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METHANE GAS AND THE DEEPWATER HORIZON OIL SPILL

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Can a tsunami result from the Deepwater Horizon Incident?

Scenarios of tsunamis are a growing concern in relation to the Deepwater Horizon incident. These scenarios involve the naturally occurring methane beneath the seafloor in the Macondo Discovery, which is the petroleum reservoir into which the Deepwater Horizon production well was drilled. Scientists and engineers are aware of the physical and chemical behavior of methane in the earth and ocean, as well as during production of petroleum.

Science does not support the notion of a methane-induced tsunami resulting from Deepwater Horizon activities. However, while the possibility of an induced tsunami is extremely remote, the Florida Department of Environmental Protection (DEP) continues to take all concerns seriously and is consulting with experts in all related scientific fields.

Keys to understanding the behavior of methane deep beneath the ocean floor

1. The geology of petroleum reservoirs,
2. What happens as oil and gas is removed from the geologic strata beneath the seafloor, and
3. The chemical and physical nature of methane.

How does oil and gas form?

Hydrocarbons (or petroleum products) form through a four-stage process that requires millions of years:

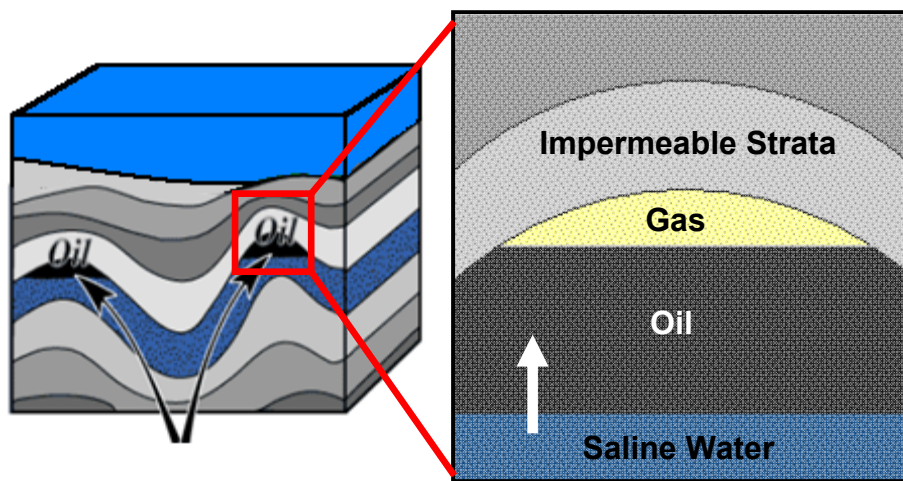
1. **Deposition:** Billions of microscopic organisms in the ocean absorb energy from the sun, storing it as organic carbon. The microorganisms die and settle to ocean floor. Over millions of years they are buried by sediment.
2. **Maturation:** Continued burial adds heat and pressure that ultimately converts the carbon and hydrogen to hydrocarbons. The rocks and sediments (strata) in which these hydrocarbons (petroleum products) are formed are called source rocks. The hydrocarbons, along with saline water, are widely scattered throughout the microscopic pore spaces in these strata.
3. **Migration:** The hydrocarbons, being less dense than surrounding saline water trapped in the strata, will migrate upward as long as the permeability of the strata allows. Permeability is the capacity of a porous rock, sediment or soil to transmit gas or fluid.
4. **Concentration:** Upward movement through permeable strata continues until one of two things happen: the hydrocarbons naturally seep from the ocean floor, or the

hydrocarbons are trapped by a cap rock or some other impermeable geologic layer. It is important to note that the petroleum reservoir formed by this process is not a large subsurface cavity but a package of rocks and sediment that have sufficient permeability to contain the hydrocarbons.

Oil and gas production

As oil and gas are removed from a deep subsurface reservoir via a production well, like the one associated with Deepwater Horizon, the microscopic pore spaces are filled by the surrounding pressurized saline water. A giant void space is not left behind once the oil and gas is withdrawn or otherwise allowed to flow out of the reservoir.

The graphic below shows how oil, gas and water are separated in a reservoir because of their different densities. The reservoir itself is comprised of permeable strata.



The Macondo reservoir lies beneath approximately 18,000 feet of rock, sediment and ocean, the latter comprising nearly 5,000 feet.

Methane

Methane is naturally present in seawater at very low concentrations. It is continually produced by bacteria in shallow marine sediments and it can also be produced at great depths below the seafloor by the same processes that produce oil. Deep seawater is cold (< 40° F), and some of the methane in the sediment may solidify to form methane hydrate or clathrate, an ice-like compound. Clathrate formation can actually act to stabilize the seafloor; however, subsequent physical disturbance or chemical alteration of the sediments can remobilize the methane, causing release of the methane to the overlying water. Methane venting from the seafloor is a natural occurrence.

As one would expect, methane dissolved in the water column is higher than normal in the vicinity of the Deepwater Horizon Incident. Methane bubbles exist as well; however, they are small and float to the ocean surface, where they are released to the atmosphere.