

Early evolution of coral reefs inferred from the results of drilling study of a deep-sea carbonate mound

Akihiro Kano[1]

[1] Earth and Planetary Sys. Sci., Hiroshima Univ

Active oceanic researches from late 1990s have observed coral community and its related highly-diverse fauna on deep-sea floor down to 1000m in depth. Now, ubiquitous distribution of the coral mounds is recognized in northeastern Atlantic. Porcupine Seabight in Irish offshore is one of the mound areas, and the Challenger Mound occurring on this seabight was selected the first target of drilling study by IODP Expedition 307. Sediments corrected from the summit of the mound reveals that the thickness of calcareous coralline deposits exceeds 150m. One of the most important outcomes from the subsequent research is Sr-isotopic dating revealing that the Challenger Mound had started growing from 2.6Ma (Kano et al., 2007). This is the age of intensification of the Northern Hemisphere Glaciation.

On the other hand, oceanographic study in Porcupine Seabight recognized that a distinct density gradient occurs at the depth of the coral mounds. This was developed by intermediate water originated from saline water from Mediterranean (Mediterranean Outflow; MO). It is noteworthy that MO enhances nutrients and primary productivity in upper layer of the NE Atlantic. Phytoplankton sinking down through the water column tends to stagnate around the density gradient, and provide food for zooplanktons that are further feeded for deep-sea corals. Combining the results from this oceanographic study and the drilling project, establishment of the coral mounds was reasonably interpreted with the model that links the intensified glaciation with development of MO.

Tropical-subtropical coral reefs are developed in shallow water, because reef-building corals require the light. However for coral reefs (or organic reefs) in a broad sense, shallow water is not the requirement. If the reef-building filter feeders lacked symbiotic algae, they rather required the abundance in food. Therefore, oceanographic and ecological consequence is that calcareous depositional bodies can be developed at the density gradient where abundance in zooplanktons is expected.

Examples supporting this hypothesis are the middle Paleozoic mud mounds. They are the carbonate bodies developed in inland and marginal seas of the Gondwana, and surrounded by clastic sediments that lack shallow water sedimentological structures. Salinity rise due to strong evaporation was expected in the inland sea that located at low latitude. Seawater having high salinity developed deepwater and the mud mounds were formed at depth of the resultant density gradient. Shallow water carbonate of Ordovician shows biofacies dominated by microbes. The Paleozoic reef metazoans that evolved in this period may have first inhabited in deep-sea environments, and later were rising up to the shallow environments by the symbiosis.