

Are we in the “Anthropocene”?

John Carey, *Science Writer*

In 2000, some two dozen top scientists gathered south of Mexico City to discuss the implications of their multidisciplinary Earth sciences research, and Paul Crutzen was getting frustrated. The work, part of the International Geosphere-Biosphere Program (IGBP) (www.igbp.net), had documented vast planetary changes caused by humans, such as soaring levels of carbon dioxide in the atmosphere. However, many of the scientists continued to refer to the present day as the Holocene Epoch, the geological period that began when the ice sheets started to retreat 11,700 years ago.

The Earth is not in the Holocene anymore, asserted Crutzen, a Dutch atmospheric chemist and Nobel laureate. Instead, he said pausing to find the right word, we’re in the “Anthropocene,” a new epoch in which the Earth’s geology has been fundamentally changed by humans (hence the description “anthropo,” meaning human).

It was a pivotal moment. “We all looked at each other and thought, wow, that really sums it up,” recalls Will Steffen, former head of the Australian National University Climate Change Institute and Executive Director of the IGBP in 2000. “The Anthropocene is an incredibly powerful unifying concept.”

As Crutzen explained in a 2000 IGBP newsletter (1), the justification for the new term is to “emphasize the central role of mankind in geology and ecology.” And in

fact, it has inspired many papers, such as a recent one in *Science* in January 2016 (2), which present detailed evidence for major geological and ecological changes caused by human activities. The notion of the Anthropocene has also captured the public’s imagination, with cover stories in magazines like the *Economist* (3). But it’s also been hard to pin down. “People are using it with great abandon, but no one knows what it means,” says Colin Waters, principal mapping geologist at the British Geological Survey. “That devalues the concept and confuses the science as well.”

And that’s why a small group of members of the Geological Society of London and other global experts created an Anthropocene Working Group (AWG) about seven years ago, to decide precisely what the word means. The working group will report to the Subcommittee on Quaternary Stratigraphy in the International Commission on Stratigraphy (ICS) (www.stratigraphy.org), which is responsible for officially dividing the Quaternary—the last 2.6 million years—into distinct epochs and ages. After running on a shoestring and staying in touch remotely and informally for years, the now 37-member AWG held its first meeting in Berlin in 2014 and plans to submit a preliminary proposal to the ICS this August to declare the Anthropocene a new geological epoch.

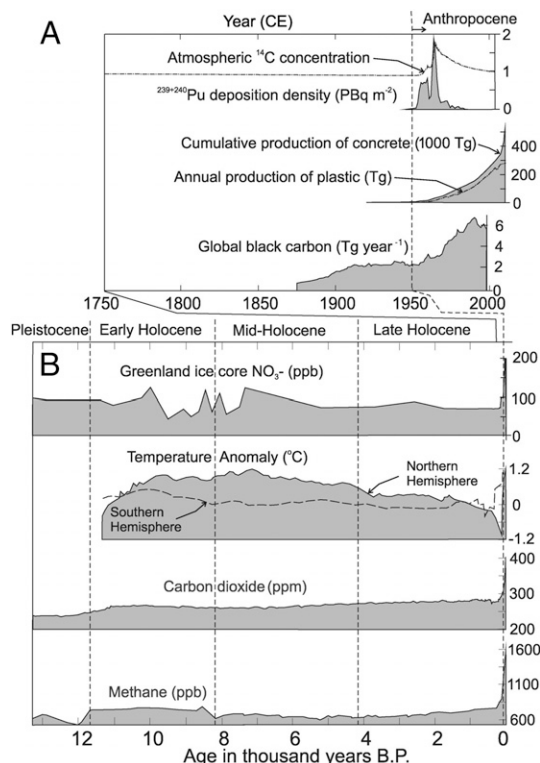
Such a determination would be a big deal. “Geologists do not tinker with the geologic stratigraphic time scale lightly,” says Georgetown University historian and AWG member, John McNeill.

It’s also highly controversial. “Yes, humans are changing the Earth, and yes, you can call it the Anthropocene,” says ICS chair Stan Finney, a geologist at California State University, Long Beach. But adding it as a new chapter to the official geologic record “misrepresents what we do,” he says. “We are set up to define rock units, not to declare some big change in the Earth’s systems.” The Anthropocene is better used as a cultural term, like Neolithic, rather than as a geological one, Finney and others argue.

Another concern is that geologists’ formal embrace of the term would be a political football. “It could have very important political implications,” says Philip Gibbard, Professor of Quaternary Paleoenvironments at Cambridge University, who originally proposed creating the AWG. He adds that advocates of action on climate change are already harnessing the idea to argue for reducing carbon emissions. But the Working Group “should deliberately avoid getting involved in politics,” he says, keeping its focus on the science.



Some argue that massive manmade changes to the environment, such as this oil sands field in Northern Alberta, are indicative of a new epoch called the Anthropocene. Image courtesy of Shutterstock/Chris Kolaczan.



Hallmarks of the Anthropocene include sharp increases in concrete, plastics, global black carbon, and plutonium (Pu) fallout (A). Other signals (B) include nitrates (NO_3^-), CO_2 , CH_4 , and global temperature rise. Reproduced from ref. 2, with permission from AAAS.

Those supporting the idea of a new geological epoch say the science is clear. Geologists hundreds or thousands of years in the future, they argue, will be able to look back to our time and clearly see the dawn of the Anthropocene written in rocks, sediments, and ice. Just as the official boundary between the Pliocene and Pleistocene Epochs 2.6 million years ago is defined by changes in the fossil record, the start of the Anthropocene would be marked by “enormous numbers of bones from humans and domesticated animals, which now make up more than 90% of the mass of all vertebrates,” says Steffen.

Obvious too, would be the huge increase in CO_2 from burning fossil fuels—at a rate 120-times greater than the increase in CO_2 that marked the start of the Holocene—and the resulting layer of ash particles. Then there’s the doubling of soil nitrogen and phosphorus from fertilizer use, the fallout from nuclear weapons testing, as well as the elevated levels of polychlorinated biphenyls, pesticides, plastics, and other man-made substances. “So many different signatures have changed so widely and in a short period of time that we suddenly have a different

planet,” says Waters, now secretary of the AWG. “That’s what makes the Anthropocene a strong concept.”

To mark the boundaries between epochs, geologists typically put a ceremonial “golden spike” into an actual geological stratigraphic section. This is usually a distinctive rock-layer feature, such as a fossil; or something like the ice core from Greenland that documents the start of the Holocene. The AWG is now discussing where to look for a stratigraphic record that could be an official reference to define the new epoch, perhaps in an ice core or in lake sediment.

Also to be hashed out is when the Anthropocene officially began. In the original 2000 IGBP newsletter article (1), and a landmark 2002 paper in *Nature* (4), Crutzen suggested a starting date in the late 18th century, when “the global effects of human activities have become clearly noticeable.” Others see a beginning several thousand years ago with the shift to agriculture, which had measurable planetary impacts. But a majority of the working group members now lean toward a mid-20th century start when—in what the IGBP dubs the “Great Acceleration” (5)—the Earth saw major increases in everything from population and gross domestic product to CO_2 levels and fertilizer use. “Take those indicators all together and it looks like the mid-20th century is the point of inflection,” says McNeill.

Will geologists officially declare the Anthropocene to be a new geological epoch? Critics are dubious. Finney even doubts that the AWG will pull together a proposal in time for the August ICS meeting. “The leaders of the working group are having too much fun publishing and getting publicity,” he says.

One objection is that the changes humans are making to the planet are so evident in current and historical records and measurements that a geological signature is unnecessary. “A lot of my geological colleagues are either baffled or see no need for this,” says Gibbard. But the skepticism may be waning, he adds: “As the evidence builds up for an impact [of humans] that is far greater than some of us had realized, it’s more likely a vote will be successful.”

In the bigger picture, the vote may be largely irrelevant. For one thing, say proponents, the term has considerable scientific value because it offers a focus for many different disciplines. “The Anthropocene is one word that brings together an enormous amount of evidence and modeling,” Steffen explains. “It is a better word than ‘global change.’” In addition, it offers a powerful way to focus political attention on the sweeping changes humans are making to the Earth, and on the need to fight problems like climate change. “Whatever the geologists decide, the train has left the station, the cat is out of the bag,” says McNeill. “The Anthropocene is an idea whose time has come.”

1 Crutzen P, Stoermer EF (2010) Have we entered the Anthropocene? *IGBP Newsletter*. Available at www.igbp.net/news/opinion/opinion/haveweenenteredtheanthropocene.5.d8b4c3c12bf3be638a8000578.html. Accessed March 4, 2016.

2 Waters CN, et al. (2016) The Anthropocene is functionally and stratigraphically distinct from the Holocene. *Science* 351(6269): aad2622-1–aad2622-10.

3 (2011) Welcome to the Anthropocene. *Economist*. Available at www.economist.com/node/18744401. Accessed March 4, 2016.

4 Crutzen PJ (2002) Geology of mankind. *Nature* 415(6867):23.

5 (2015) Planetary dashboard shows great acceleration in human activity since 1950. Available at www.igbp.net/news/pressreleases/pressreleases/planetarydashboardshowsgreataccelerationinhumanactivitysince1950.5.950c2fa1495db7081eb42.html. Accessed March 4, 2016.