



Critical review

Scaling the Anthropocene: How the stories we tell matter



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ABSTRACT

Ongoing debates in the Earth, planetary, and social sciences examine the merits and implications of traces in the stratigraphic record that would indicate that humans are now one of the 'great forces of nature'. Candidates for key marker horizons in such a stratal section include noted changes in carbon and nitrogen concentrations, plastics, radionuclides, and metals. Candidates for determining calendar age, include the tipping point in land cover from wildlands to agriculture and the first nuclear detonation. Here we offer a critical review of recent literature contributing to delineating an Anthropogenic stratum, by exploring their interpretation as initiating, sustaining, or indeed ending an Anthropocene epoch. We also offer a reflection on the layer *not* representing a new period, any more than, for instance, iridium marks a 'meteoritic' epoch between the Cretaceous and Palaeogene. We examine temporal scales for their accord with geological methods of definition and delineation, and for the opportunities and constraints each presents for understanding and responding to transformations in the Earth system. Our thesis is that increasingly fortified stances on the 'right' definition of the Anthropocene epoch follow traditions of linear and authoritarian historical accounts, and prevent discovering epistemes of human-environment interactions that are open for coexistence. The co-existence of many key transitions will sustain ongoing and fruitful deliberations over human-environment interactions that the Anthropocene proposal has initiated, promoting research that can work with the many scales, discourses, and narratives of environmental change.

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1. Introduction

Geological time periods constitute delineations suggested by expert evaluations, agreed though the International Commission on Stratigraphy (ICS), of defined faunal stages with secondary

markers and agreed radiometric dating. Delineations in Earth history suggest transformations that span global Earth systems. Naming eons and epochs represents methodological narratives of time and space that permit correlating and delineating records of significant historic periods. As such, they evolve with methodological developments, with recent examples being the rewriting of the Tertiary and Quaternary as Palaeogene and Holocene. Since [Crutzen \(2006\)](#) suggested delineating the Anthropocene as an epoch in which humans have become 'one of the great forces of

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nature', the search has been on for indicators that will span global spatial scales, and geologic time scales (Crutzen, 2006; Zalasiewicz et al., 2011a, 2011b; Waters et al., 2016). If the epoch is to be recognized by the ICS as a geological time period, it will be determined by either Global Standard Stratigraphic Age, or a Global Boundary Stratotype Section and Point, or a combination of the two (Waters et al., 2016). Potential methods for delineating by a stratotype section include carbon and nitrogen concentrations, or the presence of plastics, radionuclides, or concentrated metals. Possible events for delineation based on a standard stratigraphic age include the spread of agriculture, the invention of the steam engine, the Great Acceleration, and the first nuclear detonation (Lewis and Maslin, 2015). Indicating convergence on a mid-twentieth century delineation of the Anthropocene, Waters et al. (2016) declare this epoch is "functionally and stratigraphically distinct from the Holocene" (2016:137). As new definitions of the 'right' Anthropocene narrative emerge, Johnson and Morehouse (2014) ask whether the geographical landscape the Anthropocene imagines erases difference by universalizing human significance and naturalizing human history. However the Anthropocene is described, Latour (2015) argues that avoiding cataclysmic change requires careful attentiveness to learn what this human epoch is and what it might become.

Indeed, since Crutzen's "geology of mankind" (2002), the Anthropocene debate has remained entangled with concern for global environmental crises. Zalasiewicz et al. (2011b) argue this phenomenon has become the "most important question of our age—scientifically, socially and politically" (2011b:838). Yet, Hajer (1995) cautions that we are limited from finding solutions to environmental crises by the very discourse that has permitted their identification (1995). Relying on existing paradigms of human-environment interactions constricts our capacity to imagine alternatives. Latour (2015) suggests, what is "missing from the description of the Anthropocene is that it modifies the scale, the speed, the rhythm and ... the distribution of active agents in any political conversation ... about the entanglement of humans and non-humans" (2015:222). Such discussion around the Anthropocene is proving fertile ground for epistemic innovation (Head, 2015; Yusoff, 2013; Latour, 2015; Hamilton, 2015).

Here we consider narrative a fundamental human episteme that, through its discourses and scales, provides spatial-temporal coordinates for moving through and manipulating the world (Veland and Lynch, 2016). Drawing on this insight, we offer a critical review of the burgeoning literature on the Anthropocene by considering implications of the proposed anthropogenic strata representing a start-point, mid-point, or end-point of an epoch. Considering each of these as insisting on a linear, authoritarian, and universal narrative of human-environment relations, we argue for an alternative consideration of the human signal in the stratigraphic sections not constituting an epoch, but rather a transformative moment, or tipping-point at which multiple emergent antecedent causalities and possible future trajectories coexist. Each of these Anthropocene time scales contrapuntally directs research and management of environmental change.

2. An Anthropocene start-point

As start-point, the human signal in the stratigraphic section represents the dawn of a new epoch. This would follow convention in geology, where epochs are usually delineated by a beginning, or lower level (Lewis and Maslin, 2015). Anticipating this new condition, Zalasiewicz et al. (2011b) note that while the stratigraphic signal is negligible to date, its significance might emerge over centuries or millennia (2011b). Lewis and Maslin (2015) similarly interpret that because the geological stratigraphic record will likely allow signals of human activity to be observable for millions

of years into the future, a new epoch can now be declared. Such anticipatory semantics rest on an expectation that cultural narratives, and humanity, will continue well into the future (Castree, 2015). As such, it is a hopeful narrative, both in terms of the perpetuity of human values, and in terms of the longevity of humans storing Earth systems. "We have seen the future, and it is good", Hamilton (2015:235) writes of Ecomodernists and their vision of the 'good anthropocene'. Its anticipation is akin to that of nuclear waste managers, who in their narratives of secure storage invoke expectations that the meaning of geological formations will transmit over generations and remain meaningful millennia from now. Such longevity of story-lines has so far only been achieved by Indigenous peoples, and most notably so by Indigenous Australians.

The significance of a start point more generally is that it defines components of a 'new normal' that provides distance to a time that was different and therefore not directly relevant from here on. As start-point, Anthropogenic strata take on the role of marking a trajectory along which Enlightenment storylines, and indeed their Abrahamic metanarratives, provide incremental and cumulative understanding of Earth systems now nearing 'completion' (Hamilton, 2015). The ability to recognize human signals in the planetary system is taken as simultaneously promising solutions to planetary problems. Anthropocene prehistory, correspondingly, marks Earth systems in a 'natural' state of minimal and benign human influence. Certainly, colonial history shows a methodological bias toward this imagined state; European settlers deemed 'natural' the carefully tended open woodlands that have now become overgrown forests of the east coast of Australia and the United States (Denevan, 1992). In creating a new chapter in narratives of Earth and human history, how might we avoid similar epistemic errors in reading human traces in Earth systems? Head (2014) considers lessons from similar debates over delineating the Neolithic period in the archaeological record. That debate, she reports, resulted in a much broader understanding of how societies manipulate ecosystem assemblages for human well-being, and in the inclusion of peoples outside Eurasia and in deeper time. The ongoing Anthropocene debate might similarly place its start-point further back in Earth history.

3. An Anthropocene mid-point

As the Anthropocene discourse remains closely associated with attention to environmental crises and planetary boundaries (Steffen, 2006; Rockström et al., 2009), it is invoked by an impending Earth system transformation that we hope to avoid. In a narrative of a sustained Anthropocene, where impending environmental catastrophe is reversible or avoidable, the Anthropogenic strata may in hindsight define not a new epoch, but the nadir of a time axis of human-environment interactions. Our current time period might then prove a mid-point of an axis extending from ancient human cultures, through the current era, and into the distant future. This hopeful view of temporary and transitory change would prove akin to Dansgaard-Oeschger events detected during glacial periods, and would helpfully situate all human societies in the grand narrative of the Anthropocene, avoiding the relegation of certain traditions into pre-Anthropocenic periods. Indeed, this Anthropocene narrative would provide an epoch that spans human societies—neither the Pleistocene (2.8 mil. to 11,700 BCE) nor the Holocene (11,700 BCE to the present) can represent this span.

The anticipatory semantics of Lewis and Maslin (2015) and Zalasiewicz et al. (2011) might also support a mid-point delineation. The invention of the steam engine, the nuclear detonation, and the invention of agriculture may look near simultaneous a million years from now. Hence, geologically and spatially, the Anthropogenic boundary will probably be more diffuse than

the candidates of possible start points currently suggests. Such anticipation may not be necessary for aligning the Global Boundary Stratotype Section and Point and the Global Standard Stratigraphic Age, however. [Lowe and Bostock \(2015\)](#) suggest it might be appropriate to employ the Tabora eruption to provide “a geochronological marker for the start of the Industrial Revolution” and the ensuing carbon dioxide emissions (2015:117). Employing such a marker is arbitrary, however. Epistemologically, it may be more appropriate to look for markers corresponding with the emergence of Enlightenment thought, with Neolithic agriculture, or with the spread of humans. Other delineations might enable thinking, saying, and doing things differently in a more inclusive and innovative narrative of Earth systems; stories that involve not just the visible traces of human actions, but also the knowledge politics that produced them.

Discussing the possibility of a much earlier start to the Anthropocene, [Waters et al. \(2016\)](#) observe that humans had settled on all of the continents except Antarctica and the South Pacific islands by beginning of the Holocene (12,000 BP), reaching a total population of around 2 million. They argue that although humans did contribute to the even earlier Pleistocene extinction of megafauna, human influence on the Earth systems throughout that epoch was relatively small by comparison. Giving attention to Pleistocene anthropogenic extinction, [Ruddiman et al. \(2015\)](#) suggests the Anthropocene can be considered as starting with the mass extinction of the Australian megafaunal marsupials 50,000 years before present. Urging that research not focus on the past for its own sake, [Van der Leeuw et al. \(2011, p. 1\)](#) suggest refocusing questions about history to allow learning about future possibilities. Reconnecting with the past in novel ways, it is hoped, will enable finding sustainable ways forward.

The mid-point conception sustains a belief we may remain within planetary boundaries, and render the current crisis temporary. Supporting this view, the Ecomodernist Manifesto reads, “[t]he total human impact on the environment, including land-use change, overexploitation, and pollution, can peak and decline this century. . . humans have the opportunity to re-wild and re-green the Earth” ([Asafu-Adjaye et al., 2015](#)). They expect interventions to reverse environmental crises will cause the anthropogenic signal to wane over millennial and million-year time scales. Indeed, [Kareiva et al. \(2011\)](#) trust in a truly resilient nature capable of rapid recovery from human impacts. More powerfully, [Ellis \(2011\)](#) asserts Earth systems have increased in productivity and capacity to support humans, despite dramatically altered natural systems. Their sustaining view, then, constitutes another hopeful narrative, in which the ongoing discourse around Anthropocene processes of change enables governance alternatives that achieve advances in Earth system sustainability and human dignity.

4. Ending the Anthropocene

The Anthropogenic layer may equally signal the end of the epoch in which human societies emerged. [Waters et al. \(2016\)](#) predict, “current trends of habitat loss and overexploitation, if maintained, would push Earth into the sixth mass extinction event (with ~75% of species extinct) in the next few centuries” (2015:2622). In this narrative, the anticipation of a ‘good’ Anthropocene future gives way to apocalyptic visions of end-times in Earth systems. Advocating such a view, [Latour \(2015\)](#) argues “those who fight against apocalyptic talk and catastrophism are the ones who are so far *beyond* doomsday that they seriously believe that nothing will happen to them and that they may continue forever, just as before” (2015:224). [Hamilton \(2015\)](#) sees a ‘god trick’ in efforts to reframe the Anthropocene crises as ultimately benevolent, and warns that such theodicean views condone evil acts for the greater good they anticipate.

Having a stratum mark the end of an epoch would be the first instance in geological convention, and perhaps be more akin to an informal delineation such as termination. Considering the idea of glacial termination, [Denton et al. \(2010\)](#) explore why long intervals of cooling climate during ice ages end with a short warming leg. Similarly, one might ask whether ‘modernity’, or the ‘great acceleration’ might mark the beginning of the end of an Anthropocene. [Waters et al. \(2016\)](#) suggest the Anthropocene represents not only “the first instance of a new epoch having been witnessed firsthand by advanced human societies, it would be one stemming from the consequences of their own doing” (2015:2622). Human ability to understand our role in Earth systems here accompanies our self destruction. “If geoscientists across the disciplines are right”, [Castree \(2015\)](#) writes, “we are entering terra incognita by inadvertently ending the relatively benign conditions of the Holocene epoch” (2015:244). Akin to Adam and Eve’s expulsion from the Garden of Eden, knowledge of human entanglement in nature here accompanies termination of the relatively benign conditions of our preceding epoch. This time, our expulsion signals the ‘end of man’ ([Johnson and Morehouse, 2014](#)).

The ontological insecurities of living in ‘end times’ have been expressed in most cultures ([Walton and Shaw, 2015](#)). It signifies the end of security and a time of reckoning. In this Anthropocene narrative, science has generated its own vision of impending apocalypse. An Anthropocene future cannot securely be anticipated to follow the emergence of human societies, suggesting threats to the very foundations of human security. [Beck \(2009\)](#) warns the crumbling of ontological security contributes to the rise of fundamentalist and authoritarian governance such as fascism. Considering implications of the impending ‘death of nature’, [Walton and Shaw \(2015\)](#) caution that apathy may result from experiencing this loss of security, and urge research on interpersonal obstacles to pro-environmental behavior. An Anthropocene narrative defined by the loss of nature and future constitutes an ecological ‘horror-story’ ([Doremus, 2000](#)) in which present cascading and rapid change has decidedly cataclysmic effects on human futures.

5. The tipping point

The Anthropocene story-lines so far presented rest on the assumption that there can be a unified grand narrative of human-environment relations recorded in an appropriately defined anthropogenic stratal layer. This narrative, however, unwittingly constrains the solutions we are prepared to admit ([Hajer, 1995; Brunner and Lynch, 2010](#)). The work of several scholars reveals alternatives to linear and authoritarian histories that open opportunities for coexistence of many perspectives ([Rose, 2004; Howitt and Suchet-Pearson, 2006; Ginn, 2015; Bawaka et al., 2015](#)). That is, narratives matter; they give a sense of longevity and continuation to the present, and only ontologically secure, moment. Each Anthropocene story-line is produced by apocalyptic fantasies, and demands new visions of human agency ([Ginn, 2015](#)). More fundamentally still, distant futures cannot avoid appearing apocalyptic, since their arrival always constitutes a destruction the past ([Colebrook, 2012](#)). The present is ever a moment of transformation, an emergent tipping-point of transition. Such perspective opens for understanding ongoing environmental crises as a tipping-point that allows examining alternative epistemologies for human-environment interactions that lead into, and out of transformative moments. [Foucault \(1972\)](#) reminds us it is not only the future that is uncertain, but that the nature of our past is also obscured, distorted, and malleable. Considering the anthropogenic signal a tipping point recognizes that the extent and capacity of human agency through this transformation has been, and will remain, uncertain.

Indeed, as there is no Meteoritic epoch at the Cretaceous–Palaeogene boundary, we may envisage there being no Anthropocene epoch. Instead, the signal of human impact may mark a tipping point between states, which may themselves be stable or unstable. In this understanding, [Hamilton \(2015\)](#) argues the Anthropocene is not a description of human impacts further spreading into landscapes and ecosystems, but constitutes a phase shift in Earth system function. The Anthropocene, [Johnson and Morehouse \(2014\)](#) argue, is a world where capacity to process and analyze social, political, and physical parameters cannot keep up with their pace of change. [Hamilton \(2015\)](#) argues that if the Anthropocene event is conceptualized as an extremely short period of two centuries, it would not follow the conditions of uniformitarianism, but rather present an example of catastrophism.

Naming the Anthropocene epoch not by a set of stable features, but by the mechanism that instigated the epochal shift has liberating potential. Indeed, a more appropriate name for the human signal detected in the stratigraphic record would be the *Anthropogenic transition*. The idea of a tipping point introduces a perspective that the ‘past’ that led up to the current crisis is only partially understood, and that the current transformation is a state of flux where we have departed from past conditions, but have not yet arrived at a ‘new normal’. Indeed, nor can we.

6. Coexistence in the Anthropogenic transition

The way the Anthropocene is narrated provides an important counterpoint to the research and policy that can be imagined for solving global environmental crises. Storying the Anthropocene is not discovering an epoch ‘out there’, but seeking narratives that will prove equal to the challenge of solving global environmental crises. This requires recognizing and accommodating procedural vulnerabilities and ontological insecurities that would otherwise trap our knowledge into pre-defined paradigms and unwittingly reinvent crisis ([Hajer, 1995](#); [Giddens, 2013](#); [Veland et al., 2013](#); [Walton and Shaw, 2015](#); [Veland and Lynch, 2016](#)). If science is to be the dominant narrative of change, it will necessarily use its own metrics and measures. Defining a single authoritative and linear scientific timeline that ignores the social construction of knowledge constitutes research within a ‘hall of mirrors’ ([Rose, 2004](#)), which arguably underlies ongoing global environmental crises. If we are to take seriously our role in Earth systems, then the Anthropocene must be based on broader epistemic foundations than Enlightenment narratives of European humans and their environment. If the Anthropocene is to have significance beyond the geological discipline, it needs to capture the breadth of human cultures and epistemic traditions.

How do we narrate the complex, fractal, and syncopated nature of ontological pluralism? Speaking of coexistence across plural ontologies, [Howitt et al. \(2013, p. 136\)](#) argue,

The realities of messy, conflictual, awkward and fragile geographies of coexistence create a unique challenge – and opportunity – for engaged social and environmental scholarship... to see, think and act more coherently, more responsibly, more generously and more equitably toward just, sustainable and inclusive futures.

The Anthropocene debate has so far been closely tied up with concerns for exceeding planetary boundaries. The epoch is human-centered, not just because of anthropogenic signals in stratal sections, but because of the ethical issues these signals engender for human societies. If it is to be a ‘human’ epoch, it must take into account the social construction of nature, recognizing that the Anthropocene presents an unprecedented opportunity to also speak about human coexistence at planetary scales. This would

mark this epoch as distinct, not just in terms of material signals in the lithospheric layers, but also in the research and governance of Earth systems at this transformative moment.

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References

- Asafu-Adjaye, J., Blomqvist, L., Brand, S., Brook, B., Defries, R., Ellis, E., 2015. An ecomodernist manifesto. April 18, 2015. <<http://www.ecomodernism.org/manifesto-english/>> (accessed March 22 2016).
- Bawaka, Country, Wright, S., Suchet-Pearson, S., Lloyd, K., Burarrwanga, L., Ganambarr, R., Ganambarr-Stubbs, M., Ganambarr, B., Maymuru, D., Sweeney, J., 2015. Co-becoming Bawaka: towards a relational understanding of place/space. *Prog. Hum. Geogr.* <http://dx.doi.org/10.1177/0309132515589437>.
- Beck, U., 2009. *World at Risk*. Polity.
- Brunner, R., Lynch, A.H., 2010. *Adaptive Governance and Climate Change*. American Meteorological Society, University of Chicago Press, pp. 404. ISBN: 9781878220974.
- Castree, N., 2015. Geographers and the discourse of an earth transformed: influencing the intellectual weather or changing the intellectual climate? *Geogr. Res.* 53 (3), 244–254. <http://dx.doi.org/10.1111/1745-5871.12125>.
- Colebrook, C., 2012. Not symbiosis, not now: why anthropogenic change is not really human. *Oxford Lit. Rev.* 34 (2), 185–209.
- Crutzen, P.J., 2006. The “Anthropocene”. Springer.
- Denevan, W.M., 1992. The pristine myth: the landscape of the Americas in 1492. *Ann. Assoc. Am. Geogr.* 82 (3), 369–385.
- Denton, G., Anderson, R., Toggweiler, J., Edwards, R., Schaefer, J., Putnam, A., 2010. The last glacial termination. *Science* 328 (5986), 1652–1656.
- Doremus, H., 2000. The rhetoric and reality of nature protection: toward a new discourse. *Wash. Lee Law Rev.* 57, 11–73.
- Ellis, E., 2011. The planet of no return: human resilience on an artificial earth. *Breakth. J.* 2, 37–44.
- Foucault, M., 1972. *The Archaeology of Knowledge & The Discourse on Language*. Pantheon Books, New York.
- Giddens, A., 2013. *The Consequences of Modernity*. Wiley.
- Ginn, F., 2015. When horses won't eat: apocalypse and the Anthropocene. *Ann. Assoc. Am. Geogr.* 105 (2), 351–359.
- Hajer, M.A., 1995. *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process*. Clarendon Press, Oxford [England], New York.
- Hamilton, C., 2015. The theodicy of the ‘Good Anthropocene’. *Environ. Humanities* 7.
- Head, L., 2014. Contingencies of the Anthropocene: lessons from the ‘Neolithic’. *Anthr. Rev.* 1 (2), 113–125.
- Head, L., 2015. The Anthropoceneans. *Geogr. Res.* 53 (3), 313–320. <http://dx.doi.org/10.1111/1745-5871.12124>.
- Howitt, R., Suchet-Pearson, S., 2006. Rethinking the building blocks: ontological pluralism and the idea of ‘management’. *Geogr. Anal.* 88B (3), 323–335.
- Howitt, R., Doohan, K., Suchet-Pearson, S., Cross, S., Lawrence, R., Lunkapis, G.J., Muller, S., Prout, S., Veland, S., 2013. Intercultural capacity deficits: contested geographies of coexistence in natural resource management. *Asia Pac. Viewp.* 54 (2), 126–140.
- Johnson, E., Morehouse, H., 2014. After the Anthropocene: politics and geographic inquiry for a new epoch. *Prog. Hum. Geogr.* 38 (3), 439–456. <http://dx.doi.org/10.1177/0309132513517065>.
- Kareiva, P., Lalasz, R., Marvier, M., 2011. Conservation in the Anthropocene. *Breakth. J.* 2, 26–36.
- Latour, B., 2015. *Fifty Shades of Green*. Breakthrough Dialog, Sausalito, CA, pp. 21–23.
- Lewis, S.L., Maslin, M.A., 2015. Defining the Anthropocene. *Nature* 519 (7542), 171–180.
- Lowe, D.J., Bostock, H.C., 2015. The Anthropocene: an australasian perspective and survey. *NZ Soil News* 67, 115–120.
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, S.I., Lambin, E., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H.J., 2009. Planetary boundaries: exploring the safe operating space for humanity. *Ecol. Soc.* 14 (2).
- Rose, D.B., 2004. *Reports from a Wild Country: Ethics for Decolonisation*. UNSW Press, Sydney.
- Ruddiman, W.F., Ellis, E.C., Kaplan, J.O., Fuller, D.Q., 2015. Defining the epoch we live in. *Science* 348 (6230), 38–39.
- Steffen, W., 2006. The Anthropocene, global change and sleeping giants: where on earth are we going? *Carbon Balance Manage.* 1, 1–3. <http://dx.doi.org/10.1186/1750-0680-1-3>.
- Van der Leeuw, S., Costanza, R., Aulenbach, S., Brewer, S., Burek, M., Cornell, S., Crumley, C., Dearing, J.A., Downy, C., Graumlich, L.J., Heckbert, S., Hegmon, M., Hibbard, K., Jackson, S.T., Kubiszewski, I., Sinclair, P., Sörlin, S., Steffen, W., 2011.

- Toward an integrated history to guide the future. *Ecol. Soc.* 16 (4), 2. <http://dx.doi.org/10.5751/ES-04341-160402>.
- Veland, S., Howitt, R., Dominey-Howes, D., Thomalla, F., Houston, D., 2013. Procedural vulnerability: understanding environmental change in a remote indigenous community. *Global Environ. Change* 23 (1), 314–326. <http://dx.doi.org/10.1016/j.gloenvcha.2012.10.009>.
- Veland, S., Lynch, A., 2016. Arctic ice edge narratives: scale, discourse, and ontological security. *Area*. <http://dx.doi.org/10.1111/area.12270>.
- Walton, T., Shaw, W.S., 2015. Living with the Anthropocene blues. *Geoforum* 60, 1–3. <http://dx.doi.org/10.1016/j.geoforum.2014.12.014>.
- Waters, C.N., Zalasiewicz, J., Summerhayes, C., Barnosky, A.D., Poirier, C., Galuszka, A., Cearreta, A., Edgeworth, M., Ellis, E.C., Ellis, M., Jeandel, C., Leinfelder, R., McNeill, J.R., Richter, D., Steffen, W., Syvitski, J., Vidas, D., Wagreich, M., Williams, M., Zhisheng, A., Grinevald, J., Odada, E., Oreskes, N., Wolfe, A.P., 2016. The Anthropocene is functionally and stratigraphically distinct from the Holocene. *Science* 351 (6269), aad2622. <http://dx.doi.org/10.1126/science.aad2622>.
- Yusoff, K., 2013. Geologic life: prehistory, climate, futures in the Anthropocene. *Environ. Plan. D – Soc. Space* 31 (5), 779–795. <http://dx.doi.org/10.1068/d11512>.
- Zalasiewicz, J., Williams, M., Fortey, R., Smith, A., Barry, T.L., Coe, A.L., Bown, P.R., Rawson, P.F., Gale, A., Gibbard, P., Gregory, F.J., Hounslow, M.W., Kerr, A.C., Pearson, P., Knox, R., Powell, J., Waters, C., Marshall, J., Oates, M., Stone, P., 2011a. Stratigraphy of the Anthropocene. *Philos. Trans. Roy. Soc. Lond. A: Math. Phys. Eng. Sci.* 369 (1938), 1036–1055. <http://dx.doi.org/10.1098/rsta.2010.0315>.
- Zalasiewicz, J., Williams, M., Haywood, A., Ellis, M., 2011b. The Anthropocene: a new epoch of geological time? *Philos. Trans. Roy. Soc. Lond. A: Math. Phys. Eng. Sci.* 369 (1938), 835–841.