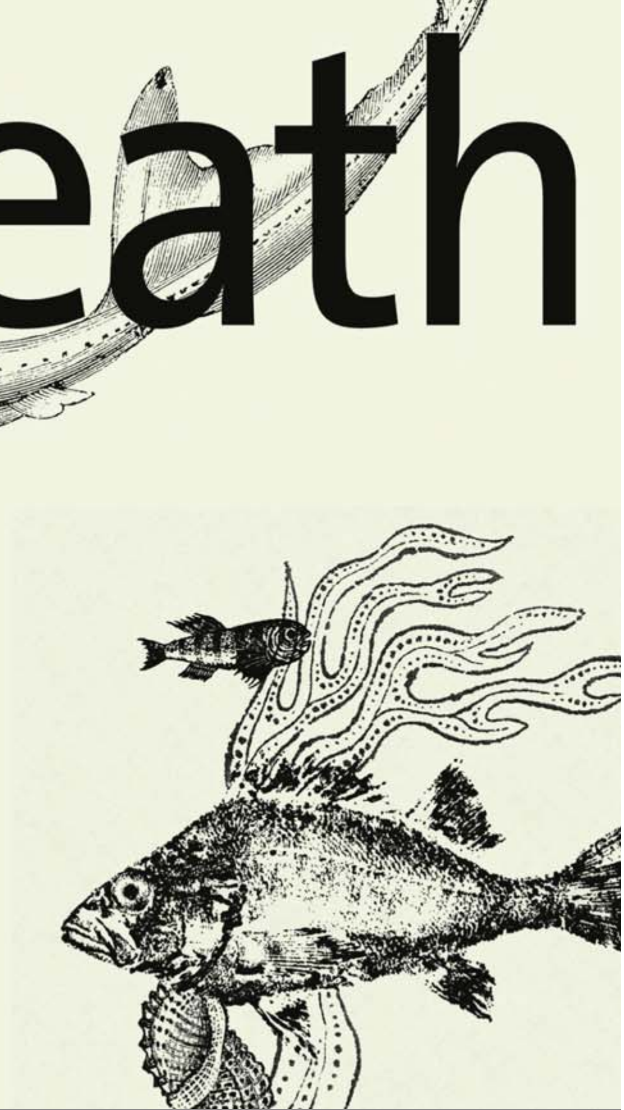
What lies beneath



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The Scientific and Environmental ROV Partnership using Existing iNdustrial Technology

In Tanzania, our environment team has been monitoring the impact of deep water drilling on the sea bed in the Ruvuma basin. As part of this work, they allowed a team from the SERPENT project at the UK National Oceanography Centre to use our remotely operated vehicle to collect data about this little-understood ecosystem.

In this article, marine biologist Dr. Andrew Gates explains what he has discovered as a result of this work, and how BG Tanzania is helping to improve our understanding of this delicate environment. As a result of this project, we will be better able to understand and manage the impact of our operations in deep water.

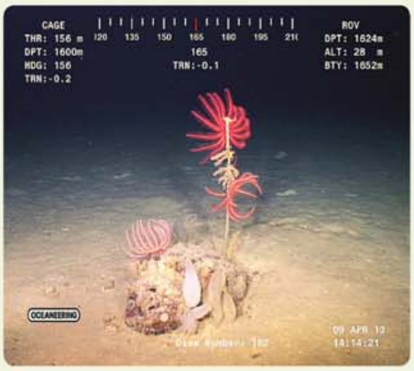
BG Tanzania is exploring in three blocks offshore Tanzania that cover an area of some 20,000 square kilometres. Within this enormous area we have drilled 14 wells, all in line with Tanzanian regulatory requirements and BG Group HSSE standards.

The absolute environmental impact of our drilling in such a large area is limited, but the team wanted to better understand what was happening in the water column and on the seabed when wells were drilled. The aim was to increase our understanding, and to be able to mitigate any negative impacts of future drilling. But their work has succeeded in deepening our understanding of the entire sub-sea ecosystem.

Partnership with the National Oceanography Centre

BG Tanzania carried out Drilling Discharge Modelling to measure the impact of the campaign on the marine environment. Though the results showed that the environmental impact of the drilling campaign was likely to be insignificant, the team wanted to improve their understanding by taking samples from the seabed.

Lodewijc Werre, BG Tanzania's environmental manager, approached Dr. Andrew Gates from the UK's National Oceanography Centre. Dr. Gates runs the Scientific and Environmental ROV Partnership using Existing iNdustrial Technology – known as SERPENT. The project allows marine biologists from the centre to operate the cutting-edge remotely operated vehicle (ROV) on board the drill ship, using it to explore the seabed and gain greater understanding of our operating environment.



From top: This observation of a hammerhead shark (Sphyrna lewini) is one of the deepest ever recorded and suggests that deep diving is an important behaviour in these animals. Below: Rocks at the Mzia site provide a different habitat to deep-sea marine animals. Here sponges, barnacles, corals and starfish use the current to filter food from the water.

"As a marine biologist this work is very exciting; with each dive we are exploring seabed that has never been seen before. ROVs are important tools for studying the deep sea but they are limited resources, so it is great that we can make use of the industry infrastructure in this way. It is so important that we understand the impacts we have in deep water and this way we can make in-situ observations as the drilling is happening."

Dr. Andrew Gates
UK National Oceanography Centre

Mapping the disturbance footprint

Dr. Gates joined the Deep-sea Metro 1 drillship at BG Tanzania's Mzia, Ngisi and Pweza sites. His first task was to map the distribution of drill cuttings around the well. A mixture of drill mud and cuttings is clearly visible close to the well site.

Using the ROVs' video camera to record the appearance of the seabed, transects are taken moving slowly away from the site. The subtle changes in appearance along the transect are termed the "disturbance gradient." Typically, by the end of a 200-metre survey line, the seabed is undisturbed.

While video surveys are helpful in showing the extent of marine disturbance, they cannot give a complete picture. To gain more detailed information, Dr. Gates used the ROVs to operate push cores to sample the top layers of the seabed. He took samples both close to and far from the well in several directions. These samples were then measured for chemicals found in drilling mud. Sediment grain size and the amount of organic carbon on the sediment's surface were also evaluated.

Understanding the deep-sea ecosystem

In addition to Dr. Gates' research into the sediments, he evaluated the fauna which make up the deep-sea ecosystem in the Ruvuma basin. It is an exciting and largely unexplored environment, with many bizarre life forms.

In the warm surface waters there is no shortage of life. As the team launched the Millennium ROV for a dive, they saw large Dorado chasing smaller fish or schools of tuna on transit to the seabed. Further down, as the light quickly fades and the water temperature cools, there are fewer creatures to be seen.

At first glance the seabed in water depths of over 1,600 metres seems like a desert. Evidence of life is revealed only occasionally as a tiny jellyfish drifts past or when the vehicle comes across small burrows or tracks in the vast expanses of deep-sea mud. Moving away from the well, as the pool of light from the ROV illuminates small areas of seabed, a diverse community of animals gradually becomes clear.

The pace of life is slow at these depths because there is little food. One of the more common animals, sea cucumbers, barely seem to move as they make their way over the seafloor. They are feeding on the mud to extract any nutrients that have settled from above.

Rocks provide a completely different habitat. They are covered with animals that feed on suspended particles or tiny animals in the water. Barnacles, starfish, sponges and anemones compete for the highest point with the strongest current flows.

The video camera records fleeting glances of deep-sea fish just outside the field of view as they drift by with the gentle current, waiting to pick up the scent of their next meal. As soon as food is available, there is a flurry of activity. When a baited time-lapse camera is deployed, scavengers arrive within minutes. They pick up the odour plume from the bait and descend on it to be photographed by the camera.

The benefits of collaboration

Collaborative projects such as this between SERPENT and BG Tanzania offer scientists access to technology and the opportunity to gather information directly from the deep sea.

Lodewijk comments, "Using this time, in situ, to monitor the impacts of drilling makes even better use of the ROVs we have on board. This in turn deepens our knowledge of deep-sea habitats and how human impacts may affect the seabed. Now we can make more realistic predictions about our environmental impact on deep water marine ecosystems in future operations."

A) An unidentified species of ctenophore (comb jelly). The tiny cilia that make up the comb rows reflect the lights of the ROV.

B) A large jelly, *Poralia* sp., seen during BOP inspections.

C) *Benthocodon* sp., a tiny jelly drifts over the seabed in the gentle current. These jellies were occasionally seen sitting on the seabed, perhaps to feed on material settling from above.

D) A shrimp hiding in amongst the polyps of a deep-water soft coral at Pweza-3.

E) A fleeting glance of the famous "piglet squid" at Pweza-3.

F) A swimming sea cucumber called *Enypniastes* sp. viewed in the water column at Pweza-3.

G) A crinoid on a small rock on the seabed at Ngisi-1.

H) This sea cucumber moves across the seabed at Ngisi-1 feeding on material that has settled on the seabed from the water column.

I) An echinothuriid sea urchin leaves a trail in mud as it moves slowly over the seafloor.

J) This stone crab (*Neolithodes* sp.) was attracted to the baited time-lapse camera at Mzia-2.

K) An amazing find. The remains of a traditional dhow provide habitat and food for anemones, worms, and crustaceans.

L) A synaphobrachid eel; one of the more common animals seen during the work off Tanzania.

M) Ophidiiform fish swim over a bedform at 1300m depth at Ngisi.

N) A remarkable chance observation of a hammerhead shark (*Sphyrna lewini*) at the seabed in deep water at Jordari.

O) A deep-sea shark feeds at the baited camera deployed at Ngisi. The camera is used to document scavanging deep-sea organisms in the area.

P) *Hydrolagus affinis*; a chimaera; a visitor to the baited cameras at Mzia-2, Ngisi-1 and Pweza-3.