



Filling the Gap Between the Cambrian Explosion and the Great Ordovician Biodiversification Event (GOBE)



Proceedings of the International Geoscience Programme (IGCP) Project 653 Annual Meeting

October 8th–12th, 2017, Yichang, China

Edited by

ZHANG Yuandong ZHAN Renbin FAN Junxuan Lucy A. MUIR



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Guangxiaspis guangxiensis Zhou, 1977 from the Guole *Konservat-Lagerstätte* (Furongian), courtesy of Dr. ZHU Xuejian

Preface

The International Geoscience Programme (IGCP) Project 653 is dedicated to investigating the onset of the 'Great Ordovician Biodiversification Event' (GOBE), by bringing together and sponsoring specialists from all parts of the world to address this perplexing theme. The GOBE, one of the major biodiversification events of the Phanerozoic, was characterized by a magnificent increase in marine biodiversity largely within the phyla established during the 'Cambrian Explosion', and by construction of a complex food web and the eventual establishment of modern marine ecosystems. There have been substantial studies of the diversity changes through the Ordovician; however, one of the remaining questions is when and how the GOBE occurred, i.e. the timing and triggering factors of the event.

The onset of the GOBE seems quite likely to have had its roots in the Furongian (late Cambrian) or even earlier; thus, the question of whether the Cambrian Explosion and the GOBE were two separate events or a single one is a current matter of debate. It has been proposed that at least one significant biotic extinction event occurred immediately prior to or at the beginning of the Furongian, which abruptly terminated a majority of the body plans and many weird organisms that originated during the Ediacaran–Cambrian transition and subsequently dominated the Cambrian ocean. As a result, the Furongian–earliest Ordovician interval was typified by low biodiversity in the ocean, particularly of the most benthic communities; instead, planktonic organisms flourished and predominated. Although most of organisms that diversified in the GOBE, such as trilobites, brachiopods, and echinoderms, appeared in the early Cambrian, other groups of organisms originated in the Furongian–earliest Ordovician interval, e.g. bryozoans, cephalopods, conodonts, chitinozoans, and probably also planktonic graptolites. Was there a 'plankton revolution'? If so, when precisely did this occur? Did the late Cambrian SPICE (Steptoean Positive Carbon Isotope Excursion) event trigger the plankton revolution by means of an oxygenation event? To address these questions, IGCP Project 653 is carrying out an interdisciplinary study of this specific interval, including the palaeontology, stratigraphy, sedimentology, geochemistry, palaeoclimatology, and paleoceanography, with a global scope.

As both the Cambrian Explosion and the GOBE have been the subject of much attention and well documented, now it is time to fill the gap separating these two great events by focusing on research on this poorly understood interval. South China, renowned for the preservation of highly continuous and well-developed successions from the Guzhangian (Cambrian Series 3) to the Upper Ordovician, is among the few classic regions where specialists from all parts of the world can investigate well-exposed sections, discuss critical topics, and figure out possible patterns by participating in the meeting and field trips. In this region, six GSSPs (Global Standard Stratotype-sections and Points) have been established in the past twenty years, for the Guzhangian, Paibian, and Jiangshanian

stages of the Cambrian Period and the Dapingian, Darriwilian, and Hirnantian stages of the Ordovician Period, providing uniquely precise calibration for studies on the onset of the GOBE.

On behalf of the Organizing Committee of the 'IGCP Project 653—Annual Meeting 2017', we would like to thank all the 61 delegates who co-authored 55 abstracts and extended summaries published in this volume and presented 39 talks and 15 posters at the meeting. These proceedings cover a fairly broad range of studies closely related to the onset of the GOBE, especially the palaeobiology, stratigraphy, *Konservat-Lagerstätten*, palaeoecology, ichnology, and geochemistry of this critical transition. We are also indebted to the three keynote speakers, Rudy LEROSEY-AUBRIL, ZHU Maoyan, and Cole EDWARDS, for their extended summaries, and keynote presentations.

We want to thank the following institutions for financial support: the National Natural Science Foundation of China, the State Key Laboratory of Palaeobiology and Stratigraphy (Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences), and the CAS Key Laboratory of Economic Stratigraphy and Palaeogeography. The IGCP Project 653 itself also financially supported a few scholars in need from outside China, and some graduate students and post-docs, to facilitate their participation in the meeting.

Finally, we would like to thank all the presenters, field trip leaders, manuscript reviewers, and volunteers for their participation and contributions, which are essential to a successful meeting.

On behalf of the Organizing Committee,
ZHANG Yuandong, ZHAN Renbin, FAN Junxuan, Lucy A. MUIR

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1 Introduction

The Fezouata *Lagerstätte*, discovered in the Lower Ordovician of Morocco, is a *Konservat-Lagerstätte* of prime scientific importance (e.g. Van Roy et al., 2015; Lefebvre et al., 2016a). It provides access not only to the ‘shelly’ (skeletonised) part of fossil assemblages, but also to non-biomineralised to lightly sclerotised organisms and to exceptionally preserved soft tissues of a complex ecosystem, mixing typical faunal elements of both the ‘Cambrian Explosion’ and the ‘Great Ordovician Biodiversification Event’ (GOBE). The Fezouata *Lagerstätte* is present at different intervals in the Fezouata Shale, a formation ranging from the lower Tremadocian to the upper Floian (Lower Ordovician) (e.g. Martin et al., 2016a; Fig. 1).

Recent papers revised the history of research of the Fezouata *Lagerstätte* (Lefebvre et al., 2016a, b), the biostratigraphy of different fossil groups, including graptolites (Gutiérrez-Marco & Martin, 2016), trilobites (Martin et al., 2016b), palynomorphs, including acritarchs and chitinozoans (Nowak et al., 2016), and conodonts (Lehnert et al., 2016), and