

News from Leg 207

Helen Bostock (ANU) sailed as a sedimentologist on Leg 207 – Demerara Rise

Where is the Demerara Rise and why were we interested in drilling it? Well the Demerara Rise is just off the coast of Suriname and French Guyana (5°N, 55°W) NE South America (Figure 1). It was the last gateway to the opening between the North and South Atlantic at the end of the Cretaceous and is presently a plateau with 2-3 km of syn and post rift sediment. Palaeogene sediments outcrop on the sea floor and the Cretaceous sediments are only shallowly buried. So the aim of Leg 207 was to retrieve these relatively thick complete sequences of shallow buried sediments to study the opening of the Atlantic and to produce high-resolution records of the extreme palaeoceanographic and palaeoclimatic events that occurred over relatively rapid time intervals during this greenhouse period. Present evidence suggests a series of Ocean Anoxic Events (OAE's) during the late Cretaceous and an extreme, short lived, climate event at the Palaeocene/Eocene boundary the - "Palaeocene/Eocene Thermal Maximum (PETM)" and also the infamous K/T impact boundary. The interest in understanding these extreme climate events during a greenhouse period (atmCO₂ 4x greater than present) when there were major changes in ocean circulation, mass extinctions, temperature extremes, anoxia, and major perturbations in the carbon cycle, is to try and understand the causes of such events and use them as analogues as to what might happen with future greenhouse warming of the planet. The irony of it is that the Black shales deposited during the Cretaceous OAE's, which contain up to 20% organic carbon, are major oil source rocks for the oil fields off the coast of South America and West Africa.



Figure 1 –
The cruise
route and
location of
the
Demerara
Rise

Leg 207 was your traditional palaeoceanographic leg with a full complement of 30 scientists, including 8 sedimentologists, 5 biostratigraphers, 2 inorganic chemists, 2 organic chemists, 2 stratigraphic correlators, 2 palaeomagnetists, 2 physical properties, 2 loggers and a token microbiologist to look for possible critters living on all the organic carbon in the black shale OAE sequences.

Leg 207 originally started from Panama, but most of the Scientists joined the Joides Resolution at the Bridgetown Port in Barbados. The poor Joides Resolution looked somewhat out of place and rather small and shabby in comparison to the enormous fancy cruise liners that pulled up along side it in the docks (Figure 2) (needless to say that most of the scientists also felt rather out of place amongst the rich holiday makers in their designer bikinis revealing rather too much flesh and displaying wonderful bright red tans!)



Figure 2 –
The JR looking rather small compared to the fancy cruise liners in Bridgetown Port, Barbados

We finally left port on the 14th January leaving behind the holiday makers, the beaches and of course the wonderful Barbadian dark rum and its associated fruit punches. With only a day and a half of transit before starting the seismic shoot and 6 hours later tripping the pipe for the first hole – the first few days were rather busy learning the ropes and ODP protocols and adjusting the body clock to 12-12 shift times etc... These few days and the first site were one steep learning curve for a virgin sailor/scientist like myself and 12 hour shifts required significant amounts of strong coffee, cookies and galley food to keep my brain engaged for this length of time.

The first site was a re-drill of DSDP site 144, which had originally been spot cored. The idea was to APC (piston core) /XCB (extended core barrel) core it, but the recovery was poor and we had significant “biscuiting”, so for the second hole and the rest of the cruise the RCB (the traditional rotary core barrel) was utilized for all the drilling, achieving much better recovery and quality of the cores.

After the first drill site when everyone was still dusting the cobwebs out after Christmas and New Year and getting used to their new tasks, we all eventually got into the ODP 12 hour routine and the cores started to flow efficiently. From the drill floor they moved to the catwalk where they were cut into convenient 1.5 m sections, the biostratigraphers removed the core catcher to work out the age, the inorganic chemists took their pore water samples to be squeezed, the microbiologists and the organic chemists took their head space samples to measure the gas concentrations. Then from the catwalk into the lab to the MST(multi sensing tool – measuring the magnetic susceptibility and natural gamma ray for the stratigraphic correlators to splice together the sequence between holes), to the core saw, when the working half went to the physical properties and sampling table and the archive half to the sedimentologists (figure 3), colour reflectance, digital imaging system and finally the palaeomagicians before being photographed and boxed - 24 hours a day 7 days a week!! By the end of the leg I think we had drilled and described over 4000 metres of core – not the most core ever processed on an ODP leg, but still quite an impressive feat!

The general sequence of sediments that were recovered from each of the sites were a Pleistocene to Miocene surficial blanket of ooze, overlying a relatively thin sequence of Oligocene greenish grey ooze before reaching the main target of the Leg which was the Palaeogene-Cretaceous greenish grey chalks (or to be more precise “nannofossil chalk with radiolarians and foraminifer” or was that “foraminifer nannofossil chalk with radiolarians”??) over lying the juicy organic rich black shales of Santonian to Cenomanian in age (or officially in the ODP lingo – calcareous carbonaceous claystones). The most diverse sediments were the syn-rift Albian sediments that were retrieved at the base of the sequence, which varied from coarse quartz sandstones to silty claystones with quartz and organic matter. The Albian sediments were still influenced by terrigenous material as South America and Africa rifted apart away, while the rest of the sequence was deposited in marine environments of various levels of oxygenation, as evidenced by the amount of organic matter and clay, until a fully oxic pelagic marine environment was established in the Eocene.

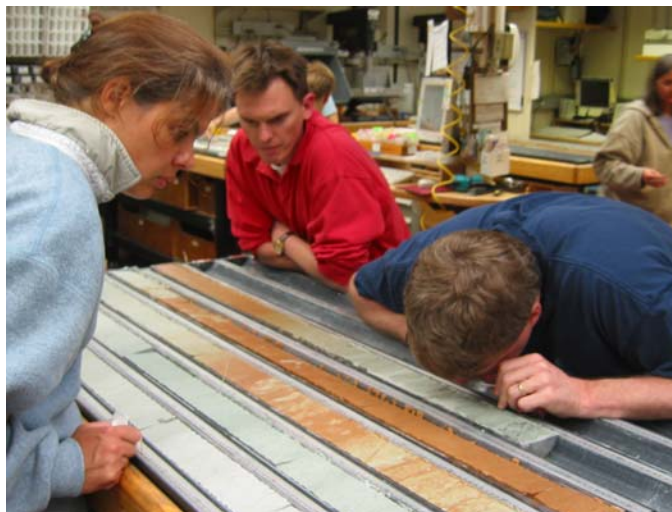


Figure 3 –
The
sedimentologists
describing the
cores

The highlights of course were retrieving the PETM at each site and the K/T at 3 of the 5 sites, complete with 1-2 cm of the ejecta layer and a relatively complete Danian sequence above the impact in several sites (Figure 4). The K/T was a special surprise as from the original DSDP site 144 it looked like there may have been significant slumping and mass wasting across this boundary, as seen at sites like Blake Nose. We also recovered several good transitions between the Campanian clay and the Santonian black shales and hopefully a relatively complete sequence through the black shales.



Figure 4 – The K/T ejecta layer with the white Maastrichtian below (including plastic dinosaur) and the Danian Strangelove ocean clays above.

Well those are the preliminary highlights of the geology of Leg 207 to date, now it is back to the lab to beaver away washing, picking and analyzing samples for the next year or so. Watch this space for future results.....

So how else did we fill our days at sea? (Other than religiously going to the gym everyday – well sometimes), watching movies, sunbathing, star gazing, and trying to avoid visiting the ice-cream machine too often!) An equator crossing just south of the Amazon Fan during our final 12 day transit to Rio de Janeiro provided some amusement. So many of the scientists, several technicians and even a couple of the crew were initiated through the Shellback ceremony (pollywog torture – Figure 5) of King Neptune’s court. Even some of the more experienced ODP’ers (including our staff scientist) with quite a few cruises under their belts were pollywogs, which took some of the pressure off the rest of us. There was no major hair loss – but mostly because several members of the party pre-empted this by shaving their heads a few days before, but I can say that it took me a good week to remove the grease from my head after the barber had her way with it, and I don’t believe I will ever consume peanut butter again in my life after having my face smeared in it on the “Baby’s” belly! Several of us of course got it worse than the rest after the previous week of pranks and the sheriff’s boxers hoisted up the flagpole and various bra’s and undies made into kites for kite flying day. I of course wasn’t involved in any of this – honest!!



Figure 5 – Pollywog torture, dunked in the cess pool and put in the stocks

Finally after our long transit down the coast of Brazil, passing endless idyllic looking beaches, dodging fishing boats, accompanied by a school of a couple hundred dolphins for half an hour on our final day at sea – we entered Rio harbour at dusk on the 6th March. This is one of the most spectacular harbour entrances in the world with the granite domes of Sugar loaf and Corcovado looming over the city (Figure 6). The smog of the city almost enhancing the mood of anticipation and excitement of arrival in the infamous Rio de Janeiro and finally stepping onto solid land, back to the real world for the first time in 2 months. However after several days of hanging out people watching on Copacabana and Ipanema beach, doing the tourist thing, going to a Brazilian soccer match at the infamous Maracana Stadium and drinking far too many Capirinhas – the exhaustion had set in and it was time to head home and recover.



Figure 6 – Sugar loaf mountain and Corcovado as the JR entered Rio de Janeiro at dusk.

So what am I up to now (other than trying to get my head down and finish off my PhD)? Well my follow up project for Leg 207 is to produce a high resolution stable isotope stratigraphy to determine how complete the Demerara Rise K/T boundary sections are – using bulk, fine fraction and eventually foraminifera. Our belief is that this may be one of the most complete K/T sections from the Atlantic Ocean. Once the stratigraphy has been determined and assuming it is as good as we believe it is – we hope to improve on Lee Kump's (1991) carbon model of the impact event and the subsequent Strangelove ocean.

Overall Leg 207 was (like all ODP cruises) very successful and hopefully all the follow up work will answer some of the original aims that the cruise set out with. I have to say for me personally it was a wonderful 2 months, I learnt an enormous amount in an environment of amazing collaboration, which certainly broadened my horizons. I met some really great people and some of the scientists who are pushing our understanding of the Cretaceous greenhouse climate, and I also got some useful hands on experience – not to mention some invaluable life skills on how to cope with interesting personalities!