Week 5 Drilling and Scientific Report for IODP Expedition 357 Atlantis Massif Serpentinization and Life

23rd November 2015 – 29nd November 2015

1. Hole summary

Hole	M0070C	M0068B	M0071C	M0075A
Latitude	30^0 8.544	30^0 7.51	30^0 7.7	30^0 7.669
Longitude	42^0 8.194	42^0 5.747	42^0 9.206	42^0 3.981
First core	22/11/2015	23/11/2015	25/11/2015	28/11/2015
Last core	23/11/2015	25/11/2015	28/11/2015	28/11/2015
Cores recovered	3	9	9	1
Drilled length (Coring)	5.21	9.6	12.15	1.72
Drilled Length (Open Hole)	0	0	0	0
Recovered length	2.21	6.34	4.48	0.65
Final depth	5.21	9.6	12.15	1.72
Hole recovery	42.42	66.04	36.87	37.79

2. Science

This week we drilled a total of five sites, penetrating a total of 32.68m and recovering 13.68m of core from the detachment fault surface of the Atlantis Massif from the four sites listed above. The week began with a third attempt at drilling a deep hole at Site M0070 (proposal site AM-07) with MeBo. Gas bubbles had been observed during previous drilling efforts at this site and monitoring while drilling had indicated depths with elevated methane concentrations. Previous attempts at this site were cut short due to mechanical issues with the drill rigs. MeBo operations at Hole M0070C ended after penetrating 5.21 m due to issues with the bottom hole assembly. These issues also prevented conducting runs of the logging tools and an attempt to install a borehole packer. Similar to Hole M0070A, the three cores recovered from Hole M0070C (2.21 m length and 42.4% recovery) consisted of basalt breccia in pelagic carbonate sand, although the degree of lithification of the carbonate sand was less than observed at Hole M0070A. Two whole round core samples were collected for ephemeral microbiology, geochemistry and contamination testing, with the rest of the material archived for OSP sampling. Prior to deployment at this site, a defect in the pump system for seafloor contamination tracer delivery was repaired, resulting in much higher concentrations of tracer delivered during drilling than had been achieved in earlier operations. Unfortunately, the Niskin bottles on the drill rig failed to close prior to recovery, but the drill rig sensor package collected logs of methane, pH, dissolved oxygen, and redox while drilling.

Next, operations returned with RD2 to Site M0068B (proposal site AM-02) to the eastern side of the Atlantis Massif southern ridge, to attempt a deeper hole where melt-rock interactions and surface samples of the deformation fault were anticipated. After roughly 36 hours, RD2 drilling at Hole M0068B resulted in 9.6 m penetration, with periods of slow penetration due to difficult drilling conditions. Continued drilling was prevented due to a core barrel becoming stuck in the bottom hole assembly, and a hydraulic oil leak on the rig limiting time to remedy the problem. Because of the stuck core barrel, it was not possible to run the magnetic susceptibility memory logging tool in open hole, but both it and the optical acoustic gamma ray tools were run twice through pipe to test deployment handling; no formation-relevant data was generated during the run Magnetic

Susceptibility run. After tripping out the drill string, a short borehole packer was inserted into the open hole, but it was partially lifted during recovery of the drill and was left in an unknown state.

Eight cores were recovered from Hole M0068B totalling 6.34 m, with a total average core recovery of 66% (based on penetration depth, although there was infill and overcoring), whereby recovery in the top four cores ranges from 71.8-105%. The cores consisted predominantly of porphyroclastic, harzburgitic serpentinite with irregular intervals of metagabbro. The cores show varying degrees of mylonitic deformation, multiple generations of veins and talc-amphibole alteration that record a complex alteration and deformation history. Core 1R consisted of a spectacular coherent section of the detachment fault surface that records outstanding relationships of tectono-sedimentary processes during exposure on the seafloor. Patchy intervals with reddish-brown, jasper-like alteration were observed in a number of cores. Drilling-induced fracturing was more prevalent in the bottom cores. Four whole round core samples were taken from cores 1R, 3R, 7R, and 8R for ephemeral microbiology, geochemistry and contamination testing, with the rest of the material archived for OSP sampling. Niskin water bottles on the rock drill were collected at the end of drilling for comparative geochemistry and microbiology analyses; fluid samples revealed relative high hydrogen concentrations in the flush waters from the borehole. A sensor package on the rock drill collected logs of methane, pH, temperature, dissolved oxygen, and redox while drilling. Repairs to the tracer pump defect prior to deployment resulted in much higher concentrations of tracer delivery during drilling.

MeBo was deployed within an hour of RD2 arriving on deck, and operations began at Hole M0071C (proposal site AM-04) at the western side of the Atlantis Massif southern ridge. This was a third attempt to get a deeper hole at this site after two previous attempts were cut short due to mechanical issues with the rigs. After over two days of drilling operations through difficult drilling conditions, drilling was terminated after penetrating 12.15 m. Two runs of the spectral gamma ray were conducted through pipe, but the dual induction tool could not be run due to tool handling problems on the rig. These problems also prevented tripping the drill pipe out of the hole, so it was not possible to install a borehole packer. Nine cores were recovered totalling 4.48 m (36.9% recovery). The cores consisted primarily of serpentinized peridotite with varying degrees of talc-amphibole alteration and mylonitic to ultramylonitic deformation and with minor metagabbro. The degree of serpentinization in the cores is variable and some intervals appear to contain relict olivine. Five whole round core samples were taken from cores 2R, 3R, 5R, 6R, and 9R after fast track multi-sensor core logging for ephemeral microbiology, geochemistry and contamination testing, with the rest of the material archived for OSP sampling. Multi-sensor core logging revealed relatively lower magnetic susceptibility in the lower core sections. Niskin water bottles on the rock drill were collected at the end of drilling for comparative geochemistry and microbiology analyses. A sensor package on the rock drill collected logs of methane, temperature, and dissolved oxygen while drilling. Hydrogen concentrations in these fluid and rock samples were relatively low, and tracer concentrations in the drill flush waters were relatively high.

Operations then moved to Site M0075 (proposal site AM-03), further to the east of the Atlantis Massif southern ridge to again attempt to recover melt-rock interactions. The RD2 was briefly deployed at Hole M0075A and penetrated 1.72 m before needing recovery due to a technical issue. A core totalling 0.65 m was recovered (37.8% recovery), consisting of serpentinite breccia in unconsolidated pelagic carbonate overlying serpentinite with talc-amphibole alteration. One whole round core sample was taken for ephemeral microbiology, geochemistry and contamination testing, with the rest of the material archived for OSP sampling. Niskin water bottles on the rock drill were collected at the end of drilling for comparative geochemistry and microbiology analyses. A sensor package on the rock drill collected logs of methane, temperature, and dissolved oxygen while drilling.

While both rock drills were undergoing maintenance, multibeam surveys were conducted over the southern wall of the Atlantis Massif and over the eastern edge of the Mid-Atlantic Ridge opposite the Massif. The week ended with the RD2 beginning drilling operations at Hole M0075B, penetrating 4 m by the close of the week.

3. HSE Activity

N/A

4. Figures

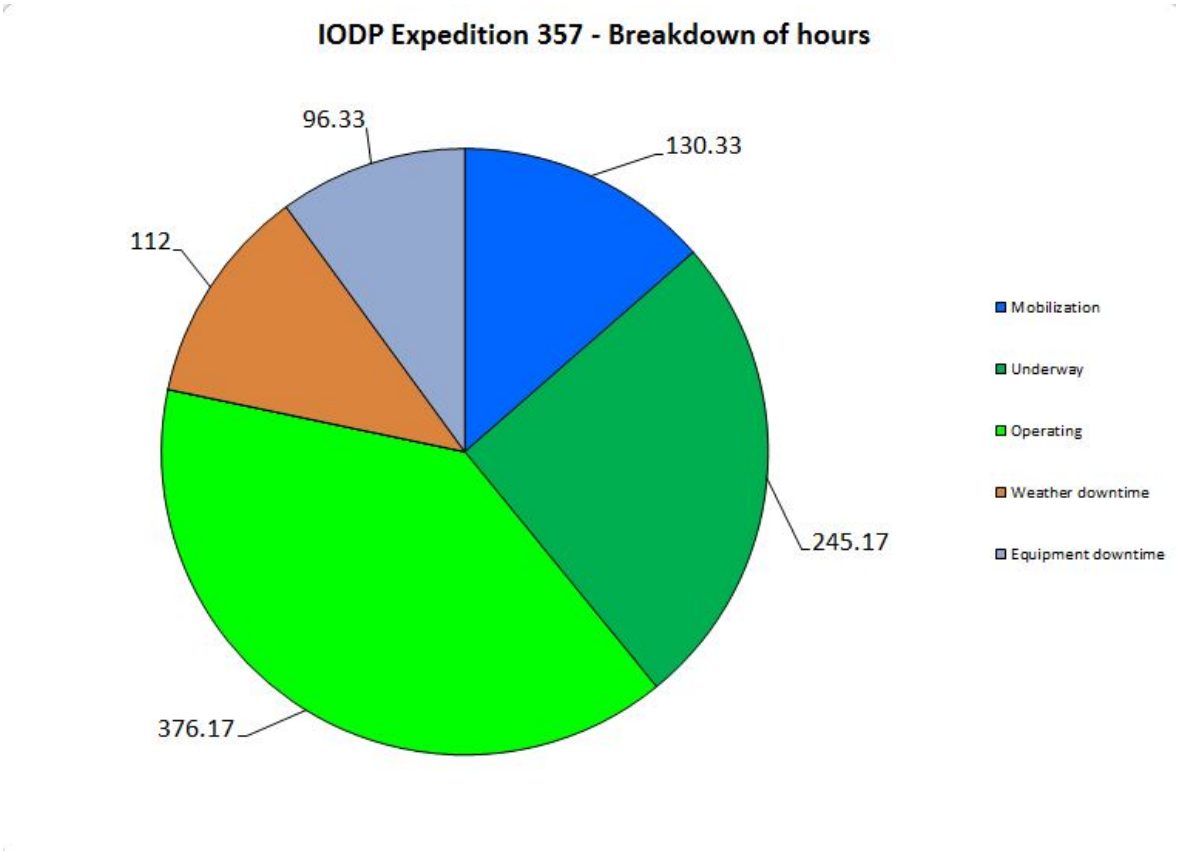

Figure1: Breakdown of hours from the start of mobilisation to midnight on November 29th.

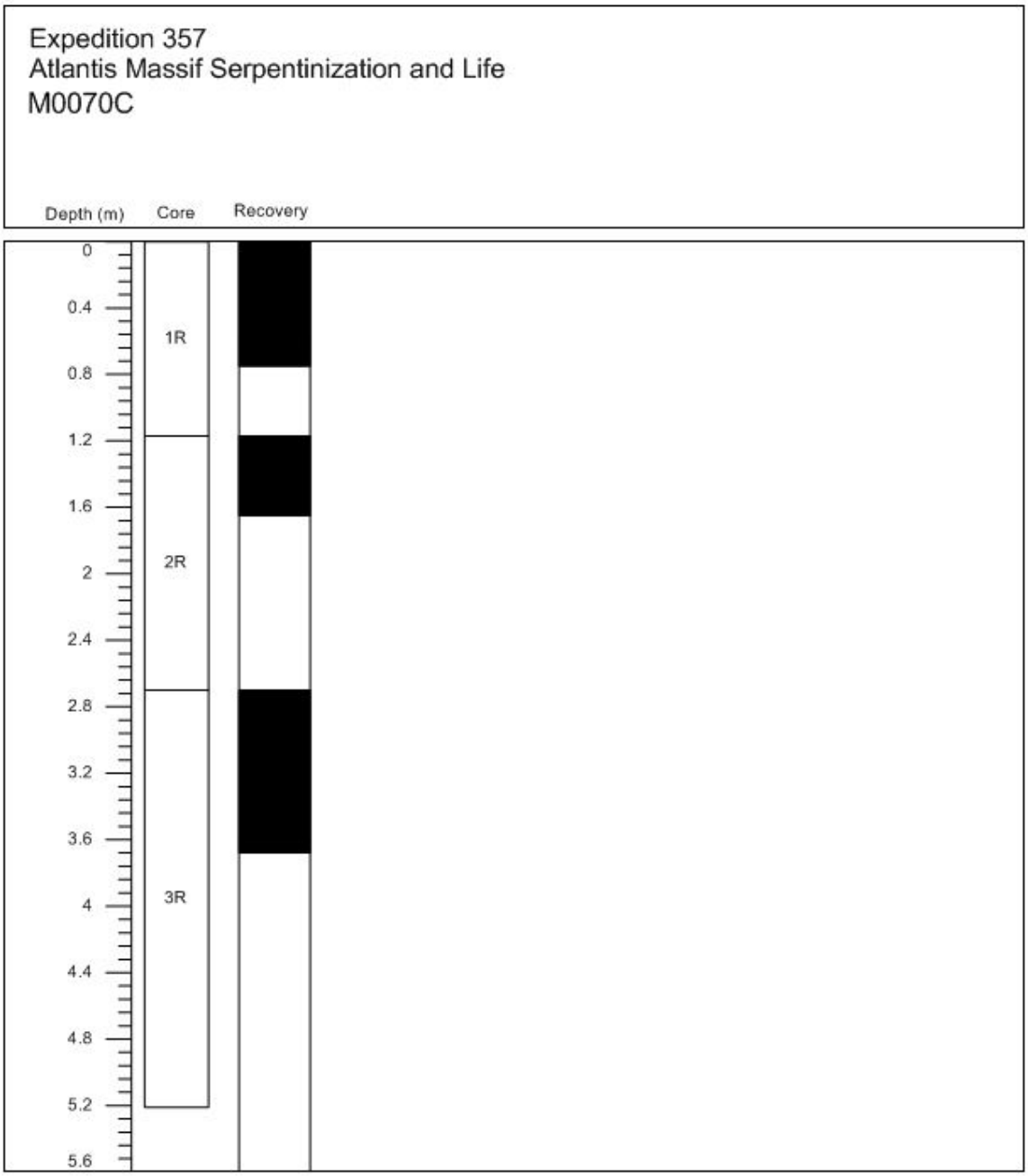

Figure 2: Core runs and recovery (Black shading) for site AM-07A, M0070C.

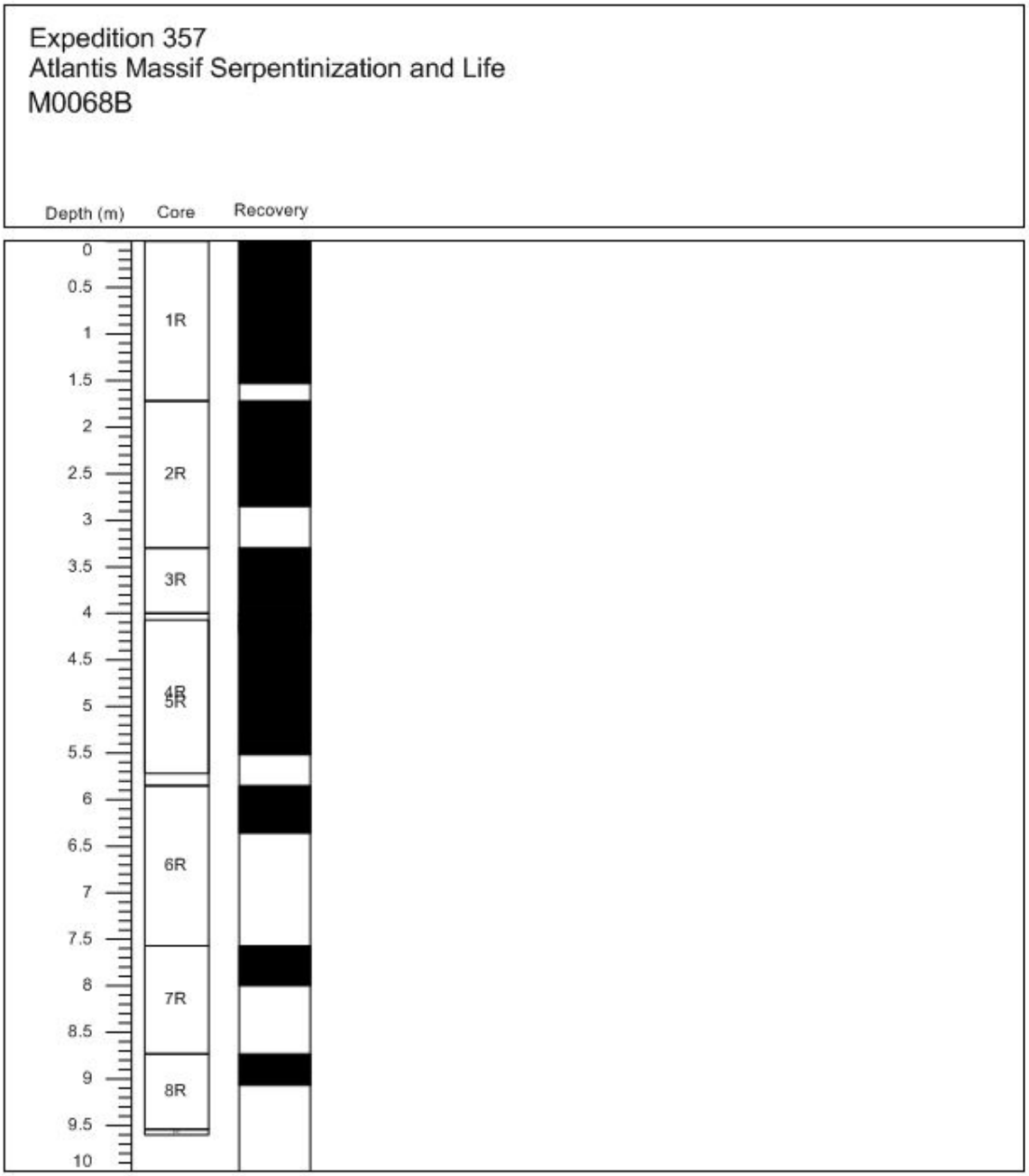

Figure 3: Core runs and recovery (Black shading) for site AM-02A, M0068B.

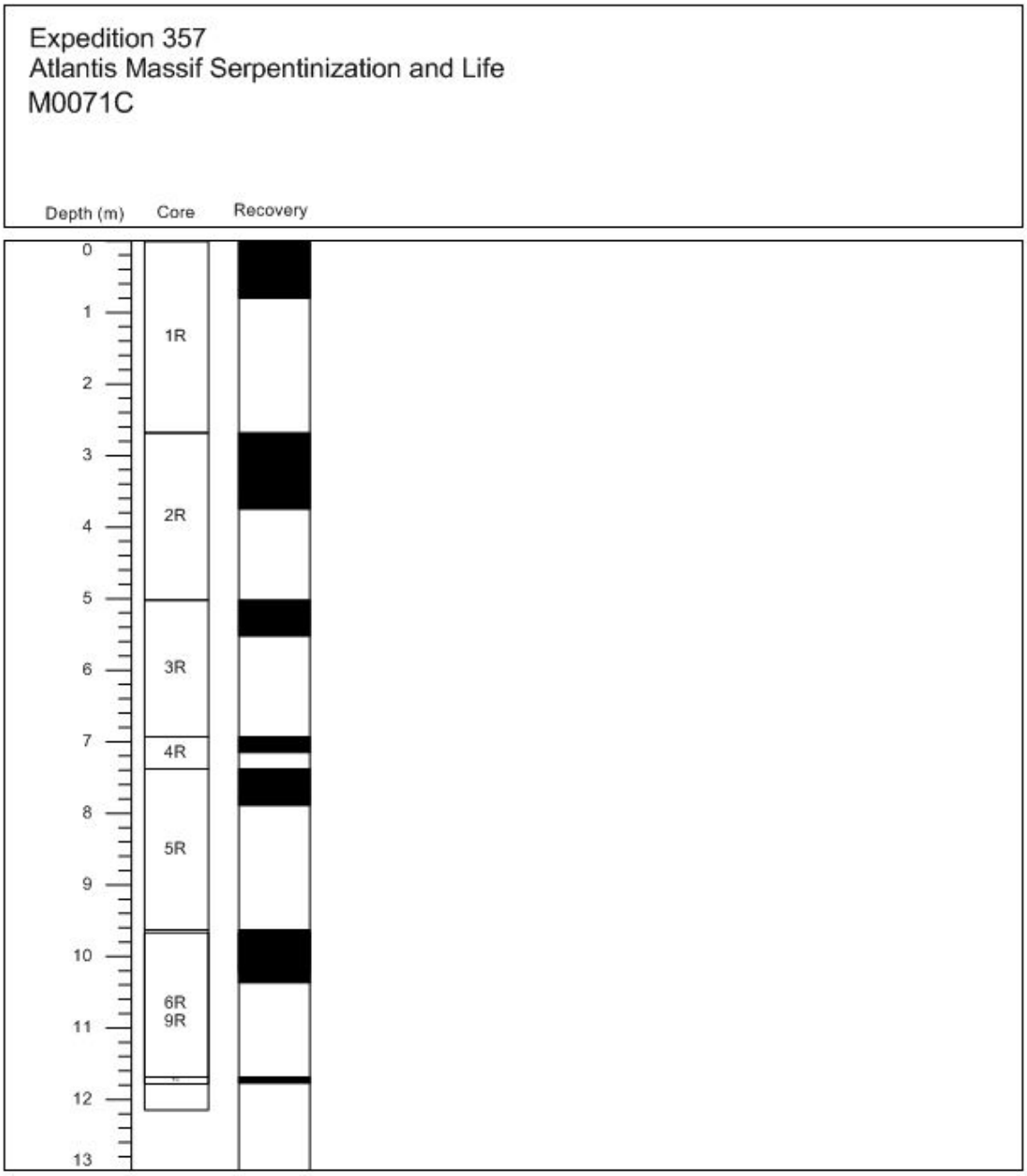

Figure 4: Core runs and recovery (Black shading) for site AM-04A, M0071C.

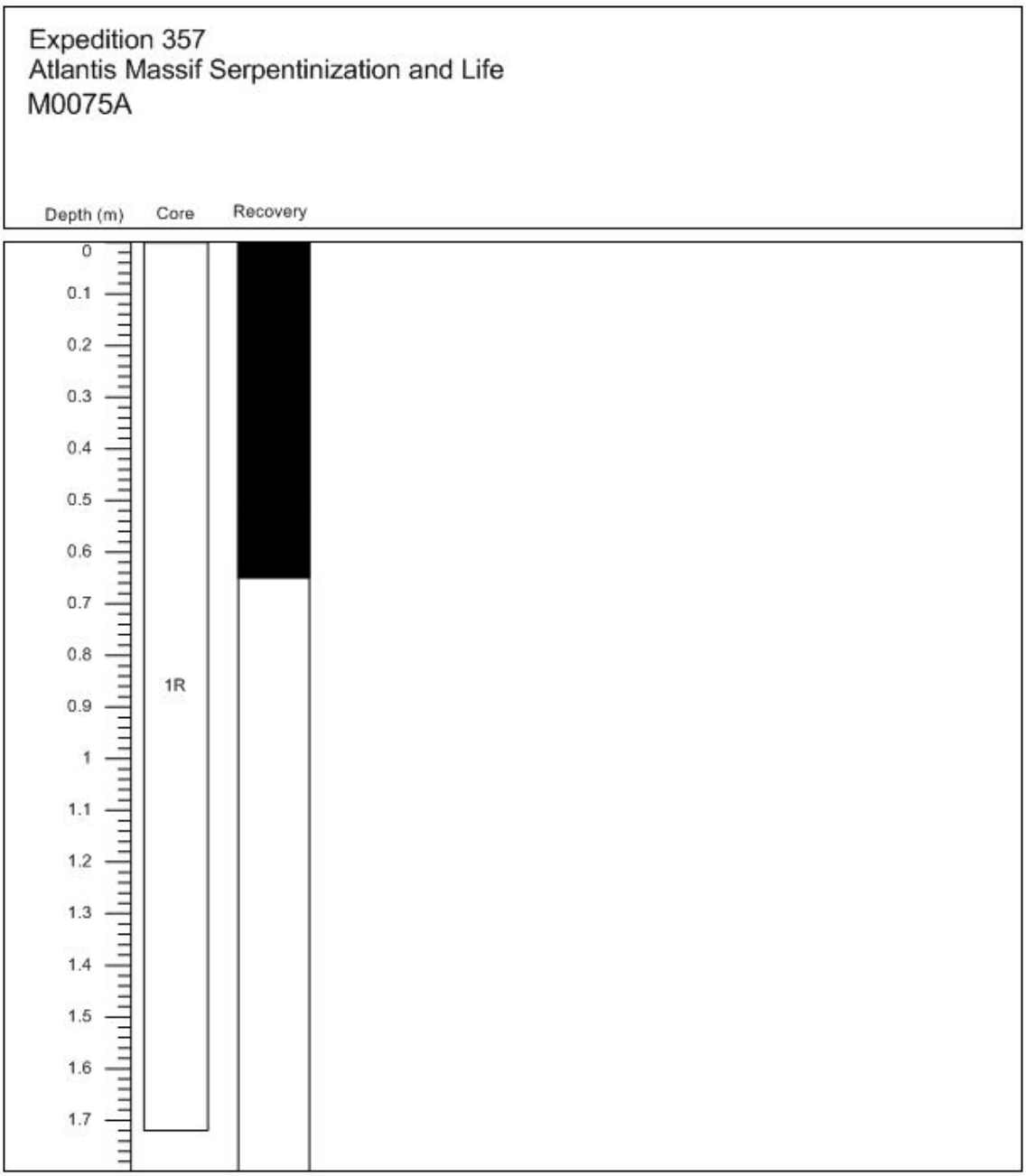

Figure 5: Core runs and recovery (Black shading) for site AM-03A, M0075A.