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Anatomically-preserved tree-trunks in late Mississippian (Serpukhovian, late Pendleian–Arnsbergian) braided fluvial channel facies, near Searston, southwest Newfoundland, Canada

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ABSTRACT

Little is known of the Mississippian palaeobotany of Newfoundland, Canada. Here we improve this situation by describing anatomically-preserved tree-trunks from the Codroy Valley, southwest Newfoundland. The tree-trunks, which have incomplete lengths of up to 8.3 m, occur in braided fluvial channel facies of the Searston Formation, a late Pendleian–Arnsbergian (upper Serpukhovian, 326.4–325 Ma) unit. Three morphotypes are present. The first, *Pitus primaeva* Witham shows exceptionally wide rays (1–8-seriate, rarely to 16-seriate) and tracheids with multiseriate pits. The second, cf. *Pitus withamii* (Lindley and Hutton) Witham has rather narrower rays (1–3-seriate), and unusually shows ray cells pitted on all walls. Both morphotypes probably represent arborescent pteridosperms. The third, *Protopitys scotica* Walton is characterized by the occurrence of very short rays (mode: 1 cell high), and represents a putative progymnosperm. Associated megafloral assemblages are dominated by *Diplotmema* and *Adiantites*, which may have comprised the foliage of the lignophytes described herein. However, in marked contrast, palynological assemblages suggest that arborescent lycopsids, sphenopsids and ferns dominated regional vegetation make-up. One resolution to this paradox is the lignophytes may have been growing on levees or well-drained uplands to the south, and washed into the basin in river channels, while pteridophytic vegetation occupied the floodplain. This inference is supported by occurrence of irregular growth interruptions in the fossil woods, suggesting trees grew under a seasonally dry tropical climate.

1. Introduction

Anatomically-preserved plants are extremely abundant in the Mississippian rocks of northwest Europe (Scott et al., 1984; Scott and Galtier, 1996). Plants are silicified, calcified or preserved as charcoal, the product of wildfire, and commonly, though not elusively, associated with volcanic environments (Scott, 1990). Widespread volcanism in this region was related to the northward subduction of the Rheic oceanic plate along the Galicia–Brittany–Massif Central line, which generated lithospheric stretching and magmatism in the British back-arc region, and uplift within the Variscan orogenic zone further south (Leeder, 1982, 1987, 1988). Although fossil plant localities are scattered across the orogenic belt in mainland Europe (e.g. Galtier et al., 1998a), by far the richest concentration occurs in the Midland Valley of Scotland (Scott et al., 1984), where volcanism was accompanied by rapid subsidence and the accumulation of a thick terrigenous succession. To date more than twenty sites have been described in detail from this basin (Falcon-Lang, 2000) and many others await full analysis.

Like the Midland Valley of Scotland, the Carboniferous basins of Newfoundland, Canada, developed along the reactivated Caledonian lineaments during the closure of the Rheic Ocean (Leeder, 1982, 1987, 1988). However, in contrast, remarkably few fossil plant assemblages have been described from this latter region. To date, a rich compressed megaflora (Bashforth, 2005) and a hundreds of permineralized cordaitalean tree-trunks (Falcon-Lang and Bashforth, 2004, 2005) have been found in a Pennsylvanian (Moscovian) outlier near Stephenville, SW Newfoundland (Latitude: 48°34′28″N, Longitude: 58°35′21″W). However, in Mississippian strata, fossil plants are limited to a compressed megaflora of uncertain age (Arber, 1910) collected at the mouth of Shawnawdithit River as it enters Red Indian Lake (Latitude: 48°37′09″N, Longitude: 58°06′29″W) and a compressed megaflora from the early Namurian Searston Formation (Bell, 1948) in the Bay St. George Basin region (Latitude: 47°49′30″N, Longitude: 59°19′50″W).

The aim of this present paper is to augment our knowledge of Mississippian palaeobotany in Newfoundland by describing a newly discovered assemblage of permineralized tree-trunks from the Searston

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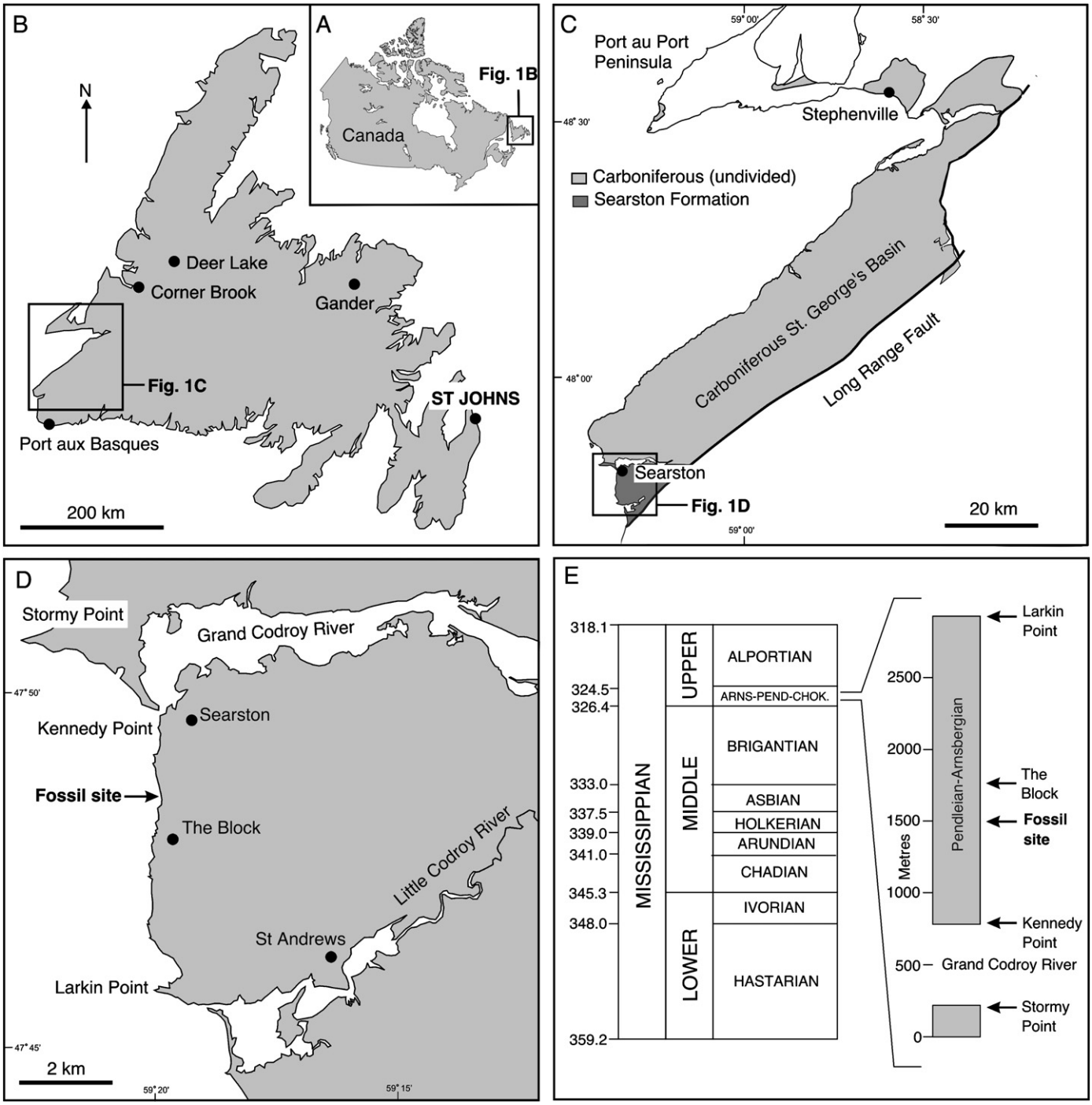

Fig. 1. Geological setting. A. Index map of Canada, B. Index map of Newfoundland, C. Carboniferous Bay St. George Basin (medium grey) highlighting the outcrop belt of the Searston Formation (dark grey) after Bashforth (2005), D. Detailed map of the outcrop belt of the Searston Formation showing the location of the fossil site between Kennedy Point and The Block, E. Summary stratigraphic column for the Searston Formation and its correlation with global stratigraphy (after Heckel and Clayton, 2006; Utting and Giles, 2008).

Formation. These discoveries shed new light on the diversification of gymnosperms during a critical period in evolutionary history leading up to the Mississippian–Pennsylvanian boundary (Gerrienne et al., 1999). This time interval witnessed a significant rise in plant diversity (Knoll, 1986; Raymond, 1996) and marked a changeover from seasonally dry vegetation dominated by gymnosperms and ferns to the establishment of widespread lycopsid 'Coal Forests' (DiMichele et al., 2001; Gastaldo et al., 2009). The new discoveries also add to the comparatively small number of late Mississippian localities with permineralized plants in North America (Lacey and Eggert, 1964; Taylor and Eggert, 1967; Jennings, 1979; Dunn 2004).

2. Geological setting

The fossils described in this paper were discovered in coastal cliffs west of Searston, near the mouth of the Great Codroy River, southwest Newfoundland, during reconnaissance work by one of us (HFL) in the summers of 2004 and 2005 (Map Reference, Codroy 11-0/14, Scale 1:50,000; Fig. 1A–C). The rocks in this region comprise the type section of the ~2950-m-thick Searston Formation (Knight, 1983), which is of late Pendleian–Arnsbergian age (upper Serpukhovian, 326.4–325 Ma) based on miospore assemblages (*Reticulatisporites carnosus* biozone; Utting and Giles, 2008). Thus, they are assigned to the latest Mississippian