structural origin. The lengths range from 7.25 to 24 km (4.5 to 15 mi) within the county. However, some lineaments extend for many kilometers outside of the mapped area.

There are two major sets of Landsat lineaments in Erie County. They are oriented approximately northwest-southeast and northeast-southwest. The vectors of the dominant set average 329° and those of the secondary set average 49°. The 329° set approximately coincides with the average regional dip of mapped subsurface beds. The 49° set generally corresponds to regional subsurface strike.

A detailed structural interpretation on the top of the Queenston Formation shows that some of the northwest lineaments locally coincide with dip reversals and other anomalies. This mapped horizon is the base of the Lower Silurian Medina Group which is currently the principal gas-producing reservoir in this region.

Lineaments which have a tectonic origin are surface expressions of faults and other structural disturbances which probably affected the crystalline basement and were repeatedly reactivated during the deposition of overlying beds.

Extensional fractures (fracture traces) interpreted from enlarged aerial photographs are abundant. The fracture traces are found in the surface lineament zones as well as in areas between lineaments. These fractures, at depth, can locally enhance the porosity and permeability of reservoir beds which, normally, are classified as "tight formations."

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Patch Reef Modeling—A Comparison of Devonian and Recent Examples

In reef research, models have been developed to define variations in the lithic and biotic development of facies. Walker and Alberstadt, and Hoffman and Narkiewicz developed models for growth of ancient reef communities. Although these models form a solid foundation by which patch reefs can be classed and zoned, they are neither complete nor accurate for all reef types. A comparison was made of Lower Devonian patch reefs from the Appalachian basin of New York, New Jersey, and Pennsylvania, and Holocene examples from the Bahamas and Florida Keys to identify the structure, orientation, community variability, and succession of the reef biofacies. The complexion and genesis of the carbonate lithofacies were also studied. Results show similarities; these include the size, areal distribution, 3-D geometry, wave-resistance potential, lateral sequences of facies, sedimentary textures and structures, vertical zonation explained by growth from low-energy to high-energy regimes, biotic diversity, growth habit and form, and postmortem alteration. Thus, when used in conjunction with the traditional models, the recent can serve as the basis for a general model which include most patch reef types. However, these models should not be used as explicit analogs for all Phanerozoic reefs. Knowing and understanding the limitations of these comparative studies are essential to a fuller comprehension of the potential for variations which exist within and between the traditional models.

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History of Displacement Along Ste. Genevieve Fault Zone, Southwestern Illinois

The Ste. Genevieve fault zone extends eastward from Missouri across the Mississippi River into Jackson County, Illinois, about 75 mi (120 km) southeast of St. Louis. Outcrop studies have dated movement along portions of the zone as pre-Middle Devonian, post-Mississippian, and post-Pennsylvanian. Present displacement is down to the north and east with throw ranging up to 3,000 ft (915 m). However, pre-Middle Devonian movement was down to the south and west.

The present upthrown block shows no evidence of vertical movement during the Cambrian and Ordovician. Nor is there any indication that the fault zone was part of the northern border of the Reelfoot basin, where earliest Paleozoic sediments infilled an aulacogen at the northern end of the Mississippi embayment.

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Structural History of Southern Illinois and Upper Mississippi Embayment

Early crustal failure produced deep grabens which filled with fluvial and marine sediments. Subsequent growth faulting during the Paleozoic deepened these troughs, allowing deposition of thick sedimentary sequences in the Reelfoot basin and Rough Creek graben. Uplift of the Pascola arch closed the Illinois basin to the south, and erosion along the arch removed much of the sedimentary record.

Subsidence of the Mississippi embayment area allowed deposition of southward thickening continental and marine sediments. Subsequent erosion has produced the present-day areal distribution of geologic units.

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Stratigraphic Traps and Deposition of Aux Vases and Uppermost Ste. Genevieve Formations (Mississippian), Southern Illinois

A basin-wide subsurface and outcrop study of the Aux Vases Sandstone was undertaken to determine the source of the sandstone, the regional extent of producing zones, the nature of its stratigraphic traps, and reservoir characteristics. The Aux Vases marks the transition from the predominantly carbonate deposits of the Valmeyeran to the clastic dominated Chesterian.

The Aux Vases in southwestern Illinois is composed of fine-grained, subangular to rounded sandstone commonly occurring in massive sand bodies 50 to 200 ft (15 to 60 m) thick. Many of these sand bodies are fluid-saturated and porous, but are not petroleum reservoirs. The eastern and central parts of the Illinois basin, where the Aux Vases is usually less than 30 ft (9 m) thick, are the major producing areas.

The overlying Renault Limestone separates the Aux Vases from lower Chesterian sands, forming a cap for many stratigraphic traps in the Aux Vases. The most common type of stratigraphic trap in the Aux Vases occurs in thin, shaly and silty sands overlying the Joppa Member of the Ste. Genevieve Limestone ("Aux Vases Lime"). Previous work has indicated that these are tidally influenced sands deposited on a platform of Ste. Genevieve oolitic limestone or grainstone. These Aux Vases platform sandstones grade laterally into either oolite, grainstone, or silty, shallow-marine shale. The best production comes from "permeability pods," where good porosity (15 to 20%) coincides with permeabilities in excess of 100 md.

Another type of stratigraphic trap occurs in a 4 to 10-ft (1 to 3 m) thick oolitic zone, in the lower part of the Joppa Member, usually separated from the Aux Vases by less than 10 ft (3 m) of dense limestone. When this oolite is loosely cemented, permeabilities are in excess of 200 md, resulting in excellent initial production (sometimes in excess of 1,000 bbl of oil/day).

Study results indicate a western source for the Aux Vases. The thickest accumulations of sand occur in the southwestern part of Illinois and display western cross-bedding. The amount of sand decreases and the amount of limestone increases in the producing part of the basin.

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Comparison of Organic-Rich Shales of Pennsylvanian Age in Indiana with New Albany Shale

Abundant black organic-rich shales occur in rocks of Pennsylvanian age in southwestern Indiana. They have not been well characterized except for a few thin intervals in small areas, the best example being at the abandoned Mecca Quarry in west-central Indiana. Although these shales are thinner and less widespread than the organic-rich shales of the New Albany Shale (Devonian and Mississippian age) they warrant characterization because of their accessibility during strip mining of underlying coals.

Organic-rich shales of Pennsylvanian age contain up to 44% organic carbon and might be considered potential oil shales. Carbon to hydrogen ratios in these shales are similar to those in the New Albany. Relatively high concentrations of certain metals occur in shales of both ages, especially where phosphate is abundant, and sulfur values for both shales