

Late Cretaceous and Tertiary Burial History, Central Texas

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ABSTRACT

In Central Texas, the Balcones Fault Zone separates the Gulf Coastal Plain from the elevated Central Texas Platform, comprising the Hill Country, Llano Uplift, and Edwards Plateau provinces to the west and north. The youngest geologic formations common to both regions are of Albian and Cenomanian age, the thick, widespread Edwards Limestone, and the thin overlying Georgetown, Del Rio, Buda, and Eagle Ford–Boquillas formations. Younger Cretaceous and Tertiary formations that overlie the Edwards and associated formations on and beneath the Gulf Coastal Plain have no known counterparts to the west and north of the Balcones Fault Zone, owing mostly to subaerial erosion following Oligocene and Miocene uplift during Balcones faulting, and secondarily to updip stratigraphic thinning and pinchouts during the Late Cretaceous and Tertiary.

This study attempts to reconstruct the burial history of the Central Texas Platform (once entirely covered by carbonates of the thick Edwards Group and thin Buda Limestone), based mostly on indirect geological evidence:

- 1) Regional geologic maps showing structure, isopachs, and lithofacies;
- 2) Regional stratigraphic analysis of the Edwards Limestone and associated formations demonstrating that the Central Texas Platform was a topographic high surrounded by gentle clinofold slopes into peripheral depositional areas;
- 3) Analysis and projection of regional updip thinning patterns of Upper Cretaceous and Tertiary formations from the Gulf Coast Basin northwestward along the San Marcos Arch, across the Balcones/Ouachita Downwarp, into the heart of the Central Texas Platform;
- 4) Derived published stratigraphic analyses of the Cretaceous Western Interior Seaway;
- 5) Estimation of burial depth from thermal maturity of Eagle Ford organic shales (overlying the Edwards by approximately 150 feet) in the outcrop area around Austin and Comstock, and in the subsurface of Wilson, Karnes, and DeWitt counties; and
- 6) Implications as to burial depth of Edwards and associated formations based upon the presence or absence of stylolites, which form in carbonate rocks under known subsurface conditions, including depth related to pressure.

The Late Cretaceous through Tertiary geologic history of the Central Texas Platform may be summarized as follows:

- a) Over the ~10 million years following the end of the Albian, the vast Edwards carbonate bank was mantled beneath a covering veneer of thin (<100 feet) early Cenomanian formations (Del Rio, Buda, and Eagle Ford–Boquillas) that did not eliminate the gentle depositional topography around the bank margins, and also did not cover some local highs along the bank margins.
- b) The western interior of the Central Texas Platform was covered by 700 to 1100 feet of open marine Austin Chalk (Santonian), Taylor Clay, and Navarro Marl (Campanian and Maastrichtian), and Midway Clay (lower Paleocene), which muted but did not obliterate depositional topography of the covered bank margins. The low-lying muddy bank was periodically exposed during this ~28 million year period, and meandering streams developed along its margins with surrounding very shallow pelagic seas.
- c) Upper Paleocene, Eocene, and Oligocene formations pinched out preferentially westward and northward onto the Balcones/Ouachita Downwarp, which coincided with the underlying Ouachita Thrust Belt and the future Balcones Fault Zone. Throughout this period (~37 million years), the exposed, low-lying bank (adjacent to coastal plain and fluvial-deltaic depositional tracts) began to be gently uplifted. This

allowed subaerial erosion to begin, of surficial Eocene sediments as well as the mantle of lower Paleocene and Upper Cretaceous soft mudrocks and marls. Gradual entrenchment of incised streams around the bank margins also occurred.

d) Beginning in late Oligocene time, the combination of accelerating gulfward downwarping and uplift of the interior resulted in increased exposure and erosion of the buried Central Texas Platform, until Georgetown and Edwards rocks began to be exposed and eroded, their detritus deposited in alluvial aprons on the adjacent coastal plain. Balcones faulting during the late Oligocene and Miocene (~23 million years) marked the culmination of uplift along the west and north side of the Balcones Fault Zone, and accelerated incision of existing streams, especially around the margins.

e) Continued regional uplift of the Colorado Plateau during late Miocene and Pliocene (~8 million years) elevated the western margins of the exposed Edwards carbonate bank, tilting the Plateau surface gently toward the southeast. Headward erosion from east and south began to cut into the high-standing carbonate mass. Streams feeding outward from the Plateau constructed sloping gravel aprons composed of carbonate and chert debris onto the coastal plain. So far, approximately 9300 cubic miles of rock has been eroded from the Edwards Plateau, Llano Uplift, Hill Country, and upper Gulf Coastal Plain as the result of Tertiary uplift and Balcones faulting, with such erosion continuing today.