

Preliminary Structure Contour Map of the Top of the Mississippian Osagian Stage in Eastern Kansas

Diana Ortega-Ariza, Eliot Manning, Angela Torres-Zamora, and Kolbe Andrzejewski

Abstract

This report accompanies a preliminary subsurface geologic map depicting the top of the Osagian Stage in eastern Kansas. The map represents a continuation of the Mississippian subsurface mapping completed in southwestern Kansas in 2025 as a part of the U.S. Geological Survey (USGS) STATEMAP program. The map illustrates the top of the Osagian Stage (Lower Mississippian Series), represented by the undifferentiated Keokuk-Burlington Limestone. In Kansas, the Osagian is generally unconformably overlain by rocks of the Meramecian Stage. The Keokuk-Burlington Limestone, which forms the uppermost Osagian unit in the state, consists primarily of cherty, siliceous, dolomitic limestone. The data shown are composed of well tops from the Kansas Geological Survey (KGS) oil and gas database (Master List of Oil and Gas Wells). The structural map illustrates the regional distribution of the top of the Osagian across eastern Kansas. The surface deepens toward the southwest, where depths range from approximately -3600 to -4600 ft. Becoming progressively shallower toward the east, surface elevations range from approximately 500 to 800 ft. In southeastern Kansas, Mississippian strata are exposed at the surface. An accompanying isochore map depicts thickness variations within the Osagian Stage across eastern Kansas. The Osagian is generally thin (0–50 ft) adjacent to the Central Kansas Uplift (CKU) and the Nemaha Uplift (NU), where erosion and structural uplift have removed much of the Mississippian section. Thickness increases away from these uplifted areas, reaching as much as approximately 400 ft in structurally lower regions. To complement the map products, we constructed three regional structural cross sections, two oriented north-south and one oriented east-west to illustrate the lateral continuity and vertical geometry of the Osagian Stage. The cross sections corroborate the regional structural and thickness trends observed in the top structure and isochore maps, providing a three-dimensional interpretation of the distribution of Osagian strata across eastern Kansas.

Methodology

Subsurface data from the KGS oil and gas database were used to construct the top Osagian structural map, which has a scale of 1:550,000. These data were used to generate a structural contour map of the top of the Osagian Stage, an isochore map, and regional structural cross sections illustrating the lateral and vertical distribution of the Osagian across eastern Kansas.

Well top compilation and Structural mapping: Approximately 1,800 Osagian well tops were exported from the KGS oil and gas database and compiled in Microsoft Excel for quality control prior to import into ArcGIS Pro and Petrel. The database was reviewed to correct typographical errors, verify surface elevations and formation-top depths, and remove irrelevant data. In counties lacking previously interpreted Osagian tops, we interpreted approximately 30 additional formation tops from available geophysical well logs to improve regional coverage.

The cleaned and interpreted well-top dataset was imported into ArcGIS Pro and Petrel to generate structural surfaces of the top of the Osagian Stage. In Petrel, the surface was generated using the convergent interpolation algorithm, whereas ArcGIS Pro used an inverse distance weighting (IDW) interpolation method. Structural contours were then generated at 50-ft intervals. Because the distribution of well control was highly uneven across the study area, with approximately 1,500 well tops in western Kansas and approximately 200 in eastern Kansas, the strengths of both interpolation methods were utilized. The Pro-generated contours better represented areas with dense well control, whereas the Petrel interpolation provided a more reliable surface in areas of sparse data. We integrated contours from both methods and manually refined as necessary, using the published Mississippian structural map (Merriam, 1960) as a regional reference.

Well logs and Isochore mapping: Wells with log data available were used to verify formation-top picks and provide thickness control for the Osagian Stage. Approximately 63 control wells were selected across the study area, generally one or two wells per county, based on the availability of interpreted Osagian and Kinderhookian formation tops and digital LAS files.

We reviewed the control wells to verify the position of the Osagian and Kinderhookian contacts and to calculate Osagian thickness. Thickness values were compiled into a dataset containing well coordinates (X and Y) and formation thickness (Z), which was imported into Petrel. An interpolated surface was then generated using Petrel's isochore interpolation algorithm to produce the Osagian isochore map.

Structural cross sections: Many of the control wells were also used to construct regional structural cross sections illustrating the geometry and continuity of the Osagian Stage. We generated three cross sections in Petrel: two oriented north-south and one oriented east-west. The two north-south sections were designed to compare the distribution of the Osagian between central and eastern Kansas.

To provide consistent regional coverage, approximately one representative well was selected from each county along each section line. We constructed cross sections primarily from digital LAS files. If LAS files were unavailable, raster well logs were digitized and converted to LAS format for incorporation into the interpretations. Gamma-ray (GR) logs were preferentially used because they were the most commonly available logs and provided the most consistent lithologic correlation across the study area. If available, spontaneous potential (SP) logs were used alongside GR logs. In wells lacking GR logs, SP logs served as the primary correlation tool. We identified the Osagian and Kinderhookian formation tops on each well and generated structural cross sections.

Results

This study produced a preliminary structural contour map of the top of the Osagian Stage across eastern Kansas (PDF; this OFR). The map illustrates the regional distribution of the Osagian, showing a general trend of progressively deeper depths toward the west and southwest and shallower depths toward the east, where the Mississippian strata locally crop out in southeastern Kansas. An accompanying isochore map depicts the thickness distribution of the Osagian Stage across the study area. The map shows that the Osagian is thinnest (0–50 ft) adjacent to the CKU and NU, where uplift and erosion have removed much of the Mississippian section. Thickness increases away from these structural highs, reaching approximately 400 ft in the deeper parts of

the basin. To complement the map products, three regional structural cross sections were constructed using geophysical well logs, two oriented north-south and one oriented east-west. The cross sections illustrate the lateral continuity and vertical geometry of the Osagian Stage and corroborate the structural and thickness trends observed in the top structure and isochore maps. Together, these products provide a three-dimensional representation of the regional distribution of the Osagian across eastern Kansas.

Coordinate Reference System

- i. Units: Field-UTM. Units of distance in the X, Y, and Z (lateral and vertical) directions are in field units (feet or miles).
- ii. Datum: NAD83 (North American Datum 1983) with “UTM83-14” used as the coordinate reference system (CRS).
- iii. Depth: Mean sea level (MSL) at 0 ft.

References

Kansas Geological Survey. “Master List of Oil and Gas Wells.” Database. Accessed 2025 and 2026. <http://www.kgs.ku.edu/Magellan/Qualified>.

Merriam, D. F., 1960, Preliminary regional structural contour map on top of Mississippian rocks in Kansas (Oil and Gas Investigations No. 22): Kansas Geological Survey, scale 1:615,000.

Funding

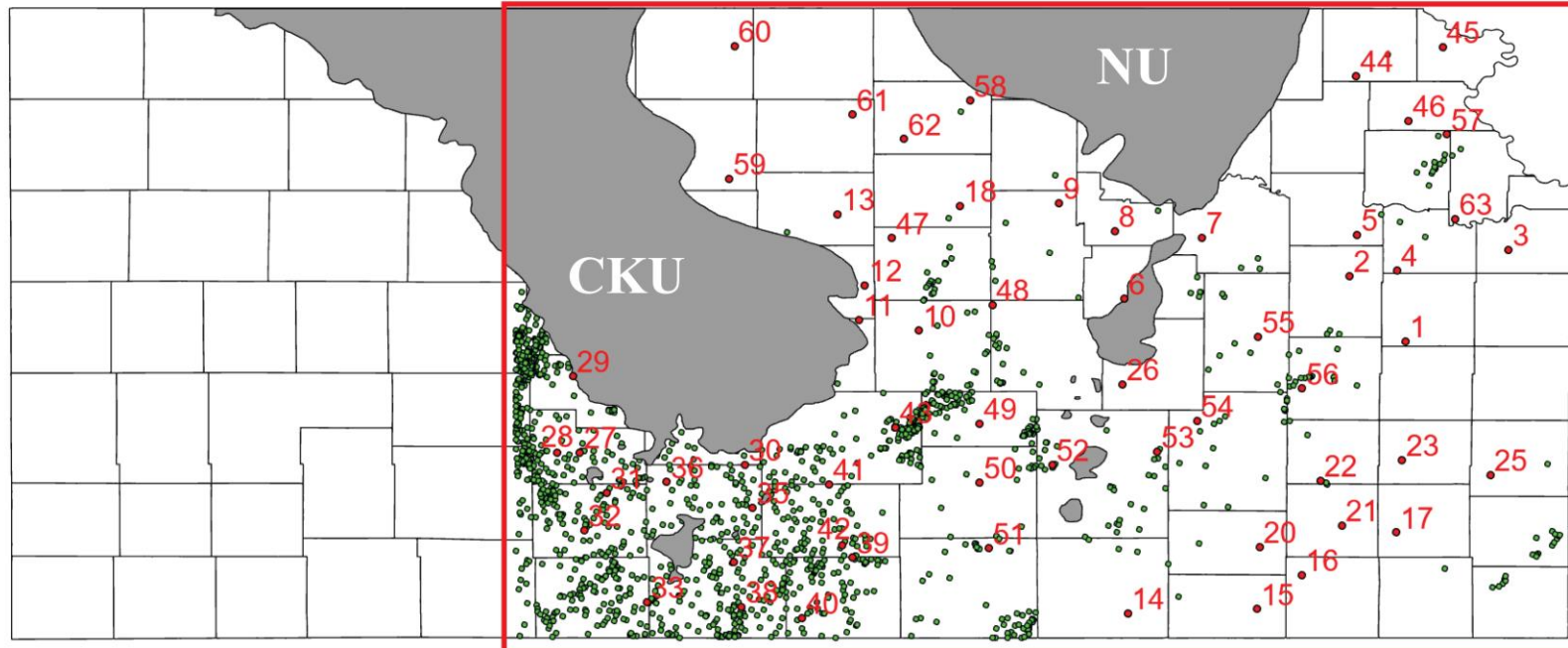
This work was funded by the state of Kansas and the U.S. Geological Survey National Cooperative Geologic Mapping Program, STATEMAP award number G25AC00518 (FY2025).

Acknowledgements

The authors thank the KGS staff whose contributions made this project possible. We are grateful to Jon Smith for managing the STATEMAP program and associated project funding. We also thank the personnel at the Data Resource Library for locating paper copies of selected well logs and providing access to log digitization software. Rhonda Houser is acknowledged for editorial review, and Souvik Bhattacharjee for providing technical support with Petrel. We also thank temporary student employee Ethan Geiger for his assistance with the initial compilation of formation-top data. The map and interpretations presented in this report were developed using SBL Petrel subsurface interpretation software and ArcGIS Pro (Esri).

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Osagian Well Tops Map

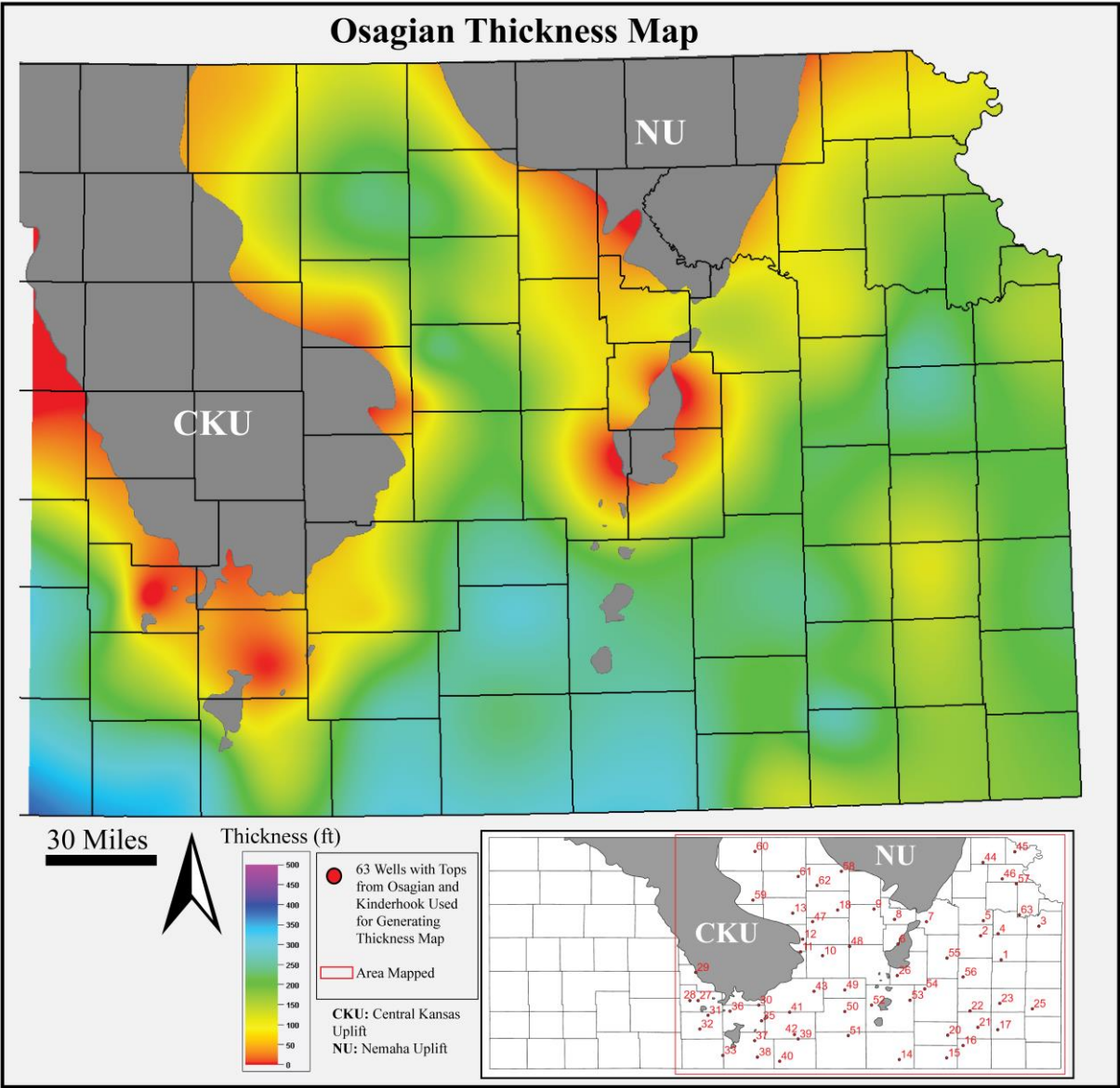


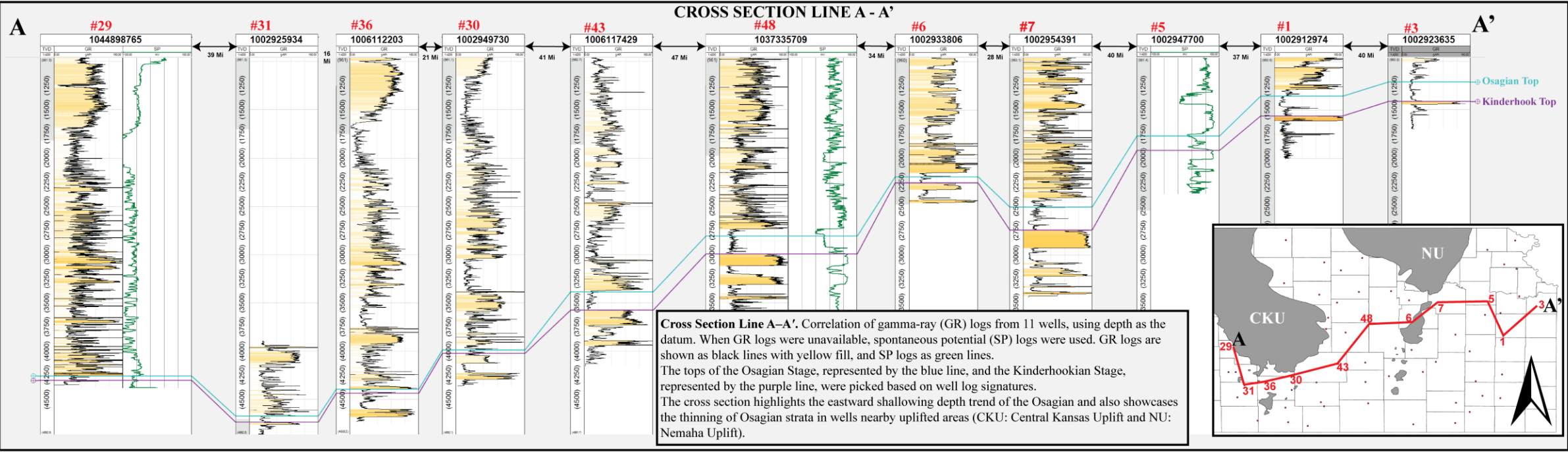
30 Miles

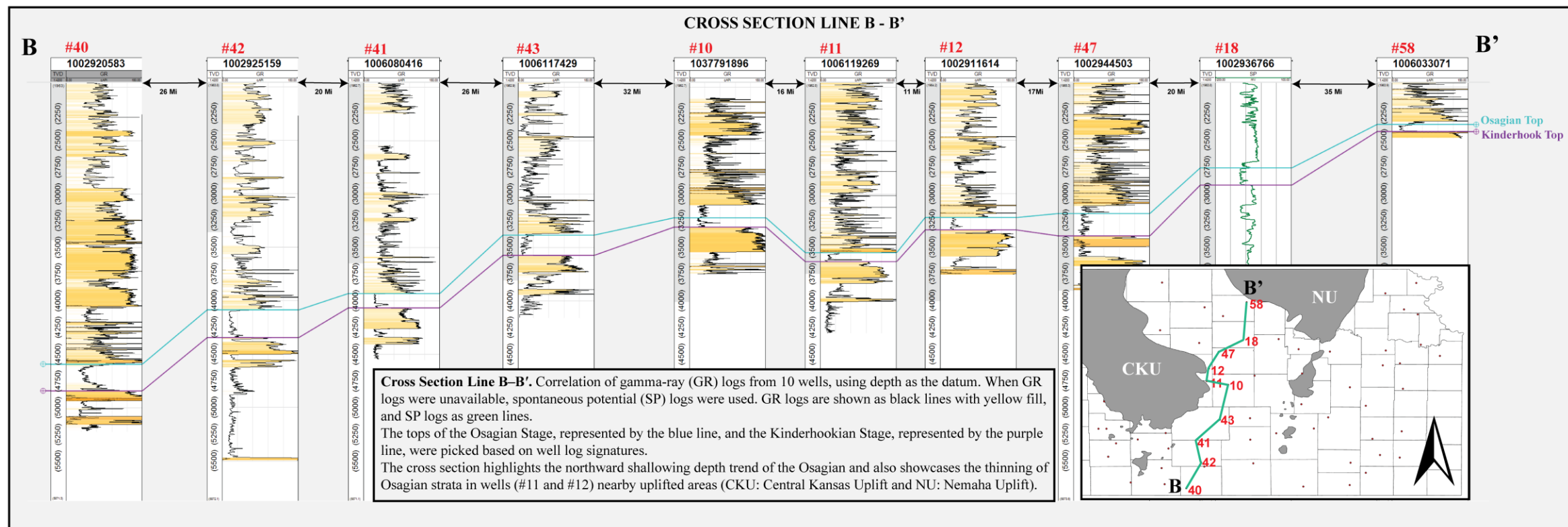


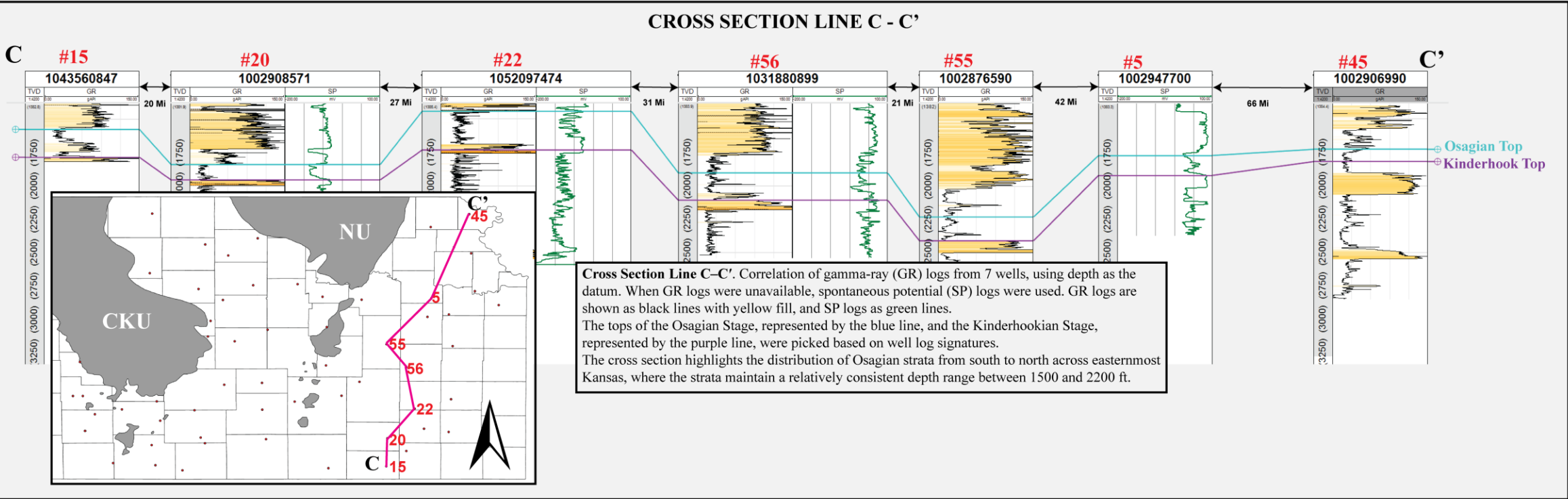
Legend

- Total Well Tops used for the Osagian Map
- 63 Wells with Tops from Osagian and Kinderhook Used for Generating Thickness Map
- Area Mapped
- CKU: Central Kansas Uplift. NU: Nemaha Uplift



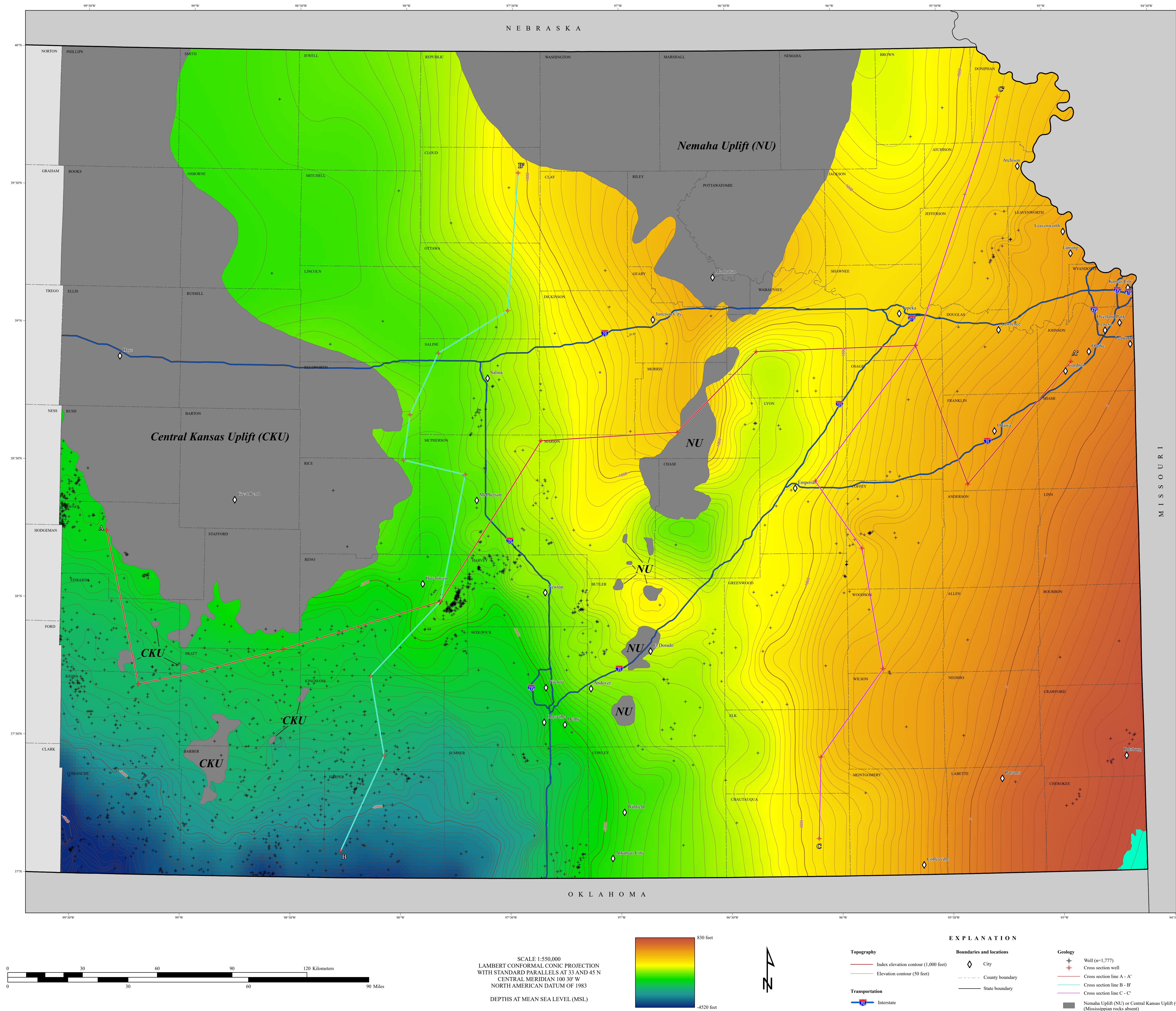






PRELIMINARY STRUCTURE CONTOUR MAP OF THE TOP OF THE MISSISSIPPIAN OSAGIAN STAGE IN EASTERN KANSAS

Diana Ortega-Ariza, Eliot Manning, Angela Torres-Zamora, and Kolbe D. Andrzejewski 2026



CURRENT KGS STRATIGRAPHIC NOMENCLATURE CHART (SUBSET)

EXPLANATION

Salem Limestone	MERAMECIAN STAGE
Warsaw Limestone	
Keokuk Limestone	
?	
Burlington Limestone	OSAGIAN STAGE
Reeds Spring Limestone Mbr.	
St. Joe Limestone Mbr.	
Gilmore City Limestone	
Sedalia Formation (Northview Formation)	LOWER MISSISSIPPIAN SERIES
Chouteau Limestone (Compton Limestone)	
Boice Shale	MISSISSIPPIAN SUBSYSTEM
?	
	CARBONIFEROUS SYSTEM

MAP LOCATION

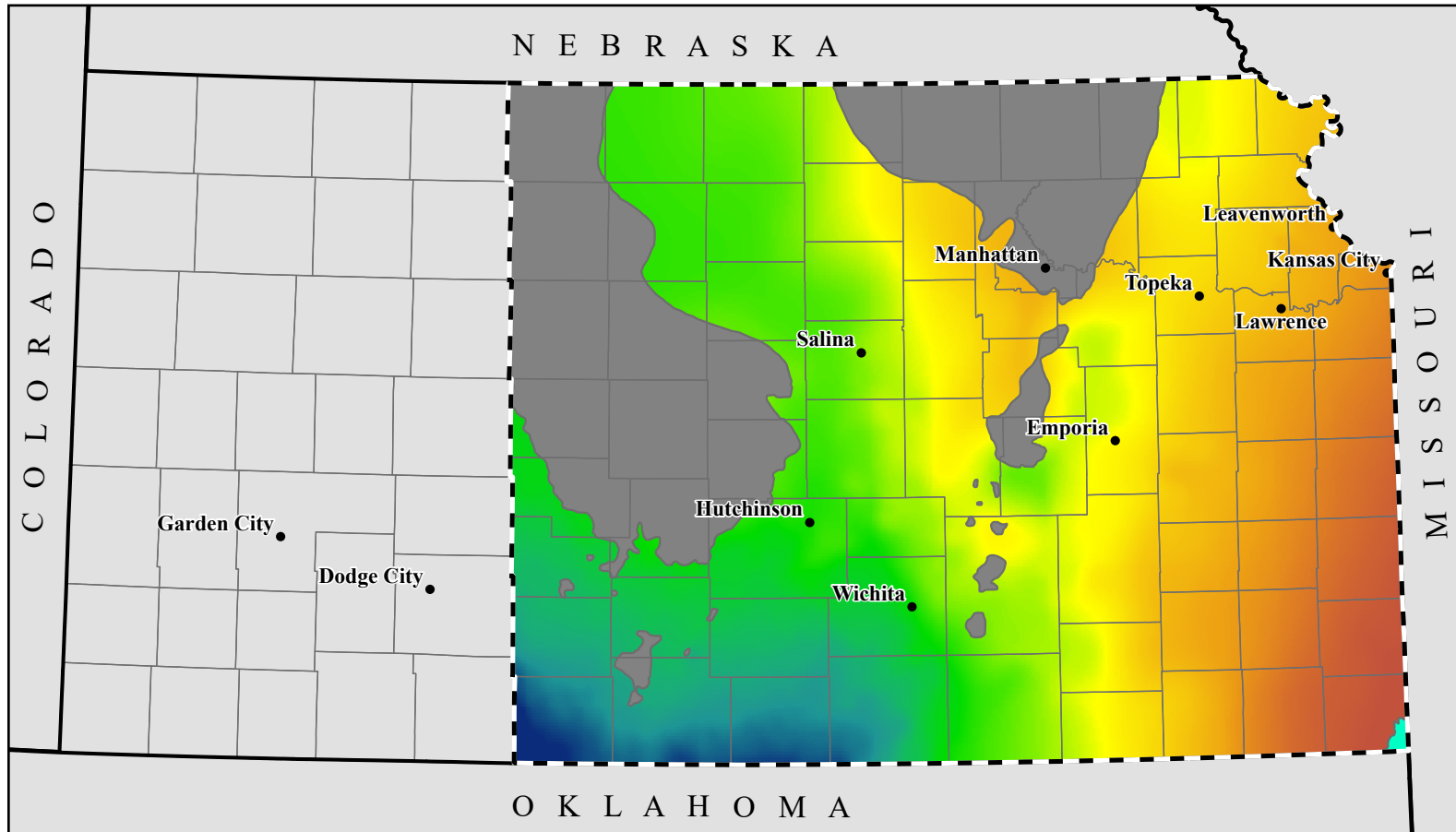


Figure 1. Example of Mississippian-age (ca. 345 million years old) limestone rocks exposed in Cherokee County, southeastern Kansas. General view of the exposure near Sechemerhorn Cave. Photo credit: Catherine Evans, Kansas Geological Survey.



Figure 2. Close-up of the area outlined by the red square in the left photograph. Photo credit: Catherine Evans, Kansas Geological Survey.



Figure 3. These limestones are commonly composed of abundant crinoid fossils, as illustrated in the close-up photograph. Photo credit: Catherine Evans, Kansas Geological Survey.

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