Palaeogeography, Palaeoclimatology, Palaeoecology 433 (2015) 233–246

Contents lists available at ScienceDirect

Palaeogeography, Palaeoclimatology, Palaeoecology

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

Revised correlation of the Frasnian–Famennian boundary and Kellwasser Events (Upper Devonian) in shallow marine paleoenvironments of New York State

Andrew M. Bush [a,b,*], Jayme D. Csonka [b], Graziella V. DiRenzo [a,1], D. Jeffrey Over [c], J. Andrew Beard [b]

[a] Department of Ecology and Evolutionary Biology, University of Connecticut, 75 North Eagleville Road, U-3043, Storrs, CT 06269-3043, USA
[b] Center for Integrative Geosciences, University of Connecticut, 354 Mansfield Road, U-1045, Storrs, CT 06269-1045, USA
[c] Department of Geological Sciences, SUNY College at Geneseo, Geneseo, NY 14454, USA

ARTICLE INFO

Article history:
Received 13 August 2014
Received in revised form 22 April 2015
Accepted 19 May 2015
Available online 27 May 2015

Keywords:
Late Devonian
Mass extinction
Black shale
Chemung
Appalachian Basin
Pennsylvania

ABSTRACT

The Frasnian–Famennian boundary (Upper Devonian) is exposed in a 200 km-long outcrop belt in New York State, with deeper paleoenvironments to the west and shallower ones to the east. Geochronology in the eastern end of the outcrop belt has been based primarily on lithostratigraphic correlation with western sections, which were dated using conodonts. We collected conodonts and brachiopods from several measured sections and numerous other localities, and these collections suggest that these east–west lithostratigraphic correlations require revision. We correlate the Wiscoy Formation with the upper Angola Formation and the Canaseraga with the upper Hanover. Thus, the Canaseraga Formation contains the Frasnian–Famennian boundary and Upper Kellwasser Event, and the dark shale above the Wiscoy is equivalent to the Pipe Creek Formation and Lower Kellwasser Event. These new correlations imply that the Lower Kellwasser Event had greater impact on the shelly benthos of New York than the Upper Kellwasser, at least for the subset of taxa examined here. All strophomenid brachiopods and rugose corals were extirpated at the Lower Kellwasser, along with numerous other brachiopods. The final species of atrypid brachiopod persisted to the Upper Kellwasser.

1. Introduction

Extinction events in the Late Devonian caused considerable biotic turnover and ecological change (e.g., Schindler, 1993; McGhee, 1996; Copper, 2002; House, 2002; McGhee et al., 2004; Sallan and Coates, 2010; Christie et al., 2013; McGhee, 2013). Two of these extinctions, the Lower and Upper Kellwasser Events (LK and UK), occurred during the late Frasnian and coincided with the deposition of the Lower and Upper Kellwasser limestones, organic-rich deposits found across Europe and northern Africa (Joachimski and Buggisch, 1993; Schindler, 1993). At several deep-water locations in western New York State, Over (1997, 2002) identified the temporal equivalents of the Kellwasser Events using conodont biostratigraphy. To the east of these locations, shallower-water facies are exposed, macrofossils are common, conodonts are rare, and geochronology is based primarily on lithostratigraphic correlations with the deeper-water sections in western New York (Chadwick, 1935; Pepper and deWitt, 1950, 1951; Rickard, 1964, 1975; Smith and Jacobi, 2000). However, new collections of brachiopods and conodonts indicate that the Frasnian–Famennian (F–F) boundary and the Kellwasser Events have generally been misplaced in the shallow-water, "Chemung" paleoenvironments at the eastern end of the outcrop belt. We suggest alternate correlations that will serve as the basis for future studies of Late Devonian extinction dynamics in the Appalachian Basin.

2. Geologic setting and stratigraphy

During the Late Devonian, sediments shed from the Acadian Mountains were deposited in the Appalachian Foreland Basin as part of the prograding clastic wedge of the "Catskill Delta" (Woodrow and Sevon, 1985; Filer, 2003; Ver Straeten, 2009). Upper Frasnian and lower Famennian strata are exposed in New York in an outcrop belt stretching from Lake Erie in the west to the Pennsylvania border south of Corning (Fig. 1A, B), with paleoenvironments shallowing eastwards. The stratigraphy and paleoecology of these strata (and correlative rocks to the south) have been addressed by numerous authors, including McGhee (1976), McGhee and Sutton (1981, 1983, 1985), Sutton and McGhee (1985), Roen and deWitt (1984), Van Tassell (1987), Warne and McGhee (1991), Castle (2000), Murphy et al. (2000), Smith and Jacobi (2001), Day and Over (2002), Filer (2002, 2003), Rode and Lieberman (2004),

* Corresponding author at: Department of Ecology and Evolutionary Biology, University of Connecticut, 75 North Eagleville Road, U-3043, Storrs, CT 06269-3043, USA. Tel.: +1 11 1 860 486 9359; fax: +1 11 1 860 486 6364.
E-mail addresses: andrew.bush@uconn.edu (A.M. Bush), jayme.csonka@uconn.edu (J.D. Csonka), gdirenzo@umd.edu (G.V. DiRenzo), over@geneseo.edu (D.J. Over), james.beard@uconn.edu (J.A. Beard).
[1] Present address: Department of Biology, University of Maryland, 4219 Biology–Psychology Building, College Park, MD 20742, USA.

http://dx.doi.org/10.1016/j.palaeo.2015.05.009
0031-0182/

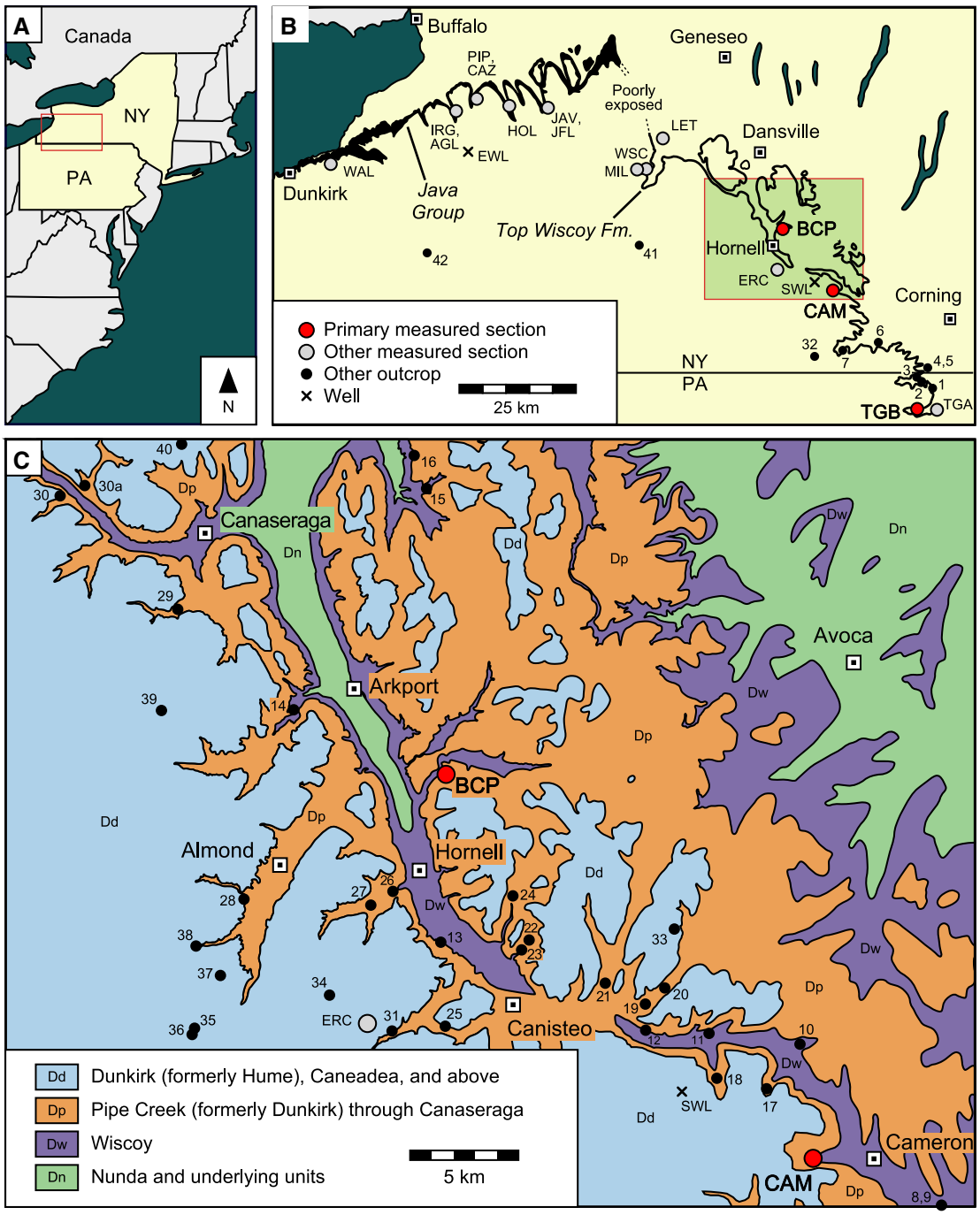

Fig. 1. Locality maps. A) Eastern United States with the field area in New York and Pennsylvania highlighted. B) Expanded view of the highlighted region from panel A. In western New York, the Java Group is marked in black. The base of the group (northern boundary) is defined by the Angola–Pipe Creek contact (LK equivalent). The top of the group (southern boundary) is marked by the Hanover–Dunkirk contact, which is slightly above the UK equivalent (Over, 1997). In the eastern end of the outcrop belt, the contact between the Wiscoy and the overlying shale is marked; previously, this contact was correlated with the Hanover–Dunkirk contact in the west, but we correlate it with the Angola–Pipe Creek contact. C) Detailed geologic map of the region highlighted in panel B. Stratigraphic assignments reflect the new correlations proposed here. Sampling locations and abbreviations are listed in Tables 1 and 2. The "primary measured sections" (BCP, CAM, and TGB) were sampled bed-by-bed for fossils, and the "other measured sections" are discussed or figured but not necessarily sampled intensively for fossils. "Other outcrops" were sampled for fossils but the sections were not measured.
Geologic maps based on Pepper and deWitt (1950), Pepper (1954), and Rickard and Fisher (1970).

Stigall Rode and Lieberman (2005), Bond and Wignall (2008), Bush and Brame (2010), Christie et al. (2013), and McClung et al. (2013).

In western New York, upper Frasnian and lower Famennian strata include shales assigned to the Angola, Pipe Creek, Hanover, Dunkirk, South Wales, and Gowanda formations (Fig. 2). Over (1997, 2002) identified the Pipe Creek as the temporal equivalent of the LK and a thin black shale interval in the Hanover located 3 m or less below the contact with the Dunkirk as the UK equivalent. The Upper Devonian is poorly exposed in parts of Wyoming County, but outcrops become common again in the Genesee River valley and eastwards (Fig. 1B; see also Fig. 1 of Pepper and deWitt, 1950).

In the eastern part of the outcrop belt, silt- and sand-rich strata of the Nunda, Wiscoy (Fig. 3D), and Canaseraga (Fig. 3B) formations are separated by gray and dark gray shales (Fig. 3A, C) that have been