Discovery of submerged coral reefs on an insular shelf, southwest of Kikai Island: toward the IODP Ryukyu coral reef drilling

Hiroki Matsuda[1]; Kohsaku Arai[2]; Takahiko INOUE[3]; Hideaki Machiyama[4]; Keiichi Sasaki[5]; Yasufumi Iryu[6]; Kaoru Sugihara[7]; Kazuhiko Fujita[8]; Masakazu Nara[9]

[1] Dept. Earth Sci., Grad. Sch. Sci. Tech., Kumamoto Univ.; [2] GSJ, AIST; [3] AIST, IGG; [4] KOCHI/JAMSTEC; [5] Cultural Properties & Heritage, Kanazawa Gakuin Univ.; [6] Inst. Geol. Paleontol., Tohoku Univ., Sendai; [7] Earth System Science, Fukuoka Univ.; [8] Univ. Ryukyus; [9] CMES, Ehime Univ.

Coral reefs are tropic to subtropic coastal ecosystems comprising very diverse organisms. Their community structure is highly controlled by various environmental factors such as water temperature, depth, irradiance, salinity, nutrient level, terrigenous input, and substrate. When all environmental factors will be favorable to the reef community, reefs initiate and grow up. To the contrary, even minor environmental deterioration will have great influences on reef builders at the limit of reef formation, resulting in the demise of reefs. Consequently, the reefs at the latitudinal limits of coral-reef ecosystems (the ”coral-reef front”) are particularly sensitive to environmental changes, associated with glacial-interglacial changes in climate and sealevel, than those in low-latitude areas. It can be considered that the coral-reef front may have migrated to higher and lower latitudes, respectively, responding to Pleistocene global warmings and coolings associated with rapid, cyclic changes in climate and oceanographic conditions and with glacioeustatic sea-level rises and falls. The COREF (coral-reef front) Project is designed to clarify the nature, magnitude and driving mechanisms of coral-reef front migration and to clarify the ecosystem response of coral reefs to Quaternary climate changes on the basis of ocean (IODP) and land (ICDP) drilling into these Quaternary reef deposits in different settings in the Ryukyus.

As a preparatory research of the COREF Project, we conducted high-resolution seismic survey, bathymetric mapping, and direct observation using ROV (remotely operated vehicle) both off the east coast of the northern Amami-o-shima Island and the southwest coast of the Kikai Island in the northern part of the Ryukyu Arc in last October. These two areas are most significant sites for the COREF Project, because they are close to the present-day northern limit of coral reef formation in the northwestern Pacific. In this survey, reef rocks, which are considered submerged coral reefs, were discovered at water depth from 70 to 100 m on the outer shelf to shelf edge off the southwest coast of the Kikai Island. They have several topographic highs, which are characterized by irregular mound-shaped structure, strong reflection of seafloor, and internal chaotic reflections. Seismic profiles show that those reef rocks are up to 10 ms thick in two-way travel time (ca. 15 m) and range from 200 to 400 m in width. The ROV observation also reveals that the topographic highs are a complex of mound-shaped reef rocks with very irregular surfaces. They are composed of a variety of reef-building organisms, such as hermatypic corals and coralline algae, and some living algae encrusts on their surfaces. Each mound-shaped reef rock ranges a few to 10 m in height and from 5 to 100 m in width. These reef rocks are surrounded by coarse-grained carbonate sediments forming dunes.

A modern coral reef, Ugami Reef, is present to the northeast of these reef rocks. Water depth gradually increases from the modern reef to the shelf edge, accompanied with the reef rocks. It is well known that Kikai Island has been elevated at a high uplift rate of maximum 2 m/kyr since the last interglacial period. Therefore, the present shelf edge at water depth from 70 to 100 m is considered to have situated in shallow marine environments suitable to the reef formation during the last glacial period. Inagaki et al. (2005) reported that corals reefs formed in a late Pleistocene glacial period (MIS4) on Kikai Island, and Sasaki et al. (2006) clarified that corals reefs existed in the last glacial period (MIS2) off Irabu Island in the South Ryukyus. From these facts, there is a possibility that the irregular reef rocks are remnants of coral reefs formed in the last glacial period, and that the coral reefs on the shelf edge were submerged with a rapid sea-level rise after the last glacial period.