# Forum Comment

doi:10.1130/ G37231C.1

## Supercritical-flow structures on a Late Carboniferous delta front: Sedimentologic and paleoclimatic significance

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Ventra et al. (2015) propose a model of hyperpycnal supercritical flow regime deposition, related to a megamonsoonal climate, for a series of interpreted cyclic steps on a Carboniferous delta-front. The new model has major implications for paleoenvironmental reconstructions of this well-studied area, in terms of climate and geographical setting. We contend that fundamental sedimentological observations do not support their proposed model.

Ventra et al. interpret that each cross-bedded 'set' is the deposit of a single mega-monsoonal flood event; we propose that each set represents multiple events; e.g., their Set 3 is at least 30 discrete events. Event bed sandstones are represented by variable to normal grading, crude cross-stratification and plane-parallel lamination, and a finer-grained top, which is generally ripple-cross laminated (Fig. 1). These are capped by a very thin, silty to fine-grained sand layer with abundant organic material, representing interflood deposition (Hampson, 1997). This repeated motif is only interrupted where bed tops are eroded. Abundant loading, dewatering and flame structures between beds and rip-up clast horizons support the interpretation of discrete depositional events (Fig. 1). A mega-monsoonal origin cannot be invoked for ~20-cm-thick beds. Ventra et al. state that there is a lack of ripple cross lamination or stratification, aside from some up-flow dipping crude laminae. Most bed tops are laminated to cross-laminated (Fig. 1). These are interpreted as current ripples, rather than antidunes or climbing ripple backsets, as they have clearly developed tangential foresets. These ripples suggest paleoflow broadly toward the east, in contrast to the overall southwesterly paleoflow. Eastward paleocurrents typically occur on the updip side of the 'undulatory beds' of McCabe (1977) and Hampson (1997), suggesting that the exposed section is oblique to depositional dip, rather than parallel as proposed. We infer that there is a significant lateral, as well as downstream, accretion component to these three-dimensional bedforms. The lack of bioturbation between beds cannot be used as evidence for the short duration of events, as there is, in general, a lack of bioturbational structures in the sandy marine sediments of the British Carboniferous Basins. However, the depositional environment as proposed by Ventra (marine delta-front) is at odds with the existing fluvial models, which are based on detailed mapping and correlations (McCabe, 1977; Hampson, 1997).

The large-scale architecture shows a progressive decrease in depositional dip that we interpret to reflect healing of scour-related topography. The depth of the scour (minimum of 13 m) corresponds to that observed in major fluvial confluences and is aligned with Hampson's (1997) interpretation. The overlying section, which Ventra et al. do not discuss, is represented by many smaller-scale trough cross beds, interpreted to represent local shallowing in a fluvial setting associated with filling of the scour. In this stratigraphic unit, features of a similar geometry but at a smaller scale are convincingly shown to represent supercritical flow conditions (Bijkerk, 2014).

In summary, we concur with the observations and interpretations of Hampson (1997) that these beds represent the fill of a major scour, potentially associated with a fluvial confluence, which filled in a stepwise manner, by gravity flow in the deepest parts, with periods of minor erosion of the downslope sides of the bedforms (e.g., Ullah et al. 2015).

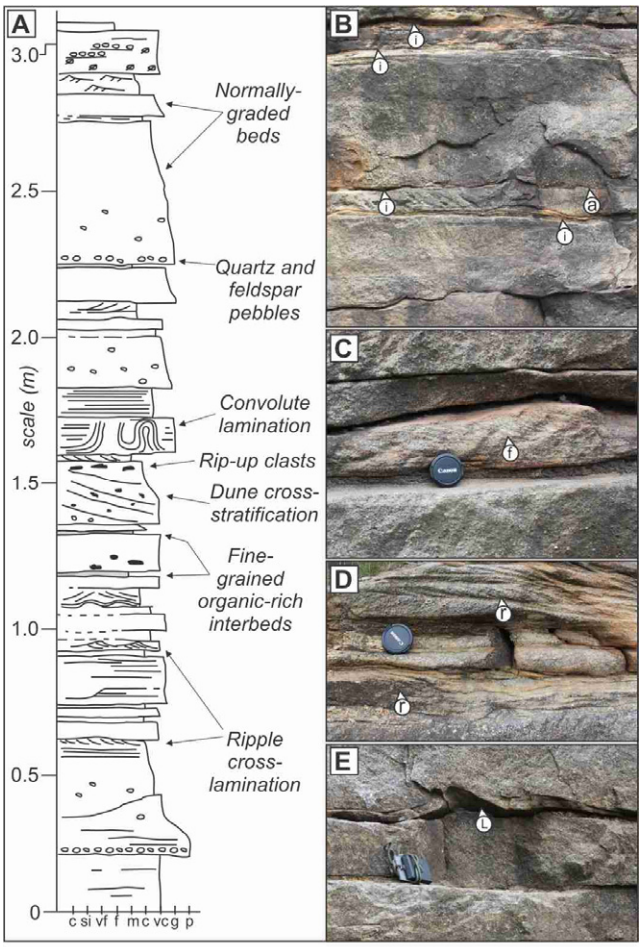


**Figure 1. A: Short sedimentological log (from the base of Ventra's [2015] 'Set 2') showing the general character of event beds. B: Character of event beds and finer interbeds (i) and amalgamation surfaces (a). C: Small dune with tangential foresets (f). D: ripple cross lamination (r) with tangential foresets. E: Loading (L) between beds.**

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Geology

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*Geology* 2015;43;e374
doi: 10.1130/G37231C.1



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