Pennsylvanian emergence of anabranching fluvial deposits: the parallel rise of arborescent vegetation and fixed-channel floodplains

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Anabranching (anastomosing) rivers are low-energy fluvial systems consisting of multiple channels separated by stable islands which evolve over time through avulsion. Such river systems host a variety of terrestrial sub-environments and habitats that have been relatively common during the Mesozoic and Cenozoic and into the present day. Anabranching requires bank stability, usually provided by vegetation or cohesive floodplain muds, both of which were prominent in the fluvial realm by the Siluro-Devonian. However, based on a literature review of 144 Cambrian–Devonian and 188 Carboniferous fluvial successions, facies interpreted as anabranching river deposits do not appear in abundance until the Pennsylvanian (Bashkirian).

Original field data from Carboniferous fluvial strata in Atlantic Canada and the SW USA support the assertion that a distinct suite of fluvial facies and sandbody geometries, still apparent in recent anabranching fluvial deposits, makes its first appearance at about this time. The channel deposits are narrow (width: thickness typically <15) with steep margins and aggradational fills, with little evidence for lateral accretion, and encased in floodplain muds with paleosols. Although it is rarely possible to demonstrate that the parent channels formed 3D networks, it is probable that some suites were anabranching. Although a few small, narrow channel bodies are known from Devonian and Mississippian formations, this "fixed-channel" style is conspicuously absent from older fluvial formations but is widespread from the Pennsylvanian onwards.

It is argued that the seemingly delayed appearance of this fluvial style in part reflects the infrequency of repeated short-term triggers for avulsion prior to a threshold-crossing increase in arborescent floodplain vegetation. The increase in arborescent vegetation through the Carboniferous would have resulted in an increase in the size, abundance, and distribution of large woody debris in fluvial channels. Such debris would have provided, for the first time, one of the most common triggers for river avulsion; as demonstrated by the fact that large log-jam deposits also first appear in the rock record during the Bashkirian.

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