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LATE CARBONIFEROUS TROPICAL FIRE ECOLOGY: EVIDENCE FROM EASTERN CANADA

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ABSTRACT. The facies distribution and botanical identity of Upper Carboniferous (Westphalian A-D) charcoal is described from four sites (Boss Point, Joggins, Clifton and Sydney) in Eastern Canada. These successions represent alluvial/coastal plain deposits. Two charcoal assemblages occur. Assemblage (1) consists of channel sandstone bodies containing cordaite and conifer wood charcoal. This assemblage records extra-swamp coniferopsid forest fires. Assemblage (2) consists of thin coals containing lepidodendrid tree stumps. Many of these stumps contain a 1–3 cm thick basal layer, composed entirely of lepidodendrid periderm charcoal. Lepidodendrid and medullosan charcoal is also scattered around the outside of these stumps. This assemblage represents fire in lowland peat-forming communities.

KEY WORDS: fire, fusain, charcoal, Carboniferous, Westphalian, ecology, conifer, lepidodendrid, Canada, Joggins

INTRODUCTION

The occurrence of wildfire can be recognised in the geologic past by the presence of fossil charcoal (fusain) incorporated into sedimentary rocks (Scott 1989). Fossil charcoal exhibits exceptional anatomical preservation allowing burned taxa to be accurately identified (Scott 1989). Charcoal is common in Upper Carboniferous rocks (Scott & Jones 1994). However, in spite of the evident importance of fire during the Late Carboniferous, very little is known about which plant communities were prone to fire (DiMichele & Phillips 1994, Falcon-Lang 1998a, 1998b). This study examines the facies distribution and botanical identity of charcoal within Late Carboniferous (Westphalian A-D) rocks in Nova Scotia and New Brunswick in order to address this question.

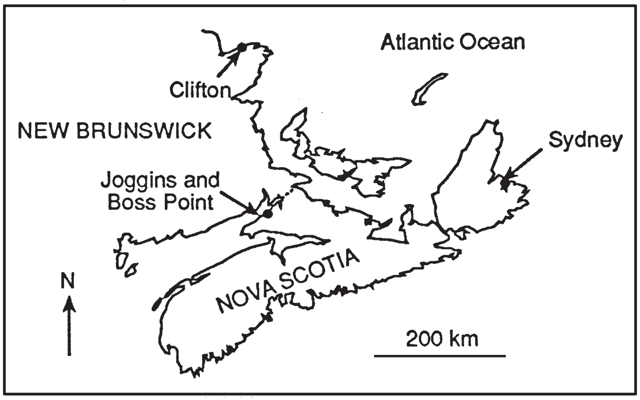

Fig. 1. Location details of studied sites

STRATIGRAPHY AND SEDIMENTARY FACIES

The four sites studied were Boss Point (Westphalian A), Joggins (Westphalian A-B), Clifton (Westphalian C) and Sydney (Westphalian D, Fig. 1). These sequences were laid down in alluvial and coastal plain settings. Two main charcoal-bearing sedimentary facies were recognised. Facies 1 consisted of channelised sandstone bodies. These were interpreted as the product of small-to-large anastomosing, meandering and braided river channels. Facies 2 consisted of green/grey mudstones containing 1–20 cm thick coals. These were interpreted as overbank clastic floodbasin deposits and short-lived peat mire deposits.

CHARCOAL ASSOCIATIONS

In Facies 1 (at all localities) charcoal consists almost entirely of large (0.5–10 cm), rounded fragments of pycnoxylic coniferopsid wood. The most common wood-type consists of tracheids (35–45 μm diameter) characterised by 4-seriate, alternately-arranged bordered pitting on the radial walls and unornamented tangential walls (Pl. 1, fig. 4). Uniseriate or biseriate parenchymous rays (2–55 cells high) are common (Pl. 1, fig. 5). This wood is classified as *Dadoxylon.* Locally, it occurs in biological connection with *Artisia* and thus is attributed to cor-

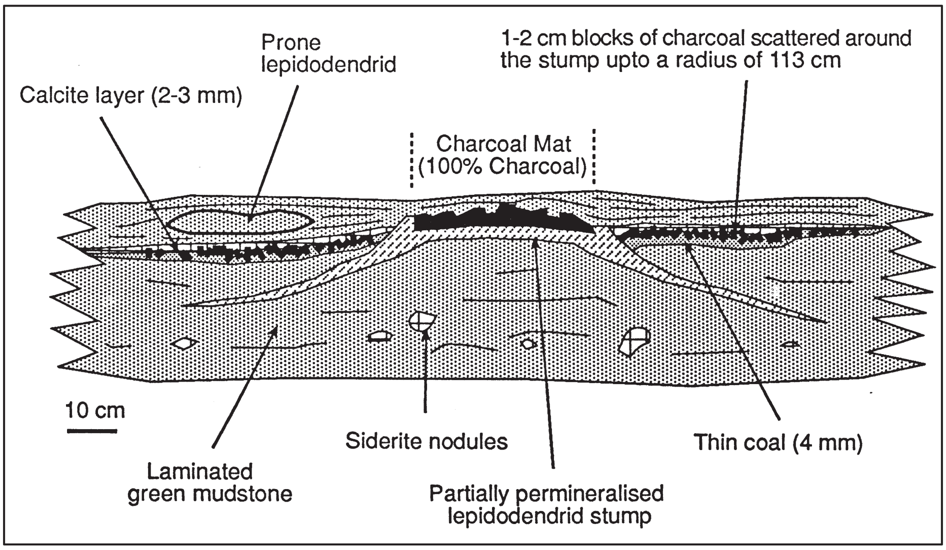

Fig. 2. Sketch of a lepidodendrid stump associated with charcoal in Facies 2 (Joggins)

daitean trees (Falcon-Lang 1998a). A rarer wood-type consists of tracheids (20 µm diameter) characterised uniseriate (rarely biseriate) bordered pitting on the radial walls and unornamented tangential. Parenchymous rays (1–8 cells high) are abundant. Cross-field pitting is cupressoid. Similar wood was described by Galtier *et al.* (1992) and is attributed with reservation to early conifers.

In Facies 2 (Joggins, Clifton and Sydney only) charcoal is commonly associated with lepidodendrid tree stumps, rooted in thin coal layers (Fig. 2). These stumps consist of a coaly bark rind surrounding a mudstone fill. Charred lepidodendrid periderm, occurs as a dense mat within the hollow base of many of these stumps (Pl. 1, fig. 1). This Charcoal Mat is composed entirely of detrital charcoal fragments, 1–2 cm in size, crushed together into a single block. These charcoal fragments consist almost entirely of blocks of lepidodendrid periderm (Pl. 1, fig. 2). Lepididendrid periderm and secondary wood charcoal (Pl. 1, fig. 3) and medullosan charcoal is also present outside the stumps, scattered within the coal in a dense layer distributed around the stumps.

INTERPRETATION OF FIRE-PRONE COMMUNITIES

Two fire-prone plant communities may be identified from the above data. Rounded cordaite/conifer charcoal fragments within the river channel deposits may have been transported downstream from extra-basinal (perhaps upland) coniferopsid forest fires (Falcon-Lang 1998b). In contrast, lepidodendrid-medullosan charcoal in coal layers represent *in situ* lowland forest-fire profiles. Mature lepidodendrid tree trunks consisted of a hollow cylinder largely composed of a thick periderm. The Charcoal Mat within the base of some of the lepidodendrid stumps was probably formed as this cylinder burned and charred material fell into the central hollow (Falcon-Lang 1998a). Charcoal outside the stumps suggests that a medullosan understorey also burned during these fires.

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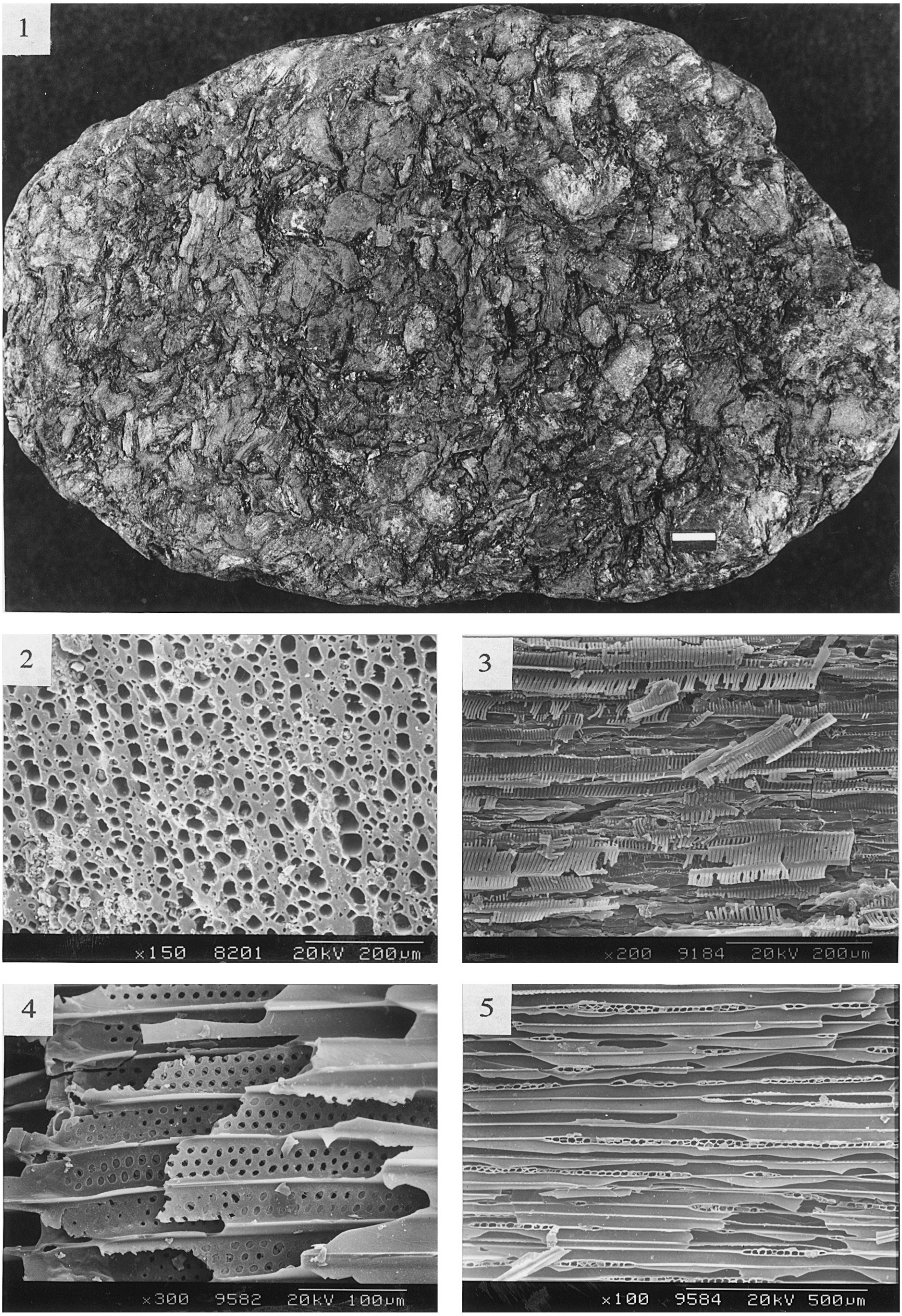
PLATE

Plate 1

1. Charcoal Mat taken from interior of lepidodendrid stump, Facies 2. Scale bar is 1 cm
2. Lepidodendrid periderm charcoal, transverse view, Facies 2 (SEM)
3. Lepidodendrid secondary wood, longitudinal view, Facies 2 (SEM)
4. *Dadoxylon* sp., radial view, Facies 1 (SEM)
5. *Dadoxylon* sp., tangential view, Facies 1 (SEM)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