

Is the Anthropocene an issue of stratigraphy or pop culture?

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THE ANTHROPOCENE DEBATE

The term *Anthropocene* recently entered into the rhetoric of both the scientific community and the popular environmental movement. Scientific proponents argue that global industrialization drives accelerated Earth-system changes unrivaled in Earth's history. The discussion now filters into geological stratigraphy with proposals to amend formal time stratigraphic nomenclature (Zalasiewicz et al., 2008, 2010). Environmentalists suggest that terms like Anthropocene foster broad social and cultural awareness of human-induced environmental changes. Advocates argue that greater awareness of humanity's role in environmental change encourages sustainable resource utilization.

Formal recognition of a new geologic epoch helps the broader scientific community solidify the idea of humanity as an Earth-system driver. Before the scientific community ventures too far, we wish to offer comment that considers the practicality of the Anthropocene to geological stratigraphy, the science to which it ultimately applies.

SUMMARY OF THE TERM ANTHROPOCENE

Crutzen and Stoermer (2000) suggest that modern technology initiated the transformation of Earth-system behavior and altered environmental processes. They offer the term Anthropocene for the time interval dominated by human activities and indicate that the onset of the human ability to significantly shape Earth's environment became notable with the Industrial Revolution. Steffen et al. (2011) argue that The Great Acceleration after World War II records a dramatic departure in monitored Earth processes from Holocene proxy trends. In contrast, Ruddiman (2005) infers that Holocene-scale anthropogenic greenhouse effects began when humans abandoned hunter-gatherer lifestyles for subsistence settlement, animal domestication, and cultivation agriculture.

The idea that humans interact with nature is not new, and philosophical ideologies about human responsibility permeate historical thinking (Hamilton, 2010; Steffen et al., 2011). *Anthropocene* offers a concept fundamentally different from

many precursors. Present human society does not have a symbiotic relationship with nature. Humanity now modifies natural processes, such as biogeochemical cycles, ocean-atmosphere transfers, and flux of surficial sediments (Steffen et al., 2011). Accelerated mass transfer of sediments (Hooke, 2000; Wilkinson, 2005) has particular interest because erosion and sedimentation produce stratigraphic records.

RELEVANCE TO STRATIGRAPHIC PRACTICE

The Anthropocene has taken root in popular culture as a new time term, and scientists embroiled in research and debate on anthropogenic climate change should benefit from formal stratigraphic adoption. However, identification of a basal boundary for the Anthropocene and the suggestion that the concept can be validated with a global stratigraphic marker is at best a bit premature. A distinct stratigraphic marker should have been forming since anthropogenic change began. As practicing stratigraphers, we are taken aback by the claim that scientists currently have sufficient evidence to define a distinctive and lasting imprint of our existence in the geologic record.

Formal stratigraphic practice (ISSC, 1994; NACSN, 2005) uses a codified approach to the development, recognition, and amendment of a timescale relevant to Earth's history. Concepts for stratigraphic units require criteria that allow for the definition, delineation, and correlation of stratiform sequences of Earth materials. Time stratigraphic units represent layers of rock containing lithologic, fossil, mineral, chemical, or geophysical signatures that allow for the recognition and measurement of geologic time.

Because the strata anticipated by the Anthropocene has not yet fully developed and it is only currently possible that a recognizable basal boundary separates it from the Holocene epoch, researchers should find difficulty in using this concept in stratigraphic practice. Stratigraphic boundaries commonly appear as abrupt in the rock record but are often imprecise in time. A boundary as broad as a few thousand years resolves most problems in deep-time stratigraphy but would be of little use to identify a boundary intended to separate events of recent centuries. Definition and delineation of a basal Anthropocene boundary would be sufficient to introduce the term, but the boundary could be potentially arbitrary if it lacks temporal precision. For example, a global marker could be diachronous across millennia if human-accelerated sedimentation were the specific attribute used to mark the basal Anthropocene.

Formal stratigraphic hierarchy (ISSC, 1994; NACSN, 2005) implies that Anthropocene would either hold the rank of epoch if equivalent to the Holocene or age if defined as a subset of the Holocene. Either way, a stratotype that records a continuous, preferably marine, sedimentation record and separates the Anthropocene from underlying units needs to be identified and correlated into the global time stratigraphy. This is a daunting task that may or may not generate significant gains in the

scientific understanding of anthropogenic Earth processes. Nonetheless, Anthropocene is in fact being used seriously among selected research circles. Workers commonly use Anthropocene informally, and stratigraphic practice does allow for informal nomenclature where suitable to resolve geological problems.

Perhaps the most relevant issue before the International Stratigraphic Commission is the establishment of a scientifically relevant concept that forwards an understanding of the problems we face as humanity interacts with the Earth system. Stratigraphic code clearly states the physical, temporal, spatial, and conceptual requirements for the development of stratigraphic units. On the other hand, the discipline of stratigraphy may also have a reputation to protect. Scientific disciplines maintain their reputation by providing the credible voice a scientific community needs in public debate.

WHAT IS IMPORTANT TO THE GEOSCIENCES?

Anthropocene provides eye-catching jargon, but terminology alone does not produce a useful stratigraphic concept. Social commentators and environmental activists benefit from the term, and it is gaining momentum among the media and writers of popular scientific literature. Scientific use of the term appears to be increasing with public acceptance, although Steffen et al. (2011) argue that the public adopted Anthropocene because of increasing scientific popularity. Perhaps this acceptance is simply because scientists from disciplines other than stratigraphy embrace the concept of Anthropocene while not appreciating the nuances of its application to formal stratigraphic practice. The most important assertion unfolding among these groups is that Anthropocene creates public awareness and formalizes the concept of human-induced environmental change.

Although we acknowledge a distinct allure for the term Anthropocene and recognize merit in the concept, pop culture does not have an interest in the stratigraphic implications of this debate. If there is an underlying desire to make social comment about the implications of human-induced environmental change, Anthropocene clearly is effective. However, being provocative may have greater importance in pop culture than to serious scientific research.

Perhaps one of the more relevant issues we in the scientific community have with terms like Anthropocene is a tendency to market catch phrases that produce questionable labels. Anthropocene has already appeared in the titles of journal papers, presentations at conferences, and proposals for research funding. Modern scientists face pressure to develop and sustain a credibility that fosters research production (Hessels et al., 2009). Could there be a clever end game in mind?

WHAT IS BEST FOR MOTHER EARTH?

We have no issue with people who recognize the ability of modern technology to transform the Earth system as humans manage a global society and economy, nor do we wish to take a stand as to whether the Earth system will eventually be enhanced, catastrophically damaged, or something in between. However, we see value in recognizing the cause and effect of one's actions. The idea that humanity should adopt the role of Earth steward is not new. Global awareness about environmental change is a separate issue from the definition of practical stratigraphic units that solve geological problems.

Modern society struggles with the implications of climate change and now ponders if humans actually alter climate. *Anthropocene* forces us to consider the implications of sending the Earth system into a completely new domain driven by our actions. Does humanity operate on such a grand scale that we drive Earth processes in ways that overshadow tectonic, climatic, and eustatic processes?

Before we amend our stratigraphy and end the Holocene, it would be best to settle the question of where in the stratigraphic record to drive the golden spike that defines when humanity became one of the preeminent forces of nature. Even so, will finding this layer lead to a globally relevant correlation? As stratigraphers, we require criteria to map the Anthropocene with relevant and consistent meaning. Presently, we are left to map a unit conceptually rather than conceptualizing a mappable stratigraphic unit.

If the prescribed conditions are met, then Anthropocene might be a useful time stratigraphic term. In essence, it describes the disruptions driven by human activities. However, elevating terms that may become iconic in pop culture is not in itself sufficient evidence to amend formal stratigraphic practice. Science and society have much to gain from a clear understanding of how humans drive Earth-system processes instead of conducting an esoteric debate about stratigraphic nomenclature. Let the Anthropocene retain its rightful place as a focal point in the culture wars over the recognition and interpretation of environmental process.

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