CHARACTERISTICS OF THE SYLVAN SHALE IN WIDELY SEPARATED AREAS

By

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Many a driller encountering a green shale in a well, irrespective of whether it carries a Cambrian or a Cretaceous fauna, immediately calls it Sylvan. Some geologists possess the mistaken idea that a green shale must be Sylvan or Tyner. Micropaleontologists, however, have determined from a detailed examination of samples in widely separated wells in Oklahoma and Kansas and from outcrop samples in many states, using paleontology, lithology, sequence of beds, and what not in making their determinations, that green shales occur as sediments deposited during practically every period of time from Cambrian to Tertiary. And what is more important, these shales vary in color and texture from place to place. Especially is this true of Richmond shales carrying a Maquoketa fauna, called Sylvan in Oklahoma.

A lithologic study of the Maquoketa from the Minnesota outcrops southward reveals interesting differences and similarities. The following descriptions would indicate a southern land mass as the origin of the sediments during the Maquoketa phase of the Richmond.

The Maquoketa of southeastern Minnesota consists of 50 to 75 feet of fossiliferous crystalline limestone at the top (the Wykoff) below which are interbedded green shales and crystalline limestones variable up to 20 feet. In southwestern Wisconsin the Maquoketa is 150 to 250 feet in thickness. It consists of thinbedded blue to gray fossiliferous shale with thin limestone beds locally and contains a thin chert conglomerate at the base.

In Iowa calcareous gray to blue-gray pyritiferous shales predominate. These shales are quite variable up to 300 feet and contain occasional thin limestone "breaks" some of which are locally quite thick. The section as a whole is very fossiliferous and contains much organic material. A hiatus exists at the top and at the base of the formation. A well in Cherokee county, northwestern Iowa, showed the Maquoketa to be absent in that area.

In the Elizabeth and Galena quadrangles in northwestern Illinois the formation consists of 100 to 200 feet of blue to drab fossiliferous shale with many limestone beds. In Pike county, Missouri, south of Hannibal, the shale is gray1green and contains many very thin agrillaceous limestone layers. A little farther south, in Jersey county, Illinois, this same green shale contains the limestone layers only in the lower part, the upper part having become quite arenaceous. There is in Pike county, Missouri, a 30-foot black shale above the green shale and separated from it by a sandy layer containing many phosphatic concretions. This black shale has also been assigned to the Maquoketa.

In the extreme southern portion of Illinois the Macquoketa section is represented by 75 feet of thin-bedded, shaly sandstone overlain by 20 feet

of blue-green shale. This has been called the Thebes sandstone and shale. North of this locality, in Cape Girardeau County, Missouri, the section consists of an upper 45-foot dark sandy shale, a middle 75-foot impure shaly sandstone, and a lower 50-foot shale similar to the upper shale but fossiliferous and not so sandy. Bridge and I have mapped this as Thebes-Maquoketa.

On the southern flank of the Ozarks in the Yellville, Arkansas, quadrangle the Cason shale is the Maquoketa equivalent. It rests unconformably on the Fernvale and consists of 12 feet of calcareous gray-green shale, sandy in places, with manganese and phosphatic concretions. The gray-green Cason shale in the Eureka Springs-Harrison quadrangle appears with a basal conglomerate. In the Ouachita Mountains there are no rocks of Richmond age present.

The Sylvan shale ranges from 50 feet in thickness at the eastern end of th Arbuckls to move than 300 feet in the western part. It is generally green or gray-green on the outcrops, though the distance of a few miles frequently makes a noticeable change in color. For example, at Lawrence, Kansas, a full section of Sylvan, consisting of about 125 feet, is green throughout, while at Vines Dome, in the Arbuckle Mountains, a detailed study reveals much more gray than green.

At Seminole a complete section shows not more than 20 feet of green shale at the top. Below this is a pyritiferous light gray shale gradually becoming darker downward until frequently at the base it might well be called a black shale. Practically the same condition is seen in wells in northern Pontotoc County. In a well in sec.20, T. 5N., R 4E., the driller logged 105 feet of light gray shale followed by 40 feet of medium gray to black shale below. In sec. 16, T. 3 N., R. 6 E., 25 feet of light gray shale was logged at the top and 130 feet of medium gray sandy shale below. A characteristic of the Sylvan in Oklahoma seems to be its paucity of megafossils. Careful examination usually reveals microfossils, especially in the lower part. Exceptions to this occur where the Sylvan is both non-calcareous and green in color. In this case, however, the green is not the typical green of the outcrop or even a gray-green. It exhibits an olive green tinge and takes on a greasy luster. This is the Sylvan of an area north of the Seminole region.

In sec. 13, T. 13 N. R. 1 W., there is much more of the typical green Sylvan than there is in Seminole. It resembles neither the Seminole Sylvan nor the Creek County Sylvan. In sec. 12, T. 19N., R. 1 W., the upper 20 feet is a green calcareous pyritiferous shale followed by about five feet of calcareous gray shale, with a 13-foot sandy gray shale below this. A few miles north of this well no more Sylvan is found, except to the west and northwest, until we reach Harvey County, Kansas. To the northwest, however, in Harper County, Kansas, the Sylvan (Maquoketa) greatly resembles the Seminole shales of the same age. A few feet of pyritiferous green shale is present at the top blow which is a medium gray calcareous shale.

In sec. 17, T. 24 S., R. 3 w., Harvey County, the upper 13 feet is dark green. Below this, 25 feet of medium green calcareous shale is followed

by 25 feet of gray-green shale with pyrite only at the base. In sec. 17, T. 15 S., R. 2 W., Saline County, the Maquoketa (Sylvan) consists of 80 feet of calcareous green clay-shale. The Maquoketa in Otoe County, Nebraska, sec. 9, T. 8 N., R. 14 E., consists of approximately 112 feet of shale and limestone, with a little sandstone. In sec. 11, T. 11 N., R. 12 E., Cass County, Nebraska, the shale is 24 feet thick, is dark gray and sandy, and contains a few dolomitic layers. In the South Dakota Black Hills the Maquoketa is represented by the Whitewood limestone. It consists of 60 to 80 feet of dense buff limestone, more or less mottled, and is conformable both above and below. The Big Horn dolomite, outcropping in the Big Horn Mountains, is apparently the equivalent of the Whitewood.

It was orginally intended to make faunal comparisons from outcrop to outcrop and from well to well, but in a short paper such a thing is impossible. It is in order to say, however, that a real similarity actually exists when comparing faunules from these various localities. I also have permission from Mr. S. W. Lowman, micropaleontologist for the Midcontinent Petroleum Corporation, to announce a discovery he has recently made concerning the Sylvan in Oklahoma and Kansas. He has found that after completely dissolving the shale in concentrated hydrochloric acid the residue will yield microfossils which are invisible upon ordinary microscopic examination. He discovered organisms similar to *Sporangites* found in the Woodford. One species is about as large as the disc-like *Sporangites huronense* and is found in the upper Sylvan from central Kansas to the Arbuckles. Another species about twice as large as the above has been found in the upper Sylvan on the outcrop and in wells near the Arbuckles. A few spindle-shaped forms have been found. There are reasons to believe that these are plant spores and there are also arguments in favor of the theory that they are graptolitic in nature.

In conclusion it is evident that the geologist or scout attempting to identify the Sylvan, using the basic idea that it is always a green shale, will come to grief sooner or later. A compilation of data obtained from detailed studies gives us a faunal similarity in all these Richmond shales but a decided lithologic dissimilarity.