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ABSTRACT

The Pitkin Limestone overlies black shale of the Fayetteville Formation and is the youngest Mississippian unit in the Paleozoic succession of northwest Arkansas. Five major facies have been delineated within the formation by a petrographic examination of samples collected from 17 measured sections: (1) oolith facies, (2) bioclast facies, (3) nodular limestone-shale facies, (4) mudstone facies, and (5) lime mud mound facies. The distribution of these facies in the Pitkin Formation suggests that Fayetteville terrigenous sedimentation was succeeded by the deposition of widespread oolith shoals and skeletal blanket sand bodies across the northern Arkansas structural platform. Sparse accumulations of lime mud formed in quiet protected areas within the coalescing carbonate complex. Increasing water depth and decreasing turbulence as Pitkin sedimentation proceeded allowed the establishment of bryozoan and blue-green algal communities. The entrapment and stabilization of carbonate mud by these organisms promoted mound development and growth. Scattered oolith shoals formed adjacent to the growing mounds in more turbulent water. Mound development was terminated in shallower water by extensive oolith and by the appearance of extensive skeletal sand accumulations in more turbulent water as regression was initiated.

INTRODUCTION

The Pitkin Limestone, the youngest Mississippian (Chesterian) unit exposed in northwest Arkansas, crops out along the northern escarpment of the Boston Mountains from Batesville, Arkansas, to Muskogee, Oklahoma. Stratigraphically the Pitkin conformably overlies the Fayetteville Formation and is unconformably overlain by the Cane Hill Member of the Hale Formation (Morrowan). In Washington County the unit crops out along a narrow northeast-southwest-trending belt from Fayetteville to Evansville, Arkansas (Fig. 1). Seventeen stratigraphic sections of Pitkin Limestone were measured throughout the study area to delineate lithofacies within the formation and to determine their regional geometry. Lithofacies determinations involved both field observations and thin-section examination. Five major facies were delineated within the formation: (1) oolith facies, (2) bioclast facies, (3) nodular limestone-shale facies, (4) mudstone facies, and (5) lime mud mound facies (Fig. 2).

LITHOFACIES

Oolitic units are usually thick to massive-bedded packstone and grainstone ranging in thickness from four inches to 11 feet. The beds commonly show a blocky weathering pattern. These oolitic strata are present without restriction in the measured sections, but are most common in the lower one-third of the formation and in the intermound areas. Oolith sand initially accumulated in shoal areas across the platform and eventually coalesced to produce blanket sand bodies. These beds grade into both bioclastic and mudstone units.

Bioclastic units for the most part are thick to massive-bedded, although thinner beds also are present. They are composed of wackestone, packstone, and grainstone. The beds commonly have horizontal partings which impart a gnarled appearance to the units; they closely resemble the lumpy, gnarled mound units. Most of the constituents of these beds are crinozoans, bryozoans, and brachiopods. Crinozoans appear to be the most dominant particle. Near the lime mud mounds bryozoans are dominant. Bioclastic beds grade laterally into all of the other lithofacies.

Nodular limestone-shale units range from six inches to eight feet in thickness. They range from lenticular beds to limestone nodules embedded in a shale matrix. The beds are composed of oncolith-intraclast mudstone and bioclastic wackestone and mudstone. The shale ranges from abundant partings to thin beds or stringers. This facies may be the flank facies of the lime mud mounds and may form a transition zone between the mounds and the intermound areas. Some of the material actually may have been derived from the lime mud mounds as a result of wave erosion. These strata grade laterally into mounds and also into bioclastic intermound strata.

Lime mudstone units range from thin to thick-bedded and commonly are in the lower 10 feet of the formation. A few shale stringers are associated with these beds. They appear dense and show conchoidal fracture on fresh surfaces. They contain very few fossils.

The lime mud mounds are massive and have a gnarled or lumpy appearance. They are usually lenticular. The mound core is composed of boundstone containing spar-filled voids and possibly stromatactis (Heckel 1972). Mound development is very localized in the area and generally is confined to the top one-half or one-third of the formation. The mound core grades laterally into nodular limestone-shale beds, or into bioclastic and oolitic beds.

DEPOSITIONAL HISTORY

Chesterian seas apparently encroached across northwest Arkansas from the southeast (Fig. 3). A decrease in Fayetteville terrigenous sedimentation was succeeded by Pitkin carbonate deposition. Examination of the Fayetteville-Pitkin contact indicates that sedimentation was continuous across the boundary. Oolith shoals with associated spillover lobes migrated across the platform as Pitkin sedimentation commenced. Coalescing oolitic and skeletal blanket sand bodies were deposited adjacent to the shoals in this initial phase of Pitkin sedimentaton. Subsidence of the platform and possibly eustatic oscillations of sea level provided the mechanism for abrupt facies changes. Throughout most of the deposition of Pitkin Limestone, sedimentation probably equaled subsidence. Differential subsidence as a result of compaction of Fayetteville Shale formed deeper or more protected areas across the platform in which a middle phase of Pitkin deposition occurred. These areas allowed the deposition of mudstone and nodular limestone-shale. It was in these areas that mound growth commenced. Fistuliporid and fenestrate bryozoans as well as *Girvanella* established themselves on the small mud mounds. Crinozoans probably attached to the flanks of the mounds, thus holding the mud together. Early inorganic cementation also may have caused diagenetic lithification of the mound (Heckel 1974). Mound growth flourished during the final phase of Pitkin sedimentation in which more turbulent conditions prevailed. Mound growth increased because of better circulation patterns and moderate current and wave activity which stimulated faunal growth and carbonate mud production, possibly by green algae. The mounds were self-perpetuating features because the communities of organisms trapped their own skeletal debris and the mud that they produced. Bioclastic and oolitic sands also formed in broad intermound areas and eventually coalesced to form extensive blanket sand bodies during the final phase of Pitkin sedimentation. At the end of Pitkin deposition, regression eventually was initiated, causing subaerial exposure and erosion of Pitkin and possibly post-Pitkin strata.

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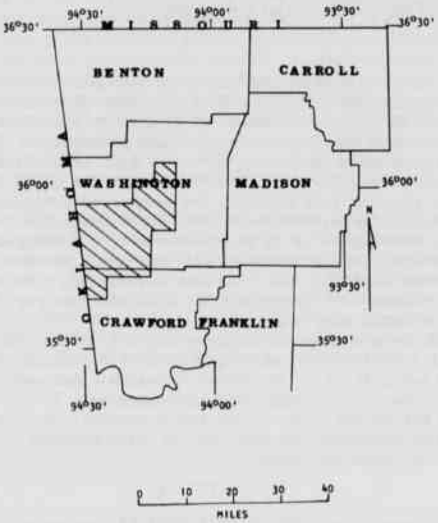

Figure 1. Location of study area in northwest Arkansas.

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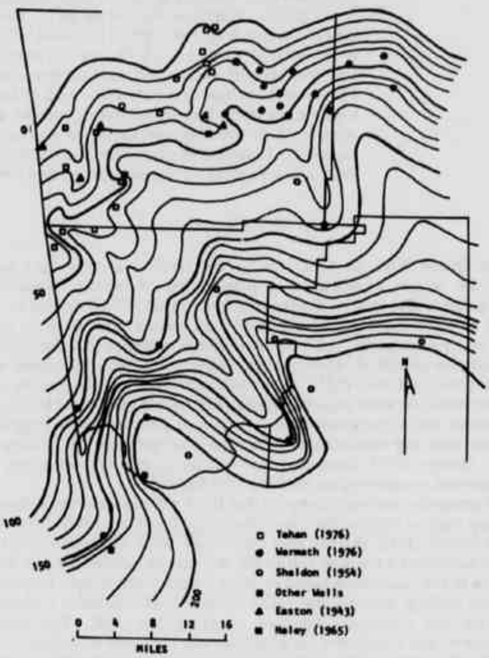

Figure 3. Isopachous map of the Pitkin Formation (from Tehan 1976).

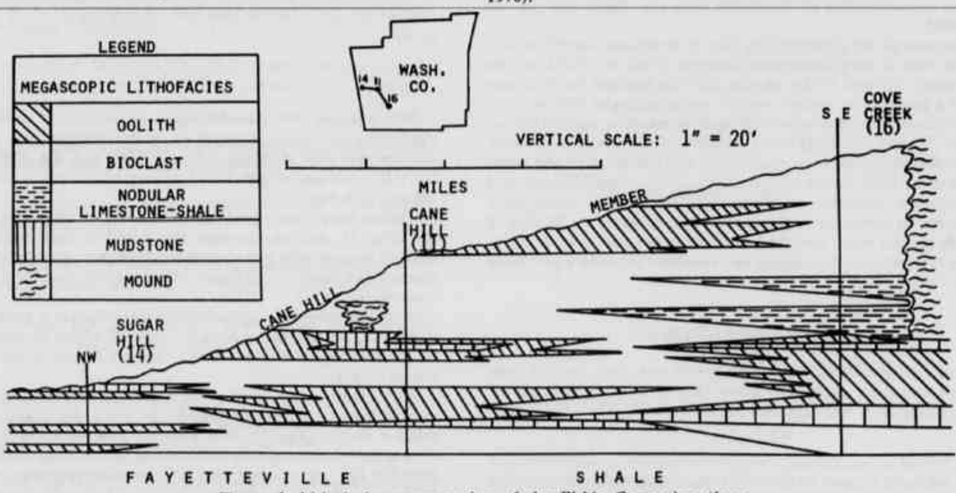

Figure 2. Lithofacies cross-section of the Pitkin Formation (from Tehan 1976). Vertical scale: 1 inch = 50 feet.