



Paleoenvironments of Early Devonian plants and fish in the Campbellton Formation, New Brunswick, Canada: invasion of the land at a classic locality

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The Campbellton Formation has long been recognized for an unusually well preserved assemblage of early plants, arthropods, and fishes, as well as some of the world's oldest coals. It represents an Early Devonian (Emsian) subtropical terrestrial environment in an intermontane setting during the Acadian Orogeny. However, paleoenvironments as revealed by a detailed sedimentological approach have not been determined. The formation developed above 6 km of Lochkovian and Pragian volcanics, from which nearly all detrital material within the Campbellton Formation has likely been derived. The contact with these volcanics can be seen as fissured rhyolite that was submerged and buried by micritic mudstone containing plants, spores, ostracods, gastropods, fish, and eurypterids. Plants fossils including representatives of the rhyniophytes, lycopsids, trimerophytes, and zosterophylloids were predominantly preserved in lakes and fluvial floodplains. Marginal lake deposits contain well preserved plants in coarse volcaniclastic siltstones with intensive alteration of feldspars to kaolinite. No roots were observed, but the excellent preservation suggests that the plants were preserved close to their growth position. Interbedded conglomerates suggest that the lakes occupied a steep-sided valley where high sedimentation rates promoted rapid burial of plant material. Deep lake deposits include massive and laminated siltstones with abundant but poorly preserved plant fragments, likely preserved where anoxic conditions developed under stable stratification. A few coals up to 10 cm thick consist of stacked cuticle material, and are probably drifted accumulations in shallow water. Fluvial sandstones and conglomerates contain comminuted plant material, and associated shales have abundant and well preserved plant material but lack much alteration of feldspars to kaolinite, although chlorite is present. Plant diversity in floodplain shales is greater than in the marginal lacustrine setting. Terrestrial arthropods are rare but scorpions, millipedes, and *Eoarthropleura* have been found in fluvial beds. One fluvial interval contains root traces; however soils are thin and immature. Thick alluvial cobble-boulder conglomerates, attributed to debris flows and hyperconcentrated flows in proximal settings, contain sandy lenses with plant material, as well as reported clasts of the giant putative fungus *Prototaxites*. Although this Emsian formation yields little evidence of rooted in-situ assemblages, plants are abundant and they and other organisms were adapted to a wide range of lowland and basin-margin environments, including proximal gravelly systems.