

THE WACO CHANNEL REVISITED: A CONTOURITE EROSIONAL MOAT ALONG THE SAN MARCOS PLATFORM?

William Wright and Gregor P. Eberli

KEY FINDINGS

- Regional subsurface mapping delineates the Waco Channel as an approximately 130-mile-long zone of pronounced Austin Chalk thinning along the eastern flank of the San Marcos Platform.
- An elongate mounded accumulation lies immediately basinward of the channel, producing a paired moat-mound geometry typical of contourite drifts.
- Taken together, the linear form of the thinning and its paired mound support reinterpretation of the Waco Channel as a contourite moat, with along-margin bottom currents driving erosion, nondeposition, and adjacent mounded deposition.

BACKGROUND AND RATIONALE

Bottom currents along continental margins produce contourite depositional systems characterized by constructional drifts and associated erosional or non-depositional moats (Rebesco et al., 2014; Price et al., 2022). These systems are common on modern margins but are comparatively difficult to recognize in the ancient record, where their geometries can be mistaken for submarine channels, gravity-flow deposits, or structurally controlled thickness variations. Regional thickness mapping offers one means of identifying the paired erosional and constructional geometries that characterize them. Price et al. (2022), for example, used regional well-log mapping to identify elongate mounded carbonate accumulations and associated moat-like zones in the Delaware Basin and interpreted them as fossil contourite systems.

The Upper Cretaceous Austin Chalk was deposited across the East Texas Basin, where the San Marcos Platform formed a prominent bathymetric high along the western basin margin. Immediately basinward of the platform lies an elongate zone of pronounced Austin thinning, referred to since the early twentieth century as the Waco Channel (Stephenson, 1929; Koger, 1981; Durham and Hall, 1991). Its origin has been debated for nearly a century. Stephenson (1929) attributed the thinning to erosion associated with the Austin-Taylor unconformity, Koger (1981) related it to erosion across the Belton structural high, and Durham and Hall (1991) interpreted the feature as a submarine channel extending basinward from Central Texas.

The Austin Chalk accumulated within the Western Interior Seaway, where circulation models invoke sustained along-margin flow, including a cool boreal water mass moving southward along the western side of the seaway and warm Tethyan water entering from the south (Lowery et al., 2018). Persistent currents of this kind provide a plausible setting for contourite deposition, though the present data set cannot link the Waco Channel to any particular water mass. This study revisits the Waco Channel using regional well-log correlations, structure

mapping, and thickness trends, and evaluates whether its geometry is better explained as a moat of a contourite drift system.

DATA SET AND METHODS

This study uses a regional subsurface database covering more than 60 counties and approximately 49,600 mi² of the East Texas Basin. More than 4,500 wells were incorporated into the regional stratigraphic framework, with geophysical logs obtained primarily from Enverus and the Texas Railroad Commission. The broad spatial distribution of these wells provides subsurface control from the San Marcos Platform, across the central East Texas Basin, and toward the Cretaceous shelf margin (Fig. 1).

Regional stratigraphic correlations were established primarily from gamma-ray and induction resistivity logs. Formation tops were correlated and picked in Petrel, with particular emphasis on identifying the Top Austin Chalk and Base Austin Chalk consistently throughout the study area. These picks were used to construct regional structural surfaces and to calculate gross Austin Chalk thickness as an isochore between the two horizons.

Three regional well-log cross sections were constructed from selected wells to examine the stratigraphic architecture of the Austin Chalk across the Waco Channel, the San Marcos Platform, and the adjacent basin. Cross-section logs were standardized to common gamma-ray (GR) and deep induction resistivity (ILD) displays so that formation boundaries and interval thicknesses could be compared between wells.

STRATIGRAPHIC FRAMEWORK

Three regional cross sections illustrate correlation of the Top Austin Chalk and Base Austin Chalk across the western East Texas Basin (Fig. 2). Both horizons can be traced consistently between wells on gamma-ray and resistivity responses, providing the framework for evaluating regional changes in gross Austin thickness.

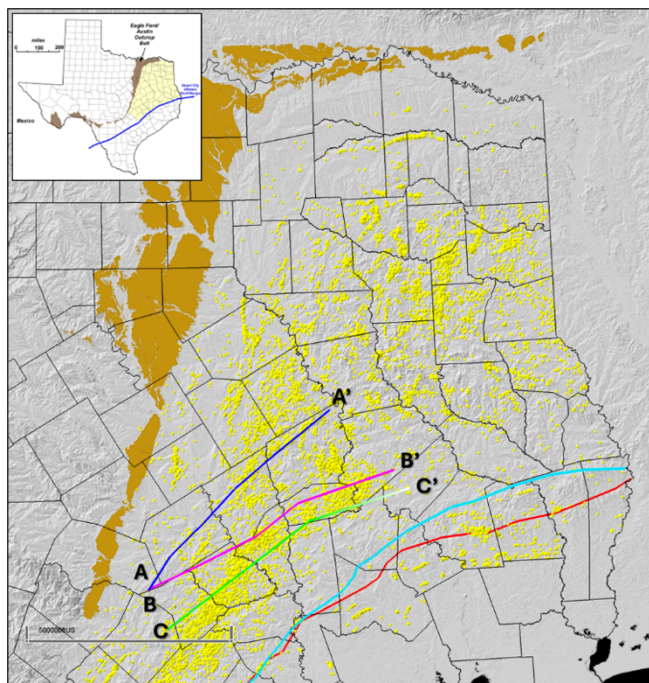


Figure 1: Regional subsurface data coverage across the East Texas Basin. Yellow points show wells in the regional database containing at least one formation-top pick; more than 4,500 wells were incorporated into the Austin stratigraphic framework. Brown polygons delineate the Austin outcrop belt, and colored lines mark cross-section locations A–A', B–B', and C–C'.

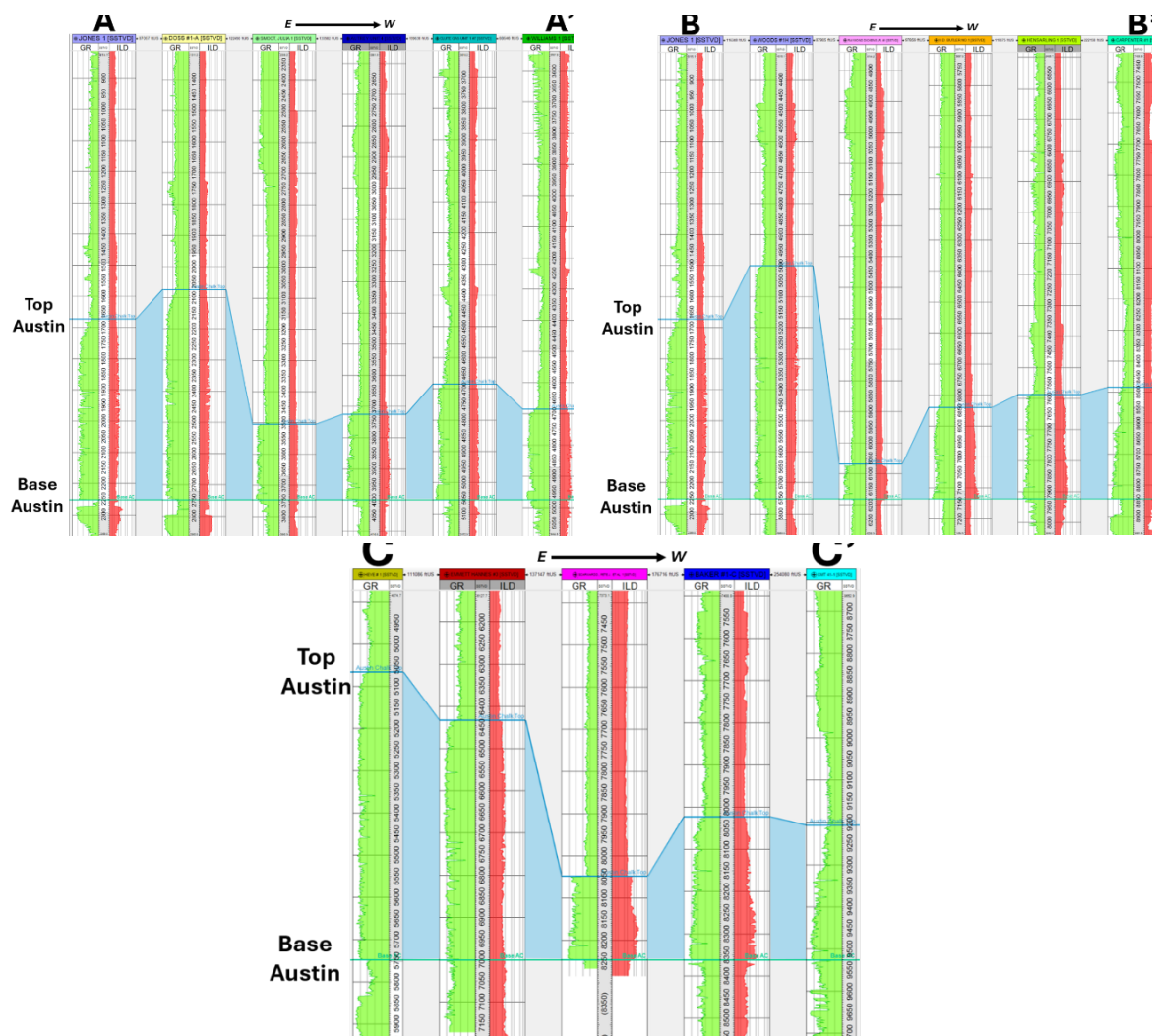


Figure 2: Regional well-log cross sections A-A', B-B', and C-C' showing gamma-ray and induction resistivity logs with correlated Top Austin and Base Austin horizons. Blue shading highlights gross Austin Chalk thickness along each transect.

All three cross sections show substantial lateral variation in thickness. In each transect, a relatively narrow zone of pronounced thinning separates thicker Austin sections on either side. Because the same geometry recurs along all three sections, the thinning represents a laterally persistent regional feature rather than an isolated well-scale anomaly.

REGIONAL STRUCTURAL FRAMEWORK

The Top Austin and Base Austin structure maps show broad basinward deepening away from the western outcrop belt and the San Marcos Platform (Fig. 3). Both horizons preserve a similar first-order configuration across the study area, with superimposed smaller-scale relief expressed as localized closed contours.

The two surfaces differ in one respect that bears directly on the origin of the Waco Channel. The thinning is carried by the Top Austin horizon alone; the Base Austin shows no corresponding deflection along the same trend. Thickness loss

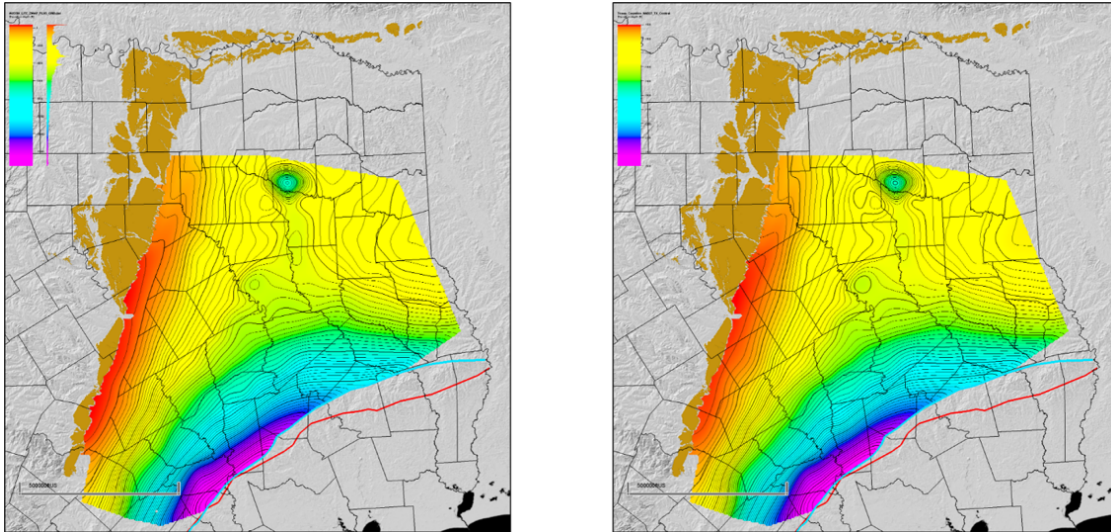


Figure 3: Structure-contour maps of the Top Austin Chalk (left) and Base Austin Chalk (right), with elevations in feet relative to sea level and 250-ft contour intervals.

therefore reflects removal or nondeposition at the top of the Austin section, not relief on the surface beneath it. A thinning produced by drape over a structural high on the base would require the opposite relationship.

THICKNESS GEOMETRY

The gross Austin Chalk isochore reveals a pronounced, elongate zone of thinning along the eastern flank of the San Marcos Platform (Fig. 4A). This feature corresponds to the Waco Channel, which can be traced for approximately 130 miles from McLennan County to Washington County and varies considerably in width along strike. Previous regional correlations report more than 200 ft of erosional relief locally within the channel (Durham and Hall, 1991).

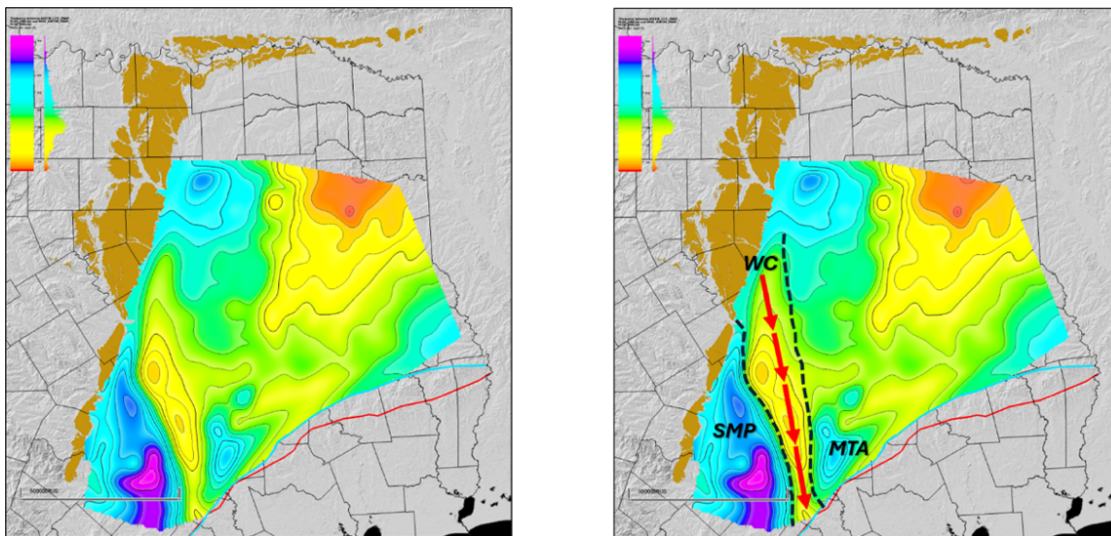


Figure 4: Gross Austin Chalk isochore shown unannotated (A) and with interpreted regional thickness features (B). The interpreted panel highlights the San Marcos Platform (SMP), Waco Channel (WC), and adjacent basinward mounded thickness anomaly (MTA).

The interpreted map (Fig. 4B) emphasizes the regional geometry. The Waco Channel forms a narrow, elongate thickness minimum directly adjacent to the San Marcos Platform, while a similarly elongate mounded thickness anomaly occurs immediately basinward. Together they define a persistent paired thin-thick geometry that parallels the western basin margin.

CONTOURITE INTERPRETATION

Erosion confined to the Top Austin is, by itself, consistent with more than one explanation, including the regional Austin–Taylor unconformity invoked by Stephenson (1929). What distinguishes the Waco Channel is its form. The thinning is narrow, continuous for approximately 130 miles, parallel to the platform margin, and paired with an equally elongate mounded accumulation immediately basinward. Regional subaerial or submarine unconformities do not ordinarily produce that geometry. Contourite systems routinely do.

Contourite systems commonly comprise elongate mounded deposits paired with narrow zones of erosion or nondeposition generated by bottom-current activity. Price et al. (2022) documented comparable relationships in the Delaware Basin, where regional thickness mapping revealed elongate carbonate mounds flanked by moat-like thickness minima interpreted as products of

bottom-current erosion and deposition. The Waco Channel and its adjacent mound reproduce that arrangement at a similar scale.

Under this interpretation the Waco Channel is the erosional moat rather than a conventional downslope submarine channel, and the mounded thickness anomaly basinward of it is the constructional component of the same system. The San Marcos Platform may have supplied the bathymetric relief needed to focus or deflect along-margin bottom currents, promoting erosion and sediment bypass within the moat and deposition farther basinward (Fig. 5).

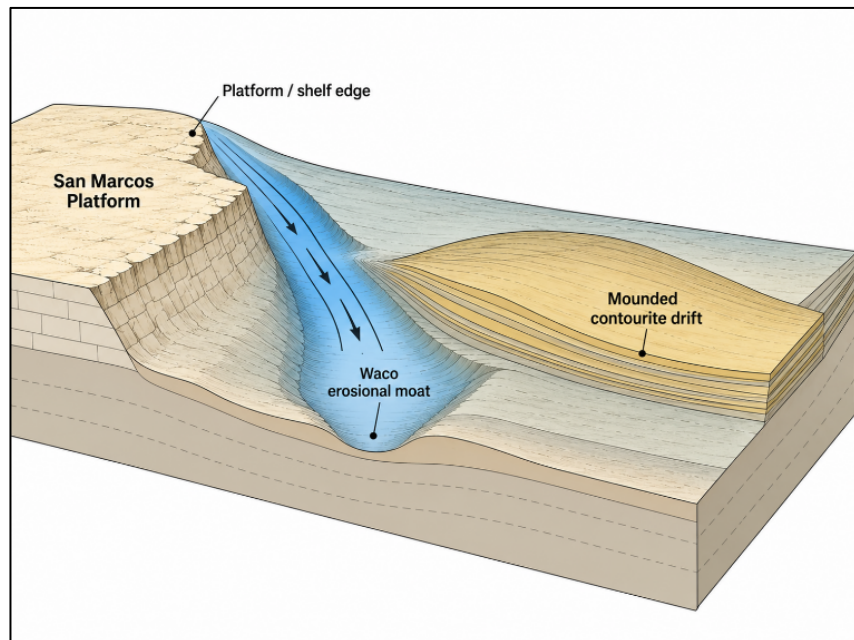


Figure 5: Conceptual model for the Waco Channel as a contourite erosional moat along the San Marcos Platform, with bottom-current erosion and bypass focused within the moat and adjacent deposition forming a mounded contourite drift.

SIGNIFICANCE AND IMPLICATIONS

The regional geometry documented here offers a new process-based interpretation of a feature debated for nearly a century. Recognition of that geometry also illustrates why regional-scale subsurface mapping matters: the relationship between the elongate thickness minimum and the adjacent mounded accumulation becomes apparent only once individual well correlations are integrated across the basin.

Well-log correlations and thickness maps constrain the large-scale geometry but cannot resolve the internal architecture or erosional surfaces expected within a contourite moat-drift system. Seismic-reflection data offer the critical test and would resolve reflection truncation, asymmetric mounded architecture, internal discontinuities, and other geometries diagnostic of bottom-current erosion and drift deposition. Confirmation of those features would substantially strengthen the case for interpreting the Waco Channel as an ancient contourite erosional moat.

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