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The Cretaceous–Paleogene (K–P) boundary at Brazos, Texas: Sequence stratigraphy, depositional events and the Chicxulub impact

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Abstract

Two cores from Brazos, Texas, spanning the Cretaceous–Paleogene (K–P) boundary, are investigated by a multidisciplinary approach aiming at unraveling environmental changes and sequence stratigraphic setting. In addition, the sedimentology of the K–P event deposit and its correlation with the K–P boundary is studied. Foraminifera and nannofossil stratigraphy indicates that both cores include a latest Maastrichtian (Zone CF1–CF2) and earliest Danian (P0, Pα and P1a) shale sequence with a sandy and Chicxulub ejecta-bearing event deposit at the K–P boundary; a hiatus of unknown duration may be present by the unconformable base of the event deposit. Planktic foraminifera as well as calcareous nannofossil abundance and diversity both decline abruptly above the event deposit (K–P mass extinction), whereas benthic foraminifera show a pronounced faunal change but no mass extinction.

Mineralogical and geochemical proxies suggest that–except for the sandwiched K–P event deposit–no facies change took place across the K–P boundary and no evidence for adverse an- or dysoxic sedimentary conditions following the Chicxulub impact was observed. Therefore, the interval bracketing the K–P event deposit is considered as highstand systems tract. Increased coarse detritus input and low planktic/benthic (P/B) foraminifera ratios during the earliest Paleocene (P0 and Pα) both suggest an increased coastal proximity or relative sea-level lowering, although the K–P mass extinction of planktic foraminifera might have influenced the P/B ratios as well. Consequently, the sandy shales of the early Paleocene are considered as late regressive highstand or as lowstand deposit. During P1a, shales assigned as transgressive systems tract overlie a pyrite- and glauconite-rich bioturbated transgressive surface or type-2-sequence boundary. The smectite-dominated clay assemblage, with minor illite, kaolinite and chlorite indicates semiarid–humid climates with no obvious shifts across the K–P boundary. The magnetic susceptibility signature during the Maastrichtian reveals a subtle cyclic (or rhythmic) pattern, whereas a high-amplitude cyclic pattern is present during the early Danian.

The K–P event deposit shows a succession of high-energetic debris flows and turbidites derived from multiple source areas, followed by a period of decreasing current energy. Deposition was likely triggered by multiple tsunami or tempestites followed by a prolonged period of reworking and settling. The Chicxulub ejecta at the base of the K–P event deposit consists of Mg-rich smectite- as well as Fe–Mg-rich chlorite–spherules. Their mineralogical composition points to target rocks of mafic to intermediate composition, presumably situated in the northwestern sector of the Chicxulub impact structure. Besides these silicic phases, the most prominent ejecta components are limestone clasts, accretionary carbonate clasts, and microspar, suggesting that the Texas area received ejecta also from shallow, carbonate-rich lithologies at the impact site on the Yucatán carbonate platform. The excellent

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