Delta Asymmetry and 3-D Facies Architecture of a Mixed-Influenced Parasequence, Ferron Notom Delta, Capital Reef, Utah, USA

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Delta asymmetry forms where there is strong wave influence and net longshore transport. Morphology and facies of the updrift and the down drift sides of asymmetric deltas are predicted to be quite different, which is significant for exploration of hydrocarbons. Delta asymmetry has been widely recognized in modern systems. In the ancient record, however, there are only very few documented examples. Based on an integrated sedimentological and ichnological study, we document the 3D facies architecture within a single parasequence in the Cretaceous Ferron Notom delta, Utah and provide the first well-documented example of delta asymmetry in the ancient record.

Two discontinuity surfaces are recognized in the studied parasequence 6 (Ps6), which subdivided the parasequence into three bed sets, marked as Ps6-1 through Ps6-3. Ps6-3 consists predominately of river-dominated facies. Within Ps6-1 and Ps6-2, however, there is a clear along-strike facies transition from shoreface in the north, into much heterolithic river-dominated delta-front facies southeastward, and into wave/storm-reworked facies further southeastward. Ichnogenera correspondingly show distinct along-strike changes from robust and healthy archetypal Cruziana and Skolithos ichnofacies into a suite characterized by horizontal, morphologically simple, facies-crossing structures of the suppressed Skolithos and Cruziana ichnofacies. Further southeastward suites show higher abundance and diversity, reflecting the archetypal ichnofacies.

The overall facies distribution and paleogeography within the parasequence suggest delta asymmetry, with net longshore transport from north to south. The asymmetric delta consists of sandier shoreface in the updrift side and mixed riverine and wave/storm-reworked facies in the downdrift side, similar to many modern examples. However, in contrast to the recent delta asymmetry models, significant paralic, lagoonal, and bay-fill facies are not documented, because of both negative shoreline trajectory during delta progradation and transgressive erosion.

The field example documented here, coupled with the abundance of modern examples, indicates that delta asymmetry should be more common in the rock record than has been identified. Careful documentation of along-strike facies variation and involving regional stratigraphic and paleogeographic control are critical to separate asymmetric deltas from other wave-influenced depositional systems in the rock record.