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## Radiocarbon dates of Holocene emergence and submergence in the Tambelan and Bunguran Islands, Sunda Shelf, Indonesia

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**Abstract:** Specimens of *Tridacna* sp. (giant clam) shell in position of growth from near high-tide level on the foreshore in the Tambelan Islands, dated by the radio-carbon method, indicate that the sea level there was relatively higher by at least 0.3 m at  $5460 \pm 110$  years B.P., and 0.4 m at  $5270 \pm 110$  years B.P. Dating of a small tree bole from peat below low-tide level in the Bunguran (Natuna) Islands indicates that the sea level there was relatively lower by at least 0.7 m at  $6260 \pm 120$  years B.P.

Evidence of a late Quaternary submergence of a few metres is widespread in the Indonesian Archipelago, in the form of raised coral reefs and raised beach terraces, and strandlines on limestone coasts (see Kuenen, 1933; Umbgrove, 1947, Smit Sibinga, 1948; Tjia, 1965 and 1968). In parts of Indonesia, particularly eastern Indonesia, the evidence has been affected by Quaternary tectonic movements. Tjia (1965) recognized four supposedly Holocene levels, at 5, 2.5, 1.5-2 and 0.5-1 m above present sea level, listed in decreasing order of age. Attempts have been made to correlate these with dated levels in Europe, Japan and elsewhere, but, as was recognised by Tjia, such correlation in the absence of dates by radiometric or other methods from the Indonesian area itself can only be very tentative.

The writer had the opportunity in April 1969 to visit briefly the Tambelan and Bunguran (Natuna) Islands of Indonesia, on the Sunda Shelf between Borneo and the Malay Peninsula, and observed evidence of a Holocene submergence in the form of dead coral reefs extending up to present high-tide level in the Tambelan Islands, and extensive sandy terraces, 1-2 m above high-tide level, behind the present beaches, in both groups of islands. Two samples of shell and one of peat, from positions indicating a relative change in sea level, were collected and dated; exact locations are given, and results summarized, in Table 1. Available maps showing the islands include British Admiralty charts 361 (Tambelan) and 1348 (Bunguran).

At Teluk Bira, Tambelan Island, the writer collected samples of shell from two shells of *Tridacna* sp. (giant clam) embedded in position of growth in dead coral about 3 m from the high tide mark. The top lip of one of these shells (UM6132) was an estimated 0.2 m, and that of the other (UM6133) about 0.1 m, below present high tide level. Since *Tridacna* lives with the top of its shell at or below low-water level, and the tidal range at Tambelan is about 0.5 m, it can be concluded that sea level at the time of life of these shells was relatively higher by at least 0.3 m (for UM6132

Table 1. Radiometric age determinations ( $C^{14}$ ) on specimens from Tambelan and Bunguran Islands, Indonesia.

Ref. No.	Material	Co-ordinates	$-\delta C^{14}$	Estimated position relative to present sea level	Age in years B.P.	Date	Estimated relative sea level implied
UM6162	Wood from peat layer	4°05.3'N 108°16.7'E	541 ± 7	About low tide level	6260 ± 120	4310 B.C.	-0.7 m or lower
UM6132	<i>Tridacna</i> shell	1°01.10'N 107°31.92'E	493 ± 7	0.2 m below high tide level	5460 ± 110	3510 B.C.	+0.3 m or higher
UM6133	<i>Tridacna</i> shell	1°01.10'N 107°31.92'E	481 ± 7	0.1 m below high tide level	5270 ± 110	3320 B.C.	+0.4 m or higher

Note: UM6162 from Teluk Sengiap, northwest coast of Pulau Bunguran (or Great Natuna Island);

UM6132 and UM6133 from Teluk Birah, northwest end of Tambelan Island.

Determinations by Isotopes Inc., Westwood Laboratories, New Jersey, USA.

age determined as  $5460 \pm 110$  years B.P.) and 0.4 m (for UM6133; age determined as  $5270 \pm 110$  years B.P.). These dates correlate with shell beds in a terrace 6 feet above river level at Butir, Brunei, Borneo dated  $5400 \pm 200$  B.P. (Wilford, 1961); Wilford points out that although this terrace marks the maximum post-glacial flooding of the lower Limbang Valley it does not necessarily prove submergence, since present shingle beds and storm beaches occur at about the same height. The dates fall within the period of Middle Littorina Submergence (see Fairbridge, 1961, p. 161–164), namely 6000 to 4600 B.P.

On Bunguran Island (also known as Great Natuna) a layer of peat containing roots and boles of small trees in apparent position of growth was found beneath the sea, 5 cm below water level at about low tide on 20 April 1969 at 1200 hours. Tidal information from the Bunguran Islands is scanty, but the mean tidal range at Pulau Laut, one of the group, is 0.7 m. The small tree boles indicate that the peat probably formed subaerially, rather than in a lagoon, and if so, the sea level at the time of formation must have been more than 0.7 m below the present level; the age of one of the tree boles was determined as  $6260 \pm 120$  B.P.

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