

Abstract

Little Creek is unique among geologic structures in Louisiana and possibly in the U.S. The surface feature, a collapse structure 4.3 km (2.7 mi) across in Cenozoic strata, lies above and crosscuts at depth a broader domal structure marked by areally restricted unconformities in Upper Cretaceous strata. Drilling shows the collapse structure extends to a minimal depth of nearly 8,000 ft (~2,440 m). H. N. Fisk originally mapped the feature in the late 1930s, at the surface on his geologic map of La Salle Parish and in the subsurface at a regional scale using oil and gas well data. Since his work, little information about the Little Creek structure has appeared in the public domain, though it appears to have garnered attention from some geologists at least intermittently. One of these, J. E. Rogers, interpreted the feature's surface unit as Carnahan Bayou Formation, Fleming Group rather than the Catahoula Formation of Fisk's original mapping, based on correlation of water well logs. This interpretation greatly increases the displacement attributable to the structure at the surface and in the shallow subsurface. Displacement measured on the contact between the Midway and Wilcox Groups at greater depth within the collapse structure is as much as 3,500 ft ($\sim 1,070$ m).

Little Creek's singular suite of characteristics and apparent lack of relation to surrounding regional structure have led to disparate conceptions of its origin. Fisk proposed no hypothesis of origin of the structure. Unpublished hypotheses formulated during the 1960s and 1970s include (1) salt withdrawal marking the location of a former salt diapir near the southeastern edge of the north Louisiana salt basin (J. E. Rogers), (2) long-term response to a meteor impact that occurred during deposition of the Upper Cretaceous chalk (M. D. Butler), and (3) response to emplacement of a deep post–Jurassic igneous diapir (D. H. Wilson). Nearly eight decades after its discovery, the structure remains an anomaly, and its distinctive aspects continue to challenge straightforward interpretation.



5. Wells Used to Construct Panel 4 Section

1. Arkansas Fuel Oil #A–13 Tremont (NW/NW Sec. 29, T. 10 N. R.2E.)

2. Placid & Justiss–Mears #1 Louisiana Central Oil & Gas (~NW/NW Sec. 35, T. 10 N., R. 2 E.)

3. Justiss–Mears Oil Co. #C–3 Tremont (NW/SE Sec. 32, T. 10 N., R.2E.)

4. Placid Oil Co. #A–5 Tremont (SE/NW Sec. 8, T. 9 N., R. 2 E.)

5. Placid #F–1 Tremont (SW/SW Sec. 14, T. 9 N., R. 2 E.)

6. Bodcaw Co. #30 LLS Bodcaw Fee (~NW/NE Sec. 20, T. 9 N., R.2E.)

7. Lamar Hunt #1 Bodcaw (SW/SE Sec. 20, T. 9 N., R. 2 E.)

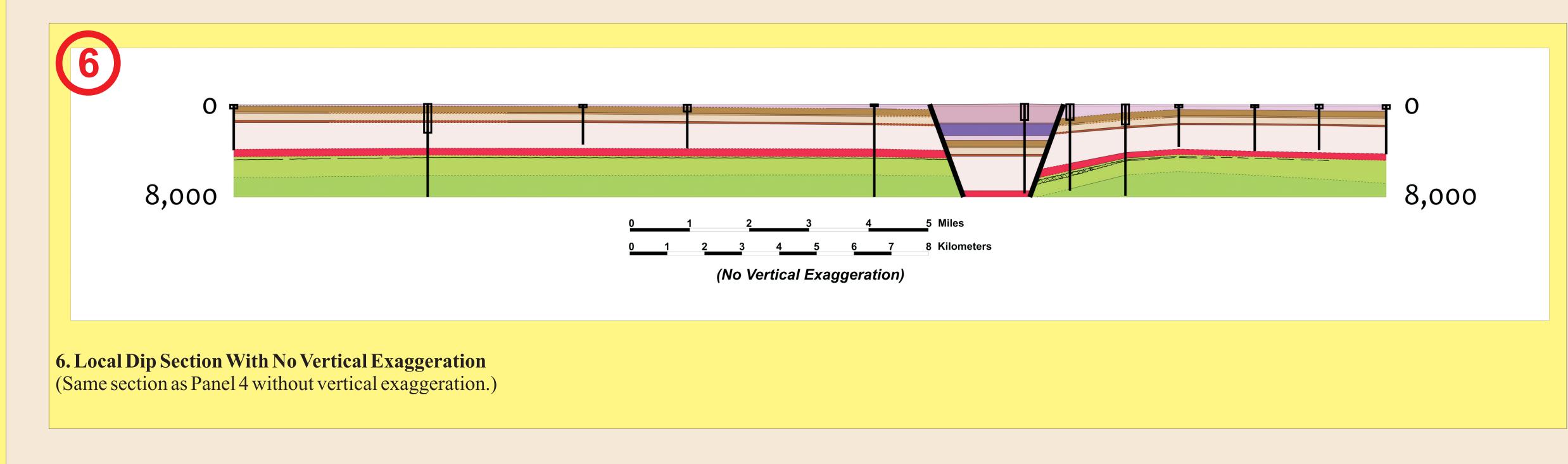
8. Placid Oil Co. #F–2 Tremont Lumber Co. (C/SE/NW Sec. 28, T. 9 N., R. 2 E.)

9. Placid Oil Co. #B–6 Goodpine (SW/SE Sec. 29, T. 9 N., R. 2 E.)

10. H. L. Hunt #F–112 Goodpine (NE/NW Sec. 5, T. 8 N., R. 2 E.)

11. Deep Rock Oil Co. #A–1 Nebo Oil Co. (NE/SW Sec. 4, T. 8 N., R.2E.)

12. J. S. Michael #A–1 Nebo Oil Co. (NE/SE Sec. 9, T. 8 N., R. 2



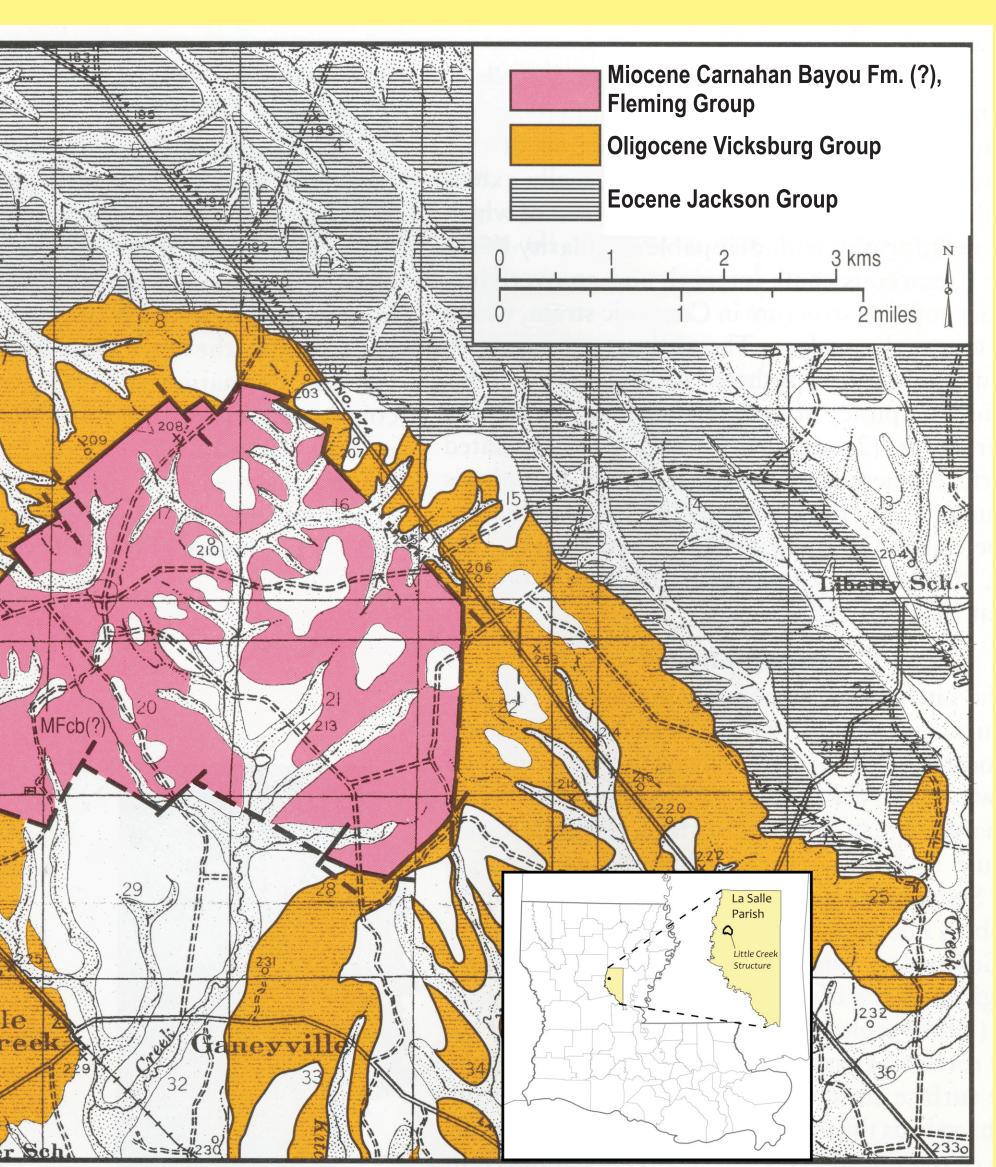
Fisk's subsurface data included only a few wells inside the perimeter of his mapped surface structure, and none was deeper than 2,400 ft (~730 m), which is notably shallow relative to later drilling. His estimation of the localized subsidence attributable to Little Creek structure consequently was based on these few wells and the thicknesses of exposed surface units. Because he mapped the interior surface unit as Catahoula Formation, and the structure is surrounded at the surface by the stratigraphically subjacent Vicksburg Group, Fisk's estimate of subsidence at Little Creek was only 100–160 ft (~30–50 m), smaller by a factor of 22–35 than the maximum displacement of the Midway–Wilcox contact inside the collapse structure (3,500 ft 1,070 m) revealed in 1965 by the drilling of the Bodcaw Co. #30 LLS Bodcaw Fee (well no. 6, T.D. = 7,895 ft 2,405 m).



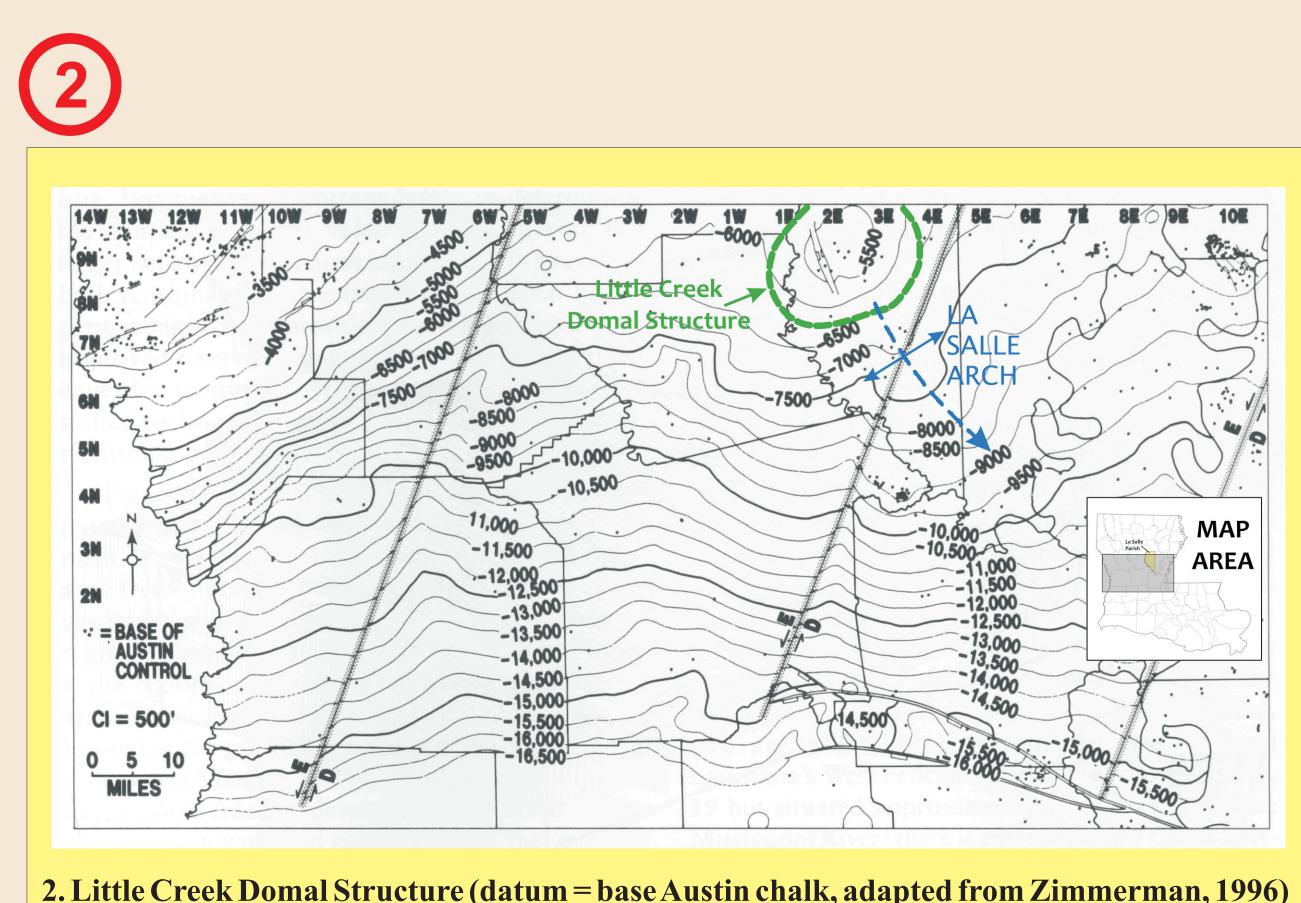
Little Creek Structure, Northwestern La Salle Parish, Louisiana

Richard P. McCulloh

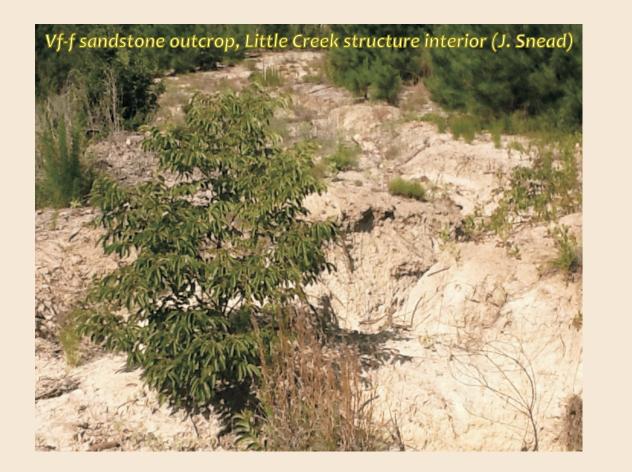
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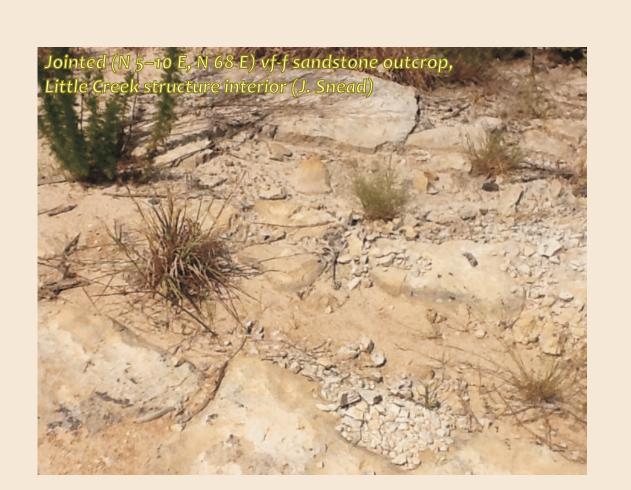


1. Surface Geology (after Fisk, 1938, modified from Echols and McCulloh, 1998) Portion of Fisk's surface geologic map encompassing Little Creek structure. Following J. E. Rogers (1982, based on correlation of water well logs), the central fill here is identified as Carnahan Bayou Formation of the Fleming Group rather than the Catahoula Formation originally mapped by Fisk (1938), requiring that the structure be entirely fault-bounded. Quaternary units not listed in the legend comprise terraced Pleistocene strata (white) and

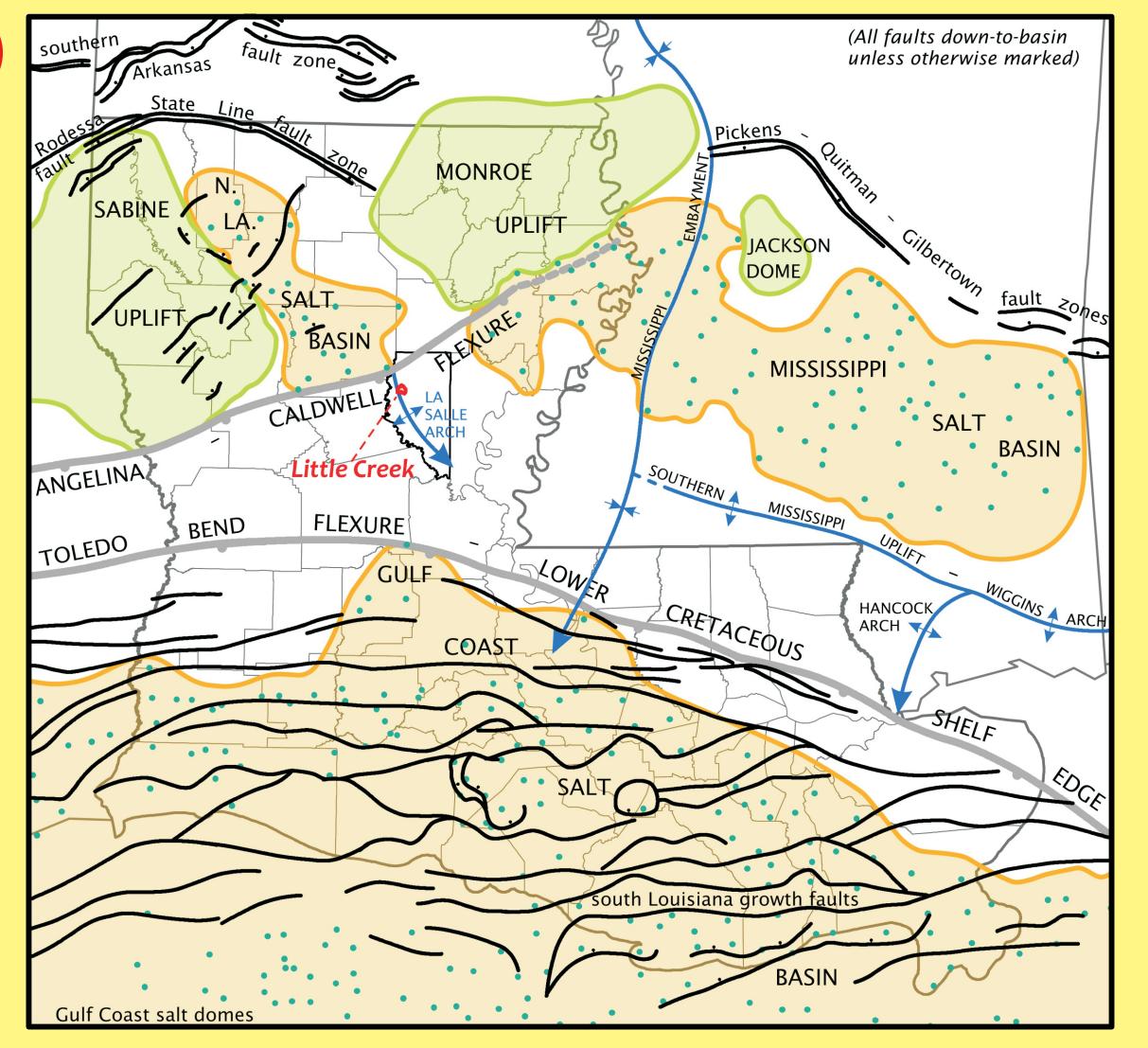


The collapse structure exposed at the surface overlies and crosscuts at depth a broader domal structure. On this map, the collapse structure is depicted as linear (a graben), perhaps to diminish its

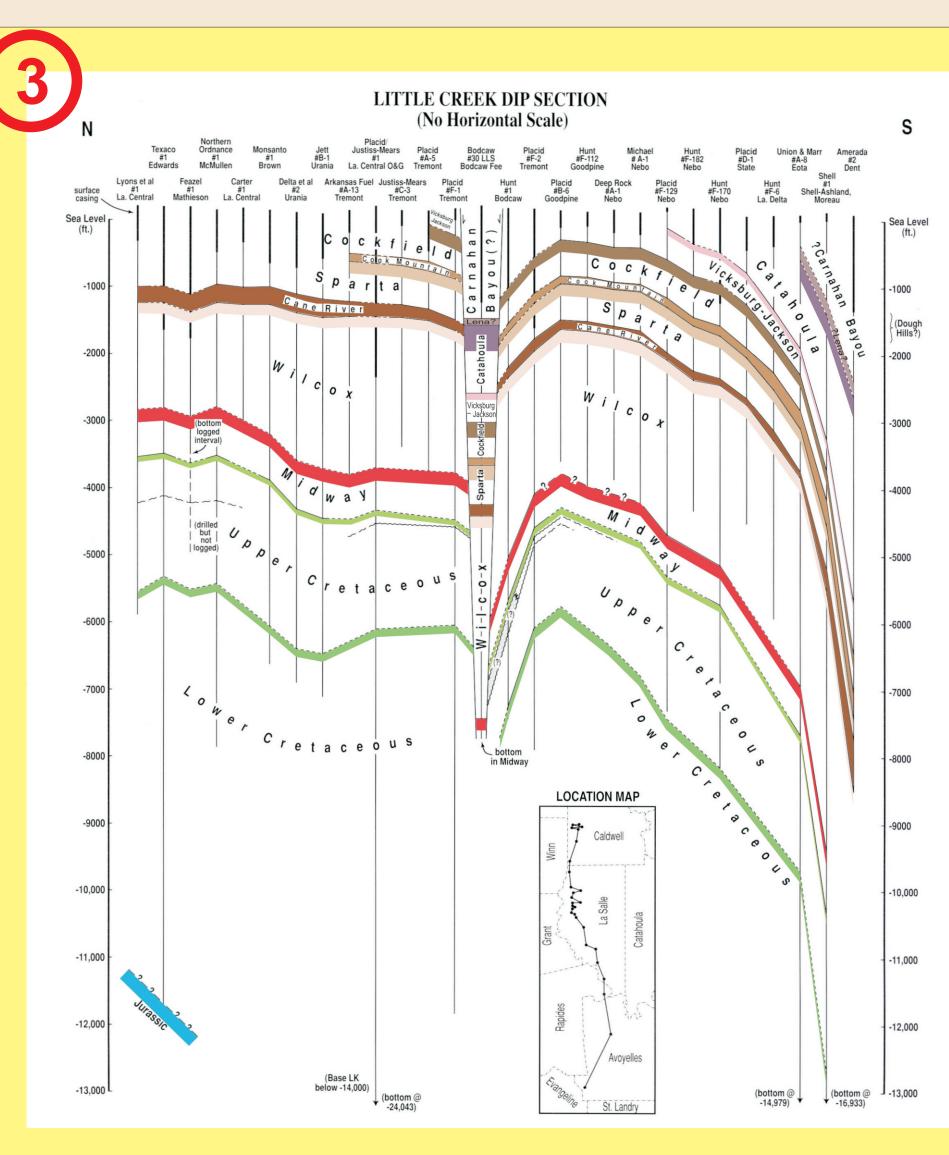


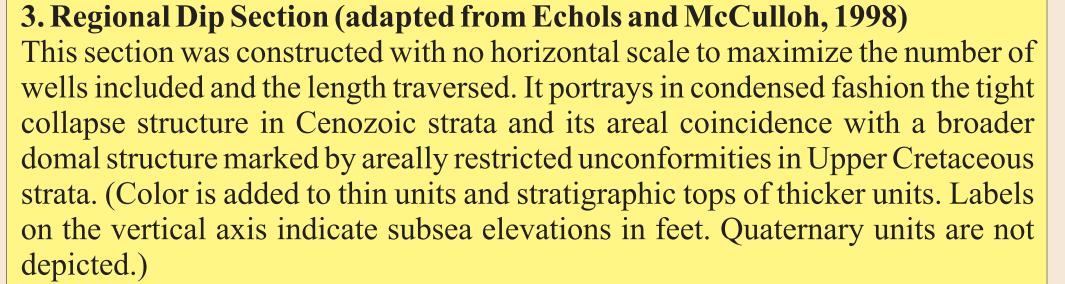


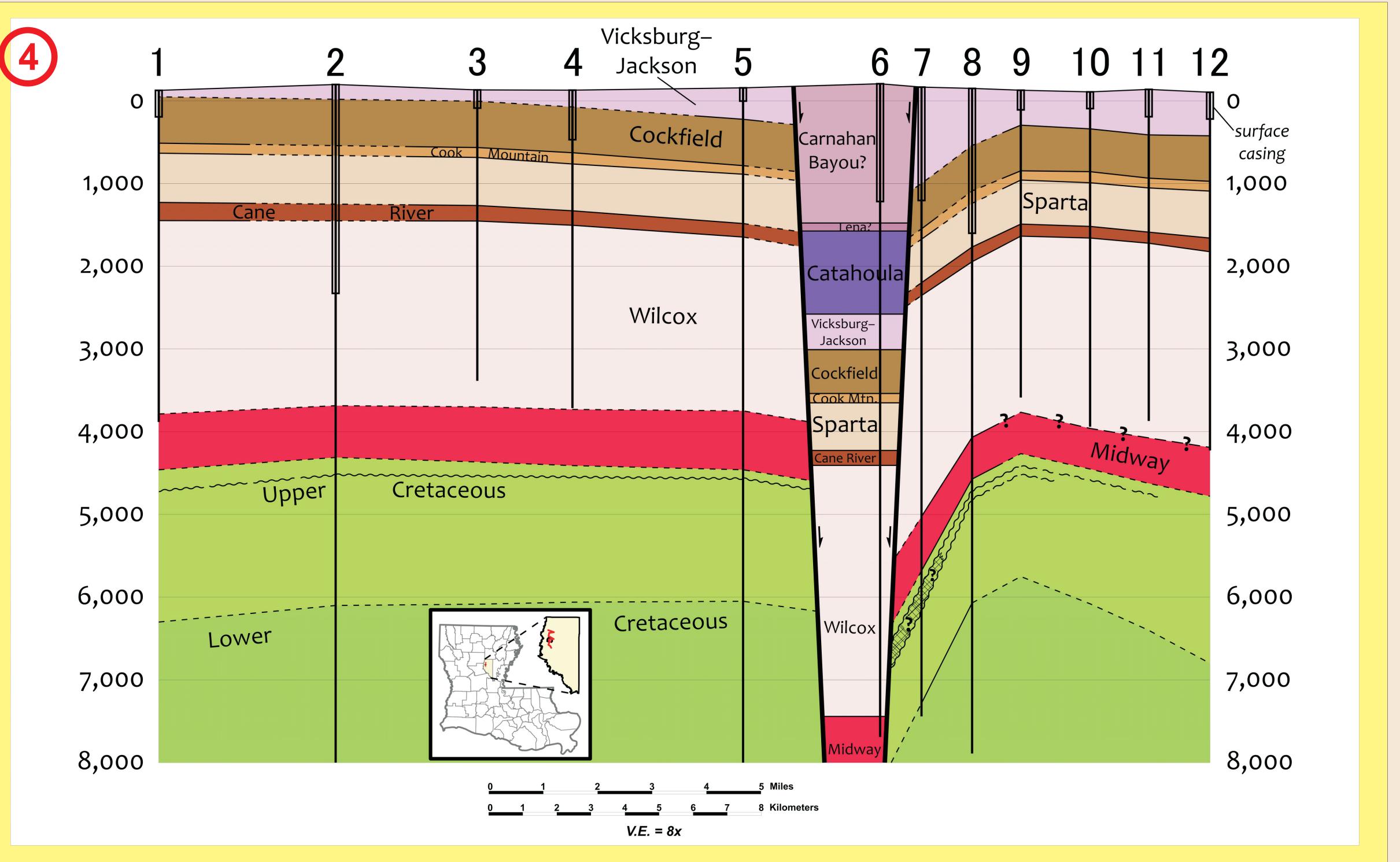
Evolving Awareness of the Magnitude of Subsidence at Little Creek



7. Hypotheses of Origin (illustrated: Little Creek collapse structure on a map of tectonic elements) Little Creek shows no obvious relation to surrounding regional structure, and Fisk proposed no hypothesis of its Rogers, J. E., 1993, Personal communication: consulting groundwater hydrologist, Alexandria, Louisiana. origin. Unpublished hypotheses conceived in the 1960s and 1970s to account for the origin of the structure include (1) salt withdrawal from a former salt diapir near the southeastern edge of the north Louisiana salt basin (J. E Rogers; see illustration), (2) long-term response following a meteor impact during deposition of the Upper Cretaceous chalk (M. D. Butler), and (3) response to emplacement of a deep post–Jurassic igneous diapir (D. H. Wilson). Today, nearly eight decades after Fisk's original mapping, the structure seems no closer to a clearly preferable genetic interpretation based upon its distinctive aspects and available data, and remains no less enigmatic than when first discovered.







4. Local Dip-Oriented Cross Section This cross section was constructed using logs of wells from Panel 3 closest to Little Creek structure (table, Panel 5). Labels on the vertical axis indicate subsea elevations in feet. (Ouaternary units are not depicted.)

Revised Dip-Oriented Cross Section With Uniform Horizontal Scale and 8x Vertical Exaggeration (Panel 4)

This section uses only those wells from the 1998 section nearest the structure, is laid out with a uniform horizontal scale and 8x vertical exaggeration, and extends to a low elevation of -8,000 ft. The spacing of these wells was some of the closest among those used on the earlier section, yet remains comparatively wide for the sake of elucidating detail. Only a single well unequivocally is situated inside the collapse structure,¹ so its depiction is generalized as in Panel 3, the perimeter intercepts as single faults and the interior contacts as unbroken and horizontal. Rogers (1993), however, related that his structure mapping on shallow-subsurface horizons penetrated by water wells (Rogers, 1967) indicated a stepping down of these surfaces within the structure, suggesting that the total displacement actually may be spread among numerous faults bounding narrow, telescoping sliverlike blocks approaching the structure's interior.

¹Well no. 7 (Hunt #1 Bodcaw) lies just inside the southern perimeter of the surface structure as mapped by Fisk (1938), and lies barely within the interpreted collapse structure on some subsurface maps. The strata penetrated by this well below the surface casing, however, are concordant with strata penetrated in wells farther to the south, and data from the surface-cased interval were not available to this exercise, s the section depicts well no. 7 as lying just outside the structure's perimeter.

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Echols, J. B., and R. P. McCulloh, 1998, Little Creek structure, T9N–R2E, La Salle Parish, Louisiana: Basin Research Institute Bulletin, v. 8, p. 30–39.

plus plates (includes two 1:62,500-scale geologic maps).

hydrologist, U.S. Geological Survey, Alexandria, Louisiana.

Rogers, J. E., 1982, Personal communication: hydrologist, U.S. Geological Survey, Alexandria, Louisiana.

Wilson, D. H., 1994, Personal communication, petroleum geologist, Vastar Resources, Houston, Texas.

Basin Research Institute Bulletin, v. 6, p. 3–15.



References

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Acknowledgments

I am indebted to James E. Rogers (hydrologist, U.S. Geological Survey retired) for numerous conversations pertaining to his stratigraphic correlations and unpublished shallow-subsurface structure mapping of the Little Creek structure prepared using water well data. Rogers, Mark D. Butler, and Douglas H. Wilson generously shared their thoughts and ideas pertaining to the structure's characteristics and origin in several conversations in the early 1990s. Chacko J. John reviewed several early versions of this content.