Fossil secret may shed light on the diversity of Earth's first animals

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Drs. Minter and Bath Enright, of the University of Portsmouth's School of the Environment, Geography and Geosciences, studied the Burgess Shale area of British Columbia, both on location in the field and with laboratory experiments. Credit: Dr. Orla Bath Enright

A large group of iconic fossils widely believed to shed light on the origins of many of Earth's animals and the communities they lived in may be hiding a secret.

Scientists, led by two from the University of Portsmouth, UK, are the first to model how exceptionally well preserved fossils that record the largest and most intense burst of evolution ever seen could have been moved by mudflows.

The finding, published in *Communications Earth & Environment*, offers a cautionary note on how palaeontologists build a picture from the remains of the creatures they study.

Until now, it has been widely accepted the fossils buried in mudflows in the Burgess Shale in Canada that show the result of the Cambrian explosion 505 million years ago had all lived together but that's now in doubt.

The Cambrian explosion was responsible for kick-starting the huge diversity of animal life now seen on the planet.

Now, Dr. Nic Minter and Dr. Orla Bath Enright have found that some of the animals which became fossils could have remained well preserved even after being carried large distances, throwing doubt on the idea the creatures all lived together.

Dr. Minter said: "This finding might surprise scientists or lead to them striking a more cautionary tone in how they interpret early marine ecosystems from half a billion years ago.

"It has been assumed that because the Burgess Shale fossils are so well preserved, they couldn't have been transported over large distances. However, this new research shows that the general type of flow

responsible for the deposits in which they were buried does not cause further damage to deceased animals. This means the fossils found in individual layers of sediment, and assumed to represent animal communities, could actually have been living far apart in distance."

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The site is an area rich in fossils entombed in the deposits of mudflows and is one of the world's most important fossil sites, with more than 65,000 specimens already collected and, so far, more than 120 species counted.

The Burgess Shale area has been fundamental to scientists in understanding the origins of animal groups and the communities they lived among and has been closely studied multiple times.

The researchers, together with collaborators from the Universities of Southampton and Saskatchewan in Canada, used fieldwork to identify how the mudflows would have behaved, and then used flume tank laboratory tests to mimic the mudflows and are confident that the bodies of certain creatures could have been moved over tens of kilometres without damage, creating the illusion of animal communities which never existed.

The Burgess Shale was discovered in the early 1900s and led to the idea of the 'Cambrian explosion' of life, with the appearance of animals representing almost all the modern phyla, and inspiring copious research and discoveries.

Dr. Bath Enright said: "Many would argue that it is fundamental, even ground zero for scientists in understanding the diversity of life."

It's not known precisely what caused the mudflows which buried and moved the animals which became fossilised, but the area was subject to multiple flows, causing well preserved fossils to be found at many different levels in the shale.

"We don't know over what kind of overall time frame these many flows happened, but we know each one produced an 'event bed' that we see today stacked up on top of one another. These flows could pick up

animals from multiple places as they moved across the seafloor and then dropped them all together in one place," said Dr. Bath Enright.

"When we see multiple species accumulated together it can give the illusion we are seeing a single community. But we argue that an individual 'event bed' could be the product of several communities of animals being picked up from multiple places by a mudflow and then deposited together to give what looks like a much more complicated single community of animals.

"Palaeontologists need to appreciate the nature of the sediments that fossils are preserved within and what the implications of that are. We could be overestimating the complexity of early marine animal communities and therefore the patterns and drivers of evolution that have led to our present day diversity and complexity."

The researchers hope to do further study to investigate whether differences in the species that are present in other fossil sites are due to evolutionary changes through time or the nature of the flows and the effects of transport and preservation of the fossils.

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