

Lecture 4. The Cambrian Explosion of Life and Rise of Marine Species

Abstract

The oldest macroorganisms known in Earth, after almost 3.5 billion years of microscopic evolution, are the Ediacara Biota (~575 million years ago =Ma), named after the Ediacaran Hills in the Flinders Ranges (South Australia) but also found in Canada, Russia, China and Namibia. Most of these organisms show no mineralization and they reveal very diverse morphologies. However, their phylogenetic relationships, even their assignment to the Animal Kingdom, is still highly controversial. Shortly afterwards, in geological terms, came the Cambrian 'explosion', the event that gave rise to most phyla –highest-rank groups within animals– some 540 Ma. Most fossil localities only preserve shells, exoskeletons or bones, but some exceptional outcrops, known as *Lagerstätten*, preserve soft-bodied organisms, and even their internal organs (gut, blood vessels, nervous system) and other delicate structures (such as eyes or gills). The first –and best studied– such locality described for this period is the Burgess Shale in Canada, but others have been located in China, Greenland and Australia. The only Cambrian Lagerstätte so far known in the Southern Hemisphere is the Emu Bay Shale (515 Ma) in Kangaroo Island (South Australia), and it contains fossils of more than 50 species of those early worms, molluscs, arthropods and chordates.

Biography

Diego graduated in Biology-Zoology (1995) and got a Postgraduate Degree in Palaeontology (1997) from the Complutense University in Madrid. Diego's first contact with Burgess Shale-type fossils was in the summer of 1994, when he visited the University of Cambridge, studying soft-bodied (non-mineralized) fossils from the Lower Cambrian Kinzers Formation of Pennsylvania with Prof. Conway Morris and early Cambrian organic-walled microfossils from northwestern Canada with Prof. Butterfield. During the summers of 1995, 1997 and 2000 Diego excavated at the Burgess Shale (British Columbia) with the Royal Ontario Museum-Toronto, under the direction of Dr. Collins. In parallel with his research on soft-bodied fossils, and due to the scarcity of such type of fossils in Spain, Diego took a different topic for his PhD Thesis: the Palaeozoic Porifera from the Iberian Peninsula (Madrid, 2002). Diego completed a two-year postdoc at the ROM (2003-2004), working with Dr. Collins on some of the Burgess Shale's most emblematic arthropod fossils (like *Marrella* and *Leanchoilia*). Upon his return to Madrid (2005) Diego headed a research project for the Spanish Research Council (CSIC) to search for Ediacaran, Burgess Shale and Orsten-type fossils in Spain, and study their palaeogeographic implications. Diego's latest work comes from collaborations with the South Australian Museum in excavating and studying the early Cambrian Emu Bay Shale Lagerstätte in Kangaroo Island (South Australia), having joined The University of Adelaide in January 2013. In late 2013 he was awarded an **ARC Future Fellowship**, with a 4-year research project entitled "Testing our knowledge on the dawn of Animal life: evidence from the fossil record against modern ecological and morphological analogues". It focuses on comparing the Ediacara Biota with the Emu Bay Shale and other Cambrian Lagerstätten from a palaeocological perspective, and includes experiments on Modern marine invertebrates to test against what we observe in the fossil record.