

# EXTINCTION OF SCULPTURED NONMARINE BIVALVES ABOUT THE CRETACEOUS-TERTIARY BOUNDARY

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The record of freshwater bivalves (Unionidae) through the Late Cretaceous (K) and early Tertiary (T) is marked by times of high and low diversity. A demarcation between one such transition from high to low diversity appears coincidentally at or just below the K/T boundary. Where best documented in the Montana, in the western portion of the Williston Basin, freshwater mollusks are abundant in fluvial channel systems. In uppermost Cretaceous strata, molluscan faunules are generally dominated by freshwater bivalves, including thick-shelled clams of both simple (*Plesielliptio*, *Rhabdotophorus*) and complex surface sculpture, and nonovate to trigonal shell shapes (*Proparreysia*, *Plethobasus*, *Pleurobema*, *Obovaria?*). Apparently, as in the distribution of dinosaurs, highly sculptured and/or trigonal-shaped unionids occur abundantly throughout the Hell Creek Formation but are absent in strata within a few meters or less of the K/T boundary.

Throughout the Williston Basin and elsewhere in the Western Interior, Paleocene freshwater bivalves, and nonmarine mollusks in general have been found, but only at a few localities that contain depauperate faunules. The only unionids found to date in the Tullock or Ludlow Formations of the Fort Union Group are ovate-elongate in shape and are simply sculptured with concentric (nonchevron) umbonal corrugations (*Plesielliptio*) or dorsal postumbonal dorsally directed curvilinear ridges (*Rhabdotophorus*) or are without sculpture ("*Unio*"). This dramatic faunal change and the reduction in abundance were long lasting. Freshwater bivalve localities remain relatively uncommon until the late middle Paleocene (late Torrejonian). Simple sculpture and shell form persisted throughout the Paleocene and into the Eocene, and unionid diversity remained low.

This change in faunal composition of unionids is presently not ascribable to a K/T bolide event. What molluscan record exists just below the boundary suggests a Paleocene faunal composition, but these occurrences are rare and possibly environmentally influenced. In North Dakota, beginning at least by the early Paleocene (middle Puercan) and extending into the middle Paleocene (middle to late Torrejonian), transgressive-regressive pulses of the Cannonball Sea (Cannonball Formation), representing the last epeiric sea in central North America, undoubtedly influenced the stability of freshwater habitats throughout the Williston Basin and elsewhere. Similar movements of the sea in the Upper Cretaceous, especially rapid transgressive events, are associated with significant changes in molluscan faunal composition. Diversification is concomitantly associated with well-marked regressions.

The final retreat of the Cannonball Sea, probably in the early part of the late Paleocene (early Tiffanian), is associated with an important increase in species richness during the middle Tiffanian (Ti3). Freshwater snails within well-established Cretaceous families diversify. In the northern plains, this fauna is that basically described by F.B. Meek and F.V. Hayden in the 1850s and '60s for the Fort Union Group. Even with excellent preservation and numerous localities, unionids during the Paleocene are represented by only a few species of simple sculpture and form, a morphology and condition that persists throughout much of the Tertiary.