

When Life Got Big: the Mistaken Point Assemblage of Newfoundland (Ediacaran, 579-560 Ma)

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The Mistaken Point assemblage marks a fundamental watershed in the history of life on Earth – the first appearance of abundant large eukaryotes after 3 billion years of mostly microbial evolution. It contains the oldest large eukaryotes (>579 Ma) and the most diverse deep-water assemblage of Ediacaran macrofossils known anywhere on Earth, and thus is probably the most important site worldwide for studying the early evolution of macroscopic life.

Simple discoid Ediacaran fossils were first described from downtown St. John's by Elkanah Billings more than a century ago, but it was the discovery of older and more complex fossils at Mistaken Point on the south-eastern tip of the Avalon Peninsula during fieldwork by S.B. Misra that vaulted the Mistaken Point assemblage onto a world stage. The Mistaken Point assemblage is currently known from numerous localities in the Avalon Peninsula of Newfoundland and from nearby Bonavista Peninsula. The organisms were benthic and soft-bodied, and lived on a muddy deep sea floor far below either storm wave base or the photic zone. They died when they were instantaneously covered by beds of volcanic ash, preserving entire communities in place and thus permitting use of modern techniques in ontogenetic analysis and spatial ecology on fossil assemblages more than half a billion years old. Several of the ash beds have been dated utilizing high-precision U/Pb analysis of zircons, providing a precise chronology of the first 15 million years of the evolution of large eukaryotes.

The oldest-known Mistaken Point fossils consist of metre-long fronds and other fossils that occur several hundred meters below a volcanic ash dated at 579 Ma. This is only 3 million years after the final Neoproterozoic ice age (Gaskiers glaciation; 582 Ma) and is directly associated with geochemical evidence for a massive oxygenation event in the deep sea, providing a probable causal link between late Neoproterozoic glaciation, oxygenation, and the advent of large eukaryotes.

Most of the fossils in the Mistaken Point assemblage are rangeomorphs, an extinct clade (“failed experiment”) utilizing self-similar branching elements that were used as modules to construct an array of taxa with highly divergent shapes. Two broad morphologic groupings can be recognized within the rangeomorphs: the rangids (e.g. *Fractofusus*, *Avalofractus*, *Bradgatia*) and the charnids (e.g. *Charnia*, *Trepassia*). Ontogenetic analyses of bedding-lane populations show that rangids grew mainly or exclusively by inflation, but charnids grew through a combination of addition of new structures and inflation of older structures. Rangeomorph communities were similar to those of modern suspension-feeding animals, implying that rangeomorphs may have been stem-group animals, but there is no evidence for guts, brains, or mobility among any of the taxa. Rangeomorphs dominated early and deeper-water Ediacaran communities worldwide, but declined throughout the Ediacaran and apparently disappeared at or before the Cambrian explosion of shelly and burrowing animals.