TAPHONOMY AND DEPOSITIONAL ENVIRONMENTS OF FOSSIL PLANT ASSEMBLAGES FROM TABULAR CARBONACEOUS SHALES OF THE BIGHORN BASIN, WYOMING

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Alluvially deposited carbonaceous shales preserve the majority of floral assemblages from the Tertiary of western North America and have the most continuous stratigraphic distribution of any plant fossil-bearing depositional environment. They are a major source of data on floral composition, paleoclimate and paleoecology but their formation is poorly understood and has been rarely documented. We have studied three laterally extensive examples from the late Paleocene-early Eocene of the Bighorn Basin, Wyoming in terms of their sedimentology and plant taphonomy. These carbonaceous shale deposits consist of a complex and variable arrangement of six inter-fingering sub-facies that pinch in and out along strike. This small scale lateral heterogeneity reflects the original mosaic of backswamp sub-environments. The sub-facies vary in both the state of preservation and amount of plant fossil material they preserve but in general contain assemblages of similar floristic composition. Preservation of plant material was dependant on local, edaphic conditions with destruction in more oxidised, bioturbated sub-environments and preservation in sub-environments that were more reduced or received more rapid sediment coverage. It is evident that there was minimal incorporation of plant material into backswamp environments from more proximal areas, even during crevasse splays, and that fossil leaf assemblages in carbonaceous shales reflect backswamp vegetation regardless of the sub-facies in which they are found.

We hypothesize that formation of carbonaceous shales was facilitated by a raised water table on a relatively impervious but vegetated substrate. The rising water table drowned vegetation, initiating build up of organic material and deposition of organic-rich beds under oxygen-reduced conditions. Variation in edaphic conditions allowed plant colonization and immature soil formation in higher, drier areas of the backswamp. Wetter areas were sparsely colonized by plants with special adaptations to waterlogging such as laterally extensive rooting systems whih did not penetrate the substrate. Incursions of fine grained sediments, as distal portions of crevasse splay events, formed lenses and discontinuous beds that incorporated and preserved plant material of similar character to that in the more organic-rich beds. In some cases splays also became colonized and were bioturbated. Carbonaceous shale formation ceased when avulsion of the main channel on to distal areas of the flood plain initiated coarser grained deposition and preservation of fossil leaf assemblages with a more riparian aspect. Comparison with modern rates of peat deposition and consideration of autocyclic avulsion rates for the early Tertiary fluvial systems of the Big Horn Basin suggests that an individual carbonaceous shale unit formed over a maximum of 2,000 years. Sub-facies containing a single fossil plant assemblage represent only a fraction of this time, in the order of hundreds of years.

We conclude that deposition of plant fossils in these distal alluvial settings is autocthonous, providing spatially and temporally well constrained "snap shots" of vegetation that originally grew on the distal alluvial flood plain. We can thus confidently use fossil plant assemblages preserved in tabular carbonaceous shales to reconstruct Tertiary paleoecological, paleoflorisitc and paleoclimatic conditions.