STRATIGRAPHY

This series of regional cross sections presents the interpreted structural and stratigraphic framework of the Illinois Basin. Existing stratigraphic problems are apparent on these regional cross sections and are discussed below. Developing solutions for these problems, however, is beyond the present scope of this project.

Rather than introduce new terminology on the cross sections, we use the stratigraphic nomenclature used in the various states in several recent publications (Shaver 1985, Willman et al. 1975, Howe 1961, McDowell et al. 1981, Adler et al. 1987).

Bonneterre/Eau Claire

The Bonneterre Formation (Cambrian) in Missouri is a predominantly carbonate unit. The Eau Claire Formation, as defined in Wisconsin and used in northern Illinois, is a siliciclastic unit (Buschbach 1975). The Eau Claire becomes predominantly carbonate southward into the Illinois Basin (Buschbach 1975), and is laterally equivalent to the Bonneterre Formation in southeastern Missouri. The Eau Claire and Bonneterre are separated from overlying carbonates by the Davis, a shaly carbonate in southern Illinois. The Davis is a member of the Franconia Formation in Illinois and the basal formation of the Elvins Group in Missouri. The Davis loses its siliciclastic component eastward beyond central southern Illinois, thereby making it difficult to pick the top of the Eau Claire. The lower portion of the Eau Claire in Illinois is also a carbonate, but it is relatively rich in siliciclastics. In Indiana and Kentucky, this lower siliciclastic carbonate unit constitutes the entire Eau Claire Formation, and the overlying carbonates are included in other units (Droste and Patton 1985). More detailed mapping and more data are needed to better define these facies relations.

Canadian Series

Strata of the Canadian Series (Ordovician) are restricted to the subsurface in southern Illinois and western Kentucky, but they crop out along the eastern flank of the Ozark Dome in Missouri. In Missouri these strata are subdivided into six formations. In ascending order, they are the Gasconade Dolomite, including the Gunter Sandstone Member at its base, the Roubidoux Formation, and the Jefferson City, Cotter, Powell, and Smithville Dolomites (Thompson 1991, Adler 1987). In Kentucky the Gunter through the Cotter Formations are recognized, although the Gunter in Kentucky is considered a separate formation (Shaver 1985, McDowell et al. 1981). The Powell and Smithville are not recognized in Kentucky. If present in Kentucky, these strata are included in either the unnamed argillaceous unit, mentioned below, or the Cotter Dolomite.

In southern Illinois, the strata of the Canadian Series are assigned to the Prairie du Chien Group (Bain 1906, p. 18; Willman and Buschbach 1975), formally subdivided into three formations. In ascending order, they are the Gunter Sandstone and the Oneota and Shakopee Dolomites. The Gunter has a patchy distribution, and where it is absent, its position is recognizable in cuttings and core only by occasional sand grains near the base of the Oneota.

The Gasconade of Kentucky and Missouri is equivalent to the Oneota of Illinois, except that in Missouri, the Gasconade includes the Gunter as a basal member. The Roubidoux correlates with the New Richmond Sandstone of west-central and northern Illinois. In the west-to-east cross section that extends from Missouri to Kentucky, the "Roubidoux" is informally recognized in southern Illinois to show its probable correlation from the adjacent states where it is formally recognized. The Shakopee in Illinois has not been further subdivided. Correlating the other Missouri units to the Shakopee was beyond the scope of this project, as lithologic differences are commonly defined on the basis of insoluble residues and are too subtle to be detected on wireline logs.

Unnamed Argillaceous Dolomite Overlying Shakopee

A shaley or argillaceous dolomite unit, previously unrecognized as distinct from and overlying the Shakopee Dolomite, is present only in wells in the southernmost part of Illinois and adjacent parts of western Kentucky and possibly southwestern Indiana. It is thickest in the Pickel well (330 ft), Union County, Illinois; the Streich well (706 ft), Pope County, Illinois; and the Davis well (460 ft), Crittenden County, Kentucky. It is present, although thin, as far north as the Cuppy well, Hamilton County, Illinois. The unit is absent in the Stephens well, Caldwell County, Kentucky, and the Duncan well, Webster County, Kentucky, even though these wells are located in the Rough Creek Graben. Also in the Stephens and Duncan wells, the Shakopee equivalent is anomalously thin, which suggests that these two wells penetrate horst blocks uplifted and eroded during the major drop in sea level that resulted in formation of the sub-Tippecanoe unconformity. The unnamed shaley dolomite unit may have been deposited prior to block uplift and eroded from these structurally high areas, in which case the unit is part of the Sauk Sequence. Alternatively, the southernmost part of the basin, including the areas of the Pickel, Streich, Davis, and adjacent wells, may have remained submerged and thereby experienced continuous deposition when the shallower parts of the basin, including the uplifted horst blocks, were subaerially exposed. The unnamed shaley dolomite may represent that continuous deposition. The shaliness may reflect an initial (lower Tippecanoe Sequence) influx of clay and silt from the basin margins; that event was followed by deposition of sandstones. By this scenario the unnamed shaly dolomite is part of the Tippecanoe Sequence.

Everton-St. Peter

The upper part of the Everton Dolomite and the lower part of the St. Peter Sandstone (Ordovician) appear to be facies of one another. The St. Peter is the nearshore peritidal and subtidal facies of the more basinward Everton (Droste and Shaver 1983). The Everton is a sandy dolomite that may contain thick St. Peter-like sandstones where these sandstones are overlain by a carbonate.

Joachim-Dutchtown

We did not differentiate the Joachim and Dutchtown Formations (Ordovician). Winslow (1894, p. 331, 352) and McQueen (1937, p. 12) defined the Joachim as a dolomite in its type area and the Dutchtown as principally a limestone. In the subsurface, however, both units may be dolomite and/or limestone, thereby eliminating the main distinguishing characteristic. The lower part of the combined unit is generally shalier, as evidenced by higher readings on the gamma ray logs, but this criterion has not been used in the past as a distinction between the units.

Mammoth Cave Group

Carbonates of the Mammoth Cave Group (Mississippian) are difficult to subdivide, since the contacts between the formations are gradational. More work and more core data are needed to work out the facies relations of this carbonate group. In these cross sections, we have attempted to correlate the formations basinwide as they have been defined in the past to aid those who use those subdivisions.

STRUCTURE

The structural configuration between the wells was taken primarily from available regional structure maps: the base of the Beech Creek in Illinois by Bristol (1967), the base of the New Albany in Illinois by Cluff et al. (1981), the base of the New Albany in Kentucky by Schwalb and Potter (1978), the top of the Galena in Illinois by Bristol and Buschbach (1973), and the base of the Roubidoux in Missouri by McCracken (1971). Other data, such as bedrock geologic maps, were checked and the most reasonable interpretations were depicted on the sections.

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EXAMPLES OF POSSIBLE HYDROCARBON PLAYS

STRUCTURAL

1. Anticlinal traps caused by tectonic folding
2. Anticlinal traps caused by draping over buried reefs
3. Fault entrapment
4. Fracturing of organic-rich shales such as the New Albany
5. Fracturing of carbonate rocks such as the Galena (Trenton)

STRATIGRAPHIC

6. Pinchouts of porous clastic rocks
7. Sand bars within incised paleovalley network; influence of the paleovalley network commonly results in stacked sandstones
8. Sub-Absaroka unconformity: truncation of reservoir rocks, especially by shale-filled paleovalleys; also, potential for reservoir development at or below unconformity caused by localized diagenesis
9. Isolated porous oolite or other carbonate shoals in Paleozoic rocks
10. Isolated Valmeyeran reefs
11. Isolated turbidites in Borden Siltstone (not identified on this section)
12. Onlap and pinchout of reservoir rocks on Sub-Kaskaskia unconformity
13. Sub-Kaskaskia unconformity: local enhancement of carbonate porosity at unconformity due to diagenesis; truncation of reservoir rocks
14. Isolated Niagaran reefs (not identified on this section)
15. Possible local traps in Joachim Dolomite caused by updip anhydrite seals
16. Sub-Tippecanoe unconformity: possible local reservoir development caused by diagenesis of Knox carbonates
17. Onlap and pinchout of reservoir rocks on paleostructures
18. Possible local traps in lower Paleozoic rocks depending on presence of suitable source rocks

LITHOLOGIES

clsgvl	clay, silt, sand, gravel
ss	sandstone
isshls	interbedded sandstone-siltstone with shale and/or carbonate
ishsls	thinly interbedded siltstone-shale-sandstone-limestone; includes coal in Pennsylvanian
slst	siltstone
sh	shale
csh	calcareous shale
ls	limestone
sdyls	sandy limestone
lsdol	dolomitic limestone or calcareous dolomite
dol	dolomite
sdydol	sandy dolomite
[symbol]	reef
[symbol]	cherty
[symbol]	shaley
[symbol]	anhydritic
xlna	crystalline rock - acidic

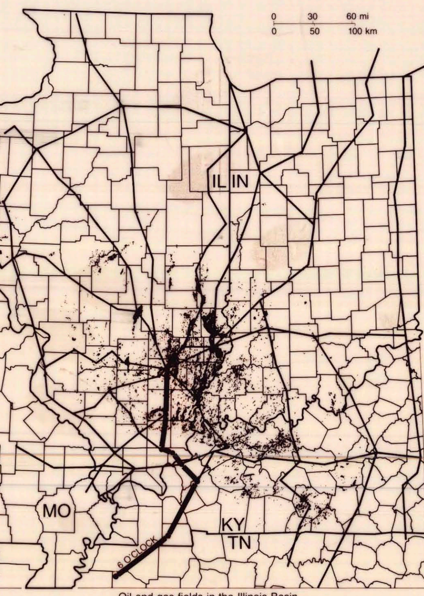
ft / m: 1000 — 300; 800; 600 — 200; 400 — 100; 200; 0

0, 5, 10 mi; 0, 5, 10, 15 km

1:250,000
vertical exaggeration 52x
log depths are in feet

NOTES:

- Stratigraphic nomenclature is based primarily on the COSUNA chart.
- Structural terminology in Illinois follows Nelson, W. John, in prep., Structural Features in Illinois: Illinois State Geological Survey Bulletin.
- Datum for this cross section is mean sea level. Structural control used within the cross section for the sub-Pennsylvanian strata was the base of the New Albany Group. Where the New Albany Group is absent, the top of the Galena Group/Trenton Limestone was used. Structural control for the Pennsylvanian strata included the base of the Pennsylvanian and the top of the Herrin Coal. Various isopach and lithofacies maps were used for further control. Surface topography was mapped from U.S. Geological Survey 1° x 2° sheets.



Oil and gas fields in the Illinois Basin

ILLINOIS BASIN CONSORTIUM CROSS SECTION PROJECT

The structural and stratigraphic framework of the Illinois Basin is portrayed in a network of regional cross sections prepared by the Illinois Basin Consortium (Illinois, Indiana, and Kentucky Geological Surveys). Most of the sections radiate from the UNOCAL #1 Cisne well in Wayne County, Illinois, the approximate center of the basin. Additional sections are oriented to traverse significant geological features in Indiana and Kentucky. As each cross section is completed, it will be available in open-file format from the state geological surveys.

This cross section is also part of the Conterminous U.S. Mineral Assessment Program (CUSMAP) study of the Paducah Quadrangle, which is a joint project of the U.S. Geological Survey and the state geological surveys of Illinois, Indiana, Kentucky, and Missouri.

6 O'CLOCK CROSS SECTION IN THE ILLINOIS BASIN

WAYNE COUNTY, ILLINOIS, TO GIBSON COUNTY, TENNESSEE

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1992

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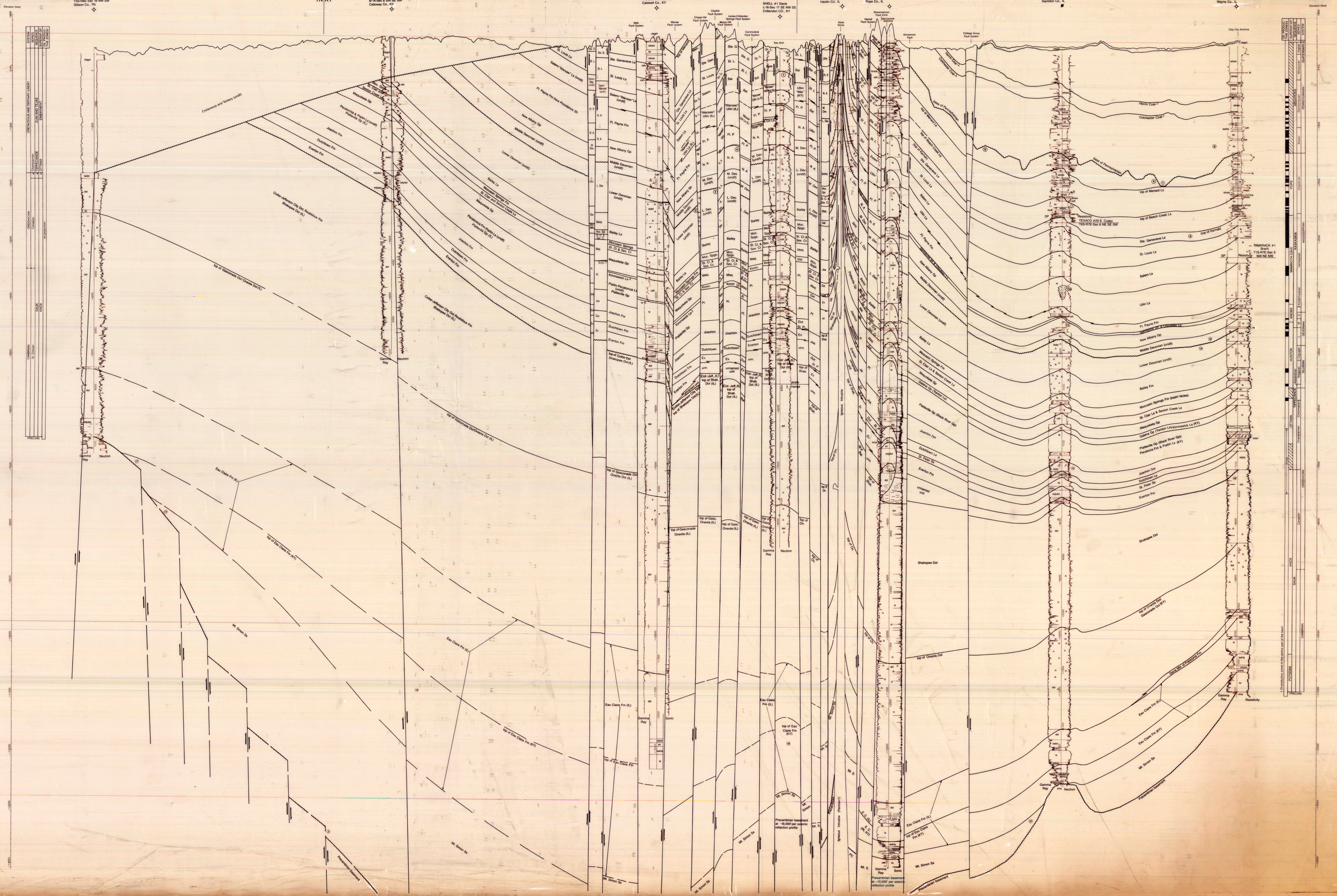
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