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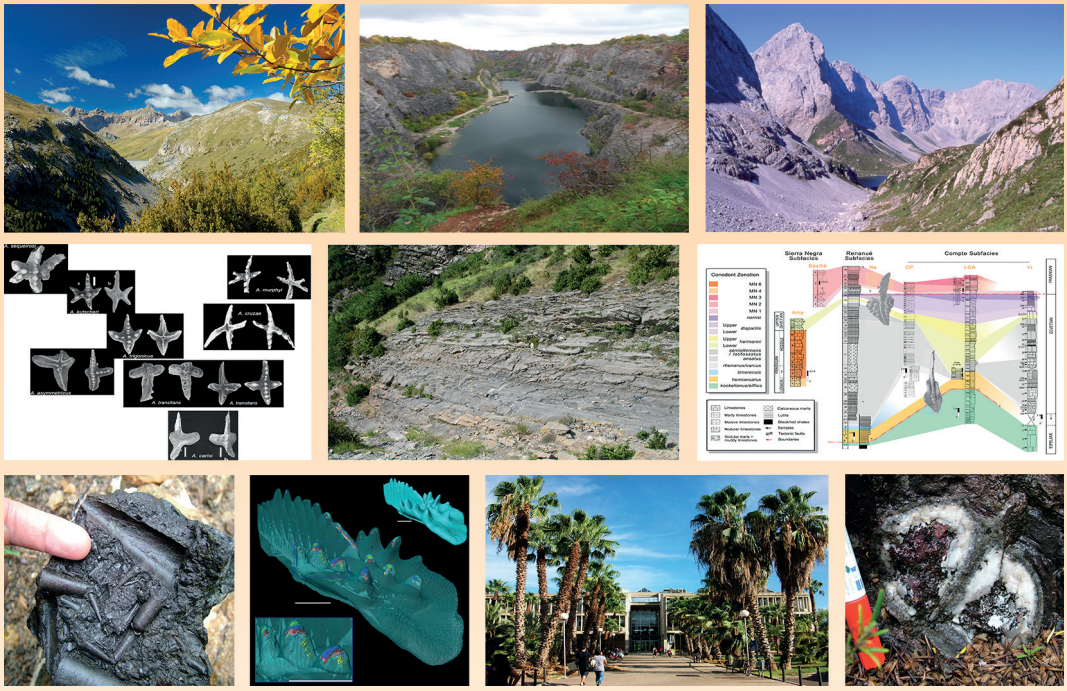

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ICOS IV

"PROGRESS ON CONODONT INVESTIGATION"

JOINTLY WITH:

THE INTERNATIONAL SUBCOMMISSION ON DEVONIAN STRATIGRAPHY ***SDS***

THE INTERNATIONAL SUBCOMMISSION ON SILURIAN STRATIGRAPHY ***ISSS***

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EDITORS: JAU-CHYN LIAO AND JOSÉ IGNACIO VALENZUELA-RÍOS

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562

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Upper left: Palaeozoic outcrops of the Tena valley, Aragonian Pyrenees (Spain). Photo by Jau-Chyn Liao.
Upper centre: Lower Palaeozoic succession in the Barrandian area (Bohemian Massif, Czech Republic). Photo by Ladislav Slavík.
Upper right: Palaeozoic succession in the Volayer Area (Carnic Alps, Italy-Austria border). Photo by Carlo Corradini.
Middle left: Ancyrodelloides lineage proposal, lower to middle Lochkovian (Lower Devonian) in the Central Pyrenees (Spain). Photo by José I. Valenzuela-Ríos.
Middle centre: Pragian-Emsian succession in the Baliera section, Benasque area, Aragonian Pyrenees. Photo by José I. Valenzuela-Ríos.
Middle right: Regional correlation in the southern part of the Central Pyrenees for the Middle to Upper Devonian. Photo by Jau-Chyn Liao.
Lower left: Orthoceras limestones (Lower Devonian) from Gerri La Sal section, Noguera Pallaresa valley. Photo by Jau-Chyn Liao.
Lower centre one: Reconstruction in 3D of the Epigondolella quadrata (Upper Triassic) of the Pizzo Mondelo (Italy). Photo by Michele Mazza and Carlos Martínez-Pérez.
Lower centre second: Main library "Eduard Boscà" in the Campus of Burjasot, University_of_Valencia (Spain).
Lower right: Schiphocrinites from the Silurian/Devonian in Gerri La Sal section. Photo by Jau-Chyn Liao.

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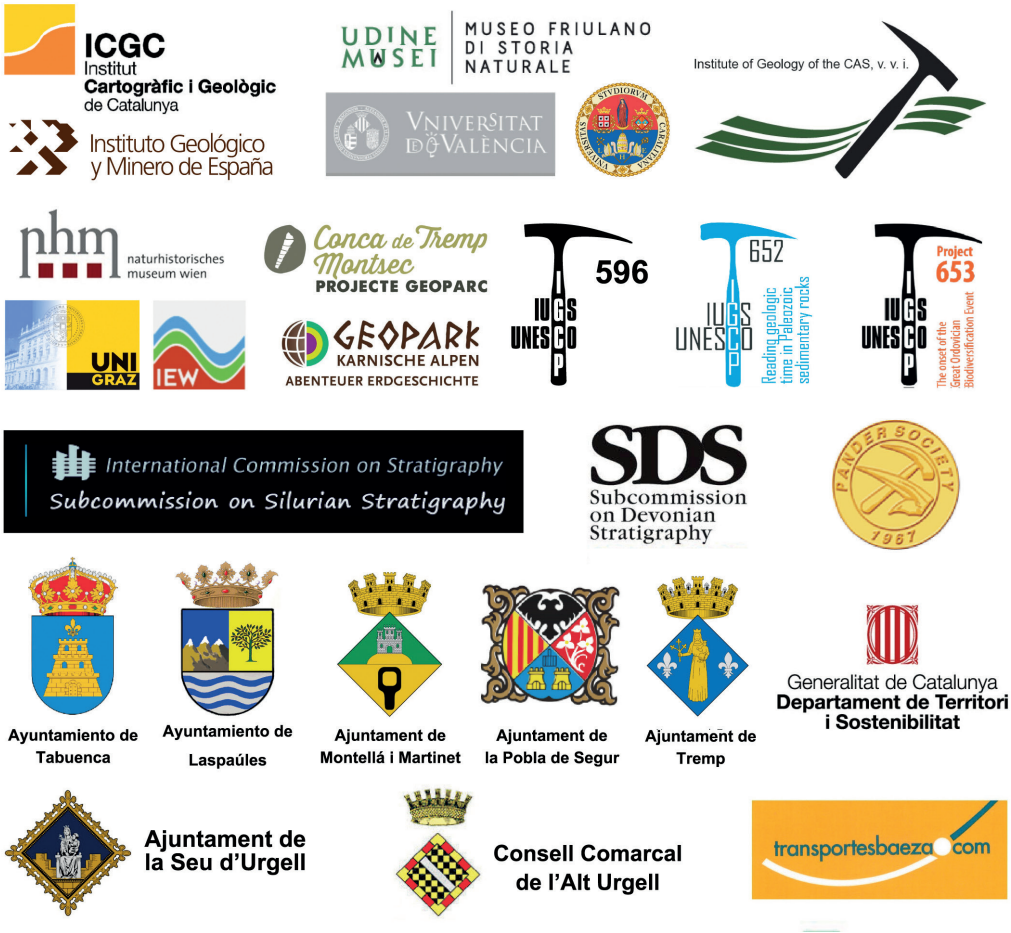
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596
652
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NEW TYPES OF EXCEPTIONALLY LARGE CONODONT APPARATUSES WITH HYALINE ELEMENTS FROM THE MIDDLE ORDOVICIAN WINNESHIEK KONSERVAT-LAGERSTÄTTE IN IOWA, USA

H. Liu[1], S. M. Bergström[2], A. Ferretti[3], D. E. G. Briggs[4], B. J. Witzke[5] and R. M. McKay[1]

[1] Iowa Geological Survey, IIHR-Hydroscience & Engineering, University of Iowa, 340 Trowbridge Hall, Iowa city, IA 52242, USA; Huaibao-liu@uiowa.edu, rjmckay@gmail.com
[2] School of Earth Sciences, Division of Earth History, The Ohio State University, 125 S. Oval Mall, Columbus, Ohio 43210, USA; Bergström.1@osu.edu
[3] Dipartimento di Scienze Chimiche e Geologiche, Università degli Studi di Modena e Reggio Emilia, via Campi 103, I-41125 Modena, Italy; ferretti@unimore.it
[4] Department of Geology and Geophysics, and Yale Peabody Museum of Natural History, Yale University, New Haven, CT 06520, USA; derek.briggs@yale.edu
[5] Department of Earth and Environmental Sciences, University of Iowa, 121 Trowbridge Hall, Iowa City, IA 52242, USA; brian-witzke@uiowa.edu

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INTRODUCTION

Only about a dozen Ordovician Konservat-Lagerstätten are known globally and such deposits are more rarer in this system than in, for instance, the Cambrian. In view of this, the 2005 discovery of an in several aspects unique such deposit at Decorah, Iowa (Liu et al., 2006, 2009) was of special paleontological interest. The Winneshiek Lagerstätte is located in a circular meteorite crater, the Decorah Impact Structure, which has a diameter of 5.6 km and covers approximately 25 km^2. It contains a crater filling a partly sandy, organic-rich, dark-grey shale, the Winneshiek Shale, which is exposed at only a single locality on the bank of the Upper Iowa River. However, two drill cores and chips from 29 wells show that this shale has a thickness of 17-27 m and overlies, with gradational contact, a thick impact breccia. The Winneshiek Shale is unconformably overlain by the widespread but largely unfossiliferous St. Peter Sandstone.

Tons of material excavated from the river bed have yielded more than 5300 cataloged specimens (Liu et al., 2017). Numerically, this collection is dominated by conodonts but it contains also representatives of a few other fossil groups (e.g. Lamsdell et al., 2015a, 2015b; Briggs et al., 2016) such as eurypterids with an estimated adult size of up to 1.7 m, phyllocarids (Briggs et al., 2016), and other non-mineralized arthropods. There are no benthic shelly fossils, such as articulate brachiopods, trilobites, bryozoans, bivalves, corals, and echinoderms, and also graptolites are missing. It appears that the Winneshiek Shale was deposited in a very quiet environment, possibly in brackish water, with a too low oxygen content in the bottom water to permit the establishment of a diverse benthic fauna.

Although not abundant, conodonts occur on many shale bedding surfaces and the conodont elements are excellently preserved in three dimensions. Very commonly, quite prominent basal bodies are preserved

attached to the crowns of the elements. A striking feature is that many elements have a gigantic size with a length of 10-15 mm and represent some of the largest conodont elements recorded anywhere.

The Winneshiek Shale fauna does not include fossils suitable for a very precise determination of the age of the unit. However, a recent chemostratigraphic $\delta^{13}C_{org}$ investigation indicates that the unit represents Stage Slice Dw2 of Bergström et al. (2009) of the global Darriwilian Stage (Bergström et al., in preparation).

CONODONT APPARATUSES

Of special interest is the fact that several of the approximately 12 conodont taxa present in the Winneshiek fauna are represented by more or less complete apparatuses. The two most common of the apparatuses were recently described and identified (Liu et al., 2017) as *Archeognathus primus* Cullison, 1938 and *Iowagnathus grandis* Lui, Bergström, Witzke, Briggs, McKay and Ferretti, 2017. These are the first hyaline conodont apparatuses formally described in the global conodont literature.

Archeognathus primus has a 6-element apparatus of a previously unknown type. It includes one pair of blade-like multidenticulated coleodiform (S) elements and two pairs of archeognathiform (P) elements. All elements have very robust basal bodies that rival, or exceed, the crowns in size.

The apparatus of *I. grandis* includes 15 ramiform elements of alate (one element) and bipennate or angulate, and tertiopedate morphology (seven pairs). Bedding-plane apparatuses show that these elements were arranged in two opposing rows. In general architecture, this apparatus type shows a closer similarity to post-Ordovician apparatuses of ozarkodinid type than to those of *Promissum* and *Icriodella* (formerly *Notiodella*) from the Upper Ordovician Soom Shale of South Africa (Aldridge et al., 1995, 2013). However, the apparatus of *Iowagnathus grandis* differs from these apparatus types in the arrangement and appearance of the elements. Detailed study and description of the several other apparatuses present in the Winneshiek Shale are expected to add substantial new information to our most incomplete knowledge about the apparatus organization of other hyaline Darriwilian taxa, which has remained essentially unknown.

Despite the fact that no soft parts have been identified in the Winneshiek specimens, the very large size of the apparatuses (up to 2-4 cm) suggests that the Winneshiek conodont animals reached a substantial size. Comparison with the apparatus size in the soft-part preserved conodont animals from the Carboniferous of Scotland suggests that the Winneshiek animals may have reached a length of 0.5 m or more.

The conodonts from the Winneshiek Shale provide a wealth of new information and this deposit has the potential to become one of the key Lower Paleozoic units for research on conodont apparatus architecture and element morphology.

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