NEWS

Researchers including (left to right) Matt Lowe, Vernon Asper and Andy Gossett have been studying the impact of the oil spill on ocean chemistry.

M. SCHROPE

Oil cruise finds deep-sea plume

Nature reports from the research ship *Pelican* as scientists map the hidden extent of the Deepwater disaster.

HOUMA, LOUISIANA

The first oceanographic research expedition into the Deepwater Horizon oil-spill zone has uncovered evidence that a deep-sea plume — probably made of oil, and not visible on the surface — seems to be spreading from the ruptured wellhead.

Environmental concerns following the oil-well blowout on 20 April initially focused on the effects of spilled oil on the Gulf of Mexico shoreline, which hosts many fishing communities and wildlife reserves. The discovery of the plume suggests that much of the oil may instead be lurking deep below the sea surface, with potentially dire consequences for marine organisms.

The find is already raising questions about the possible impact of the widespread use of oil dispersants to tackle the spill, and comes amid growing dissatisfaction among researchers about the limited efforts that have been made so far to study the spill and accurately gauge its size.

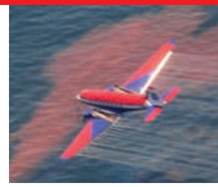
The team that found the plume is from the National Institute for Undersea Science and Technology (NIUST), a cooperative effort between the University of Mississippi in Oxford and the University of Southern Mississippi in Hattiesburg, funded by the National Oceanic and Atmospheric Administration (NOAA) in Silver Spring, Maryland. The researchers had originally been scheduled to map sea-floor formations in the Gulf of Mexico, just 15 kilometres from the Deepwater Horizon platform, and to survey historically significant shipwrecks using autonomous underwater vehicles launched from the Louisiana Universities Marine Consortium's 35-metre-long research vessel *Pelican*.

But when the oil-well blowout happened, just days before the ship was scheduled to depart, team leaders decided that the group should divert to oil studies and set about getting approval from NOAA, which is funding the expedition through a competitively awarded grant. "We felt that the mapping that we wanted to do could wait and that it would be an inappropriate use of this valuable ship time to do something that was not as urgent as the oil study," says NIUST oceanographer Vernon Asper.

For the first week of the cruise, much of the NIUST work focused on taking samples of sediment cores throughout the region, to develop a reliable baseline for future studies of oil that may settle to the sea floor. After a week of establishing a series of study sites, the team returned to port briefly to take on additional equipment — and a *Nature* journalist.

On their fourth day back at sea, on 12 May, the scientists made an astonishing find. "You've got to see this," said Arne Diercks, rushing into the ship's main lab. As those aboard gathered in the control room where data from a lowered sampling system come through in real time, Diercks, NIUST's chief scientist for the cruise, pointed out the telltale instrument readings. At a depth of around 1,000 metres, the team seemed to have struck oil.

The team's hypothesis was based on three



THE SCIENCE OF DISPERSANTS
The giant experiment in the Gulf of Mexico.
go.nature.com/ffAAPt

S. LEHMANN/US COAST GUARD

key readings. The transmissometer, which measures the blocking of light by particles or opaque dissolved matter in the water, showed a serious hike in murkiness. The fluorometer, tuned to measure fluorescence given off by dissolved oil, was also giving readings many times higher than normal. And oxygen levels had dropped, suggesting heightened activity by microbes as they consume the oil and associated organic material.

"We've got to home in on this," Asper said excitedly. "You never see signals like that in the open ocean." The team spent much of the remaining time at sea mapping the boundaries of a plume that extends about 45 kilometres southwest from the wellhead and roughly 10 kilometres wide at depths of 1,000–1,400 metres (see 'Oil zone'). On returning to previously sampled sites, the team showed that the plume was shifting, but that it generally remained at least 100 metres above the sea floor.

Dispersant debate

Data received from NOAA while the researchers were still at sea confirmed that deep-water currents at the time were flowing southwest, further suggesting that the plume they were measuring was oil emanating from the well. However, the group will not be able to confirm the plume's composition until tests on collected water samples are performed this week.

Aboard the *Pelican*, the NIUST team watched as news of the plume spread, and eventually began getting satellite calls from journalists. On 16 May, at a daily press briefing, officials from energy company BP, which operates the well, skipped over an initial request for comment on the plume. In response to a second question, BP spokesman Andrew Gowers said: "We have no confirmation of that, but my observation as a layman is that oil is lighter than water and it tends to go up."

Many scientists had also assumed that this was the case, although others had predicted that because of the depth of the leak, certain components of the oil would separate out as they rose to the surface and settle into a subsurface layer. Still, the magnitude of the plume was an unpleasant surprise.

Experts including Jeffrey Short, an environmental chemist with the conservation advocacy group Oceana, based in Washington DC, have suggested that oil coming straight from the well could naturally break into small, less-buoyant droplets that would be capable of forming such a plume below the surface. But underwater use of dispersants, a previously untried technique that was approved by the Environmental Protection Agency (EPA) on 15 May, may also play a part by shaping the oil into smaller droplets. For several days before that announcement, and while the NIUST team was studying the plume, BP applied more than 100,000 litres of dispersant at the sea floor during EPA-sanctioned tests.

Biogeochemist Samantha Joye at the University of Georgia in Athens, who works with the NIUST team and will be analysing the plume water samples, says that either possibility or a combination of both could explain the plume. But "it doesn't matter if it's dispersed oil or natural crude, it's going to have a huge impact", she says.

Thomas Shirley, a marine biologist at Texas A&M University in Corpus Christi, says that although little oil has washed ashore and the harm to coastal ecosystems has so far been minimal, offshore species may be at greater risk. Toxic compounds from the floating oil could threaten species living near the surface, including commercially important fish and their prey, he says. Meanwhile, toxins from the underwater plume could affect deep corals and other species, a problem that could be exacerbated by dispersant use, which breaks up the oil into smaller particles and makes it easier for animals to take in. Shirley suggests that deep-dwelling organisms such as zooplankton might be hit by the low oxygen levels in the plume, which could take months or years to recover because oxygen is slow to diffuse into the deep. The plume could form a barrier that blocks the normal up-and-down daily migration of numerous organisms, and could block the flow of particles of organic debris from the surface to the deep where they are a critical food source.

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"We've certainly put a kink in the efficiency of the system out there," says Shirley, "but how much effect that will have and for how long, we don't know."

Shirley says that as the effects of the deeper oil come to the fore, accurately assessing how much oil is gushing from the wellhead will be even more important. The official US Coast Guard estimate is 795,000 litres per day. However, a number of groups have questioned the figure, and Short says that the underwater plume could be further evidence that the true flow rate is much higher than the official figure.

Whereas NOAA administrator Jane Lubchenco has argued that the estimate is reasonable and that having a more accurate rate would not change the response strategy, some researchers feel that knowing the spill's true size is essential to understanding its full biological impacts, and deciding whether massive deployment of dispersants is the best option.

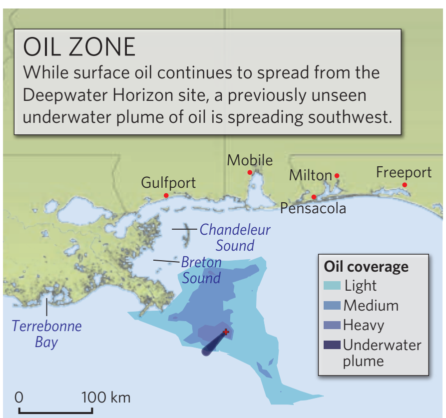
"I think that knowing the volume of oil is very important," says Shirley, "and I would urge BP to make all the video they have available and work with people to provide all the data possible." BP's ultimate legal liability for damages could be directly tied to the size of the spill, adds Short: "That is a long-standing principle in these sorts of cases." Last week, the administration of President Barack Obama sent a letter to BP asking for clarification on the company's financial redress plans and reiterating the position that BP is responsible for all clean-up costs and economic damage. A BP spokesman declined to comment on the potential implications of the plume.

For now, both the gushing oil and the US political debate over drilling continue. On 16 May, BP reported that it had managed to insert a tube into the pipe coming out of the well, which it says is capturing about 320,000 litres of oil per day. And the company is pursuing several other options to capture leaking oil or close off the well before it can finish drilling a separate relief well, a process that could take months.

On 14 May, the team aboard the *Pelican* all gathered in the galley to watch a press conference in which President Obama said that offshore drilling remains an important part of the overall US energy policy, although any movement towards expanding it is on hold. Short says that the drilling debate centres in part on weighing the benefits of oil against the environmental impact. "If the environmental impacts are an order of magnitude larger than anyone dreamed of, that's probably going to be a factor in the debate," he says, "I suspect BP has its eye on that too." ■

Mark Schrope

Read the full account of the *Pelican*'s mission at http://go.nature.com/TBKWnY



SOURCE: NOAA