

MEANDERING CHANNELS: DETECTING FRESHWATER AND BRACKISH-WATER CONDITIONS FROM THE ICHNOFABRIC APPROACH

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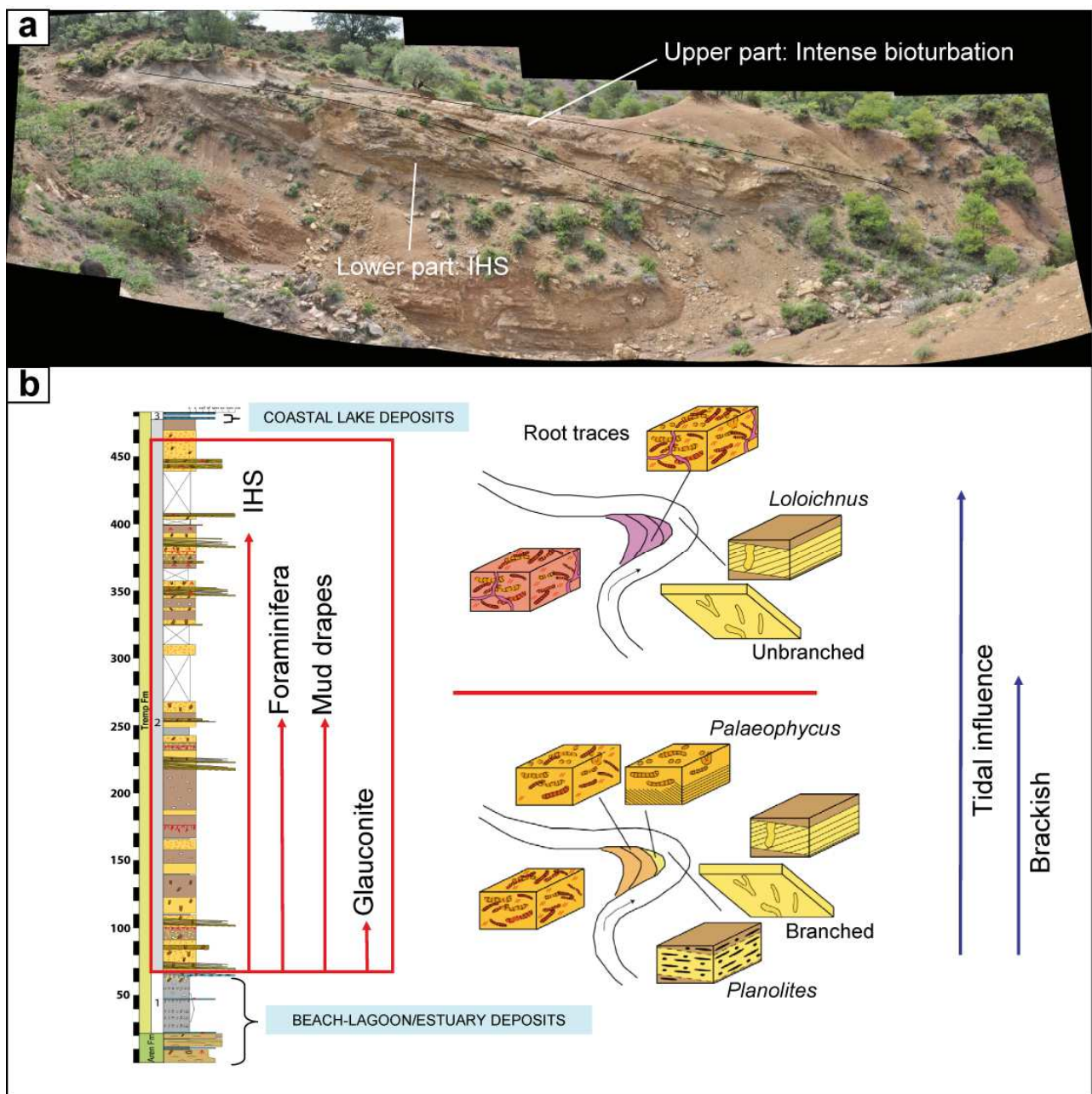
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Meandering channels occur in fluvial environments but also are common in coastal settings, where they can be modulated by the action of tide and/or waves, and affected by salinity fluctuations. Because tidal and wave-generated features are not always preserved and some of these structures may occur in more than one environment (i.e. inclined heterolithic stratification in fluvial, estuarine and open-marine settings), accurate interpretations of the depositional setting of meandering channels can be difficult using only physical sedimentology. However, by means of the ichnofabric approach, it is possible to distinguish between a continental or a marginal-marine setting and also to differentiate the associated subenvironments in order to delineate complex facies mosaics. This study is based on the Upper Cretaceous deposits of the Tresp Formation in South-Central Pyrenees (Spain), which record sedimentation in a meandering channel system located close to the shoreline. These deposits have been considered as formed in a fluvial-freshwater system (e.g. Vila et al., 2013) but signatures of marine/tidal influence have been documented as well (Díaz-Molina, 1987; Díez-Canseco et al., 2013). The meandering channel deposits of the Tresp Formation outcrop along a 300 m stratigraphic section, displaying numerous examples of their depositional geometry and the detailed distribution of their sedimentological and ichnological attributes (Figure 1a).

The ichnofabric approach has been integrated with detailed sedimentological data (Figure 1b) and has allowed to identify eight ichnofabrics located at the lower part and the upper part of the point bars and in the overbank area. The ichnofabrics of the lower part of the point bars are dominated by dwelling structures with a low bioturbation index, which suggest high-energy conditions. On other hand, the ichnofabrics of the upper part of the point bars and of the overbank area are dominated by feeding structures, typically represented by *Taenidium* isp. with moderate to high bioturbation index, suggestive of low-energy conditions. The eight ichnofabrics are grouped in two main ichnofabrics assemblages, reflecting freshwater and brackish-water conditions (Figure 1b). Both ichnofabric assemblages show common features related with its location in meander loop deposits (i.e. high- and low-energy ichnofabrics or overbank ichnofabrics with high index of bioturbation) and also specific characteristics associated with the salinity conditions (e.g. dominant ichnotaxa, distribution and abundance of root trace fossils). The brackish-water ichnofabric assemblages (observed in the lower part of the studied section, Figure 1b) occur in the upper estuarine channels seaward of the maximum salinity limit, while the freshwater assemblages of the upper part of the section occur landward of the maximum salinity limit (see Mangano & Buatois, 2004).

The ichnofabric approach allows a more accurate understanding of the sedimentary system recorded in the Tremp Formation. The estuarine channels of this unit can be compared with the channel-fill deposits present in the Mc Murray Formation of Alberta (i.e. Pemberton et al., 2001). Although physical attributes are similar in both units, our ichnofabric analysis shows a more proximal emplacement for the Tremp Fm channels, displaying clear evidence of freshwater conditions, which have not been recorded in the estuarine point-bar deposits of the Mc Murray Formation.

Figure 1.- a) Meandering-channel deposits of the Tremp Formation. The outcrop displays the geometry of the two point-bar bodies and the distribution of the sedimentological and ichnological features. b) Integration of the sedimentological data with the ichnofabric approach. Two ichnofabric assemblages are identified, the lower corresponding to brackish-water conditions and the upper to freshwater conditions.



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