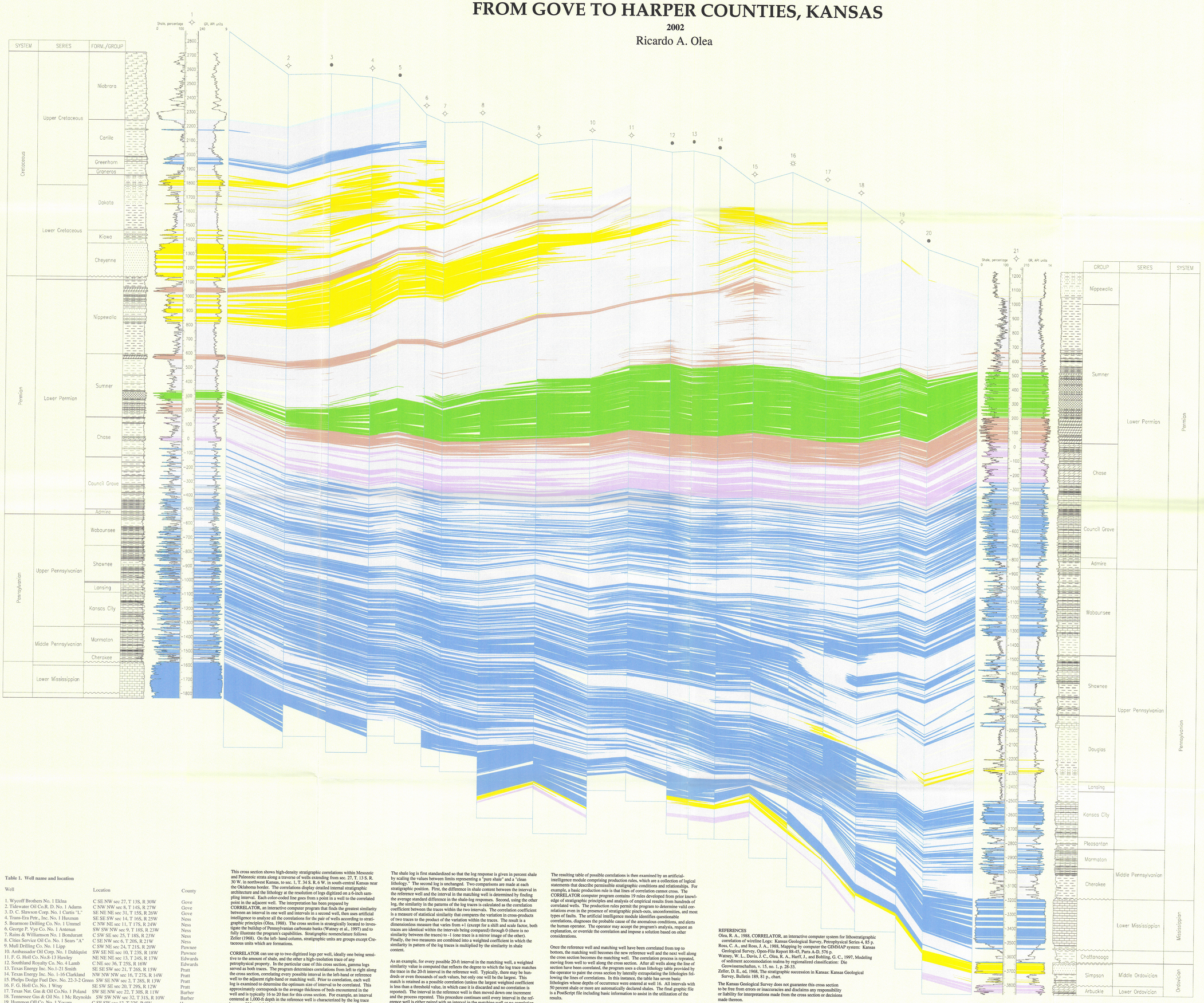
LITHOSTRATIGRAPHIC CROSS SECTION FROM GOVE TO HARPER COUNTIES, KANSAS

2002

Ricardo A. Olea

KANSAS GEOLOGICAL SURVEY
THE UNIVERSITY OF KANSAS
Technical Series 16
Plate 1



Computer compilation
and cartography
by
Jorgina A. Ross
John C. Davis
David R. Collins

Geology revised
by
D. F. Merriam
W. L. Watney

PRODUCTION SYMBOLS

- Oil well
- Gas well
- Dry well

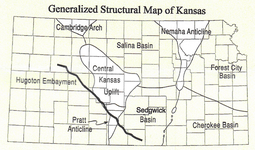
Datum is sea level
Vertical scale is in feet
Vertical exaggeration: 200X

0 5 10 mi
0 5 10 15 km

LITHOLOGY SYMBOLS

Anhydrite, Chalk, Dolomite, Limestone, Salt, Sandstone, Shale

Generalized Structural Map of Kansas



Generalized Geologic Map of Kansas

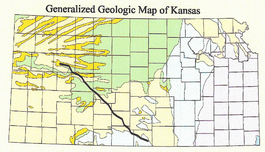


Table 1. Well name and location

Well	Location	County
1. Wycoff Brothers No. 1 Eklna	C SE NW sec 27, T 13S, R 30W	Gove
2. Tidewater Oil Co.R. D. No. 1 Adams	C NW NW sec 8, T 14S, R 27W	Gove
3. D. C. Slawson Corp. No. 1 Curtis "L"	SE NE NE sec 31, T 15S, R 26W	Gove
4. Trans-Era Petr., Inc. No. 1 Huxman	SE SE SW sec 14, T 16S, R 25W	Ness
5. Bearmore Drilling Co. No. 1 Ummel	C NW NE sec 11, T 17S, R 24W	Ness
6. George P. Vye Co. No. 1 Antenan	SW SW NW sec 9, T 18S, R 23W	Ness
7. Rains & Williamson No. 1 Bondurant	C SW SE sec 25, T 18S, R 23W	Ness
8. Cities Service Oil Co. No. 1 Sears "A"	C SE NW sec 6, T 20S, R 21W	Ness
9. Mull Drilling Co. No. 1 Lipp	C SW NE sec 24, T 21S, R 20W	Pawnee
10. Ambassador Oil Corp. No. 1 Dahlquist	SW SE NE sec 10, T 23S, R 18W	Pawnee
11. F. G. Holl Co. No.8-13 Hawley	NE NE NE sec 13, T 24S, R 17W	Edwards
12. Southland Royalty Co. No. 4 Lamb	C NE sec 36, T 25S, R 16W	Edwards
13. Texas Energy Inc. No.1-21 Smith	SE SE SW sec 21, T 26S, R 15W	Pratt
14. Texas Energy Inc. No. 1-16 Clarkland	NW NW NW sec 16, T 27S, R 14W	Pratt
15. Phelps Dodge Fuel Dev. No. 22-3-2 Green	SW SE NW sec 2, T 28S, R 13W	Pratt
16. F. G. Holl Co. No. 1 Wray	SE SW SE sec 20, T 29S, R 12W	Pratt
17. Texas Nat. Gas & Oil Co.No. 1 Poland	SW SE NW sec 22, T 30S, R 11W	Barber
18. Tennessee Gas & Oil No. 1 Mc Reynolds	SW SW NW sec 32, T 31S, R 10W	Barber
19. Hummon Oil Co. No. 1 Yocam	C SE SW sec 13, T 32S, R 9W	Harper
20. Aurora Gasoline Co. No. 1 Miller	SE SE NE sec 11, T 33S, R 8W	Harper
21. National Oil Co. No. 2 Pulliam	NE NE NW sec 1, T 34S, R 6W	Harper

This cross section shows high-density stratigraphic correlations within Mesozoic and Paleozoic strata along a traverse of wells extending from sec. 27, T. 13 S. R. 30 W. in northwest Kansas, to sec. 1, T. 34 S. R. 6 W. in south-central Kansas near the Oklahoma border. The correlations display detailed internal stratigraphic architecture and the lithology at the resolution of logs digitized on a 6-inch sampling interval. Each color-coded line goes from a point in a well to the correlated point in the adjacent well. The interpretation has been prepared by CORRELATOR, an interactive computer program that finds the greatest similarity between an interval in one well and intervals in a second well, then uses artificial intelligence to analyze all the correlations for the pair of wells according to stratigraphic principles (Olea, 1988). The cross section is strategically located to investigate the buildup of Pennsylvanian carbonate banks (Watney et al., 1997) and to fully illustrate the program's capabilities. Stratigraphic nomenclature follows Zeller (1968). On the left- hand column, stratigraphic units are groups except Cretaceous units which are formations.

CORRELATOR can use up to two digitized logs per well, ideally one being sensitive to the amount of shale, and the other a high-resolution trace of any petrophysical property. In the particular case of this cross section, gamma logs served as both traces. The program determines correlations from left to right along the cross section, correlating every possible interval in the left-hand or reference well to the adjacent right-hand or matching well. Prior to correlation, each well log is examined to determine the optimum size of interval to be correlated. This approximately corresponds to the average thickness of beds encountered in the well and is typically 16 to 20 feet for this cross section. For example, an interval centered at 1,000-ft depth in the reference well is characterized by the log trace between 990- to 1,010-ft depth, or by the values of 41 successive log readings. This pattern is compared to all possible 20-ft intervals in the matching well. For computational efficiency, a search interval is customarily specified to avoid examination of the matching well over its entire depth.

The shale log is first standardized so that the log response is given in percent shale by scaling the values between limits representing a "pure shale" and a "clean lithology." The second log is unchanged. Two comparisons are made at each stratigraphic position. First, the difference in shale content between the interval in the reference well and the interval in the matching well is determined by finding the average standard difference in the shale-log responses. Second, using the other log, the similarity in the patterns of the log traces is calculated as the correlation coefficient between the traces within the two intervals. The correlation coefficient is a measure of statistical similarity that compares the variation in cross-products of two traces to the product of the variation within the traces. The result is a dimensionless measure that varies from +1 (except for a shift and scale factor, both traces are identical within the intervals being compared) through 0 (there is no similarity between the traces) to -1 (one trace is a mirror image of the other). Finally, the two measures are combined into a weighted coefficient in which the similarity in pattern of the log traces is multiplied by the similarity in shale content.

As an example, for every possible 20-ft interval in the matching well, a weighted similarity value is computed that reflects the degree to which the log trace matches the trace in the 20-ft interval in the reference well. Typically, there may be hundreds or even thousands of such values, but only one will be the largest. This match is retained as a possible correlation (unless the largest weighted coefficient is less than a threshold value, in which case it is discarded and no correlation is reported). The interval in the reference well is then moved down one increment and the process repeated. This procedure continues until every interval in the reference well is either paired with an interval in the matching well or no correlation is found.

The resulting table of possible correlations is then examined by an artificial-intelligence module comprising production rules, which are a collection of logical statements that describe permissible stratigraphic conditions and relationships. For example, a basic production rule is that lines of correlation cannot cross. The CORRELATOR computer program contains 19 rules developed from prior knowledge of stratigraphic principles and analysis of empirical results from hundreds of correlated wells. The production rules permit the program to determine valid correlations even in the presence of stratigraphic pinch-outs, unconformities, and most types of faults. The artificial intelligence module identifies questionable correlations, diagnoses the probable cause of the anomalous conditions, and alerts the human operator. The operator may accept the program's analysis, request an explanation, or override the correlation and impose a solution based on other considerations.

Once the reference well and matching well have been correlated from top to bottom, the matching well becomes the new reference well and the next well along the cross section becomes the matching well. The correlation process is repeated, moving from well to well along the cross section. After all wells along the line of section have been correlated, the program uses a clean lithology table provided by the operator to paint the cross section by laterally extrapolating the lithologies following the lines of correlations. In this instance, the table has seven basic lithologies whose depths of occurrence were entered at well 16. All intervals with 50 percent shale or more are automatically declared shales. The final graphic file is a PostScript file including basic information to assist in the utilization of the results.

For this publication, this explanation and the two maps of Kansas have been added to the CORRELATOR final file using the GIMMAP (Geodata Interactive Map Management, Analysis and Production) software developed by the Kansas Geological Survey (Ross and Ross, 1988), Photoshop®, and Canvas®.

REFERENCES

Olea, R. A., 1988, CORRELATOR, an interactive computer system for lithostratigraphic correlation of wireline Logs: Kansas Geological Survey, Petrophysical Series 4, 85 p.

Ross, C. A., and Ross, J. A., 1988, Mapping by computer the GIMMAP system: Kansas Geological Survey, Open-File Report 88-45, Parts A-D, 576 p.

Watney, W. L., Davis, J. C., Olea, R. A., Harff, J., and Bohling, G. C., 1997, Modeling of sediment accommodation realms by regionalized classification: Die Geowissenschaften, v. 15, no. 1, p. 28-33.

Zeller, D. E., ed, 1968, The stratigraphic succession in Kansas: Kansas Geological Survey, Bulletin 189, 81 p., chart.

Suggested reference to this cross section:
Olea, R. A., 2002 Lithostratigraphic cross section from Gove to Harper counties, Kansas: Kansas Geological Survey, Technical Series 16, plate 1, vertical exaggeration 200X.

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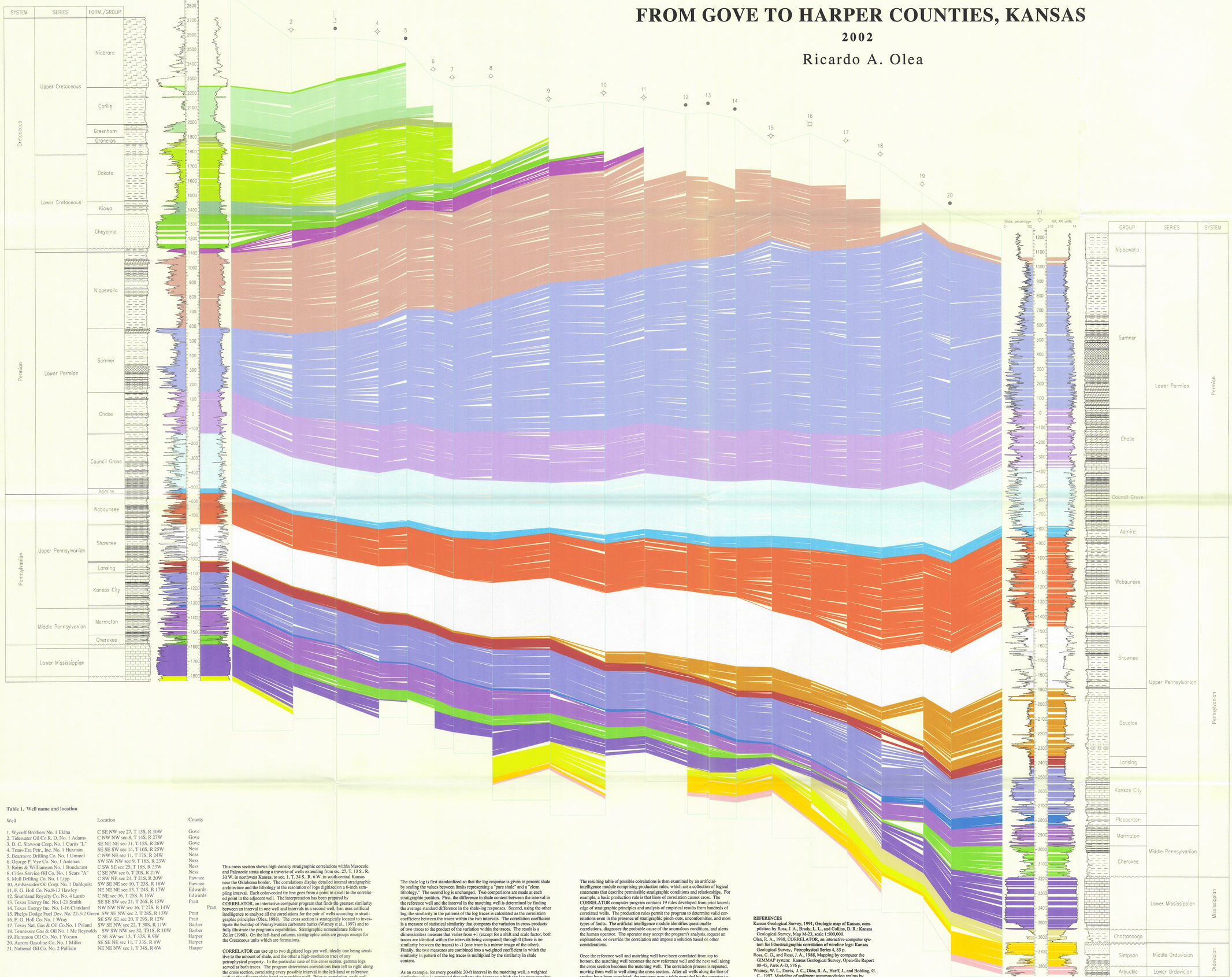
KANSAS GEOLOGICAL SURVEY
THE UNIVERSITY OF KANSAS
Technical Series 16
Plate 2



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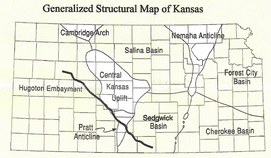

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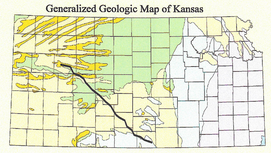

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REFERENCES

Kansas Geological Survey, 1991, Geologic map of Kansas, compilation by Ross, J. A., Brady, L. L., and Collins, D. R.: Kansas Geological Survey, Map M-23, scale 1:500,000.

Olea, R. A., 1988, CORRELATOR, an interactive computer system for lithostratigraphic correlation of wireline logs: Kansas Geological Survey, Petrophysical Series 4, 85 p.

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