Oil spills raise arsenic levels in the ocean, says new research

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Oil spills can increase levels of toxic arsenic in the ocean, creating an additional long-term threat to the marine ecosystem, according to research published today in the journal *Water Research*.

Arsenic is a poisonous chemical element found in minerals and it is present in oil. High levels of arsenic in seawater can enable the toxin to enter the food chain. It can disrupt the photosynthesis process in marine plants and increase the chances of genetic alterations that can cause birth defects and behavioural changes in aquatic life. It can also kill animals such as birds that feed on sea creatures affected by arsenic.

In today's study, a team from Imperial College London has discovered that oil spills can partially block the ocean's natural filtration system and prevent this from cleaning arsenic out of the seawater. The researchers say their study sheds light on a new toxic threat from the Gulf of Mexico oil leak.

Arsenic occurs naturally in the ocean, but sediments on the sea floor filter it out of seawater, which keeps the levels of naturally occurring arsenic low. However, arsenic is also flushed into the ocean in wastewater from oil rigs and from accidental oil spills and leakages from underground oil reservoirs.

In the study, the researchers discovered that oil spills and leakages clog up sediments on the ocean floor with oil, which prevents the sediments from bonding with arsenic and burying it safely underground with

subsequent layers of sediment. The scientists say this shutdown of the natural filtration system causes arsenic levels in seawater to rise, which means that it can enter the marine ecosystem, where it becomes more concentrated and poisonous the further it moves up the food chain.

The scientists say their work demonstrates how the chemistry of sediments in the Gulf of Mexico may be affected by the current oil leak. Professor Mark Sephton, from the Department of Earth Science and Engineering at Imperial College London, says:

"We can't accurately measure how much arsenic is in the Gulf at the moment because the spill is ongoing. However, the real danger lies in arsenic's ability to accumulate, which means that each subsequent spill raises the levels of this pollutant in seawater. Our study is a timely reminder that oil spills could create a toxic ticking time bomb, which could threaten the fabric of the marine ecosystem in the future."

Wimolporn Wainipee, postgraduate and lead author of the study from the Department of Earth Science and Engineering at Imperial College London, adds:

"We carried out our study before the leak in the Gulf of Mexico occurred, but it gives us a big insight into a potential new environmental danger in the region. Thousands of gallons of oil are leaked into the world's oceans every year from big spills, offshore drilling and routine maintenance of rigs, which means many places may be at risk from rising arsenic levels, which could in the long run affect aquatic life, plants and the people who rely on the oceans for their livelihoods."

For their research, the team analysed a mineral called goethite, one of the most abundant ocean sediments in the world, which is an iron bearing oxide.

The team carried out experiments in the laboratory that mimicked conditions in the ocean, to see how the goethite binds to arsenic under natural conditions. They discovered that seawater alters the chemistry of goethite, where low pH levels in the water create a positive change on the surface of goethite sediments, making them attractive to the negatively charged arsenic.

However, the scientists discovered that when they added oil, this created a physical barrier, covering the goethite sediments, which prevented the arsenic in the oil from binding to them. The team also found that the oil changed the chemistry of the sediments, which weakened the attraction between the goethite and arsenic.

In the future, the researchers plan to analyse other minerals such as clays and carbonates that are sediments on the ocean floor. Sediment content varies from ocean to ocean and the researchers will analyse how oil affects their ability to bind to arsenic after a spill.

More information: "The effect of crude oil on arsenate adsorption on goethite" Water Research journal, Friday 2 July 2010.

Provided by Imperial College London