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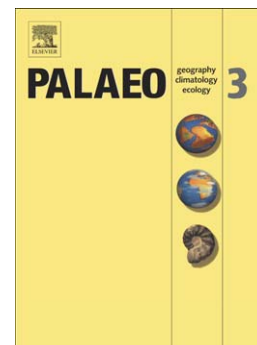
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## The terrestrial landscapes of tetrapod evolution in earliest Carboniferous seasonal wetlands of SE Scotland

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### ABSTRACT

The Lower Mississippian (Tournaisian) Ballagan Formation in SE Scotland yields tetrapod fossils that provide fresh insights into the critical period when these animals first moved onto land. The key to understanding the palaeoenvironments where they lived is a detailed analysis of the sedimentary architecture of this formation, one of the thickest and most completely documented examples of a coastal floodplain and marginal marine succession from this important transitional time anywhere in the world. Palaeosols are abundant, providing a unique insight into the early Carboniferous habitats and climate.

More than 200 separate palaeosols are described from three sections through the formation. The palaeosols range in thickness from 0.02 to 1.85 m and are diverse: most are Entisols and Inceptisols (63%), indicating relatively brief periods of soil development. Gleyed Inceptisols and Vertisols are less common (37%). Vertisols are the thickest palaeosols (up to 185 cm) in the Ballagan Formation and have common vertic cracks. Roots are abundant through all the palaeosols, from shallow mats and thin hair-like traces to sporadic thicker root traces typical of arborescent lycopods.

Geochemical, isotope and clay mineralogical analyses of the palaeosols indicate a range in soil alkalinity and amount of water logging. Estimates of mean annual rainfall from palaeosol compositions are 1000–1500 mm per year. The high mean annual rainfall and variable soil alkalinities contrast markedly with dry periods that developed deep penetrating cracks and evaporite deposits. It is concluded that during the early Carboniferous, this region experienced a sharply contrasting seasonal climate and that the floodplain hosted a mosaic of closely juxtaposed but distinct habitats in which the tetrapods lived. The diversification of

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