SCIENCE CHINA
Earth Sciences

• PREFACE •

December 2010 Vol.53 No.12: 1747–1749
doi: 10.1007/s11430-010-4077-x

Evolution of marine and terrestrial geobiodiversity in the history of the earth

People have long been curious about the history of life on the earth—how many different species have existed, when they first occurred, how they evolved over geologic time, and how they reacted to major environmental crises. Although tremendous progresses have been made during the past decades, mysteries in evolution of life abound that remain to be deciphered. Millions of different types of organisms that inhabited the earth during the long geologic time have been recorded. Scientists have strived to develop the principles and theories in helping us understand how life has evolved in response to its living environment. Life on earth originated from organic structures more than three billion years ago and was first developed in the sea. All inferences of terrestrial ecosystem prior to the Middle Silurian come from indirect evidence. From the Middle Silurian onward, vascular plants began to develop on land. Since then, the marine and terrestrial ecosystems have become the two most important interplayed parts of the biosphere. The co-evolution of marine and terrestrial biodiversities as well as interactions with their living environments has become one of the most intriguing subjects for paleontologists, for it bears importantly on understanding current, and anticipating future, human-induced environmental changes.

During the past three decades, one major breakthrough in paleontology is the establishment of the database of the Phanerozoic marine fossil invertebrates by Jack Sepkoski. He and his colleagues recognized in 1980s that the stratigraphic distributions of biodiversity during the Phanerozoic is very uneven based on numbers of marine families within 91 metazoan classes known from the Phanerozoic fossil record. The geologic record displayed that geobiodiversity rapidly increased after the Snowball Earth in the Neoproterozoic. It was succeeded by an intriguing array of extinctions, biological radiations, and biogeographic shifts that have restructured ecosystems in the context of atmospheric chemistry, oceanic structures, land-sea configurations and changing climates. This kaleidoscopic history reflects the constant interaction between life and environment. Since then, study of the interplay between life and environment during the long history of the earth has been regarded as the key to unraveling the mechanism of biological evolution. It is also emerging as an especially important field in earth sciences.

Although major discoveries in paleontology have been made in China during the last three decades, progress has been slow in the area of macroevolution studies because of lack of integrated approaches. Thus, it is reasonably expected that the study of biodiversity evolution in the earth history would have progressed more rapidly and broadly if paleontologists with varied interests and expertise had worked together. Many major scientific problems that otherwise would have eluded a specialist on a narrow fossil group alone have recently become possible to tackle, thanks to the cooperation among paleontologists studying different fossil groups and the collaboration with experts in related fields such as geochemistry, plate tectonics, paleoclimatology and geochronology. The value of integrative research on the earth-life system is quite evident.

China is one of a few countries with the most complete geologic record containing the most abundant fossil resources. Previous studies of biodiversity patterns largely neglected the data from China. This is unfortunate, for regional studies certainly bring to light global phenomena because global patterns are pieced together through integration of regional studies. To investigate major biological evolutionary patterns in China, a first National Basic Research Program of China (973 Project) entitled “Origin, radiation, extinction and recovery of critical intervals during the geologic time” was funded by the Ministry of Science and Technology (MST) of China in 2000. This represents the first large national project on paleontology. More than 70 Chinese colleagues joined the project and focused their studies on paleontology based on geologic records in China. The project successfully achieved a number of breakthroughs and significant discoveries in the studies of the origin and radiation of life, the mass extinctions and their subsequent recoveries in the Phanerozoic. On the basis of the great success of the first 973 Program, the second 973

