

High-resolution multibeam bathymetric survey for coastal seafloor geomorphology and related sciences

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The geomorphology of shallow coastal regions has been modulated by repeated subaerial and submarine processes during glacio-eustatic sea-level change. However, in contrast to the vast knowledge that has been accumulated regarding terrestrial landforms, few previous studies have dealt with shallow seafloor landforms, which represent former terrestrial landscapes modified by present marine processes, from a geomorphological perspective.

A broadband multibeam echosounder (Sonic 2022, R2 Sonic, LLC) and its accessory system were introduced to H. Kan's laboratory in 2010 using JSPS Grant-in-Aid for Scientific Research A. We have carried out our bathymetric survey in Kume, Ishigaki, Kikai Islands and the southeastern and northwestern coasts of Okinawa Island in the Ryukyus, southwestern Japan since 2010.

The Sonic 2022 has a variable ultrasonic frequency of 200 to 400 kHz, 256 ultrasonic beams and selectable swath coverage of 10 to 160 degrees. The typical ultrasonic beam widths parallel and orthogonal to the direction of travel are within one degree of each other when an ultrasonic frequency of 400 kHz is selected. We used a VS111 GPS compass system with A20 and A30 antennas (Hemisphere Inc.) combined with a dynamic motion sensor (DMS-10, Teledyne TSS Ltd.), a sea surface sound velocity sensor (miniSVS, Valeport Ltd.), a sound velocity profiler (MicroSVP, AML Oceanographic Ltd.). Overlap of at least ~20% (typically ~50%) was implemented throughout the bathymetric survey to ensure 100% coverage of the surveyed area. The minimum and maximum depth was 1m and 400m, respectively. The HYPACK2010 software was used for both hydrographic survey and data processing. IVS3D Fledermaus was used for three-dimensional visualization.

We conducted geomorphological studies of the coastal seafloor in the coral reef areas of the Ryukyu Islands based on our high-resolution bathymetric map with a grid size of 1 m combined with SCUBA diving observations. For example, the submerged tropical karst features were discovered in Nagura Bay, Ishigaki Island (Kan *et al.* 2015). This is the first description of submerged humid tropical karst using multibeam bathymetry. Along with the geomorphological studies, we have also started biological and archeological studies in our bathymetric areas to promote interdisciplinary researches which link natural and human sciences.

Keywords: multibeam ecosounder, coastal seafloor geomorphology, biology, archaeology, coral reefs, Ryukyu Islands