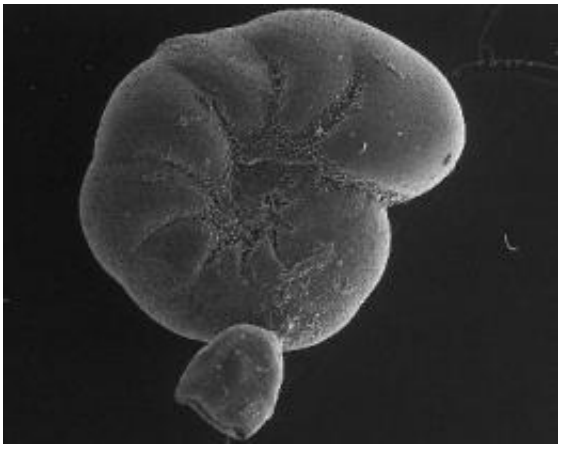
Tiny foraminifera shells can help assess recovery after oil spill

September 15 2010, By Robert Sanders



A normal foram, about one-half millimeter across, with an attached cup-shaped parasite (bottom). Parasitized forams are more common when oil is present. More than 32 years after the Amoco Cadiz spilled oil in a marsh on the coast of France, the number of parasitized forams remains higher than before the 1978 spill. (Image: Marie-The Venec-Peyre and Annachiara Bertolini)

(PhysOrg.com) -- Millimeter-size marine organisms called foraminifera have been used to monitor pollutants in marshes and oceans, and could help to assess recovery in the Gulf of Mexico following the three-month long Deepwater Horizon oil spill.

That was the message from a French/American team of researchers who recently reported on the health of French marshes and mudflats 32 years after the Amoco Cadiz spilled 220,000 tons of oil along the Brittany

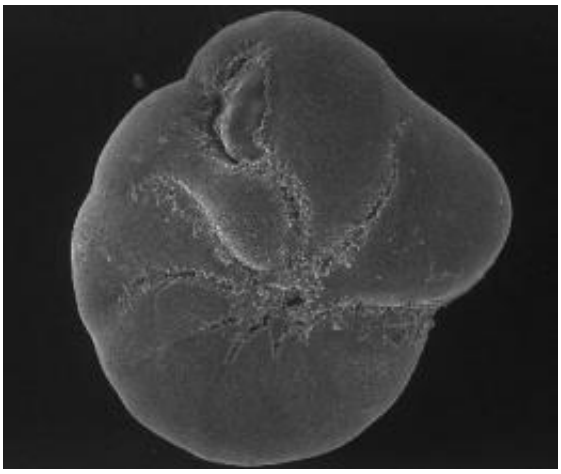
coast in 1978.

"Our key to looking at these environments was the percentage of deformed foraminifera," said report co-author Jere Lipps, University of California, Berkeley, professor of integrative biology and an expert on foraminifera. "The percentage went way up during the oil spill, and then after about two years came back down to 2 or 3 percent, and that is where we see it today."

The results were presented Sept. 7 by Lipps' colleague, Marie-Thérčse Vénec-Peyré of the Muséum National d'Histoire Naturelle in Paris, at the international Forams 2010 symposium in Bonn, Germany.

The presentation was part of a session on Foraminifera as bioindicators of human impacts, and included discussion of "forams" as monitors of water quality along the Mediterranean coast, off Southern California, in Norwegian fjords and among atolls in the Pacific Ocean.

"We think of foraminifera as a very useful monitoring tool," said Lipps, who is a curator in UC Berkeley's Museum of Paleontology. To assess the impact of an oil spill in a marsh, for example, "you just grab a small cup of mud, wash it through a screen and look at it for deformed shells. You don't have to do any measurement on organisms or sediments in order to see the results."



The last three chambers of this foraminifera are severely deformed in response to pollution. One chamber is smaller and abnormal, while the last two are smaller than normal. The foram is one-half millimeter across, magnified 180 times. (Image: Marie-The Venec-Peyre and Annachiara Bertolini)

In assessing the health of the ocean floor, on the other hand, foraminifera are so sensitive that "we can tell within an hour or two of when the sample comes up on the ship what the conditions are down below," he said.

Lipps is applying for federal grants to develop foraminifera as indicators of oil pollution in the marine environment, in general, and in the Gulf, in particular.

"If there is oil on the Gulf sea floor, as some people have suggested, it could have an impact on the foraminifera that live there," Lipps said. "The foraminifera might be the only thing that you can recover, because they have shells that are preserved. Other things disintegrate, but foraminifera leave a permanent record."

The foraminifera used in this study are pin-head size, single-celled

protists that secrete a calcium carbonate shell, called a test, that remains on the ocean bottom after the organism dies. Fossilized forams have been used by the oil industry for decades to identify the age and ancient environments of rock deposits they drill through.

What makes foraminifera so useful is that their shells deform in the presence of chemical pollution, including oil, and they have a very short life span — about 30 days. The rapid turnover means that living forams indicate the current state of pollution, while cores through sediment can reveal past history of pollution.

The team's test case was the Amoco Cadiz, an oil tanker that broke apart on the north coast of Brittany on March 16, 1978, eventually polluting 360 kilometers of coastal rocks, bays, marshes and estuaries, as well as offshore subsurface areas.

Working in the Morlaix estuary, a site impacted by the spill, Vénec-Peyré in 1978 collected living foraminifera of the species Protoelphidium paralium eight months after the spill and found a variety of abnormalities: deformed shells, defects in calcification, growth irregularities and parasites. Some shells had additional chambers, others had calcified protrusions such as knobs or swellings, while others had undersized chambers caused by a slowing or halt in the addition of chamber walls. Many foraminifera shells had attached parasites.

Based on samples collected before the spill and monthly samples collected from November 1978 to June 1980, the French researchers led by Vénec-Peyré found shell deformities and decreased growth rates for a year following the spill. Within one year after the spill, 21 percent of shells showed decreased growth rates, 8 percent were deformed and half were parasitized. The fact that in two years these numbers had declined nearly to pre-oil levels suggested that the oil pollution was responsible, although the cause — such as toxic compounds in the oil, oxygen

depletion or decreased nutrients resulting from the oil slick — remains unclear.

With funding from the France-Berkeley Fund, Vénec-Peyré, Lipps and their colleagues collected mud samples in April and May of 2010. The samples showed that forams were about comparable to pre-oil levels: The percentage of deformed P. paralium was about 3 percent, while 2 percent showed evidence of slow growth. The percentage of parasitized forams, however, was much higher — 15 percent compared to 4 percent before the oil spill - though significantly lower than the 50 percent parasitism rate a year after the oil spill.

The researchers believe they are looking at ongoing pollution from boats and agriculture, not the lingering results of the Amoco Cadiz spill, while the high rate of parasitism may indicate compromised fitness due to stress.

"Foraminifera are good indicators of the rate of recovery in oiled marine environments, especially in marshes and mudflats, at least for the smaller organisms affected by a spill," Lipps said. "Recovery probably won't happen any faster than that."

Provided by University of California - Berkeley