

IODP Expedition 310:  
Tahiti Sea-level  
Week 2 Report (13<sup>th</sup>-19<sup>th</sup> Oct, 2005)

October 20, 2005

## **Operations**

Logging of Hole M0005D (TAH-03, #4C): The logging operation at Hole M0005D continued with excellent logs being obtained until the hole finally collapsed after pulling back the HQ pipe to 17 m below the sea bed. The logging tools were in danger of becoming stuck in the top-hole section, and were retrieved. After a heading change, the remaining HQ pipe was pulled, the DART was lifted and operations at Hole M0005D ceased at 1310 hrs, 13<sup>th</sup> October. A post-drilling sea bed survey using the down-pipe camera was conducted before leaving the hole.

Hole M0005E (TAH-03A, #4D): Before departing Site M0005, 4 hammer samples were taken at Hole M0005E (approximately 5 m along slope from Hole M0005D, 61.34 m water depth). 4 samples were taken to a depth of 2 m below sea bed, and with typically 80 % recovery. After curation, these samples were handed to the microbiologists to sample at will, before the remainder was passed to the sedimentologists and coral specialists for description. Operations at Hole M0005E were concluded by 1635 hrs, 13<sup>th</sup> October. Before progressing to the next Site, the DP Hunter conducted a 360° maneuver to verify that positioning offsets at the drill string were zero.

Hole M0006A (TAH-03A, #5): A move to deeper water (~80 m) was undertaken, and the DP Hunter was repositioned above Hole M0006A in 81.58 m water depth. Another 4 hammer samples were collected primarily for microbiology before the drill string was lowered onto what appeared to be a very steep slope. Both the ship's transponder and tautwire indicated that they were sliding downslope, and suggested that the bathymetric data was insufficient to allow a reasonable picture of the sea bed. Any slope instability may have led to the DART sliding away downslope, and the decision was made to avoid the outer reef edge until either more sea bed information was obtained or modifications are made to the DART to allow greater stability on steep slopes. Site M0006 was departed at 2300 hrs, 13<sup>th</sup> October.

Hole M0007A (TAH-03A, #3): Hole M0007A was located further back from the reef edge than Sites M0005 and M0006, in 44.45 m water depth. The sea bed was surveyed using the down-pipe camera, and at 0330 hrs, 14<sup>th</sup> October, 4 hammer samples were taken. After hammer sampling, the HQ string was run and rotary coring commenced at the same hole. Coring continued with good recovery for the rest of the day. TD (44.4 m) was reached at 0120 hrs, 15<sup>th</sup> October.

Logging of Hole M0007A (TAH-03, #3): Prior to tripping the HQ pipe, the gamma tool was run inside the pipe. Logging results from Hole M0005D indicated that the shape of the gamma trace through the pipe, when scaled accordingly, did not differ significantly

when compared to the open hole trace, although statistically the results are less useful. This procedure will be adopted when logging future holes on this Expedition. After gamma logging, the HQ pipe was tripped, the core barrel removed, and the string re-run with a casing shoe to 7.5 m below sea bed. Open hole logging commenced from TD to the casing shoe. After running the resistivity and hydrochemical tools in the open hole section, the acoustic imaging tool would not progress much beyond the casing shoe, despite being run with a sinker bar. Logging was terminated at Hole M0007A at 0700 hrs, 15<sup>th</sup> October.

Hole M0007B (TAH-03A, #3): After a post-drill sea bed survey using the down-pipe camera, the DP Hunter moved 50 m along slope to Hole M0007B. 2 hammer samples were collected before rotary coring commenced at the same hole. Core recovery was poor in the top part of the hole, and the coring parameters were checked for any changes that may have been responsible. Zero bit weight and high rates of penetration confirmed that an open structure was being drilled. The formation became more compact with depth, and the recovery improved accordingly. Coring continued until 0630 hrs, 16<sup>th</sup> October.

Logging of Hole M0007B (TAH,03A, ~#3A): The HQ pipe was tripped and a casing shoe fitted before the pipe was re-run to the base of the hole for in-pipe gamma logging. After gamma logging, the HQ pipe was pulled to 24.6 m below sea bed and the resistivity, hydrochemical, acoustic imaging and optical imaging tools run. It was not possible to log the entire bottom-hole section due to hole blockage (below 30 m below sea bed). Logging at Hole M0007B was completed by 1410 hrs, 16<sup>th</sup> October.

Transit from Site M0007 to Site M0008: The remainder of the HQ pipe was pulled and a sea bed survey using the down-pipe camera was conducted. The survey showed that the DART had been drilled well into the sea bed (1.5 m) and had left a shallow, debris-filled depression. However, the surrounding sea bed showed minimal disturbance from the drilling. The DART was then lifted onto the deck through the moonpool and secured. At 1700 hrs, 16<sup>th</sup> October, the vessel departed Site M0007 and headed for Site M0008, located on transect TAH-02A off the northeast coast of Tahiti, arriving at 2400 hrs.

Hole M0008A (TAH-02A, #3): Shortly after arrival at 2400 hrs, a sea bed survey using the down-pipe camera was conducted. At 0400 hrs, 17<sup>th</sup> October, coring operations began at Hole M0008A. This hole was to serve as a reference hole for the other holes on the transect. However, the material recovered consisted of river deposits of unconsolidated basalt gravel and pebbles, mixed with volcanoclastic sediments. As a result, recovery was poor throughout (24.5 %). TD was reached at 40.2 m below sea bed, and operations ended at Hole M0008A at 1720 hrs, 17<sup>th</sup> October.

Hole M0009A and M0009B (TAH-02A, #5): An assessment was made of where to drill next, in light of the results obtained at Hole M0008A. It was decided to attempt to drill the pinnacle at site TAH-02A, #4 on seismic profile SISM 079. Acknowledging that the feature imaged on the seismic line may be the result of side-swipe, and may possibly be located off the seismic line, a localized search was made for a suitable drilling location

using the echosounder and the tautwire to detect a shallower than expected water depth. No suitable position was located, and at 2100 hrs, 17<sup>th</sup> October, the vessel was positioned above a flat terrace (Hole M0009A) nearby and drilling operations commenced and continued until 1915 hrs, 18<sup>th</sup> October. Recovery was moderate to poor (43.1 %) to TD of 23.04 m below sea bed. However, promising coral material was recovered and it was decided to attempt to recover the same section in a new hole nearby. By 2000 hrs, the HQ pipe had been recovered and the DART lifted off the sea bed, and by 2015 hrs the vessel was positioned above Hole M0009B, approximately 5 m downslope from Hole M0009A. Coring operation commenced and continued until 1200 hrs, 19<sup>th</sup> October, with an improved recovery of 66.26 %.

Logging of Hole M0009B (TAH-02A, #5): Prior to logging Hole M0009B, the hole was reamed. Logging began at 1530 hrs, 19<sup>th</sup> October, with the resistivity and hydrochemical tools run open hole over the interval 6-21 m below sea bed. A hole blockage near the post-glacial / Pleistocene boundary, which resisted attempts to clear with the chisel tool, prevented the tools from being run below approximately 21 m below sea bed. Optical image logs were collected 6-18.1 m below sea bed, and acoustic image logs between 6-13.8 m below sea bed. Logging of Hole M0009B was concluded by 2320 hrs, 19<sup>th</sup> October.

*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
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

**Science**

The reef formations recovered in Holes M0007A and M0007B display two successive sequences, from top to base:

A) The upper sequence is comprised of 42 m of corallal frameworks heavily encrusted by microbialites (laminated and columnar microbial fabrics), and locally interlayered with coarse skeletal sands and gravels rich in coral and algal fragments. Microbialites are very abundant and represent locally the major structural and volumetric component of the reef rock. They developed within the primary cavities of the reef framework where they generally overlie thick coralline algal crusts.

Corals are well preserved and form distinctive assemblages, from top to base :

a) Massive colonies of *Porites*, *Astreopora* and faviids, associated with encrusting colonies of *Montipora* and agaricids. Sections of massive coral colonies are up to 60 cm-thick. This assemblage generally forms loose frameworks characterized by large primary cavities partly filled with skeletal sands and gravels including coral and red algal fragments, and *Halimeda* segments. This coral community has been reported on modern outer reef slopes, in moderate to high energy conditions, at depths ranging from 5 to 15 m.

Occurrences: Hole M0007A, Cores 6R through 19R. Hole M0007B, Cores 11R through 16R.

b) Robust branching colonies of *Acropora* and *Pocillopora*), associated with massive *Porites* colonies, tabular *Acropora* (*Acropora hyacinthus* ? and *Acropora* gr. *humilis*) and encrusting faviids. Large primary cavities are partially filled with bioclastic sands and coral fragments. Traces of bioerosion on coral colonies occur locally. In modern environments, this coral assemblage is characteristic of reef crests and upper reef slopes, that are exposed to strong wave action in water depths less than 5 m.

Occurrences: Hole M0007A, Cores 20R through 29R. Hole M0007B, Cores 17R through 33R.

The reported succession of coral assemblages suggests therefore a deepening-upwards coral reef sequence. The base of the coralgal-microbialite sequence corresponds to poorly lithified skeletal grainstone that contains fine sand-sized volcanic grains in Core 34R-CC from Hole M0007A, and to a 30 cm-thick interval composed of branching coralline algae in Core 34R from Hole M0007B.

B) The lower sequence is comprised of well lithified limestone rich in red algal crusts and corals (especially robust branching *Acropora*). Subaerial diagenetic processes are indicated by the recrystallization of coral skeletons and by the occurrence of abundant centimetre-sized solution cavities.

Occurrences: Hole M0007A, Cores 35R and 36R. Hole M0007B, Cores 34R and 35R.

Hole M0008A exhibits a 40 m-thick sequence composed of alternations of :

a) black, dark brown to reddish brown poorly-indurated volcanoclastic sediments including clay, silt and cross-laminated volcanoclastic medium- to coarse-grained sandstone, locally containing rounded, granule- to pebble-sized gravel of basalt;

b) basalt gravels, pebbles and cobbles, locally embedded in a brownish gray matrix of volcanoclastic coarse sand and mud.

This sequence is interpreted as fluvial to coastal deposits. The local occurrence of reworked coral fragments (piece of tabular *Acropora*, branch of *Pocillopora*) indicates that some corals (reefs?) developed nearby.

Holes M0009A and M0009B displays a coralgal-microbialite reef sequence in which microbialites (laminated and thrombolitic microbial fabrics) usually represent the major volumetric and structural component. This sequence includes several successive coral assemblages, from top to base:

a) Foliaceous *Montipora* and submassive coral colonies (*Porites*, *Leptastrea*) are thinly coated by red algae to form loose frameworks. This coral assemblage characterizes moderate to quiet energy environments in the middle part of the reef slope at depths greater than 20 m.

Occurrence : Hole M0009B, Cores 1R through 8R.

b) An assemblage dominated by robust branching *Pocillopora* and *Acropora* and, to a less extent, tabular *Acropora*. The corals are usually thickly encrusted by red algae. Large primary cavities are partially filled with skeletal sands and gravels. This coral association characterizes high-energy shallow water environments

Occurrences : Hole M0009B, Cores 9R and 10R and 13R through 15R.

c) Massive coral colonies (*Porites*, *Leptastrea*) and encrusting agaricids. Sections of those colonies are up to 25 cm long. The corals are heavily encrusted by red algae and microbialites. This community has been reported on modern outer reef slopes, in moderate to high energy conditions, at depths ranging from 5 to 15 m.

Occurrences : Hole M0009A, Core 6R ; Hole M0009B, Cores 11R and 12R.

The apparent interlayering between the reef sequence described above and dense grey limestone rich in recrystallized corals (*Porites*, acroporids, *Pocillopora*, foliaceous *Montipora*) and red algal crusts in Cores 1R through 6R-1 in Hole 0009A, suggests that this sequence was deposited on the karstified/deeply eroded surface of the underlying limestone.

Occurrences : Hole M0009A, Cores 1R through 6R-1 and Cores 7R and 8R-1.

At 21.51 m in Core 15R from Hole M0009B, the coralgal-microbialite reef sequence overlies a well lithified grey coralgal and skeletal limestone (*Halimeda* packstone) exhibiting diagenetic overprints characterized by the recrystallization of coral skeletons and by the occurrence of large solution cavities. Coral assemblages are dominated by massive corals (*Porites*), foliaceous *Pachyseris* and robust branching *Acropora*.

Occurrences : Hole M0009B, Cores 15R through 18R.

## **Technical Activities**

Detailed in 'Operations'.

## **HSE Activities**

On the 19th October at 0035 hrs, the DP alarm procedure initiated an emergency response to evacuate the rooster box of all personnel. The main computer performed a re-boot and although the back-up system took over it did not indicate that it had done so. Subsequently, and only for a few minutes, the DP Officer did not know if the vessel was going to maintain station and correctly requested personnel evacuation of the rooster box until the status of the DP could be confirmed. A few minutes later the 'all clear' was given and normal operations resumed. All procedures worked exactly to plan.

A ship inspection visit by third party/potential clients from Neptune and Placer Dome carried out an independent H&S audit on the vessel and were well pleased with their findings, the procedures of the vessel and our contractors.