SUBSURFACE STRUCTURE OF THE BASE OF THE KINDERHOOK - NEW ALBANY SHALE IN CENTRAL AND SOUTHERN ILLINOIS

BY

ALFRED H. BELL

PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

URBANA, ILLINOIS

1943
Errata

On your copy of Report of Investigations 92, please make the following corrections:

Below Palestine, insert, "Menard - ls., sh."

State Geological Survey, Urbana, Ill.

10-25-43
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Topographic Mapping in Cooperation with the United States Geological Survey.
This Report is a Contribution of the Oil and Gas Division.

May 30, 1943
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1 Subsurface structure map of the base of the Kinderhook-New Albany shale in central and southern Illinois and showing oil and gas fields as of May 1, 1943
SUBSURFACE STRUCTURE OF THE BASE OF THE KINDERHOOK - NEW ALBANY SHALE IN CENTRAL AND SOUTHERN ILLINOIS

BY

ALFRED H. BELL

INTRODUCTION

During the past six and a half years, more than 16,800 wells have been drilled for oil and gas in Illinois. The great majority of them are located in the southern half of the State, especially in the Illinois basin (fig. 1), which is here used to mean the deep part of the Eastern Interior basin and is located between the DuQuoin monocline on the west and the LaSalle anticlinal belt on the east. Until 1937 the subsurface structure of the Illinois basin was largely unknown because of lack of drilling. Now, however, the amount of drilling in the Illinois basin is comparable with that in other parts of the State, and consequently it is possible to make structure maps of it which show a considerable degree of detail.

Previously regional structure maps covering the Illinois basin and its marginal areas on a small scale and with a large contour interval have been published. As an initial step in making available the subsurface structural data revealed by the new drilling, it seemed desirable to prepare for publication a regional structure map on the scale of several other maps of Illinois, namely 1:500,000 or approximately 8 miles to 1 inch, and having a contour interval of 100 feet (pl. 1). The base of the Kinderhook-New Albany shale was chosen as a suitable key horizon. (See geologic column.)

In order that their relation to the structural features may be readily seen, the oil and gas pools as of May 1, 1943, are shown by a red overprint.

To keep the map from being crowded, place names, county names, names of structural features, and township and range lines have been omitted. Separate index maps of counties, townships, and ranges (fig. 2) and of names and locations of principal structures (fig. 3) are included.

PRINCIPAL STRUCTURAL FEATURES

The regional geosyncline which is known as the Eastern Interior basin is outlined by the boundary of the Pennsylvanian system (fig. 1). The Eastern Interior basin comprises about four-fifths of Illinois and the adjacent parts of southwestern Indiana and western Kentucky. In this area the rocks generally dip inward from the margins toward an area in which they are deepest, situated in Wayne, White, and Hamilton counties. Here the base of the Kinderhook-New Albany shale is more than 4,800 feet below sea-level (pl. 1). Although this deepest part of the basin is at about the midpoint of the Eastern Interior basin in an east and west direction, it is far south of the geographic center of the basin.

The LaSalle anticline was named from the city of LaSalle, Illinois, which is located to the north of the area here mapped (pl. 1 and fig. 1). However, the contours in and near McLean County indicate a profound break between the LaSalle anticline in the area where it was named and in the area to the south. For this reason the phrase "LaSalle anticlinal belt," used by L. A. Mylius, is used here.

The LaSalle anticlinal belt is more than 200 miles long, from a point north of Illinois River near LaSalle to the In-1 For example, see Illinois Geological Survey Ill. Petroleum No. 38, Development in Eastern Interior basin in 1940, fig. 3, pp. 4-5, 1941.

Fig. 1.—Index map of Eastern Interior basin and Illinois basin.
### GEOLOGIC COLUMN FOR SOUTHERN ILLINOIS

<table>
<thead>
<tr>
<th>System or Series</th>
<th>Group or Formation, and Lithology*</th>
</tr>
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<tbody>
<tr>
<td>Pleistocene</td>
<td>Glacial drift and loess</td>
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<tr>
<td>Pliocene</td>
<td>Chert gravel</td>
</tr>
<tr>
<td>Eocene</td>
<td>Sand and clay</td>
</tr>
<tr>
<td>Cretaceous</td>
<td>Sand and clay</td>
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<tr>
<td></td>
<td>McLeansboro group—sh., ss., this ls., and coal</td>
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<tr>
<td></td>
<td>Carbondale group—sh., ls., ss., coal</td>
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<tr>
<td></td>
<td>Tradewater group—ss., sh., and thin coal</td>
</tr>
<tr>
<td></td>
<td>Caseyville group—ss., sh., and thin coal</td>
</tr>
<tr>
<td></td>
<td>Kinkaid—ls., sh.</td>
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<tr>
<td></td>
<td>Degonia—ss.</td>
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<tr>
<td></td>
<td>Clore—ls., sh.</td>
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<td>Palestine—</td>
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<td></td>
<td>Waltersburg—ss.</td>
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<td>Vienna—ls., sh.</td>
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<tr>
<td></td>
<td>Tar Springs—ss.</td>
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<td></td>
<td>Glen Dean—ls., sh.</td>
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<tr>
<td></td>
<td>Hardinsburg—ss.</td>
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<td></td>
<td>Golconda—ls., sh.</td>
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<td></td>
<td>Cypress—ss.</td>
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<td>Paint Creek—ls., sh.</td>
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<td>Bethel—ss.</td>
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<td>Renault—ls., sh., ss.</td>
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<td></td>
<td>Aux Vases—ss.</td>
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<td></td>
<td>Iowa</td>
</tr>
<tr>
<td></td>
<td>Ste. Genevieve—ls.</td>
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<td>Rosiclare—ss.</td>
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<tr>
<td></td>
<td>Fredonia—ls.</td>
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<td>St. Louis—ls.</td>
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<td>Salem—ls.</td>
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<td>Warsaw—ls.</td>
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<td>Keokuk—ls.</td>
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<td>Burlington—ls.</td>
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<td></td>
<td>Fern Glen—ls.</td>
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<td></td>
<td>Kinkaid—ls., sh.</td>
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<td></td>
<td>Iowa</td>
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<td></td>
<td>New Albany—sh.</td>
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<td></td>
<td>(Base is key horizon)</td>
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<tr>
<td>Devonian</td>
<td>Limestone and dolomite</td>
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<tr>
<td></td>
<td>Dolomite and limestone</td>
</tr>
<tr>
<td></td>
<td>(formations undifferentiated)</td>
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<tr>
<td>Silurian</td>
<td>Maquoketa—sh.</td>
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<tr>
<td></td>
<td>Kimmswick—ls.</td>
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<td></td>
<td>Plattin—ls.</td>
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<td>Joachim—ls.</td>
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<tr>
<td></td>
<td>St. Peter—ss.</td>
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<tr>
<td>Ordovician</td>
<td>Unidentified</td>
</tr>
<tr>
<td>Pre-St. Peter</td>
<td>Unidentified</td>
</tr>
</tbody>
</table>

*ls.—limestone; ss.—sandstone; sh.—shale.
Fig. 2.—Index map of Illinois for counties, townships, and ranges.
Fig. 3.—Index map of Illinois for principal structural features discussed in this report.
diana state line on the Wabash River south of Vincennes. The general trend is south-southeast but this is broken by numerous cross-folds in the southern part of the belt. One of the most prominent is the Oakland anticlinal belt which intersects the LaSalle anticlinal belt at the Westfield pool, Clark County. Flanking the LaSalle and Oakland anticlinal belts on the east is the Marshall-Sidell syncline which extends nearly north-south for more than 100 miles.

The DuQuoin-Centralia monocline is a belt of relatively steep eastward dips which extends slightly east of north from the vicinity of DuQuoin to a point about 20 miles north of Centralia, a total distance of about 60 miles. It is considered to bound the Illinois basin on the west.

The Illinois part of the Shawneetown-Rough Creek fault-zone marks the approximate southern boundary of the Illinois basin. Three prominent anticlinal belts lie in the Illinois basin: (1) the Salem-Louden, (2) the Clay City, and (3) the Wabash River. From the south these have trends varying from slightly east of north to about N. 40° E.

Relation of Production to Structure

Most, but not all, of the larger productive areas are on anticlinal structures which are large enough to be shown as closures on the map (pl. 1) on which the contour interval is 100 feet. Examples of large fields on structural closures shown by the map are the Salem (No. 173), Marion County, and the Louden (No. 120), Fayette and Effingham counties, among the new fields, and the Westfield (No. 200), Clark and Coles counties, among the old fields.

Several series of oil pools are located along anticlinal belts of which the principal ones are the following:

(1) The pools of the old Southwestern Illinois field on the south part of LaSalle anticlinal belt from the Westfield pool (No. 200), Clark and Coles counties on the north, to the St. Francisville pool (No. 166), Lawrence County, on the south.

(2) The pools from North Boos (No. 30), Jasper County, to Aden (No. 1), Wayne County, on the Clay City anticlinal belt.

(3) The pools from Allendale (No. 154), Wabash County, to New Harmony Consolidated (No. 142), White County, on the Wabash River anticlinal belt.

(4) The pools from Louden (No. 120), Fayette County to Dix (No. 65), Jefferson County, on the Salem-Louden anticlinal belt.

The map reveals that many small pools are located on "noses" or anticlines without enough closure to show on the map, for example Bartelso (No. 14), Clinton County; Cordes (No. 61), Washington County; St. Jacob (No. 168), Madison County; Iola (No. 100), Clay County; Sailor Springs (No. 172), Clay County. A large number of small pools, however, are not on any well-defined structural features shown on this map, for example, Bonpas (No. 28), Bonpas West (No. 29), Parkersburg (No. 159), Samsville (No. 174), and Bone Gap (No. 27), all in Richland and Edwards counties. The delineation of the structural features of such pools requires a larger scale and a smaller contour interval than the present map.

Non-productive Structures

The map shows a number of structural closures on the northern part of the LaSalle and Oakland anticlinal belts, which have produced no oil or only a little oil in spite of having been tested by numerous wells to the Devonian, "Trenton," or St. Peter. Among these are the Oakland dome in the west part of Edgar County, the Tuscola dome in the central part of Douglas County, two domes in Champaign County, one in the east-central part and one near the west border, and one in Champaign and Ford counties near Gibson City. A dome in the southwest part of Coles County, near Mattoon, is the site of a small oil field and is located a few miles west of the LaSalle anticlinal belt.

The reasons for the lack of oil accumulation on the numerous structures in the northern part of the LaSalle anticlinal belt and vicinity are not known but some possible explanations may be mentioned. The structures may have once contained oil which was later flushed out by fresh water of surface origin. This is suggested by the fact that analyses of the waters contained in the St. Peter
sandstone show a progressive decrease in dissolved mineral content from south to north. The Chester series and the Ste. Genevieve formation, which contains the “McClosky lime,” have together produced most of the oil in the Illinois basin, and these strata thin out and disappear from south to north. On the LaSalle anticlinal belt the northern boundary of the Chester series is in southern Clark County. The relative yield of oil per acre increases progressively from Clark County on the north to Lawrence County on the south.

The important part played by structure in controlling the accumulation of oil in many Illinois oil pools is illustrated by the map. Another factor which may be of equal or even greater importance in some fields is the presence of sand lenses which were features of original deposition. This subject may be more appropriately treated in more detailed studies of smaller areas.

ACKNOWLEDGMENTS

The cooperation of many oil companies and individuals who furnished data used in preparing the map and report is gratefully acknowledged. Dr. C. W. Carter, Dr. W. H. Easton, and Mr. P. G. Luckhardt, all of the Survey staff, assisted in compiling the data.
FOOTNOTES TO COLUMN HEADINGS

TABLE 1

- All fields to be listed alphabetically, and if by counties, the latter also in alphabetical order.

- Use as many numbered lines as necessary to list in order of increasing depth each reservoir productive of oil, gas or condensate. In multi-reservoir fields the (upper) line on which the field name is placed should reflect, in certain columns, the totals of the separate reservoirs listed below it. Show name of producing formation, and show its age by abbreviation as follows: C., Cambrian; Ord., Ordovician; Sil., Silurian; Dev., Devonian; Miss., Mississippian; L., Lower; M., Middle; U., Upper; Penn., Pennsylvanian; Perm., Permian; Tri., Triassic; Jur., Jurassic; L., Lower; U., Upper; Cret., Cretaceous; Eoc., Eocene; Olig., Oligocene; Mio., Mioocene; Pl., Pliocene.

- Volume of gas produced from the field and not returned to the reservoir. Indicate measurement pressure base in special footnote.

- Only gas production shown in the gas production column of this table, and only oil shown in the oil production column of this table, should be considered in calculating entries for this column, i.e., entries should correspond with gas production for the year divided by oil production for the year.

- Include all original completions, but exclude workovers or wells deepened or plugged back. Abandoned refers only to wells abandoned after having produced oil, gas or condensate and is not to include wells abandoned without having secured production.

- A well producing both oil and gas is classified as an oil well, unless it has been designated as a gas well by the State regulatory agency. Gas wells are wells producing gas only or condensate, and wells producing gas with some oil but classified as gas wells by the State regulatory agency.

- Show type of operation as indicated by the following symbols: F, pressure maintenance; G, gas injection; W, water injection; C, cycling.

- Show weighted average gravity A, P, I, as oil is delivered to the pipe lines and percentage of sulphur, if any, in the oil. Where oils from more than one reservoir are commingled and delivered into the pipe line at a gravity of 26 to 26.9, show as 26°, etc.

- Show character of formation by code letter as follows: A, anhydrite; G, chalk, Gs, conglomerate; Ch, chert; Cb, cap rock; D, dolomite; De, arkose dolomite; Gw, granite wash; Sh, shale; L, limestone; LS, limestone, sandy; OL, oolitic limestone; S, sandstone.

- Figures represent ratio of pore space to total volume of net reservoir rock expressed in per cent. F indicates reservoir rock is of porous type, but ratio is not known by the author. G, indicates that the reservoir rock is of cavernous type; and F, fissure type.

- Show actual depth to top of producing zone or reservoir. If producing zone is a series of interbedded sands and shales, and the sands are all productive or capable of producing, show the depth to top of top sand member.

- Show actual average thickness that is producing or known to be productive. If, for example, average thickness of productive zone above water level is 50 feet, show 50 feet, even though walls are completed in only upper 10 or 15 feet of zone.

- A, anticlinal; AF, anticlinal with faulting as important factor; A, anticlinal with faulting as minor factor; A, accumulation due to both anticlinal and monocline structure; D, dome; DS, salt dome; H, strata arc horizontal or nearly horizontal; IC, monocline with accumulation due to change in character of stratum; IF, monocline-fault; MI, monocline with accumulation against igneous barrier; ML, monocline-lens; MJ, monocline-unconformity; IF, monocline with accumulation due to sealing at outcrop by capstalt; N, nose; S, syncline; SL, shoreline; T, terrace; TF, terrace with faulting as important factor.

- Show name of deepest stratigraphic zone tested and total depth of well that tested such zone, whether it is deepest well in field or not.

- Correct entry not determinable.