IODP Expedition 310
Tahiti Sea-level
Week 6 Report (10th Nov – 16th Nov, 2005)

November 16th, 2005

Operations

Hole M0023A (TAH-02A-4F): From 0000 hrs, 10th Nov, the DART was raised to the moonpool after abandoning coring at Hole M0022A. The DP Hunter moved to a new area over a drowned reef to conduct an echosounder survey, approximately 100 m SW of Prospectus site TAH-02A-4. From 0200 hrs, 10th Nov, 9 x ~110 m echosounder traverses were made over the drowned reef pinnacle, from which a site for Hole M0023A was chosen in 67 m water depth. After a short camera survey, coring operations at Hole M0023A started at 0635 hrs, 10th Nov, and ended at 2245 hrs that day after reaching a TD of 31.36 mbsf with a total recovery of 77.20 %.

Hole M0023B (TAH-02A-4G): After raising the DART a short distance from the sea bed, the DP Hunter was positioned above Hole M0023B, 5 m SW of the previous hole in 67 m water depth. Coring operations at Hole M0023B began at 0120 hrs, 11th Nov, and ended at 1540 hrs that day at a TD of 31.12 mbsf with a total recovery of 67.90 %. The coring operation proceeded smoothly, with excellent core recovery in long core runs in often very porous formation.

Logging of Hole M0023B (TAH-02A-4G): Prior to logging, the drill pipe was pulled and the hole flushed to 30 mins before the drill pipe was run-in with a casing shoe to approximately 6 mbsf. Logging commenced at 1700 hrs, 11th Nov. Initially, the tools would not pass below the casing shoe, even after the chisel tool was worked in the hole. The casing show was run to the base of the hole and back, before the chisel tool was deployed to check that the casing shoe was clear. Logging operations re-started at 2000 hrs, with the tools reaching a maximum depth of 28.5 mbsf. A DP malfunction caused the vessel to move off location during the logging but the situation was recovered and the hole and equipment remained intact. The optical and acoustic logs preview indicated that there were many cavities in the formation. Logging finished at Hole M0023B at 0310 hrs, 12th Nov.

Hole M0024A (TAH-02A-5F): After clearing away the logging tools and lifting the DART back into the moonpool, the vessel moved to conduct an echosounder survey in an area over a drowned reef pinnacle approximately 100 m E of Prospectus site TAH-02A-5. From 0515 hrs, 12th Nov, 14 x 50 m echosounder traverses were made, from which a site for Hole M0024A was chosen in 90 m water depth. Coring operations at Hole M0024A began at 1010 hrs, 12th Nov, and finished at 0400 hrs, 13th Nov at a TD of 32.3 mbsf. Total recovery was 83.74 %.

Hole M0025A (TAH-02A-5G): A site for Hole M0025A was chosen from the echosounder survey conducted on the 12th Nov, 25 m NNW of Hole M0024A. The DART touched down in a water depth of 105.4 m and coring began at 0530 hrs, 13th Nov, and finished at 1645 hrs that day at a TD of 20.93 mbsf. Total recovery was 74.23 %.

Hole M0026A (TAH-02A-4H): Following another echosounder survey over a 50 x 35 m area approximately 180 m E of Prospectus site TAH-02A-4 over a drowned reef pinnacle, a site for Hole M0026A was chosen. It proved difficult to interpret the results of the echosounder survey (three strong seabed echoes and widely differing water depths over a few metres) and it took some time before identifying a suitable site in 105 m water depth. Coring operations at Hole M0026A started at 0920 hrs, 14th Nov, and were completed by 1105 hrs that day at a TD of 12.4 mbsf. Total recovery was 58.45 %.

Hole M0025B (TAH-02A-5H): After lifting the DART at Hole M0026A, the DP Hunter moved to previous Site M0025 to core at Hole M0025B. After taking a taut-wire depth of 95 m, the DART

was lowered and coring began at 1215 hrs, 14th Nov. Coring finished at 0100 hrs, 15th Nov, at a TD of 20.5 mbsf with a total recovery of 71.19 %.

Hole M0021B (TAH-02A-5I): After raising the DART to 50 m above sea bed, the vessel was moved back to Site M0021 to core at Hole M0021B. Once on position, the taut-wire depth was taken as 80 m. The DART and drill pipe were lowered and coring at Hole M0021B commenced at 0630, 15th Nov, and continued until 2210 hrs that day. TD was 32.81 mbsf and the total recovery was 65.57 %.

Logging of Hole M0021B (TAH-02A-5I): Prior to logging, the hole was flushed before the HQ pipe was run back into the hole with a casing shoe. Logging of Hole M0021B commenced at 0030 hrs, 16th Nov and was competed by 0645 hrs that day. All tools were run to 15 mbsf. Once logging was completed, the DART was lifted onto deck and secured for the transit back to the Port of Papeete.

Transit and demobilization: The DP Hunter departed the last site at 0815 hrs, 16th Nov, and arrived at the Port of Papeete at 1145 hrs. Demobilization of the vessel will take place for the rest of the 16th and on the 17th Nov.

Summary of holes drilled to date

Hole	Latitude	Longitude	Water depth (m)	Drilled length (m)	Recovery (m)	Recovery (%)	Depth reached (mbsf)
M0005A	17° 45.989733'S	149° 33.052517'W	59.13	16.35	5.37	32.84	16.35
M0005B	17° 45.989733'S	149° 33.052517'W	59.13	12.35	9.24	74.82	21.75
M0005C	17° 45.991467'S	149° 33.047600'W	59.63	27.91	14.81	53.06	27.91
M0005D	17° 45.991467'S	149° 33.047600'W	59.63	79.17	51.35	64.86	102.17
M0005E	17° 45.992117'S	149° 33.045433'W	61.34	2	1.6	80.00	2
M0006A	17° 46.015133'S	149° 33.051483'W	81.58	2	1.55	77.50	2
M0007A	17° 45.955317'S	149° 33.041100'W	44.45	44.4	30.74	69.23	44.4
M0007B	17° 45.946200'S	149° 33.068150'W	41.65	47.93	27.02	56.37	48.23
M0007C	17° 45.955667'S	149° 33.012783'W	43.35	30.75	11.13	36.20	32.25
M0008A	17° 29.620700'S	149° 24.431033'W	62.65	38.7	9.49	24.52	40.2
M0009A	17° 29.317367'S	149° 24.206350'W	99.71	21.54	9.29	43.13	23.04
M0009B	17° 29.315283'S	149° 24.204400'W	100.31	26.29	17.42	66.26	27.12
M0009C	17° 29.312550'S	149° 24.208633'W	99.85	24.41	12.66	51.86	25.66
M0009D	17° 29.315283'S	149° 24.201117'W	103.18	43.31	23.62	54.54	44.59
M0009E	17° 29.314300'S	149° 24.212083'W	94.94	19.4	14.10	72.73	20.5
M0010A	17° 29.397800'S	149° 24.167917'W	89.53	33.25	10.02	30.14	34.6
M0011A	17° 29.369650'S	149° 24.160617'W	101.34	16.08	7.89	49.07	17.65
M0012A	17° 29.429067'S	149° 24.110367'W	77.05	32.3	8.37	25.91	34.1
M0013A	17° 29.411933'S	149° 24.111000'W	90.55	9.55	1.1	11.52	11.7
M0014A	17° 29.369733'S	149° 24.123650'W	99.25	18.61	8.65	46.48	14.41
M0015A	17° 46.044450'S	149° 32.849850'W	72.15	41.08	29.87	72.71	42.18
M0015B	17° 46.043483'S	149° 32.846133'W	72.3	40.12	28.83	71.86	40.12
M0016A	17° 46.053433'S	149° 32.856450'W	80.85	37.91	21.58	56.92	38.31
M0016B	17° 46.053417'S	149° 32.853567'W	80.35	27.62	14.31	51.81	44.62
M0017A	17° 46.012350'S	149° 32.843317'W	56.45	40.56	22.94	56.56	40.56
M0018A	17° 46.041583'S	149° 32.895900'W	81.8	40.05	24.63	61.50	40.05
M0019A	17° 32.079917'S	149° 35.919500'W	58.75	65.81	27.06	41.12	66.96
M0020A	17° 32.041400'S	149° 35.927717'W	83.30	41.83	29.47	70.45	42.16
M0021A	17° 29.340850'S	149° 24.168933'W	82.3	33.58	25.14	74.87	34.23
M0021B	17° 29.342733'S	149° 24.169217'W	81.7	32.21	21.12	65.57	32.81
M0022A	17° 29.271317'S	149° 24.269117'W	117.54	7.7	4.4	57.14	8.8
M0023A	17° 29.416933'S	149° 24.277033'W	67.98	31.36	24.21	77.20	31.36
M0023B	17° 29.419117'S	149° 24.278600'W	67.58	31.12	21.13	67.90	31.12
M0024A	17° 29.291750'S	149° 24.235800'W	90.44	31.85	26.67	83.74	32.3
M0025A	17° 29.281450'S	149° 24.241967'W	105.4	20.33	15.09	74.23	20.93
M0025B	17° 29.286200'S	149° 24.249583'W	100.84	19.4	13.81	71.19	20.5
M0026A	17° 29.358667'S	149° 24.150917'W	107.3	11	6.43	58.45	12.4

Science

All holes described below were drilled in the Tiarei area.

Holes M0023A and M0023B

Holes M0023A and M0023B exhibit two carbonate sequences characterized by their lithological features and their biotic composition, from top to bottom :

1) Coralgal-microbialite frameworks in which microbialites (laminated and thrombolitic microbial fabrics) usually represent the major volumetric and structural component; thrombolites usually represent the last stage of encrustation.

This sequence is characterized by the following successive coral assemblages:

a) Foliaceous *Pachyseris* associated wtih massive *Cyphastrea* and *Astreopora*.
Occurrences : Hole M0023B, Cores 1R through 3R.

b) Encrusting *Montipora* and *Pavona*, unidentified foliaceous unidentified corals, and robust branching colonies of *Pocillopora* associated with fragments of foliaceous *Pachyseris* and branching *Porites.*
Occurrence : Hole M0023B, Core 4R.

c) Massive *Porites* and faviids (*Leptastrea*).
Occurrences : Hole M0023A, Cores 1R through 3R; Cores 5R-1 and 6R.

d) Branching *Porites* associated with encrusting *Montipora*.
Occurrences : Hole M0023A, Cores 4R and 5R-CC and R-1.

e) Encrusting *Porites*, unidentified encrusting corals, and tabular *Acropora*.
Occurrence : Hole M0023A, Core 8R.

f) Branching *Porites* and robust branching *Pocillopora* associated with encrusting and massive *Porites,* tabular and robust branching *Acropora*, branching *Pocillopora*, encrusting *Montipora* and fragments of foliaceous *Pachyseris* and branching *Pavona*.
Occurrences : Hole M0023A, Cores 8R through 12R. Hole M0023B, Cores 5R through 13R.

g) Encrusting *Montipora*, massive faviids, and unidentified encrusting corals.
Occurrences : Hole M0023A, Cores 12R and 13R.

h) Branching *Porites* and robust branching *Pocillopora*.
Occurrence : Hole M0023A, Core 13R.

2) Coralgal-microbialite frameworks and coral boundstone that exhibit evidences of diagenetic alteration. Solution cavities occur throughout this interval. The cavities are filled with multigenerational (at least 2 stages) infillings : a well lithified, pale brownish limestone followed by a semi-consolidated dark brown sand including skeletal grains. Corals include massive faviids, robust branching/corymbose *Acropora*, and robust branching *Pocillopora*.
Occurrences : Hole M0023A, Core 14R through 16R; Hole M0023B, Core 16R.

Downhole logging high quality data acquired on the lower sequence from Hole M00023A provided important data that will be of great use to reconstruct the integrality of depositional sequences recovered in that hole. Logging data are very consistent with the lithological data obtained in intervals characterized by a good recovery.

Hole M0024A

Four carbonate sequences have been identified in that hole from top to bottom:

1) Coral-microbialite frameworks dominated by dark gray microbialites (laminated and thrombolitic microbial fabrics). There are no *in-situ* corals in Core 2R. Large cavities occur throughout this interval. Cavity walls are commonly veneered by microbial dendritic fabrics.

This sequence is characterized by the following successive coral assemblages:

a) Submassive and branching *Porites* in Core 1R.
b) Robust branching *Pocillopora* and unidentified encrusting corals associated with branching *Porites* and encrusting faviid in Cores 3R and 4R-1

c) Branching *Porites* associated with encrusting *Porites*, branching *Pocillopora*, foliaceous/encrusting *Montipora*, and unidentified encrusting corals in Cores 4R-2 through 10R-1 (top).
d) Robust branching *Pocillopora* associated with branching *Porites* in Core 10R-1 (21-135 cm).
e) Columnar *Porites* in Cores 10R-1 (bottom) and 10R-2.
f) Massive *Porites* (some of which are massive columnar colonies) associated with branching *Porites* and robust branching *Pocillopora* in Cores 11R through 14R.
g) Massive *Porites* associated with robust branching *Pocillopora* in 15R.

Occurrence : Cores 1R through 15R.

2) A gray well lithified skeletal-algal limestone rich in *Halimeda* segments and abundant volcanic elements. This limestone is underlain by volcaniclastic sediments.

Occurrence : Cores 15R and 16R.

Hole M0025A

Reef deposits recovered from Hole M0025A are divided into four successive sequences from top to bottom :

1) Alternations of dark gray to brownish limestone clasts and gravels and well lithified gray skeletal and algal limestone bearing coral colonies (e.g. encrusting *Montipora* in Core 1R) and volcanic elements.

Occurrence : Cores 1R and 2R.

2) Well lithified coralgal-microbialite frameworks. Microbialite displays a thrombolitic fabric. Large cavities, some of which are partly filled with skeletal sand with *Halimeda* segments, occur throughout this interval. The cavity walls are usually coated by thrombolitic microbial fabrics.

This sequence is characterized by the following successive coral assemblages:

a) Encrusting *Montipora* and fragmented branching *Porites* in Cores 3R and 4R.
b) Massive *Porites* (exhibiting locally a columnar growth form) associated with branching colonies of *Porites*, encrusting *Pavona* and robust branching *Pocillopora* in Cores 5R through 7R.
c) Encrusting corals (including *Montipora*) and branching *Porites* in Core 8R.
d) Branching *Porites* (dominant), encrusting corals (including *Montipora*) and submassive *Porites* in Core 9R.
e) Massive/submassive Porites in Core 10R.

Occurrence : Hole M0025A, Cores 1R through 10R.

3) A gray well lithified gravelly and sandy bioclastic packstone/grainstone and coral boundstone composed mainly of encrusting corals (including *Montipora*) and thin encrusting nongeniculate coralline algae. Solution vugs occur in these limestones.

Occurrence : Hole M0025A, Cores 10R and 11R.

4) Volcaniclastic calcareous sandstone interlayered with sandy limestone. Solution vugs occur and their walls usually display a brown staining. A conglomerate that contains basalt pebble occurs at the base of Core 13R.

Occurrence : Hole M0025A, Cores 12R and 13R.

Hole M0025B :

Two sedimentary units have been distinguished in Hole M0025B, from top to bottom :

1) Coral-microbialite frameworks in which dark gray microbialites (thrombolitic fabrics) are the main component. Large cavities occur throughout this interval. Cavity walls commonly display

a dendritic microbial fabric. *Halimeda* segments are commonly found embedded in microbialites filling the cavities from Core 4R downwards.

This sequence is characterized by the following successive coral assemblages:

a) Encrusting colonies of *Pachyseris* and *Porites*, as well as branching *Porites* fragments in Core 1R.
b) Branching *Porites* associated with encrusting colonies of *Montipora* and *Porites* in Cores 2R through 6R.
c) Robust branching colonies of *Pocillopora* in Core 6R.
d) Branching colonies of *Porites* in Core 7R.
e) Robust branching colonies of *Pocillopora* and massive to columnar *Porites* colonies, respectively at the top and at the base of Core 7R.
f) Massive colonies of *Porites* in Cores 10R through 12R with robust branching colonies of *Pocillopora* at the base of Core 11R and top of Core 12R, encrusting colonies of *Montipora* and branching *Porites* fragments at the top of Core 12R.

At the base of the Core 12R the coralgal-microbialite frameworks display a stronger lithification.

Occurrence : Hole M0025B, Cores 1R through 12R.

2) Dark gray to brownish **v**olcaniclastic sediments that include some fragments of red algal crusts and skeletal fragments (tiny shells, *Halimeda* segments ?).

Occurrence : Hole M0025B, Cores 12R (bottom) and 13R.

Hole M0026A :

Four units have been distinguished in Hole M0026A, from top to bottom :

1) Coral-microbialite frameworks that are characterized by the following successive coral assemblages :

a) Encrusting colonies of *Montipora* and *Pavona* in Cores 2R and 3R.
b) Columnar massive colonies of *Porites*, up to 70 cm long, associated with massive colonies of *Leptastrea* and *Favia* (Core 5R) in Cores 3R through 6R. Horizons including fragments of branching *Porites* and *Pocillopora*, limestone clasts and/or shells occur locally between massive colonies.

Occurrence : Hole M0026A, Cores 1R through 6R.

2) A well cemented *Halimeda* floatstone including volcanic grains.

Occurrence : Hole M0026A, Core 6R (bottom).

3) Alternations of gravels and pebbles made of coral fragments (robust branching *Pocillopora*, *Fungia*, *Alveopora*), limestone clasts and basalt elements, and coral colonies (*Porites*, robust branching *Acropora*).

Occurrence : Hole M0026A, Cores 7R and 8R.

4) Volcaniclastic sediments.

Occurrence : Hole M0026A, Core 8R (bottom).

Holes M0021B

Two carbonate sequences have been identified in Holes M0021B based on their lithological features and their biotic composition, from top to bottom :

1) Microbial-coral frameworks dominated by microbialite crusts that are comprised of thick laminated fabrics overlain by thrombolitic accretions. This sequence is characterized by the following successive coral assemblages, from top to bottom :

a) Encrusting *Montipora*, *Pavona* and *Leptastrea*, foliaceous *Pachyseris,* and massive *Acanthastrea* in Cores 1R and 2R.
b) Encrusting *Montipora* and robust branching *Pocillopora* in Core 3R.

c) Branching *Porites* (dominant) and foliaceous *Montipora* in Cores 4R through 7R.
d) Branching *Porites* (dominant) associated with encrusting *Porites* and *Montipora*, branching *Pocillopora*, robust branching *Pocillopora*, and submassive *Porites* in Cores 8R through 16R
e) Encrusting *Montipora* and *Porites* associated with robust branching *Pocillopora* in Cores 17R and 18R.

Occurrence : Hole M0021B, Cores 1R and 18R.

2) Sandy bioclastic grainstone (Core 19R, interval 0-11 cm) and algal limestone (Core 19R, interval 11-30 cm). The sandy bioclastic grainstone is made up chiefly of shell fragments, *Halimeda* segments, algal-coated coral fragments, echinoid spines and nongeniculate coralline algal crusts. The algal crust limestone consists of thin encrusting coralline algae associated with unidentified encrusting corals.

Occurrence : Hole M0021B, Core 19R.

3) Coral boundstone (Core 20R-1 and the top of the Core 20R-2) and sandy grainstone (Core 19R) and limestone (20R-2). The coral boundstone contains *in-situ* corals of encrusting corals (including *Montipora*) and encrusting/tabular acroporiid. Solution cavities occur, some of which are rimmed by stalagmitic cements. Cavities/vugs are partly filled with multigenerational infillings consisting of dark grey volcaniclastic skeletal sand overlain by microbialites.

Occurrence : Hole M0021B, Cores 19R and 20R.

HSE Activities

On 11th Nov, a DP malfunction caused emergency evacuation of personnel from the rooster box. All but the logging operator obeyed this instruction immediately. Nevertheless the rooster box was safely and speedily evacuated by all, the problem was resolved without the excursion going over 5 m. All pipes remained intact and the logging tool still ran freely. The DP console went into standby mode for no apparent reason and this is being investigated. The logger has been reminded of the procedures for operations in the rooster box and of his duty to the safety of himself and other personnel.

On 13th Nov, a boat and fire drill was carried out at 1100 hrs.