Week 1 Drilling and Scientific Report for IODP Expedition 347 Baltic Sea Paleoenvironment

13th September 2013 – 19th September 2013

1. Hole summary

Hole	M0059A	M0059B	M0059C
Latitude	55° 0.295' N	55° 0.299' N	55° 0.2898' N
Longitude	10° 6.491' E	10° 6.508' E	10° 6.4697' E
First core	13/09/13 at 19:30	15/09/2013	19/09/2013
Last core	15/09/13 at 06:50	18/09/2013	Ongoing at 24:00 on 19/09/13
Cores recovered	1H to 28X (28 cores)	1H to 29P (24 cores)	1H to 15H (15 cores)
Drilled length (Coring)	86.7 m	48.43m	43.82 m
Drilled Length (Open Hole)	N/A	95.6 m	N/A
Recovered length	85.41 m	28.63 m	49.25 m
Core recovery	98.41 %	59.11 %	105.2%
Final depth	86.7 mbsf	204.3 mbsf	
Hole recovery	98.41 %	14.03 %	

2. Science

The drillship, *Greatship Manisha*, left Kiel on the evening of September 12th and passed through the locks of the Kiel Canal to start the IODP Expedition 347, Baltic Sea Paleoenvironment. The goal is to drill seven sites in Danish and Swedish waters and in the Baltic Sea proper. Three of these sites are exclusively focused on paleoclimate and the geological and glacial history of the Baltic Sea, while four sites combine this objective with deep biosphere studies. The *Manisha* arrived at the first site, BSB-3 in the Lille Belt, on Friday, September 13th, and coring started just before midnight on the same day. During the first week, three holes were cored at BSB-3: M0059A, B and C, of which the first two were dedicated paleoceanographic holes while the third hole combined microbiology and paleoceanography.

The coring during this MSP expedition uses piston coring until refusal and a rotary core barrel or other techniques when this is no longer possible. Full length piston core runs are 3.3 m. The paleo-cores are not split offshore but are stored in refrigerators at +4C to be brought to the IODP Core Repository in Bremen where a sampling party will take place in January-February 2014. The description of cored sediments onboard is therefore largely dependent on samples taken from the core catchers. This description is supplemented by down-hole logging and other sources of information.

Advanced piston coring at M0059A recovered an upper 50 m sequence of black Holocene mud, gas charged in the upper 10m, and a 34 m sequence of greenish-gray clay below. Down to c. 20 mbsf the Holocene mud displayed benthic foraminifera, diatoms and remains of coastal marine fauna and flora, including algae and eelgrass, parts of bivalve shells, and chitinous remains of small crustaceans and insects. From 50 to 84 mbsf the sediment was clay with intermittent, weak cm-scale colour lamination. The clay turned into silty sand in the lowermost part of the sequence. In this clayey part of the core, fossils were scarce apart from some pieces of mollusk shells and wood together with foraminifera, probably reworked.

Coring got stuck at 84 mbsf and Hole M0059A had to be abandoned. The vessel moved 20m to Hole M0059B. Due to the nearly 100% recovery in Hole 59A(98.55%), continuous coring commenced in the new hole at 60 mbsf, with the upper section being open-holed. It was chosen to recommence coring at 60mbsf to catch a distinct kick in the magnetic susceptibility data which

would provide an accurate tie-in between the two holes. This was encountered in the first core run. The general lithology from 60 mbsf down to 85 mbsf was the same as in M0059A and a good correlation between Hole A and B could be made using both the sedimentological descriptions and the MSCL data. No microfossils were found apart from a few foraminifera at around 70 mbsf. At 89 mbsf a hard diamicton was encountered and drilling had to stop. The material in the core catcher indicated a diamicton of sand and stones with little silt. Tills with this composition are known to have a northeasterly provenance and can be attributed to the main ice advanced over the area reaching the LGM at c 23 to 21 kyr BP. It thus seems likely that the recovered diamicton can be assigned to this ice advance.Based on the interpretations of the seismic profiles presented it was at this point decided to open-hole down to the anticipated Eemian deposits at 160 mbsf, with spot-sampling to confirm the lithology. Hole M59B was then logged. Interestingly, the logging possibly shows an Eemian sequence between 145 and 155 mbsf as suggested by an increase in resistivity.

A third hole, M0059C, was cored from the seabed with good recovery down to the clay / till interface, repeating the same general lithology in the upper c. 80 mbsf. As this was a microbiological hole the sequence was densely sampled for microbiological investigations. From 80 mbsf and down to the presumed Eemian unit every three metres will be sampled by hammer coring for OSL dating of the diamicton.

A third hole, M0059C, was cored with the main objective to do high-resolution sampling for microbiology and geochemistry. As this sampling often consumes whole round core intervals of mostly 5-10 cm length, a large portion of the cores is removed with the remainder stored in the refrigerator. The recovery in the upper 80 m was again very good and repeated the same general lithology as found in Holes A and B. Microbiology and geochemistry sampling was very intensive in the beginning, especially in the upper 9 mbsf, where large changes in microbiology and in interstitial water chemistry were expected. Here sampling intervals were about one sample per section (1.5m), depending on the parameter. Further down the hole, the frequency decreased to one sample per core or less. Most microbiology samples were preserved or frozen for later analyses of microbial community size and composition, functional genes and gene expression, etc. Some samples were maintained at +4C under anaerobic conditions for later experiments on microbial growth and metabolic activity. These samples will be transported by boat to land and distributed to the relevant laboratories within a few days after retrieval so that the planned experimentation can begin before the microbiology and chemistry change.

At 83 mbsf microbiology sampling was stopped because uncontaminated samples could not be obtained in the underlying glacial till. From 84 mbsf and through the tills down-holing alternated every three meters with sampling by hammer corer. The objectives are to determine the age of the tills by OSL dating and to search for the presumed Eemian unit. At the time of writing the down-hole logging has indicated a 10-m deep interval of enhanced resistivity beneath 145 mbsf which could be the targeted unit.

Interstitial water was obtained from Hole A by Mannheim squeezing or Rhizon sampling and provided the first important information on the chemical zonation in the Holocene mud and post-glacial clay. Mineralization rates in organic-rich Holocene mud were very high as seen from extremely high alkalinity and ammonium concentrations. At the transition to the underlying 30-m deep clay there was a sharp drop in alkalinity and ammonium which, surprisingly, approached zero in the middle of the clay layer. This drop is expectedly due to a dynamic diffusion front created by organic matter mineralization in the Holocene mud and progressing down into the clay. Methane concentrations were high throughout both the Holocene mud and the glacial clay, and most cores showed gas bubbles when retrieved on deck. Methane approached zero at the transition between post-glacial clay and glacial till. Hydrogen sulfide was high only in the top section of the hole and not detected below that section. Interestingly, the paleo-salinity of the Baltic Sea system appears to be still reflected today in the pore water salinity, which reaches a maximum in the middle of the Holocene mud and a minimum in the glacial lake clay. Our interstitial water sampling stopped at the transition to the glacial till at 80 mbsf because intact pore fluid could not be obtained. At 117 mbsf in M0059B, however, a 60 cm clay interval was secured which turned out to be valuable as it revealed the interstitial water chemistry in the middle of this highly porous formation.

3. Figures

Figure 1 – Recovery and depth versus time plot at Hole M0059A (up to conclusion of hole).
Figure 2– Recovery and depth versus time plot at Hole M0059B (up to conclusion of hole)
Figure 3 Recovery and depth versus time plot at Hole M0059C (Up to 24:00 on 19th September)

IODP Expedition 347

Hole 59A progress summary

Latitude: 55° 0.295 N
Longitude: 10° 6.491 W
Water depth: 31.2 m

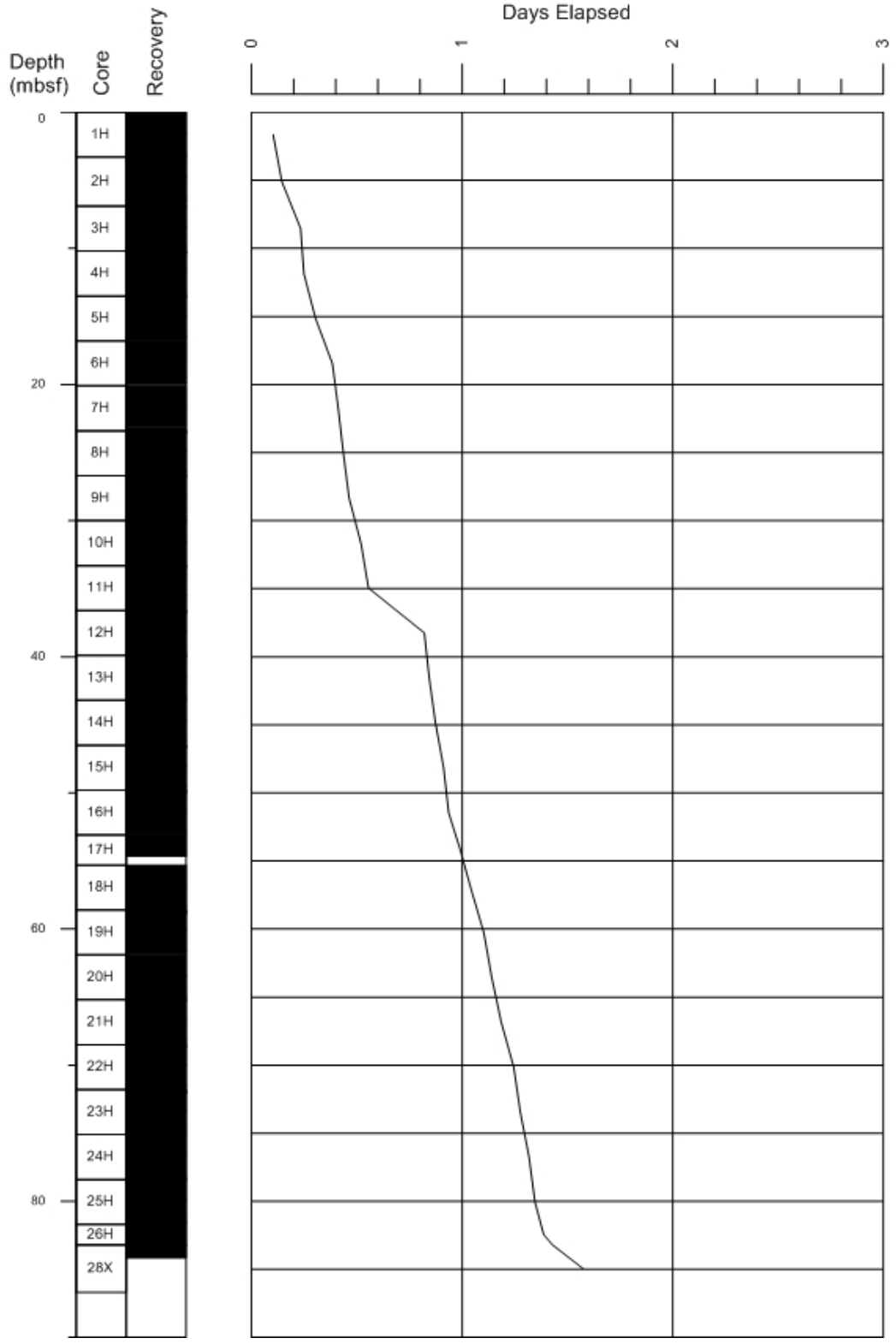

Figure 1

IODP Expedition 347

Hole 59B progress summary

Latitude: 55° 0.299 N
Longitude: 10° 6.508 W
Water depth: 31.2 m

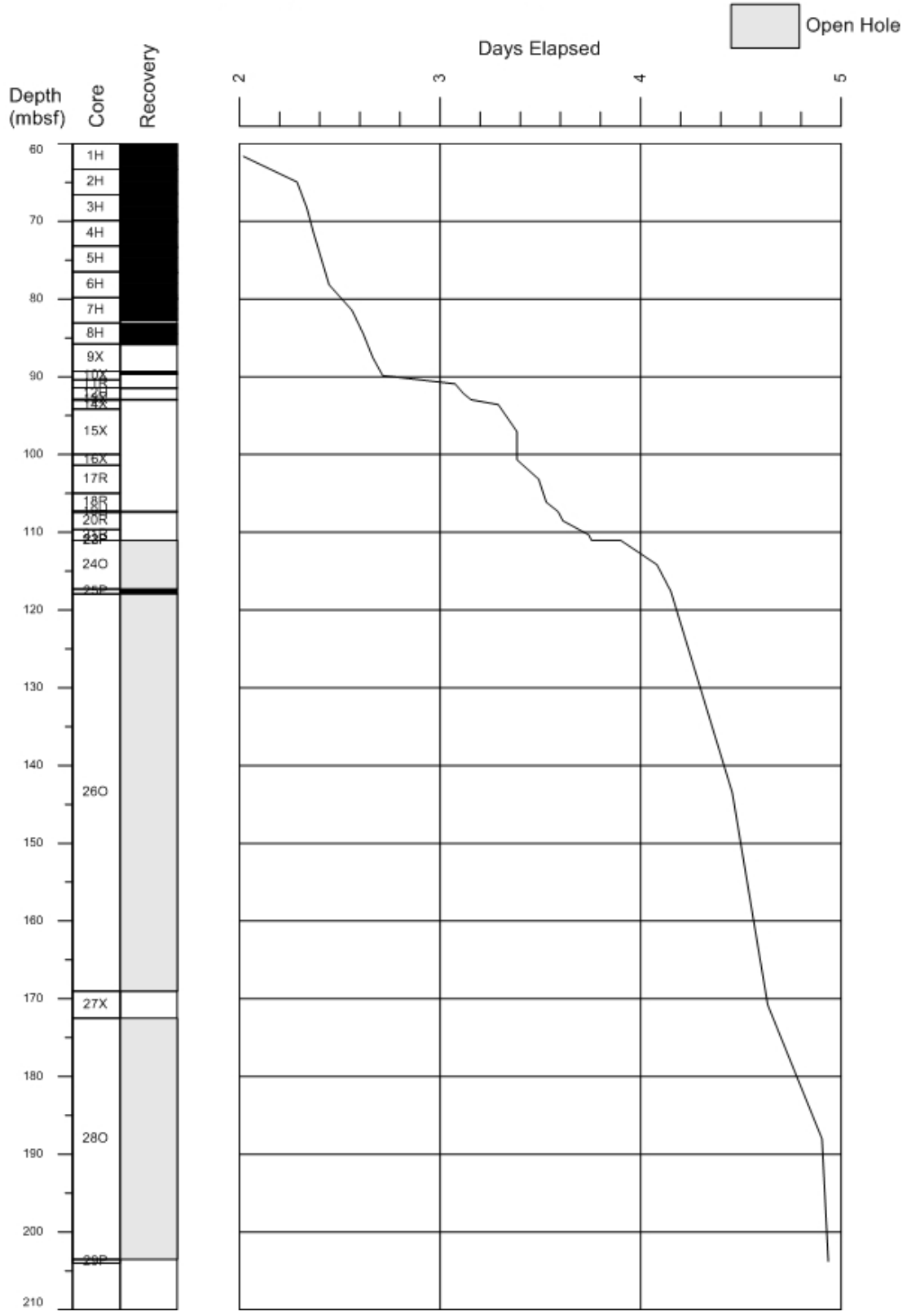

Figure 2

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Hole 59C progress summary

Latitude: 55° 0.2898 N
Longitude: 10° 6.4697 W
Water depth: 31.2 m

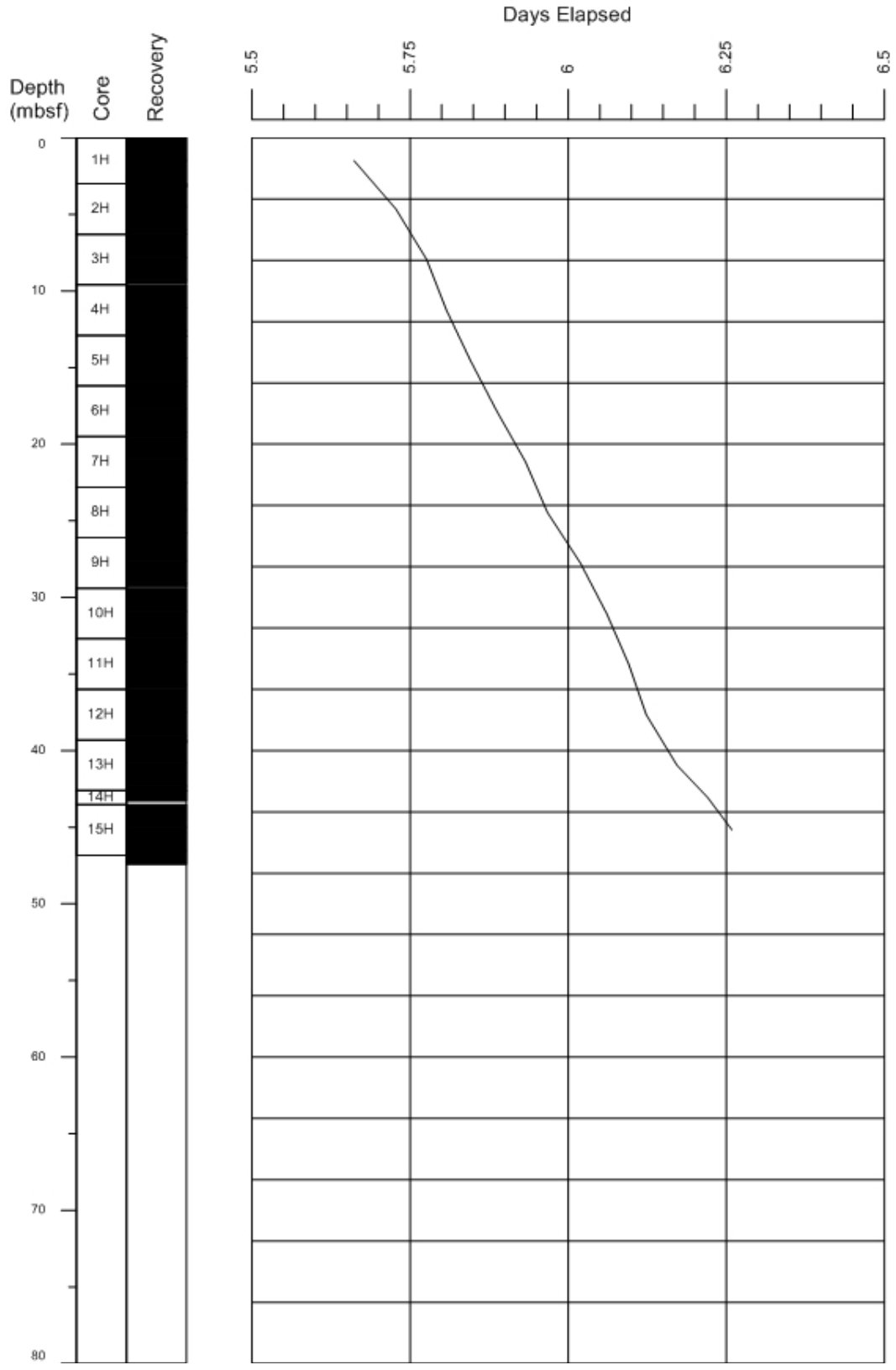
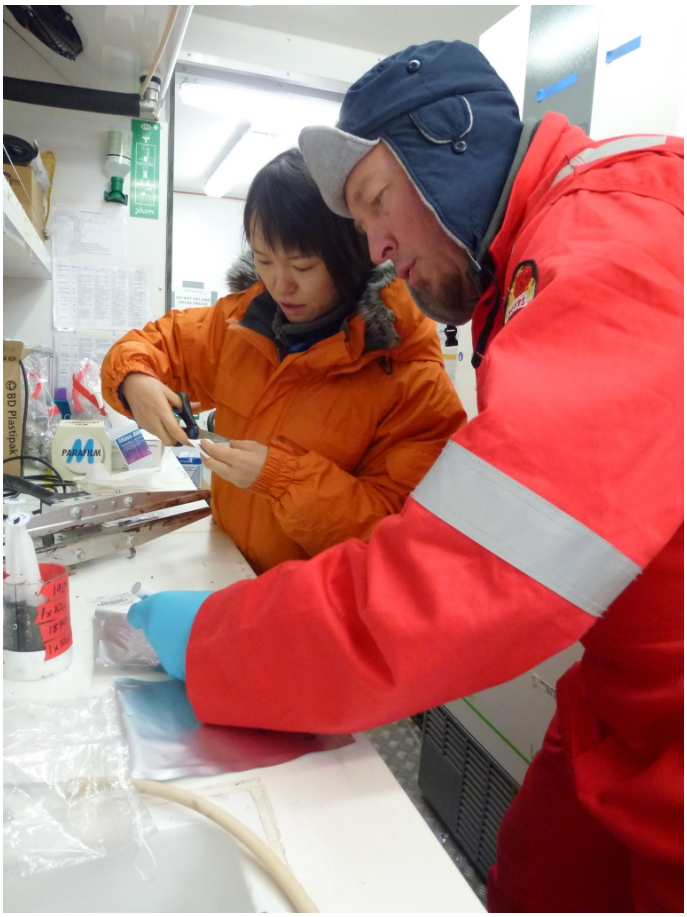


Figure 3



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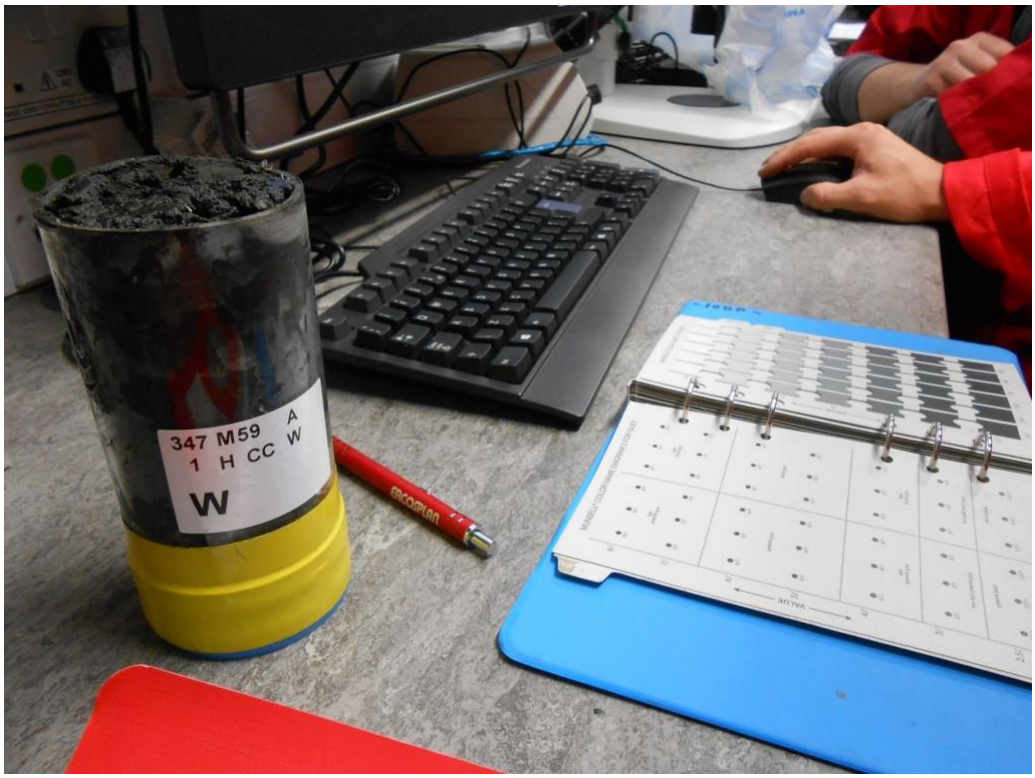

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