CLIMATE AND BIODIVERSITY IN THE EARTH HISTORY: KEY EVENTS AND NEW FINDINGS

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Traces of interactions of climate and life in the geological record continue to offer surprises that may indicate causative links. Conventionally, early Earth has been considered to be a warm place due to high content of the greenhouse gases in the atmosphere, with CO_2 content about 70 times the current level. However, a study by Rosing et al. (2010) argues that the ancient CO_2 content was no more than 3-4 times higher than today based on the thermodynamic modelling of Fe-minarals found in old sediments and atmospheric constraints. In spite the lower amount of the solar energy reaching the Earth during the early history because the Sun was about 25-30% less luminous, the smaller area of continents and clearer skies due to absence of biogenic cloud condensation nuclei resulting in lower planetary albedo prevented the Earth to turn into a snowball before the first global glaciation near the end of the Archean, about 2.9 billion years (Ga) ago. An earlier study (Rosing & Frei, 2004) had suggested that the oxygen-producing, photosynthesizing microorganisms may have evolved already 3.8 Ga ago.

According to the Snowball Earth hypothesis, during one to three times, the Earth was completely or almost completely covered by a global ice sheet during the Cryogenian period in late Proterozoic, about 850-650 million years ago (Ma). During the following Ediacaran period, 650-542 Ma, the Earth melted, and became a cradle of multicellular life. According to new interpretations, most Ediacaran organisms belong to a stem-group of Metazoa that had part of the regulatory genes generating body plans somewhat similar to some Cambrian Metazoa (Erwin, 2009).

Since 542 Ma, the most relevant episodes that shaped the biotas on the Earth were the Cambrian and Ordovician diversifications, and the Ordovician diversification, and the conquest of land from the Ordovician to the Devonian. The diversification of life was interrupted by several mass extinction events (Bambach, 2006), of which the largest ones occurred in the end of the Ordovician (440-450 Ma), Late Devonian (360-375 Ma), end of the Permian (251 Ma), end of the Triassic (205 Ma) and end of the Cretaceous (65 Ma). It has been suggested that global cooling caused or contributed to the end- Ordovician, late Devonian anf Permian-Triassic extinctions, and, possibly, some others. All these extinction events have been followed by the episodes of biotic recovery usually lasting about 10-15 millions of years. These interactions between climate and living systems, with certain dramatic episodes, have been relevant for shaping the diversity of life in the Earth history, including the life as we know it today.

References

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