Integrated stratigraphy of the Austin Chalk (Coniacian – early Campanian) in south Texas: unravelling tectonic control on depositional geometries

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Sediments of the Austin Chalk Group were deposited during the Coniacian – early Campanian on the northern margin of the proto-Gulf of Mexico. Although chalk deposits typically consist of fine-grained material deposited in low energy conditions, the integration of outcrop and subsurface data from Bexar County illustrates large-scale lateral heterogeneities of individual beds that are capped by discontinuity surfaces. The goal of this research is to understand the mechanisms behind lateral thickness variations and formation of stratigraphic discontinuities within chalk deposits, in order to update depositional models that help to predict lateral and vertical heterogeneities within chalk reservoir architecture.

The lower Austin Chalk consists of argillaceous chalk with finely abraded skeletal material separated by thin marl stringers and contains numerous shallow channel-cut features. The presence of extensive shell lag deposits, high energy facies, and lateral thickness variations of chalk beds within the upper Austin Chalk indicates a change in depositional regime influenced by relative sea level change or other paleoenvironmental conditions. The correlation of gamma ray profiles of measured outcrops to geophysical logs of water wells drilled through the Austin Chalk Group in Bexar County enhances the stratigraphic framework within the study area. This is complemented by the chemostratigraphic ($d^{13}C$) correlation of the succession of the Bexar County to well-dated reference sections, whereas the paleoenvironmental conditions that led to periodic non-deposition of chalk and formation of stratigraphic discontinuities were traced using geochemical proxies measured by X-ray fluorescence spectrometry.

The improved stratigraphic framework reveals that the lower Austin Chalk thins from Bexar County across the San Marcos Arch, while the upper Austin Chalk thickens from Bexar County across the San Marcos Arch. Large-scale lateral thickness variations within the Austin Chalk Group could be induced by either local tectonic inversion around the San Marcos Arch or contour parallel bottom currents involved in the redeposition of the chalk sediments. Depositional geometries of the Austin Chalk Group in Bexar County are heavily influenced by interplay of tectonic and paleoenvironmental forces under periodic high-energy conditions during periods of relative low sea level.