Expedition Log for IODP Expedition 313
New Jersey Shallow Shelf

Week 7 – 15th June

In her final report before leaving the platform, Carol Cotterill gives us a virtual tour of the drilling floor.

Main Street, onto which all our containers face, is often busy with activity, with core moving between containers and the reefers (refrigerated units). However, lurking at the end of this is the major (and very noisy) hub of activity known as the drilling floor. There is an orange line at the end of main street that we can't cross without ear defenders and safety glasses as well as hard hats and steel toe caps. However, when safe, the drillers and drilling coordinators are keen to explain to the scientists how drilling operations run. Hopefully the following explanations and photographs will give you a virtual tour of the drilling floor.

(J.Inwood©ECORD/IODP)

(*D.Smith©ECORD_IODP)*

Views of the drill floor from the accommodation block and from the Billy Pugh basket, showing the suspended platform, the drilling derrick, the barrels, casing and drilling mud stored on top of the ESO containers and the mud tanks down at the base of the crane (left hand side of the second photo).

The drilling rig being used has come from Salt Lake City. It is a CS4002 system, more usually deployed from a truck. However, for this expedition, we have mounted the rig right on the edge of the *L/B Kayd's* deck. We have suspended a platform around the rig, allowing the drill pipe and casing to pass straight down over the side of the vessel. However this does mean the drillers operating the rig are suspended over the water!

Control panel on the drilling rig showing the many dials and levers the drilling crew monitor constantly for water pressure, torque, pullback and pushdown pressure on the drill bit and mud supply rates amongst other things *(D.McInroy©ECORD/IODP).*

View from the drillers platform looking up at the derrick *(E.Gillespie©ECORD/IODP).*

Different drilling muds are being used depending on the lithology and drilling strategy. Guar Gum is derived from a ground bean and is a common constituent of ice cream, chewing gum, toothpastes and shampoos, but is also used in mining, paper manufacture and the textile industry! Bentonite is a common drilling mud, again used in many different industries. EZI Gold is an inhibitor that helps prevent the expanding clays swelling and trapping the pipe, whereas salt helps densify the mud. The mix depends on the viscosity required and the main purpose – Guar Gum is very good at lifting drilling cuttings whereas Bentonite is good at casing the hole and improving hole stability where there may be flowing or loosely consolidated sands. Other factors to be considered include pressure changes experienced while drilling through high-pressure artesian water zones – adding salt to guar gum forms a very dense mud which is useful for damping down high pressure. One combination developed during this expedition is a mix of Bentonite and Guar Gum – nicknamed “Gumbo” by the drillers.

Graham Tulloch (ESO Drilling Coordinator) shows Takeshi Hayashi the mud mix in the tanks, while Jess (DOSECC) mixes up another batch of Guar Gum *(C.Cotterill©ECORD/IODP).*

A number of different casings, drill pipes, barrels and bits are used during the operation, again depending on the lithology encountered downhole. The casings can be slick or buttress – generally slick is used to penetrate or “spud in” to the seabed to anchor the top of the hole and provide a smooth entry point for the drill pipe, whilst buttress casing is most often used from the drill floor down through the water column and just into the seabed. Slots are cut into the buttress to allow the drill cuttings being lifted by the muds to escape out of the pipe.

Welding tabs across the joints in slick casing to help prevent any unscrewing caused by rotation during drilling *(C.Cotterill©ECORD/IODP).*

Once the casing is set, the complicated task of choosing the correct pipe, bit and Bottom Hole Assembly (BHA) begins. We have a number of bits to choose from depending on the lithology we are expecting – Polycrystalline Diamond (PCD), tungsten carbide or a diamond impregnated bit with carbide matrix. We also have two diameters of drill rods we can run – PQ and HQ – with HQ, being the narrowest, capable of fitting inside the PQ barrel. It’s a steep learning curve understanding bits!

Inside the drill string (either multiple PQ or HQ rods run together) is the inner core barrel, containing an inner plastic liner to collect the core, and fitted with a shoe to aid penetration of the barrel. It can also contain a core lifter and basket catcher, which is fitted internally, and is used to hold soft sediments in, preventing them slipping out of the barrel as it is being raised.

Shoe, core spring basket catcher combination and inner core barrel*(C.Cotterill©ECORD/IODP).*

Diamond impregnated bit with shoe and basket catcher. *(D. Smith©ECORD/IODP).*

PCD PQ bit and PCD ALN coring bit and tungsten carbide casing shoe (to the right in the picture *(E. Gillespie©ECORD/IODP).*

Sometimes adaptations have to be made that are unexpected! In the photograph below Jess, one of the DOSECC drillers, is having to cut vertical mud ways into the drill bit. The drillers were recording high backflow (pressure) when drilling down into a clay layer, and adding these mud ways helped relieve that pressure by giving the mud and drill cuttings a means of escape up the outside of the drill string rather than pushing back against the drill bit and string.

Cutting mud ways into a drill pipe *(C.Cotterill©ECORD/IODP).*

One of the most time consuming jobs when drilling and coring is when the drillers have to trip or round trip the drill pipe. When drilling down, pipe is added or “run”. If there is a problem at depth, or a bit needs replacing, the pipe has to be “tripped” and brought back up to the drill floor.

Jay brings the pipe back down into the pipe rack after tripping it out *(J-N. Proust©ECORD/IODP).*

A round trip involves bringing it up and then sending it back down again. The deeper the hole gets the longer it takes to trip pipe or retrieve the core barrel after drilling a 3 m run. As an example, to trip 200 m of pipe from shallow depths can take ~90 minutes if all goes to plan!

Series of photographs showing the process of running a double stand of pipe in. ***(G. Tulloch©ECORD/IODP).***

In the left hand photo above, Jess and Jay are attaching the mud swivel to the double stand (2 pipes each of 3 m) about to be run. This supplies the drilling mud down into the pipe from the mud tanks. Next the pipes gets winched from horizontal to vertical (middle photo) where Jess attaches them to the top of the previous pipe run in (right hand photo). Shaun (at the controls) can then raise the drilling rig top drive up the pipe, tighten it so it grasps the pipe, and start rotation for the next round of drilling.

Once a core run is completed (one pipe at 3 m), an overshot is sent down the barrel. This latches onto the top of the core barrel enabling the barrel to be winched out of the hole, bringing the core back with it, encased in a clear plastic rigid inner liner which sits inside the core barrel during the coring process.

Retrieving the core barrel often pushes a fountain of drilling fluids ahead of it! ***(C.Cotterill©ECORD/IODP).***

Once on deck the liner containing the core is removed from inside the core barrel, and gets taken straight to a bench for the core curators to work on it. They cut the core into 1.5 m sections, capping each end – the top of each section with a blue cap and the bottom with a clear cap – sealing the caps with acetone. The core then begins its journey from the drill floor into Main Street and through the containers.....

Capping the core as it arrives on deck *(J. Inwood©ECORD/IODP).*

The core begins its journey up Main Street! *(E.Gillespie©ECORD/IODP).*