Palaeogeography, Palaeoclimatology, Palaeoecology 361–362 (2012) 61–72

Contents lists available at SciVerse ScienceDirect

Palaeogeography, Palaeoclimatology, Palaeoecology

journal homepage: www.elsevier.com/locate/palaeo

Palaeoenvironments of Early Devonian fish and other aquatic fauna of the Campbellton Formation, New Brunswick, Canada

Kirsten L. Kennedy [a], Randall F. Miller [b], Martin R. Gibling [a,*]

[a] Department of Earth Sciences, Dalhousie University, Halifax, Nova Scotia, Canada B3H 4R2
[b] Steinhammer Palaeontology Laboratory, Natural Science Department, New Brunswick Museum, Saint John, New Brunswick, Canada E2K 1E5

ARTICLE INFO

Article history:
Received 24 February 2012
Received in revised form 28 July 2012
Accepted 2 August 2012
Available online 8 August 2012

Keywords:
Emsian
Vertebrates
Eurypterids
Palaeoenvironments
Sedimentology

ABSTRACT

The palaeoecology and palaeoenvironments of the classic fish-bearing strata of the Campbellton Formation are here described. A well-documented fossil assemblage includes acanthodian, placoderm, chondrichthyan, and cephalaspid fishes, tracheophyte remains, eurypterids, ostracods, and molluscs. As part of the Old Red Sandstone continent, the Emsian Campbellton Formation occupied a small basin within the mountainous terrain of the Acadian Orogen, and may have connected through a narrow seaway to a closing foreland basin. The highest diversity of vertebrate fossils was found above a basal unconformity with Val d'Amour Formation volcanics, marked by fissure-fills and unstratified breccia representing a craggy, irregular palaeosurface that provided shelter for some fauna and sediment for rapid burial of skeletal remains. Overlying prodeltaic calcareous siltstones are also highly fossiliferous, and represent a low energy habitat. Occurrences of pterygotid eurypterids, cephalaspids, and chondrichthyans in deltaic sandstones, place these taxa in a habitat that may have been variably fresh or brackish. The surrounding landscape was vegetated with primitive tracheophytes, and abundant plant debris is preserved throughout the basin. The diverse assemblage of fish, arthropods, gastropods, plants and microbial growths suggests that a trophically complex ecosystem was in existence.

1. Introduction

Lower beds of the Campbellton Formation, exposed near Atholville, New Brunswick, Canada, contain a world-class faunal assemblage of Early Devonian (Emsian) vertebrates which, along with the formation's plant-bearing localities, have been of interest to palaeontologists since the late-nineteenth century (Whiteaves, 1881; Dawson, 1882). These strata continue to be recognized as an important representation of an Emsian landscape where early plants and arthropods occupied terrestrial habitats while early fishes and eurypterids dominated marginal waters (Shear et al., 1996; Miller et al., 2003). The fish-bearing Atholville locality discussed here is located about 35 km from the middle Frasnian Escuminac Formation (Hesse and Sawh, 1992; Cloutier et al., 1996) at Miguasha National Park—a UNESCO world heritage site representing the Devonian "Age of Fishes." The Campbellton sites are about 17 million years older, and the two localities together provide an extended record of fish evolution in the same geographic area. During the Emsian, early fish were living in endemic communities in fresh, brackish, and marine waters (Halstead, 1985), and significant global diversity is seen in the co-occurrence of gnathostome and agnathan vertebrates, an overlap rarely seen outside the Devonian (Purnell, 2001). Fossil collections of cephalaspids (Plate I, a–d), placoderms (Plate I, e), acanthodians (Plate I, f–i), chondrichthyans (Plate I, f, j–o), and eurypterids (Plate I, p–s) made in the Campbellton Formation reflect this diversity and, now that new stratigraphic work has been accomplished (Kennedy and Gibling, 2011), the ecosystems and habitats in which these species lived can be recognized.

1.1. Locality and geologic setting

The Campbellton Formation, about 1 km thick, crops out discontinuously between Atholville and Dalhousie, New Brunswick, Canada, along the southern coast of the Restigouche River and Chaleur Bay (Fig. 1). This area has been intensively studied with regards to the exquisite fossil assemblage of fish, plants, and invertebrates (Whiteaves, 1881; Gensel and Andrews, 1984; Gensel and Kasper, 2005; Miller, 2007a, 2007b; and references therein). Recent sedimentological work has divided the formation into two belts, each representing a sub-basin, possibly separated by a palaeotopographic high (Kennedy and Gibling, 2011). Here, we focus on the fish-bearing beds of the western belt, elsewhere referred to as the "Atholville Beds" (Dineley and Williams, 1968), which include fluvial and deltaic facies associations, as well as the contact zone with the underlying Val d'Amour Formation. Spores from the western belt compare well with the *annulatus-sextantii* assemblage zone of Richardson and McGregor (1986) (Gamba, 1990), suggesting a mid Emsian age for the lower

* Corresponding author. Tel.: +1 902 494 2355; fax: +1 902 494 6889.
E-mail addresses: kennedy@dal.ca (K.L. Kennedy), randall.miller@nbm-mnb.ca (R.F. Miller), martin.gibling@dal.ca (M.R. Gibling).

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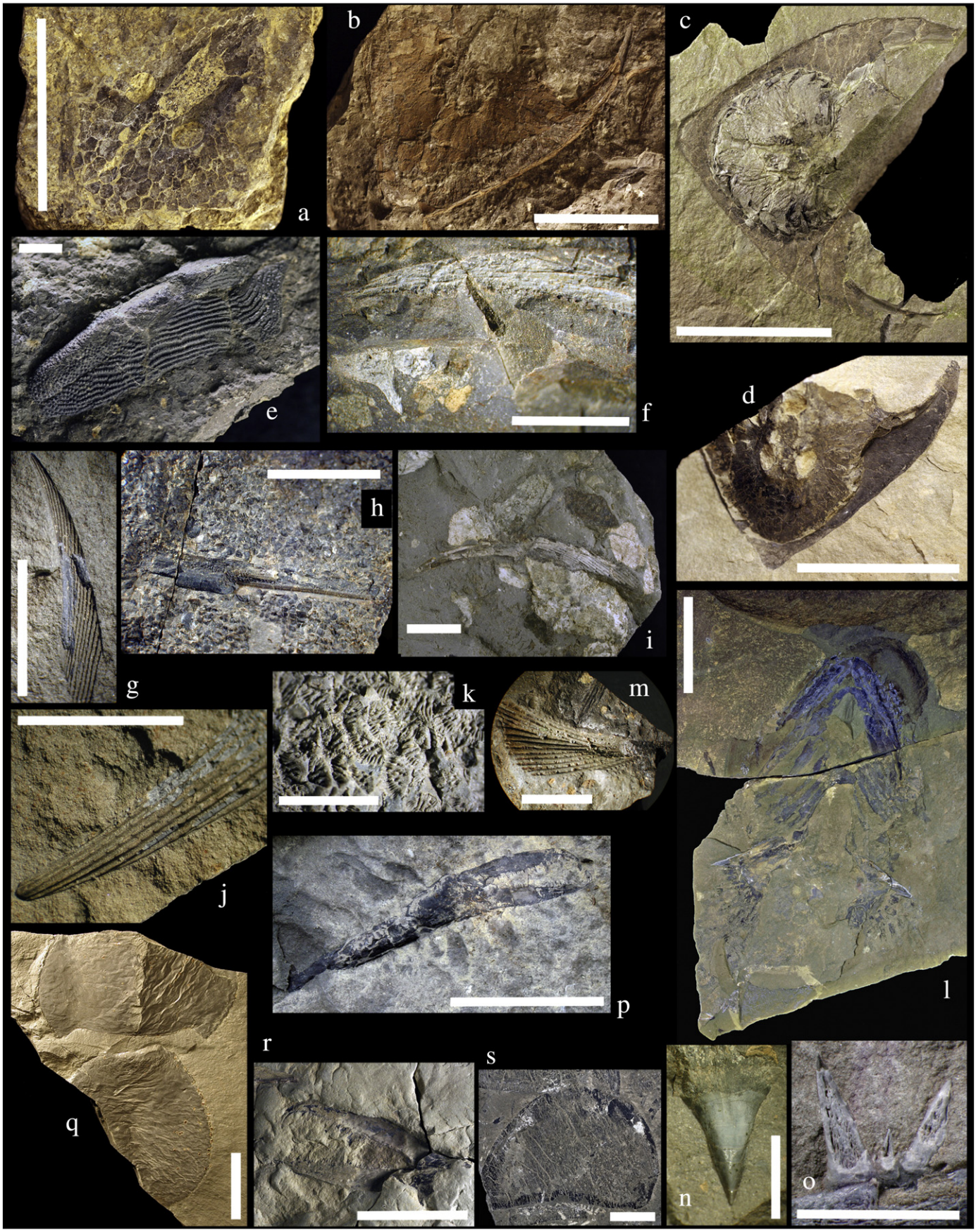
http://dx.doi.org/10.1016/j.palaeo.2012.08.002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