Abstract

Upper Mississippian organic-rich mudstones from Germany, the Netherlands, and Belgium belong to the least known lithology in the entire Carboniferous rock record of NW Europe. They are assumed to be classic examples of hemipelagic quiet water deposits that are accumulated under anoxic bottom water conditions. Facies variability and sedimentological constraints of these fine-grained sediments (i.e. Chokier Formation, *Actinopteria* Black Shale Event, and Geverik Member/ Epen Formation) are identified on the basis of detailed rock descriptions and thin section petrography. In total, over 400m of stratum have been logged on a centimeter scale. To circumstantiate the conclusions drawn from thin section petrography, a multidisciplinary approach has been followed. This approach comprises scanning electron microscopy, palaeontology, X-ray diffraction, organic geochemistry (TOC, VR, TS), and X-ray fluorescence.

Thin section data demonstrates that, in spite of their macroscopic homogeneity, investigated mudstones are microscopic heterogeneous, independent of their location and stratigraphy. Assumed anoxic conditions cannot be confirmed for the majority of the strata. A restricted ichnofabric, indicated among others by *Planolites*, *Teichichnus,* and cryptobiode-formational structures, hints that at least dysoxic conditions were temporarily favored within specific intervals. However, apart from the oxygen content of the unconsolidated sediment, alteration of textural features depends on the ratio of bioturbation rate to sediment accumulation rate.

Concerning the depositional mechanisms, which caused the formation of the different mudstone facies, it can be shown that sedimentation by settling from the water column is of minor importance for the majority of mudstones under consideration. In contrast, relatively rapid sedimentation by swift moving bottom currents dominates the depositional environment. Due to a common microfabric, the ‘lenticular fabric’, it has to be stressed that the Namurian organic-rich mudstones from the NW European Carboniferous Basin of Belgium and the Netherlands have a common genetic history. These mudstones are the result of erosion and redeposition of soft mud clasts, and they confirm bed-load transport by currents as an important mechanism for this Variscan foreland basin. Moreover, contemporaneous greywacke sheds in more proximal parts of the basin, caused by the rising Variscan orogeny, might indicate that these accumulations can be regarded as their distal fine-grained equivalents. Thus, these ubiquitous features for the Namurian mudstones contradict

the classic models for the deposition of organic-rich mudstones, which imply sedimentation by pelagic rain and anoxic bottom-water conditions. In conclusion the depositional mechanisms causing the formation of the investigated mudstones are much more diverse, complex and dynamic, and are often interrelated.

In addition, this study shows that accumulation of the few meters thick upper Viséan *Actinopteria* Black Shale Event of the Rhenish Mountains, which is intercalated in a calciturbuditic succession, is controlled by current-driven micro-event deposits. Compareable to the Namurian mudstones from Belgium and The Netherlands, deposition by settling from the water column is of minor importance for this important isochronous marker horizon. Preservation and enrichment of the eponymous bivalve *Ptychopteria (Actinopteria) lepida* is caused by non-erosion. Previously, the *Actinopteria* Shale was only known from the Rhenish Mountains and the Harz Mountains. Petrographic investigations and detailed rock description indicate that it also occurs within the subground of the Netherlands.

Although the use of additional methods depends on the questions being asked and resulting scale of investigation, these results show that a multidisciplinary approach is greatly beneficial when interpreting data derived from thin section petrography.