Lower Palaeozoic alluvial systems: the sedimentological impact of evolving vegetation in terrestrial environments

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In present-day alluvial environments, the impact of vegetation on sedimentological processes and deposits is well known. A vegetated catchment may decrease sediment yield, sediment erodability, Hortonian overland flow, aeolian winnowing of fines, the proportion of sediment transported as bedload, may increase bank stability, infiltration into substrates, bed roughness, and can promote the production of chemically-weathered clays and soils and the adoption of a meandering style. As such it is generally understood that, prior to the evolution of terrestrial vegetation during the Lower Palaeozoic, ancient alluvial systems were markedly different from modern systems, with many systems adopting a "sheet-braided" style. This understanding has previously informed the interpretations of many Precambrian pre-vegetation alluvial successions, but there has been relatively little work regarding Lower Palaeozoic alluvial successions that existed during the active colonization of terrestrial substrates by plants.

In this study, a comprehensive review of 141 Cambrian to Devonian alluvial successions documented in published literature was combined with original field data from 20 alluvial successions from across North America and Europe (including locations in New Brunswick and the Gaspé Peninsula), in order to identify changes in the sedimentary style of alluvial strata while vegetation was evolving and colonizing alluvial environments. This approach has established clear trends indicating an increase in mudrocks and sandstone maturity, and a decrease in overall sand grain size through the Lower Palaeozoic, suggesting that primitive vegetation cover was able to promote the production and preservation of muds and increase the residence time of sand-grade sediment (and thus sediment reworking) in the alluvial system. It has also enabled the first stratigraphic occurrence of certain vegetation-dependent sedimentary features to be pinpointed and tied directly to the onset of specific evolutionary adaptations recorded in the palaeobotanical fossil record. Examples of these include the first markedly heterolithic alluvial sequences (which first appear at the same time as the most primitive vegetation), pedogenic calcite (which appears at the same time as the first vascular plants), and vertisols, coal, and lateral accretion surfaces (which only appear after the evolution of deep rooting).

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