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Census of the Indian Springs Lagerstätte, Poleta Formation (Cambrian), western Nevada, USA

Adam M. English [a,*], Loren E. Babcock [b]

[a] Chevron North America, 5750 Johnston Street, Lafayette, LA 70503, USA
[b] School of Earth Sciences, Division of Geological Sciences, The Ohio State University, 125 South Oval Mall, Columbus, OH 43210, USA

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ABSTRACT

Intervals of exceptional fossil preservation collectively termed the Indian Springs Lagerstätte occur in the middle member of the Poleta Formation (Cambrian, Series 2, Stage 3) in Esmeralda County, Nevada, USA. The preserved macrofauna and taphonomic modes are similar to those of the Spence Shale Lagerstätte of Utah (Cambrian Series 3). The Indian Springs macrofauna mostly consists of biomineralizing organisms such as trilobites, helicoplacoids, hyolithids and inarticulate brachiopods. Multi-element taxa such as helicoplacoids and chancelloriids are commonly articulated. Examples of preserved nonbiomineralized anatomy include mantle setae of brachiopods, demosponge skeletons, hyolithid gut tracts, trilobite appendages, algae, cyanobacteria, and body parts of nonbiomineralizing arthropods. The Indian Springs Lagerstätte is dominated by fine siliciclastics, and was deposited in an offshore shelf setting subjected to storm-initiated sediment pulses. Exceptional preservation was facilitated by obrution-type deposition, presumably in dysoxic or anoxic muds, and in environments where organismic remains were removed from durophagous carnivores and scavengers, including bioturbators.

1. Introduction

The Neoproterozoic–Cambrian transition was a time of dramatic and well documented change in the global biosphere. Marine organisms underwent considerable evolutionary innovation during a time of marked change in marine ecosystems influenced by a variety of biologic, geochemical, sea level, and tectonic changes (e.g., Dornbos and Bottjer, 2000; Babcock, 2003, 2005; Zhu et al., 2006; Lieberman, 2008, and references therein). The first stratigraphic appearances of many recognizable clades of animals coincide with this change (e.g., Allison and Briggs, 1993; Conway Morris, 2000; Hagadorn, 2002; Babcock, 2005). Our understanding of this important time interval is enhanced through global occurrences of "Burgess Shale-type" deposits. These deposits, also referred to as deposits of exceptional preservation, and Konservat–Lagerstätten, include the remains of nonbiomineralizing organisms and typically show a more complete fossil record than fossil deposits that only preserve biomineralizing organisms (e.g., Conway Morris, 1979; Allison and Briggs, 1993; Babcock et al., 2001).

The Indian Springs Lagerstätte (Cambrian, Series 2, Stage 3; Figs. 1, 2) is one of about thirty known Burgess Shale-type deposits, and is one of several situated along the Cordilleran margin of Laurentia (see Hagadorn, 2002). It consists of a series of stratigraphically thin layers yielding exceptionally preserved fossils in the middle member of the Poleta Formation in the Montezuma Range, Esmeralda County, Nevada (Babcock et al., 2000a; English, 2007).

The Indian Springs Lagerstätte is one of the oldest known Paleozoic deposits of exceptional preservation from Laurentia. This report includes a census of the preserved macrofauna recovered from layers showing a concentration of exceptional preservation, interpretation of 45 depositional setting, discussion of mechanisms that influenced macrofauna composition, and comparisons with other Lagerstätten.

2. Geologic setting and stratigraphy

A thick succession of Cambrian siliciclastics and carbonates in the Great Basin records the presence of a broad and rapidly subsiding ramp on the western Laurentian margin throughout the Paleozoic (e.g., Stewart, 1966; Kepper, 1972, 1976; Moore, 1976; Robison, 1976, 1991; Rees, 1986; Corsetti, 2002; Babcock et al., 2007). Cambrian units, including the Poleta Formation, are exposed in a series of outcrops in the northern part of the Montezuma Range, Esmeralda County, Nevada (Fig. 1). The Montezuma Range is a north-trending range that is part of the Basin and Range Province. Faulting, folding, and volcanic cover are frequent in the Montezuma Range and often obscure stratigraphic sections.

The Poleta Formation measures up to 125 m in thickness in Indian Springs Canyon and consists of three members referred to as the lower member, middle member, and the upper member (Stewart, 1970; Hollingsworth, 1999, 2005; Streng et al., 2005). These three members have been interpreted (Hollingsworth, 2005; English, 2007)

* Corresponding author.
E-mail address: akxl@chevron.com (A.M. English).

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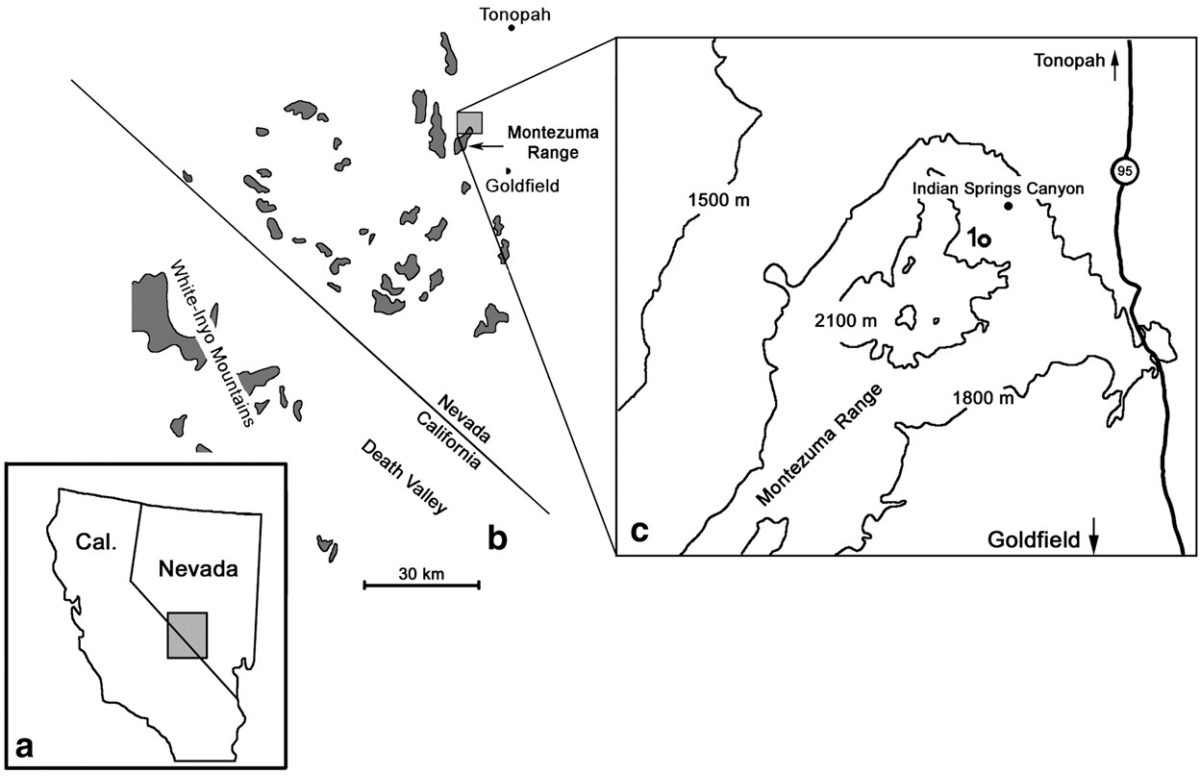

Fig. 1. Map of Nevada–California area showing general location of the Montezuma Range (a, b), and detail of the Montezuma Range, Esmeralda County, Nevada showing collecting localities (c). 1 exposures of Lower Member and Middle Member of the Poleta Formation (GPS: N 37° 43.39′, W 117° 19.29′).

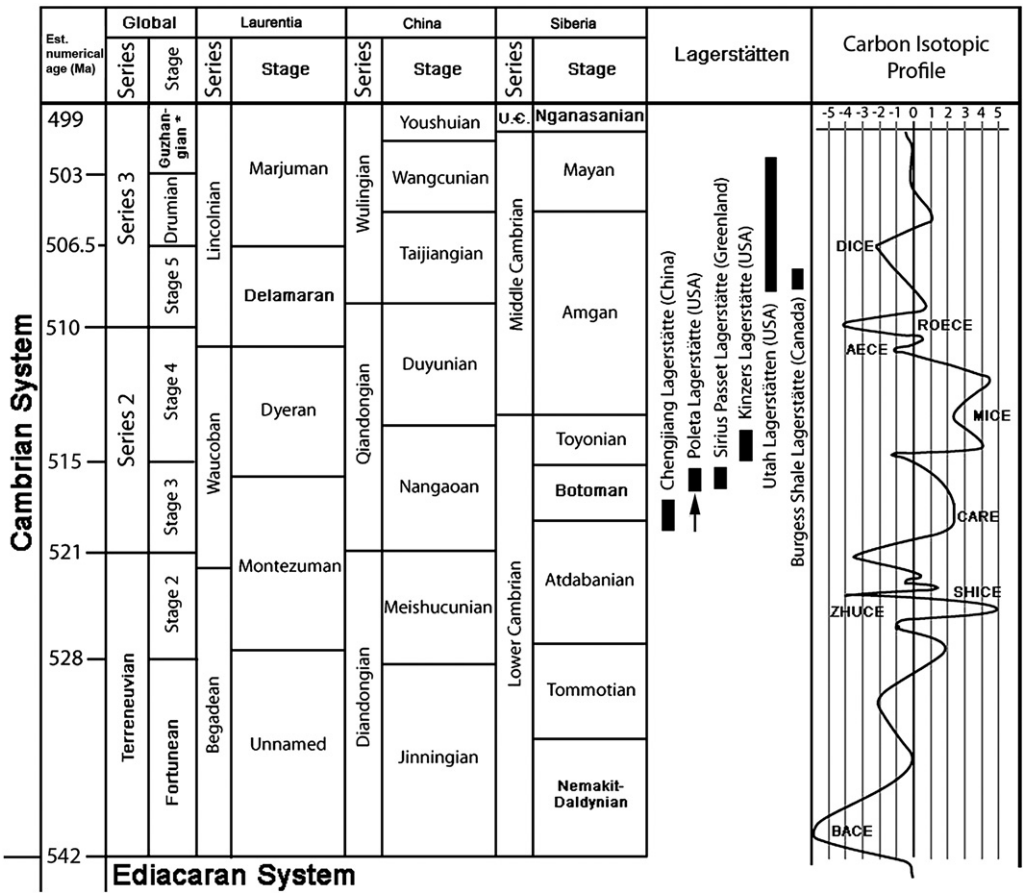

Fig. 2. Correlation chart of the pre-Furongian part of the Cambrian System, comparing global chronostratigraphic usage, regional stratigraphic usage in three paleogeographic blocks, Lagerstätten deposits, and secular variations in carbon isotopes (modified from Zhu et al., 2006).