Available online at www.sciencedirect.com
ScienceDirect
Palaeoworld 15 (2006) 360–366
Palaeoworld
www.elsevier.com/locate/palwor

Research paper

Significance of Middle Cambrian mixed carbonate-siliciclastic units for global correlation: southern Nevada, USA

Robyn A. Howley [a,*], Margaret N. Rees [b], Ganqing Jiang [a]

[a] *Department of Geoscience, University of Nevada Las Vegas, Las Vegas, NV 89154-4010, USA*
[b] *Public Lands Institute, University of Nevada Las Vegas, Las Vegas, NV 89154-2040, USA*

Received 28 December 2005; received in revised form 12 July 2006; accepted 16 October 2006
Available online 3 November 2006

Abstract

Sequence-stratigraphic analysis of the Middle Cambrian Highland Peak, Bonanza King, Swasey, and Wheeler formations in the Great Basin refines platform-to-basin correlations and distinguishes local tectonic events from eustasy. This analysis provides a reliable sea-level history through the *Ptychagnostus gibbus* and *Ptychagnostus atavu*s trilobite intervals and confirms that the Global Stratotype Section and Point (GSSP) at the first appearance datum (FAD) of *P. atavus* was deposited during an overall sea-level rise. Deposition during the Middle Cambrian *Ehmaniella*/*Bolaspidella* biozones in the western U.S. is represented by two lithologically distinct successions: (1) a poorly fossiliferous, shallow-water, mixed carbonate-siliciclastic succession that is widespread across southern Nevada and southeastern California and (2) a highly fossiliferous, deeper water, fine-grained, siliciclastic succession in central Nevada and western Utah. The deeper water succession was deposited within the fault-controlled House Range Embayment and contains the *P. atavus* GSSP. Correlation of these disparate successions had been hampered by a lack of high-resolution biostratigraphic data, and limited chemostratigraphy and sequence stratigraphy. In this study, sequence-stratigraphic analysis indicates that the Condor Member of the Highland Peak Formation and the "mixed unit" of the Bonanza King Formation are the shallow-water platform equivalents of the basal Wheeler Formation encompassing the *P. gibbus* and lower *P. atavus* zones. The deepening event that is recorded in the *P. gibbus* Zone represents a major flooding surface that may be used as an important event marker for regional and global correlation. The overlying *P. atavus* GSSP, however, is within the later stage of transgression and may represent a globally synchronous event that can be correlated from platform to basin.

Keywords: Cambrian; GSSP; Laurentia; Stratigraphy; Nevada; Utah

1. Introduction

Global Stratotype Sections and Points (GSSP) provide important references for establishing a global chronostratigraphic framework. Because the appearance and disappearance of species are not necessarily synchronous globally and their preservation varies according to sedimentary facies, an integrated bio-, chemo- and sequence-stratigraphic approach is essential for a broad regional and global correlation of GSSPs.

The GSSP at the FAD of the cosmopolitan agnostoid trilobite *Ptychagnostus* (or *Acidusus*) *atavus* in the Drum Mountains of Utah, USA (Fig. 1) was deposited during a transgression that began near the base of the underlying *Ptychagnostus gibbus* Zone in the basal Wheeler Formation (Rowell et al., 1982; Langenburg, 2003; Babcock et al., 2004; Fig. 2). The *P. atavus* GSSP marks the base

* Corresponding author. Tel.: +1 702 895 5054; fax: +1 702 895 4064.
E-mail address: rhowley@unlv.nevada.edu (R.A. Howley).

1871-174X/$ – see front matter © 2006 Nanjing Institute of Geology and Palaeontology, CAS. Published by Elsevier Ltd. All rights reserved.
doi:10.1016/j.palwor.2006.10.010

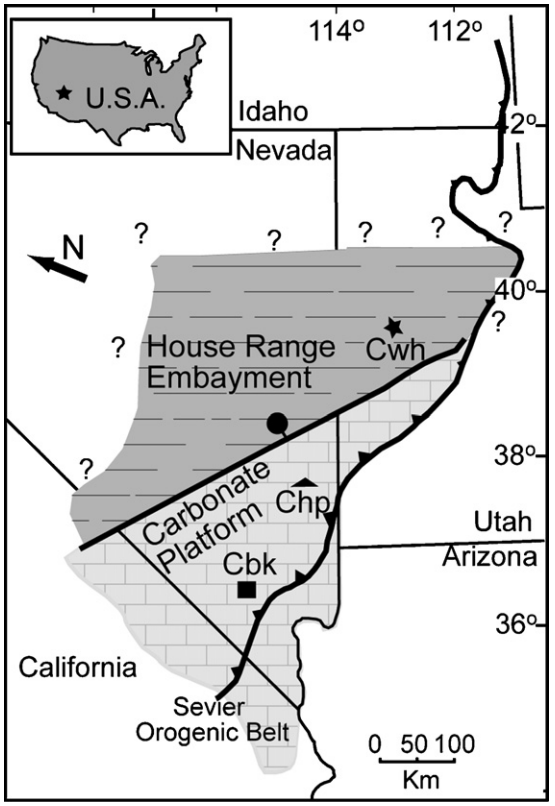

Fig. 1. Paleogeographic reconstruction of the northwestern margin of Laurentia during the Middle Cambrian. Shown are prominent formations and their areas of deposition (modified from Palmer, 1971). North arrow indicates the direction of Cambrian North. Chp: Highland Peak Formation; Cbk: Bonanza King Formation; Cwh: Wheeler Formation. The Panaca section is marked with a triangle, a square marks the Indian Ridge (in the Spring Mountains) location, and the black star indicates the location of the Drumian Stage GSSP, marked by the first appearance of *Ptychagnostus atavus*, in the Drum Mountains, Utah (Babcock et al., 2004).

of the Drumian Stage (formerly known provisionally as Stage 6) of the Cambrian (Babcock et al., 2005). The existence of this GSSP within a slope-to-basin deposit (Rees, 1986), however, limits correlation to a wide range of environments including those on the adjacent shallow-water platform. A broader correlation has had limited success because *P. atavus* is virtually unknown from shallow-water platform rocks. General correlation of this GSSP to shallow-water platform equivalents has relied mostly on broad lithostratigraphic correlations and low-resolution biostratigraphy of restricted polymerid trilobite faunas. This study integrates biostratigraphy with lithostratigraphy and sequence stratigraphy to enhance the applicability of the GSSP at *P. atavus* and to provide a framework for future detailed chemostratigraphic studies across this interval.

2. Geologic setting

During the middle part of the Cambrian, the western margin of North America (northwestern margin of Laurentia) was rapidly subsiding in response to the breakup of Rodinia during the late Neoproterozoic (Bond and Kominz, 1984; Levy and Christie-Blick, 1991; Prave, 1999). A broad continental terrace composed of terrigenous sediment was formed during subsidence, and subsequently became the location of a broad carbonate platform (Palmer, 1971; Fig. 1). Conditions were excellent for carbonate production along the continental shelf because of the low-latitude location of Laurentia and the global greenhouse climate, with only slight evidence for glacial activity in the interior of Gondwana (Erdtmann and Miller, 1981; Scotese and McKerrow, 1990).

Near the end of deposition recorded by the *Ehmaniella* biozone (marked by the beginning of the *P. gibbus* trilobite zone), shallow-water carbonate deposition was interrupted by a fault-controlled asymmetric trough through Nevada and western Utah: the House Range Embayment (Kepper, 1976; Robison, 1982; Rees, 1986; Fig. 1). House Range Embayment deposition consisted of fine-grained siliciclastic and carbonate sediments of the Wheeler Formation and equivalents (Fig. 2). Siliciclastic sediments were thought to have bypassed the nearby shallow-water platform where sediments of the Highland Peak and Bonanza King formations were being deposited (Rees, 1986). Because of the paucity of fossils in the platform deposits, detailed correlation between the Wheeler and members of the Highland Peak and Bonanza King formations had not been available. Based on lithological similarities and polymerid biostratigraphy, Merriam (1964) and Palmer (1971) both correlated the Swasey Limestone below the Wheeler Formation to the Step Ridge Member of the Highland Peak Formation (Fig. 2). The base of the Condor Member of the Highland Peak Formation correlates with the base of the "mixed unit" of the Bonanza King (Osleger and Montañez, 1996; Howley and Rees, 2001; Howley, 2002). It is concluded in this study that the bases of the mixed carbonate-siliciclastic deposits of the Condor Member and the "mixed unit" of the Bonanza King Formation are equivalent to the base of the Wheeler Formation in the House Range Embayment.

3. Stratigraphic study results

An approximately 80-m-thick interval encompassing portions of the Step Ridge, Condor, and Meadow Valley members of the Highland Peak Formation was studied near Panaca, Nevada and placed in a sequence-