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ANU RADIOCARBON DATE LIST VIII

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AUSTRALIAN GREAT BARRIER REEF EXPEDITION

The aims of the 1973 Great Barrier Reef Expedition's radiocarbon dating programs were: 1) to collect live specimens from various reef environments to serve as modern reference standards, 2) to evaluate suitability of materials from drilling, geomorphic, and sediment programs for dating purposes, and 3) to date appropriate samples related to those programs. Radiometric ages provide a time scale for evolution of reefs and reef islands, and the history of sea level in the area.

While a massive rise in level of sea (>100m) since the maximum of the last glaciation is universally accepted, there is little agreement as to when this transgressing sea first reached its present position in the Holocene, and directions and magnitudes of sea level change since that time; there is even conflict as to whether the most recent significant change has been a fall or rise in sea level. Detailed local studies, using a range of well controlled sea level criteria and dates, are required if Holocene time-sea level curves are to be accepted with any degree of confidence. Because reef areas possess an array of present and paleo-sea-level markers together with abundant datable materials they are particularly appropriate sites for investigating recent sea level changes. Nevertheless, serious problems in identifying changes based on reef data exist, although they are not always readily acknowledged. During the Royal Society — University of Queensland Expedition to North Great Barrier Reef in 1973 we became particularly conscious of both the utility of reef data and problems associated with its interpretation. This list presents evidence for a recent sea level history by utilizing data solely obtained from Expedition without recourse to earlier commentaries on this or adjacent areas of the Great Barrier Reef (Hopley, 1978), nor to sea level histories from other regions.

As part of the same Expedition an investigation of stratigraphy of several reef islands using shallow coring techniques was planned. Logistical difficulties limited drilling to two sites, Bewick (14° 26′ S, 144° 40′ E)

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and Stapleton Is (14° 19′ S, 144° 51′ E). The primary objective at these sites was to test the hypothesis that islands in this part of Great Barrier Reef have been formed by incremental addition of reef sediment during successive Quaternary marine transgressions. For this purpose drill performance was recorded in detail and all pieces of core were megascopically described.

Samples were obtained from various reef environments within 5° lat range between Raine (11° 36° S) and Low Is (16° 23′ S) on North Great Barrier Reef. However, nearly 90% of samples were coll within 1° band between Stapleton Island (14° 19′ S) and Three Isles (15° 07′ S).

1) *Live specimens.* Although a wide variety of corals and mollusks was collected dating was restricted to *Halimeda,* a calcified green algae growing on reef flats of many islands. Both organic carbon fraction (living plant tissue) and inorganic carbonate plates have been dated (ANU-1272A & B, ANU-1273A & B, Bewick Reef).

2) *Fossils, rocks, and sediments.* Limestone rocks included beach rocks, and various categories of rampart rocks varying from loosely cemented bassett edges, through more firmly cemented lower platform rocks to tough, firmly lithified rocks of higher platform. With rampart rocks, ages were desired on both skeletal materials and some cements. Where massive corals and tridacnids were present, they were cut out or broken from the matrix and prepared and examined by microscope.

Separation of smaller branching corals and mollusks from the cementing matrix, and removal and isolation of cement from within coral pores, proved much more difficult. Tiny slabs of coral and cement were cut and examined microscopically, and contaminants (either coral or cement) removed by saw and/or dentist's drill. Examination of thin sections of these samples suggests that it is unlikely that all contamination was removed, and therefore ages, notably ANU-1208 (coral), ANU-1380 (coral), ANU-1381 (matrix), ANU-1601 (matrix), ANU-1602 (matrix) must be interpreted accordingly.

Only three beach rocks were dated. Two contained *Tridacna* valves (ANU-1386, -1591) on the surface, which were prized out, cut, and examined in the usual manner. The third (ANU-1596) was a bulk sample; thin-section examination indicated the presence of acicular aragonite cement. In this case, no attempt was made to separate allochems and cement. Dated samples from limestone rocks included 6 corals, 12 *Tridacnids,* 4 matrix cements, and 1 bulk calcarenite.

Samples of loose sediments from individual horizons and sediment units contained three types: sand (17 samples), coral fragments (4 samples), and mud (1 sample). Cay sands were sieved at 0.5F intervals and a split of total detritus falling between medium to very coarse sand (2 to −1F units) was submitted for bulk age determination. Thin-section examination indicated a variety of skeletal constituents, mainly Foraminifera, *Halimeda,* other calcareous algae, and molluscan and coral fragments, the proportion of each constituent varying between samples.

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In a number of instances secondary material was present in intraskeletal voids and chambers, but not in sufficient quantities to affect significantly validity of ages.

Four samples of sandy-gravels from the reef islands were dated. Between 5 and 15 stick coral fragments in −1 to −4F size range were selected from each sample and physically cleaned of surface contaminants. Interior void sediment and borehole linings were not removed; but such contaminants were estimated to compose less than 3% of total sample mass.

3) *Drill cores.* The drilling program yielded both consolidated and unconsolidated material suitable for dating. For drilling technique and sampling method, see Thom (1978). Sample size was limited by 35.5mm internal diam core barrel and highly variable lithologies with depth. Quantity of material submitted for dating was barely adequate, inhibiting further treatment (Thom, Orme, and Polach, 1978).

Selection of samples, based on stratigraphic and geomorphologic criteria and physical pretreatment was carried out by the collector in consultation with the ANU Radiocarbon Laboratory and samples dated as submitted, without further physical or chemical pretreatment.

Ages are reported as *conventional radiocarbon ages* BP (Olsson, 1970, p 17) using, however, the *ANU Sucrose* contemporary radiocarbon dating standard (Polach, 1979; Currie and Polach, 1980) as a frequent cross check of our 0.95 NBS Oxalic value. The *conventional radiocarbon ages* BP are corrected for isotopic fractionation based on either an estimated $d^{13}C$ value (Polach, 1976; Stuiver and Polach, 1977) with an uncertainty of estimate never smaller than $\pm 2‰$, or measured $d^{13}C$ value with an error of measurement never larger than $\pm 0.2‰$. The $d^{13}C$ values are expressed wrt to PDB; the error of estimate or measurement is incorporated in the age $\pm$ error calculation. The calculations, presentation, and annotations follow the suggestions made by Stuiver and Polach (1977). Thus, $D^{14}C$ is the relative difference between the ^{13}C corrected sample activity (count rate) and the measured and ^{13}C corrected oxalic acid activity (count rate). The *conventional radiocarbon age* (t) is, thus, defined as

$$t = -8033 \ln \left(1 + \frac{D^{14}C}{1000} \right)$$

All $d^{13}C$ measurements are estimated $0.0 \pm 2.0‰$ except where noted. Samples were submitted by Dept Biogeography and Geomorphology, Australian National University.

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SAMPLE DESCRIPTIONS

Samples are listed on island-by-island basis starting from Raine Island in N to Low Isles in S.

Raine Island

ANU-1591. **$D^{14}C = -136.4 \pm 7.0‰$** **1180 ± 70**

Tridacna shell from surface of beach rock near beacon at E end of Raine I. (11° 35′ S, 144° 02′ E). Beach rock overlain by guano rock. Coll by D Hopley.

Fisher Island

ANU-1640. **$D^{14}C = -544.3 \pm 5.1‰$** **6310 ± 90**

Tridacna shell resting on fossil micro-atolls in growth position at base of cemented coral shingle platform on S side Fisher I. (12° 15′ S, 143° 14′ E). From 0.6m below platform surface. Coll by D Hopley.

Stainer Reef

ANU-1639. **$D^{14}C = -462.1 \pm 5.5‰$** **4980 ± 80**

ANU-1639R. **$D^{14}C = -460.6 \pm 5.2‰$** **4960 ± 80**

Coral (*Favites abdita*) from area of fossil micro-atolls in growth position which emerge 5cm above sandy reef flat, some 250m ESE of Stainer sand cay (13° 57′ S, 143° 50′ E). ANU-1639R is repeat determination of same specimen. Coll by D Hopley.

Stapleton Reef series

ANU-1663. **$D^{14}C = -322.6 \pm 6.5‰$** **3130 ± 80**

ANU-1664. **$D^{14}C = -325.3 \pm 7.7‰$** **3160 ± 90**

ANU-1721. **$D^{14}C = -480.3 \pm 8.5‰$** **5260 ± 130**

Drill core series (14° 20′ S, 144° 50′ E); ANU-1663 coll from depth 8.5m below hwst and consists of loose calcareous sand. ANU-1664 is reef calcarenite coral fragment from ca 10m below hwst. ANU-1721 is unidentified coral fragment (possibly *Galaxa* sp) from 13m below hwst. Coll by B G Thom.

ANU-1555. **$D^{14}C = -332.0 \pm 6.1‰$** **3240 ± 70**

Moderately well sorted clean coarse calcareous sand. Bulk sample from depth of 55 to 80cm beneath grassy surface of 2.3m high sand cliff exposure on S side of Stapleton cay ca 100m from W end. Coll by R McLean.

Bewick Reef series

ANU-1387. **$D^{14}C = -307.0 \pm 6.5‰$** **2950 ± 80**

Moderately sorted medium-sized calcareous sand. Bulk sample of partly weathered creamy-brown sand from soil pit horizon 25 to 40cm beneath grassy surface on E slope of E-most ridge on Bewick (14° 28′ S, 144° 47′ E) sand cay, ca 25m W of cay-mangrove margin. Coll by R McLean.

ANU-1559. **$D^{14}C = -420.0 \pm 5.7‰$** **4380 ± 80**

Moderately sorted medium-sized calcareous sand. Bulk sample of grayish weathered sand from depth 15cm beneath surface at crest of W-most ridge on Bewick sand cay. Ca 25m SE of drill hole site. Coll by R McLean.

ANU-1386. **$D^{14}C = -223.5 \pm 6.9‰$** **2030 ± 70**

Tridacna shell from surface of high beach rock outcropping on N shore of Bewick sand cay close to drill site. Base of tridacnid valve was lightly cemented to beach rock surface on which was growing *Sesuvium* and algae. Beach rock outcropping fronted by mangroves and backed by sandy slope covered with grasses and *Pemphis*. Coll by R McLean.

ANU-1280. **$D^{14}C = -977.1 \pm 3.1‰$** **>30,350 ± 1150**

Fine-grained calcarenite.

ANU-1281. **$D^{14}C = -986.2 \pm 3.7‰$** **$>34{,}400 \begin{matrix} +2500 \\ -1900 \end{matrix}$**

Coral fragment.

ANU-1282. **$D^{14}C = -990.4 \pm 2.3‰$** **$>37{,}300 \begin{matrix} +2200 \\ -1700 \end{matrix}$**

Coral and coralline algae fragment.

ANU-1283. **$D^{14}C = -560.6 \pm 6.8‰$** **6610 ± 130**

Coral *(Porites?)* fragment.

ANU-1284. **$D^{14}C = -577.3 \pm 6.9‰$** **6920 ± 130**

Coral fragment.

ANU-1395. **$D^{14}C = -547.8 \pm 6.5‰$** **6380 ± 120**

Coral fragment. Drill core series: samples ANU-1280 to -1282 recovered below disconformity in drill core, as indicated by recrystallization of biomicrite (ANU-1280) and corals (ANU-1281, -1282) to low magnesium calcite. ^{14}C results must be considered *minimum ages* only. Samples ANU-1283, -1284, and -1395 are aragonite rich coral fragments (possibly *Porites* sp). ANU-1283 recovered from below disconformity. Sample's location believed to be result of cave-in during drilling. Disconformity occurs at ca 4m below lwst, with ANU-1395 located at contact. Coll by B G Thom. *Comment*: nine samples recovered from shallow coring on Bewick and Stapleton were dated. ANU-1283, -1284, and -1395 were non-crystallized corals with high aragonite content. ANU-1281 and -1282 were clearly recrystallized samples in which primary aragonite of coral specimens had been converted to calcite. Similar modification is suggested by low Mg calcite content of biomicrite (ANU-

1280). Only three dates were obtained from Stapelton core. Two of these were on samples of high aragonite content, while one, a reef calcarenite fragment possibly containing coralline algae, had a high magnesium calcite content (ANU-1664). Other samples were coral fragments (ANU-1721) and loose carbonate sand (ANU-1663).

ANU-1272A. **$D^{14}C = +129.2 \pm 7.7‰$** **>Modern**
Est $d^{13}C = -4.0 \pm 2.0‰$

Halimeda, green algae, inorganic carbonate fraction.

ANU-1272B. **$D^{14}C = +173.1 \pm 8.5‰$** **>Modern**
Est $d^{13}C = -24.0 \pm 2.0‰$

Organic carbon fraction of ANU-1272A. Dilution, 49% sample.

ANU-1273A. **$D^{14}C = +122.1 \pm 6.6‰$** **>Modern**
Est $d^{13}C = -4.0 \pm 2.0‰$

Halimeda, green algae, inorganic carbonate fraction.

ANU-1273B. **$D^{14}C = +115.3 \pm 8.4‰$** **>Modern**
Est $d^{13}C = -24.0 \pm 2.0‰$

Organic carbon fraction of ANU-1273B. Dilution, 47% sample. *Comment*: contemporary environmental check: 2 samples of calcium carbonate secreting algae (ANU-1272, -1273) coll to check contemporary ocean bicarbonate ^{14}C levels. Results indicate predictable increase in ^{14}C activity due to atom bomb testing (Gillespie and Polach, 1979). Coll by H A Polach.

ANU-1385. **$D^{14}C = -77.0 \pm 7.6‰$** **640 ± 70**

Coral *(Platygyra)* from loosely cemented coral shingle deposit with bassett edge — lower platform morphology on NE Bewick reefs, traverse no. 1. Outcropping 100m landward of reef edge, between inner edge of reef flat and 1.5m high scarp of high platform which forms seaward side of gravel cay. Coll by R McLean.

ANU-1208. **$D^{14}C = -297.5 \pm 6.2‰$** **2840 ± 70**

Coral.

ANU-1609. **$D^{14}C = -224.2 \pm 6.9‰$** **2040 ± 70**

Tridacna. ANU-1208 and ANU-1609 from strongly cemented rampart rock of high platform 20m SW ANU-1385 on traverse no. 1, NE part of gravel cay on Bewick reef, firmly embedded in corroded platform surface. Coll by R McLean.

ANU-1608. **$D^{14}C = -90.1 \pm 7.2‰$** **760 ± 65**

Tridacna shell from surface of innermost of 3 shingle ramparts on traverse no. 2, E side of Bewick reef. Sample exposed on grassy slope abutting mangrove swamp 100m W of gravel cay's active beach. Coll by R McLean.

Ingram-Beanley Reef series

ANU-1393. **$D^{14}C = -76.5 \pm 7.6‰$** **640 ± 70**

ANU-1394. **$D^{14}C = -415.3 \pm 6.8‰$** **4310 ± 100**

Coral *(Porites)* from separate reef blocks of boulder tract on N side of reef (14° 25′ S, 144° 55′ E), 300m NE Ingram I. ANU-1393 coll from largest single coral head 2.2m above reef flat level, 80m from reef edge. ANU-1394 from innermost coral head, 1.5m high, in sandy reef flat 130m from reef edge. Coll by R McLean.

ANU-1642. **$D^{14}C = -335.3 \pm 6.3‰$** **3280 ± 80**

Calcareous sand.

ANU-1410. **$D^{14}C = -331.2 \pm 6.3‰$** **3230 ± 80**

Calcareous sand. Both bulk samples of moderately well sorted sand from 2 to 5cm beneath cay surface. ANU-1642 at 50m from beachline in center of low cuspate promontory on W side of Ingram I. ANU-1410 from highest part of cay, 120m NW of SE end. Coll by R McLean.

Watson Island series

ANU-1389. **$D^{14}C = -61.3 \pm 7.9‰$** **510 ± 70**

Tridacna shell.

ANU-1390. **$D^{14}C = -95.5 \pm 7.5‰$** **810 ± 70**

Coral favid.

ANU-1391. **$D^{14}C = -175.4 \pm 7.1‰$** **1550 ± 70**

Tridacna shell.

ANU-1392. **$D^{14}C = -168.2 \pm 7.2‰$** **1480 ± 70**

Tridacna shell. Samples taken from outer rampart to innermost fossil ridge across SE end of Watson, a coral shingle island (14° 29′ S, 144° 56′ E). All samples from loose surface shingle; ANU-1389 from highest part of contemporary outer rampart; ANU-1390 from top of lower platform; ANU-1391 and -1392 from penultimate and innermost ridges, respectively, on N side of island proper abutting mangrove swamp. Coll by R McLean.

Howick Cay

ANU-1605. **$D^{14}C = -260.2 \pm 6.7‰$** **2420 ± 70**

Coral *(Diploastrea heliopora)* from series of massive coral heads cemented into high calcarenite platform on SW corner of Howick Cay (14° 30′ S, 144° 57′ E). Coll by R McLean.

Houghton Reef series

ANU-1287. **$D^{14}C = -517.4 \pm 9.9‰$** **5850 ± 170**

Faviid coral head from area of fossil micro-atolls in mangrove swamp N central part of reef, 220m S reef edge, 400m E sand cay (14° 32′ S, 144° 58 E). Coll by R McLean.

ANU-1595. $D^{14}C = -339.4 \pm 6.1‰$ **3330 ± 80**

Faviid coral head beneath calcarenite at juncture of reef flat and rocky scarp. Coll by McLean.

ANU-1596. $D^{14}C = -282.6 \pm 6.3‰$ **2670 ± 70**

Calcarenite bulk sample containing calcareous sand and cement. Coll by R McLean.

ANU-1413. $D^{14}C = -357.4 \pm 6.1‰$ **3550 ± 80**

Tridacna shell from 20cm thick cemented stick coral layer overlying calcarenite. Coll by H A Polach. Last three samples form vertical sequence in high calcarenite platform at W end sand cay.

Coquet Island

ANU-1411. $D^{14}C = -125.2 \pm 6.1‰$ **1070 ± 60**

Tridacna shell from surface of highest part of broad shingle ridge 80m SE of navigation light on main cay (14° 32′ S, 145° 00′ E). Coll by R McLean.

Leggatt Reef series

ANU-1556. $D^{14}C = -251.9 \pm 6.5‰$ **2330 ± 70**

Moderately sorted coarse calcareous sand. Bulk sample from surface of high flat (14° 33 S, 144° 51′ E) in center of sand cay. Coll by R McLean.

ANU-1286. $D^{14}C = -514.0 \pm 7.6‰$ **5800 ± 130**

Tridacna shell in growth position among high micro-atoll field exposed in area of fallen mangrove immediately E of sand cay and S of sand pit. Coll by R McLean.

Hampton Reef

ANU-1207. $D^{14}C = -454.7 \pm 4.7‰$ **4870 ± 70**

Faviid coral in growth position from area of high micro-atolls (14° 33′ S, 144° 52′ E) covered by *Rhizophora* mangroves and mangrove mud. Coll by B G Thom.

East Pethebridge Island

ANU-1384. $D^{14}C = -255.9 \pm 6.7‰$ **2370 ± 70**

Faviid coral in growth position area of high micro-atolls (14° 45′ S, 145° 05′ E) in gap between cemented shingle platforms at SW end of island. Coll by R McLean.

Turtle Island series

ANU-1597. $D^{14}C = -266.0 \pm 6.5‰$ **2480 ± 70**

ANU-1598. $D^{14}C = -291.0 \pm 6.9‰$ **2760 ± 80**

Calcareous sandy-gravel from soil Pit 1 on lower terrace NW side of island (14° 44′ S, 145° 13′ E) 25m S of beach line. Bulk samples;

ANU-1597 at depth 25 to 35cm, ANU-1598 at depth 85 to 100cm. Coll by R McLean.

ANU-1388. **$D^{14}C = -338.6 \pm 6.3‰$** **3320 ± 80**

Coral *(Acropora)* fragments from soil Pit 2 on high shingle ridge 25m S of Pit 1. Sample from depth 40 to 55cm. Coll by R McLean.

ANU-1477. **$D^{14}C = -162.6 \pm 7.6‰$** **1430 ± 70**

ANU-1478. **$D^{14}C = -423.3 \pm 6.3‰$** **4420 ± 90**

Tridacna shells from separate outcroppings of cemented rampart rock between mangrove swamp and moat on SW part of reef. ANU-1477 from outer platform 10cm below upper level of cementation. ANU-1478 from inner platform 24cm below surface. Coll by D Hopley.

ANU-1480A. **$D^{14}C = -128.4 \pm 8.4‰$** **1100 ± 80**
Est $d^{13}C = -24.0 \pm 2.0‰$

Fibrous mud.

ANU-1480B. **$D^{14}C = -240.9 \pm 15.4‰$** **2210 ± 170**
Est $d^{13}C = -24.0 \pm 2.0‰$

Organic sediment.

ANU-1479. **$D^{14}C = -457.0 \pm 6.1‰$** **4910 ± 90**

Coral *(Cyphastrea)*. Samples from shallow bore hole in small enclosed depression between two old coral shingle ridges at SE end of main island. Depression is occupied by living mangroves and floored by 0.6m thick deposit of black fibrous mud which overlies at least 0.3m of coral shingle. ANU-1480, fibrous mud, separated into two fractions: 1480A, coarse fibers, rootlets and bark retained of sieve meshes 10F and 25F; and 1480B, fine gray clayey sediment which passed through 44F mesh and contained black organics but not fibers. ANU-1479 from shingle containing corals and shells beneath mangrove mud horizon. Coll by D Hopley and A Bloom.

Nymph Island series

ANU-1285. **$D^{14}C = -368.9 \pm 6.8‰$** **3700 ± 90**

Faviid coral in growth position from high micro-atoll field exposed in drainage outlet to large pool in SW portion of island (14° 38′ S, 145° 15′ E). Coll by R McLean.

ANU-1592. **$D^{14}C = -346.3 \pm 6.0‰$** **3420 ± 75**

Tridacna shell.

ANU-1383. **$D^{14}C = -356.0 \pm 6.2‰$** **3540 ± 80**

Tridacna shell.

ANU-1602. **$D^{14}C = -253.7 \pm 6.5‰$** **2350 ± 70**

Calcitic cement. Samples from high platform of cemented rampart rock 100m SE of pond outlet in SW part of reef. ANU-1592 from

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cemented stick shingle layer at top of platform. Coll by D Hopley. ANU-1383 firmly embedded in rock, 0.5m from base of scarp. ANU-1602 from 30cm beneath platform surface. Coll by R McLean.

ANU-1476. **$D^{14}C = -62.5 \pm 8.1‰$** **520 ± 70**

Tridacna shell from cemented lower platform at SE end of small shingle island on SW part of reef. Sample embedded in rock 15cm below upper surface of platform. Coll by D Hopley.

Eagle Reef

ANU-1560. **$D^{14}C = -307.8 \pm 6.3‰$** **2960 ± 70**

Well sorted calcareous sand. Bulk sample from main sand ridge (14° 25′ S, 145° 23′ E) in center of N side of cay, 50m from beach. Coll by R McLean.

Two Isles series

ANU-1558. **$D^{14}C = -384.5 \pm 6.0‰$** **3900 ± 80**

Well sorted calcareous sand. Bulk sample from depth of 45 to 60cm in soil pit beneath forest on backslope of high sand ridge (15° 03′ S, 145° 27′ E) 60m from beach in N central part of main cay. Coll by R McLean.

ANU-1871. **$D^{14}C = -56.4 \pm 7.5‰$** **470 ± 60**

Coral (*Porites*) micro-atoll in growth position excavated from 30cm beneath reef flat surface in center of reef close to degraded bassett edge. Coll by T Scoffin. Unpub date of 1978 to check age of reef flat formation and truncated bassett edge.

Low Wooded Island series

ANU-1594. **$D^{14}C = -95.0 \pm 7.2‰$** **800 ± 60**

Coral *(Porites* cf *lobata)* micro-atoll in growth position at junction of inner edge of contemporary shingle rampart and moat 190m SE of aeroplane wreckage at W end of island (15° 06 S, 145° 25′ E). Coll by R McLean.

ANU-1603. **$D^{14}C = -530.8 \pm 5.4‰$** **6080 ± 90**

Coral *(Platygyra lamellina)* micro-atoll passing beneath lower cemented shingle platform at junction with moat in S central part of island. Coll by D Hopley.

ANU-1604. **$D^{14}C = -338.9 \pm 6.1‰$** **3320 ± 70**

Tridacna shell from surface of high cemented platform outcropping at SW end of enclosed pool 80m W of beach on E side of island. Coll by R McLean.

Three Isles series

ANU-1641. **$D^{14}C = -238.4 \pm 6.7‰$** **2190 ± 70**

Moderately well-sorted coarse calcareous sand. Bulk sample from 20cm depth in soil pit on lower terrace, 75m W of beacon at W end of sand cay. Coll by R McLean.

ANU-1554. **$D^{14}C = -364.5 \pm 6.0‰$** **3640 ± 70**

Well-sorted coarse calcareous sand. Bulk sample from 60cm depth in soil pit in shallow basin in high ridge 40m E of beacon at W end of cay. Coll by R McLean.

ANU-1553. **$D^{14}C = -340.6 \pm 6.2‰$** **3350 ± 80**

ANU-1414. **$D^{14}C = -330.2 \pm 6.2‰$** **3220 ± 80**

Well-sorted coarse calcareous sand from 2 horizons exposed in 2.5m high cliff at E end of cay. Bulk samples at 43 to 68cm (ANU-1553) and 100 to 160cm (ANU-1414) below top of cliff. Coll by R McLean.

ANU-1475. **$D^{14}C = -166.2 \pm 7.4‰$** **1460 ± 70**

Tridacna shell cemented 20cm beneath surface of lower platform at exposed edge above moat on SE side of Third Island. Coll by D Hopley.

ANU-1380. **$D^{14}C = -373.1 \pm 8.6‰$** **3750 ± 110**

ANU-1381. **$D^{14}C = -245.4 \pm 7.6‰$** **2260 ± 80**

ANU-1382. **$D^{14}C = -316.0 \pm 5.6‰$** **3050 ± 70**

Sequence from high rampart rock platform outcropping in central E part of mangrove-shingle cay. ANU-1380, coral *Pavona* firmly cemented in basal facies of platform. Dilution, 47% sample. ANU-1381, calcitic matrix surrounding ANU-1380. ANU-1382, *Tridacna* shell from loosely cemented coral shingle veneer, 20cm thick, on upper surface of high platform. Coll by R McLean.

East Hope Island series

ANU-1412. **$D^{14}C = -313.2 \pm 6.3‰$** **3020 ± 70**

ANU-1643. **$D^{14}C = -310.8 \pm 6.4‰$** **2990 ± 80**

Moderately well-sorted coarse calcareous sand. Bulk samples, ANU-1412 from 79 to 86cm horizon in soil Pit 1 on highest ridge in center of cay (15° 45′ S, 145° 28′ E), and ANU-1643 from 30cm depth in Pit 3 on low sand terrace, 15m from beach line at E end of cay. Coll by R McLean.

West Hope Island series

ANU-1599. **$D^{14}C = -140.0 \pm 7.4‰$** **1210 ± 70**

Coral *(Acropora)* fragments from 40cm beneath surface of E-most ridge in shingle ridge sequence found on NE side of island (15° 45′ S, 145° 27′ E). Coll by R McLean.

ANU-1600. **$D^{14}C = -99.9 \pm 7.5‰$** **(?)>850 ± 70**

Coral *(Acropora)* fragments from surface of highest shingle ridge in sequence 75m from E beach and 25m from mangrove swamp to W. Sample possessed large quantity of post-mortem contaminants. Coll by R McLean.

Pickersgill Cay

ANU-1606. **$D^{14}C = -252.2 \pm 6.7‰$** **2330 ± 70**

Well-sorted coarse calcareous sand. Bulk sample from top of unvegetated sand bank (15° 52′ S, 145° 33′ E). Coll by R McLean.

Low Isles series

ANU-1607A. **$D^{14}C = -88.0 \pm 7.5‰$** **740 ± 70**

ANU-1607B. **$D^{14}C = -67.4 \pm 12.2‰$** **560 ± 110**

ANU-1601. **$D^{14}C = -46.5 \pm 9.7‰$** **380 ± 80**

Samples from cemented coral shingle deposit forming bassett edges on inner edge of reef flat 250m NW of Green Ant I. on E side of reef (16° 24′ S, 145° 33′ E). ANU-1607A, coral *(Acropora)*. ANU-1607B, dilution, 41% sample, and ANU-1601 were high magnesium calcite matrix. Coll by R McLean.

ANU-1593. **$D^{14}C = -95.1 \pm 7.2‰$** **800 ± 70**

Tridacna shell from surface of inner shingle rampart at S end of mangrove-shingle island on E side of reef. Coll by R McLean.

ANU-1557. **$D^{14}C = -272.0 \pm 6.4‰$** **2550 ± 70**

Moderately sorted very coarse calcareous sand. Bulk sample from sand cay surface 75m W of Lighthouse. Coll by R McLean.

General Comment: radiometric ages and measured or estimated elevs of concordant coral colonies provide indisputable evidence that sea level in N region of Great Barrier Reef first reached its approx present position ca 6000 yr BP. Dated materials of this age from four different reefs which cover some 3° lat indicate spatial extent of evidence and likelihood that similarly aged materials could be preserved on other reefs in region. Levels of extensive Houghton and Leggatt micro-atoll fields relative to living reef flat and moated corals suggest that by 5800 yr BP the sea had passed above its present level. The possibility of moating at these two central reef sites at such an early stage of development of reef-top features is considerably less than would be likely later on. Stainer and Hampton corals also indicate that sea level was above present level 1000 yr later (4900 BP) while those from Three Isles and Nymph suggest that highest level for which we have evidence, in excess of 1m, was attained ca 3700 yr BP. Dates of transported clasts from cemented shingle ramparts of equivalent ages at these 2 sites illustrate that fossil *in situ* corals could have been in moated situations. Surface level of fossil micro-atoll field at East Pethebridge is 0.6m above measured living reef flat corals, but this could also have been a moated situation. But age of 2370 ± 70 yr BP (ANU-1384) indicates that sea level was then close to or marginally above present level. Subsequent course of sea level and time of its return to present level is not well documented although by 2300 yr BP it was near present level. Also important is that reefs and superficial reef-top deposits, at least on some reefs in area, have had up to 6 millennia in which to evolve and adjust to sea level around present position. Even if some corals were moated and reflect locally perched water levels, these fundamental conclusions are not affected.

The drilling program resulted in 2 drill holes which gave some data on development of reef island complexes in N Great Barrier Reef Province in late Quaternary. Bewick I. hole suggested presence of several discontinuities in the subsurface where 8 lithologic units were identified, separated in 3 instances by facies transitions and in 4 other cases by disconformities, the uppermost of which was confirmed by several lines of evidence, including ^{14}C dates, and clearly separated Holocene from late Pleistocene sediments. The Bewick core also showed marked changes in environmental conditions in time, upper part containing sediments deposited under relatively high energy conditions.

The observed degree of contamination on validity of ^{14}C ages cannot be quantified. Mineralogic and microscopic examination suggests that the great bulk of skeletal, rock, and sediment sample ages are valid. Of samples listed it is believed that of surface samples, only ANU-1600 gives an unreliable age, although some others should be used with caution. Drill core dates beyond 30,000 yr BP on recrystallized material should be considered as min ages only. The last interglacial (ca 120,000 yr BP) is a more likely age for coral growth (Thom, Orme, and Polach, 1978), but until unrecrystallized corals can be found, this assumption cannot be tested, eg, by uranium series dating.

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