Burps that warmed the world

Yorkshire rocks reveal an ancient global catastrophe, report Dave Kemp, Angela Coe and Anthony Cohen.

The sea cliffs around Whitby in Yorkshire might seem an odd place to record a global environmental catastrophe, yet 183 million years ago their sediments witnessed one of the most dramatic climatic changes ever known.

Essentially, the Earth burped three times, releasing methane gas on an almost unimaginably large scale, and profoundly affecting climate and life (see *Planet Earth*, autumn 2005, p32). The gas came from melting methane hydrate. Methane hydrate forms when the methane that bacteria produce by breaking down organic matter in marine sediments gets locked up in ice. About 183 million years go, at the time the Whitby rocks formed, vast amounts of methane hydrate suddenly melted.

How could we tell? The rocks preserve an exceptionally detailed record of the climate. They contain different forms (isotopes) of carbon, and the ratios of these told us there had been three separate and unusually large enrichments of the isotope carbon-12. This is very abundant in methane hydrate, making hydrate the only likely source.

Methane is a powerful greenhouse gas, and once in the atmosphere, it would have rapidly warmed global climate. It would also have reacted with oxygen, forming carbon dioxide, a longer-lived greenhouse gas. We already knew from earlier geochemical measurements on these rocks that ocean temperatures rose by as much as 8°C at this time. Fossils found here show this all happened during a 'mass extinction' of more than 50 per cent of marine animals—probably caused by this environmental catastrophe.

Intriguingly, we've discovered that predictable wobbles in the Earth's orbit may have started the melting. The three regular pulses of methane exactly match the wobbles that periodically bring our planet closer to the Sun, warming the oceans. Carbon dioxide, released at the same time from a large region of volcanic activity in the southern hemisphere, called the Karoo-Ferrar Large Igneous Province, would have strengthened this warming.

Each release of methane and subsequent build-up of carbon dioxide occurred over less than 2000 years (a mere blink of an eye to an Earth scientist), but the Whitby rocks show that the Earth's climate took about 250,000 years to recover. Today, we're releasing large amounts of carbon dioxide, primarily by burning fossil fuels and producing concrete. It is even possible that we're releasing it faster than it would have accumulated after the methane burps. Given this, the sudden and devastating effects, and the slow recovery 183 million years ago, we should learn what we can from ancient climate change. Our research tells us a great deal about how the Earth, and life, reacts to abrupt, large-scale increases in atmospheric carbon dioxide, and to the accompanying increase in global temperature. It may help us better understand the consequences of our present-day activities.

Want to know more?
You can read a scientific paper on this research in the journal *Nature*, vol. 43, p396.

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