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INFERRED TIDAL FLAT PALEOENVIRONMENTS IN LEIPERS LIMESTONE (ORDOVICIAN) OF ABANDONED QUARRY, DADE COUNTY, GEORGIA

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ABSTRACT

Several paleoenvironments have been recognized in exposure of the Leipers Limestone (Ordovician) in an abandoned quarry near Interstate 24, Dade County, Georgia. The paleoenvironments include part of an ancient tidal flat complex:

	Facies	*Interpretation*
1.	Gray and green shale	Low supratidal-high subtidal
2.	Fossiliferous micrite	High intertidal-low supratidal
3.	Pelsparite	Intertidal
4.	Biosparite	Low intertidal-high subtidal

Short-term shifts of the strand line across the tidal flat led to cyclic admixtures of the four facies.

INTRODUCTION

Upper Ordovician carbonate rocks, belonging to the Leipers and Shellmound Formations, are exposed in an abandoned quarry near the eastbound lane of Interstate 24 in Dade County, Georgia approximately one half mile from the Hamilton County, Tennessee border (Fig. 1).

Figure 2 is an artist's sketch of the quarry face that shows the location of measured sections. Milici (1972) has give the stratigraphic sequence along I-24 in a road

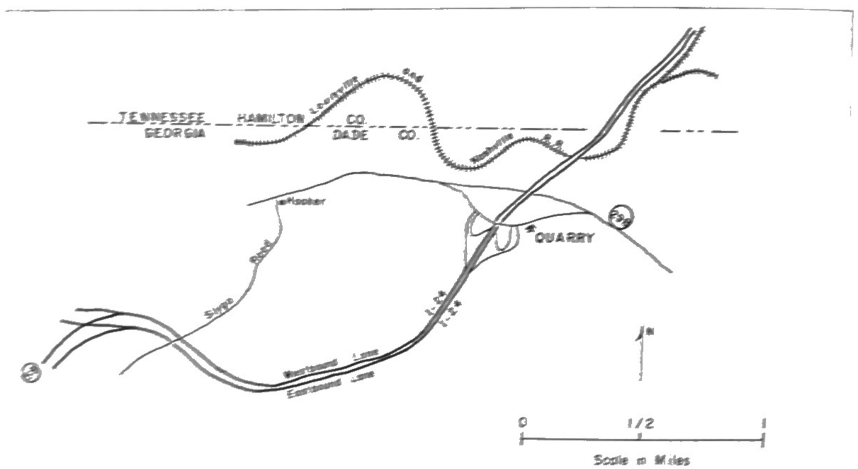

FIG. 1: *Location of Quarry along I-24, Dade County, Georgia.*

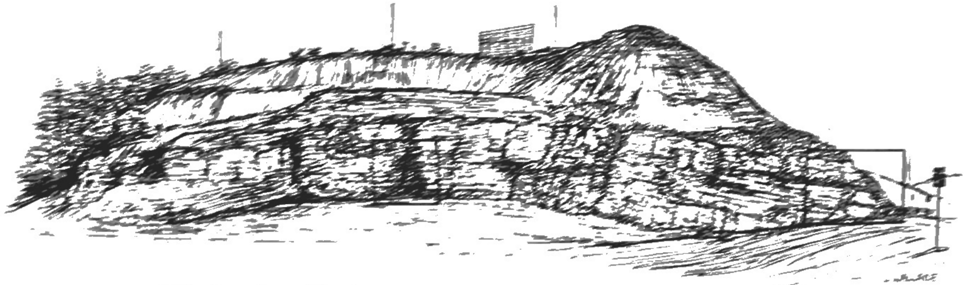

FIG. 2: *Artist's Sketch of Quarry Exposure of Leipers Limestone along I-24.*

FIG. 3: *Generalized Stratigraphic Section, Leipers Limestone, Dade County, Georgia.*

log. Chowns (1972) included these quarry exposures in a study of Upper Ordovician rocks across northern Georgia and Southeastern Tennessee.

It is the purpose of this study to develop a sedimentational model for the Ordovician Leipers Limestone. These rocks were examined for bedding geometry, large- and small-scale structures, texture and composition with the view of interpreting their sedimentational history.

METHODS

Figure 3 is a generalized stratigraphic section of the Leipers Limestone exposed in a quarry along I-24, Dade County, Georgia. Samples A-O were slabbed, thin-sectioned and examined for small-scale bed forms as well as texture and composition.

Description

Four rock types have been recognized in the Leipers Limestone:

1. Shale, green and medium to greenish gray, thin-bedded (up to 3" thick).
2. Fossiliferous micrite, light to medium gray, laminated, burrowed (vertical burrows) and bioturbated, birdseye structures, dolomitization ranges from incipient to extensive (rhomb diagonal ranges from 16 to 144 microns), microscopic vari-shaped pyrite masses and silt-sized to fine sand-sized quartz.
3. Pelsparite, light to dark gray, laminated, mud cracked, rippled, cross bedded, burrowed (vertical burrows) and bioturbated, birdseye structures, locallized incipient dolomitization, microscopic vari-shaped pyrite masses and silt-sized to fine sand-sized quartz.
4. Biosparite (calcisparrudite), light to dark gray, coarse gastropod and coral fragments.

INTERPRETATION

DeVries Klein (1971) described a fining-upward sequence of sediment across clastic intertidal flats as suspension sedimentation that produced high tidal flat muds and clays.

Van Straaten and Kuenin (1958) pointed out that, in tidal flat environments, clay-sized particles increase "as one passes from inlets communicating with the open sea toward the inner shores."

Shinn, Lloyd and Ginsburg (1969) indicated that modern carbonate intertidal-flats northwest of Andros Island, Bahamas, are composed of pellets. Primary sedimentary laminations are largely destroyed by burrowing organisms. Living fauna consists of gastropods, worms and burrowing fiddler crabs. Algal mats occur in the upper transitional part of the intertidal flats.

Laporte (1967) recognized ancient intertidal facies,

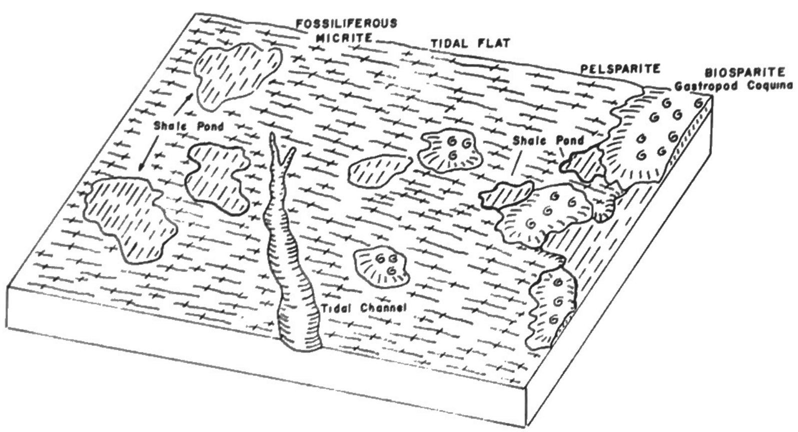

FIG. 4: *Sedimentational Model of Leipers Limestone exposed in an Abandoned Quarry near I-24, Dade County, Georgia.*

in the Lower Devonian Manlius Formation of New York State, as composed of alternating thin beds of sparsely fossiliferous, pelletal, carbonate mudstone and skeletal calcarenite; primary structures include: scour-and-fill, cross stratification and limestone-pebble conglomerate. A few mudcracks indicate intermittent subaerial exposure. The supratidal facies is characterized by non-fossiliferous, laminated, mudcracked, dolomitic pelletal carbonate mudstone. Mudcracks and birdseye structures indicate frequent subaerial exposure; thin bituminous films separating individual carbonate laminae suggest the presence of algal mats.

Walker and Laporte (1970) summarized the work of others and listed lithologic, paleontologic, and primary sedimentological criteria for tidal flat and shallow subtidal carbonate environments. The environments recognized are: (1) supratidal, (2) high intertidal, (3) low intertidal and (4) subtidal. Criteria for recognizing supratidal environments are similar to those given by Laporte (1967). High intertidal is marked by: mudcracks, intraclasts, thin- to medium-bedding, scour-and-fill, vertical burrows and birdseye structures may be present. Low intertidal may be identified by: a small amount of mudcracking, intraclasts, thin- to medium-bedding, scour-and-fill, a few vertical burrows and a few horizontal burrows. Subtidal characteristics may be: massive or lumpy bedding and horizontal burrows.

Zenger (1972) stated that discovery of Holocene supratidal dolomite has led geologists to think much ancient dolomitization to have been supratidal and penecontemporaneous. Features such as lamination, presence of evaporites, birdseye structures and presence of dolomite, if considered singley are not indicative, but rather suggestive of supratidal conditions. It is the collective nature of these features in ancient rocks that is convincing. In certain examples the distinction between ancient intertidal and supratidal environments is equivocal. Therefore, dolomite occurrence can be interpreted as intertidal rather than entirely supratidal.

Figure 3 shows that the Leipers Limestone sequence fines-upward, that is pelsparite, pelmicrite and biosparite grade upward to fossiliferous micrite. Thin green shales are more common in the lower part of this section. The key to interpretation of the thin shales lies in the characteristics of surrounding limestones which are far more sensitive indicators of environmental differences than are the shales. Two cycles of sedimentation have been recognized. Each cycle generally contains the following sequence: pelsparite-biosparite-pelsparite-fossiliferous micrite.

Type 1—Shale. This sediment was probably a suspension deposit and may have formed anywhere from low supratidal to high subtidal. The green shales may have accumulated in extremely shallow pools under reducing conditions.

Type 2—Fossiliferous Micrite. Abundant micrite, probably the result of suspension sedimentation, with locallized extensive dolomitization and birdseye structures suggests deposition in a high intertidal or low supratidal zone.

Type 3—Pelsparite. Pellet-rich sediment and associated bed forms, typical of intertidal deposition, suggest accumulation on a tidal flat.

Type 4—Biosparite. Accumulations of coarse fragments of gastropods and corals are interpreted as ancient coquina deposits which probably formed in low intertidal to high subtidal zones.

The generalized stratigraphic section of the Leipers Limestone (Figure 3) reveals a partial admixture of four rock types; however, there is a general trend of low to high intertidal sediments from the bottom to the top of the exposure. These observations suggest numerous, minor, or short-lived, shifts of a strand line across a portion of an ancient tidal flat complex, as well as a longer-lived landward or seaward shift of the tidal flat environment.

SUMMARY AND CONCLUSIONS

Four rock types have been observed in the Upper Ordovician Leipers Limestone exposed in an abandoned quarry along Interstate 24 in Dade County, Georgia:

Facies	*Interpretation*
1. Shale	Suspension sedimentation-low supratidal-high subtidal
2. Fossiliferous micrite	Suspension sedimentation-high intertidal-low supratidal
3. Pelsparite	Intertidal
4. Biosparite	Low intertidal to high subtidal

Figure 4 is a sedimentational model showing a suggested paleogeographic arrangement of several environments on an ancient tidal flat complex.

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