**Week 4 Drilling and Scientific Report for IODP/ICDP Expedition 364 Chicxulub Impact Crater 2016**

**30th April 2016 – 06th May 2016**

## 1. Operations

Coring continued throughout April 30th. Due to a change in lithology, core runs were shortened to ~1.5 m on average, and coring rate reduced. By the end of a day, a total of 11 core runs (Core 62R to 72R) were completed, advancing the hole 15.75 m reaching 699.09 mbsf. Core recovery was lower than previous days but still averaged 81%.

On the May 1st, essential maintenance of the rig was carried out for the majority of the morning. Once complete, the core barrel was recovered to deck and upon inspection, it was found that the Core Catcher contained a 'stub' of core which was considered to have been left behind by the previous run (72R). Set-up for logging commenced and the pipe was tripped to 507 mbsf, just below the depth of casing, to enable open hole logging. Logging operations commenced and continued for the remainder of the day and logging personnel were transferred to the platform on the crew boat *Linda F*. The first tool run down hole was the induction magnetic susceptibility standalone tool, followed by a tool string comprising the spectral natural gamma ray, the sonic, and the fluid and temperature conductivity tools, run from ~698 mwsf to 507 mwsf. Towards the end of the day a tool string comprising spectral natural gamma ray, caliper and acoustic borehole imager was sent down the hole.

Downhole logging operations continued during the early hours of the May 2nd. The tool string, as outlined above, was run uphole from ~697 mwsf at very high resolution. While rig-up for VSP operations was ongoing, marine mammal and protected species observations were carried out. Following technical issues with the depth encoder, the VSP tool was lowered to 696 mwsf and run uphole at high-resolution. Marine mammal and protected species observation continued throughout, and for a period after VSP operations. Upon completion of downhole logging operations, maintenance of the drill rig continued for the remainder of the day. The crew vessel Linda F arrived and logging personnel disembarked.

On May 3rd maintenance of the drill rig was complete and running in of pipe began. The base of hole was reached at 03:25 h and coring commenced. The core (73R) was recovered to deck and upon inspection, fragments of the drill bit were found in the core liner indicating the bit had worn in places. The pipe was tripped to recover the BHA for inspection. The decision was made to case and cement the borehole, and step down to a standard PQ3 size to improve efficiency of the coring. Casing of the hole started and continued through the remainder of the day. The total depth reached using oversized PQ3 size was 701.64 mbsf. During the day, the crew vessel Linda F arrived to transfer supplies and personnel.

Running of the casing continued until 05:10 h on the May 4th. The casing was set by pumping cement to the base of the hole and allowed to cure. To maximize operational time while the cement was curing, a wireline tool sting comprising the natural gamma ray and acoustic imager was sent downhole. Upon completion of the downhole logging exercise, the drill string was run into the hole in preparation for coring; this continued for the remainder of the day.

Running of the pipe continued until 02:30 h on the morning of the May 5th. Upon reaching the base of the hole, coring of the cement began with a cement core recovered at 0329 h. Coring continued throughout the day and was intermittently interrupted to carry out essential maintenance on the drill rig. Coring runs were kept short to maximize recovery in difficult lithology. A total of 7 cores were recovered throughout the day, advancing the hole by 5.7 m. Core recovery was 100% and quality was very good. By midnight, a depth of 707.34 mbsf had been achieved and coring continued.

On May 6th, coring continued throughout the day at a steady rate. Nine cores were recovered in total, and the hole was advanced by a further 21.35 m. Core recovery was 100% and the quality of core recovered was excellent. At the end of the day the hole, coring continued and the hole was at a depth of 728.69 mbsf.

## 2. Hole summary

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|---|---|
| **Hole** | M0077A |
| **Latitude** | 21°26.996' N |
| **Longitude** | 89°56.968'W |
| **First core** | 62R |
| **Last core** | 89R |
| **Cores recovered** | 28 |
| **Drilled length (Coring)** | 47.15 m |
| **Drilled Length (Open Hole)** | 0 m |
| **Recovered length** | 44.70 m |
| **Depth in hole** | 728.69 m |
| **Hole recovery** | 95% |

## 3. Science

At the start of the week, April 30th, a Science Party staffing change occurred during which time a cross-over science meeting was held to discuss the results to date. Micropaleontologists Lowery and Bralower disembarked along with microbiologist Cockell; impact petrologists Rae and Poelchau and co-chief scientist Morgan embarked.

Core recovery was variable on April 30th with all recovered core being polymict lithic breccia or melt-bearing breccia, with the deeper sections becoming more melt rich – i.e. transitioning from melt-poor to melt-rich. The lithology is proving challenging to drill, and drilling rates are relatively slower. Clasts are marl, limestone, melt, and occasional granite. The green and gray clasts are identified as melt; they contain bubbles and vesicles as well as smaller clasts.

On May 1st, we conducted logging operations. The acoustic imaging log is of excellent quality, especially in the marlstone and limestone deposits, and the caliper showed that the hole was in good condition and of near-constant size. The VSP data looked of high quality to the 700 m depth; first arrivals were clear. Based on one-way travel time, the decrease in density at ~618 m at the top of the lithic wacke and melt bearing breccias corresponds to the bright reflector that caps the peak ring. At 700 m, the base of the hole was still within the low-velocity zone at the top of the peak ring. Therefore, a further ~50-100 m of lower-velocity impact breccias are expected before reaching a depth where there is a low-frequency reflector and a gradual increase in velocity suggesting a change in lithology.

Coring operations were resumed on May 2nd, and a single core was recovered comprising a melt-rich impact breccia, similar to previous cores. Coring was suspended on May 3rd to run in casing and a smaller drill string.

On May 4th, wireline logging acquisition within the casing was carried out while waiting for the cement at the base of the casing to cure. This was undertaken to investigate the possibility of acoustically imaging the borehole formation through the steel casing. Preliminary interpretations of the acoustic impedance images show the presence of a signal which may represent the geological formation. Further tests would be required to fully assess the feasibility of this approach.

On May 5th, coring resumed but progress was slow due to lithology. The cores collected were of high quality and near 100% recovery and exhibit larger clasts of mixed lithologies, from limestones to granites. Observations show evidence of greater heat as melt clasts are being entrained into the matrix while molten. Cores were classified as a melt-rich melt bearing breccia. The final core collected during the day had a large granitic clast within a thick section of melt.

Coring continued through May 6th and an additional ~21 m of core were collected, all of excellent quality. As with the previous day, large dark melt clasts in places 10s of centimeters long were observed interspersed with melt-bearing breccia that included both sedimentary and igneous clasts. Multi-sensor core logger shows some high magnetic susceptibility intervals. Based on the VSP results we anticipate being within the impact breccia / low velocity interval for at least another

25 m but the contact with the more intact peak ring below could be gradational.

## 4. HSE Activity

N/A

## 5. Outreach Activity

Expedition participants continued to blog at;
esoexpedition364chicxulubimpactcrater.wordpress.

## 6. Figures

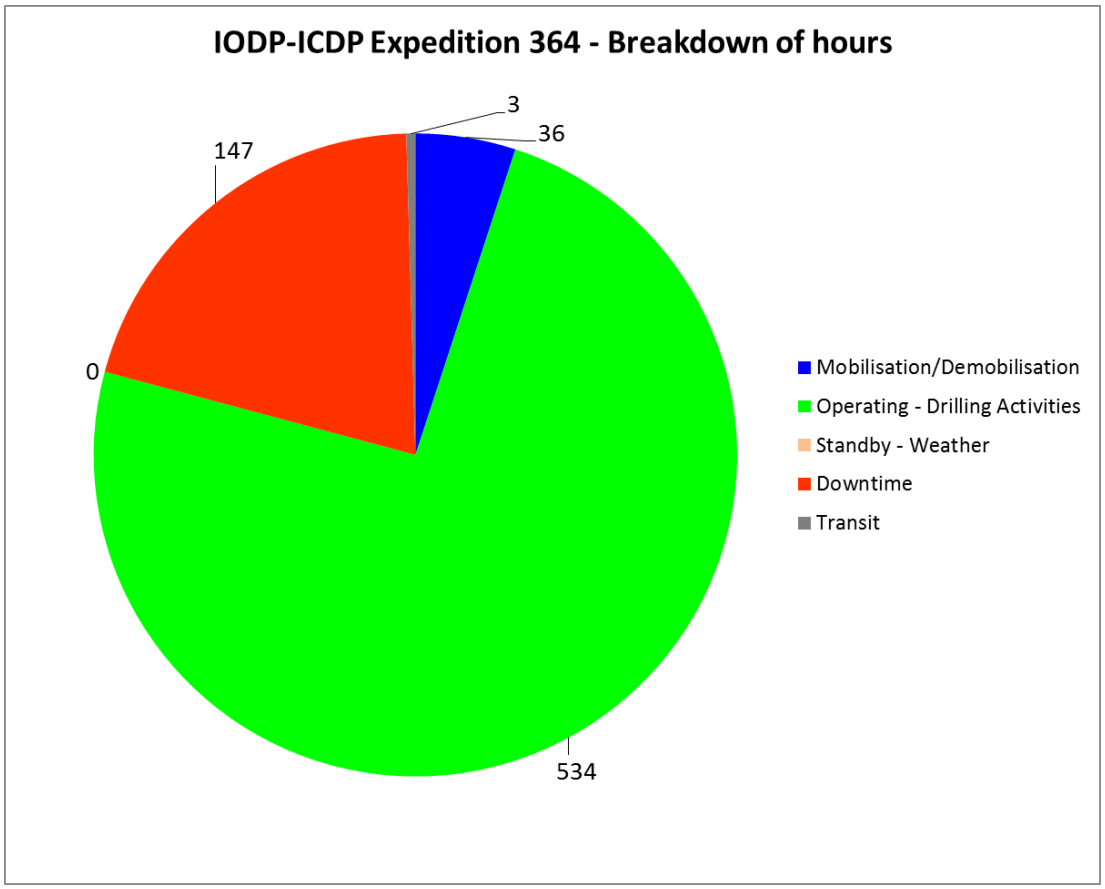


Figure 1: Breakdown of hours from 00:00 April 30th to 24:00 May 6th.

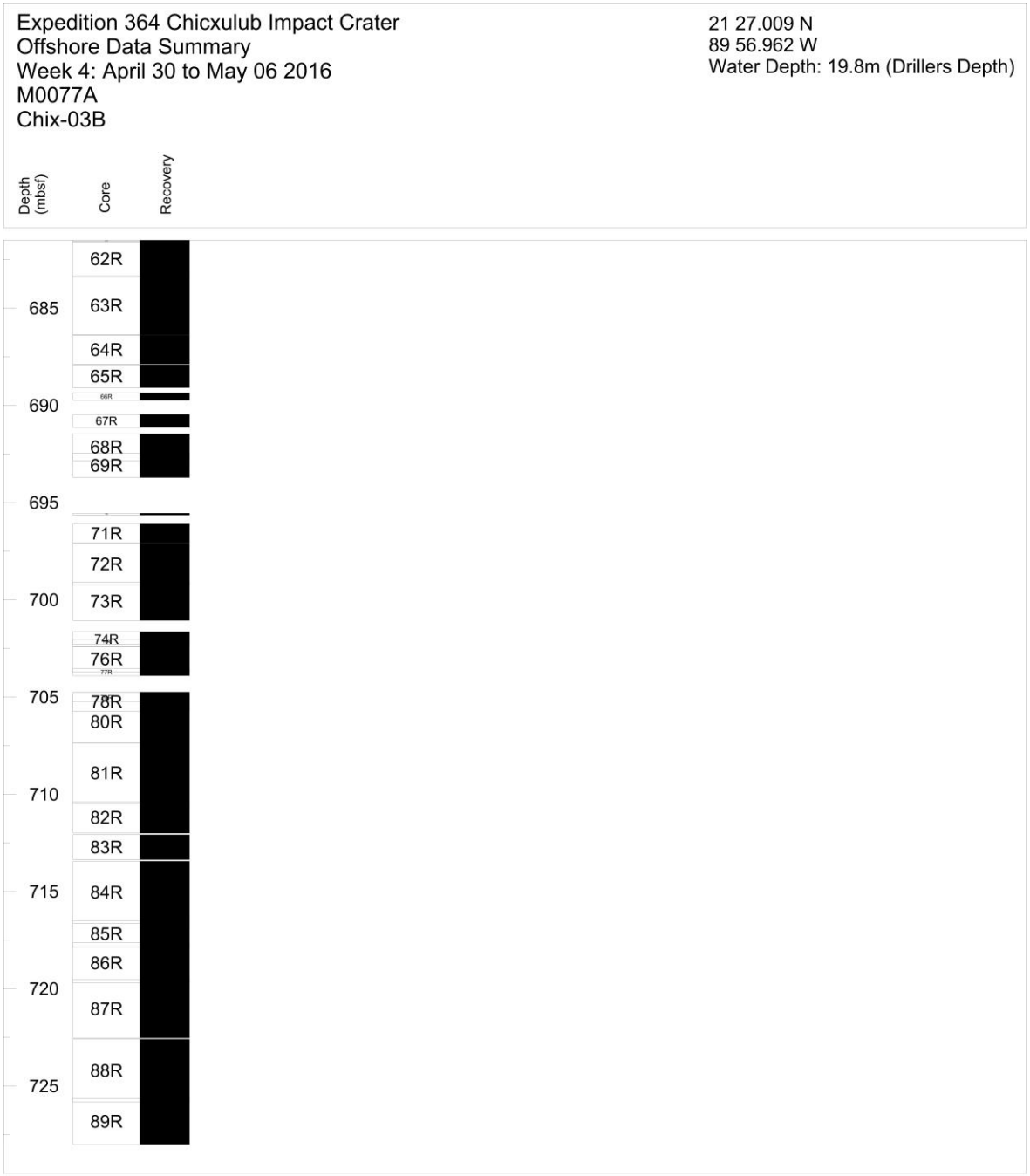


Figure 2: Core Recovery during operations from 00:00 April 30th to 24:00 May 6th

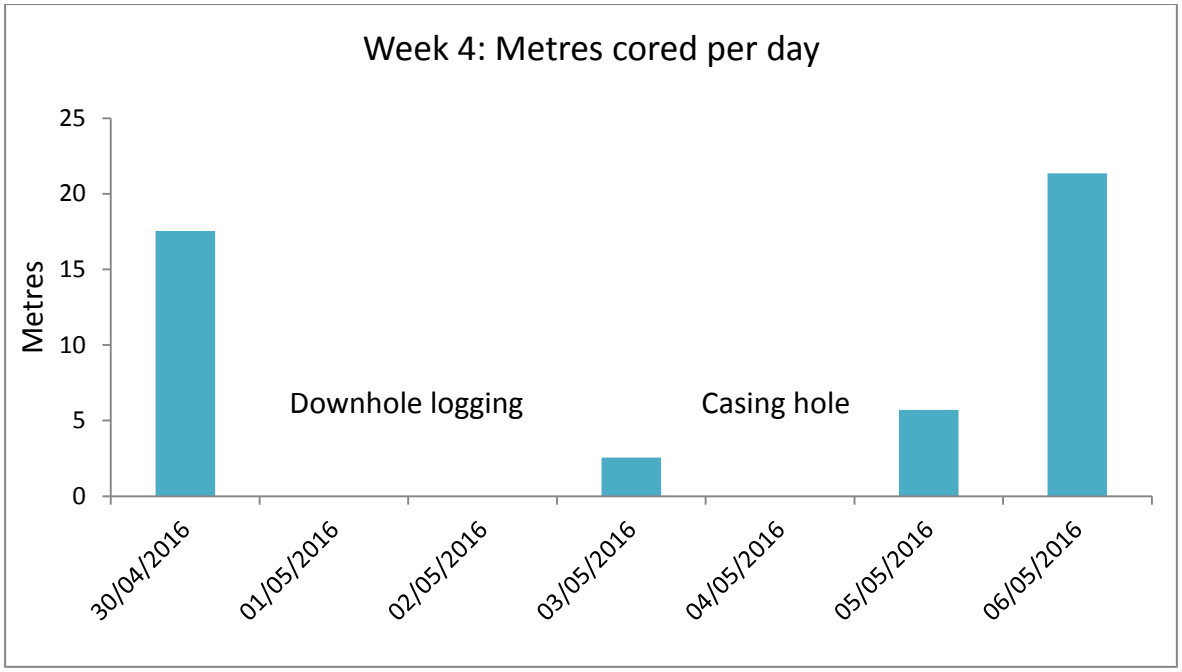


Figure 3: Week 4 coring rates.

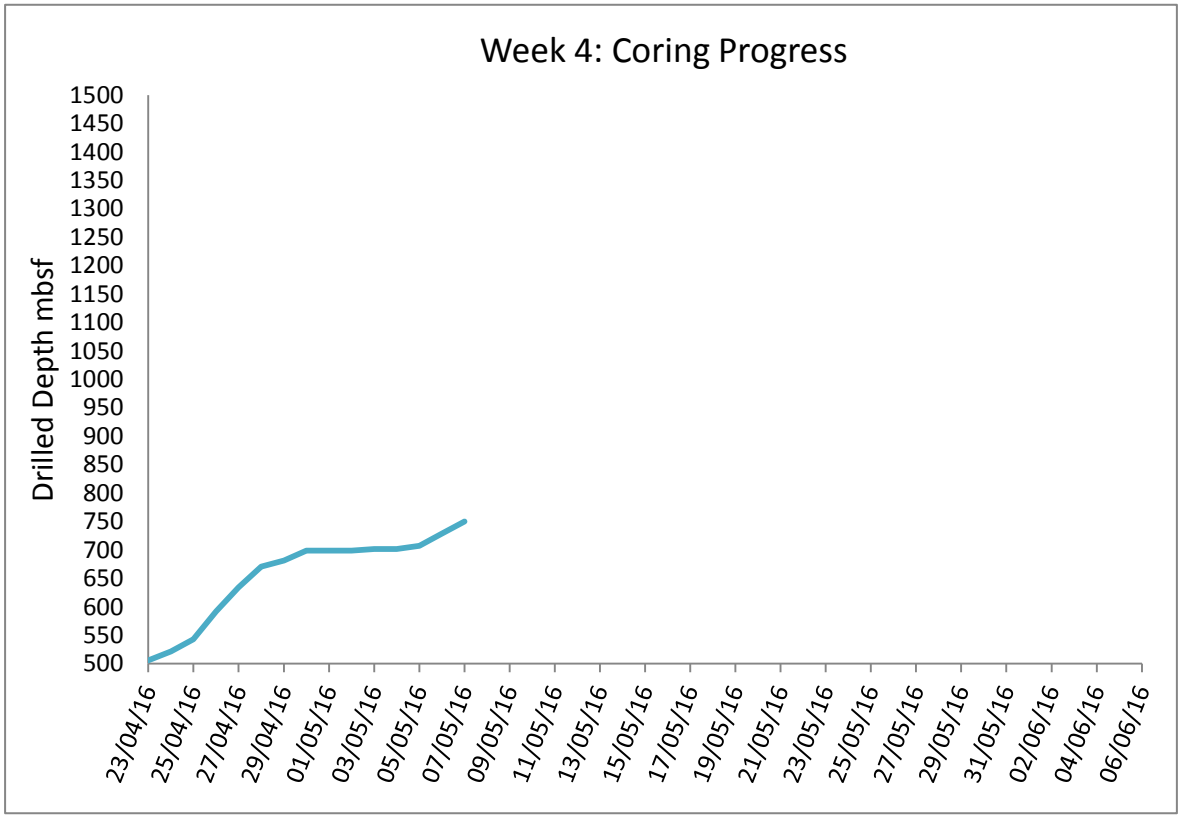


Figure 4: Coring progress at end of week 4, May 6th.

## 7. Photographs