

SOME HIGHLIGHTS OF THE CARBONDALE GROUP (PENNSYLVANIAN) IN THE SUBSURFACE IN INDIANA

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ABSTRACT: The Pennsylvanian System in Indiana is composed in ascending order of the Raccoon Creek, Carbondale, and McLeansboro Groups. The Carbondale contains the rocks between the base of the Colchester Coal and the top of the Danville Coal Members and is composed, in ascending order, of the Linton, Petersburg, and Dugger Formations. These formations contain laterally persistent limestone and coal Members that can be traced in the subsurface throughout much of the Illinois Basin. Flooding surfaces are recognized above the Colchester, Houchin Creek, Springfield, and Herrin Coals. The Carbondale ranges in thickness from 270 to 430 feet.

KEYWORDS: Carbondale Group, Pennsylvanian, subsurface Indiana.

INTRODUCTION

The Pennsylvanian System in Indiana is composed of three groups. In ascending order, they are the Raccoon Creek, Carbondale, and McLeansboro Groups (Figure 1). The purpose of this short report is to note the evidence for the rapid flooding of several of the Carbondale coal swamps by basin-wide marine waters and to present a map showing the thickness of Carbondale rocks in the subsurface of Indiana.

GENERAL STRATIGRAPHY

Shaw and Savage (1912) first used the name Carbondale Formation for rocks exposed near Carbondale in Monroe County, Illinois. Kosanke, *et al.* (1960) described the formation in Illinois as the rocks between the base of the Colchester (No. 2) Coal and the top of the Danville (No. 7) Coal. Wier and Gray (1961) defined the Carbondale Group in Indiana as the rocks between the top of the Seelyville Coal Member of the Staunton Formation and the top of the Danville Coal Member of the Dugger Formation. In their report on the Raccoon Creek Group of the Illinois Basin, Droste and Horowitz (in press) proposed that the base of the Colchester Coal instead of the top of the Seelyville Coal be used basin wide to mark the top of the Raccoon Creek Group. In this note, we follow that usage (Figure 1). The Carbondale Group contains, in ascending order, the Linton, Petersburg, and Dugger Formations (Figure 1).

PENNSYLVANIAN SYSTEM	McLeansboro Group		Fm.	Member	
			Dugger	Danville Coal	Universal Ls.
				Hymera Coal	Providence Ls.
	Herrin Coal				
	Petersburg		Alum Cave Ls.	Springfield Coal	
			Stendal Ls.	Houchin Creek Coal	
	Linton		Survant Coal		
			Velpen Ls.	Mecca Shale	
				Colchester Coal	
	Carbondale Group				
Raccoon Creek Group					

Figure 1. Chart showing the stratigraphic nomenclature used in this report.

Unlike the formations of the Raccoon Creek and McLeansboro Groups, the three Formations of the Carbondale contain several coal and limestone Members that have extensive lateral continuity. Although each of these Members cannot be identified on every log from every well, we are able to identify these selected key members (Figure 1) and their stratigraphic equivalents in the subsurface in Indiana, Illinois, and Kentucky. From one location to another, all of the key coals are replaced by sandstones and all of the key limestones are replaced in one area or another by a fossiliferous shale facies. However, because we can identify the stratigraphic position of these key markers on most logs, we can correlate these selected units in the subsurface throughout most of the Illinois Basin.

COAL AND LIMESTONE COMBINATIONS

A noteworthy feature of Carbondale rocks is that many of the coal members that can be recognized basin wide are overlain by limestone members that also can be recognized basin wide. Consider the combination of the Springfield Coal and Alum Cave Limestone. The Springfield Coal is probably the most often basin-wide identified key marker in the Pennsylvanian System. The Springfield is thick enough in numerous areas throughout the basin to be a very important present and future commercial coal.

An interesting question presents itself. How big was the swamp in which the Springfield peat accumulated? The question has no precise answer because the

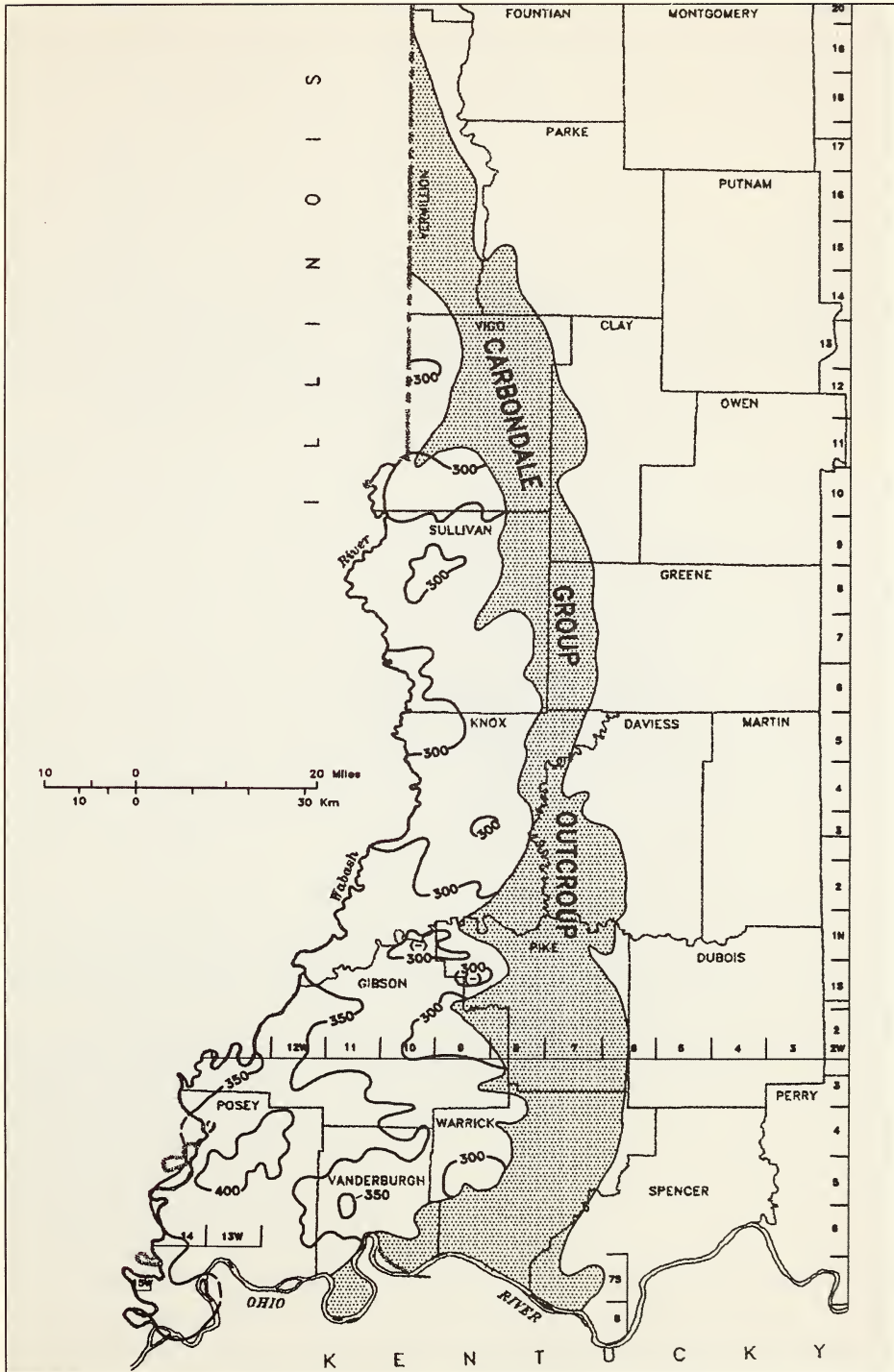


Figure 2. Map showing the thickness of the Carbondale Group in southwestern Indiana. The contour interval is 50 feet.

Springfield occurs at the bedrock surface around the Illinois Basin. Nevertheless, using the eroded limits of the Springfield, we can determine that the Springfield swamp was at least tens of thousands of square miles in area. The entire swamp area was very near sea level, the water table was very high, and the area had very little relief. The interpretive setting was a coastal swamp bounded transitionally on one side by the sea and on the other side by a somewhat higher coastal plain. A few major rivers flowed through the swamp, and these streams transported terrigenous sand and mud from distant inland sources through the swamp to the sea. The location of the rivers can be mapped (Eggert, 1982; Eggert and Adams, 1985). At the stratigraphic position of the Springfield, the coal is replaced by contemporaneous fluvial sediments, channel sandstone, and overbank deposits. This facies relationship explains the earlier statement that every basin-wide coal member is replaced in one area or another by sandstone.

The top of the Springfield Coal is slightly younger eastward. The regional transgressive event (see below) moved across the basin from the south and west to the north and east so that the youngest Springfield Coal is found along the eastward margin of its eroded limit. Although the Springfield Coal does not have the time precision that an ash bed would have, we believe that the top of the Springfield Coal is, within currently available resolution, an approximate time plain in the Illinois Basin.

In many places, several feet of black and very dark gray marine shale separates the Springfield Coal below from the Alum Cave Limestone above. The Alum Cave is a medium- to dark-colored argillaceous limestone containing abundant echinodermal debris and common brachiopod and molluscan fragments. In some places, fusulinids, ostracods, and bryozoans are present. At numerous locations, dark gray fossiliferous shale containing lenses and nodules of limestone occupy the Alum Cave interval. The limestone and associated marine shale of the Alum Cave interval document a fully marine transgression. This basin-wide event records a rapid flooding of the Springfield coal swamp. In the terminology of sequence stratigraphy, a flooding surface overlies the Springfield Coal.

Are there similar events at other stratigraphic positions in the rocks of the Carbondale Group? The interval containing the Mecca (marine) Shale and Velpen Limestone above the Colchester Coal (Figure 1) documents a transgression with a flooding surface above the Colchester. The Stendal Limestone and its Illinois equivalent, the Hanover Limestone, have been correlated with limestones in Oklahoma, Missouri, and Kansas (Wanless, 1957). Clearly, a flooding surface occurs above the Houchin Creek Coal. The Providence Limestone above the Herrin Coal is recognized basinwide and records a flooding surface above the Herrin. Although no basin-wide coal is found below the Universal Limestone (Figure 1), we suggest that the Universal lies above at least a partial flooding surface.

THICKNESS

Our control is based on well records in the files of the Indiana Geological Survey. For the subsurface study of the Carbondale Group in Indiana, we correlated more than 10,000 well logs. For the thickness map (Figure 2), we used no more than one log per section (*i.e.*, one well per square mile). The Carbondale ranges in thickness from 270 feet to 430 feet. Carbondale rocks in Indiana thicken southward and westward. Northward from central Knox and Daviess Counties (Figure 2), the thickness variation of the Carbondale is small and is within a few 10's of feet of 300. The group exceeds 400 feet in a small depocenter in central and northern Posey County (Figure 2). The southwestward thickening may be a consequence of regional subsidence imposed on variable local rates of subsidence within the basin.

SUMMARY

The Carbondale is much thinner (400 feet) than the Raccoon Creek (1200 feet) or McLeansboro (700 feet) Groups. However, in the rocks of the Carbondale, we see recorded the well-developed basinwide coal and limestone combinations that document several cycles of rapid marine transgression with flooding surfaces above the Colchester, Houchin Creek, Springfield, and Herrin Coals and below the Universal Limestone.

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