

## CAMBRO-ORDOVICIAN SUBSURFACE STRATIGRAPHY OF THE BLACK WARRIOR BASIN IN MISSISSIPPI

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### ABSTRACT

The stratigraphy of the Cambro-Ordovician sequence in the Black Warrior Basin of northern Mississippi is known only from subsurface data. Little has been published on this thick sequence of carbonates and a great deal of confusion exists with regard to formational boundaries and ages. A recent study by Alberstadt and Repetski (1989) utilizing conodonts from the Magnolia Petroleum #1 Pierce well (Monroe Co., MS) affords a much better understanding of the age relationships of the sequence than was previously available. The present study is an effort to differentiate the Cambro-Ordovician strata based on the available conodont data and the lithologic character of the strata.

Of the 152 wells which have reached at least the Ordovician, only two have penetrated the entire Cambro-Ordovician sequence. These two wells are the Pruet & Hughes #1 Dunlap Brothers (Lafayette Co., MS) and the Exxon #1 Fulgham (Oktibbeha Co., MS). The sequence as revealed in the Dunlap well consists of an apparently "complete" section of 7950 feet of carbonates with minor amounts of quartzitic sand in the base of the section. The 6744-foot section of Cambro-Ordovician strata in the Fulgham well is incomplete; much of the Cambrian section is absent apparently due to nondeposition. The absence of much of the Lower Cambrian strata in the Fulgham well illustrates the high relief nature of the crystalline Precambrian basement. Although the absence of these strata is interpreted to be due to nondeposition, structural conditions and/or erosion of these missing strata cannot be ruled out. Cambro-Ordovician strata are interpreted to have been deposited on shallow carbonate shelves and banks which remained essentially stable throughout deposition. Very small changes in sea level caused widespread transgressions-regressions on these stable shelves. Regressions led to the formation of repeated and extensive periods of karstification interpreted to be represented as zones of high porosity in the subsurface.

As only nine wells have reached the Cambrian it is difficult to ascertain what a "normal" section is, but the subsurface in Mississippi as it is presently known is similar to the Cambrian section exposed in the southern Appalachians of Alabama. The Cambrian System attains a maximum composite thickness of 6343 feet and is differentiated into five formations. In ascending order, these are: Weisner Quartzite, Shady Dolostone, Rome Formation, Conasauga Limestone and Copper Ridge Dolostone. The Weisner Quartzite is a thin zone (maximum thickness of 180 feet) of fine to very coarse-grained, predominantly quartzitic sandstone resting unconformably on the rugged Precambrian surface. The Shady Dolostone is a relatively pure dolostone with minor amounts of quartzitic sand and anhydrite and attains a maximum known thickness of 1152 feet. The Rome Formation is of variable lithology, ranging from nearly homogeneous shale to argillaceous dolostone, and is 708 feet thick at its known maximum. The Conasauga Limestone reaches a thickness of 1718 feet and consists of limestone with varying amounts of dolostone. The Copper Ridge is a cherty dolostone which attains a maximum thickness of 2585 feet and marks the top of the Cambrian System. The Copper Ridge Dolostone is difficult to differentiate from the overlying Knox Dolostone (Ordovician) but the top is picked at a point consistent with a noticeable resistivity decrease on electric logs along with an increase in the amount of chert lithologically.

The Ordovician System is represented by a maximum composite thickness of 6778 feet of nearly pure carbonate strata. Only Lower Ordovician and earliest Middle Ordovician (Whiterockian) strata are present and these sediments are differentiated into four formations based on lithology. In ascending order, these are: Knox Dolostone, Knox Limestone, Stones River Dolostone and Stones River Limestone. The Knox Dolostone consists of a maximum thickness of 1906 feet of dolostone with varying amounts of chert and sand. Well-rounded quartz sand grains are characteristic of the Knox Dolostone. Locally, sand is present in sufficient amounts to form what would more properly be described as dolomitic sandstones. These sandstones are thin and discontinuous but do seem to be present in roughly equivalent zones of the Knox Dolostone. The Knox Limestone is a thick (maximum of 2657 feet), largely bioclastic limestone characterized by abundant sponge spicules and algal components. The Stones River Dolostone attains a maximum of 1535 feet in thickness and is differentiated from the Knox Dolostone by the general lack of sandy zones and a finer grained texture. The Stones River Limestone is a micritic to finely crystalline limestone which reaches a maximum thickness of 680 feet. A thin graptolitic shale occurs at the top of the unit locally. Graptolites present in a core taken from the Florida Exploration #1 Morrison (Pontotoc Co., MS) at the top of the Stones River Limestone, have been identified as Middle Ordovician (Mellen, 1982), further supporting the age assignments made based on conodonts from the Magnolia Petroleum #1 Pierce well about 40 miles to the southeast.

In spite of the fact that only a small amount of oil (7811 bbls) and gas (800,000 MCF) has been produced from the Cambro-Ordovician section to date in Mississippi, large reservoirs may be present in these strata analogous to the prolific

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CAMBRO-ORDOVICIAN STRATIGRAPHIC COLUMN OF MISSISSIPPI

E R A T H E M	S Y S T E M	S E R I E S	S T A G E	G R O U P	FORMATION	THICKNESS	LITHOLOGIC DESCRIPTION
P A L E O Z O I C	O R D O V I C I A N	M I D D L E	W R T K E I - A S R	S T R O V I E E S R	STONES RIVER LIMESTONE	141-680'	LIMESTONE, GRAY TO LIGHT TAN, MICRITIC TO FINELY CRYSTALLINE, ARGILLACEOUS IN TOP, THIN DARK GRAY-BLACK SHALES AT TOP LOCALLY, TRACES SANDY IN BASE
					STONES RIVER DOLOSTONE	289-1535'	DOLOSTONE, GRAY TO TAN, GREENISH-GRAY, VERY FINE TO FINELY CRYSTALLINE, TRACES SANDY, ARGILLACEOUS IN PART, BRECCIATED ZONES ("SNOW ZONE"), BENTONITES
		L O W E R	C A N A D I A N	K N O X	KNOX LIMESTONE	490-2657'	LIMESTONE, GRAY TO TAN, VERY FINE TO FINELY CRYSTALLINE, BIOCLASTIC IN LARGE % (FOSSILS INCLUDE: SPONGE SPICULES, CONODONTS, CRINOID STEMS, ALGAE)
					KNOX DOLOSTONE	650-1906'	DOLOSTONE, GRAY TO TAN, GREENISH-GRAY, FINE TO MEDIUM CRYSTALLINE, CHERTY, VERY SANDY (VERY FINE TO COARSE-WELL ROUNDED-"FROSTED"), BRECCIATED ZONES ASSOCIATED WITH RED AND YELLOW MOTTLED INTERVALS
	C A M B R I A N	U P P E R			COPPER RIDGE DOLOSTONE	795-3200'	DOLOSTONE, GRAYISH-TAN TO DARK BROWN, FINE TO COARSLEY CRYSTALLINE, SANDY, CHERTY (COMMONLY CONTAINS "FLOATING" EUHEDRAL DOLOMITE CRYSTALS) BRECCIATED ZONES-RED AND YELLOW MOTTLING
		M I D D L E			CONASAUGA LIMESTONE	0-1187'	LIMESTONE, GRAYISH-TAN, MICRITIC TO FINELY CRYSTALLINE, DOLOMITIC IN PART, THIN DOLOSTONE BEDS, ARGILLACEOUS, MAY CONTAIN THIN DARK GRAY CALCAREOUS SHALE INTERBEDS, VERY SANDY IN BASE-SAND RANGES FROM VERY FINE TO VERY COARSE (UP TO 1/4" IN DIAMETER), CHALKY IN SMALL PART, RARELY GLAUCONITIC NEAR THE BASE OF THE UNIT
		L O W E R				ROME FORMATION	0-708'
					SHADY DOLOSTONE	220-1152'	DOLOSTONE, LIGHT GRAY TO BROWN, "SALT AND PEPPER" FINE TO MEDIUM CRYSTALLINE, SANDY, COLITIC,
					WEISNER QUARTZITE	0-180'	SANDSTONE, VARICOLORED, FINE TO VERY COARSE GRAINED QUARTZITIC, FELDSPATHIC IN SM %, GLAUCONITIC IN PART
	PRECAMBRIAN BASEMENT					GRANITE AND "GNEISSIC" ROCK	

Ellenburger-Arbuckle trend of Texas and Oklahoma. While drilling the Tipperary #1 Harpole-Campbell well in Quitman County, a zone of very high porosity was encountered in the Copper Ridge Dolostone from 7608 to 7725 feet. The bit "fell" the first 24 feet of this 117 foot zone and circulation was lost. A drill stem test was conducted from 7610 to 7725 feet and, although the well subsequently loaded up and died, it flowed at an average rate of 12,300 barrels of saltwater per day during the first five minutes of the test. This zone of high porosity is interpreted to be a collapse breccia formed during one of many periods of karstification during the Cambro-Ordovician.

All hydrocarbon production to date has occurred in what is informally referred to as the "Snow Zone" of the Stones River Dolostone. The "Snow Zone" is a widespread zone of porosity due apparently to a period of regional emergence and subsequent karstification. Other zones of similiar character to the "Snow Zone" occur throughout the carbonates of the Cambro-Ordovician section. Numerous hydrocarbon shows, good reservoir rocks and the existence of large undrilled structures suggest that commercial oil and gas fields in this vast relatively unexplored trend await the drill bit in Mississippi.

### REFERENCES CITED

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