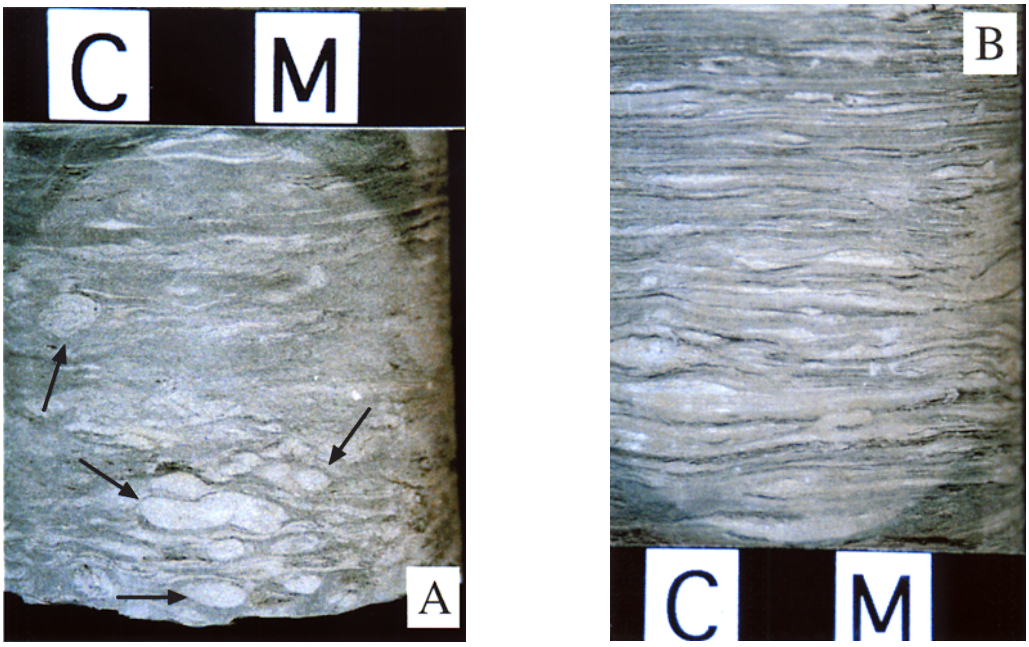

Figure 2.25. Core sections showing the fabric of the laminated to lenticular bedded siltstone and fine sandstone facies. (A) This core section from the Island Creek Shale contains abundant horizontal burrow molds (arrows) that disrupt laminations and lenticular bedding. (Core #3)
(B) This core section from the middle Farley shows finer laminations and contains fewer burrows. (Core # 3)

Figure 2.26. Photo showing nature of laminated to lenticular bedded siltstone to fine sandstone facies as it appears on weathered outcrop. Typical expression is as a platy to slightly fissile siltstone to fine sandstone. Ripple cross-laminations are rarely visible except on very fresh outcrops.

Shepard (1964) also discussed the presence of well-laminated sediments in the delta front of the Mississippi and stated that delta facies can be recognized by the abundance of lamination and the scarcity of marine organisms. Whereas the presence of burrows, especially in the Island Creek-Lane, indicates some bioturbation, the abundance of preserved sedimentary structures suggests rapid deposition that outpaced bioturbation. Therefore, it is most likely that the laminated to lenticular bedded siltstones and fine sandstones present in the middle Farley and Lane-Island Creek represent accumulations of marine, tidally dominated delta front to prodelta sediments rapidly deposited in shallow water or perhaps in depths to approximately 80 meters.

Organic-rich Mudstone and Coal

Darkly colored mudstones with high concentrations of plant debris, rootlets and organic matter occur in the southern part of the field area. These thin mudstones (15 to 50 cm thick) range in color from olive gray to grayish black (5Y 4/1-N2). The deposits are blocky to massive and not fissile. Also, there is a thin coal (2 to 5 cm thick) which may grade upward to typical dark mudstone. In addition to the abundant plant debris and rootlets, there is a fauna of very small (1 cm or less) bivalves. These fossils are rare and are the only body fossils observed.

Environmental Interpretation

Dark gray to black shales of the Midcontinent are typically attributed to deposition in deep, anoxic waters far offshore (Heckel, 1977). These deep-water black shales are typically fissile and contain phosphate, pyrite, and an abundance of such pelagic fossils as conodonts and ammonoids (Heckel, 1977). The dark organic-rich mudstones described in the current study, however, are not fissile and do not contain phosphate or pelagic fossils.

It appears more likely that the dark organic-rich mudstones described herein were deposited in a brackish marsh or lagoonal environment. Lagoonal bottom sediments are muddy and black with hardly any traces of primary bedding visible due to bioturbation (Reineck & Singh, 1975). Reducing conditions within lagoonal environments are characterized by abundant well-preserved plant debris (Reineck & Singh, 1975) such as is preserved in the organic-rich mudstone and coal facies of this study. The thin coal seam in this facies further supports the interpretation of a lagoonal environment as does the absence of abundant and diverse fauna. The rare body fossils are small and probably are a restricted, dwarfed fauna.

Blocky Mudstone

Blocky mudstones (Fig. 2.27) are present in the middle Farley and the Island Creek Shale. In all occurrences the blocky mudstones are noncalcareous and comprise fine silt to clay with abundant mica. Colors typically range from medium, light gray (N6) to light olive gray (5Y 6/1) on fresh outcrops and in cores. Weathered outcrops have a large variety of colors with mottling common. Additional colors observed include shades of brown, olive green, and bluish gray.

The mudstones of the middle Farley are massively bedded and exhibit irregular curved fractures on outcrops. Hand samples and core sections break into irregular blocky masses 2 to 10 cm in longest dimension, with irregular to curved, slightly glossy fracture surfaces. In middle Farley outcrops and cores, striations are common on the glossy fracture surfaces (Figure 2.28). Body fossils are absent from all occurrences, but plant debris is abundant both on outcrops and in cores (Figure 2.29). Additionally, small tubular structures filled with light brown (5YR 5/6) residues are also common in the middle Farley.

The blocky mudstones of the Island Creek are of a slightly different nature than those found in the middle Farley. The Island Creek blocky mudstones are also massive bedded but have much more consistent coloration. The Island Creek blocky mudstones contain rare body fossils, typically small bivalves. The other main difference is that the blocky mudstones of the Island Creek have no glossy, striated fracture surfaces.

Environmental Interpretation

The blocky mudstones of the middle Farley exhibit features common to ancient soils. Watney *et al.* (1989) indicated diagnostic features used to identify paleosols including: (1) rhizoliths (rootlets), (2) ped surfaces in blocky mudstones, and (3) color mottling or isolated horizons of color. The blocky mudstones of the middle Farley and Island Creek have all of these features.

The blocky or brecciated nature of the mudstones results from the relict ped structure of the soil. Ped surfaces in the middle Farley are recognizable by their irregular to slightly curved surfaces with glossy striated coatings. The slightly glossy, surfaces of the blocky mudstones represent cutans and the striations are slickensides. Slickensides form in clayey soils where peds are repeatedly heaved past one another by swelling and shrinking during episodes of wetting and drying (Retallack, 1990).

The mottled coloration of the middle Farley blocky mudstones is also characteristic of paleosols. Color mottling is typically a result of differential oxidation of iron and redistribution and formation of clay minerals (illuviation) (Watney *et al.*, 1989). Further evidence of paleosol development are the small tubular structures that represent rootlets. Based on these several characteristics common to paleosols, the blocky mudstones of the middle Farley are confidently identified as ancient soil horizons.