

Coverage and Status of the Anthropocene - *inclusivity of data and transdisciplinary issues in iso-chronically defining human-witnessed youngest earth time periods*

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Paper version of a talk in Lecture series: What is the Anthropocene? Exploring transdisciplinary collaboration for sustainable change (S.J. Kluiving, N.C van den Bongardt, Amsterdam Sustainability Institute), held Tuesday 5 September 2023, at Vrije Universiteit Amsterdam, The Netherlands.

The talk has also been recorded: see the youtube channel of the series

Abstract:

The talk centered on what the Anthropocene is in data from what disciplines, and to whom this matters. A brief time line of the use of the term starting in the year 2000 shows gradual broadening adoption and at the same time diversification of the meaning. In parallel, a definition effort progressed, with geological definition arguably receiving most attention. The talk then mapped out how the Anthropocene is currently seen by different groups from different disciplines in natural sciences (atmospheric science, ecology, earth system science, geology), spatial social sciences and humanities, and we do this by looking at time dimensions (short/long duration of the period, gradual or sharp beginnings), the spatial dimension (intrinsically of global scale and of major magnitude, or not), the naming dimension (is the name correct? causal?). Subsequently the types of data that document Earth and man's joint developments over the last centuries are covered, starting from the so-called planetary dashboard. What data from which disciplines begets what other data in terms of precision and coverage in this period. Geological data is also part of that overview and valuable. But Anthropocene geological data also is thin and far less in coverage. For a rationale of calling out the Anthropocene or for deciding on a pragmatic-optimal sharp onset, other Earth system and socio-economic metrics – the ones originally used to call for it – are the more complete ones, data worked up with geological method supplements these. This data reality for youngest time perhaps should be weighed in, in procedural steps (proposal formulation, voting) to include the term officially in the international geological time scale, especially when advocating a mid-20th start (Zalasiewicz et al., 2017; Anthropocene Working Group). Such transdisciplinary inclusivity of data is not covered, however, in the standing definition procedures for chronostratigraphical units.

Introduction

In his talk, Kim Cohen covers what the Anthropocene is, how this is underpinned by data from what disciplines, considering the last few centuries. He starts with to whom from what background the Anthropocene mattered, first in the early 2000s, then in 2008-2016, then in 2016-2023. He then weighs the relative importance of data per discipline when seeking a sharp-onset multidisciplinary aligned definition for the Anthropocene as periodisation of the youngest bit of earth time [the duration of the present, if you wish].

Adoption of the Anthropocene as a term and concept has occurred steadily since its introduction in the early 2000s (e.g. Crutzen & Stoermer, 2000, Crutzen, 2002), most rapidly in the Earth System Sciences (Steffen et al., 2005). From the start, it was clear that the Anthropocene encompasses global change, i.e. not anthropogenic climate change or environmental impact solely, but all human presence and impacts on earth and environment and systemic changes associated with it. By 2013 it

had incarnated in academic journals titles Anthropocene (Elsevier) and The Anthropocene Review (Sage). Actual geological adoption began to be considered around 2007-2008 and led to the start of the Anthropocene Working Group (AWG, within the International Commission of Stratigraphy: ICS). The AWG formed in 2009, relatively early, and tasked with exploring/proposing a geological definition for the Anthropocene.

In 2008-2016 general adoption and discussion of the term further broadened to Humanities, Social Sciences, Environmental Sciences, Geosciences etc. Also criticism on the term started to appear, and diversification of the meaning attached to it (not just 'post-industrial', not just 'human impact to earth'). The AWG completed its exploration phases and positioned for a mid-20cy onset (Waters et al, 2016; Zalasiewicz et al., 2017; Ellis, 2018). The term now had become an established one in Earth System Science & Environmental Sciences, and a debated one in Geology.

Through 2016-2023 the Anthropocene has caused a discourse in the Humanities and Social Sciences, in parallel to the use and discussion and debate in the Natural Sciences. The term no longer was new to main stream media, that continue to use it and give 'scientific debate on it' attention to general public started to occur in this time period. The AWG now started work on a formal stratigraphic introduction proposal, for which they embarked on detailed scientific investigation of 12 highest quality sites from across the world from a range of settings, work on it completed in 2022, and selection of a principle site settled in 2023. Various criticism on the AWG also started to occur.

What is the Anthropocene to whom

Cohen maps out how – as illustration of the diversifications and as outcome of the timeline – how the Anthropocene is currently seen by different groups from different disciplines, positioning them on a time dimension, spatial dimension and a naming dimension (figure 1).

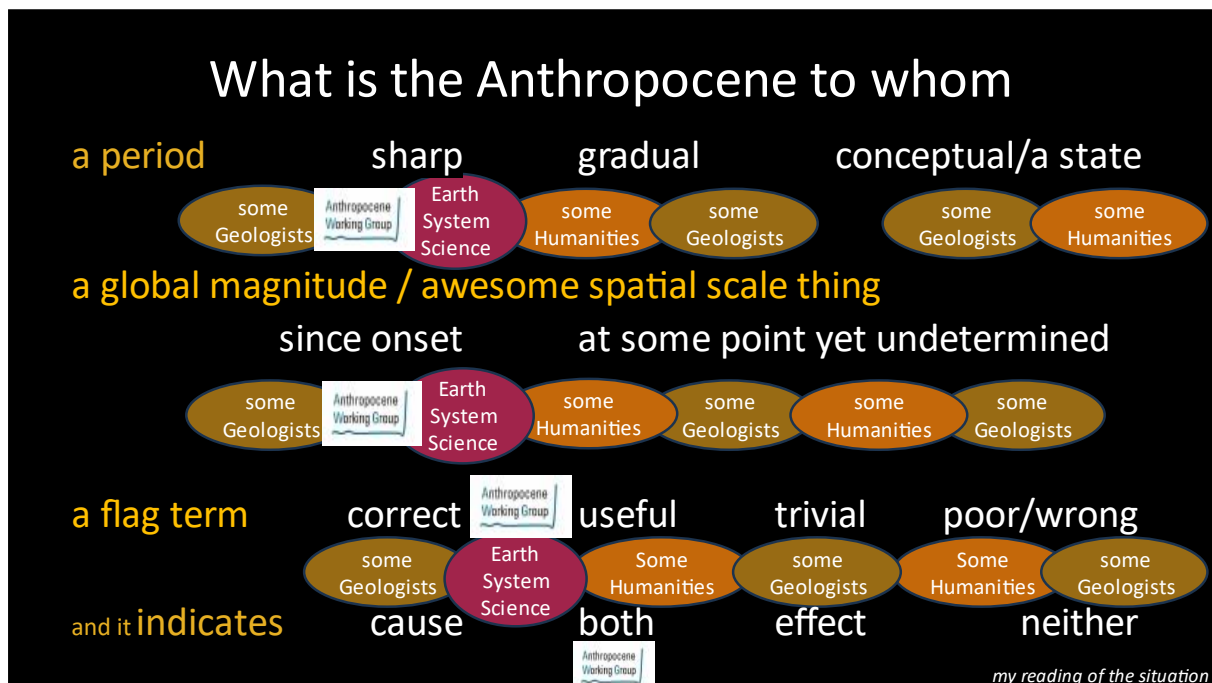


Fig. 1 – Diverse positions regarding concept and meaning of the Anthropocene (K.M. Cohen, this lecture)

The AWG opts for a sharp onset at a time of rapid, great, global-scale change, aligned in a diverse set of metrics, non-geological and geological. Other groups stress the graduality of nature of growing

human impact and therefore the non-sharp meaning of their Anthropocene. Related to this is what spatial meaning the term has: to the AWG the Anthropocene starts when human impact surpassed magnitudes of common natural ones *globally and in multiple components* of the earth system (and step changes into that were largest and strongest aligned in the mid-20th cy, said data – see below). To many who prefer a gradual onset, the supporting indications for that are earlier, regional step changes, or a single earth system component bearing a human impact global signal is spotlighted – the timings of which are not just all earlier, the idea of reaching global in multiple components, and the multi-criteria alignment in time is then removed from the onset definition concept: gradual-onset Anthropocenes become global at a later moment than its beginning ('at some point' in Fig. 1). Other groups advocate it too early to call the Anthropocene magnitude, especially on the long run ('yet undetermined').

On a different level, the semantics of the Anthropocene have made groups take diverse positions to use and definition (including objection). The AWG regards the term as perhaps not perfect, but still mostly correct and most of all a useful flag term, as it stuck from the get going and is in wide use nowadays (perhaps making it trivial to start discussing it again). The break in naming logic that the nominal 'Anthropocene' ('human current'; Cohen's loose translation) would cause in the otherwise ordinal list of Cenozoic Series with e.g. Eocene ('dawn of current') succeeded by Miocene ('half current'), Pleistocene ('nearly current') and finally Holocene ('wholly current'), is to be suffered. Other groups have coined alternative names, highlighting a different cultural or materials aspects than 'man'. Some of these also stuck somewhat, but not as widely. In this light it is also interesting to consider whether 'Anthropos' is included in the name because of being the culprit of the break with the Holocene (cause), or its impacts are wide spread present (effect), or both. To some, averseness to the Anthropocene is because of its name and linkage to causality.

What is the Anthropocene in data

Cohen presents a figure of Steffen et al. (2005), output of interdisciplinary research efforts from the time that data compilation for 'Planetary Boundaries' concept explorations was happening, dubbed the planetary dashboard at the time, and later also the 'dashboard of the Anthropocene'. It shows alignment of rapid increase in the mid-20 cy in most if not all metrics (natural system components measured data, socio-economic indicator data): a feature named the 'Great Acceleration'. Example of socio-economic metrics are e.g. (urban) population, total real GDP, paper consumption and international tourism. Natural trends include e.g. atmospheric CO₂ concentration (Keeling curve, supplemented with ice-core derived data back in time), counts of great floods, metrics from ocean ecosystems (loss of biodiversity, change of chemistry). Strong evidence for the mid-20 cy Great Acceleration comes from the rising values and/or accelerations in virtually all diagrams – and with these increases tipping-points were passed and impossibilities to naturally return back to earlier, less impacted states closer to natural variation bounds introduced.

Cohen then asks what disciplines provided the biggest bodies of data to make such dashboard plots, and illustrates it with a timeline diagram showing the coverage of data (Fig. 2). The point is that spatial social sciences (say: accountancy of human activity; inventorying, census) and environmental and biological survey data from Natural Sciences (accountancy of state of earth; measuring, monitoring), and not to say writings (institutionalized, mass-media and personal archives) is far more abundant and evenly globally covered and redundant, than data gathered with geological methods (e.g. observe aftermath record, deduce cause from that). For a mid-20th cy start Anthropocene, coverage by *geological* data as worked up by the discipline is very thin (also with the 12 sites worked on 2018-2022 by AWG, e.g. <https://www.anthropocene-curriculum.org/the-geological-anthropocene>). This is of course very different for all earlier geological time ('way back'), towards

which historical account and direct observation-based disciplinary coverage rapidly thins - and where geological methodology shines and takes over lead. One may also say that geological archiving (by the earth as a system) is a more widespread and permanent and independent of human culture and for that reason, and for that reason a good choice to work with when characterizing the period, the break with that before, and normative comparisons with earlier times of major global change.

For a rationale of calling out the period and defining its onset (if sought in the youngest centuries), the importance of Anthropocene geological record should not be made too large – suggests the diagram graphically. It would be wise – also for geologists – to be inclusive to data collected using measurements, from monitoring of earth changes (environmental, atmospheric, ocean, life, natural and human-caused, wild, agricultural, industrial and urban). It also stresses the need for inter- and transdisciplinary collaboration to understand very youngest earth time: the proposed ‘Anthropocene’ and its stepped(?) differences with centuries just before.

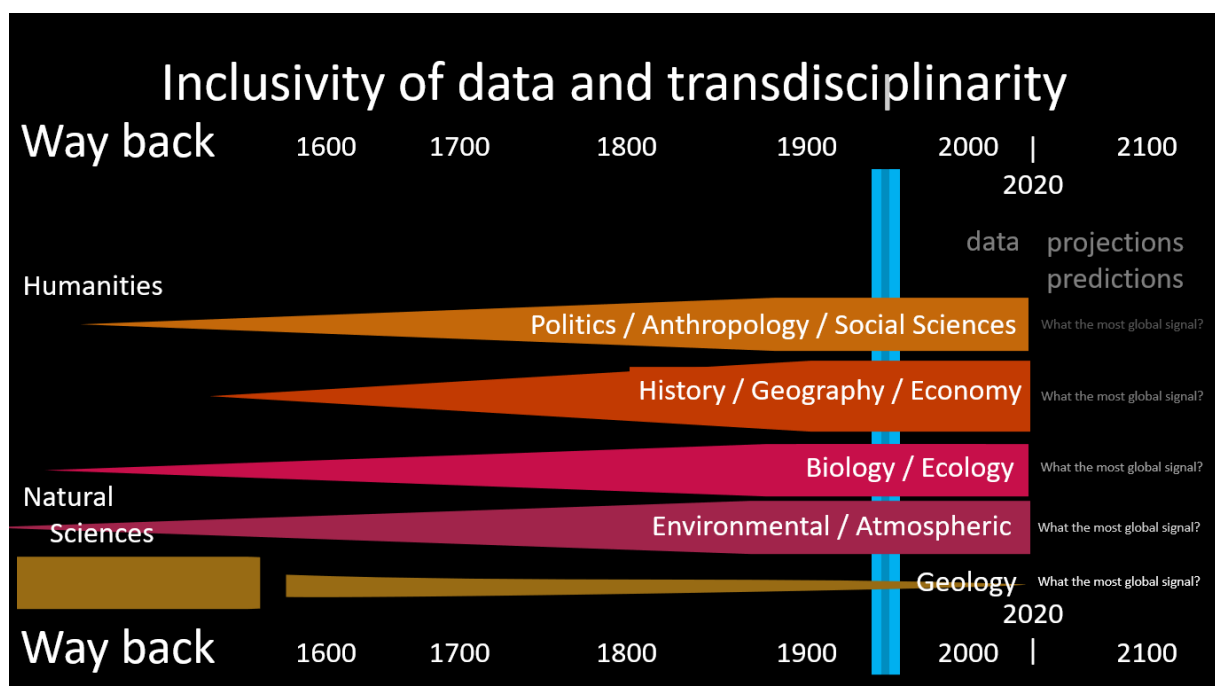


Fig. 2 – Qualitative comparison of reach of data from different disciplines (K.M. Cohen, this lecture)

Interdisciplinary periodization of young earth time

A part of the criticism to the AWG (a group of broader composition than geologists alone) is that they were inclusive in considering data transdisciplinary when exploring the rationale (2008-2016; Ellis 2018), but now have become less so in their technical work aiming at geological definition. This criticism is amplified when the AWG activities towards a strong geological proposal that can be accepted broadly by geologists ('at long last'), convince a majority of geologists in the voting commissions, is equated to overall scientific acceptance, as phrased in less careful media outlets and as sensed in turn by many engaged with the topic.

This brings us to the current positions regarding the geological definition [paraphrased, not quotes]:

1. The AWG considers the Anthropocene to represent: Global scale irreversible, unprecedented-rate and magnitude human impacts on earth commenced c. 1950. This geological reality warrants sharp definition. The 'Great Acceleration' was the Anthropocene onset. Defining the period this way is useful and possible. A GSSP location is prepped and advised: an annual layer in Crawford Lake, a small lake near Hamilton, Canada.
2. Some ex-AWG members oppose the proposal prepared for the vote. To them Global Change is an environmental reality too, but they regard concept nor onset of the 'Anthropocene' are sharp ones. They also regard the transdisciplinary discourse not helped by a primarily geological definition, and hence oppose such definition. How to see it per discipline, is hard to unify between disciplines, geologist should not be the one making this decision.
3. The ICS International Commission on Stratigraphy would say: Official geological terms should be defined. Proposals are discussed, voted, approved. Upcoming terms are unofficial until ratification. GSSPs (a point a very well-studied geological section, target for anyone to correlate to) for Stages/Ages (one rank below the System/Period of the proposed Anthropocene) are preferred way of defining the lower boundaries of time units. GSSAs are an alternative (defined as an numeric age result, rather than as a point in rock).

The AWG proposal is now virtually submission ready. The contents of the proposal would be:

a) Rationale to introduce the term, b) Rationale for rank, c) Definition of a tie-point for the onset boundary, in a purposely most-suitable selected site [as said: Crawford Lake proposed GSSP], d) ordered list of multiple globally replicating signals [Plutonium isotopes, Combusted Carbon spherules, Nitrogen Fertilizer isotopic shifts, cumulative fossil fuel Carbon isotopic shifts....], at the GSSP site and elsewhere, and e) a date stamp associated to the boundary [e.g. Summer 1950].

After submission, the proposal will be discussed over email for one month (possibly a second month), with some opportunity to change formulations by the Subcommittee on Quaternary Stratigraphy (SQS; the Quaternary Period comprises the Pleistocene, Holocene and proposed Anthropocene; Cohen is a voting member). After that, a voting follows and if passed then it is the International Commission on Stratigraphy (ICS; Cohen is a non-voting officer) that is to vote to approve the proposal. If this also passes, it is send to the executive of the International Union of Geological sciences (IUGS) for ratification. If that also passes, the new time period is drawn in an updated version of the ICS' International Chronostratigraphic Chart (Cohen et al., 2013) and tabulated versions of it, released on www.stratigraphy.org. Typically there is also some news/press item with the ratification, and at a later moment a dedication ceremony at the GSSP locality.

At the time of the original talk (Sept. 2023), the hope is to have these procedures all passed by August 2024 (if not aborted at a non-pass), as then the International Geological Congress is running (Busan, South Korea), during which the ICS and IUGS and executives will change.

Concluding remarks

Cohen rounds off by stating that in his opinion, across disciplines and despite diversity regarding the term, there is a lot of value in the term Anthropocene, and in connecting it to the alignment of sharp rises in many different earth system metrics in the mid-20 cy. In that sense he subscribes to the selection of the AWG as the start, and because it is many different signals that align, it is also relatively free from arbitrariness or bias against a specific economic or cultural development. He adds that within the geological discipline, there is also specific pragmatic value for those that would otherwise work in the Holocene: many geological rules of thumb and methods 'break' (cannot meaningfully be applied) in very youngest, human overprinted time and record; in practice, Holocene

geological data sets are often cut-off in their uppermost bits anyways and replaced by better quality measured-data alternatives (to not begin about radiocarbon dating and their use of 1950: as a fixed datum Present).

If rationale and onset definition for the Anthropocene are compared to other geological periodizations (Holocene and all others before), it cannot be overstated how much of an edge case the Anthropocene is. The talk highlighted this mostly through the *data diversity* that is in play, and the much stronger qualities of non-geological data that the natural and social sciences have managed to collect and preserve during the last few centuries. An ideal definition proposal should thus have an inclusive attitude to non-geological scientific data series, and should carefully consider the GSSA technical definition option next to that of GSSP (e.g. Cohen & Gibbard, 2019). The mid-20cy onset definition then can just be on cleaning up 'how present live earth time is attached to past geological time'.

Short last recommendations are (i) To avoid framing that geologists decide on how to call the present (in communications amongst geologists, in broader communications), and (ii) To avoid connecting the 'onset debate' (when did it begin and with what route should that be defined; dogmatics against pragmatics) to 'scientific acceptance status': the term is in very wide use, and very widely accepted, we passed that stage ca. 2016.

Acknowledgements

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Web links placed in the text:

<https://www.anthropocene-curriculum.org/the-geological-anthropocene> website created around the work of the AWG, on initiative of Haus der Kulturen der Welt, Berlin (hkw.de)

www.stratigraphy.org website ICS International Commission on Stratigraphy