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PALEODEPOSITIONAL MODEL OF THE HARTSELLE FORMATION AND MONTEAGLE LIMESTONE (MISSISSIPPIAN) EXPOSED IN A ROADCUT ALONG EASTBOUND INTERSTATE-24, DADE COUNTY, GEORGIA

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ABSTRACT—The Mississippian Hartselle Formation and Monteagle Limestone complex are exposed in a roadcut along Interstate-24 (eastbound lane) in Dade Co., Georgia. Here, they contain carbonate units and dark-gray shales with dolomicrite. The geometry, large- and small-scale sedimentary structures (anatomy), and texture and composition of these rock units were used to develop a paleodepositional model. Six types of rocks were identified: biomicrite (wackestone); biosparite (grainstone); oosparite (grainstone); dolomicrite (mudstone); pelbiomicrite (wackestone); dark-gray shale. Two general ancient environments of deposition were interpreted: shallow sea floor (high subtidal), trough crossbedded, rippled and low-angle crossbedded (products of current activity); shallow, marginal marine bay or lagoon (shale), with associated dolomicrite tidal channel infilling (low intertidal). The high subtidal units formed during a rise in sea level and the low intertidal with a fall in sea level.

Interpretation of the Mississippian Hartselle Formation exposed in a roadcut along the eastbound lane of Interstate-24, just inside the north boundary of Dade Co., Georgia, near the junction of Interstate-59, was the main objective of this study. In a regional sense (in the states of Alabama, Georgia, Kentucky, and Tennessee), the Hartselle has been identified (in surface and subsurface) as a stratigraphic unit composed largely of shale and sandstone with less carbonate material. Hence, the Hartselle has been informally named "The Clastic Break" between the underlying, oolitic Monteagle Limestone and the overlying, dark-gray Bangor Limestone.

MATERIALS AND METHODS

A strip-map of this exposure was prepared from 35-mm color slides and used to determine the morphology and sedimentary structures (anatomy) of lithologic units. Spot samples of carbonate units were thin-sectioned to determine texture and composition. Salient features of carbonate rock classifications of Folk (1959) and Dunham (1962) were combined to enable more complete description.

STRATIGRAPHY

Figure 1 presents a generalized stratigraphic sequence of Mississippian units in the vicinity of Interstate-24 in Georgia and Tennessee. The Fort Payne Formation is the lowermost unit in the Mississippian system and consists largely of cherty, dolomitic, echinoderm-rich limestone approximately 45 m in thickness. The Warsaw Limestone may reach a thickness of 15 m and is composed of lime-mud and lime-sand units. Chert-rich dolomitic limestone and greenish shale units mark the St. Louis Limestone which may attain a thickness of 23 m. The oolitic Monteagle Limestone is approximately 76 m thick.

In this region, the Hartselle Formation ranges up to 59 m in thickness and consists of dark-gray shale with a few carbonate layers. In this roadcut, the Hartselle consists of carbonate units and four shale zones (with dolomicrite), depending on where the base of the Hartselle is drawn. Unequivocally, the top of the upper shale zone marks the top of the Hartselle; however, the lowermost shale zone is overlain by an oolitic unit, and it may be considered part of the Monteagle.

The Bangor Limestone is composed of dark-gray carbonate and shale units, all approximately 76 m thick. The uppermost Mississippian stratigraphic unit is the Pennington Formation. Approximately the upper one-third of the Pennington is clastic (maroon, purple, red, and green shales and dark-green graywacke sandstones). The remainder of the Pennington consists largely of lime mud and lime sand along with dolomitic carbonate. The total thickness of the Pennington is approximately 91 m.

GENERALIZED MORPHOLOGY AND ANATOMY

Figure 2 shows the generalized morphology and anatomy of each rock unit in this Interstate-24 roadcut. The lowermost exposure in this roadcut (designated A) belongs to the Monteagle Limestone, is 3.1 m thick, rippled, and thin- to medium-bedded, and is a grainstone or biosparite (fossil fragments or grains set in a clear, crystalline calcite cement).

Unit B is in the Monteagle, is 0.6 m thick, and consists of two rock units. The lower unit contains 0.3 m of dark-gray shale. The upper unit is 0.3 m thick, has an irregular or scoured base, and is a wackestone or dolomitic biomicrite (fossil grains set in a lime-mud matrix that has been extensively reorganized to a microscopic mosaic of dolomite crystals).

The 4.3 m of unit C form the upper unit in the Monteagle. At the base of this unit, there are low-angle, foreset beds that are overlain by trough crossbeds. This rock unit is a grainstone or oosparite (oolites set in a clear calcite cement).

The lowermost unit of the Hartselle Formation (D) is 1.1 m thick. Dark-gray shale composes the lower part of this unit. A 0.2-m thick dolomicrite (mudstone) layer (pellets, or peloids, of lime mud, with ghost structures, have been compacted and largely reorganized to a

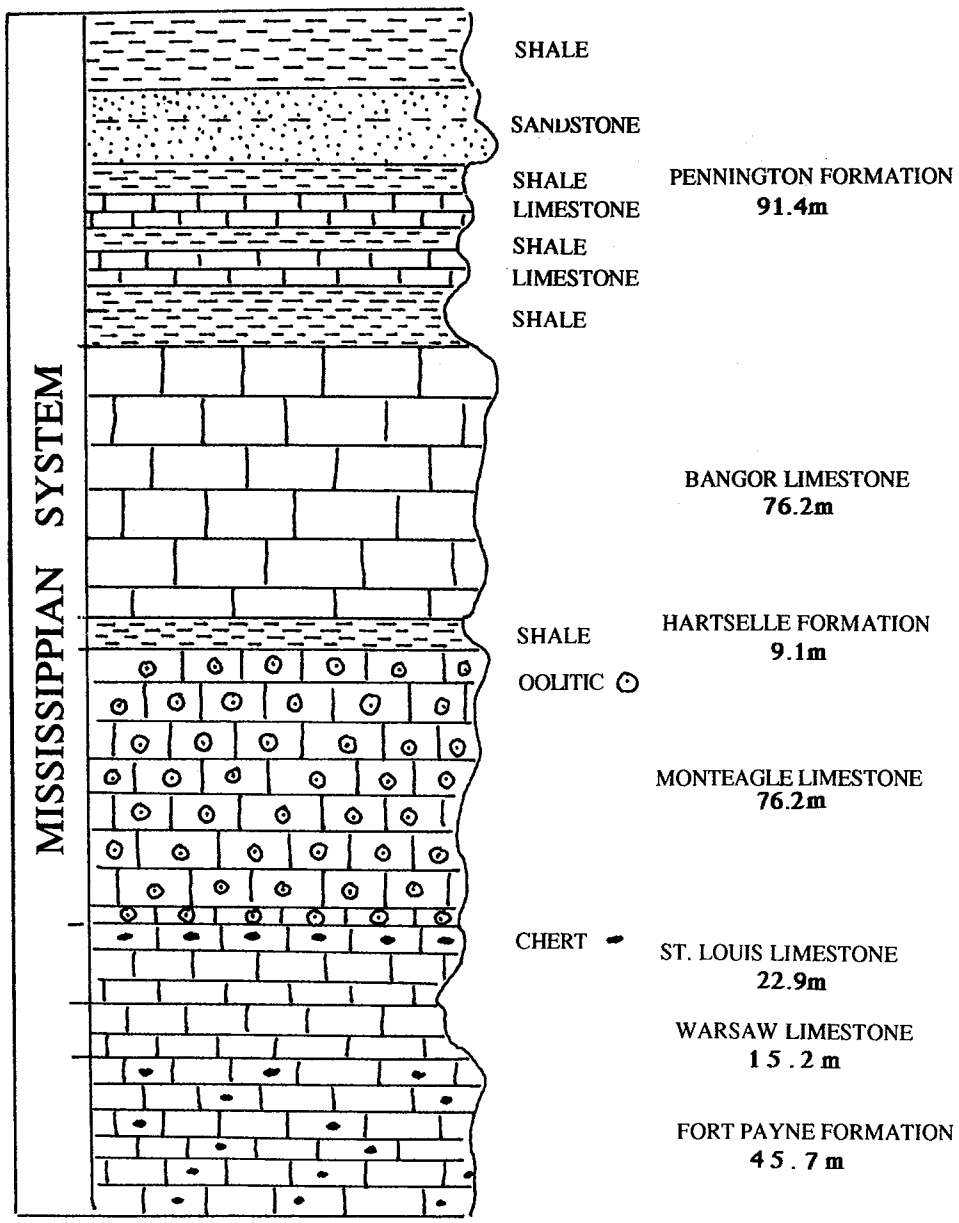

FIG. 1. Generalized stratigraphic column of Mississippian units.

microscopic mosaic of dolomite crystals) with an irregular, or scoured, base forms the upper part of this unit.

Unit E is 1.5 m thick and is a complex of dark-gray shale with a dolomicrite layer showing an irregular (scoured) base plus scattered irregularly shaped lenses of dolomicrite. The 0.6 m of a wackestone, or biomicrite (fossil fragments set in a matrix of lime mud) and grainstone (biosparite) complex, showing low-angle crossbedding with a lag gravel of fossil debris at the base, make up unit F. A complex of dark-gray shale and layers of dolomicrite with scoured bases form 1.5 m of unit G.

Unit H is 2.1 m thick and displays two low-angle crossbedded deposits with scoured bases that are composed of a biomicrite (wackestone)-biosparite (grainstone) complex. A thin, dark-gray shale separates these two deposits.

A 1.2-m thick complex of dark-gray shale and layers of dolomicrite with scoured bases mark unit I. Unit J is unique in this section. It is 1.8 m thick, and a thin bed of dark-gray shale overlies a rippled, mottled (dark and light gray), partly dolomitized deposit of wackestone, or pelbiomicrite (pellets, or peloids, and fossil grains in a partly dolo-

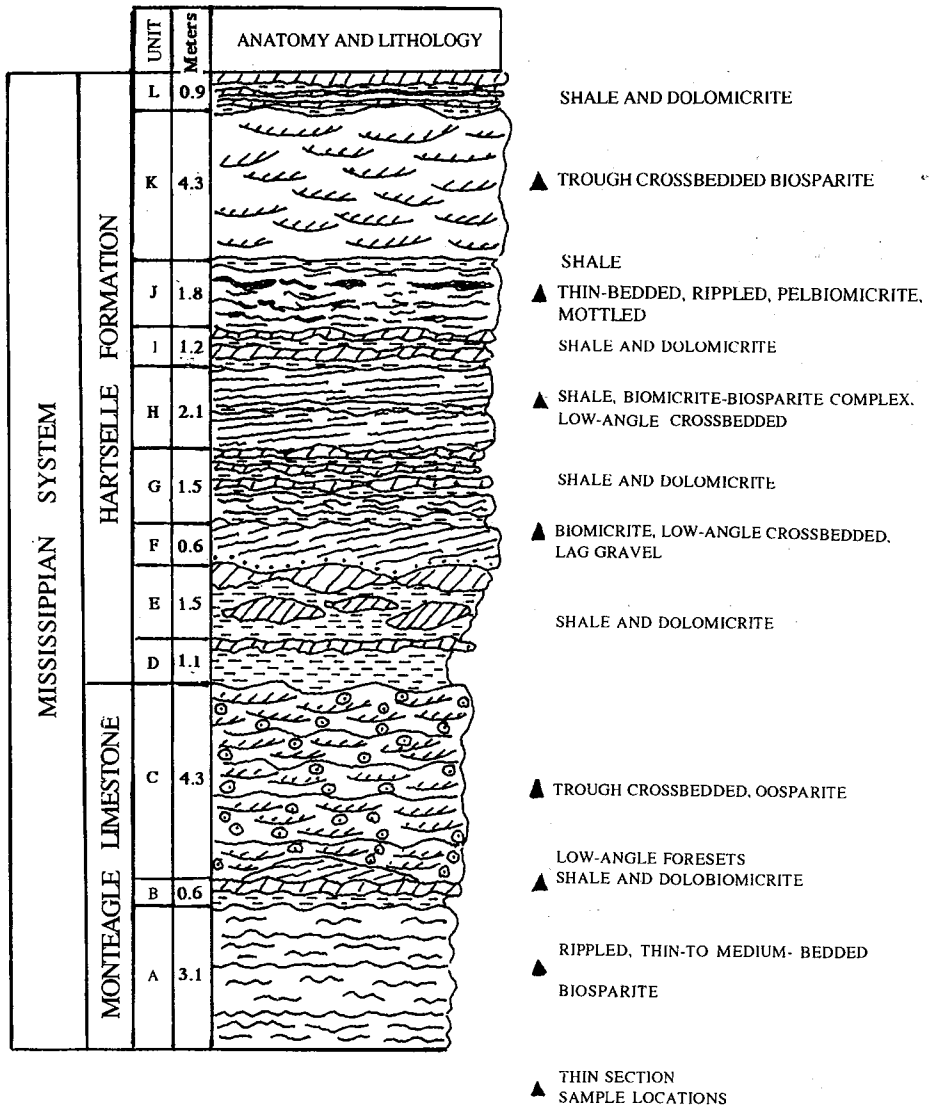

FIG. 2. Generalized morphology and anatomy of a roadcut exposure along Interstate-24, Dade Co., Georgia.

mitized lime-mud matrix). Organic, or bituminous, stringers are present in this pelbiomicrite. Unit K is composed of 4.3 m of grainstone (biosparite) with trough crossbeds.

Unit L is 0.9 m thick. It is a complex of dark-gray shale and thin, interlayered dolomicrite units with scoured bases. A thick (approximately 1.5 m), dark-gray shale overlies unit L. The top of this shale unit is considered as the upper boundary of the Hartselle Formation. Table 1 summaries the textural and compositional Limestone and Hartselle Formation.

DEPOSITIONAL MODEL

Bergenback et al. (1972), Bergenback (1978), and Bergenback et al. (1980) have proposed a lower Carboniferous model with the Bangor Limestone and Pennington Formation tidal flat complex prograding from east to west over platform carbonates of the Hartselle and Monteagle stratigraphic units (Fig. 3). The Hartselle Formation may be considered as composed of deposits of a transitional nature between the lower tidal flat complex of the Bangor and the open shelf megaripple and tidal bar accumulations of the Monteagle.

Figure 3 depicts units B, D, E, G, I, and L as associated with a fall of sea level which, in turn, marks them as low intertidal (shallow, marginal marine) paleoenvironments with dark shales that accumulated in shallow bays or lagoons. These lagoonal deposits were scoured by tidal channels, or creeks, and infilled with muddy lime sediment that was later dolomitized. The dark-gray shales are winnowed materials derived from Upper Carboniferous meandering and braided streams in areas of

higher gradient to the east. Units A, C, F, H, and K accumulated during a rise in sea level and formed rippled, megarippled, and tidal bar (active current) deposits on an open shelf environment. Features associated with the work of Shinn et al. (1969) on a modern platform carbonate tidal flat complex situated northwest of Andros Island, The Bahamas, guided interpretation of these ancient Mississippian rocks.

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TABLE 1. Texture and composition of carbonate rock samples from the Monteagle Limestone and Hartselle Formation. See Fig. 2 for stratigraphic location of units.

Deposit	Unit	Classification		Description
		Folk (1959)	Dunham (1962)	
Monteagle Limestone	A	Biosparite	Grainstone	Bryozoan, echinoderm, and brachiopod grains dominate; endothyrid and ostracod grains in minor amounts; calcite spar cement
	B	Dolobiomicrite	Dolomitic wackestone	Echinoderm and bryozoan grain dominate with less endothyrid grains and intraclasts; rock is poorly sorted and has a mud-supported framework with extensive dolomitization of lime-mud matrix
	C	Oosparite	Grainstone	Ooids, or oolites, dominate; echinoderm, bryozoan and brachiopod grains abundant; less endothyrid, gastropod, and ostracod grains; rock is moderately sorted with a grain-supported framework; crude laminae in trough crossbeds; calcite spar cement
Hartselle Formation	E	Dolomicrite	Dolomitic mudstone	Extensive dolomitization of lime mud (micrite) by microscopic crystals of dolomite; grains of bryozoans, echinoderms, and brachiopods widely scattered throughout
	H	Dolomitic biomicrite and biosparite	Dolomitic wackestone	Bryozoan and echinoderm fragments dominate with less endothyrid and ostracod grains; scattered superficial oolites present; rock is grain-supported; crude laminae with both micrite matrix and spar cement; vertical burrows present; micrite matrix extensively dolomitized
	J	Pelbiomicrite	Wackestone	Echinoderm grains and peloids most abundant along with bryozoan and ostracod grains; minor amounts of endothyrid and gastropod grains plus less rip-up clasts; rock is grain-supported and micrite matrix partly dolomitized (accounts for mottled appearance in a weathered exposure); bituminous (organic) stringers in rippled unit J represent algal mat remains
	K	Biosparite	Grainstone	Echinoderm and bryozoan grains dominate; less trilobite, brachiopod, and gastropod grains and superficial oolites; rock is grain-supported; cement is spar

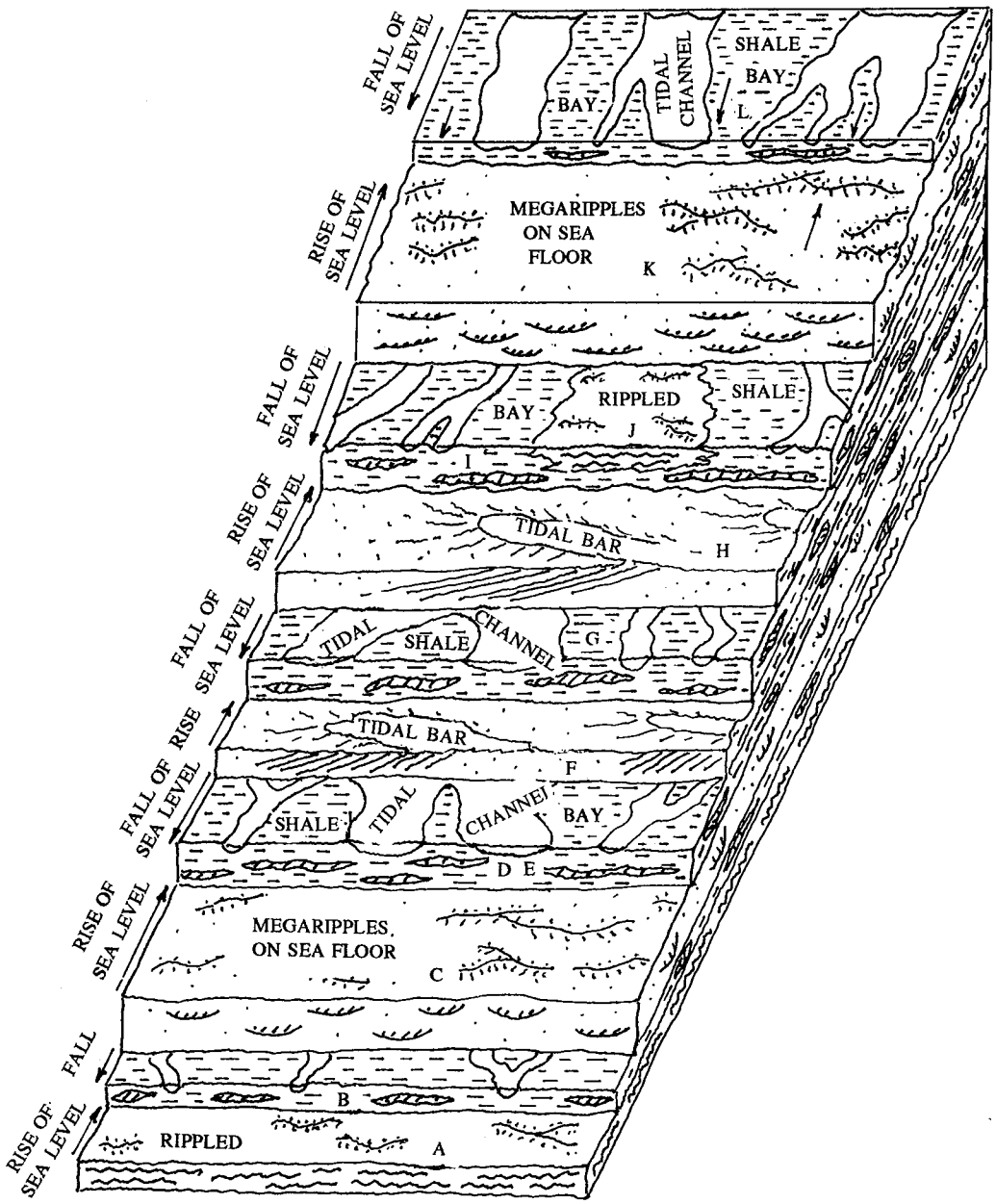

FIG. 3. Paleodepositional model of the Mississippian Hartselle Formation.

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