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Where Did All the Oil Go?

Due to the environmental disaster's unprecedented scope, assessing the damage caused by the 2010 Deepwater Horizon spill in the Gulf of Mexico has been a challenge. One unsolved puzzle is the location of 2 million barrels of submerged oil thought to be trapped in the deep ocean.

[UC Santa Barbara's David Valentine](#) and colleagues from the Woods Hole Oceanographic Institute (WHOI) and UC Irvine have been able to describe the path the oil followed to create a footprint on the deep ocean floor. The findings appear today in the Proceedings of the National Academy of Sciences.

For this study, the scientists used data from the Natural Resource Damage Assessment process conducted by the National Oceanic and Atmospheric Administration. The United States government estimates the Macondo well's total discharge — from the spill in April 2010 until the well was capped that July — to be 5 million barrels.

By analyzing data from more than 3,000 samples collected at 534 locations over 12 expeditions, they identified a 1,250-square-mile patch of the deep sea floor upon which 2 to 16 percent of the discharged oil was deposited. The fallout of oil to the sea floor created thin deposits most intensive to the southwest of the Macondo well. The oil was most concentrated within the top half inch of the sea floor and was patchy even at the scale of a few feet.

The investigation focused primarily on hopane, a nonreactive hydrocarbon that served as a proxy for the discharged oil. Researchers analyzed the spatial distribution of hopane in the northern Gulf of Mexico and found it was most concentrated in a thin layer at the sea floor within 25 miles of the ruptured well, clearly implicating Deepwater Horizon as the source.

“Based on the evidence, our findings suggest that these deposits come from Macondo oil that was first suspended in the deep ocean and then settled to the sea floor without ever reaching the ocean surface,” said Valentine, a professor of [earth science](#) and biology. “The pattern is like a shadow of the tiny oil droplets that were initially trapped at ocean depths around 3,500 feet and pushed around by the deep currents. Some combination of chemistry, biology and physics ultimately caused those droplets to rain down another 1,000 feet to rest on the sea floor.”

Valentine and his colleagues were able to identify hotspots of oil fallout in close proximity to damaged deep-sea corals. According to the researchers, this data supports the previously disputed finding that these corals were damaged by the Deepwater Horizon spill.

“The evidence is becoming clear that oily particles were raining down around these deep sea corals, which provides a compelling explanation for the injury they suffered,” said Valentine. “The pattern of contamination we observe is fully consistent with the Deepwater Horizon event but not with natural seeps — the suggested alternative.”

While the study examined a specified area, the scientists argue that the observed oil represents a minimum value. They purport that oil deposition likely occurred outside the study area but so far has largely evaded detection because of its patchiness.

“This analysis provides us with, for the first time, some closure on the question ‘Where did the oil go and how?’ ” said Don Rice, program director in the National Science Foundation’s Division of Ocean Sciences. “It also alerts us that this knowledge remains largely provisional until we can fully account for the remaining 70 percent.”

“These findings should be useful for assessing the damage caused by the Deepwater Horizon spill as well as planning future studies to further define the extent and nature of the contamination,” Valentine concluded. “Our work can also help to assess the fate of reactive hydrocarbons, test models of oil’s behavior in the ocean

and plan for future spills.”

Co-authors are G. Burch Fisher and Sarah C. Bagby, postdoctoral researchers in the Valentine Lab; Robert K. Nelson, Christopher M. Reddy and Sean P. Sylva of WHOI; and Mary A. Woo of UC Irvine. The research was funded by the National Science Foundation.

About UC Santa Barbara

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