Stratigraphy of the Blaine Formation in Beckham County, Oklahoma[1]

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Introduction

Western Oklahoma is well known for its extensive outcrops and vast reserves of gypsum in the Blaine and Cloud Chief formations. The gypsum beds are of Middle Permian age and they crop out over three principal regions in parts of 15 counties. The greatest thickness of gypsum in all these regions is in the Blaine formation at the southwestern corner of the State, mainly over a 600-square mile area in Beckham, Greer, and Jackson Counties. Since the earliest investigation by Gould beginning in 1902, these gypsum-bearing beds have been a fascinating and at times perplexing field of study, first regarding their stratigraphic relations and more recently regarding their potential commercial use for plasters and gypsum wallboard.

Excellent exposures of strata in the Blaine formation are found in escarpments and badlands along rivers in parts of the southwestern region, but the area that is critical to stratigraphic understanding is in the southern third of Beckham County, where the Blaine and associated rocks strike generally eastward along the south flank of the Anadarko basin for a distance of 40 miles (Fig. 1). It is in the western part of this area that the Blaine formation is 200 feet thick, the greatest thickness known on the outcrop in Oklahoma. One hundred and fifty feet, or 75 percent, is massive gypsum, including at the top an 85-foot bed which in earlier work was unrecognized.

The summary results given in this paper are from a program of investigations by the Oklahoma Geological Survey of the geology and gypsum resources in southwestern Oklahoma. Two phases of the program have been completed (Scott and Ham, 1957; Murphey, 1947) and others are in progress.

Earlier Classification

In the earliest geological work on southwestern and west-central Oklahoma, Gould (1902, 1905) grouped all gypsum-bearing strata under the term "Greer formation." He stated that rocks of the Greer cropped out in two principal areas. Gypsum of the eastern area, chiefly in Custer and Washita Counties, was believed to be equivalent to gypsum in the western area, chiefly in Beckham, Greer, and Jackson Counties. This classification was shown to be erroneous when both Gould (1924) and Sawyer (1924) recognized in western Oklahoma a large synclinal fold which came to be called the Anadarko basin. Gypsum in the eastern part of Washita County was shown to lie in the central part of the basin and therefore to be much younger than the gypsum of southern Beckham County, on the south flank of the basin. The "eastern area of the Greer" became the Cloud Chief formation, and the "western area of the Greer" was stated to be equivalent to the Blaine formation of Blaine County and the northwestern region.

The term Greer was no longer needed and was dropped from formal usage, but the names for individual gypsum and dolomite beds in the Beckham-Greer-Jackson County region were retained because these beds could

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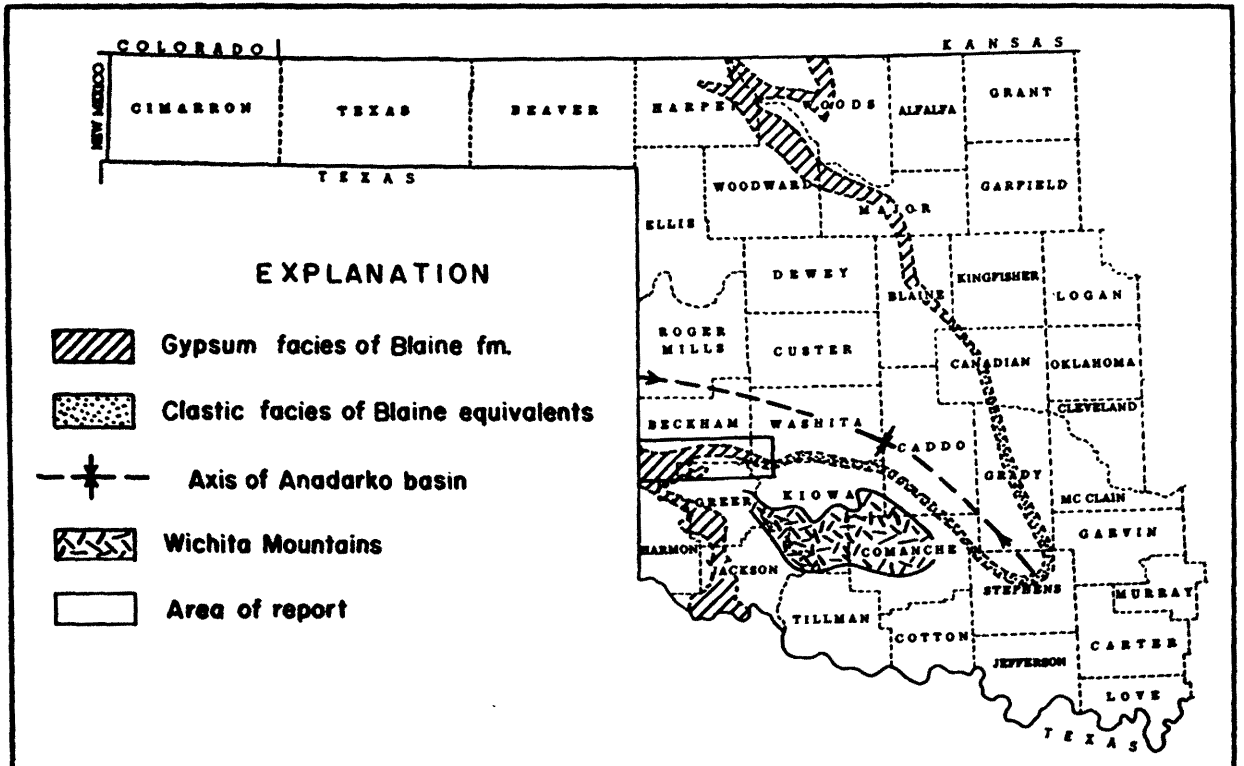

Figure 1. Index map of western Oklahoma showing outcrop and regional facies of the Blaine formation

not be traced directly into those of the Blaine formation in Blaine County. For 100 miles along the outcrop in the southeastern part of the Anadarko basin, equivalents of the Blaine are represented by clastic sediments into which the evaporite beds grade both from the north and from the west. These clastic sediments form the landward portion of a delta built up from a southeastward source in early Middle Permian time (Fig. 1).

Gould's classification of the Blaine formation in Beckham County and elsewhere in southwestern Oklahoma did not, according to the extent of present knowledge, represent actual equivalents of the Blaine formation at the type locality in Blaine County, and furthermore his classification was partly in error because it was based on an incomplete knowledge resulting from the reconnaissance nature of his field investigations.

Present Classification

The new classification and present concept of stratigraphic relations of the Blaine formation in southwestern Oklahoma, as exemplified in the critical area of southern Beckham County, are illustrated in Figure 2. In this classification the Blaine formation is made up essentially of gypsum, and the formation contains all the thick gypsum beds of early Middle Permian age on the outcrop in southwestern Oklahoma. It consists of four members of nearly pure gypsum, five closely related beds of thin dolomite, and three beds of red and gray-green shale which separate the evaporites into cyclic units. Where fully represented the formation ranges in thickness from 130 feet to 200 feet. It thickens westward, mainly by addition of gypsum at the top, and it disappears eastward by gradation into shale. In its broader classification the Blaine is part of the El Reno group, of probable early Guadalupean age, which consists of (ascending) the Duncan sandstone, Flowerpot shale, Blaine formation, and Dog Creek shale. The lower boundary of the Blaine formation is conformable with the Flowerpot shale, and the upper boundary is one of lateral gradation with the Dog Creek shale. Units of the Blaine formation are classified as follows.

Van Vacter gypsum member. The youngest of the Blaine members is the Van Vacter gypsum (Scott and Ham, 1957), which rests directly upon the Mangum dolomite. Where measurable on the outcrop, it ranges in thickness from 35 feet in T. 8 N., R. 21 W., at the southeastern corner of Beckham County, to 85 feet in T. 7 N., R. 27 W., at the Oklahoma-Texas boundary. The rate of increase in thickness to the west is nearly constant, and probably the greatest thickness of this member is in Texas. The disappearance of the Van Vacter gypsum to the east is abrupt, as it grades into shale within the 6-mile length of T. 20 W.

A bed of fine-grained platy dolomite one to 4 feet thick, correlated with the Acme dolomite in the Blaine formation of Texas (Lloyd and Thompson, 1929: 951), occurs 52-58 feet above the Mangum dolomite. These two dolomite beds serve as valuable markers from which it can be demonstrated that the Van Vacter gypsum is a direct facies equivalent of shale in the lower part of the Dog Creek formation. The thickness of the Van Vacter, as well as the thickness of the Blaine formation itself, is thus inversely proportional to the thickness of the Dog Creek shale.

The Van Vacter is the thickest member of the Blaine formation, and in the area of greatest thickness it makes up nearly half the formation. Elsewhere in southwestern Oklahoma the thinning of the Blaine results from thinning at the top of the Van Vacter, as the remaining members have a reasonably constant thickness of 90-115 feet.

In Gould's early work the gypsum now called Van Vacter was not recognized, and the top of the Blaine formation was placed at the top of

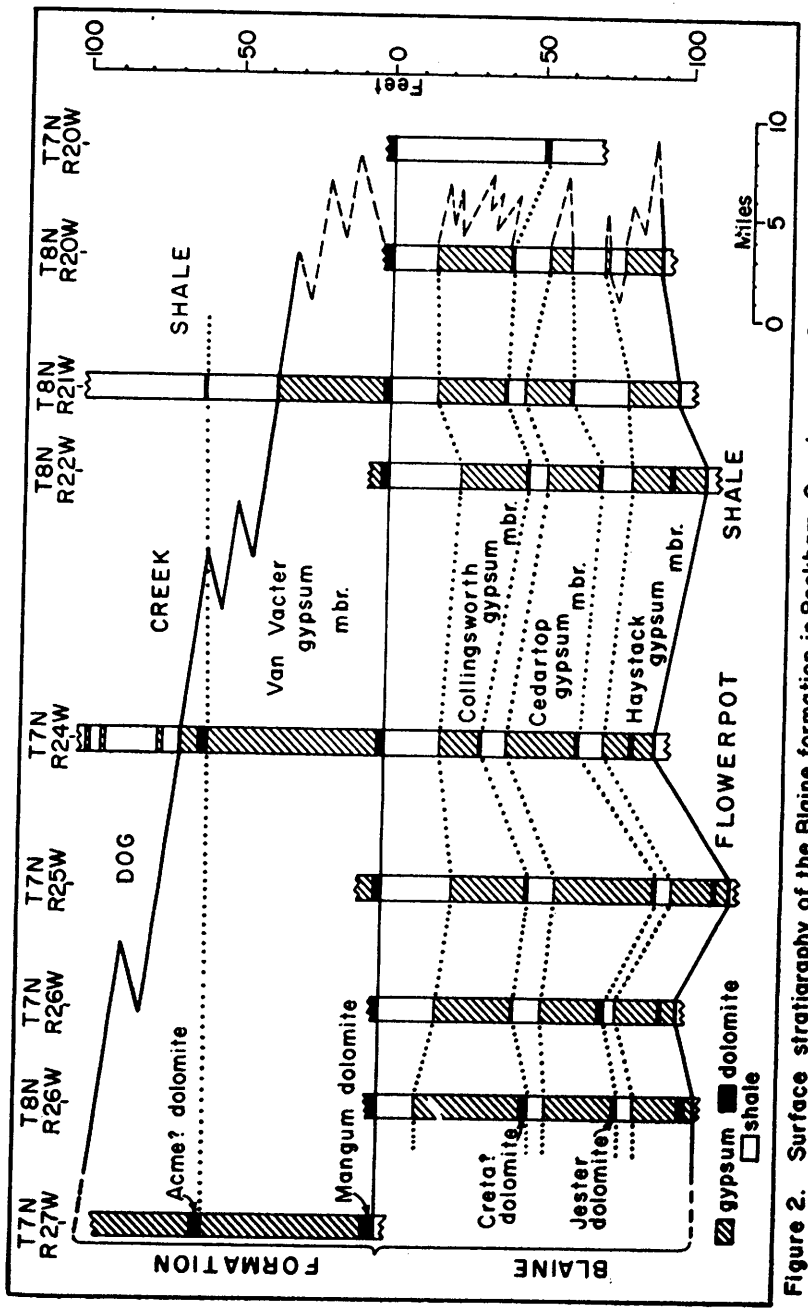

Figure 2. Surface stratigraphy of the Blaine formation in Beckham County area, Oklahoma

the Mangum dolomite. Named by Gould (1905: 71) for exposures near the town of Mangum, this bed is fine-grained to oolitic dolomite one to 5 feet thick. It crops out extensively in the region and is used for the datum in Figure 2.

Collingsworth gypsum member. The Collingsworth member is the first gypsum below the Mangum dolomite. It was named by Gould (1902: 56) from exposures in Collingsworth County, Texas. In most outcrops it is 22 to 25 feet thick but it ranges in thickness from 13 feet to 34 feet, being thinnest in the central part of the area and thickest at the western edge. Like the Van Vacter, it is composed of white and nearly pure massive gypsum. At the base of the Collingsworth is a fine-crystalline to oolitic dolomite 0.5 to 2.0 feet thick, closely resembling the Mangum, which possibly is equivalent to the Creta dolomite of Jackson County (Suffel, 1930: 32). Two to 3 feet above this basal dolomite is a second dolomite bed that is widely distributed in southwestern Beckahm County but which is lacking in the southeastern part of the county.

Above the Collingsworth gypsum, separating it from the Mangum dolomite, is red and gray-green shale that ranges in thickness from 12 to 24 feet and averages 18 feet.

Cedartop gypsum member. The thinnest gypsum member of the Blaine formation is the Cedartop, named by Gould (1902: 56) from Cedartop Butte in the NE¼ sec. 2, T. 7 N., R. 21 W. Its average thickness in southern Beckham County is 19 feet and its range is 7 to 32 feet, the greater thicknesses being in the western part of the area. Massive white or light gray gypsum makes up the member. As determined by Murphey (1957: 18-21), the dolomite 0.2-2.0 feet thick at its base is the bed to which the name Jester was applied by Suffel (1930: 55). The Jester is thickest in the west but it is extensively developed and is easily traced to sec. 32, T. 8 N., R. 20 W., where it and the Cedartop gypsum disappear by graduation into shale.

Above the Cedartop is a bed of shale consistently about 8 feet thick.

Haystack gypsum member. The basal member of the Blaine formation, and also the most uniform in character and thickness, is the Haystack gypsum. It normally crops out as a well-exposed ledge of white gypsum 20 feet thick. The range is 17 to 25 feet, the maximum thickness being not in the western part of the area, as in the case of other Blaine gypsum members, but in T. 8 N., R. 22 W., in the southeastern part of Beckham County, just 15 miles from the area in which it grades eastward into shale. An unnamed dolomite bed normally 0.5 to 1.0 foot thick occurs in the lower or middle part of the gypsum.

The Haystack gypsum was named by Gould (1905: 69) from exposures capping Haystack Butte, a prominent landmark in northwestern Greer County, sec. 23, T. 7 N., R. 23 W.

In the new nomenclature currently being used by the Oklahoma Geological Survey, the Haystack gypsum is defined as the basal member of the Blaine formation in southwestern Oklahoma. It is the lowest thick gypsum bed of the El Reno group, and from reasoning published elsewhere (Scott and Ham, 1957: 16-20) it is believed that the Haystack is equivalent to the basal gypsum member of the Blaine formation in Blaine County.

The new classification differs in two essential respects from the original given by Gould, as both the top and bottom of the Blaine formation are changed. Both the Kiser and Chaney gypsum beds, each 2 to 4 feet thick and respectively about 25 and 50 feet below the Haystack, are excluded from Gould's Blaine and are placed in the underlying Flowerpot

shale; and the top of the Blaine is no longer placed at the top of the Mangum dolomite but at the top of the overlying Van Vacter gypsum member. As the Van Vacter gypsum is probably equivalent to the Shimer gypsum at the top of the Blaine in Blaine County (Scott and Ham, 1957: 18-20), it follows that the Blaine formation as now defined consists of virtually exact equivalents in the southwestern and northwestern regions of outcrop in Oklahoma.

References Cited

Gould, C. N. 1902. General geology of Oklahoma. Okla. Dept. Geol. and Nat. Hist. Bien. Rept. 2, p. 42-57.

..... 1905. Geology and water resources of Oklahoma. U. S. Geol. Surv., Water-Supply and Irrigation Paper 148: 39-71.

..... 1924. A new classification of the Permian redbeds of southwestern Oklahoma. Amer. Assoc. Pet. Geol. Bull. 8: 323-334.

Lloyd, A. M., and Thompson, W. C. 1929. Correlation of Permian outcrops on eastern side of the West Texas Basin. Amer. Assoc. Pet. Geol. Bull. 13: 945-956.

Murphey, C. W. 1957. Areal geology of the Erick area, Beckham and Greer Counties, Oklahoma. Unpublished thesis, Univ. Okla. 102 p.

Sawyer, R. W. 1924. Areal geology of a part of southwestern Oklahoma. Amer. Assoc. Pet. Geol. Bull. 8: 312-319.

Scott, G. L., Jr., and Ham, W. E. 1957. Geology and gypsum resources of the Carter area, Oklahoma. Okla. Geol. Surv., Circ. 42: 64 p.

Suffel, G. G. 1930. Dolomites of western Oklahoma. Okla. Geol. Surv. Bull. 49: 32-64.