Review of Palaeobotany and Palynology 230 (2016) 47–55

Contents lists available at ScienceDirect

Review of Palaeobotany and Palynology

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

The macroalga *Bosworthia* from the Cambrian Burgess Shale and Kaili biotas of North America and China

Mengyin Wu [a], Steven T. LoDuca [b,*], Yuanlong Zhao [c], Shuhai Xiao [d]

[a] Department of Economics and Management, Guiyang University, Guiyang, Guizhou 550005, China
[b] Department of Geography and Geology, Eastern Michigan University, Ypsilanti, Michigan 48197, USA
[c] College of Resource and Environment Engineering, Guizhou University, Guiyang, Guizhou 550003, China
[d] Department of Geosciences, Virginia Tech, Blacksburg, Virginia 24061, USA

ARTICLE INFO

Article history:
Received 22 September 2015
Received in revised form 19 March 2016
Accepted 6 April 2016
Available online 20 April 2016

Keywords:
Cambrian
Bosworthia
Kaili biota
Burgess Shale
Macroalgae

ABSTRACT

A comprehensive restudy of all material assigned in previous reports to the noncalcified macroalgal genus *Bosworthia* Walcott from the Burgess Shale Formation (Cambrian Stage 5) of western Canada and the slightly older Kaili Formation of South China, together with investigation of previously unpublished material, indicates important morphological differences between the two species heretofore included within the genus. On the basis of these differences, *B. gyges* is removed from the genus and assigned to *Walcottophycus* gen. nov. Most specimens previously assigned to *Bosworthia* from the Cambrian of China, including those assigned to *B. simulans* Walcott, are transferred to *W. gyges*, and it is concluded that *Bosworthia* remains unknown in China. Morphological details for this material when evaluated in the context of molecular clock studies and other fossil macroalgae indicate that *B. simulans* may belong to the extant red algal subclass Rhodymeniophycidae (Florideophyceae) and indicate that *W. gyges* may be an early form of bryopsidalean alga within the Chlorophyta.

1. Introduction

Walcott (1919) erected the macroalgal genus *Bosworthia* to accommodate three specimens from the Greater Phyllopod Bed of the Burgess Shale Formation (Cambrian Stage 5) at the Fossil Ridge (now Walcott Quarry) site, two of which were assigned to the type species, *B. simulans* Walcott, and the third to *B. gyges* Walcott. No additional Burgess Shale specimens have been formally assigned to *Bosworthia* since that initial study, and Walcott's sparse descriptions constitute the only formal taxonomic treatment of this material to date. Specimens attributed to *Bosworthia*, however, have been reported from the Kaili Formation of China (Cambrian stages 4–5) (Mao et al., 1994; Yang et al., 1999; Yang, 2006; Zhao et al., 2011). To develop a better understanding of this material, a detailed study was undertaken that included all specimens previously assigned to *Bosworthia* from the Burgess Shale and Kaili biotas, as well as a large number of unpublished specimens from the latter. Results indicate that the Burgess Shale material is best placed among two genera, and that *Bosworthia* (sensu stricto) remains unknown from the Cambrian of China.

2. Material and methods

The *Bosworthia* type material was examined using a binocular microscope at the Smithsonian Institution National Museum of Natural History. Kaili Formation study material, totaling over 30 specimens, was studied in similar fashion at Guizhou University. For all study specimens, high-resolution morphometric data were collected from digital images using the open source program ImageJ. Scanning electron microscope (SEM) study of GTBM-9-2-636 from the Kaili Formation was conducted using an FEI Quanta 250 FEG at the Subsurface Energy Materials Characterization and Analysis Laboratory (SEMCAL), School of Earth Sciences, Ohio State University. The specimen was imaged uncoated under low vacuum, and backscattered electron (BSE) images were obtained using an accelerating voltage of 15 keV. Repository abbreviations as follows: GTB, GTBM, GTBJ, Guizhou University, Guiyang, China; USNM, Smithsonian Institution National Museum of Natural History, Washington D.C., USA.

3. Results

3.1. Burgess Shale Formation material

Walcott's two syntypes of *Bosworthia simulans*, USNM 35426 and USNM 35427, show a similar style of preservation, each specimen consisting of a thin slightly glossy film with a faint silvery cast. In direct

* Corresponding author.
E-mail address: sloduca@emich.edu (S.T. LoDuca).

http://dx.doi.org/10.1016/j.revpalbo.2016.04.001
0034-6667/

light, they are only just discernible from the surrounding shale (Plate I, 3). In polarized light, however, the contrast between specimen and matrix is enhanced, and the specimens, therefore, are more apparent (Plate I, 1, 4). The thallus of USNM 35426, as preserved on the slab surface, has a maximum width of 70 mm and comprises a number of branches arrayed in radial fashion around a dark, roughly ovoid central area