New insights on the regional architecture and dynamics of mixed fluvio-aeolian deposits from Middle Buntsandstein in the southern margin of the German Basin

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Résumé

During the Lower Triassic, the German Basin in central Europe was bordered by the London-Brabant Massif, the Fennoscandian High, and the Bohemian Massif. This endorheic basin experienced an overall arid climate punctuated by humid phases enhancing runoff from adjacent highlands. Perennial and ephemeral fluvial systems are believed to have occurred across arid alluvial plains in the southern margin of the basin, with interbedded aeolian sediments preserved.

In north-eastern France (southern margin of the basin), well-preserved Lower Triassic continental sandstones allowed us to undertake a detailed sedimentological analysis based on outcrops and core data spanning the Middle Buntsandstein. Three main facies associations can be distinguished, mainly based on sediment transport processes: (i) fluvial facies-amalgamated cross-bedded pebbly to fine sandstones interpreted as long-lasting or episodic river systems, (ii) mixed fluvio-aeolian facies-splays deposited attributed to ephemeral lakes or playas deposits, and (iii) pure aeolian facies-dune and sand-flat deposits supposedly deposited in dry or damp interdunes.

This study focuses on a sub-basin inherited from the Saar-Nahe Carboniferous-Permian basin. A presumed paleo-fairway, bordered by the Bohemian and Rhenish massifs and the

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Variscan belt to the south, guided sediment transport and accumulation. Our dataset includes a new 140 m-long core within the lowermost part of the succession located in Freyming-Merlebach and a 2 km-long quarry outcrop with a Digital Outcrop Model, the Barrois quarry, within the uppermost part of the succession. Within the fairway, the Middle Buntsandstein succession transitions from proximal fluvial conglomerates to aeolian and playa sandstones, reflecting variations in aridity. After a maximum of aridity recorded with playa and aeolian deposits, fluvial systems were reactivated, followed by a major conglomerate progradation and topped by paleosoils unevenly truncated by the Hardegsen Unconformity. Our study provides a west-to-east regional-scale log correlation using 3 regional key wells and our new dataset. This transect shows that during arid periods, preserved dune fields are located mainly in the west while playa-type deposits are dominant in the east. These facies variations suggest spatial and temporal facies partitioning due to climate changes and basin morphology, offering insights into the dynamic evolution of the basin under fluctuating environmental conditions.

Mots-Clés: Middle Buntsandstein, Fluvial and eolian deposits, Sedimentary architecture, Cyclicity of deposits, Preservation factor