1 Deep Time as a Novel Lens of Planetary Politics

> *When viewed in deep time, things come alive that seemed inert. New responsibilities declare themselves. A conviviality of being leaps to mind and eye. The world becomes eerily various and vibrant again. Ice breathes. Rock has tides. Mountains ebb and flow. Stone pulses. We live on a restless Earth*.
>
> (Macfarlane, 2019, pp. 15–16)

This Element investigates the politics of deep time as the realm in which societies interact with processes on a geological or even cosmic timescale. The aim is to examine deep-time interactions in order to provide a rationale for and conceptualization of the politics of deep time. As of now, the temporal depth of human actions conflicts with the short-termism of current political systems and institutions, which remain dominated by the election cycles of just a few years or policy programs of a few decades at best. Yet, the Anthropocene as an ongoing planetary event has brought to the foreground deep-time interconnections of human agency with the Earth system and, to an even greater extent, has highlighted that the Earth, while on very long timescales, is a restlessly changing and always provisional planet irrespective of human influence (Bauer et al., 2021; Gordon, 2021; Macfarlane, 2019). Despite this recognition of strong temporal interdependencies, we still lack a basic understanding of how societies can politically handle the interconnections between several decades, centuries, millennia, or eons, as well as the potential generations to come. In line with a previous call for "deep-time organizations" that exist over long periods of time to address deep-time challenges, this Element argues for the internationally coordinated establishment of a "deep-time observatory" (Hanusch & Biermann, 2020). The goal of the observatory would be to compile an inventory of deep-time interactions, in order to develop an evidence-based foundation for the politics of deep time as a core pillar, keeping the planet habitable and enabling the autonomy of future generations in the long run.

Within this introduction, I aim for a concise approximation of this politically and rather unfamiliar realm of deep time. I aim to show why it is distinct from and yet in most cases incorporates similar notions as other political concepts, such as the time policies for sustainability politics, politics of future generations, or long-term governance (Boston, 2016; Reisch, 2015; Underdal, 2010). Futures that referred to children's children in a sustainability context are replaced by Earth time periods, in which it is not even clear whether and in what form human societies will experience these (Horn, 2017). The politics of deep time are thus related to yet are distinct from politics concerned with a handful of generations in the past or future. Drawing from the spatial notion of multilevel governance, one has to develop the notion of a "multitemporal governance," this has only been conceptualized for the short-term

level of election periods and the medium- to long-term level of certain future generations; the level of processes taking place within cosmic timescales, however, has to date been omitted. Therewith, I contribute to a wider paradigm shift in the global environmental politics research in the Anthropocene (Biermann, 2021).

Deep time is a realm far beyond human existence yet entangled with it. To better understand the character and scales of deep time, I start here with a brief analogy with everyday life, namely, food. First, imagine buying food for the next seven days. One would probably select certain foods that must be eaten within the first few days, such as lettuce, but one would also purchase items that can be cooked in a week from now, such as potatoes. Next, consider the seven-generation principle of the Haudenosaunee, according to which decisions today should benefit seven generations in the future. To guarantee that the seventh generation in the future can enjoy food, one would have to plant olive trees, so that future generations can also enjoy tasty food and make dining tables from the wood of the olive trees. Finally, try to imagine how food relates to the next seven geological epochs. The Cenozoic era, spanning approximately 66 million years, consists of seven geological epochs, namely, the Paleocene, Eocene, Oligocene, Miocene, Pliocene, Pleistocene, and Holocene. Within this timeframe, the Chicxulub asteroid impact occurred around 66 million years ago, leading to the extinction of non-avian dinosaurs. Thinking about our relationship with food that operates within these vast timeframes means ensuring that the genetic diversity of crops, which has been forming over millions of years, does not become extinct and allows the regeneration of biogeochemical soil flows that enable respective plantation. Within the last 2.5 billion years, for example, no other force had a greater impact on the nitrogen cycle than humans, largely due to nitrogen fertilizers used in agriculture (Canfield et al., 2010). Yet, we overlook political practices and institutions that are capable of dealing with these kinds of timeframes, timeframes so vast that numbers lose meaning. This encapsulates the politics of deep time.

While such relations with Earth system processes, which form over cosmic timescales, may sound fairly distant and technical at first glance, they are vastly politicized and drive world politics. When US president Trump, for example, claimed "OIL (ENERGY) IS BACK!!!!" (Trump, 2020), a "Great Again" retrotopia of a romanticized past based on fossil-fuels, formed ca. 286 to 360 million years ago, became a powerful future image of reactionary movements around the world (Hanusch & Meisch, 2022). This indicates that changes in civilizations are profoundly interrelated with changes in their conceptions of time. While several other disciplines have started investigating these interrelations, such as philosophy (Landa, 2000), history (Chakrabarty, 2009), or educational sciences (Zen, 2001) among others, an explicit treatment of the politics of deep time is overdue.

When comparing the politics of deep time to related temporal concepts in social science research, its distinct character can be further distilled. First, political time is concerned with diverse temporal understandings that are determined by political institutions and actors within the political process itself, such as the timing of decision-making or regime change (Goetz, 2019). Consequently, long-term politics refers to the long-term problems and policies over years, decades, or centuries, but rarely millennia or more (Siebenhüner et al., 2013). In a similar vein, anticipation studies, such as research on emerging technologies, are a methodological approach aiming to understand possible future trajectories and to act accordingly, mostly within a maximum time range of decades (Poli, 2017). Studies concerning the politics of future generations overwhelmingly focus on a few generations into the future (Boston, 2016; González-Ricoy & Gosseries, 2016), with the exception of some concepts proposing timeless trusteeship ideas (Thompson, 2010; see Section 3.2). Similar to geohistory or "une histoire quasi immobile" and the notion of the "longue durée" (Braudel, 1966, p. 16), Big History or the Climate of History can be partly related to the politics of deep time, as it strives to integrate human history with the history of the universe, without exemplifying what this means in terms of politics (Chakrabarty, 2021; Christian, 2011). Timescapes are yet another and probably the most encompassing approach in social theory that comprise a cluster of various interacting temporal phenomena, ranging from timing, tempo, duration, sequence, and timeframes to modalities of past, present, and future, but have primarily served as a theoretical approach (Adam, 1998). While the politics of deep time incorporate a range of the above-mentioned and similar approaches – the generation of our great-grandchildren is, for example, a tiny part of this – an explicit and comprehensive treatment of the inhuman cosmic timescales from a political perspective is, to the best of my knowledge, lacking.

This Element proceeds as follows: in order to outline a conceptual framework of the politics of deep time (Section 5), I investigate *why* deep-time interactions make the politics of deep time essential (Section 2), *how* deep time is currently politicized (Section 3), and *what* concrete cases should be treated as politics of deep time (Section 4). I thus introduce the notion of the politics of deep time from scratch as both an analytical framework and a political necessity. After all, we must learn to talk temporally about time. Acquiring a temporal view is a demanding exercise, yet it allows for novel insights into the ever-changing relationships between humans and the planet.

2 The Why: Deep-Time Interactions

> Rocks are not nouns but verbs.
>
> (Bjornerud, 2018, p. 8)

This section develops the very basis of a new kind of politics. It starts by defining deep time as the realm in which societies interact with processes on a geological or even cosmic timescale. Thereafter, deep-time encounters are investigated to unveil deep-time interactions. Based on this, I identify normative objectives for the politics of deep time, namely, democracy and habitability.

2.1 Definition of Deep Time

I define deep time as the realm in which societies interact with processes on a geological or even cosmic timescale. Deep time is thus a relational concept that covers the interactions between societies and processes taking place within geological and cosmic times. Although often used interchangeably, particularly in a non-geological discourse, deep, geological, and cosmic time can be distinguished with regard to their definition (Burchfield, 1998; McPhee, 1981).

Cosmic time encompasses the timeframe since the Big Bang ca. 13.8 billion years ago until the ultimate fate of the universe, which will eventually manifest in the form of a Big Crunch in ca. 20 billion years, a Big Rip in ca. 50 billion years or a Big Chill in ca. one googol year. Cosmic time is thus a synonym for the age of the universe, whereas geological time refers to the timeframe of the Earth's existence, ranging from its formation 4.54 billion years ago to its absorption by the Sun in ca. 7.5 billion years. Geological time is thus synonymous with the age of planet Earth. Geological time is part of cosmic time, with "us as creatures of this earth, as beings that are constituted by a double temporality: rhythmically structured within and embedded in the rhythmic organisation of the cosmos" (Adam, 1998, p. 13; see Figure 1).

The discovery of these vast amounts of time relating to the existence of the Earth and the Universe was in some cultures, at least in the Christian dominated parts of the world, preceded by a much more anthropocentric interpretation of the beginning of everything. A prime example is the assumption that the Earth is no older than a few thousand years (see Figure 2).

The proposition of a much older Earth, based on geological, rather than religious, timescales, dates back to at least the eleventh century to two polymaths, namely, Ibn Sina during the Islamic Golden Age and Shen Kuo during the Song dynasty. Going further back, Hinduism and Buddhism refer to the idea of "kalpa," which is similar to the notion of a cosmological eon. However, James Hutton is mostly referred to as the discoverer of geological time in which

"we find no vestige of a beginning, no prospect of an end" (Hutton, 1788/2010, p. 304). In 1788, at Siccar Point on the east coast of Scotland, Hutton observed how two different rock types layered on top of each other, later known as "Hutton's unconformity," and concluded that the Earth's surface is the result of cyclic geological processes that are too slow to have taken place in biblical timeframes (see Figure 3). Stones thus may be perceived as a critter themselves; at least they have the potential to transfer people into nonhuman scales of time (Cohen, 2015; Reinert, 2016).

As his "Theory of the Earth" (1788/2010) was criticized as illogical and atheistic, for example, by other geologists such as Richard Kirwan, he published "An Investigation of the Principles of Knowledge and of the Progress of Reason, from Sense to Science and Philosophy" as a three-volume edition including his "Theory of the Earth" and additional material to justify his findings. John Playfair, a colleague who accompanied James Hutton at Siccar Point, described the recognition of the discovery a few years later as follows:

> We felt ourselves necessarily carried back to the time when the schistus on which we stood was yet at the bottom of the sea, and when the sandstone before us was only beginning to be deposited. . . .Revolutions still more remote appeared in the distance of this extraordinary perspective. The mind seemed to grow giddy by looking so far into the abyss of time; and while we listened with earnestness and admiration to the philosopher who was now unfolding to us the order and series of these wonderful events, we became sensible how much farther reason may sometimes go than imagination can venture to follow. (Playfair, 1805, p. 73)

Geological time, in this vein, becomes materially accessible and visible through its presence in the here and now, "palpably present in rocks, landscapes, groundwater, glaciers, and ecosystems" (Bjornerud, 2018, p. 162), but remains in part invisible and inaccessible in the depths of the Earth or in the vastness of outer space (Chakrabarty, 2018; Szerszynski, 2017).

The discovery of geological time was not only a revolutionary moment in geology. It inspired the great theories of the sciences, including Charles Darwin's "The Origin of Species" (1859), as well as poets and novelists alike in terms of the implications for the missing justification of humans as the pride of creation (Buckland, 2013; Ziolkowski, 1990). As a consequence, it is argued that the discovery of geological time is next to the Copernican Revolution, Darwin's theory of evolution, and Freud's theorization of the subconscious, one of the four great revolutions which led to a decentering of human subjectivity: "What could be more comforting, what more convenient for human domination, than the traditional concept of a young earth, ruled by human will within days of its origin. How threatening, by contrast, the notion of an almost incomprehensible

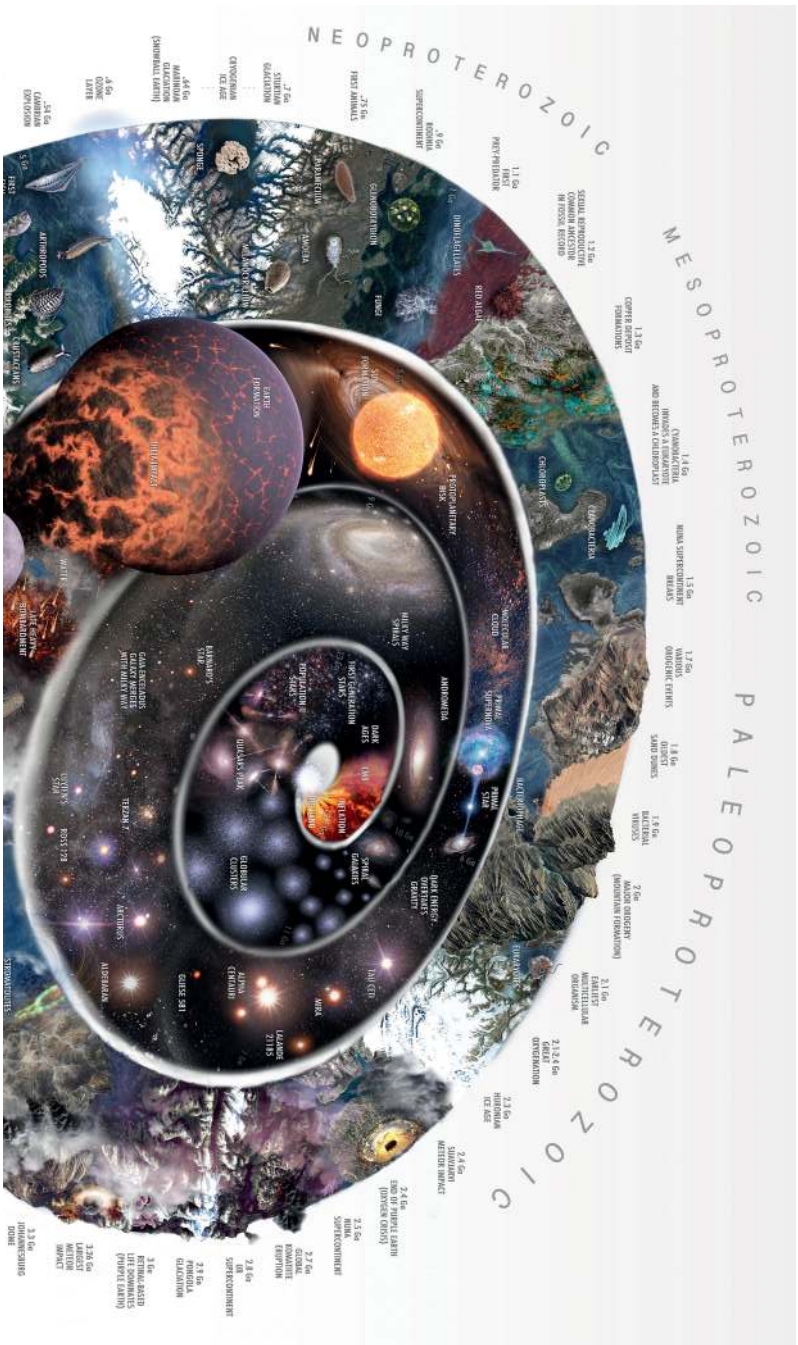

Figure 1 The cosmic time spiral starting with the Big Bang and a focus on the geological time o
one billion years, with the most recent 90 degrees corresponding to only 5

Source: Reprinted with the permission of Pablo Carlos Budassi (2020), available at www.pablocarlosbudass

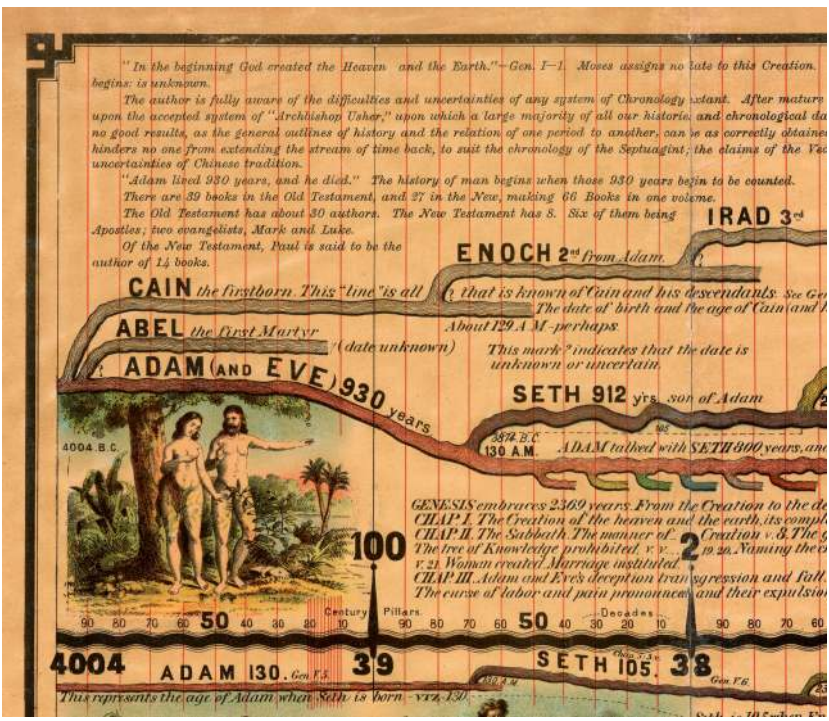

Figure 2 Details of Sebastian C. Adam's Synchronological Chart (1881) showing the chronology of the Earth according to James Ussher's (1650) Annals of the World, beginning at 6 pm on October 22, 4004 BC, with the creation of Adam and Eve. The chart was reproduced in Bibles by the Oxford University Press until 1910.

Source: © David Rumsey Map Collection, David Rumsey Map Center, Stanford Libraries, CC BY-NC-SA 3.0; available at www.davidrumsey.com/luna/servlet/detail/RUMSEY~8~1~226099~5505934:Composite–Adams–Synchronological-

immensity, with human habitation restricted to a millimicrosecond at the very end!" (Gould, 1987, p. 2).

Therefore, human societies should comprehend the fact that planet Earth existed before and during, and will exist after *Homo sapiens*. Consequently, the past covers a timeframe ranging from the first *Homo sapiens* ca. 315,000 years ago back to the Big Bang. A closer look at processes taking place within this timeframe demonstrates that the separation between cosmic, geological, and biological timeframes becomes blurred. Not only are there bacteria, and thus life, in Siberian soil which can repair their own DNA and survive for at least 500,000 years (Johnson et al., 2007), but also the origin of many minerals is related to biological processes, demonstrating

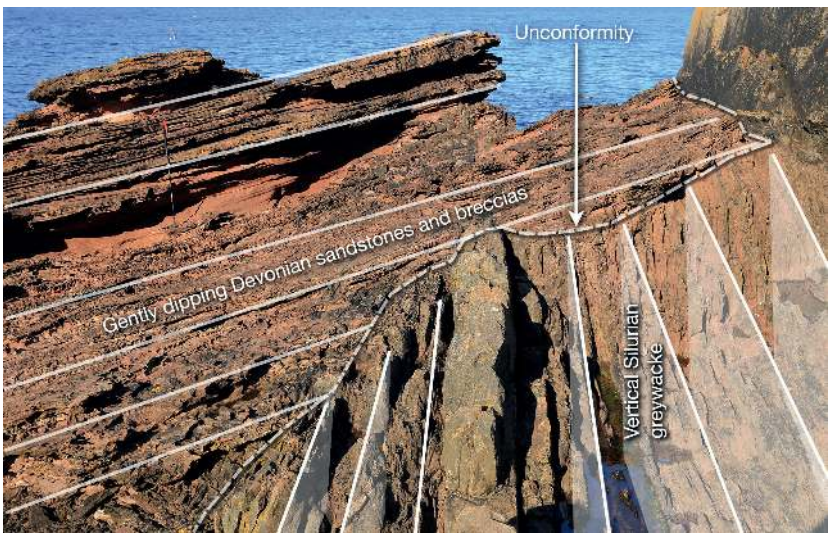

Figure 3 Hutton's unconformity at Siccar Point, Scotland. The lines illustrate the differing orientation of the strata between the two stone types from different ages.

Source: Image by Mike Brooks © Herefordshire & Worcestershire Earth Heritage Trust; available at https://deeptime.voyage/siccar-point/

the coevolution of life and minerals as a result of permanent interchange (Ehrlich, 1996). The time during the presence of *Homo sapiens* on planet Earth covers the timeframe of the existence of *Homo sapiens* from ca. 315,000 years ago toward a yet unknown point in the future, when a "homo noveau" might start to form, for example, by natural mutation, by separation of *Homo sapiens* on two planets, by genetic engineering or, in a transhuman manner, by integrating artificial intelligence devices, with the resulting relationship between both unfolding its agency. A future after the existence of *Homo sapiens* covers a timeframe ranging from the emergence of a homo noveau to the unknown fate of the universe. In the meantime, the Atlantic Ocean will close again and in ca. 250 million years, a new super-continent, Pangea Proxima, will form; whether humans will exist then is unknown (Williams & Nield, 2007). Of course, such timeframes are hard to imagine, and yet, the very moment one reads these sentences, once also "used to be the unimaginable future" (Brand, 1999, p. 164).

Hutton's discovery thus brought about a bifurcation of the Earth's and human history, which the notion of the Anthropocene is reuniting again. This reunion becomes explicit by illuminating human interactions with processes taking place within geological timescales in the form of

stratigraphic, biostratigraphic, and chemostratigraphic signatures and the physical stratigraphic signatures of the Technosphere (Northcott, 2015; Zalasiewicz et al., 2019).

How societies know about and perceive time on the one side, and how they are organized and govern themselves on the other side thus depend on each other. Societal relations regarding knowledge of the timeframes of the Earth's and the Universe's existence changed during the course of history and will likely be subject to change in the future. How societies perceive their relationship to these large timeframes fundamentally changes worldviews. Depending on societies' perception of the Earth's age, whether it is some thousand or some billion years old, their self-conception and politics differ. When it comes to such vast amounts of time, which may be measurable but are yet so unfamiliar that they can barely be comprehended, the way in which relationships with these are shaped become particularly important. This characterizes deep time.

In theoretical terms, the separation between societies and their understanding of time, in contrast to geological and cosmic time, aligns with the distinction made between an A- and B-series in time philosophy (McTaggart, 1908). The A-series refers to the subjective experience of time, where events are ordered dynamically according to their position in relation to the present moment, namely, past, present, or future. The Heraclitean character of the A-series can thus be closely aligned to societal time perceptions. The B-series refers to a rather objective and fixed sequence of events with either earlier or later than other events in t_1, t_2, t_3, and so on. The Parmidean character of the B-series thus aligns with the block universe underlying cosmic and geological time. Several concepts exist that potentially connect the A- and B-series, including the "specious present" (James, 1893; Kelly, 1882), "tensed facts" (Swinburne, 1990) and "time consciousness" (Dainton, 2023). However, these concepts usually refer to the individual and not societal level. Deep time is conceptualized here as a means of connecting the A- and B-series at a societal and political level. The societal experience of time is closely tied to the events that societies perceive taking place around them, while it is difficult to comprehend the vast timescales of geological or even cosmic time within societal experiences. Deep time can provide a bridge between the A-series and B-series of time. Deep time allows to connect the societal experiences of time with the reality of the universe, as deep time explicates the interactions between both.

In methodological terms, "Numbers do not seem to work with regard to deep time. Any number above a couple of thousand years – 50,000, 50 million – will with nearly equal effect awe the imagination" (McPhee, 1981, p. 21; see also Ginn et al., 2018, p. 214). An illustrative example of this is that 85 million years