Cambrian Saint Croixan and early Early Ordovician Canadian. It is bounded below by the unconformity on the Precambrian basement and above by the Knox unconformity. The Sauk sequence was deposited throughout the study area of northern Ohio, which includes the western portion of the Appalachian basin, the Ohio-Indiana platform to the west, and the southernmost portion of the Michigan basin northwest of the Ohio-Indiana platform. The major lithostratigraphic units, all in the subsurface, are the Cambrian Mount Simon Sandstone, Shady Dolomite, Eau Clair Formation, Rome Formation, Conasauga Formation, and Kerbel Formation, and the Cambrian-Ordovician Knox Group.

Stratigraphic interpretations generally show that the Sauk sequence begins with clastic deposition occurring in the north-central and western portions of Ohio and predominantly carbonate and open-marine clastic deposition occurring in eastern and south-central Ohio. The location of the present Cincinnati arch marks a transition zone between the two sedimentary regimes. The final stage of Sauk sequence deposition was marked by a major marine transgression that resulted in deposition of the Knox Dolomite over the entire study area.

Producing reservoirs occur in four stratigraphic-structural settings. The Copper Ridge Dolomite (Knox Group) on the eastern edge of the Ohio-Indiana platform has oil production from glauconitic sandstone reservoirs.

Basinward, the Cambrian dolomitic Rose Run Sandstone Member occurs at the top of the Copper Ridge Dolomite. Mainly gas has been discovered in the Rose Run in secondary reservoirs formed during erosion of the Knox unconformity. Middle Ordovician shales and impermeable limestones are the seals.

The majority of hydrocarbon production from the Knox Dolomite is located in central Ohio's Morrow County where erosional remnants of vuggy dolomite on the Knox unconformity form paleotopographic highs with Middle Ordovician shale as the seal. Other small pools consist of vuggy dolomite reservoirs with small structural closures.

Although no significant amounts of hydrocarbons have been discovered below the Copper Ridge Dolomite, high porosities and permeabilities in the Mount Simon Sandstone and Eau Claire Formation lend potential to these rocks for liquid waste disposal.

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Genesis of Phosphatic Sediments in Cincinnatian Series (Upper Ordovician), Southeastern Indiana and Southwestern Ohio

Few workers have considered the origin of lower Paleozoic phosphate-rich strata, especially in the light of recently proposed phosphorite depositional models. Selected samples of limestones and shales from the Cincinnatian Series have been examined to determine the environmental factors contributing to the accumulation of phosphatic sediments.

The conditions of phosphate accumulation have been interpreted from a detailed description of the stratigraphic sequence, sedimentary structures, textures, and fossil content of each locality. Microfacies analysis of the limestones revealed that phosphate is largely confined to intragranular pores of bioclasts (echinoderm debris, juvenile mollusks, bryozoan zooecia). The phosphatized bioclasts are concentrated as basal lag deposits above discontinuity surfaces, as starved ripples within shale beds, and as burrow infillings. The zones of phosphatic concentration directly overlie bioclastic wackestones.

The original phosphatization process probably occurred within the sediments that formed the bioclastic wackestones. The ichnofossils (and, in part, the body fossils) indicate that there was a low rate of sedimentation, high organic input, high initial water content (> 50%), normal oxygen concentrations, and pervasive bioturbation of a muddy substrate. The confining microenvironments necessary for the reducing conditions of phosphate precipitation were the intragranular pores of bioclasts, such as bryozoans, filled with organic-rich muds. Early diagenesis of phosphate took place within the pores, and these relatively denser allochems were subsequently winnowed from the unconsolidated muddy substrate by episodic high-energy events. The resultant deposits were phosphatic sands that also underwent biogenic disturbance and further physical redeposition.

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Depositional Trends of Clinton Section in East-Central Ohio

The Lower Silurian Clinton section in east-central Ohio is a clastic wedge of sandstones, shales, and carbonates. Previous studies have shown that the Clinton section was deposited as a delta prograding westward over reworked clastics of the Ordovician Queenston Shale.

Geophysical log data were used to construct total Clinton sandstone and sandstone cleanliness maps of the delta margin. Clean-sand maps show the distribution of sand and shale in an offshore bar system in west-central Holmes County. Similar studies in adjoining counties indicate an extension of this bar system, which coincides with the Newburg pool in southern Medina County. Stratigraphic cross sections show the intertonguing relationship of sand, shale, and carbonate lithosomes typical of a deltaic system. The clastics of the upper Cabot Head grade westward into calcareous sands and thickening carbonates. Slice maps show the distribution of these deposits during time.

Production of oil and gas in Holmes County has been concentrated along the north-trending thick sands of the delta-margin bar system. Sand isopach maps, cross sections, and a porosity foot map show the distribution of thinner fluvial and fluvial delta-margin sands in western Holmes County.

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Relationship of Fracture-Induced Gas Reservoirs to Stratigraphic Controls in Eastern Devonian Shales

A new exploration method is advanced based on the hypothesis that some fractured shale reservoirs are related to a stratigraphic-type trapping mechanism at lithofacies boundaries where gray shales grade laterally into dark, radioactive shales having different physical and chemical characteristics. Hydrocarbons are postulated to move through these indurated, fine-grained shales as they do during late primary migration. Whatever mechanisms are operating at shale lithofacies, facies changes are systematic depositional events that can be mapped using conventional subsurface geologic methods. Shale gas fields associated with the mapped position of shale facies changes are found in all three eastern basins.

Gas occurrences from 139 wells were projected into a stratigraphic test section in Kentucky and West Virginia. Several facies changes and 232 gas occurrences are documented; they show a trend of gas occurrences near shale facies changes. For example, the middle Huron, more than 200 ft (61 m) thick, changes from 88% black to 2% within 17.2 mi (28 km); 87% of reported gas in the unit occurs in that same distance. Of 66 major shows or increases (> 100 mcf or 2,830 m^3) in the Ohio Shale, 88% fall within the 17.2 mi (28 km) in which the total unit changes from 86% black to 16%.

Facies changes appear to define trends of shale gas potential within specific beds; thus, a new element has been added to shale gas exploration methodology. The methods developed can be used to test the applicability of the hypothesis to the eastern basins.

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Sedimentology, Diagenesis, and Porosity Development of Middle Silurian Lockport Dolomite, Johnson County, Kentucky

A complete core of the Lockport Dolomite reveals the presence of five distinct lithofacies. Proceeding upsection from the underlying littoral Keefer Sandstone, these units are: (1) extensively burrowed and sparsely fossiliferous mudstone-wackestone (initial transgression); (2) thinly bedded, crinoidal packstone-grainstone (open shelf); (3) stromatoporoid-coral-crinoidal packstone (open shelf); (4) oolitic-peloidal packstone-grainstone (shoal); and (5) finely laminated mudstone (tidal flat). The middle to upper sections reflect a shoaling-upward sequence that grades into the overlying Salina Formation sabkha sediments.

Original rock textures have been veiled for the most part by dolomitization. Petrographic analysis indicates that dolomite occurs in two forms: (1) as a fine to medium crystalline replacement mineral, and (2) as a coarse crystalline cement (including saddle dolomite) filling vugs and fractures. The first variety is eogenetic, having formed primarily as a result of freshwater/seawater mixing during occasional subaerial exposure of sediments. The coarser dolomite is of late (mesogenetic) origin.

Historically, the Lockport has been an important oil and gas producer in eastern Kentucky. Secondary porosity development is significant and