IODP Expedition 310
Tahiti Sea-level
Week 4 Report (27th Oct – 2nd Nov, 2005)

November 03, 2005

Operations

Hole M0015A (TAH-03A-1): After completing Hole M0007C, around 300 m to the NW, the DP Hunter moved to Site M0015 in 72.15 m of water. After a short bathymetry traverse to locate a site for the hole, drilling operations began at 0030 hrs, 27th October, and continued until 0325 hrs, 28th October. TD was 42.28 mbsf. There was generally good core recovery, with usually less than one metre core runs between bit blocking, and 72.71 % average recovery for the hole.

Logging of Hole M0015A (TAH-03A-1): Prior to logging, Hole M0015A was reamed and flushed for 1 hour, after which the core barrel was removed and the drill string re-run with a casing shoe. Logging commenced at 0630 hrs, 28th October. Initially the casing depth was set at 7 m but the logging tools would not pass downhole beyond 20 m, so they were removed and the casing run to the base of the hole then pulled back to 20m. Logging then was possible in the bottom part of the borehole but one tool was stuck for a while and had to be eased free with the downhole hammer. Thereafter logging continued successfully, the casing was pulled back to 7 m and the remainder of the hole logged, with overlap. Logging operations at Hole M0015B were completed by 1930 hrs, 28th October. The string was then tripped to deck and the DART lifted off seabed.

Hole M0016A (TAH-03A-1A): After moving to new Site M0016, a taut-wire bathymetry traverse was conducted to locate a site for Hole M0016A. By 2400 hrs, 28th October, the DP Hunter was positioned above Hole M0016A in 80 m water depth. Shortly after midnight on the 29th October, coring operations began. Throughout the day, coring continued with fairly poor recovery and the drilling indicated that the formation had many cavities. Coring at Hole M0016A was terminated at 0620 hrs, 30th October, at a TD of 38.31 m. This was due to difficulty in overcoming bit blocking and, after a string trip to clean the whole core barrel system, the HQ inner barrel could not re-enter the outer pipe due to the string bending. It is most likely that the DART had moved on the seabed, possibly through subsidence.

Hole M0016B (TAH-03A-1B): Hole M0016B was located 5 m east of Hole M0016A. Initially the non-coring insert bit was used to drill down to 17 m below seabed and then coring continued with variable but generally good core recovery. Coring operations ended at 0230 hrs, 31st October, at a TD of 44.62 m.

Search to locate new hole at Site M0006 (TAH-03A-5): After moving to previous Site M0006, a taut-wire site survey was conducted along a short transect. This survey was abandoned after the DART touched down on the sea bed unexpectedly, indicating that the bathymetry for this area was not accurate. After running the down pipe camera to check

for stinger damage, and lifting the DART higher from the sea bed, a new taut-wire survey was conducted 10 m east of the previous transect. A suitable site was found, but when the DART was lowered it touched the sea bed 2 m deeper than indicated by the taut-wire. The topography of the sea floor was suspected to be very uneven at this survey location, so a new survey transect was initiated 10 m east. During this survey, the DART unexpectedly touched sea bed again. The sea bed depth at Site M0006 appeared to change rapidly, and the changes were not evident on the bathymetry data. Therefore the search for a new site was abandoned, the DART lifted into the moonpool, and the DP Hunter returned to previous Site M0015.

Hole M0015B (TAH-03A-1C): The DP Hunter moved back to previous site M0015 to start new Hole M0015B in 71.53 m water depth. Coring operations began at 1330 hrs, 31st October, and were completed by 1730 hrs, 1st November, at a TD of 40.12 m. Due to the fact that very short core runs were being achieved in the lower part of the hole and most liners were being crushed, the last four or five runs were made using the split chromed steel liners commonly used elsewhere in this type of coring. The immediate result was longer core runs before jamming, better core recovery and improved preservation of delicate structures. Some horizons which would previously have been crushed were kept intact or kept in their correct cored position. As core collected in this manner is not surrounded by a permanent liner after removal from the splits, there were some curation and petrophysics problems to be overcome. These were rapidly resolved to the satisfaction of all and the method may be further used for critical areas where the enhanced core recovery is important.

Hole M0017A (TAH-03A-1D): Hole M0017A was located approximately 60 m north of Hole M0015B in 56.5 m water depth. Before touching down with the DART, a sea bed camera survey was run to check for living corals. None were observed, and so coring operations began at 2300 hrs, 1st November. A faster penetration rate was achieved due to the use of steel split liners which gave the drillers a much more sensitive indicator of bit blocking. As a consequence, they were able to detect bit blocking much quicker and were sometimes able to avoid it. This meant that the core runs were longer and the number of wireline trips reduced. Core recovery also improved. No problems were encountered with the subsequent curation or science through the use of steel split liners. Coring was completed by 1600 hrs, 2nd November, at a TD of 40.56 m.

Logging of Hole M0017A (TAH-03A-1D): Prior to logging Hole M0017A, the hole was flushed. There was some difficulty with a stuck HQ pipe while trying to trip the drill string, which could be rotated but not uplifted. The string eventually came free. A casing shoe was fitted for the logging operation. Logging commenced at Hole M0017A at 2130 hrs, 2nd November.

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
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

Science

Holes M0015A and M0015B

Holes M0015A and M0015B exhibit four carbonate sequences characterized by their lithological features and their biotic composition.

1) The uppermost carbonate sequence comprises coralgal bindstone composed mainly of encrusting corals (including agariciid) and nongeniculate coralline algae. Coral assemblage includes branching *Porites* and *Montipora*, and encrusting agariciids. Some cavities are brown in colour and partly filled with well and moderately consolidated skeletal sands or veneered by microbialites.

Occurrence : Hole M0015B, Cores 1R and 2R.

2) The second carbonate sequence consists of 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:

- In Hole M0015A :
    a) Encrusting (*Montipora, Pavona* and agaricids) and foliaceous (*Pachyseris*) corals in Cores 1R through 6R.
    b) Robust branching *Acropora* associated locally with encrusting *Pavona* in Cores 7R through 10R.
    c) Tabular *Acropora* associated with massive *Montastrea*, robust branching *Pocillopora* and encrusting *Millepora* in Cores 11R through 17R.
    d) Branching *Porites* associated with unidentified encrusting corals in Cores 18R through 24R.
    e) Tabular and robust branching *Acropora* in Cores 25R and 26R.
    f) Branching *Porites* and *Pocillopora* in Cores 27R through 32R.
    g) Robust branching *Pocillopora* and branching *Porites* in Cores 33R and 34R.

- In Hole M0015B :
    a) Encrusting corals (*Montipora*, agariciids) and submassive *Porites* in Cores 3R through 6R.
    b) Robust branching *Acropora* and submassive *Porites* in Cores 7R and 8R.
    c) Submassive *Porites*, encrusting (agariciids) and tabular corals in Core 9R.
    d) Massive *Porites* in Cores 10R through 12R.
    e) Encrusting *Montipora* (Core 13R), massive *Porites* (Core 15R) and faviids (Core 17R) in Cores 13R through 18R.
    f) Tabular *Acropora* associated with branching *Pocillopora*, thin encrusting *Porites* and unidentified encrusting corals in Cores 19R through 21R
    g) Branching *Porites* associated with branching *Pocillopora*, massive faviids (*Montastrea*), encrusting corals (including agaricids) and tabular *Acropora* in Cores 22R through 32R.
    h) Branching *Porites* and robust branching *Pocillopora* in Cores 33R through 35R

    Occurrence : Hole M0015A, Cores 1R through 34R; Hole M0015B, Cores 3R through 35R.

3) The third carbonate sequence includes coral colonies embedded in a bioclastic grainstone/packstone matrix interlayered with coral clasts encrusted by nongeniculate coralline algae and/or microbialites. Corals include massive colonies of *Porites* and robust branching and branching colonies of *Pocillopora*.

Occurrence : Hole M0015B, Core 35R (base) through 37R.

4) The lowest carbonate sequence consists mainly of coral and skeletal limestone, with local intercalations of gravel and sand layers. Coral assemblage is dominated by tabular, robust branching, and branching *Acropora*, massive *Porites* and robust branching and branching *Pocillopora*. Corals are usually encrusted by coralline algae. *Halimeda* segments are locally abundant.

Subaerial diagenetic processes are indicated by the recrystallization of coral skeletons and the occurrence of large solution cavities that display a brown to red brown staining.

Occurrence : Hole M0015A, Cores 35R through 41R; Hole M0015B, Cores 37R (base) and 38R.

Downhole logging data acquired in Hole M00015A provided important data that will be useful to reconstruct the depositional sequences recovered in this hole and to analyze the internal structure of reef frameworks.

Holes M0016A and M0016B -

Three carbonate sequences have been identified in Holes M0016A and M0016B based on their lithological features and their biotic composition.

1) The uppermost sequence is made up of clasts of beige to brown well lithified limestone containing foliaceous *Pachyseris*.

Occurrence : Hole M0016A, Core 1R.

2) The second sequence is composed of coralgal-microbialite frameworks displaying distinctive coral assemblages:

Hole M0016A

a) Encrusting corals (*Montipora*) and, to a less extent, massive faviids and *Porites* or *Montipora* in Cores 1-CC through 6R.
b) Encrusting *Pavona* and *Montipora*, tabular *Acropora* and robust branching *Pocillopora* in Cores 7R through 12R.
c) Branching *Pocillopora* in Cores 13R and 14R.
d) Tabular *Acropora* and branching *Acropora* or *Porites* (?) in Cores 15R and 16R.
e) Tabular *Acropora* in Core 17R.
f) Branching *Porites* and encrusting corals (*Montipora*) in Cores 18R through 23R.
g) Branching *Porites* and *Pocillopora* in Cores 24R through 27R.
h) Unidentified encrusting corals in Cores 28R through 32R.
i) Massive *Porites* in Cores 33R through 36R.

Hole M0016B

a) Branching *Porites*, tabular *Acropora* and robust branching *Pocillopora* in Core 1R through 3R.
b) Branching *Porites* and encrusting *Montipora* in Cores 4R and 5R.
c) Massive *Porites* and associated encrusting *Montipora* in Cores 6R and 7R.

d) Branching *Porites* and thin encrusting *Montipora* in Cores 8R through 19R. This assemblage alternates with robust branching *Pocillopora* and massive *Porites* corals in Cores 14R through 19R.
e) Massive *Porites* associated with branching *Pocillopora* and *Acropora* in Cores 20R through 22R-1.

Occurrence : Hole M0016A, Cores 1R-CC through 36R; Hole M0016B, Cores 22R-1.

3) The lowermost sequence consits of yellow brown coralgal and skeletal limestone including massive *Porites* and fragments of robust branching *Pocillopora*. The occurrence of very large solution cavities that display a yellow staining indicates subsequent subaerial diagenetic processes.

Occrurence : Hole M0016A, Core 22R-CC through 24.

Hole M0017A -

Three successive sequences have been recognized based on the visual observation of cores from Hole M0017A.

1) The uppermost sequence includes algal-coated coral clasts and *Halimeda* packstone/ floatstone. The *Halimeda* limestone is well consolidated and composed mainly of *Halimeda* segments associated with foraminifers (benthic and encrusting foraminifers), bryozoans, echinoids and mollusks.

Occrurence : Hole M0017A, Cores 1R through 2R.

2) Coral-microbialite frameworks. Cores 5R through 8R recovered loose coral-microbialite frameworks characterized by the widespread occurrence of microbialite crusts. In Cores 9R through 17R, microbialites form massive crusts (up to 20 cm-thick) over corals and red algae, and locally represent to the major structural and volumetric component of the frameworks. They usually correspond to a two stage encrustation composed of very thick laminated fabrics overlain by thrombolitic accretions. Large primary cavities are partly filled by micritic sediments including *Halimeda* segments. This sequence is characterized by the following successive coral assemblages:

a) Encrusting coral (*Montipora*) in Core 3R-CC.
b) Massive *Porites* in Core 4R.
c) Encrusting *Montipora* and *Acanthastrea* associated with fragments of branching *Porites* (?) in Core 8R.
d) Tabular and corymbose *Acropora* and massive *Porites* in Cores 9R and 12R.
e) Massive *Montastrea* and *Leptastrea* in Core 14R.
f) Encrusting *Montipora* and *Leptastrea*, robust branching *Pocillopora* and branching *Porites* (?) in Cores 15R and 17R.

g) Branching *Porites*, encrusting agariciids, and tabular/encrusting *Acropora* in Core 18R.
h) Tabular acroporoiids, and massive *Porites* in Core 19R
i) Unidentified encrusting corals in Core20R.

Occurrence : Hole M0017A, Cores 3R through 20R.

3) The lowermost sequence consists of well lithified coralgal bindstone and coral rudstone/floatstone, both interlayered with skeletal packstone/grainstone. The bindstone contains *in-situ* colonies of thin encrusting and foliaceous corals, and submassive faviids (*Favia/Montastrea*). Solution vug/cavities are found throughout this interval; some of which are partly filled with internal sediments.

Occurrence : Hole M0017A, Cores 3R through 21R.

Downhole logging data acquired in Hole M0017A provided important data that will be useful to reconstruct the depositional sequences recovered in this hole and to analyze the internal structure of reef frameworks.

HSE Activities

On 27th October, an emergency man-overboard and boat drill was carried out with ship's crew. The safety boat was launched and the lifeboats swung out but not launched. The opportunity was taken to obtain some photos of the DP Hunter from the sea.

On 28th October, E.Gillespie (ESO) joined the ship by pilot boat and D. Baxter left on same boat to return to the U.K.

On 29th October, the German TV production crew joined the ship by pilot boat.

On 30th October, a fire drill was completed successfully.

On 31st October, an echosounder was ordered. To avoid any equipment and environmental damage in deeper water where the DART could hit uncharted obstructions or be landed on impossibly steep slopes, the echosounder will operate in the moonpool and will be used for short line surveys at each proposed site. This to ensure that suitable landing sites at the desired water depths can be found and occupied. No personnel are on the rig rooster box during moves so there is no danger to personnel, but it is also not acceptable for the operator to put equipment at unnecessary risk and possibly end up having to collect debris from the seabed.