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Hiku's Coconut Tree

Geomorphological development and Prehistoric Sites on the Atolls, Northern Cook, Polynesia

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This paper is intended as an investigation of the relationship between development of the late Holocene reefs and human settlement on the newly-created geomorphological features. Examples from Tongareva, Manihiki, Rakahanga and Pukapuka in the Northern Cooks will be discussed. The data are based on the surveys which were conducted as a part of our archaeological research project during 1985 to 1991.

Generally, the reef flat of atolls occurs near the low-tide mark, because the vertical growth of coral reefs are usually limited by the mean low water level. Particularly, the micro-atolls colonies of Goniastrea and Porites on a reef flat thrive close to the water-air interface at low water level. When remnants of emerged micro-atolls are found *in situ* in excavations, they are indicators of past sea-levels. The differences in elevation between the fossilized ones and their living counterparts in the same locality are measured. Emerged wave notches were also found to indicate such sea-level changes. The results of our measurements are summarized in Figure 2. The post-glacial rise of sea-level occurred at a diminishing rate and reached slightly higher than the present level around 4000 yBP. Dr. Pirazzoli has arrived at the conclusion through his field surveys in the Tuamotus that the mean sea-level during the late Holocene reached a maximum of approximately 0.9 m above the present and remained so until c. 1200 yBP. He believes this trend may represent a regional eustatic pattern, because the area investigated seems to have been tectonically stable during the late Holocene period.

Our results basically coincide with the Pirazzoli's model, but our maximum elevation does not show so high 0.4 to 0.5 m at 3580 yBP from Manihiki and Rakahanga. The sea-level fall which followed the high stand exposed part of the reef on which sediments accumulated. Unconsolidated coral sand and rubble started accumulating on the exposed intertidal limestone reef flat after 2000 yBP.

Photo 1 shows excavated beach-rock and lithified sand from the bottom of a trench from the Tautua site, located at the lagoon side of Tongareva atoll. It dips 10 degrees seaward and it's top surface lies at 0.6 to 0.8 m above the present high tide level. It has been 1840 to 1360 yBP. Therefore the relative difference with modern beach-rock that can be found elsewhere on the island within the present tidal limits may represent the

high stand of the sea during that period. Soon after transgression ended and sea level stabilized, traces of human settlement appeared around 1000 yBP. This event could have coincided closely with the building up of the atoll islands. When enough sediments had accumulated, and the island itself maintained its height and size, the water-table under the ground was formed. The island developed an ecosystem able to support terrestrial life forms. (Fig. 4)

These facts suggest that 2000 years at least may have passed between the emergence of the reef platform and establishment of human settlement. The oldest date of human occupation is 1090 yBP among the atolls of Manihiki, Rakahanga and Tongareva. These three atolls have shown evidences of very similar dates for coral development. Whereas, a question for very early initial settlement on Pukapuka, nearly 2300 yBP, remains. In Pukapuka beneath the conglomerate bench, old reef rock of probable Pleistcene age commonly stands 1 m above the present high tide level. It is possible then that the age of emergence of the island was earlier than the other atolls, although more detailed scrutiny is needed.

Figure 5 shows the locations of excavated areas on Motu Hakamaru islet of Manihiki atoll. Transects were selected across the island from ocean side to lagoon side with good representation of geomorphological sequences and chronology of the island formation. The island was formed primarily by the deposition of a single ridge as a rampart loaded by high energy waves upon the reef flat. Site D shows the sediments of boulder and gravel which built up at about 4m above sea-level. Decreased energy of ocean waves on the lagoon side deposited relatively fine-grained sand. Site C shows that a process of boulder deposition has continued intermittently with periodic addition during the large storms inside of the rampart.

The most conspicuous alteration of geomorphology by man is the digging of pits for cultivation of Cyrtosperma taro at the depression in the central portion of the islet. This can be seen at Site B. The bottom of these pit, 30 cm maximized, reached the level of the fresh water lens. The soil contains large quantities of gray brown colored organic matter and sand, PH is 6.4 to 6.5. A rather compact layer, of silt or clay texture, overlies the coral substrate. PH is little higher at 8.2.

Site A was the habitation area where initial human settlement took place. It is likely that when the first people arrived on the islet around 620 yBP, the terrestrial ecosystemes were still fairly simple and immature. The most important evidence that the island was already colonized by coconut trees during this stage was found. Human activities are apparent in the stratigraphy of the site, as indicated by the vertical stripes in Figure 5. These layers indicate the degree of cultural activities, and contain a maximum

of 15% organic material with the incorporation of humus. The black color mainly resulted from the mixture of charcoal from cooking fires. PH of the soils are lower around 7.2 or 6.4.

Since the establishment of the initial human settlement, the sediment has continued to accumulate with successive layers, indicating the increase in organic material accompanying cultural remains like coconut graters photo 2, scrapers, fish hooks and digging spade made of pearl shell, etc. It can be estimated that the sedimentation of organic soils proceeded at the rate of 21 to 23 cm per century from the layers of site A. These deep organic deposits are sharply contrasted to the sedimentation rate of areas lacking archaeological deposits where these layers are shallow and weakly developed. A sedimentation rate of only 25 cm per century is indicated from uninhabited areas. It can be regarded as only 1/10 the accumulation process at inhabitated areas. This resulted from the maximum use of limited space on the island by an increasing human population. Man himself rapidly causes terrestrial environmental complexity.