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Establishment of deep-water coral mound and evolution of early animals

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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. One of the prominent mound areas is Porcupine Seabight in Irish offshore where the mounds develop in a depth around the boundary between the surface water and the saline intermediate water (Mediterranean Outflow; MO). In order to specify the oceanographic conditions for mound development, the Challenger Mound occurring on this seabight was selected as the first target of drilling study by IODP Expedition 307. Sediments corrected from the summit of the mound penetrated the calcareous mound more than 150m thick. Results of Sr (Kano et al., 2007) and oxygen isotopic revealed that the mound had started growing from 2.3Ma when the Northern Hemisphere Glaciation was intensified. This timing support the importance of density gradient around the mound depth, which was established together with the modern ocean circulation, e.g. intensified NADW.

Primary production in Porcupine Seabight is high. Phytoplankton sinking down through the water column tends to stagnate around the density gradient, and provide food for zooplanktons that are further feuded for deep-sea corals (White, 2007). This is the crucial link between water-mass structure and coral community. Combining the results from oceanographic studies 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.

Scenario for the deep-water coral mounds may provide an analog for evolution of the early animals in late Neoproterozoic. Ocean after the Snowball Earth was eutrophic, stratified, and therefore reserved a huge mass of particulate organic matter (Rothman et al., 2003). The organic reservoir could be the food for animals, which might have stimulated multicellularization of protozoan. This scenario is a new paradigm for the animal evolution, which is consistent to broad temporal coincidence to the glaciation, and to filter feeding habits of the two most primitive animals (porifera and cnidaria). The scenario also explains updated fossil records of the Ediacaran period.