

Evidence for a Widespread Tsunami Deposit Within the Upper Devonian Three Forks Formation of North Dakota and Montana-A Possible Impact-Related Event

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The Upper Devonian (Famennian) Three Forks Formation of North Dakota and Montana has been characterized predominantly as shallow marine, variably sandy carbonate ramp or platform deposits (evaporative tidal flats/mudflats, shallow platform packstones/grainstones, sabkhas, redbeds) by multiple authors. A distinct, anomalous, regional-scale, gamma ray marker zone is sandwiched between the Upper Three Forks Formation Torquay Member (predominantly tidal flat/mudflat laminites) and underlying carbonates composed of thinly interbedded tidal flat, shallow platform, and redbed deposits. The anomalous layer ranges from approximately 12 to 18 feet in thickness, and includes layers of chaotic, mud-rich carbonate breccias, mud-rich carbonate breccias that crudely fine upward, and massive to faintly burrowed carbonate mudstones. The breccia matrix is predominantly a grey-green argillaceous dolomudstone with anomalously high iridium concentrations. Clasts within the breccias are polymictic, generally poorly sorted, and angular to subangular in shape. The anomalous layer has an appearance of chaotic, stacked, deepwater carbonate debris flows and suspension deposits. However, proximity to shallow evaporitic carbonates makes this interpretation problematic. The presence of elevated iridium concentrations within a widespread debris-rich layer suggests these beds are related to a mega-tsunami generated by an impact event in the late Devonian. In addition, grey-green laminations within the overlying Torquay Member are also enriched with iridium, and may represent dust layer fallout related to documented smaller impact events within this timeframe.