III. ^{14}C APPLICATIONS

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RADIOCARBON PROFILES OF ROCKY ISLET, XI-SHA ISLANDS: EVIDENCE OF RECENT CRUSTAL MOVEMENTS IN THE SOUTH CHINA SEA

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The Xi-Sha Islands comprise 35 coral reefs, cays, and islets lying to the northwest of the South China Sea. Since Miocene time, > 1200m of bioherms developed on slowly subsiding granite-gneiss bed rock. These sediments provide evidence for sea-level changes and crustal movements in the South China Sea.

GEOLOGIC SETTING

According to an echo sounding survey, the Xi-Sha Islands consist of eight coral reefs scattered regularly around a northeast to northwest trend line. This suggests that the growth of these reefs is tied to the regional tectonic trend and relates to the evolution of the South China Sea.

Rocky Islet and Yong-Zing Islet lie on the same reef flat in the Xuan-Dei Islands to the north of the Xi-Sha Islands. The distance between both islets is only ca 1000m, but the geomorphology of both islets are quite different. Rocky Islet consists of cemented bioclastic limestone and its maximum elevation is 15m, the highest of the Xi-Sha Islands. Rocky Islet is surrounded with cliffs except in the southeast. An unconformity boundary exists in the strata at 8 to 10m elevation. The Yong-Xing Islet is a sandy cay with vegetation, consisting of uncemented coral-shell sands 20 to 22m thick. At the center of the islet the elevation is only +3 to +5m. These factors suggest that an active fault existed between both islets under the reef flat. Due to the vertical movements of this fault, Rocky Islet was uplifted and emerged, as illustrated in figure 1.

RADIOCARBON AGE DETERMINATIONS

Thirty samples obtained from three profiles of Rocky Islet have been ^{14}C dated, using the ^{14}C half-life of 5568 years. The first results were rather surprising because the ^{14}C age of the profiles were reversed, ie, the lower strata were younger than the upper strata (fig 2). Such an anachronism can be explained by the depositional process, as illustrated in figure 3.

The bioclastic limestone on the Rocky Islet seems to be lithified under air and has been dissolved and leached by rain

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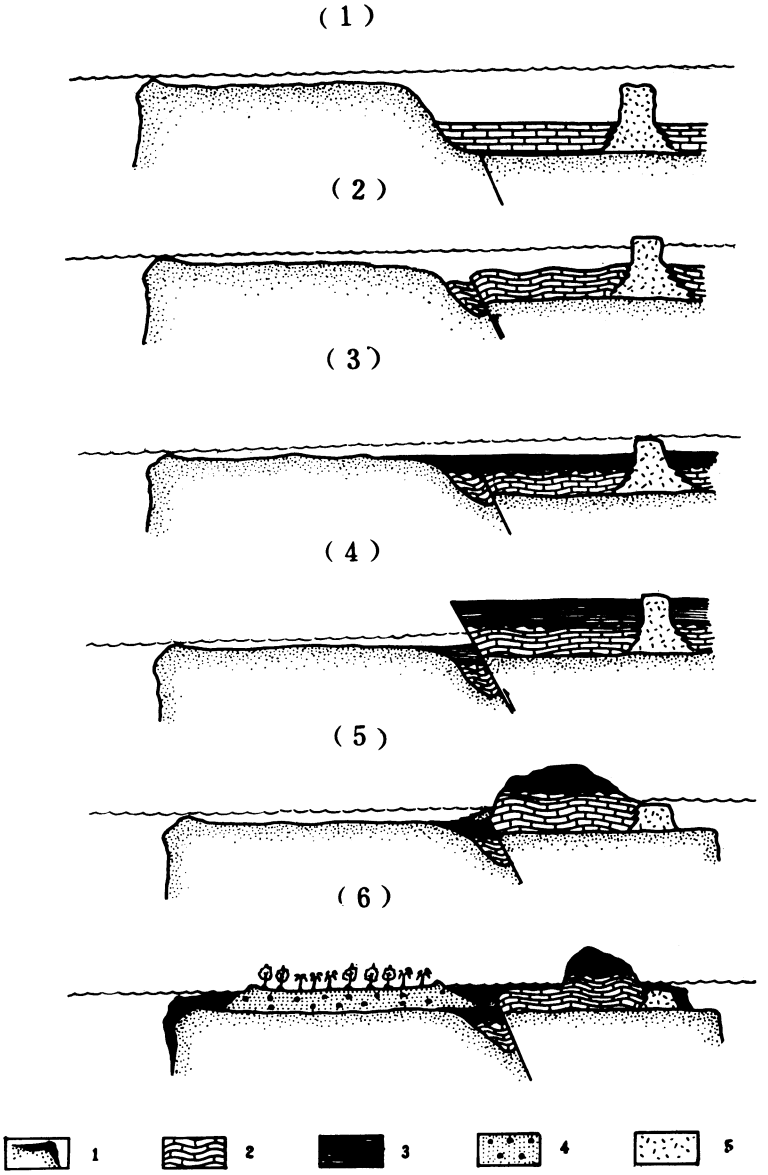

Fig 1. Stages of development of Rocky and Yong-Xing Islets. Key: 1) reef limestone and modern reef flat; 2) lower bioclastic limestone; 3) upper bioclastic limestone; 4) coral-shell sand; 5) reef patch

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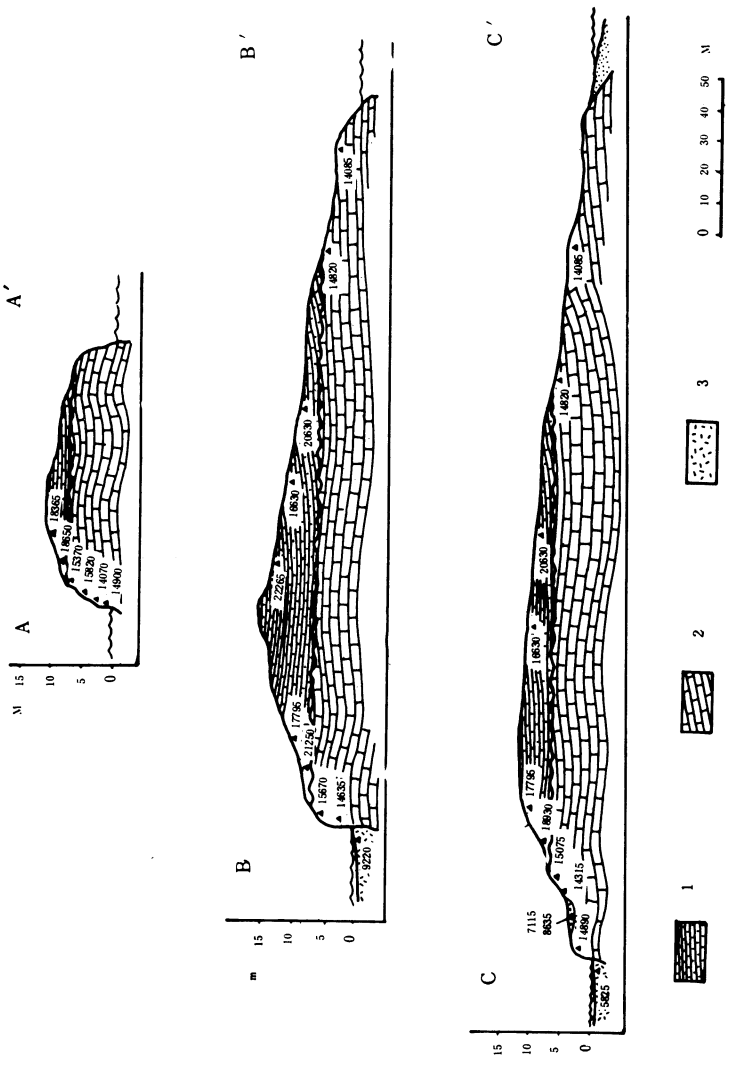

Fig 2. ^{14}C profiles of Rocky Islet.
Key: 1) upper bioclastic limestone;
2) lower bioclastic limestone;
3) coral conglomerate and reef limestone

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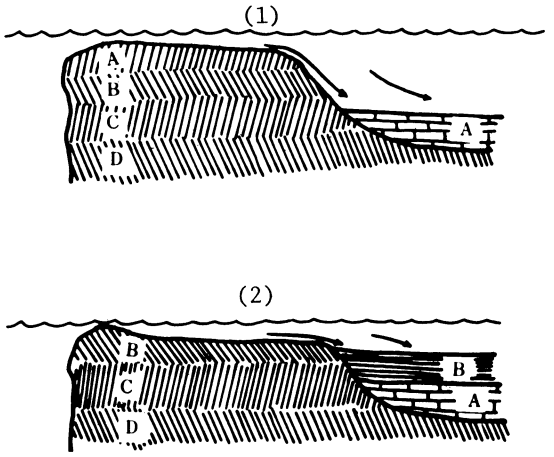

Fig 3. Deposition in a lagoon showing the formation of an anachronistic profile

water. Based on the proportion of cements within the samples, we assume that the maximum proportion of contamination by modern carbon was possibly up to 20%. Thus, we must add 7000 years to the ^{14}C ages for 16,000-year-old samples. Thus, the corrected ages of the lower strata should be 21,000-23,000 yr BP. If the upper strata were deposited 2000 yr after the former, then the ages of the upper strata should be 19,000- 21,000 yr BP.

ESTIMATE OF UPLIFT RATES

In order to estimate the uplift rates, we must establish the position of sea level during the deposition of sediments. From the echo-sounding data, two submarine terraces were recognized at depths of 20 to 25m and 50 to 60m. We deduce that both submarine terraces were probably formed during a time when glacially-lowered sea level transformed these atolls into temporary high islands. We believe that the submarine terraces of 20 to 25m were formed during the Würm glaciation, ie, the level of the sea, while depositing bioclastic limestone, was 20m below the present level. If the depth of the lagoon where bioclastic limestone was deposited is assumed to be 10m, the range of uplift of Rocky Islet would be 45m and the mean uplift rate, ca 2.25m/1000 yr.

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DEVELOPMENT STAGES

Stages of development on Rocky Islet and Youn-Xing Islet are illustrated in figure 1. Because the atolls that had developed were destroyed by submarine volcanoes and faulting during the Pleistocene, the ring feature of the atoll seems to have disappeared in the Xuan-Dei and Eastern Islands although it remained in the other islands. From AD 1605 to 1969, five earthquakes approaching magnitude six occurred along the littoral extent of South China. We conclude that recent crustal movements in this region have been rapid since the late Pleistocene.

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