Marker Beds in the Lower Desmoinesian Of Northeastern Oklahoma

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The strata here referred to as Lower Desmoinesian are the Cherokee rocks of earlier reports. The Oklahoma Geological Survey proposes to drop the use of the term Cherokee in Oklahoma and to use the formation names of the McAlester Basin throughout eastern Oklahoma. The formations considered here are, from oldest to youngest, the Hartshorne formation, the McAlester formation, the Savanna formation, the Boggy formation, and the Senora formation. Oakes has shown that the Thurman sandstone formation and the Stuart shale formation do not extend into northeastern Oklahoma.

There has been little stratigraphic work and mapping in the Lower Desmoinesian rocks from the Arkansas River to the Kansas state line since the quadrangle mapping of Siebenthal, Ohern, and Smith in the early years of this century. Oakes (8) mapped and described the Broken Arrow coal and associated strata in part of the area, and a graduate student working under his direction mapped the Chelsea sandstone and immediately subjacent beds in Rogers County (1). Lowman (6, 7) published short papers on some phases of the stratigraphy, but without maps. Small scale maps and some of the stratigraphic data from the unpublished work of Siebenthal, Ohern, and Smith were published in county reports in Oklahoma Geological Survey, Bulletin 40, and in Weidman's report (10) on the zinc district.

During the summers of 1950, 1951, and 1952 the writer and graduate students working under his supervision mapped and studied the Lower Desmoinesian strata from the Arkansas River valley northward to the Kansas-Oklahoma state line. Much of this field work was done under the auspices of and with the financial assistance of the Oklahoma Geological Survey. As in any modern study of this type, good results are possible only with the cooperation of interested colleagues. By means of consultations and field conferences Hugh D. Miser, Malcolm C. Oakes, Robert H. Dott, Wallace B. Howe, Walter Searight, and John Warren contributed invaluable knowledge, observations, advice and encouragement. Graduate students at the University of Oklahoma who have mapped and studied the Lower Des-

moinesian rocks in parts of the area are Charles D. Claxton, Louie P. Chrisman, Clarence Lohman, Jack L. Tillman, Mark Hobbs, Jimmy Tom Lontos, and John Graves.

The stratigraphic dividing line between the Lower Desmoinesian and the Upper Desmoinesian (in Kansas this is the Cherokee-Marmaton boundary) is the base of the Blackjack Creek limestone (Lower Fort Scott limestone). It has been found in our work that several marker zones can be mapped for long distances, and that others can be mapped over a greater area than had been previously realized. The upper unit of the Lower Desmoinesian is the Senora formation. Near the top of the Senora and separated from the Blackjack Creek by a few feet of black shale which contains phosphatic nodules, is the Breezy Hill limestone. Howe (4) was the first to recognize that limestone in Oklahoma, and he discovered that the coal which lies close beneath it is not the Mulky or Fort Scott coal, but is a coal bed which he named the Iron Post coal. The Breezy Hill limestone and the Iron Post coal have been traced from near Fort Scott, Kansas, to a point near Broken Arrow, Oklahoma, and the limestone has been mapped to extreme western Wagoner County on the south side of the Arkansas River. Through Craig County and northern Rogers County slabs of the limestone line strip pits in the Iron Post coal and elsewhere this limestone can be recognized because it is overlain by black shale and lies at the top of or a few feet above a coal and underclay.

Thirty-five feet below the base of the Breezy Hill is the widely recognized Verdigris limestone, which is the Ardmore limestone of Kansas and Missouri terminology. The limestone is from three to eleven feet thick and is underlain by a black shale with phosphatic nodules. It has been mapped in Oklahoma from the Kansas state line to south of the Arkansas River in extreme northeastern Okmulgee County. The most widely stripped coal in northeastern Oklahoma (Broken Arrow coal) normally lies twenty feet below the Verdigris, but in contrast to all other stratigraphic intervals, the shale in the interval thins southward and the Verdigris limestone south of the Arkansas River is separated from the coal by four feet of black shale and serves as part of the cap rock.

The discontinuous distribution of the Chelsea sandstone has been established by our work and that of Austin. In northern Craig County the Chelsea is absent and part of its interval is occupied by the Mineral coal and its cap rock, here named the Russell Creek limestone. The name is derived from Russell Creek in Township 29 North, Range 20 East, and the type section is designated as that on the farm of Mrs. Leep on the east bank of Russell Creek where it is flowing south in the NE¼ SW¼ sec. 15, T 29 N, R 20 E. The Russell Creek limestone can be seen on the waste heaps of strip pits northwest and west of Welch. Richard Alexander has found fusulinids in it in sec. 16, T 28 N, R 20 E. The limestone is mappable in northern Craig County and is widely distributed in Kansas and Missouri.

The base of the Chelsea sandstone is a recognized mapping horizon in southern Craig County, Rogers County, and Wagoner County. Near the base of the Chelsea sandstone is a limestone which was named the Tiawah limestone by S. W. Lowman (7). This limestone overlies a coal, which, with the help of W. B. Howe has been shown to be the Pilot coal (properly the Tebo coal) of Kansas and Missouri. The Tiawah limestone in the northern part of the area consists of two thin clay ironstone beds serving as the cap rock of the coal. Southward it is several feet above the coal and is immediately underlain by a black shale with phosphatic concretions. There is a thin zone of concretions just above the limestone. In southwestern Wagoner County it is known northwest of Coweta and south of the Arkansas River southwest of Coweta. At these localities the main bed of the limestone is a myalinid coquinite. In this area, the base of the Senora formation and the top of the Boggy formation lies in the shale interval a short distance below the Tiawah. The name Tiawah is taken from that

of a small town five miles southeast of Claremore. The type section is here established as that in the north road cut on Oklahoma Highway 20 on the west side of the hill in the SW¼ sec. 12, T 21 N, R 16 E.

About the middle of the Boggy formation and a few feet above the Bluejacket sandstone is the Inola limestone of Lowman (6). The Inola limestone has been found to consist of four separate fossiliferous beds each lying in a separate cyclothem and with coal seams under the first, third, and fourth. The term Inola is here restricted to the lower limestone of the four. The type locality is Inola Mound, but the type section is here designated as the section exposed in the south road cut on Oklahoma Highway 20 on the west face of the hill just east of the Rogers County-Mayes County line, near the northwest corner of sec. 18, T 21 N, R 18 E. The limestone is here 1.9 feet thick and contains *Wedekindellina henbesti* (Skinner), *Fusulina leei* Skinner, and *Eoschubertella gallowayi* (Skinner). Charles Ryniker in a personal communication reports fusulinids from the limestone on Inola Mound. The Inola limestone (restricted) and the immediately superjacent limestones are important in aiding the field geologist to differentiate between the Bluejacket and the Taft sandstones, but their solubility combined with their position between two thick sandstones has resulted in their weathering to unrecognizable soil at most places. One or more of the limestones can be found at scattered localities from the northern edge of Mayes County to northern McIntosh County, but their discontinuity of outcrop precludes use as a mapping horizon.

The base of the Bluejacket sandstone has long been a prominent and widely used marker. As shown by Howe (4) the boundaries of the sandstone were misinterpreted at the type locality. Claxton, Chrisman, Lohman, and Tillman have found the thickness of the sandstone to be as erratic on surface as it is known to be in subsurface, but were able to map the base continuously across the area, and Wilson, Oakes and others have carried the mapping into the McAlester Basin. The Oklahoma Geological Survey now defines the Boggy and Savanna formations so that their contact is drawn at the base of the Bluejacket.

Seventy feet below the base of the Bluejacket sandstone, and thus in the Savanna formation is a limestone which is the cap rock of a persistent, thin, but locally workable coal. This limestone has been mapped from the Kansas line south to beyond Warner in Muskogee County. Howe found a locality in Kansas where what is probably the same limestone is sporadically developed in a strip pit and is the cap rock of the Rowe coal. The limestone was referred to as the "Lower Boggy lime" by Wilson and Newell (11). The distinctness of this limestone and its usefulness as a mapping horizon over a wide area make it desirable to give it a name. The limestone is here named the Doneley limestone member of the Savanna formation. The name is derived from the Doneley School, which is shown on the United States Geological Survey, Topographic Map of Vinita Quadrangle in the NW¼ sec. 27, T 26 N, R 20 E. This school has been replaced by the Peasant Hill school which is at the same location. The type section is one mile north of the school building, in the NW¼ sec. 16, T 26 N, R 20 E in the south bank of the creek which crosses the north-south section line road and the exposure is about 100 feet east of the road. The name first appeared in the unpublished Master of Science thesis of Louie P. Chrisman (2). At the type section, the Doneley is a calcareous clay ironstone three inches thick, lying eight inches above a thin coal and its underclay.

The Doneley is the uppermost of the three persistent "brown limes" of the Savanna formation. The other two, Sam Creek and Spaniard, are exposed only at wide intervals north of Wagoner County, but have been traced into Craig County and are believed to extend into Kansas without known exposure.

The Warner sandstone of the McAlester formation is the only McAlester sandstone bed to persist from the McAlester Basin onto and across the shelf

area. It was traced to Vinita by Renfro and a small map of its distribution was published in the Wilson and Newell (1937) report. The writer and his students have traced the base of the sandstone in detailed mapping from the Arkansas River into Kansas. North of the Arkansas, it is remarkably uniform in thickness and in lithologic characteristics, and it is an excellent marker horizon. The Little Cabin sandstone of the Vinita area is the same sandstone and that name is not used.

In the Lower Desmoinesian rocks of northeastern Oklahoma, which is the shelf area of the McAlester Basin, there are then eight excellent marker beds and mapping horizons: the Breezy Hill limestone, the Verdigris limestone, the Russell Creek limstone (new), the base of the Chelsea sandstone, the Tiawah limestone, the base of the Bluejacket sandstone, the Doneley limestone (new), and the base of the Warner sandstone.

TABLE I

Mapping Horizons in the Lower Desmoinesian of Northeastern Oklahoma

FORMATION	MEMBER	MAPPING HORIZON
	Breezy Hill limestone	Base of Breezy Hill
	Iron Post coal	
	Verdigris limestone	Verdigris limestone
	Broken Arrow coal	
SENORA FORMATION	Russell Creek limestone	Russell Creek limestone
	Mineral coal	
	Chelsea sandstone	Base of Chelsea
	Tiawah limestone	Tiawah limestone
	Tebo coal	
	Taft sandstone	
BOGGY FORMATION	3 cyclothems	
	Inola limestone	
	Bluejacket sandstone	Base of Bluejacket
	Doneley limestone	Doneley limestone
	Rowe coal	
SAVANNA FORMATION	Sam Creek limestone	
	Spaniard limestone	
MCAESTER FORMATION	Warner sandstone	Base of Warner
HARTSHORNE FORMATION	not certainly recognized in northeastern Oklahoma	

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