

3D Seismic Imaging of High Relief Precambrian Landforms in East-Central Ohio

The Ohio Geological Survey has periodically updated the Precambrian Unconformity surface structural contour map for Ohio. The most recent update is "Structure Contour Map on the Precambrian Unconformity Surface in Ohio" by Mark Baranoski in 2002. This map is referred to as PG-23. Mark compiled historical sample and log tops, and confirmed Precambrian structures with gravity, magnetics, and 2D seismic where possible. The paper also summarizes previous works and interpretations pertaining to the Precambrian Unconformity and is a very good reference when starting a study on the Ohio Precambrian Unconformity.

EMF has identified three high relief Precambrian Landforms (Structures) using 3D seismic. One of the Structures is shown on PG-23 and the other two are new features. The Mount Simon Sandstone is truncated against all three structures and the topographic relief of the feature has affected the deposition of the overlying Paleozoic formations. In all cases the structures appear to be the result of highly resistant igneous rocks being preserved during erosion at the Precambrian Unconformity. The locations of the three Precambrian Unconformity Structures are shown in Figure 1.

The first Structure is called the Utica Structure in this report because of its proximity to Utica, Ohio. This Structure is shown on PG-23 as the eastern portion of Feature 25, "unnamed faults along COCORP seismic lines." Feature 25 is defined by Precambrian tests at the border of Licking and Knox Counties that were drilled in the early 1990's by Michigan Geosearch. Figure 2 is an iso-time map of the Precambrian Unconformity horizon. The iso-time map covers only a portion the eastern side of the Utica Structure. The 795-millisecond contour is the approximate truncation point of the Cambrian Mount Simon Sandstone against the Structure. Figure 3 is a seismic panel with the Precambrian Unconformity (Basement) Horizon color coded brown and the Cambrian Mount Simon Sandstone Horizon color coded purple. The estimated area of the Utica Structure based on seismic and geologic mapping is about 5,000 acres with a maximum relief of about 650 feet.

The Licking Structure located in Licking Township, Licking County, Ohio. The Licking Structure is elongate in N10E to S10W direction and is 400 feet to 1,000 feet wide with 200 feet to 400 feet of relief. The length of the Structure on the 3D seismic is 4.4 miles and the structure continues off the 3D to the north and south. Figures 5, 6, and 7 are three west to east seismic sections across the Licking Structure starting to the north and moving south. The truncation of the Mount Simon Sandstone and the draping of the younger Paleozoic rocks over the Structure are observed in the seismic sections. The profile of the Licking Structure can be interpreted as an igneous dike.

The Thorn Structure is located in Thorn Township, Perry County, Ohio. The structure is roughly circular in shape and the edges of the feature are clearly defined in all directions on the 3D. The area of the Thorn Structure is approximately 465 acres and has a maximum relief of about 400 feet. Figures 9, 10, 11, and 12 are west to east, south to north, southwest to northeast, and northwest to southeast seismic sections, respectively. In all seismic panels the truncation of the Mount Simon Sandstone and the drape of the younger Paleozoic formations over the Structure is observed. The profile of the Thorn Structure can be interpreted to be an igneous plug or neck.

Figure 13 is an Ohio Total Intensity Aeromag map with the Utica, Licking, and Thorn Structures superimposed. This map suggests that the Utica, Licking, and Thorns Structures could be part of continuous series of high relief Precambrian Unconformity landforms that are part of a larger igneous complex.

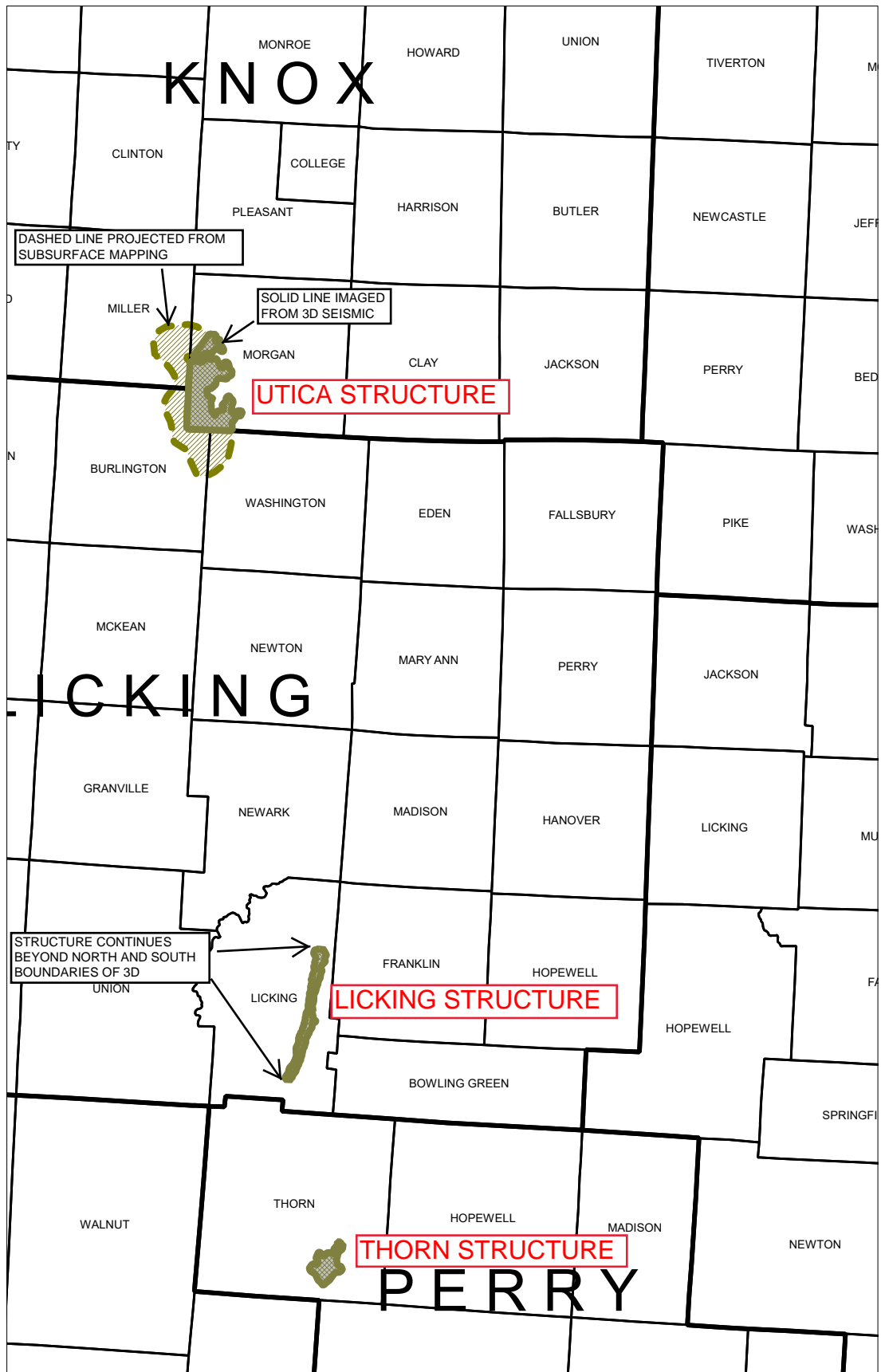
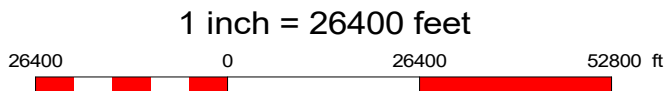


Figure 1: Base map with Precambrian landforms identified with 3D seismic.



EMF GEOSCIENCE		
PRECAMBRIAN BASEMENT STRUCTURES IDENTIFIED ON 3D SEISMIC KNOX, LICKING, AND PERRY COUNTIES, OHIO		
PREPARED BY: EMF GEOSCIENCE	Date:	15 November, 2023
	Scale:	1 IN = 5 MILES

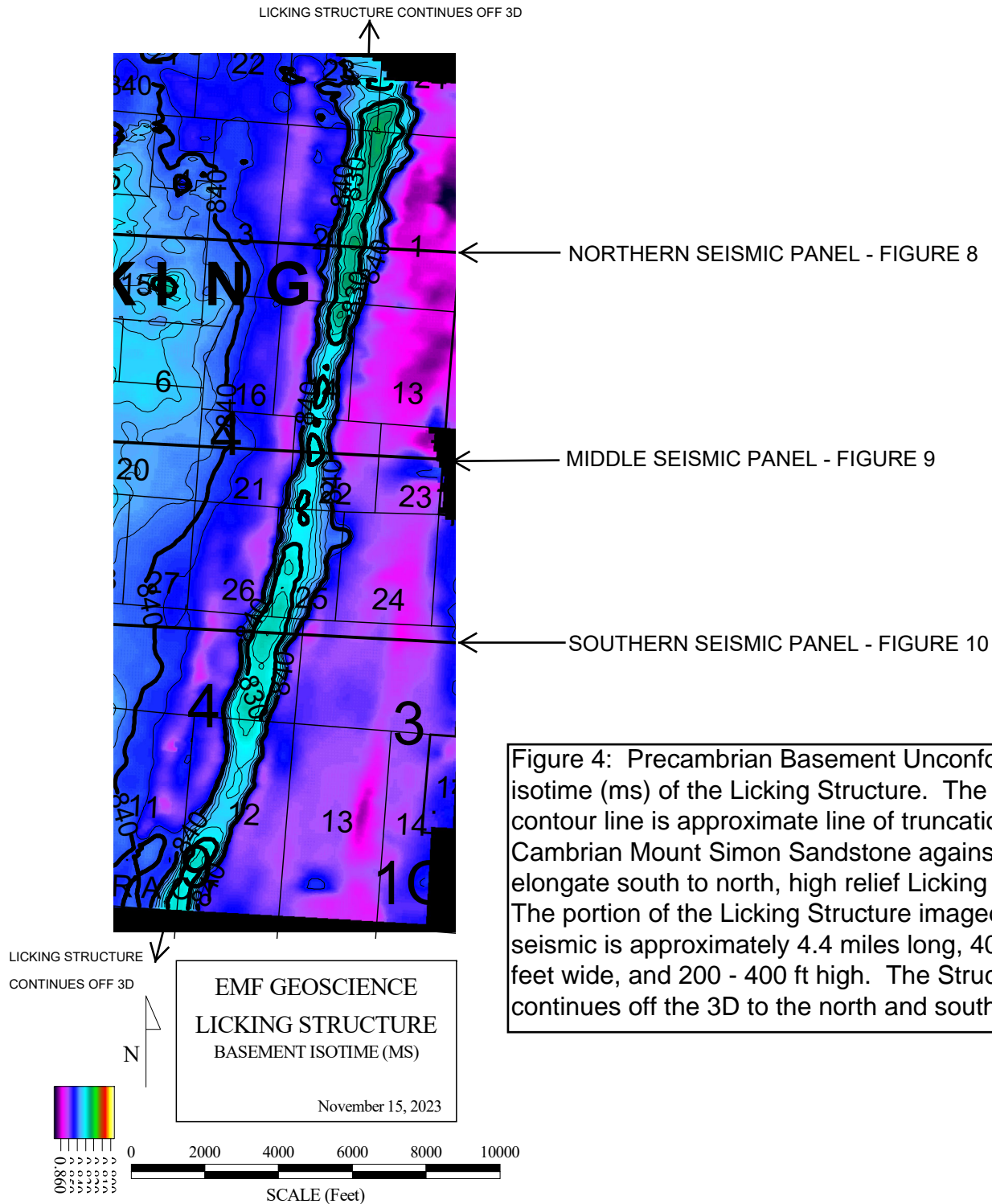


Figure 4: Precambrian Basement Unconformity isotime (ms) of the Licking Structure. The 840 ms contour line is approximate line of truncation of Cambrian Mount Simon Sandstone against the elongate south to north, high relief Licking Structure. The portion of the Licking Structure imaged by 3D seismic is approximately 4.4 miles long, 400 -1,000 feet wide, and 200 - 400 ft high. The Structure continues off the 3D to the north and south.

LICKING PRECAMBRIAN BASEMENT STRUCTURE - WEST TO EAST SEISMIC INLINE – NORTHERN LINE

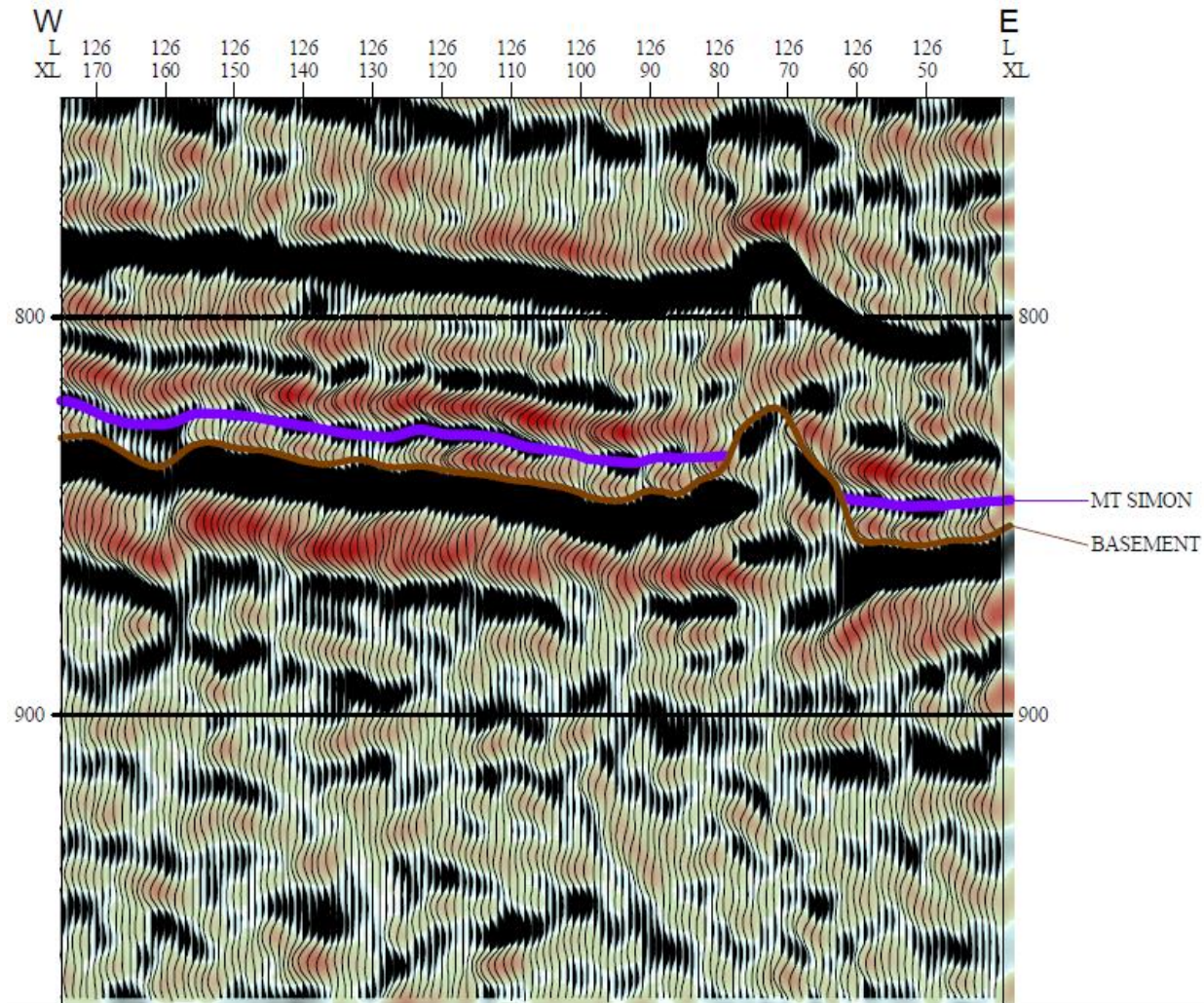


Figure 5: Northern west to east seismic panel through the Licking Structure. The brown horizon line is the Precambrian Basement Unconformity. The purple horizon line is the Cambrian Mount Simon Sandstone which was deposited on the Precambrian Unconformity. Note that the Mount Simon Sandstone is truncated against the elongate, high relief Licking Structure and younger formations are draped over the Structure. and younger formations are draped over the Structure.

LICKING PRECAMBRIAN BASEMENT STRUCTURE - WEST TO EAST SEISMIC INLINE – MIDDLE LINE

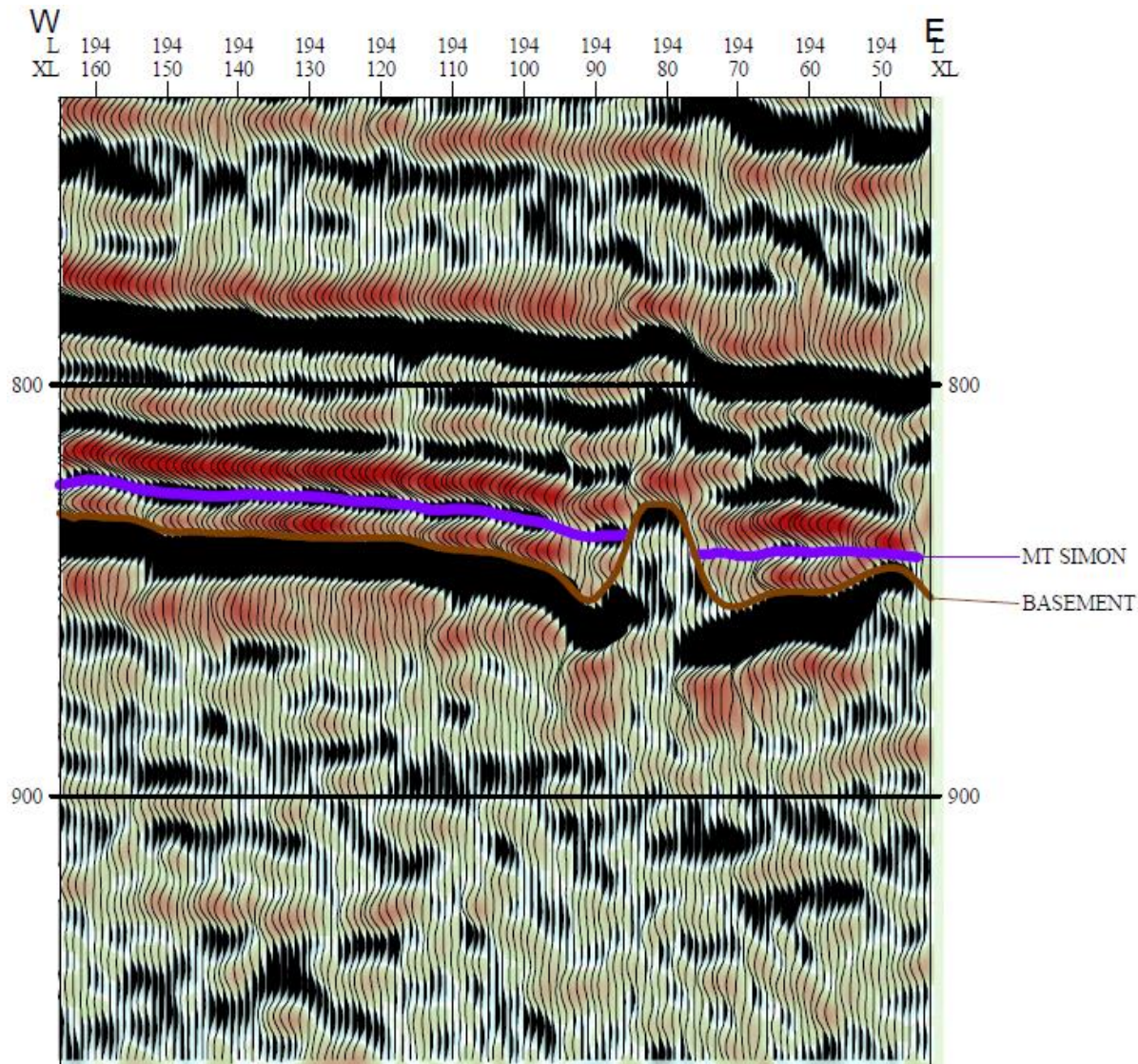


Figure 6: Middle west to east seismic panel through the Licking Structure. The brown horizon line is the Precambrian Basement Unconformity. The purple horizon line is the Cambrian Mount Simon Sandstone which was deposited on the Precambrian Unconformity. Note that the Mount Simon Sandstone is truncated against the elongate, high relief Licking Structure and younger formations are draped over the Structure.

LICKING PRECAMBRIAN BASEMENT STRUCTURE - WEST TO EAST SEISMIC INLINE – SOUTHERN LINE

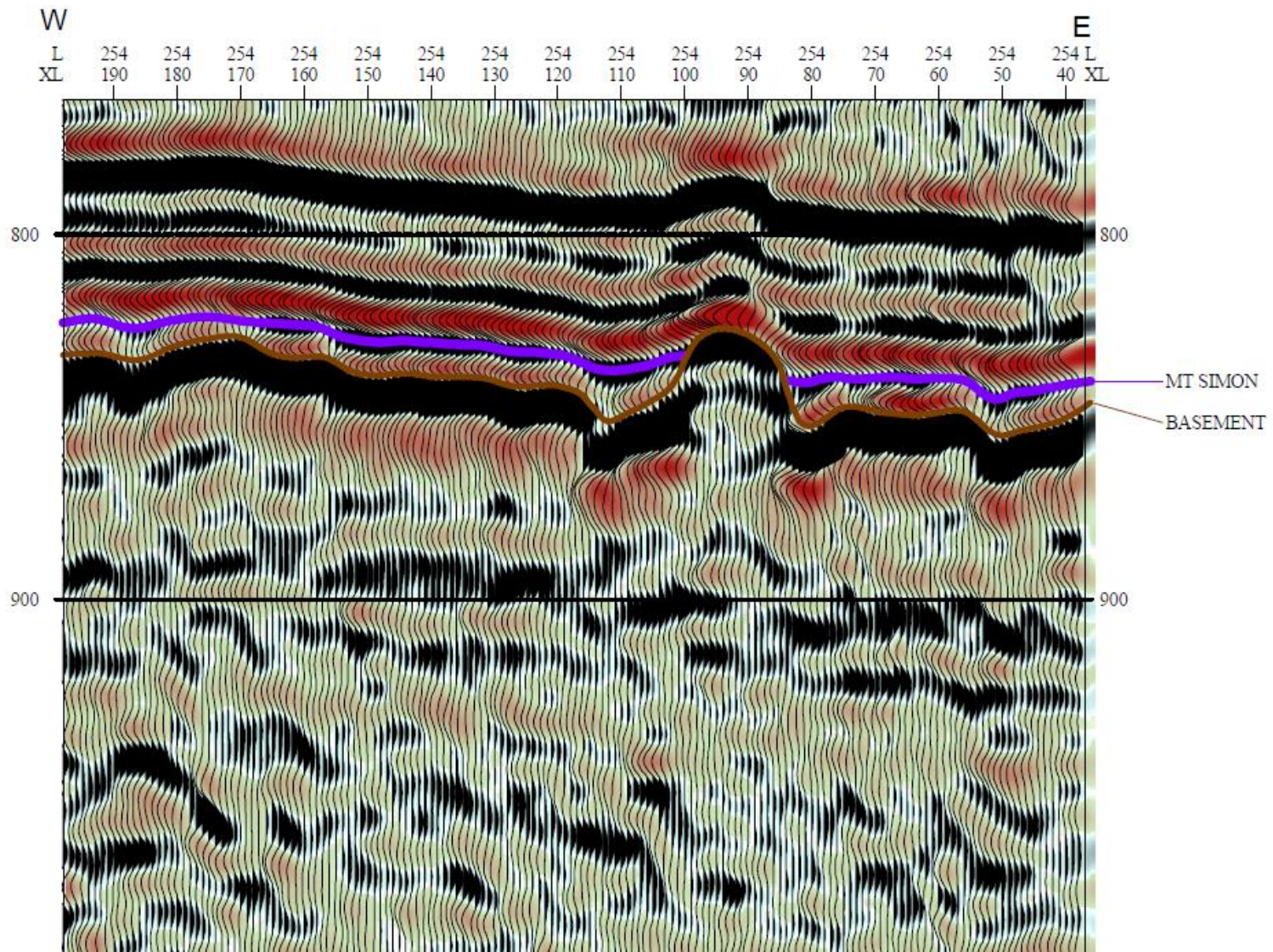
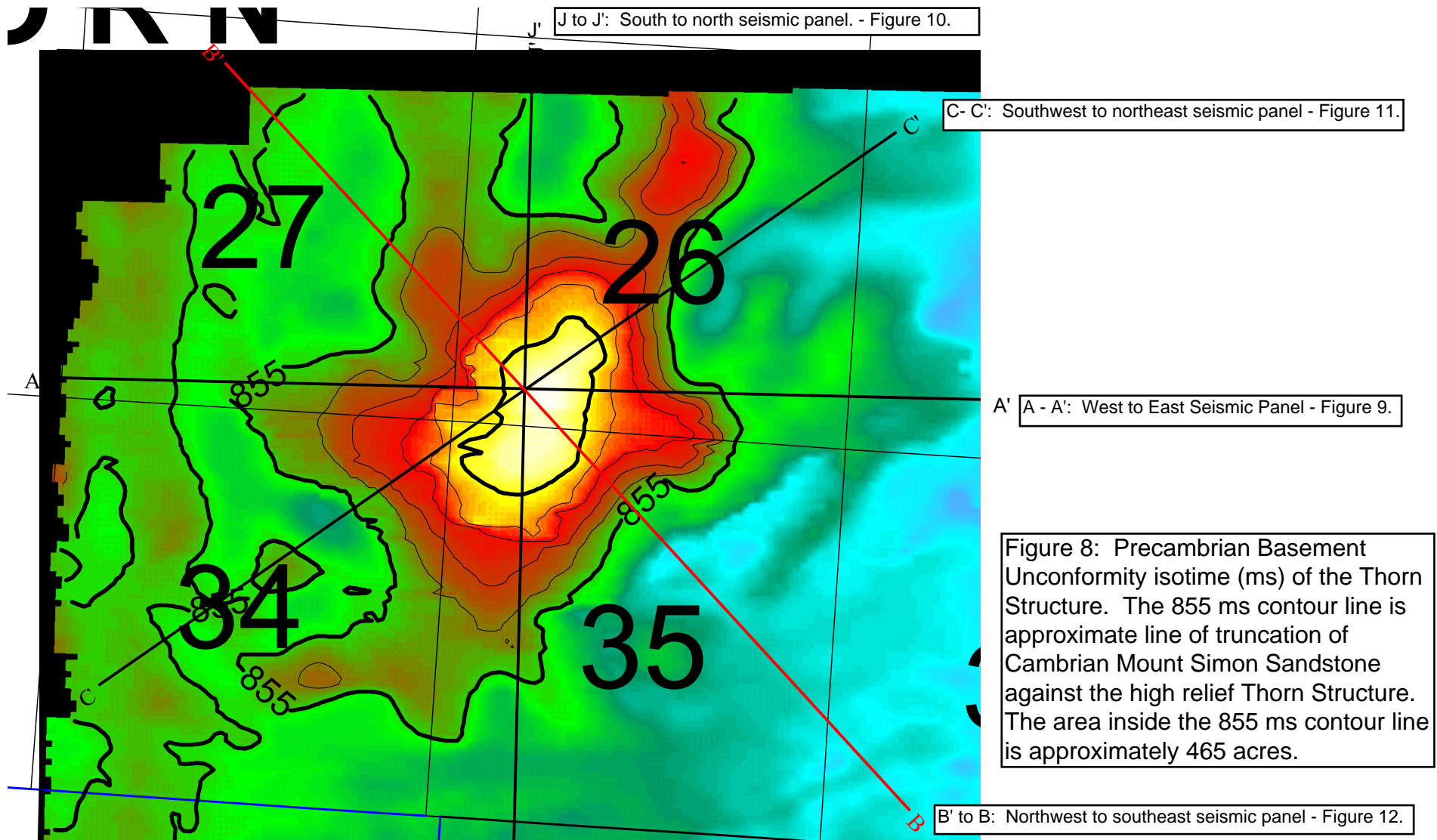


Figure 7: Southern west to east seismic panel through the Licking Structure. The brown horizon line is the Precambrian Basement Unconformity. The purple horizon line is the Cambrian Mount Simon Sandstone which was deposited on the Precambrian Unconformity. Note that the Mount Simon Sandstone is truncated against the elongate, high relief Licking Structure and younger formations are draped over the Structure.



J to J': South to north seismic panel. - Figure 10.

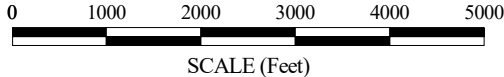
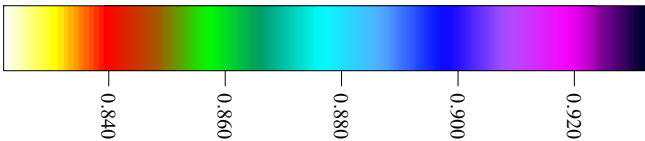
C- C': Southwest to northeast seismic panel - Figure 11.

A' A - A': West to East Seismic Panel - Figure 9.

Figure 8: Precambrian Basement Unconformity isotime (ms) of the Thorn Structure. The 855 ms contour line is approximate line of truncation of Cambrian Mount Simon Sandstone against the high relief Thorn Structure. The area inside the 855 ms contour line is approximately 465 acres.

B' to B: Northwest to southeast seismic panel - Figure 12.

EMF GEOSCIENCE
 THORN STRUCTURE
 BASEMENT ISOTIME (MS)
 5 MS CONTOUR INTERVAL
 November 14, 2023



THORN PRECAMBRIAN BASEMENT STRUCTURE – WEST TO EAST SEISMIC INLINE

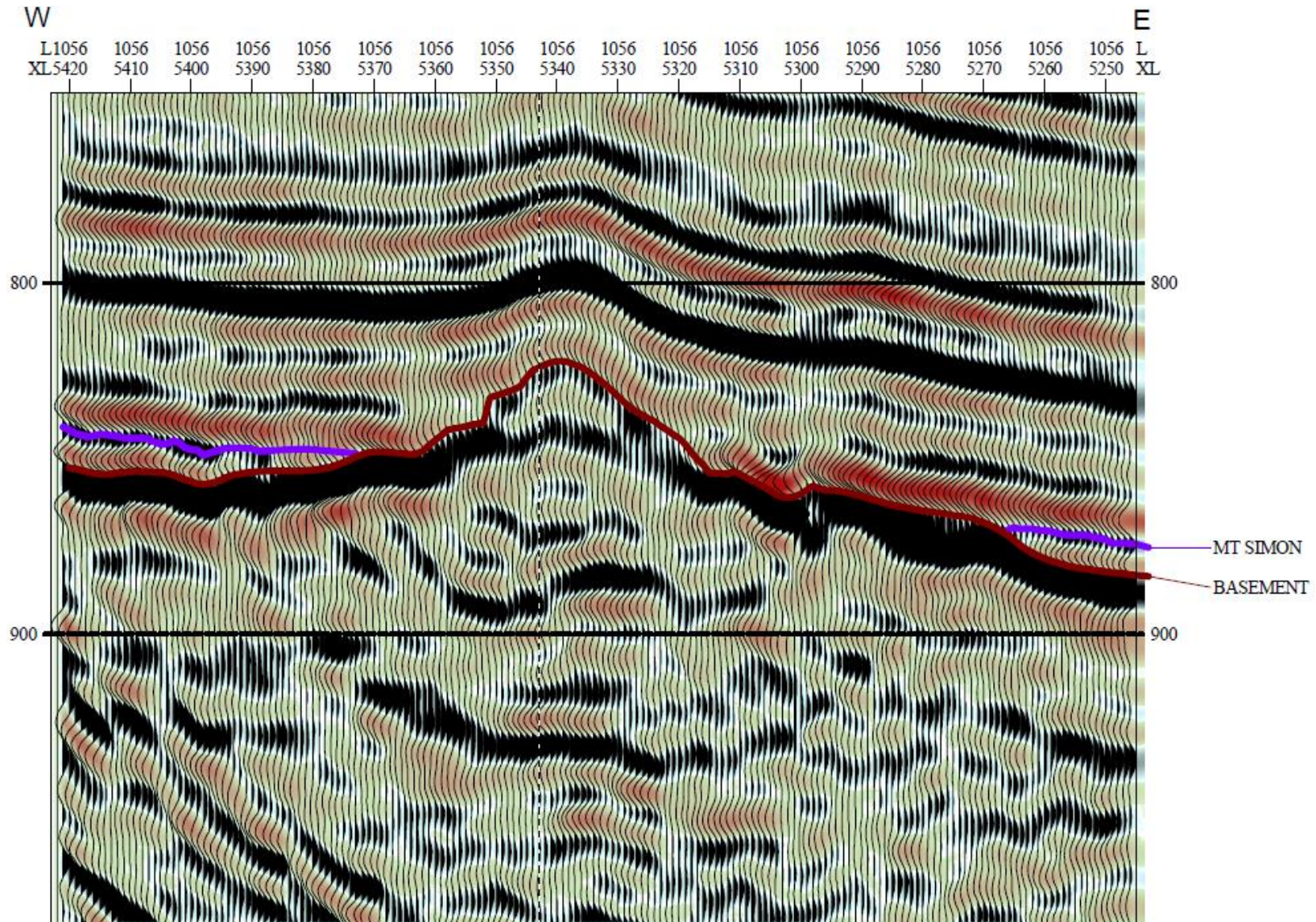


Figure 9: West to east seismic panel through the Thorn Structure. The brown horizon line is the Precambrian Basement Unconformity. The purple horizon line is the Cambrian Mount Simon Sandstone which was deposited on the Precambrian Unconformity. Note that the Mount Simon Sandstone is truncated against the high relief Thorn Structure and younger formations are draped over the Structure.

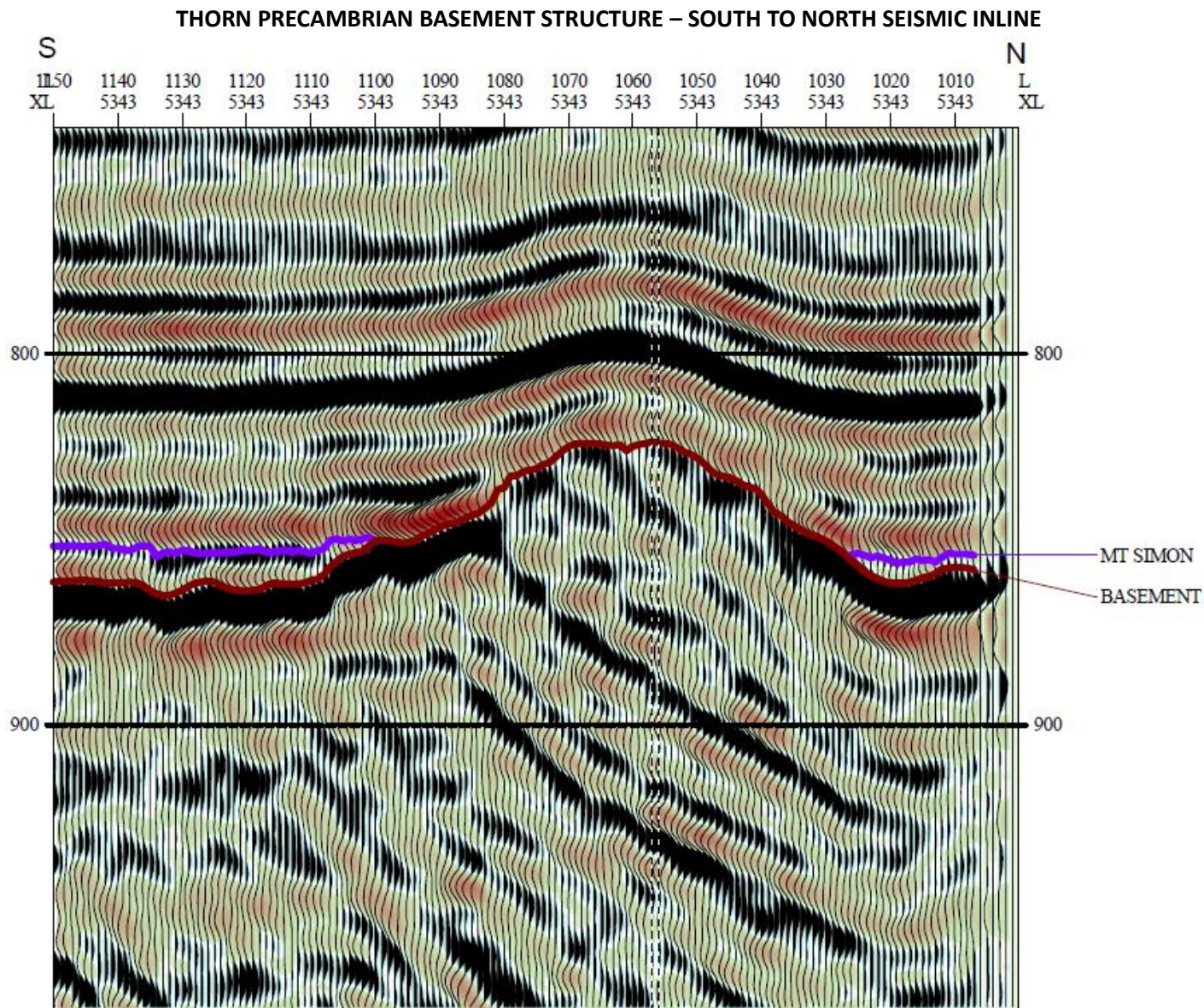


Figure 10: South to north seismic panel through the Thorn Structure. The brown horizon line is the Precambrian Basement Unconformity. The purple horizon line is the Cambrian Mount Simon Sandstone which was deposited on the Precambrian Unconformity. Note that the Mount Simon Sandstone is truncated against the high relief Thorn Structure and younger formations are draped over the Structure.

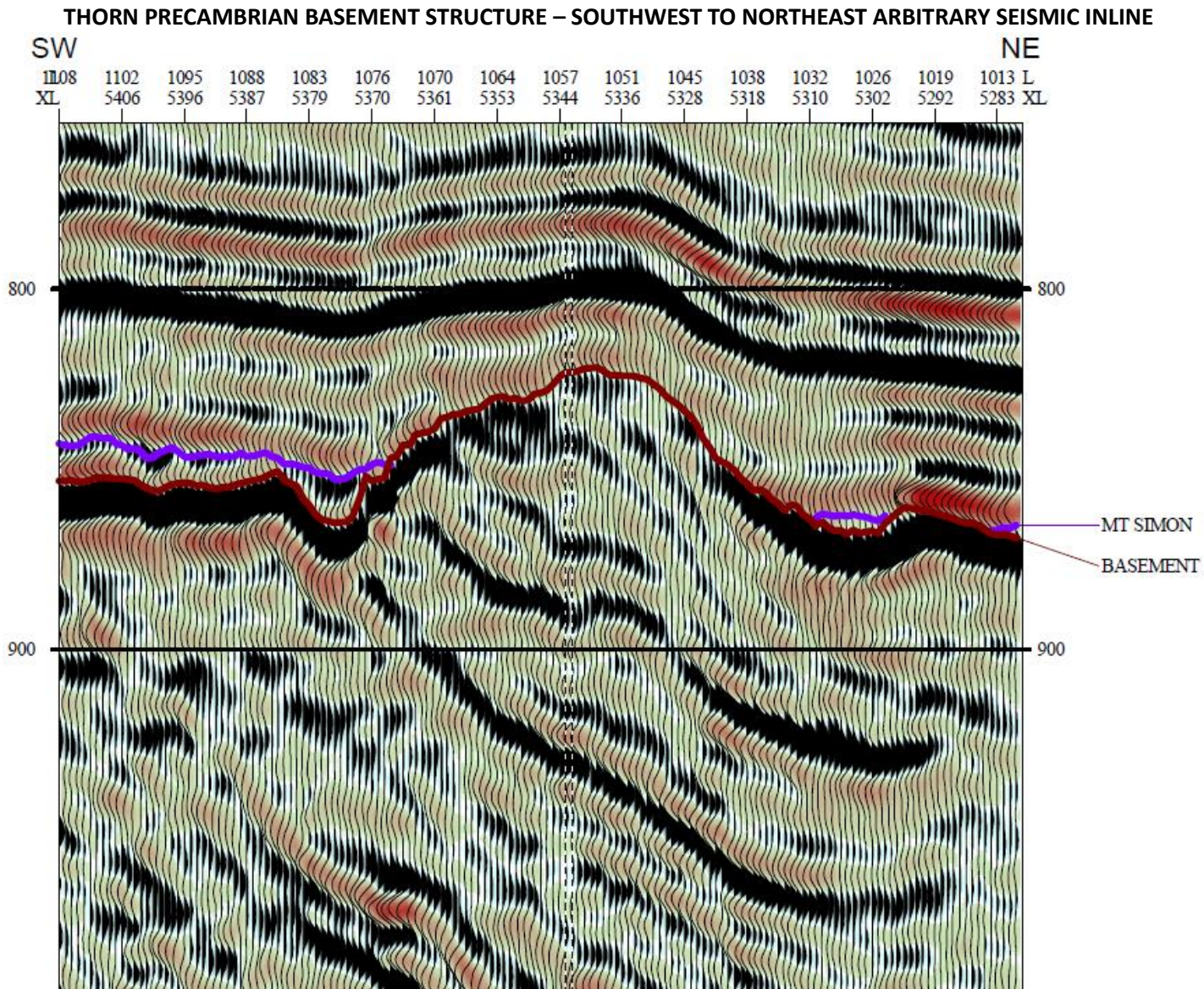


Figure 11: Southwest to northeast seismic panel through the Thorn Structure. The brown horizon line is the Precambrian Basement Unconformity. The purple horizon line is the Cambrian Mount Simon Sandstone which was deposited on the Precambrian Unconformity. Note that the Mount Simon Sandstone is truncated against the high relief Thorn Structure and younger formations are draped over the Structure.

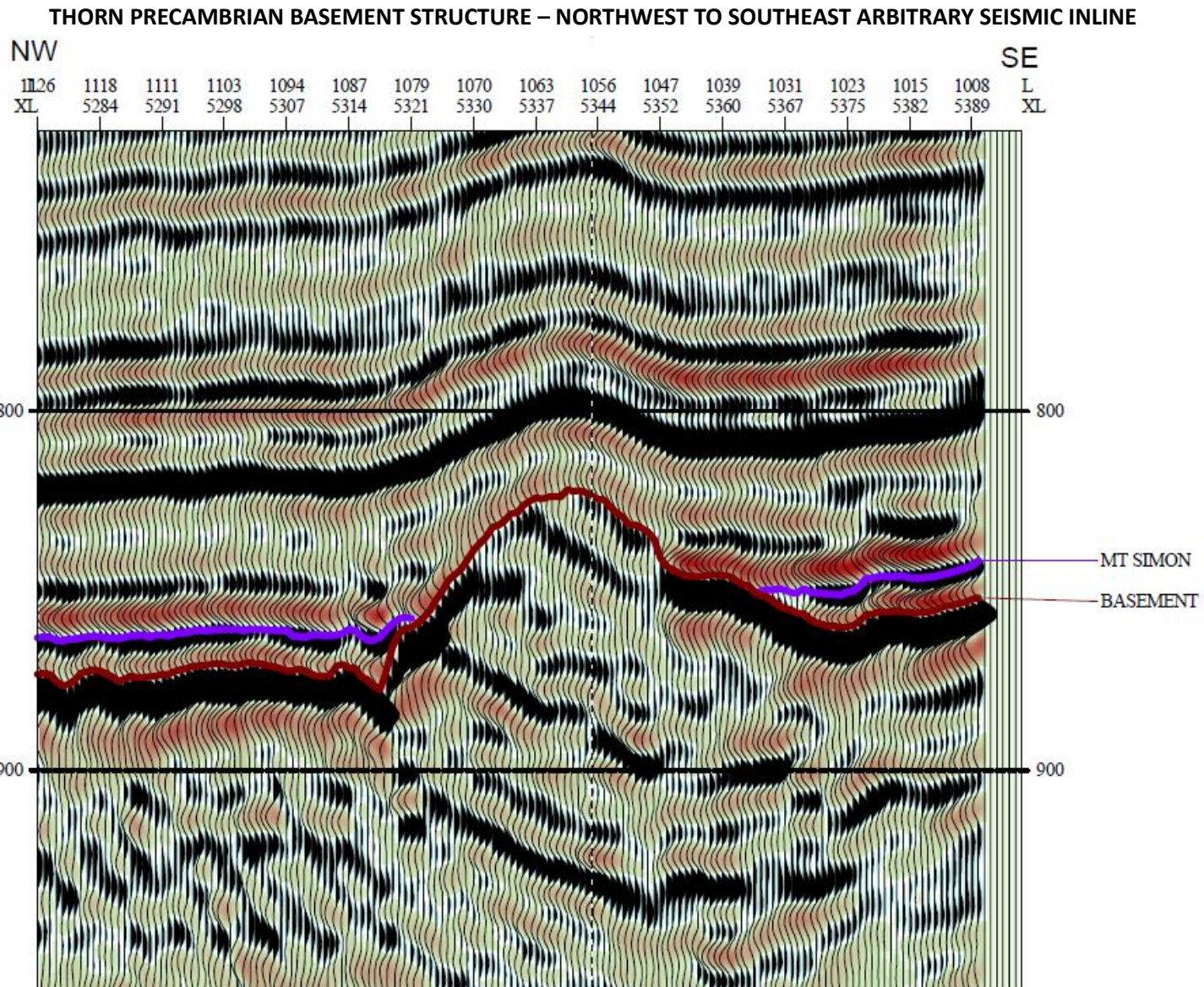
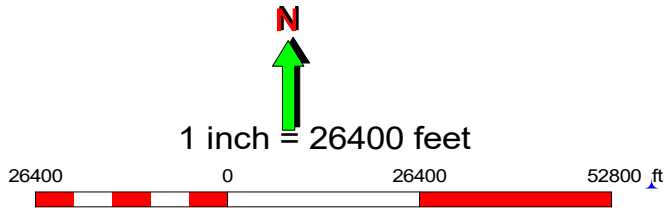
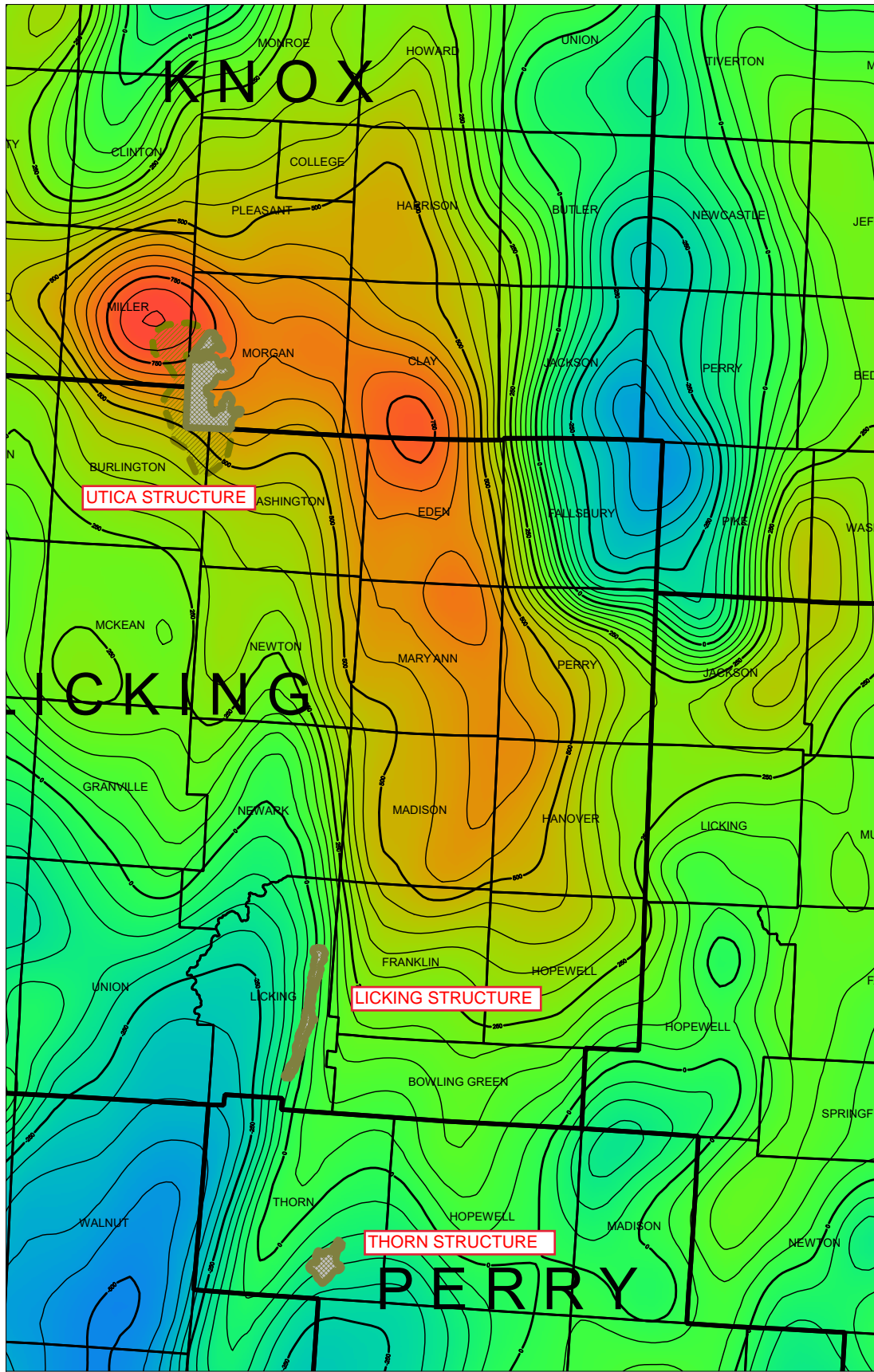


Figure 12: Northwest to southeast seismic panel through the Thorn Structure. The brown horizon line is the Precambrian Basement Unconformity. The purple horizon line is the Cambrian Mount Simon Sandstone which was deposited on the Precambrian Unconformity. Note that the Mount Simon Sandstone is truncated against the high relief Thorn Structure and younger formations are draped over the Structure.



EMF GEOSCIENCE		
PRECAMBRIAN BASEMENT STRUCTURES IDENTIFIED ON 3D SEISMIC WITH OHIO TOTAL INTENSITY AEROMAG KNOX, LICKING, AND PERRY COUNTIES, OHIO		
PREPARED BY: EMF GEOSCIENCE	Scale: 1 IN = 5 MILES	Date: 15 November, 2023

Figure 13: Ohio Total Intensity Aeromag showing the possible connection of the Utica, Licking, and Thorn Structures.