Preliminary Study on the Holocene Carbonate Deposition of Taiping-Dao, Nansha(Spratly) Islands

Shou-Yeh Gong¹, Chao-Shing Lee², Chin-Li Su², Chung-Han Hu²
¹.Dept. of Geology, National Museum of Natural Science
².Institute of Applied Geosciences, National Taiwan Ocean University

Abstract

Taiping-Dao, the largest islet of the Nansha Islands of South China Sea, is a sand cay developed on Holocene coral reef. Reef-flat surface of the islet was surveyed. Most of the flat is covered by coral cobbles/shingles and bioclastic sands; living corals only occur along the margin. Carbon 14 dating of reef rocks taken on the reef-flat surface and in drill cores indicates that the Holocene reef development began about 7.9 ka and the reef flat and sand cay might have started to build up 4.7 ka and kept expanding in a progradation mode since then.

Introduction

Taiping Dao, located at 10°23’N and 114°22’E, is the largest islet of the Nansha Islands, South China Sea. The islet is at the northwest margin of the Zheng He Reef, and measures about 1350 m in NE-SW direction and 350 m in NW-SE direction at its maximum. The subsurface sequence of Taipiong-Dao consists of entirely carbonate sediments and developed under the impacts of Pleistocene glacio-eustasy (Gong et al., 2003, Gong et al., 2005). In this presentation, we report the preliminary results of our survey on the Holocene sedimentation of Taipiong-Dao.

Results

The islet itself is entirely covered by bioclastic sands and guano deposits. Beaches form all around the islet, however beach rocks only develop along the north coast. Except for being slightly cemented, and being stained by guano and humus matter, the sands on the island are basically the same as the beach sands in terms of grain size and constitutes. Both are composed of fine- to medium-grained bioclastic sands mostly derived from corals. Evidently, the islet is capped by sand cay above coral reef and stabilized by vegetation in its latest stage of development.

On the reef flat, the surface sediments vary from inner flat to outer flat as shown in Figure 1. The sedimentary facies, from inner to outer flat, can be identified to be: (1) bioclastic sands/gravels, (2) bioclastic sands/gravels with sparse sea grass, (3) bioclastic sands/gravels with dense sea grass, (4) coral boulders/shingles, (5) living reefs. It is evident that the wave energy reduces from the outer flat to the inner flat. The facies pattern is basically similar on all sides of the Taiping Dao. There are no obvious windward or leeward characteristics observed. Except for the beach rocks, the distinctions between the lagoon and open water coasts are also insignificant.

The biocalstic sands/gravels are commonly stabilized by sea grass *Thalassia* on the inner to middle part of the reef flat. The distribution of sea grass differs from that of previous study (Lewis and Lin, 1994). Whether this is a seasonal feature or a long-term
trend requires further study. If we ignore the sea grass factor, the sedimentary facies on
the reef flat can be simplified as living reef along the margin, coral shingles/boulders on
the outer flat and bioclastic sands/gravels on the inner flat.

Short borehole cores were taken on the reef flat and thin-sections were made. The
locations of the cores are plotted in Figure 1. In four of the cores, pristine corals were
recovered for AMS-C\(^{14}\) dating. The radiocarbon ages were corrected using CALIB
Program v.5.0.1 by Stuiver and Reimer, and listed in Table 1. The inner flat is dated
from 3718±92 cal yrBP to 3075±105 cal yrBP, while the outer flat is dated to be
1193±71 cal yrBP.

It caught our attention that the reef-flat development is only active along the
margin where living corals occur below 2m in water depth. There are ver scarce living
corals on the reef flat, except for occasionally occurring micro-atolls of \textit{Porites} corals.
This observation is consistent to report by Dai and Fan (1994). Dai and Fan (1994)
pointed out that the paucity in coral abundance had not resulted from fishing or other
human activities.

In reefs of the Indo-Pacific areas, the reef flats, especially the inner flats, are
typically the places of high abundance of living corals. The lacking of living corals on
reef flat of the Taiping Dao is unusual and therefore requires explanation. According to
our preliminary measurements and previous reports (Chen and Huang, 1981; Chen and
Hsia, 1982), we tentatively consider high sea-surface temperature is the reason for
paucity of living corals on reef flat of the Taiping Dao.

Short cores drilled on the reef flat reveal that, below a thin veneer of sediments, the
reef flat is mostly composed of algal-coral boundstones and well lithified. Such
occurrence suggests that the flat is truly built by reef growth but not sediments
accumulation, and its upward growth has ceased. The preliminary results of AMS-C\(^{14}\)
dating (Table 1) also indicate the reef flat has ceased its upward development a few
thousands years ago, and likely developed in a progradation mode. Whether the cease
of upward growth is due to diminishing space limited by sea level, or due to that
sea-surface has been too warm for a few thousands years requires further study.

\textbf{References}

Chen, T.S. and S.T. Huang, 1981: The study and investigation of fishery resources at
Spratly Islands (Nan-Sha-Chuan-Tao), \textit{2}, 55pp. (in Chinese)

Chen, C.H. and W.L. Hsia, 1982: The study and investigation of fishery resources at
Spratly Islands (Nan-Sha-Chuan-Tao), \textit{3}, 73pp. (in Chinese)

(in Chinese)

Gong, S.-Y., H.S. Mii, T.F. Yui, F.W. Huang, P.K. Torng, W.R. Chi, S.T. Huang, S.W.
Wang, K.M Yang and , J.C. Wu, 2003: Deposition and Diagenesis of Late Cenozoic
Carbonates at Taipingdao, Nansha (Spratly) Islands, South China Sea. \textit{Western

Gong, S.Y., H.S. Mii, K.Y. Wei, C.S. Horng, C.F. You, F.W. Huang, W.R. Chi, T.F. Yui,
P.K. Torng, S.T. Huang, S.W. Wang, J.C. Wu and K.M Yang, 2005: Dry climate
near the Western Pacific Warm Pool: Pleistocene caliches of the Nansha Islands,
South China Sea. \textit{Palaeogeogr. Palaeoclimatol. Palaeoecol.}, \textit{226}, 205-213..
Table 1. AMS radiocarbon dating of fossil corals from reef-flat surface and drill cores of the Taiping-Dao.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>material</th>
<th>radiocarbon age</th>
<th>calibrated age</th>
</tr>
</thead>
<tbody>
<tr>
<td>East-1</td>
<td>coral</td>
<td>3856±30 BP</td>
<td>3718±92 yrBP</td>
</tr>
<tr>
<td>West-3</td>
<td>coral</td>
<td>3483±35 BP</td>
<td>3273±86 yrBP</td>
</tr>
<tr>
<td>West-5</td>
<td>coral</td>
<td>3322±35 BP</td>
<td>3075±105 yrBP</td>
</tr>
<tr>
<td>West-7a</td>
<td>coral</td>
<td>1712±30 BP</td>
<td>1193±71 yrBP</td>
</tr>
<tr>
<td>-9 m</td>
<td>coral</td>
<td>4662±55 BP</td>
<td>4761±115 yrBP</td>
</tr>
<tr>
<td>-11.8 m</td>
<td>coral</td>
<td>4757±65 BP</td>
<td>4924±104 yrBP</td>
</tr>
<tr>
<td>-21 m</td>
<td>coral</td>
<td>7487±30 BP</td>
<td>7864±87 yrBP</td>
</tr>
</tbody>
</table>
Figure 1. Sedimentary facies of the islet and reef flat of Taiping Dao, Nansha Islands.