New study indicates carbon release to atmosphere ten times faster than in the past

June 5 2011

The rate of release of carbon into the atmosphere today is nearly 10 times as fast as during the Paleocene-Eocene Thermal Maximum (PETM), 55.9 million years ago, the best analog we have for current global warming, according to an international team of geologists. Rate matters and this current rapid change may not allow sufficient time for the biological environment to adjust.

"We looked at the PETM because it is thought to be the best ancient analog for future climate change caused by fossil fuel burning," said Lee R. Kump, professor of geosciences, Penn State.

However, the researchers note in the current issue of *Nature Geoscience*, that the source of the carbon, the rate of emission and the total amount of carbon involved in this event during the PETM are poorly characterized.

Investigations of the PETM are usually done using core samples from areas that were deep sea bottom 55.9 million years ago. These cores contain layers of calcium carbonate from marine animals that can show whether the carbon in the carbonate came from organic or inorganic sources. Unfortunately, when large amounts of greenhouse gases --carbon dioxide or methane -- are in the atmosphere, the oceans become more acidic, and acid dissolves calcium carbonate.

"We were concerned with the fidelity of the deep sea records," said Kump. "How do we determine the rate of change of atmospheric carbon

if the record is incomplete? The incomplete record makes the warming appear more abrupt."

Kump and his colleagues decided to look at information coming from areas that were shallow arctic ocean bottom during the PETM. During a Worldwide Universities Network expedition to train graduate students from Penn State, the University of Southampton, University of Leeds, University of Utrecht and University of Oslo in how projects develop, the researchers visited Spitsbergen, Norway. They uncovered a supply of rock cores curated by a forward-thinking young coal-mining company geologist, Malte Jochmann.

"Deep-sea cores usually have from 10 cm to a meter (about 4 inches to 3 feet) of core corresponding to the PETM," said Kump. "The Spitsbergen cores have 150 meters (492 feet) of sediment for the PETM."

The larger sediment section, made up of mud that came into the shallow ocean contains organic matter that can also supply the carbon isotope signature and provide the greenhouse gas profile of the atmosphere. With the larger core segment, it is easier to look at what happened through time and ocean acidification would not degrade the contents.

"We think the Spitsbergen core is relatively complete and shows an interval of about 20,000 years for the injection of carbon dioxide during the PETM," said Kump.

Using the data collected from the cores, the researchers forced a computer model to in essence run backward. They set up the models to find the proper amounts of greenhouse gases and atmospheric temperature that would have resulted in the carbon isotope ratios observed in the cores.

The outcome was a warming of from 9 to 16 degrees Fahrenheit and an

acidification event in the oceans.

"Rather than the 20,000 years of the PETM which is long enough for ecological systems to adapt, carbon is now being released into the atmosphere at a rate 10 times faster," said Kump. "It is possible that this is faster than ecosystems can adapt."

Provided by Pennsylvania State University