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CRITICAL PERSPECTIVE ON DEMARKING ANTHROPOCENE EPOCH

Kanwar Muhammad Javed Iqbal¹, Muhammad Irfan Khan²

¹National Institute of Maritime Affairs, Bahria University, Islamabad

^{1,2}Department of Environmental Science, International Islamic University, Islamabad,
Pakistan;

Email: kanwar.javediqbal@gmail.com

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ABSTRACT

There is growing debate about demarcation of a third geological epoch in quaternary period of Earth's history to be named as '*Anthropocene*'. The 'Anthropocene Working Group (AWG)' of 'Sub-commission on Quaternary Stratigraphy' of the 'International Commission on Stratigraphy (ICS)' proposed the optimal beginning of *Anthropocene* from the middle of 20th century. In the context, this paper critically examined the criteria / markers proposed by the AWG of ICS and reviews the other options with arguments in order to support a more rationalized decision about demarcation of *Anthropocene* epoch. Based on analysis, it is found that there is a lack of consensus about the starting point and markers of *Anthropocene* due to the existence of a diverse range of proposed markers for the same. The geological point of view believes that it should be linked to some stratigraphic changes, which requires millions of years in time scale. The environmentalists argue that the early onset of changes on the surface of the earth be linked as primary markers, which became very relevant and significant with the industrial revolution. The social scientists argue the population growth intensified the anthropogenic impact on the earth's environment. Consumption of resources and changes in lifestyle patterns led transformation in socio-cultural nexus for which markers should be linked for the start of *Anthropocene*. Based on arguments, it is deciphered that the proposed criteria / markers to start *Anthropocene Epoch* from middle of 20th century are underdeveloped since there are strong counter arguments exist. It would be wise to start the *Anthropocene Epoch* since the year 1800.

INTRODUCTION

The term '*Anthropocene*' is rapidly growing and becoming very common in scientific and other disciplines. It carries not only perspectives about global

changes occurred as a result of anthropogenic aspects but also the human insights about subsequent socio-political and philosophical repercussions (Rull, 2017). There is growing debate among geologists launched by Nobel Prize winner Paul Crutzen (Jan Zalasiewicz et al., 2019) about demarcation of a third geological epoch in quaternary period of Earth's history to be named as '*Anthropocene*' marking it from very early onset of noticeable anthropogenic impact on earth's geological system, along with, but not limited to, human-induced climate change. This proposed division of a third epoch in the quaternary period is being linked with intensity of anthropogenic activities particularly since the beginning of 20th century. During this epoch, the world has transformed from nature-based ecosystem to energy dependent socio-ecological system of modern civilization where per capita carbon footprint has increased many folds. The *Anthropocene* epoch may be contextualized in two dimensions, one is the context of 'comfort' for humankind and second is its energy dependence, which interfered and influenced the natural balance of climatic system worldwide (Iqbal et al., 2020a).

The realization of anthropogenic imprint at global scale has begun as early as 1800s and the period was informally and occasionally termed as *Anthropocene* on logical grounds over the last two decades; but it has not accepted formally yet (Steffen et al., 2011). 'The Anthropocene Working Group (AWG)' of 'Sub-commission on Quaternary Stratigraphy' of the 'International Commission on Stratigraphy (ICS)' proposed optimal beginning of *Anthropocene* from the middle of 20th century by linking it with quantum of accelerated industrialization, population growth and globalization; with a primary marker of nuclear bombing and tests from the early 1950s (J. Zalasiewicz et al., 2020). However, lack of consensus observed on the proposed starting point for the *Anthropocene*.

In the context, this paper critically examined the criteria proposed by the AWG of ICS, and reviewed the other options by developing arguments for contextualizing the aspects of population growth, transport (Williams, *et al.* 2019) and industrialization to support a more rationalized decision about demarcation of *Anthropocene* epoch.

METHODOLOGY

This qualitative research paper relied on a three-step method. Firstly, it explored the state of knowledge on the topic of the paper by employing google scholar's search engine and shortlisted a range of literature for the application of widely accepted standard content analysis technique (Crowther & Lancaster, 2012; Elo & Kyngäs, 2008; Iqbal & Haider, 2020). Anthropocene, markers, geological time scale, stratigraphy, starting point, population growth, industrialization and human imprint were the important key words used for exploring the literature. Secondly, it gathered experts' opinion on '*Anthropocene* markers' set by AWG-ICS, through three (03) consultative sessions and dialogues with experts' groups held in Islamabad. Expert's feedback was acquired through group exercises on flip charts by following the similar pattern of Iqbal et al. (2020a, 2020b) supported by situational analysis and scenario building (Z. binti A. Hassan et al., 2014; Sladowski & Paruch,

2017). Thirdly, it developed arguments and draw conclusion based on content analysis of scrutinized literature and outcome of the experts' opinion sessions.

CRITICAL REVIEW AND DISCUSSION

The current geological time i.e., the 'Quaternary Period', started about 2.6 million years ago, is characterized by the cold and warm eras in Earth system. The cold episodes are generally termed as glacial ages i.e., more specifically the Quaternary Ice Ages which last about 100,000 years, and subsequently interrupted and transitioned through the warmer inter-glacial ages which lasted about 10,000. The current Quaternary period is the division of geological time scale, which is more often categorized as the "Age of Humans." The beginning of this period is characterized by the appearance of *Homo erectus* in Africa, and then the subsequent evolution of more intelligent and bigger brains with the passage of time on the '*hominid line*'. The scientifically characterized steady cooling phase of the planet Earth, from about 8,300 to 4,200 years ago, is now well known as the '*Northgrippian age*'. The '*Holocene*' is scientifically characterized with a mega drought and sudden decline in temperature, which was occurred around 4,200 years ago and also termed as the youngest '*Meghalayan age*' worldwide. It is reported that the worldwide complex phenomenon of drought and low temperature during '*Meghalayan age*' had destroyed many civilizations across the globe. To be more precise, we are living in Holocene Epoch's '*Meghalayan age*', as the *Anthropocene* is not recognized formally on geological time scale.

The existing historic time scale division is connected with the geological shifts in the Earth system (Lewis & Maslin, 2015). There is a growing debate and a range of diverse arguments exist about the need of a new geological time scale unit in the backdrop of visible change due to anthropogenic human imprint that has altered the natural system and ecological balance. On one hand, there is a global consensus found on the anthropogenic environmental impact that led concerns about environmental security due to context-dependent scenario of burning fossil fuel along-with concerns about the energy security (M. Hassan et al., 2019, 2021), and the term Anthropocene. While, the other side lacks consensus to formally demark Anthropocene (Iqbal et al., 2020a) which is being considered to have a fundamental relationship change in geological system of the Earth and humans (Braje & Lauer, 2020; Lewis & Maslin, 2015). In fact, the literature could be essential in exploring the current views on defining the description of *Anthropocene* considering the relevant changes for this critical transitional phase in geological time scale (Tschirhart & Bloomfield, 2020), which has a wide variety of markers along-with diverse groups of stakeholders.

The '*Anthropocene*' term although originated in a scientific context, it has been in utilization in several other fields of studies including political sciences, philosophy, ecological sciences, law. Today, there is a consensus about the purpose of this term i.e. to define the global transformation we have witnessed, and to designate a new geologic epoch characterized by the anthropogenic impact on Earth system (Crutzen & Stoermer, 2000; Cruzen, 2002; Rull, 2017). On contrary, there is lack of consensus about its starting point due to a diverse and wide range of contradicting arguments and perspectives about the *Anthropocene* markers. The major precursor for lack of

consensus is the cross-cutting nature of majority of the anthropogenic drivers which are influencing the global debate.

In literature, we found Stoppani (1873) who strongly argued on the technical aspects of the term being advocated. According to him, the overall human imprint on the earth system due to anthropogenic alterations in physical, biological and geological settings and natural processes is quite sufficient to enter into a new era, which may be called '*Anthropozoic*' instead of '*Anthropocene*'. He agrees to the prefix part of the proposed new time scale name but tends to disagree with suffix with the argument that '-zoic' is the corresponding suffix for an era, whereas '-cene' is the specific suffix for an epoch, in accordance with geological time scale units. Stoppani (1873) not only tried to describe the '*Anthropozoic*' but also suggested markers for it. He called attention to that the rock formations during human life contained the actual proof expected to characterize this new era in geological terms. He proposed that land time units ought to be characterized based on characteristic rock features, it is illogical to expect to represent and name another geological unit without the associating tangible proof contained in rocks, which make the geological clock.

A proposal by AWG-ICS to formalize the demarcation of *Anthropocene* epoch in Holocene age was developed in 2016, which suggested *Anthropocene* to be at the level of series or epoch in the geological time scale and its starting point would terminate the continuation of Holocene Epoch/ Series including the '*Meghalayan Age*'. Further, its starting point would be optimally placed in the middle of 20th century, coinciding with the array of geological proxy signals preserved within recently accumulated strata and resulting from the 'rapid acceleration' of population growth, industrialization and globalization criteria / markers. The sharpest and most globally synchronous of these signals, that may form a primary marker, is made by the artificial radionuclides spread worldwide by the thermonuclear bomb tests from the early 1950s. The AWG is pushing things for the official recognition of '*Anthropocene*' epoch by demarking it somewhere in middle of 20th century.

It is good thing that AWG has narrowed down the global discussion that stretched on a wide range of proposed markers in social, environmental and technological context. But the criteria and markers proposed by AWG are still underdeveloped as demerits are apparently superseding the merits. For instance, the arguments of AWG regarding population growth marker have shortcomings. There is a need to understand the population growth rate viz-a-viz increase in population size over time. It is quite evident that population growth rate has dropped during the 20th century, though a steady increase is witnessed in global population, which is a normal phenomenon. However, population-doubling time has declining trends compare to 19th century. At the same time, concerns about population pressure were remained a major concern and historically responded by considering it a challenge. In 1798, Thomas Robert Malthus gave theory of geometric and arithmetic progressions of population size and the food production respectively (Malthus, 1798). It warned upcoming difficult scenarios due to un-attended population growth and fuelled concerns about widespread and worst famine scenarios worldwide

that ultimately led the promulgation of 'Census Act 1800' in Britain. So, concerns about population pressure are an old fashion subject. Afterwards, his theory was criticized regarding his future prediction about stone-age scenario in the context of un-attended population and pressure on resources, with the reasons of undermining the intellectual wisdom of future generations. However, his theory has strong linkages with human security aspects and can be considered a good marker for the *Anthropocene* from social and environmental point of view. It is fact that global population has increasing trends over period but at the same time, population growth rate has witnessed negative trends in some areas. The given scenario raises a question on AWG's proposed markers i.e., 'is it rationale to take a controversial and un-scientific ground for the starting point of a geological timeline'?

Sahay (2020) thinks that humankind has significantly affected each part of the planet Earth system. Each progression along the natural, biological and / or social evolution of people; like discovery of fire, the first mass-scale human migration out of Africa, domesticating plants and animals, scientific and industrial revolution, and so on, has thus prompted climate change, global warming, invasive species, and mass extinction of species. Lately, there has been an overall agreement among the scientific community that people have now altered the planet's climatic conditions so much that we have the claim of already been living in *Anthropocene* or the *Epoch of Humans* - a new geological time scale unit for the planet Earth, official fate of which is yet to be decided. The social scientists argue the population growth has intensified the anthropogenic impact on earth's environment because of utilization of natural resources and changes in way of life designs drove change in socio-cultural nexus.

The suggestion that the effect of humankind in the world has left an inimitable impression, even on the size of geological time, has as of late acquired a lot of ground. Ellis (2018), a member of AWG, summed up the division of *Anthropocene* in his book titled 'Anthropocene: a short introduction'. He characterized numerous markers including the worldwide climate change, shifting trends in weather system, mass-scale environmental pollution including contamination due to plastic, radioactive fallout, invasion of exotic species and extinction of species etc.

Stegner et al. (2021) examined sediment cores from Sears Ville Reservoir, a 129 years old reservoir located in the eastern foothills of the San Francisco Peninsula to characterize the anthropocene. They collected eight sediment cores ranging from 7.4 to 8.5 meters in length that appear to have bottomed out on the pre-reservoir surface, indicating average sedimentation rates of 6 to 7 cm per year. This exceptionally high sedimentation rate allows them to explore the Anthropocene geologic record on a sub-annual scale. Based on their study, they are of the view that human activities changed our planet over the course of the Holocene, but the scale of impacts increased dramatically around the mid-20th century, representing the start of the Anthropocene.

Odada et al. (2020) discovered geological resources along the shorelines of East Africa, lakes and peats as magnificent records of ecological and climatic

changes. They think that investigation of these sedimentary records has added to the worldwide knowledge of changes triggered by anthropogenic practices related to the '*Anthropocene*' in the context of environmental and biological system. Odada et al. (2020) contended that people have habituated East Africa for millennia, however until around 300 years ago, their environmental impact was restricted and regional. The effects were intensified during the nineteenth century because of rapid population growth, agricultural extensification and intensification for the purpose of food security that was to a great extent, driven by colonists. During this period, the overprinting of natural changes by people is clear, set apart by critical changes in sedimentation, properties of sediments, and lake water quality as an outcome of land and water degradation and over exploitation of natural and oceanic/aquatic biological system, products and services. There have been spatio-temporal lags in the changes; contingent upon locality, however there is an assemblage of these impacts from the mid-1900s, which support the AWG's proposed division of 1950 as the beginning of the Anthropocene to some extent. This proposal is also supported with the argument that the scale of anthropogenic impacts increased manifolds around middle of 20th century (Stegner et al., 2021). Off-course, this is just one of the discussed options for demarking the Anthropocene with reasonable, rationalized and widely accepted markers. However, there is a need to fully understand human civilization and the culture evolved together with push and pull factors responsible for the alterations in the global ecological system in an unprecedented manner. Here, the anthropological context becomes very important in order to examine and understand the essence how and when humans actually became the real and strong agent of change due to which we are entered into and debating the *Anthropocene* in the perspectives of humanity (Sahay, 2020).

There are some other arguments about demarcation of Anthropocene. Ruddiman (2013) brought up three criticisms regarding this conceivable activity. In his view, first, history of significant human changes of Earth's environment went even before the 1900s. For instance, extinction of Australian and American mammals; large scale deforestation of arable areas throughout the planet; formation of anthropogenic wetlands for rice irrigation; and in recent centuries, furrowing of grasslands and steppes for transformation to croplands. His subsequent complaint is that the formal chronostratigraphic rules followed by the AWG reject any acknowledgment of these early changes: the fast pulse-like like extinctions because they were just continent based, and clearing of forests, systems for rice irrigation, and grassland furrowin. Third, the traditional methodology the AWG follows – adding regions to the standard Geologic Column – is to a great extent dismissed today among researchers working in the latest geologic record, as is evident from the uncommon notification of the Pleistocene sub-divisions in paleoclimate books. Hence, the utilization of a casual, adaptable '*Anthropocene*' is desirable over the imperatives that would be forced by characterizing a formal '*Anthropocene*'. These contentions are additionally upheld by the pluralist arguments with respect to the Anthropocene markers, which are intriguing because of an exceptionally diplomatic position by thinking about the case as moving window and differ to its fixed point in time (Stallins, 2020).

The timescaping approach the presence of plastics and the nuclear tools as the candidate markers of the onset of the current epoch (Bensaude-Vincent, 2021) depicts contradiction between these two. There is an interesting tale about the ecological effects of micro-plastics (particles <5 mm) which are being advocated as potential markers for the beginning of Anthropocene, since they were explored for a decade by “Leibniz Institute for Baltic Sea Research” (do Sul & Labrenz, 2020). This is very much contrary to the actual proposal of the Working Group of ICS regarding the nuclear technology / bombing.

It is fact that ‘*Anthropocene*’ has become a frequently and widely used term in a diverse range of fields. However, misconceptions prevail that act as limiting factors for consensus based validity and legitimacy on scientifically precise grounds and markers (Rull, 2017). A typical misguided judgment is that the “Anthropocene” term and the idea began toward the start of this century yet truly the concept was completely advanced over 140 years prior (Rull, 2017). Another continuous misrepresentation is that the “Anthropocene” is now a formal geological term. In any case, the cycle of its formalization as another unit of the Geological Time Scale has not yet started. Another ineffectively tended to the angle is the meaning of future human development, from both social and evolutionary perspectives, in the possible meaning of another geological age as the “Anthropocene”(Rull, 2017).

There is also a question regarding the quantum of rapid industrialization, ‘whether it had more flux during the mid of 20th century or in the beginning of 21st century’? There is a conflict regarding this criterion. The geological point of view believes that it should be linked with some stratigraphic changes, which requires millions of years on time-scale. However, the environmentalists argue that the early onset of changes on the surface of the earth be linked as primary markers, which became very relevant and significant with the industrial revolution for which major markers include the invent of steam engine in year 1814 – the first locomotive and subsequent burning of coal and fossil fuel. Therefore, linking Anthropocene with atomic bombing in mid-20th century to justify starting point for Anthropocene is not rationale.

CONCLUSION

This paper has tried to analyse and provide current state of the knowledge and consensus about demarking *Anthropocene Epoch*. Based on analysis, it is found that there is a lack of consensus about the starting point and markers of *Anthropocene* due to the existence of a diverse range of proposed markers for the same. According to geological point of view onset of *Anthropocene* should be linked with some stratigraphic changes, which requires millions of years in time scale. The environmentalists argue that the early onset of changes on the surface of the earth be linked as primary markers, which became very relevant and significant with the industrial revolution. The social scientists argue that the population growth intensified the anthropogenic impact on the earth’s environment. Due to consumption of resources and changes in lifestyle patterns led transformation in socio-cultural nexus for which markers be linked for the start of *Anthropocene*. However, it is good thing that AWG has narrowed down the global discussion that stretched on a wide range of

proposed markers in social, environmental and technological context. But the criteria and markers proposed by AWG are still underdeveloped as demerits are apparently superseding the merits. Based on arguments, it is deciphered that the proposed criteria / markers to start *Anthropocene Epoch* from middle of 20th century are not rationale since there are strong counter arguments exist. However, it would be wise to start the *Anthropocene Epoch* since the year 1800.

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