by Martin J. Head[1], Jan A. Zalasiewicz[2], Colin N. Waters[2], Simon D. Turner[3], Mark Williams[2], Anthony D. Barnosky[4], Will Steffen[5], Michael Wagreich[6], Peter K. Haff[7], Jaia Syvitski[8], Reinhold Leinfelder[9], Francine M.G. McCarthy[1], Neil L. Rose[3], Scott L. Wing[10], Zhisheng An[11], Alejandro Cearreta[12], Andrew B. Cundy[13], Ian J. Fairchild[14], Yongming Han[11], Juliana A. Ivar do Sul[15], Catherine Jeandel[16], J.R. McNeill[17], and Colin P. Summerhayes[18]*

The Anthropocene is a prospective epoch/series, not a geological event

[1] Department of Earth Sciences, Brock University, 1812 Sir Isaac Brock Way, St. Catharines, Ontario L2S 3A1, Canada;
*Corresponding author, *E-mail: mjhead@brocku.ca*
[2] School of Geography, Geology and the Environment, University of Leicester, University Road, Leicester LE1 7RH, UK
[3] Environmental Change Research Centre, Department of Geography, University College London, Gower Street, London WC1E 6BT, UK
[4] Jasper Ridge Biological Preserve and Department of Biology, Stanford University, Stanford, CA 94305, USA
[5] Fenner School of Environment and Society, Australian National University, Canberra, ACT 0200, Australia
[6] Department of Geology, University of Vienna, A-1090 Vienna, Austria
[7] Nicholas School of the Environment, Duke University, 9 Circuit Drive, Box 90238, Durham, NC 27708, USA
[8] INSTAAR, University of Colorado, Boulder, CO 80309, USA
[9] Department of Geological Sciences, Freie Universität Berlin, Malteserstr. 74-100/D, 12249 Berlin, Germany
[10] Department of Paleobiology, Smithsonian Museum of Natural History, 10th Street and Constitution Avenue, NW, Washington, DC 20560, USA
[11] State Key Laboratory of Loess and Quaternary Geology, Institute of Earth Environment, Chinese Academy of Sciences, Xi'an 710061, China
[12] Departamento de Geología, Facultad de Ciencia y Tecnología, Universidad del País Vasco UPV/EHU, Apartado 644, 48080 Bilbao, Spain
[13] Ocean and Earth Science, University of Southampton, National Oceanography Centre, Southampton, UK
[14] School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham B15 2TT, UK
[15] Leibniz Institute for Baltic Sea Research Warnemüende (IOW), Rostock, Germany
[16] LEGOS, Université de Toulouse, CNES, CNRS, IRD, UPS, 14 avenue Édouard Belin, 31400 Toulouse, France
[17] Georgetown University, Washington DC, USA
[18] Scott Polar Research Institute, University of Cambridge, Lensfield Road, Cambridge CB2 1ER, UK

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The Anthropocene defined as an epoch/series within the Geological Time Scale, and with an isochronous inception in the mid-20th century, would both utilize the rich array of stratigraphic signals associated with the Great Acceleration and align with Earth System science analysis from where the term Anthropocene originated. It would be stratigraphically robust and reflect the reality that our planet has far exceeded the range of natural variability for the Holocene Epoch/Series which it would terminate. An alternative, recently advanced, time-transgressive 'geological event' definition would decouple the Anthropocene from its stratigraphic characterisation and association with a major planetary perturbation. We find this proposed anthropogenic 'event' to be primarily an interdisciplinary concept in which historical, cultural and social processes and their global environmental impacts are all flexibly interpreted within a multi-scalar framework. It is very different from a stratigraphic-methods-based Anthropocene epoch/series designation, but as an anthropogenic phenomenon, if separately defined and differently named, might be usefully complementary to it.

Introduction

The late Paul Crutzen conceptualized the Anthropocene as an interval when humans became the dominant geological/Earth System force on Earth, justifying it as a new geological epoch on the grounds that, for numerous environmental parameters, our planet has already far exceeded the natural variability of the Holocene Epoch. Crutzen suggested a possible inception in the latter part of the 18th century, coinciding with the onset of the Industrial Revolution in Europe (Crutzen and Stoermer 2000; Crutzen 2002), although he agreed that a proposed mid-20th century beginning (Meybeck, 2001) might be equally valid (pers. comm. to M. Meybeck, 2003). To test this concept from a geological/stratigraphic perspective and identify the timing of the global reach required for chronostratigraphy, the Anthropocene Working Group (AWG) was inaugurated in 2009 by the Subcommission on Quaternary Stratigraphy (SQS), itself a constituent body of the International

Commission on Stratigraphy (ICS). Meanwhile, in 2004, the Earth System science community described a major upturn in the rate and magnitude of numerous global socio-economic indicators and Earth System trends occurring in the mid-20th century, termed the Great Acceleration (Steffen et al., 2004, 2007, 2015; Head et al., 2021). Many of the Great Acceleration drivers have already produced clear and widespread signatures in geological records and many other natural archives.

The abundant and growing evidence that Great Acceleration stratigraphic signals support formal definition of an Anthropocene epoch/series has been set out in a series of publications (Waters et al., 2016; Zalasiewicz et al., 2017, 2019, 2020; Syvitski et al., 2020; Head et al., 2021). Critical examination of this evidence by the AWG led to a non-binding vote in 2016 indicating preference for a chronostratigraphically defined Anthropocene (Zalasiewicz et al., 2017). An AWG binding vote in 2019 affirmed by supermajority that the Anthropocene should be a formal chronostratigraphic/geochronologic unit within the International Geological Time Scale (GTS), with a base aligned with stratigraphic signals dating to the mid-20th century (AWG, 2019). The overall process of working towards a definition now advances with active research on 12 reference sections of which many will be proposed as candidate Global boundary Stratotype Sections and Points (GSSPs) (Waters et al., 2018; Head et al., 2021). This characterization of the Anthropocene aligns the Earth System science definition with chronostratigraphic conceptualizations of the term. The Anthropocene effectively represents a planetary response to human drivers rather than the drivers themselves and would be just as significant if caused by some other agency. Nonetheless, it is the tight cluster of stratigraphic signals around the mid-20th century, supported by historical and instrumental records, that affords practicality and chronostratigraphic precision to within a decade or less.

Against this wealth of detailed analysis, Gibbard et al. (2021) proposed that the Anthropocene should not be considered a formally defined chronostratigraphic unit within the GTS, but an informal ‘geological event’. They framed this *event* as a highly time-transgressive and flexibly interpreted phenomenon, with a duration extending back at least 50,000 years to include Late Pleistocene megafaunal extinctions and yet also facilitating “*robust stratigraphic characterization*”. We welcome this proposal as it prompts a refocusing of the Anthropocene concept, and anthropogenic impacts generally, through the lens of geological events and their correlation. Our response here complements a more detailed analysis of how the geological impacts of humans may be classified (Waters et al., submitted). In particular, we focus on whether their concept constitutes an *event* in the usual meaning of the term in geology, whether such a unit would be geologically robust, and if so, how it would relate to an Anthropocene Epoch.

The Nature of Geological Events

An *event* in geology has no formal status, and hence is not one of the hierarchical ranks of units within the International Chronostratigraphic Chart (ICC) which forms the basis of the GTS. Accordingly, although it refers to a *happening* in time (Salvador, 1994, p. 73), it does not have a chronostratigraphic terminological counterpart and has therefore come to refer to the geological expression of the event as

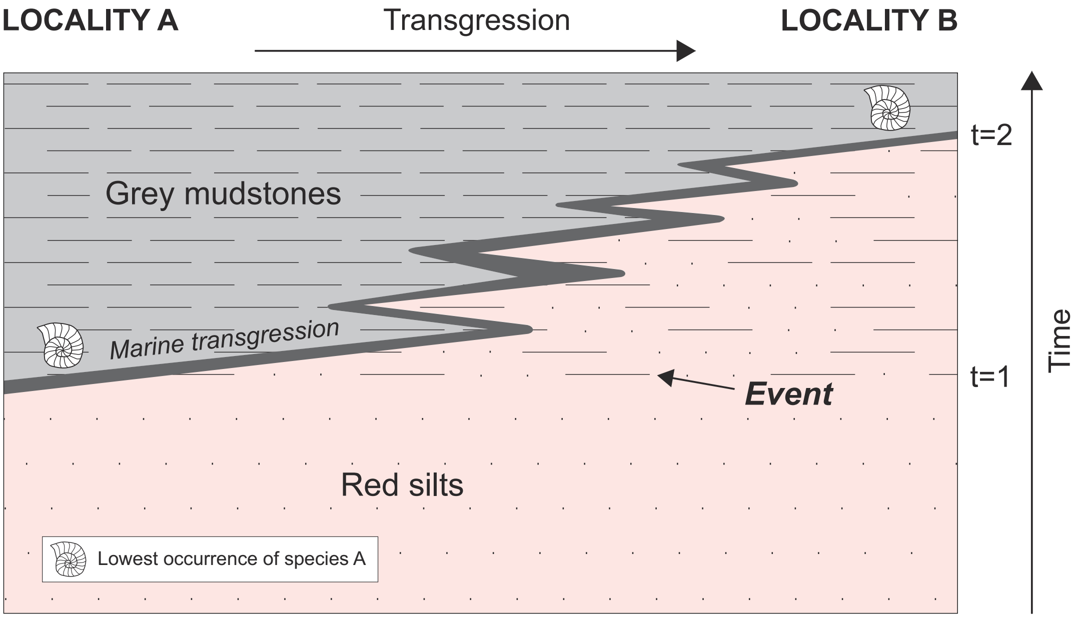

Figure 1. ‘Event stratigraphy’ as depicted by Ager (1973). Ager intended events to be as near isochronous as possible. In this case, both the base of a lithostratigraphic unit (grey mudstones) and a facies-controlled biostratigraphic horizon (the lowest occurrence of fossil species A) observed at localities A and B are diachronous owing to a marine transgression from left to right (from t=1 to t=2). The boundary between the transgressive grey mudstones and the red silts, marked by a heavy zigzag line in Ager’s diagram and reproduced here, in reality would be gradational as well as diachronous. However, the onset of the marine transgression (t=1) has also caused the red silts at locality B to become abruptly muddier. This subtle but rapid shift is the ‘event’ (a rise in relative sea level at t=1) and recalls the stratal surfaces of sequence stratigraphy, which are recognised as chronostratigraphic markers (Vail et al., 1977). Quaternary stratigraphy usually uses events in the same near-isochronous sense. Modified from figure 7.1 of Ager (1973).

well as the event itself. *Event stratigraphy* typically refers to the stratigraphic traces of events, whether depositional, erosional or geochemical (Rawson et al., 2002), that are not significantly diachronous. Indeed, Ager (1973), who introduced the term 'event stratigraphy', specifically valued events for their ability to cut across diachronous boundaries (fig. 7.1 in Ager, 1973; Fig. 1). As conceived by Ager (1973) and reiterated by Salvador (1994, p. 117), the most stratigraphically useful geological events are short-term and essentially instantaneous events such as bolide impacts, tsunami floods, storms that produce tempestites, volcanic eruptions, and other abrupt phenomena (e.g., Walliser, 1996). However, the term *event* has also been liberally applied to longer-duration and variably diachronous episodes relating to marine transgressions/regressions, mountain building glacial advances/retreats or specific climate perturbations, biotic extinctions, evolutionary innovations, modifications to ocean chemistry such as oceanic anoxic events, and paleomagnetic polarity reversals. Geological events thus range from very local, such as a mass flow event within one part of a lake, to regional, such as a large volcanic eruption, earthquake, or oceanic anoxic event, through to global such as glacio-eustatic events, or major bolide impacts. It is misleading to suggest, as Gibbard et al. (2021) do, that events are time-transgressive by nature. As they state, an event can last a second, which by any definition of geological or historical time is isochronous, and the main use of abrupt events is to provide correlatory tie-lines, including those used to recognise chronostratigraphic boundaries (Salvador, 1994, p. 79).

In exploring the concept of a geological event that recognizes human influences, events from *within the Quaternary* seem most relevant. Quaternary events generally follow Ager's (1973) 'event stratigraphy' in being nearly synchronous and relatively brief in their duration, typically a fraction of a Milankovitch climate cycle. In the case of the 8.2 and 4.2 ka events of the Holocene, they are climate-based which allows multi-criterion recognition. An event stratigraphy approach has been used to identify and correlate stadial–interstadial oscillations from $\delta^{18}O$ and [Ca^{2+}] records in Greenland ice cores for the Late Pleistocene and Early Holocene (104–8 ka before the year 2000 [b2k]; Rasmussen et al., 2014; Fig. 2). The Late Pleistocene events are recognised as Greenland stadials GS 1–26 and interstadials GI 1–25, with many being divided into sub-events. The interstadials are broadly the Greenland equivalent of Dansgaard–Oeschger events recognised across the North Atlantic, and both schemes are regional in their strict application. Within these regional constraints they are nearly synchronous, even though their Southern Hemisphere/Antarctic counterparts (which have their own nomenclature as numbered Antarctic Isotope Maxima) are phase-shifted by about a thousand years owing to the thermal bipolar seesaw (EPICA, 2006) and have a more gradual waveform (Ahn and Brook, 2007). Moreover, Greenland stadials and interstadials have abrupt onsets representing shifts in climate state completed in years or decades, representing regional tipping points being passed in response to gradual change within the ocean–atmosphere climate system (Rasmussen et al., 2014; Fig. 2). The North Atlantic ice-rafted debris events of the Holocene (Heinrich, 1988; Bond et al., 1997, 2001) are similarly short-lived (centuries) and are essentially isochronous. They appear linked to chronologically in-phase climatic anomalies on a global scale (Zielhofer et al., 2019), and Bond events 5 and 3 may relate to the 8.2- and 4.2-ka climate events that respectively serve as primary guides to the bases of the Northgrippian and Meghalayan stages of the Holocene. It must be emphasized that even those events of relatively long duration within the Greenland ice core classification have abrupt onsets, and these constitute precise, isochronous reference points for the event stratigraphy (Rasmussen et al., 2014, p. 15; Fig. 2). This application of geological events for the Quaternary is generally, therefore, very different from the highly diachronous and gradational concept employed by Gibbard et al. (2021).

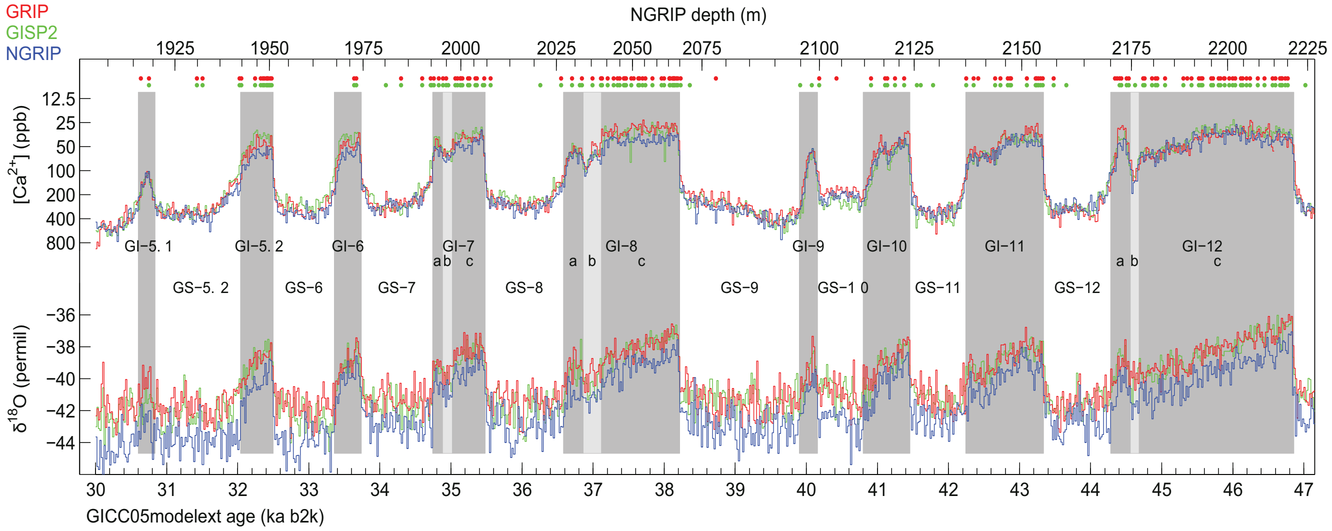

Figure 2. Event-stratigraphic framework using three Greenland ice cores (GRIP, GISP2, and NGRIP) from 30 to 47 thousand years before the year 2000 (ka b2k) within the Late Pleistocene. A crucial feature of this event utilization is the abrupt, near-synchronous onset of each event, allowing precise correlation. The 20-year average values of $\delta^{18}O$ (ice) and [Ca^{2+}] reflect mainly local temperatures and atmospheric dust loading, respectively. Coloured dots below the upper NGRIP depth axis mark the positions of tie points used to align the NGRIP time scale with the GRIP and GISP2 records. GS = Greenland Stadial (full glacial; no shading), GI = Greenland Interstadial (relatively mild; dark shading with light grey denoting cold sub-events). Modified from figure 1 of Rasmussen et al. (2014).

Nevertheless, over time, the term ‘event’ has also come to represent collectively a broad set of phenomena whose nature and effects vary widely across scales of time and space, including those associated with dynamic sequence stratigraphy. The deeper-time examples quoted by Gibbard et al. (2021), the Great Oxidation Event (GOE) and the Great Ordovician Biodiversification Event (GOBE), lie at the extreme end of this range — indeed, to the extent that the term ‘event’ has been contested for both of them. Shields et al. (2021) consider the GOE to be a complex ‘episode’ that spans ~200 Ma and includes named globally correlatable events such as the Lomagundi Event, a carbon isotope excursion. Servais and Harper (2018) and Servais et al. (2021) question whether the GOBE should be considered an event, as its >30 Ma duration includes a complex succession of more conventionally understood and named bio- and chemo-events. The other such example quoted by Gibbard et al. (2021), the invasion of the continents by land plants, has to our knowledge not been regarded as a geological ‘event’ (although individual events within this protracted invasion are recognised; Gibling and Davies, 2012), and in any case this process extended broadly from the Ordovician to the Carboniferous (Wellman, 2010). As reinterpreted by Shields et al. (2021) for the GOE, these extended phenomena more closely fit the definition of an ‘episode’ of the North American Stratigraphic Code (NASC, 2005), as the highest in their series of diachronic units that intersect with, rather than replace, chronostratigraphic units (NASC, 2005, p. 1584 and their fig. 10).

The ‘Event’ as an Interdisciplinary Concept

The Anthropocene of Gibbard et al. (2021), while presented as a ‘geological event’, is formulated to serve also the environmental and social sciences, thus facilitating greater congruence with these fields of research. It is defined as ‘*the aggregated effects of human activities that are transforming the Earth system and altering biodiversity, producing a substantial record in sedimentary strata and in human-modified ground*.’ (Gibbard et al., 2021, p. 2). It recognizes the agency of social and environmental processes in producing global environmental change, emphasising transformative human cultural practices. Included are impacts on biodiversity, the emergence of agriculture, industrialization, and deforestation – indeed the earliest cultural practices to leave a signature on global environmental conditions. But it is not merely an external envelope. It discerns ‘*cultural and historical differences, sociopolitical divisions, and economic inequalities ... at a variety of scales (e.g., households, communities, society, etc.),*’ and incorporates ‘*various historical and social processes (e.g., urbanization, colonial violence, industrialization, capitalist production, etc.)*’. It ‘*facilitates analytical attention on multiple social and historical processes and important differences among them while also encouraging a more integrative perspective on human transformations of environmental and evolutionary processes from local to global scales*.’ This is a complexly structured, highly interpreted entity constrained

Figure 3. The Northgrippian–Meghalayan stage boundary intersecting the temple staircase at Tell Mozan (the ancient city of Urkesh), northern Mesopotamia, now northern Syria. This staircase was constructed/reconstructed in several phases: the earliest (Early Dynastic II; ~2750/2700–2600 BCE) and a subsequent phase (~2400 BCE) are both Northgrippian in age, and a final phase (1500 BCE) is Meghalayan (Buccellati and Kelly-Buccellati, 2007). This stage boundary consigns evidence of human activity (a single archaeological structure) to both sides of that boundary without hindering archaeologists. As with other formal boundaries of the Quaternary, it ties archaeology usefully to the Geological Time Scale. A formal Anthropocene Series in essence would be no different. Modified from figure 3 of Kelly-Buccellati (2015).

by cultural, anthropological, and sociopolitical interpretations that may change as our understanding of human-driven transformations evolves. This is not a geological event by normal convention but an interdisciplinary concept that interfaces with the geological record only through a highly interpretive and dynamic filter.

The Nature of Chronostratigraphic Boundaries

It is claimed that a chronostratigraphic Anthropocene would "*consign significant evidence that attests to human modifications of the Earth's surface and systematic functioning to one side or the other of the agreed-upon boundary*" (Gibbard et al., 2021, p. 3). This is an intrinsic feature of the Geological Time Scale as its subdivisions are defined by GSSPs: each represents an instant in time that defines an isochronous surface, and so will always intersect ongoing planetary processes. Viewed from sufficiently fine resolution, such a boundary may cut indiscriminately through human history. The Meghalayan Stage GSSP (Walker et al., 2018), which the Quaternary community welcomed (Ashworth, 2018), is a pertinent example. This GSSP, placed in a stalagmite from India with a base dated at 4200±30 a BP (where BP refers to 1950 CE), defines the Northgrippian–Meghalayan stage boundary. Extending above and below this boundary are geological and archaeological expressions of a rich history of civilization. City states, irrigation farming, mining, bronze working, writing, mathematics, and organized religion had already become established during the preceding Northgrippian Age. On a local scale, the base of the Meghalayan Stage cuts through archaeological features, such as in the city of Tell Mozan (ancient Urkesh) in northern Mesopotamia (Fig. 3). This isochronous boundary simply represents the need within Earth Sciences for an inflexible geological time framework, and it does not hinder archaeologists and social scientists who in any case use calendar years for measuring time. The boundary in fact helps connect historical/archaeological records with the geological time scale.

Few GSSPs therefore cleanly separate all aspects of a planetary transformation. The greatest Phanerozoic shift in the Earth System occurred near the Permian–Triassic boundary, and is linked to greenhouse gas emissions from the Siberian Traps large igneous province. The emissions lasted many thousands of years, their oceanographic, climatic and biotic effects for hundreds of thousands (Burgess et al., 2014; Black et al., 2018; Jurikova et al., 2020; Viglietti et al., 2021), and the consequences of the extinction were of course permanent. No positioning of a GSSP could put all the causes and effects tidily to one side of the boundary, yet like all GSSPs in the geological record, the one at the P–T boundary effectively defines a practical and consistent time datum for comparing different signals recorded in different stratigraphic successions. The concern that a chronostratigraphic Anthropocene would cause a '*masking, conflating, and suppressing evidence of significant social differences and complexities*' (Gibbard et al., 2021, p. 6) misrepresents the purpose of a GSSP, which is simply to subdivide geological time into convenient, stable, objective units. On the human scale, every GSSP boundary since the advent of modern *Homo sapiens* divides experience into before and after. Therefore, there will be continuities between, and differences and complexities within, the intervals so defined, as with all units of the GTS.

The proposed 'Anthropocene Event' of Gibbard et al. (2021) is more analogous to the Renaissance, a diachronous cultural transformation across Europe that is understood and communicated in reference to a chronological framework marked in calendar years. The terms 'Renaissance' (with its multi-scalar, multi-temporal, socio-political, cultural and artistic dimensions) and 'fifteenth century' (a strict time interval), while clearly not synonymous, are complementary and both are needed. Calendar years provide the same essential temporal framework as do chronostratigraphic units on the GTS. An Anthropocene series/epoch and the anthropogenic 'event' concept of Gibbard et al. (2021) likewise appear to be complementary and are certainly not mutually exclusive.

Stratigraphic Practicality and Earth System Science

The event approach of Gibbard et al. (2021) claims to be "*practical*" and "*enabling robust stratigraphic characterization*". Stratigraphy is above all a practical science and so the aim is laudable, but these authors offer no stratigraphic examples to show how this would be achieved. In reality, the 'event' envisioned by Gibbard et al. is stratigraphically nebulous. Their 'event' encompasses significant geologically preserved human impacts, but its timing, extent and significance will differ by discipline and worker. This flexibility may usefully complement a chronostratigraphic Anthropocene, but cannot substitute for it.

The vast array of geological signals associated with the mid-20th century in fact provides the most stratigraphically robust basis for recognizing the base of the Anthropocene. The timing aligns with the Great Acceleration and reflects profound and geologically persistent changes to the planetary system. These geological signals are supported by a large body of observational evidence that human actions from the mid-20th century onwards have propelled the Earth System rapidly beyond Holocene conditions to a yet-to-be-determined future state. Human-driven changes to the Earth System are already profound in terms of their rates (IPBES, 2019; IPCC, 2021) and magnitudes (Waters et al., 2016; Head et al., 2021). Direct human perturbation of the biosphere and emissions of greenhouse gases are driving: a rapid decline in biodiversity and ecosystem function, together with the irreversible homogenization of biological communities; an increasing rate of species extinctions since the beginning of the 20th century (Ceballos et al., 2015); a dramatic decline in vertebrate populations and increased rates of extinctions since the middle of the 20th century (Ceballos et al., 2017, 2020; WWF, 2020); rapidly increasing global atmospheric surface temperatures; changes in atmospheric circulation and precipitation patterns; warming of the upper ocean, rising sea level and coastal erosion; acidification of the oceans; an increasing severity of extreme weather events such as heatwaves, tropical cyclones, wildfires, and intense rainfall and flooding; and the melting of polar ice sheets, sea ice, glaciers, and permafrost.

At the planetary level, the evidence from Earth System science for the Anthropocene as a new epoch in Earth history beginning in the mid-20th century is clear (Steffen et al., 2016): (i) the Earth System is no longer operating within the Holocene envelope of variability; (ii) the circulation systems of the planet's two great surficial fluids – ocean and atmosphere – are being increasingly perturbed, driving changes in global geochemical, nutrient, sediment and hydrological

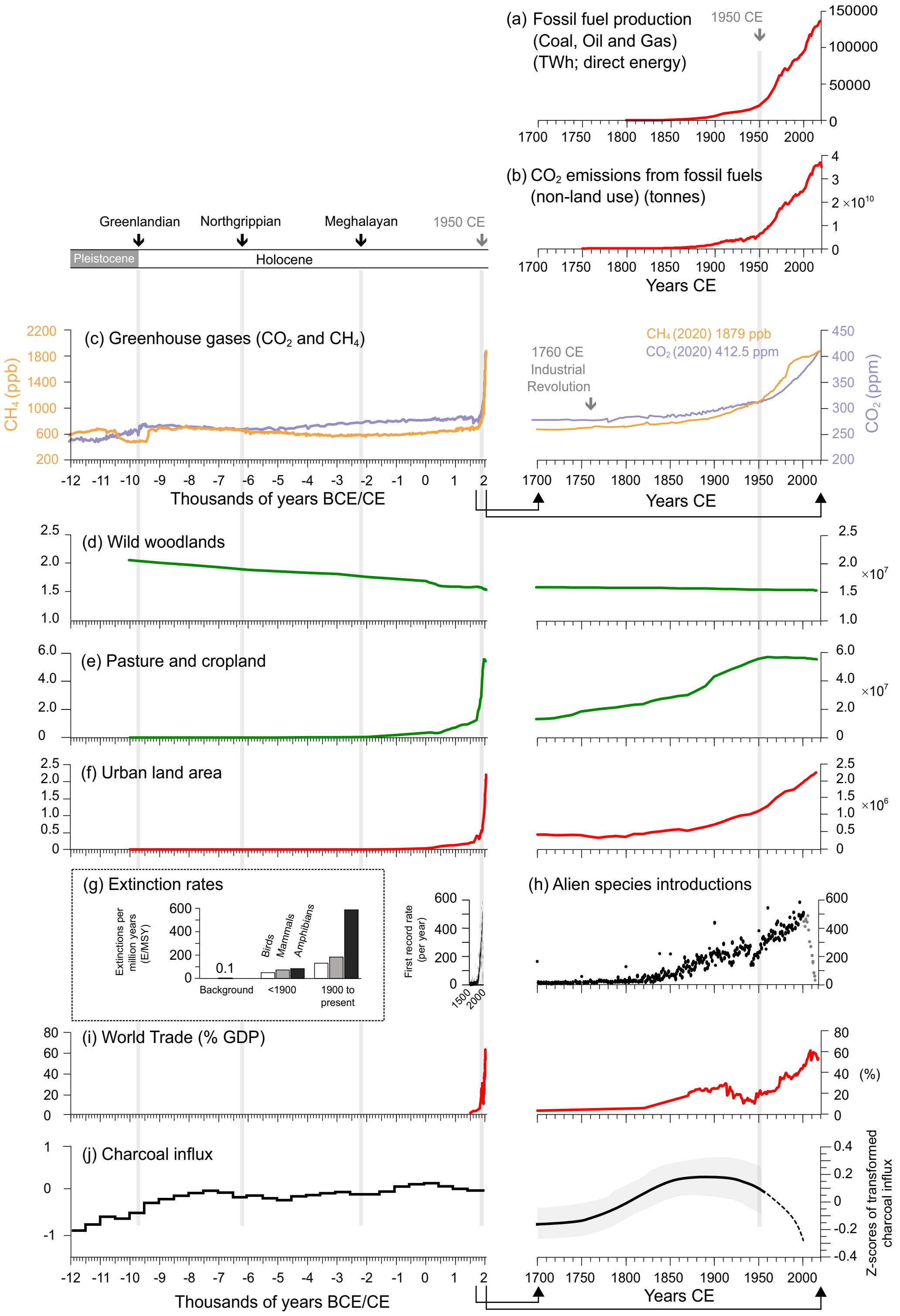

Figure 4. Geological and historical timelines using empirical data to reveal the true scale and timing of social and environmental changes shown in figure 1 of Gibbard et al. (2021). a) fossil fuel consumption (https://ourworldindata.org/fossil-fuels); b) CO_2 emissions from fossil fuels (https://ourworldindata.org/co2-emissions#global-co2-emissions-from-fossil-fuels-global-co2-emissions-from-fossil-fuels); c) CO_2 and CH_4 data from Antarctic ice cores and direct atmospheric measurements (https://ourworldindata.org/atmospheric-concentrations and https://www.epa.gov/climate-indicators/climate-change-indicators-atmospheric-concentrations-greenhouse-gases, respectively); d), e) and f) anthropogenic biomes (https://ourworldindata.org that uses data from Ellis et al., 2020 from 10,000 BCE to 2015 CE); g) extinction rates (Pimm et al., 2014), where E/MSY is the number of extinctions per million species years; h) first record rate (per year) of all neobiotic species reported by Seebens et al. (2017), although data after 2000 CE (grey dots) are incomplete owing to the delay between sampling and publication; i) global trade data is from https://ourworldindata.org on exports as % GDP 1500 CE to present; and j) global charcoal influx (biomass combustion): data from (left panel) Power et al. (2008) and (right panel) Marlon et al. (2008).

cycles; (iii) the planet's system trajectory has very likely escaped from its pacing by Milankovitch (orbital) cycles over the past >2.6 million years (Ganopolski et al., 2016); (iv) changes to biodiversity and ecosystem functioning are even more long-lasting (Williams et al., 2015, 2016); and (iv) human actions, particularly their strong increase since the mid-20th century, are the primary drivers of these fundamental changes in the Earth System.

The evidence is abundant, confined to a short time interval, and global in distribution (Waters et al., 2016; Zalasiewicz et al., 2019; Syvitski et al., 2020; Head et al., 2021). This interval – in reality recorded by a cluster of distinct lithological, chemical and biological event markers enabling extremely high-resolution correlation – accords closely with event stratigraphy as originally proposed by Ager (1973) and with many Quaternary usages of the event concept, and its value is in the practical application of chronostratigraphy. While the earlier impacts of humans are critical to understanding the processes by which the Earth System has changed and the relative importance of humans in causing these changes, they are neither as globally synchronous nor as clearly marked by so many varied and tightly clustered geological signals as those occurring in the mid-20th century.

The Validity and Utility of Mid-20th Century Transformative Change

The 'Anthropocene Event' of Gibbard et al. (2021) by including *all* human activities and processes of possible and varying global relevance over fifty millennia, minimizes and obscures the much more recent, profound, and abrupt planetary changes that underpin the Anthropocene of chronostratigraphy and Earth System science. These changes are depicted in their figure 1 in a way that obscures the reality of the Great Acceleration. In our Figure 4, we quantify the comparable but specific trends they illustrate qualitatively, so as to reveal the true magnitudes and rates of change. The speed and scale of many of these more recent changes, a large number of which are geologically long-lasting, already irreversible, and rising sharply from the mid-20th century onwards, demonstrate Crutzen's conception beyond reasonable doubt, that conditions characterizing the Holocene Epoch have already ended. To match this, a substantial and highly distinctive stratigraphic record has already accumulated as a material consequence. Thus, the case for an Anthropocene epoch and series to succeed the Holocene is overwhelming. Indeed, *not* to recognise the Anthropocene formally would mean that the Geological Time Scale, which typically reflects major phases of Earth's evolution, would depart from observed geological reality.

Etymology

The etymology of the term Anthropocene has direct bearing on its use in geology. Based on the Greek *Anthropos*, human, and *kainos*, new or recent, this term conforms to a long-standing practice initiated by Charles Lyell in 1833 of naming epochs of the Cenozoic Era (his 'periods' of the 'Tertiary epoch') with a distinctive '-cene' suffix. The term means 'recent human', broadly in keeping with the Earth System science- and AWG-conceptualized Anthropocene that excludes limited and/or localised human stratigraphic impacts during the Holocene and before. It conveys the rank of epoch/series appropriately because the rates and magnitudes of planetary change during the mid-20th century have decisively exceeded Holocene norms (Fig. 4).

The term Anthropocene has nonetheless taken on many additional meanings in other disciplines since its introduction by Crutzen (Zalasiewicz et al., 2021), and a growing number of terms now use the '-cene' ending as alternatives to, or partial synonyms of, the chronostratigraphic Anthropocene (see Hallé and Milon, 2020). If the *event* approach is found useful for the concept described by Gibbard et al. (2021), which appears different from other usages of the term, then giving it a distinctive new name would avoid confusion. That new name would most appropriately avoid incorporating the suffix '-cene', which by convention, and as intended by Lyell (1833), is assigned only to chronostratigraphically defined geological epochs/series of the Cenozoic.

Final Considerations

The chronostratigraphic Anthropocene as an epoch/series with a base coincident with a rich array of stratigraphic signals dating to the mid-20th century is the preferred definition by the AWG, offering a robust chronostratigraphic datum of global extent that is not provided by the anthropogenic event concept proposed by Gibbard et al. (2021). Furthermore, in focusing on the Great Acceleration, *a planetary perturbation caused by human activities rather than the activities themselves*, it aligns with the definition preferred by the Earth System science community from which the term Anthropocene originated. It would be identified through comparable rigorous processes of definition as, and named in agreement with, other epochs in the Cenozoic Era. At fine scale, its isochronous base will bisect the traces of natural and human-derived processes, but this is an intrinsic feature of all units within the GTS. Humans are not depicted as a '*homogenous global force*' (Gibbard et al., 2021), but their impacts crossed a planetary threshold in the mid-20th century, and these have left a sharp, permanent and unambiguous geological record. The 'Anthropocene Event' of Gibbard et al. (2021) by contrast, is neither a stratigraphic nor chronostratigraphic concept, but rather a broadly defined set of phenomena with variable geological expression unified only by being anthropogenic. It operates at mostly local to regional scales and is almost exclusively terrestrial in its application. Always subject to interpretation, it may be compounded by the challenge of distinguishing human-induced changes from those of non-human drivers. This is a very different concept to the chronostratigraphic Anthropocene, but separately defined and differently named might usefully serve as an independent but complementary means of recognising the long and varied history of human impact on our planet.

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Martin J. Head is a stratigrapher and Full Professor of Earth Sciences at Brock University, Canada, with affiliations at the University of Toronto and Wolfson College, Cambridge. He is currently Vice-Chair of the International Subcommission on Quaternary Stratigraphy (SQS), having served as its Chair (2012–2020), and is Co-Convener of its Working Group on the Middle–Upper Pleistocene Subseries Boundary. Martin is concurrently a voting member of the SQS Working Group on the Anthropocene and of the International Subcommission on Stratigraphic Classification, and an advisory board member of the INQUA Stratigraphy and Chronology Commission (SACCOM). He specializes in marine dinoflagellate cysts and acritarchs of the late Cenozoic including their biostratigraphy, paleoecology and taxonomy.

Jan Zalasiewicz is Emeritus Professor of Palaeobiology at the University of Leicester, UK, having formerly worked as a field geologist and biostratigrapher at the British Geological Survey. He is Chair of the International Subcommission on Quaternary Stratigraphy (SQS) (2020–), having served as SQS Secretary (2012–2020). He has also served as Chair of the SQS Working Group on the Anthropocene (2009–2020), as Vice-Chair of the International Subcommission on Stratigraphic Classification (2008–2016), and as Secretary, then Chair, of the Stratigraphy Commission of the Geological Society of London. He has worked on the stratigraphy and sedimentology of mainly lower Palaeozoic and Quaternary terrains.

Colin N. Waters is a retired principal mapping geologist, formerly of the British Geological Survey, with specific interest in Carboniferous and Anthropocene stratigraphy. He is an Honorary Professor at the Geography, Geology and the Environment School, University of Leicester, and in 2019 was Visiting Professor at the University of Vienna. Colin has been Secretary of the Stratigraphy Commission of the Geological Society of London since 2006. He has 144 peer-reviewed publications. He has been Secretary of the Anthropocene Working Group from 2011 and its Chair since 2020.

Simon Turner is a Senior Research Fellow in Geography at University College London. He has been Secretary of the Anthropocene Working Group (AWG) since 2020, serving as the scientific coordinator for a collaborative project between the AWG and the Haus der Kulturen der Welt, Berlin to seek a Global boundary Stratotype Section and Point for the Anthropocene. He applies physical, chemical, paleoecological, and statistical analyses of sediments and other materials to assess the range of human activities represented therein and the significance of associated human impacts especially during the last century, and to determine how legacy historical contaminants persist in contemporary ecosystems.