pinches out, and in northern Woodward County the interval to the dolomite has lessened to 4 feet or about threefold. Many one- to 3-foot gray-green siltstones occur throughout the Flowerpot shale, but one bed, about 220 feet below the top, is well cemented and contains many shale pebbles, giving the appearance of an indurated conglomerate. The lower contact of the Flowerpot shale is indefinite, and tentatively the Cedar Hills boundary is drawn at the first prominent siltstone at the top of a siltstone-shale sequence. This is numbered bed 19 because it is the 19th prominent siltstone down from the top of the Flowerpot shale in the area (see figure 1).

Cedar Hills formation

This formation is named from exposures in Kansas where it is 180 feet thick (Norton, 1939: 1789). Several siltstone members were traced from Major County southward through Blaine County into Kingfisher County, these units being numbered 19 through 25. They are mostly coarse-grained siltstones separated by red-brown shales, with a total thickness of 105 feet. The base is not exposed in Blaine County. Because of lack of continuous mapping into the type region, the upper boundary is uncertain, but within Blaine County all the mapped units are uniform in lithology and thickness, and the intervals between them are constant. There is excellent opportunity for exact correlation pending further study. Preliminary structure contours drawn on the Cedar Hills units suggest uniform dip and strike with the Blaine formation, taking into account the northward depositional thinning of the Flowerpot and higher units.

References Cited

Evans, Noel. 1931. Stratigraphy of Permian beds of northwestern Oklahoma. Amer. Assoc. Pet. Geol. Bull. 15: 405-439.

Green, Darsie A. 1939. *In* Norton 1939. Amer. Assoc. Pet. Geol. Bull. 23: 1817-1818.

Norton, George N. 1939. Permian redbeds of Kansas. Amer. Assoc. Pet. Geol. Bull. 23: 1751-1819.