Gas escaping from ocean floor may drive global warming

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Gas escaping from the ocean floor may provide some answers to understanding historical global warming cycles and provide information on current climate changes, according to a team of scientists at the University of California, Santa Barbara. The findings are reported in the July 20 on-line version of the scientific journal, *Global Biogeochemical Cycles*.

Remarkable and unexpected support for this idea occurred when divers and scientists from UC Santa Barbara observed and videotaped a massive blowout of methane from the ocean floor. It happened in an area of gas and oil seepage coming out of small volcanoes in the ocean floor of the Santa Barbara channel — called Shane Seep — near an area known as the Coal Oil Point seep field. The blowout sounded like a freight train, according to the divers.

Atmospheric methane is at least 20 times more potent than carbon dioxide and is the most abundant organic compound in the atmosphere, according to the study's authors, all from UC Santa Barbara.

"Other people have reported this type of methane blowout, but no one has ever checked the numbers until now," said Ira Leifer, lead author and an associate researcher with UCSB's Marine Science Institute. "Ours is the first set of numbers associated with a seep blowout." Leifer was in a research boat on the surface at the time of the blowouts.

Aside from underwater measurements, a nearby meteorological station measured the methane "cloud" that emerged as being approximately 5,000 cubic feet, or equal to the volume of the entire first floor of a two-bedroom house. The research team also had a small plane in place, flown by the California Department of Conservation, shooting video of the event from the air.

Leifer explained that when this type of blowout event occurs, virtually all the gas from the seeps escapes into the atmosphere, unlike the emission of small bubbles from the ocean floor, which partially, or mostly, dissolve in the ocean water. Transporting this methane to the atmosphere affects climate, according to the researchers. The methane blowout that the UCSB team witnessed reached the sea surface 60 feet above in just seven seconds. This was clear because the divers injected green food dye into the rising bubble plume.

Co-author Bruce Luyendyk, professor of marine geophysics and geological sciences, explained that, to understand the significance of this event (which occurred in 2002), the UCSB research team turned to a numerical, bubble-propagation model. With the model, they estimated methane loss to the ocean during the upward travel of the bubble plume.

The results showed that for this shallow seep, loss would have been approximately one percent. Virtually all the methane, 99 percent of it, was transported to the atmosphere from this shallow seep during the blowout. Next, the scientists used the model to estimate methane loss for a similar size blowout at much greater depth, 250 meters. Again, the model results showed that almost all the methane would be transported up to the atmosphere.

Over geologic time scales, global climate has cycled between warmer, interglacial periods and cooler, glacial periods. Many aspects of the forces underlying these dramatic changes remain unknown. Looking at past changes is highly relevant to understanding future climate changes, particularly given the large increase in atmospheric greenhouse gas concentrations in the atmosphere due to historically recent human activities such as burning fossil fuels.

One hypothesis, called the "Clathrate Gun" hypothesis, developed by James Kennett, professor of geological sciences at UCSB, proposes that past shifts from glacial to interglacial periods were caused by a massive decomposition of the marine methane hydrate deposits.

Methane hydrate is a form of water ice that contains a large amount of methane within its crystal structure, called a clathrate hydrate. According to Kennett's hypothesis, climatic destabilization would cause a sharp increase in atmospheric methane — thereby initiating a feedback cycle of abrupt atmospheric warming. This process may threaten the current climate, according to the researchers. Warmer ocean temperatures from current global climate change is likely to release methane currently trapped in vast hydrate deposits on the continental shelves. However, consumption of methane by microbes in the deep sea prevents methane gas released from hydrates from reaching the ocean surface and affecting the atmosphere.

Bubbles provide a highly efficient mechanism for transporting methane and have been observed rising from many different hydrate deposits around the world. If these bubbles escape singly, most or all of their methane would dissolve into the deep-sea and never reach the atmosphere. If instead, they escape in a dense bubble plume, or in catastrophic blowout plumes, such as the one studied by UCSB researchers, then much of the methane could reach the atmosphere. Blowout seepage could explain how methane from hydrates could reach the atmosphere, abruptly triggering global warming.

Thus, these first-ever quantitative measurements of a seep blowout and the results from the numerical model demonstrate a mechanism by which methane released from hydrates can reach the atmosphere. Studies of seabed seep features suggest such events are common in the area of the Coal Oil Point seep field and very likely occur elsewhere.

The authors explain that these results show that an important piece of the global climate puzzle may be explained by understanding bubble-plume processes during blowout events. The next important step is to measure the frequency and magnitude of these events. The UCSB seep group is working toward this goal through the development of a long-term, seep observatory in active seep areas.

Source: University of California - Santa Barbara