

Helicity of Charophyte gyrogonites through time

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The fossil record of the charophytes or stoneworts is based on the calcified female fructifications, termed gyrogonites. The basic structure of all recent gyrogonites consists of strictly five enveloping cells that twist around the inner egg cell in a clockwise direction. Because the spirals appear in lateral view to climb upwards from right to left, this type is conventionally called sinistral or “sinistrorse”. Dextral gyrogonites, with spiral cells that are counter-clockwise twisted, were restricted to the Palaeozoic. In contrast to the very conservative vegetative structure of the plant's thallus, the gyrogonites underwent significant changes that are of phylogenetic and biostratigraphical interest.

The oldest charophytes are documented from the Late Silurian in Ukraine and in Sweden. The most primitive morphology attributed to the charophytes displayed vertical and even segmented enveloping cells. However, dextral gyrogonites already coexisted with this primitive type. The hitherto oldest sinistral gyrogonites were found in the Middle Devonian of Canada. Although the biogeographical distribution of the Palaeozoic charophytes makes evidence that the clockwise coiled gyrogonites expanded rapidly whereas the counter-clockwise coiled did regress, both types of helicity were present until the Late Permian.

The Permian-Triassic Boundary event (250 My ago), which is currently considered the most catastrophic biological crisis of the Earth's history, also marked the definite extinction of the dextral charophytes. The possible force that caused the selection of only one type of chirality of the gyrogonites remains speculative (Soulié-Märsche, 2004).

From the P/T boundary onwards up to Present, all charophyte gyrogonites display the modern coiling pattern composed of five enveloping cells surrounding the egg cell in a clockwise direction. Despite this simple basic structure, the mesozoic charophytes show large patterns of variation, which are classified into four different families and about 50 genera. During the Cretaceous, a very particular group, the Clavatoraceae family, displayed fructifications in the form of a complex utricle composed of an inner gyrogonite with five sinistral spiral cells surrounded by additional calcified vegetative cells.

The Cretaceous-Tertiary boundary event (the K/T crisis, 65 My ago) caused the extinction of the Clavatoraceans. Since the beginning of the Tertiary, progressive reduction of the morphological types led to the relatively poor modern flora classified as a single family with seven genera.

References

- Soulié-Märsche, I. 2004: Charophyte gyrogonites, the result of enantioselective influence 250 Million years ago. In: Palyi, G., Zucchi, C. & Caglioti, L. (eds), *Progress in Biological Chirality* p. 365-375. Elsevier Publ., Oxford.