The "Anthropocene" epoch: Scientific decision or political statement?

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ABSTRACT

The proposal for the "Anthropocene" epoch as a formal unit of the geologic time scale has received extensive attention in scientific and public media. However, most articles on the Anthropocene misrepresent the nature of the units of the International Chronostratigraphic Chart, which is produced by the International Commission on Stratigraphy (ICS) and serves as the basis for the geologic time scale. The stratigraphic record of the Anthropocene is minimal, especially with its recently proposed beginning in 1945; it is that of a human lifespan, and that definition relegates considerable anthropogenic change to a "pre-Anthropocene." The utility of the Anthropocene requires careful consideration by its various potential users. Its concept is fundamentally different from the chronostratigraphic units that are established by ICS in that the documentation and study of the human impact on the Earth system are based more on direct human observation than on a stratigraphic record. The drive to officially recognize the Anthropocene may, in fact, be political rather than scientific.

INTRODUCTION

Since the publication in *GSA Today* of the article titled, "Are we now living in the Anthropocene?" (Zalasiewicz et al., 2008), the proposal that a new epoch in the geologic time scale called the "Anthropocene" be established has received greatly increasing attention in both scientific and public media (e.g., *Nature*, *Scientific American*, *Science*, *Geoscientist*, *The New York Times*, *Los Angeles Times*, *The Economist*, *National Geographic*, *Der Spiegel* online, to name a few). This attention arises from the desire by some for official recognition of the impact of humans on the Earth system, specifically its surface environments. A 2011 editorial in *Nature* asked, "Geologists are used to dealing with heavy subjects, so who better to decide on one of the more profound debates of the time: does human impact on the planet deserve to be officially recognized? Are we living in a new geological epoch—the Anthropocene?" The editorial answered the questions as follows:

> *Official recognition of the concept would invite cross-disciplinary science. And it would encourage a mindset that will be important not only to fully understand the transformation now occurring but to take action to control it. … Humans may yet ensure that these early years of the Anthropocene are a geological glitch and not just a prelude to a far more severe disruption. But the first step is to recognize, as the term Anthropocene invites us to do, that we are in the driver's seat. (Nature, 2011, p. 254)*

That editorial, as with most articles on the Anthropocene, did not consider the mission of the International Commission on Stratigraphy (ICS), nor did it present an understanding of the nature of the units of the International Chronostratigraphic Chart on which the units of the geologic time scale are based. We take this opportunity to provide the greater geoscience community with an understanding of the charge of the ICS and an appreciation of the history and nature of the units of the International Chronostratigraphic Chart. We compare the concept of Anthropocene to that of the systems, series, and stages of the International Chronostratigraphic Chart. We examine its usefulness as a unit defined by the criteria in the *International Stratigraphic Guide* (http://www.stratigraphy.org/index.php/ics-stratigraphicguide). We address the question of whether or not the International Commission on Stratigraphy is being asked to make what is in effect a political statement.

THE ICS AND THE INTERNATIONAL CHRONOSTRATIGRAPHIC CHART

The ICS, the largest constituent scientific body in the International Union of Geological Sciences (IUGS), is composed of a three-person executive board and 16 subcommissions, each with ~20 voting members, who together represent more than 50 countries. Its charge is to define a single hierarchal set of global chronostratigraphic units with precisely defined boundaries that can be correlated as widely as possible. Boundaries are selected at levels that best set limits to the chronostratigraphic unit that they delimit, and boundary definition employs the concept of Global Standard Stratotype Section and Point (GSSP) as set out in the *International Stratigraphic Guide* (Salvador, 1994) and in revised ICS guidelines (Remane et al., 1996). The web-based archive of the chronostratigraphic units and GSSPs approved by ICS and

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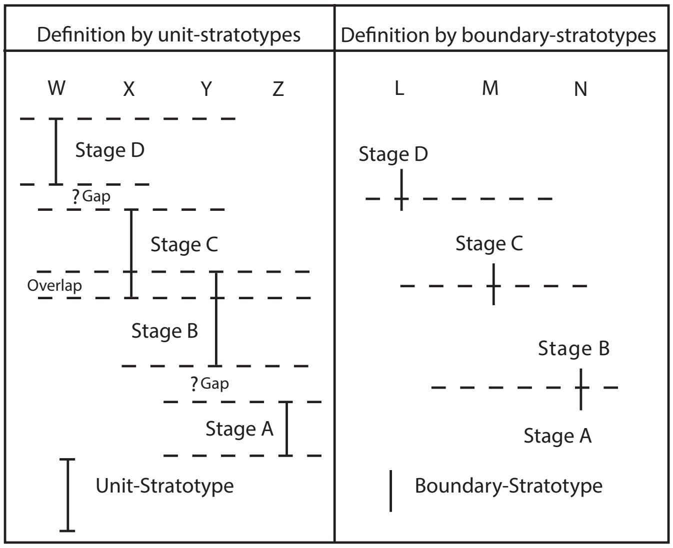

Figure 1. Advantage of defining chronostratigraphic units (stages) by lower boundary-stratotypes rather than by unit-stratotypes. Under boundary-stratotypes a specific level (horizontal dashed line) within a stratotype section (solid vertical line) serves to define the base of the superjacent unit and the top of the subjacent unit. Capital letters refer to widely separated type localities. Modified from Salvador (1994, their fig. 14).

ratified by IUGS is the ICS International Chronostratigraphic Chart and the Table of GSSPs, which are linked to the publications of the ratified GSSP proposals (www.stratigraphy.org).

Most of the systems, series, and stages of the ICS International Chronostratigraphic Chart were first defined from type sections or type areas in Europe, and they served as the basis for temporally correlating stratified Phanerozoic rocks worldwide primarily on their paleontological content. Although the traditional chronostratigraphic units were initially characterized by and correlated on the biostratigraphy of macrofossils, the biostratigraphy of microfossils became more widely used because they offered higher resolution and more widespread correlation. More recently, records of magnetostratigraphy, chemostratigraphy, cyclostratigraphy, and sequence stratigraphy have been established for most units, thus adding more varied and global stratigraphic signals for correlation. Thus, the concept of chronostratigraphic units today is a composite of stratigraphic information from successions worldwide.

When the traditional units were first named, boundaries between successive units were rarely defined. In fact, many units in type areas are bounded above or below by unconformities or covered intervals, and type areas of successive units are often at different locations. With continued study in type areas, with the study of stratigraphic successions elsewhere, and with the increased resolution of long-distance correlation, many successive chronostratigraphic units were discovered to either overlap or to be separated by gaps (Fig. 1). Furthermore, because of paleoecological and paleogeographical limits to the fossil content on which the units were recognized and because of the lack of specific boundaries, different interpretations of the stratigraphic extent and status were accorded to the same unit from one region to another, and multiple sets of regional series and stages were established for many systems (e.g., Webby, 1998). These deficiencies complicated stratigraphic nomenclature and hindered communication.

Since the time of Nicolas Steno, those who observed stratified rocks and considered the processes by which they formed accepted the concept that stratigraphic successions recorded the passage of time. Present-day bodies of strata are distinguished from the interval of time in the past when they accumulated as sediment by the use of two sets of terms. Chronostratigraphic terms apply to rock units (system, series, and stage), and geochronologic terms apply to time units (period, epoch, and age). These differences in terminology and concepts are presented in all stratigraphic guides and codes, even in first-year historical geology textbooks, and date to the 2nd International Geologic Congress in Bologna in 1881 (Vai, 2004).

A GSSP defines a stratigraphic boundary between two successive chronostratigraphic units in a single, continuous stratigraphic section. It sets the lower limit to the content of stratigraphic signals in a designated unit; hence, the upper limit to the content of the subjacent unit. The detailed succession of stratigraphic signals through the boundary interval is the basis for interpreting the correlation of that boundary into successions at other localities. The correlation of boundaries between successions in different localities is no different from correlating various stratigraphic levels or intervals within a unit, except that a GSSP is preferably placed at a stratigraphic level that provides the best set of stratigraphic signals for worldwide correlation. Use of lower-boundary GSSPs results in a succession of units between which there are no gaps and no overlaps (Fig. 1). A proposal for a GSSP is evaluated on several criteria (Remane et al., 1996), with the most important being that the boundary interval in the stratotype section has a diversity of stratigraphic signals that serve as the reference for the most reliable long distance correlation possible.

Since the first GSSP was ratified in 1972 for the boundary between the Silurian and Devonian systems, 62 of the 100 boundary levels that define the stages, series, and systems of the ICS Chart (download from www.stratigraphy.org) have ratified GSSPs. Most often, these sites are marked with an explanatory panel, a formal plaque (Fig. 2), and a "golden spike" (Fig. 3).

Figure 2. Plaque that marks the Global Standard Stratotype Section and Point (GSSP) for the base of the Thanetian Stage (Paleocene Series, Paleogene System) at Zumaia, the Basque Region, Spain.

Figure 3. Top of golden spike emplaced in bed that is the Global Standard Stratotype Section and Point (GSSP) for the Thanetian Stage. Length of "rock hammer" is 5 cm.

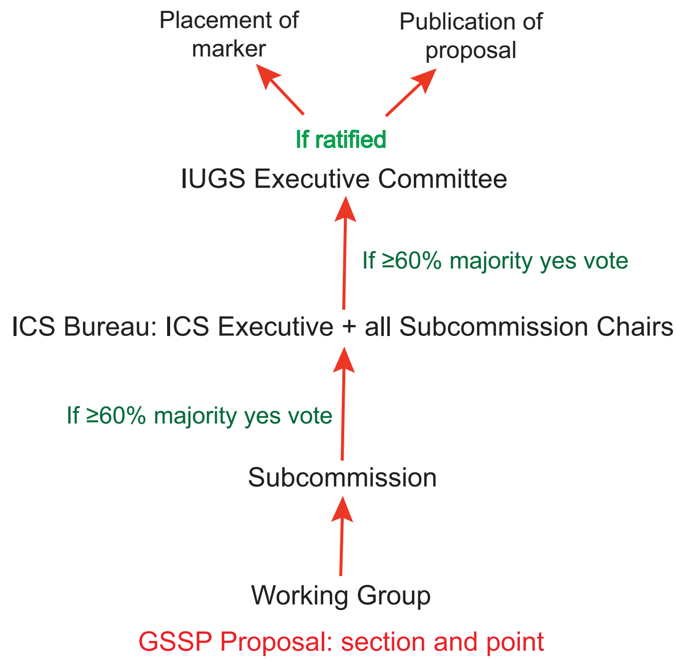

Figure 4. Workflow for approval and ratification of a Global Standard Stratotype Section and Point (GSSP) proposal. Extensive discussion and evaluation occurs at the level of the working group, subcommission, and International Commission on Stratigraphy (ICS) Bureau. If approved at these successive levels, a proposal is forwarded to the International Union of Geological Sciences (IUGS) for ratification. This process is also followed for other ICS decisions on standardization, such as approval of names of formal units, of revisions to the units, and to revision or replacement of GSSPs.

They are regarded as international geostandards, and their protection and future scientific study are encouraged. Each one serves as the primary definition of a boundary, which is the succession of stratigraphic signals in a boundary interval and the single signal at the stratigraphic level at which the boundary is placed. Locating the boundary in stratigraphic successions elsewhere is an interpretation made to the standard reference, the GSSP, after evaluation of all stratigraphic signals. The formal process of ratification of a GSSP (Fig. 4) begins with preparation of a written proposal by a working group comprised of specialists on the boundary interval. Development of a formal proposal requires extensive investigations of candidate stratotype sections and boundary levels worldwide. Following consensus approval of a proposal by the working group, it is then considered by the voting members of the relevant ICS subcommission. If approved by the subcommission, the proposal is forwarded to the ICS executive for consideration and voting by the ICS executive and the chairs of the 16 subcommissions. If approved at this level, the proposal is forwarded to the IUGS Executive Committee for ratification. Following ratification, the GSSP proposal must be published and posted on the ICS website, and the GSSP must be marked. The rigorous criteria on which a GSSP proposal is evaluated and the several levels of evaluation and consideration by which it is approved and ratified give validity and authority to ratified GSSPs as international geostandards.

A geochronologic unit (period, epoch, age) is the time interval during which the strata of a chronostratigraphic unit accumulated (Salvador, 1994). Geologic and biologic events and settings of the past, recorded in and interpreted from the rock record, are expressed in terms of geochronologic units. Once two successive GSSPs have been ratified, all the rocks that can be correlated to levels between the GSSPs are the stratigraphic record from which past events in Earth's history are interpreted for that interval of time. Geochronologic terms yield a relative geologic time scale, and calibrated ages make up a numerical geologic time scale. Calibrated numerical ages do not define the boundaries; they are subject to refinement and recalibration. It is the GSSP, a specific stratigraphic level in a stratotype section, that defines the boundary and to which numerical ages are calibrated to varying degrees of certainty.

THE ANTHROPOCENE

The term Anthropocene is widely used. In its latest iteration, it refers to the present, when human impact on Earth's surface, atmosphere, and hydrosphere has been deemed to be global. International organizations; national, regional, and local governments; nongovernmental organizations; and industries have taken steps to mitigate and remediate the impact where its nature is judged to be deleterious. Nevertheless, human impact is immense and potentially increasing. But, the question is: Should the Anthropocene be approved by the ICS and ratified by the IUGS as an official unit of the ICS International Chronostratigraphic Chart?

STRATIGRAPHIC RECORD OF THE ANTHROPOCENE

In contrast to all other units of the ICS chart, the concept of the Anthropocene did not derive from the stratigraphic record. It arose with Paul Crutzen (2002), a Nobel Laureate in Chemistry, who suggested that because of a greatly increased human impact on the Earth system, we had entered a new epoch, for which he proposed the term Anthropocene. Zalasiewicz et al. (2008) considered the effects referred to by Crutzen and raised the question of whether the effects justified the need for a new term, and if so, where and how its boundary might be placed. The ICS Subcommission on Quaternary Stratigraphy established a working group in 2009 to consider these questions. Since then, discussion of the Anthropocene has been extensive, with articles in both scientific publications and the public media, as well as in the greater academic sphere, including the social sciences and the legal community.

Summaries of anthropogenic changes to the Earth system and their occurrence in the stratigraphic record can be found in Zalasiewicz et al. (2008, 2011) and Waters et al. (2014a, 2014b). That stratigraphic record is negligible (Walker et al., 2015), especially with a boundary set at 1945, as recently proposed by the Anthropocene working group (Zalasiewicz et al., 2015). Most of the stratigraphic records mentioned are potential records that might appear in the future; they are based on predictions. Human structures, excavations, boreholes, bioturbation of soils (agriculture) and the sea floor (drag net fishing) are not strata. Made ground, refuse piles, mine dumps, and leach pads are made by humans rather than by natural sedimentation. The strata with records of anthropogenic change are speleothems, ice cores, and non-lithified sediments of rivers, marshes, lakes, coasts, and the ocean floor. In most of these depositional settings, it would be difficult to distinguish the upper few centimeters of sediment from the underlying Holocene, or sediment that has accumulated versus that that is in transit. Published logs with geochemical signatures of human impact are at most a few tens of centimeters thick (Nozaki et al., 1978; Al-Rousan et al., 2004; Marshall et al., 2007). Locating a boundary at 1945 would be difficult for anthropogenic isotope shifts in greenhouse gases that have been rising for 100 years or more (Wolff, 2014).

DEFINING THE ANTHROPOCENE BY ITS BASE (GSSP) OR BEGINNING (GSSA)

The Anthropocene working group has focused on defining the base or beginning of the Anthropocene, and several recent proposals have been published (e.g., Lewis and Maslin, 2015). That of Zalasiewicz et al. (2015), co-authored with 25 other members of the Anthropocene working group, sets a GSSA (Global Standard Stratigraphic Age) for the Anthropocene as 1945, the year of the first nuclear bomb explosion. Regrettably, focusing on the definition of the beginning of the Anthropocene can result in the lack of consideration of its stratigraphic content and its concept. It conveys the opinion that units of the geologic time scale are defined solely by their beginnings, rather than their content.

Zalasiewicz et al. (2004, p. 1) argued that the distinction between chronostratigraphic and geochronologic units is no longer necessary because of the widespread adoption of GSSPs "in defining intervals of geologic time within rock strata." Because GSSPs are placed at stratigraphic horizons that also represent specific points in time, two successive GSSPs define an interval of time that is a geochronologic unit (period, epoch, age), and all strata interpreted as deposited during that interval of time would comprise the corresponding chronostratigraphic unit (system, series, stage). The difference between this concept and that espoused in the *International Stratigraphic Guide* (Salvador, 1994)—that chronostratigraphic units and their boundaries serve to define corresponding geochronologic units—is subtle, yet important. It is stratigraphic content that allows for the recognition and correlation of a chronostratigraphic unit. Most correlations are made within units and not to their boundaries. The GSSP serves to set a limit on the stratigraphic content of a unit; it defines a boundary, not a unit. Formal systems, series, and stages have been recognized since 1881, yet the first GSSP was not ratified until 1972. Obviously, chronostratigraphic units and their corresponding geochronologic units were used long before there were GSSPs. The *International Stratigraphic Guide* (Salvador, 1994) provides specific criteria for definition of chronostratigraphic units, but it provides no guidelines whatsoever for defining geochronologic units other than the intervals of time represented by the corresponding chronostratigraphic units. Furthermore, the guide discusses GSSPs only with regard to defining boundaries of chronostratigraphic units and not to defining beginnings or ends of geochronologic units. For these reasons, the concept and definition of chronostratigraphic units of Zalasiewicz et al. (2004), which are further presented in Zalasiewicz et al. (2008, 2011, 2015), are not consistent with the history of these units nor with the *International Stratigraphic Guide*.

The lower boundary of the Cretaceous System is not yet defined by a GSSP, and neither are the Lower Cretaceous Series and its constituent stages (Berriasian, Valanginian, Hauterivian, Barremian, Aptian, and Albian). Nevertheless, these are traditional units of the ICS Chart and thus are units of the geologic time scale. They have content. They can be correlated into stratigraphic successions worldwide. They have long been used worldwide. Their deficiency is that limits have not been formally set for their stratigraphic content. At an ICS workshop in 2010, the proposal of Zalasiewicz et al. (2004) was considered at length and rejected unanimously by the ICS voting members, who considered the distinction as unnecessary and obvious. It is of concern that this rejected concept is being followed by the Anthropocene working group and promoted in both scientific and public media.

The focus of proponents on the beginning of the Anthropocene has led to a misrepresentation by the leaders of the working group in the lead article (Waters et al., 2014b) of *A Stratigraphical Basis for the Anthropocene* (Waters et al., 2014a). The second paragraph states, "J. Phillips used the major mass extinction at the end of the Permian in 1840 to recognize the beginning of both the Triassic Period and of the Mesozoic Era." This statement is false. The Triassic was established in 1837, and Phillips (1840) focused on the term Palaeozoic. The term Mesozoic was used only once in a list contained within parentheses. In 1841, Phillips mentioned the Mesozoic only in one sentence:

> *The lower of these …, the Magnesian Limestone formation, contains corals, brachiopoda, and fishes, so extremely similar in detail or analogous in their general history to the corresponding forms of the mountain-limestone, that it is impossible in any fair classification to sever this group of fossils from the Palæozoic series; while, on the other hand, the upper of the two formations, the Red-Sandstone and Keuper series, presents almost no resemblance to the older, but a decided analogy to the newer, or, as we wish to call it, Mesozoic series of the Oolites. (Phillips, 1841, p. 355)*

Later, in his book *Life on Earth: Its Origin and Succession*, Phillips (1860, p. 64) described the prevalent fauna in each system as rising to a maximum and dying away to a final minimum to be followed again in the next system, with "the most remarkable of these zones of least life being the two that separate the Palaeozoic from the Mesozoic and the Mesozoic from the Cenozoic." Nowhere does Phillips (1860) mention a mass extinction as marking the beginning of the Triassic, and Phillips actually used his compilation of fossil data to argue against the theory of natural selection proposed the previous year by Charles Darwin. Yet, Waters et al. (2014b) cites Phillips (1840) to assert that human-induced changes to the stratigraphic record, although they are still yet to be recorded, are reason enough for officially recognizing the Anthropocene as a new unit on the geologic time scale. In fact, many, if not most, of the ratified GSSPs are at stratigraphic levels that do not represent major changes to the Earth system, whether geologic or biologic. For example, the bases of the Ordovician, Devonian, Carboniferous, and Permian systems are placed at the lowest occurrences of single graptolite or conodont species. They were chosen at stratigraphic levels within boundary intervals that offered the best potential for reliable, worldwide correlation. Waters et al. (2014b) also stated that units have historically been defined on significant events, when in reality it is the lack of definition of boundaries that has long plagued long-distance correlation of chronostratigraphic units. It is of concern that the history and nature of chronostratigraphic units have not been fairly conveyed.

Justification for defining the Anthropocene with a GSSA is found in the Holocene and the Precambrian. Repeated statements by Zalasiewicz et al. (2008, 2011, 2015) that the Holocene was defined by a GSSA are misleading. A formal definition of the Holocene with its base (beginning) defined by a GSSA was never approved by ICS nor ratified by IUGS; a numerical age of 10,000 ^{14}C yr B.P. was simply adopted by convention by the INQUA Holocene Commission, but it was then considered temporary (Walker et al., 2015). For the Precambrian, ICS adopted a set of numerical ages for the definition of boundaries between Archean and Proterozoic Eons and between their constituent eras (Remane et al., 1996). However, during these eons and eras, voluminous stratigraphic records accumulated and extensive bodies of plutonic and metamorphic rock were generated. Rock-based temporal classifications were established for each shield area long ago, but global units defined by isotopic ages allowed for a global standard time scale. The GSSAs were set at large round numbers, but those exact values cannot be located precisely in stratigraphic sections. Remane et al. (1996) considered them as theoretical postulates and pointed out their status only for boundary definition in the Precambrian. Today, the ICS Subcommission on Precambrian Stratigraphy is striving to replace the units defined by GSSAs with units defined by GSSPs, considering the latter to be more useful (Van Kranendonk et al., 2008). It is of concern that proponents of the Anthropocene do not fully explain the origin and concept of GSSAs.

THE NATURE AND UTILITY OF THE ANTHROPOCENE

The Anthropocene, as currently popularized, is fundamentally different from the chronostratigraphic units that are the charge of the ICS. It is the present and future versus the past. Events and effects and impact are observed, measured, and documented by humans as they occur and are dated with the Gregorian calendar (Wolff, 2014), and geologic events are too (e.g., 1906 San Francisco earthquake, 1980 eruption of Mount St. Helens). The stratigraphic record is the past. It is studied in order to *interpret* past events in Earth's history, and these interpretations require the application of stratigraphic techniques, concepts, and principles. In spite of this detachment of the Anthropocene from the concept and use of chronostratigraphic units, the term Anthropocene may have utility. It is popular among a diverse scientific community, social scientists, and the media. It does raise awareness that, as with anthropogenic climate change, the human impact on the Earth system is global, and that human impact may have initiated a cascade of events that will greatly alter Earth's surface, oceans, and atmosphere.

The term Anthropocene is of similar character to the term Renaissance. Both refer to richly documented, revolutionary, human activities that are dated in the Gregorian calendar. Both carry significant connotation. Although a precise date in calendar years is not specified for the Renaissance, the term is established and conveys a singular meaning of the content of that period, where it began, how it evolved, and how it spread. The same applies to Anthropocene if its concept is the human impact on Earth's surface. Without doubt, scholars have argued over the singular human creation, whether in literature, architecture, or art, that initiated the Renaissance, but there is no need to define its beginning, because the dates and locations of the creations are well established. Furthermore, it would be contrary to current practice to define its beginning at a single point in time because it is a cultural movement that is not tied to a single date. The same is true for the Anthropocene, whether it is a hydroelectric dam constructed in the Italian Alps, a gold mine in South Africa, the dramatic increase in carbon combustion during the Industrial Revolution, the growth of a megacity, the clearing of rain forests, or the increase in CO_2 in the atmosphere and the resulting increase in global surface temperatures. Is putting an official beginning on the Anthropocene any more advantageous than on the Renaissance? The only reason appears to be to give it credence as a unit of the geologic time scale.

The year 1945, proposed as the beginning of the Anthropocene, was selected because it marks the first atomic bomb explosion that initiated a period of atmospheric testing, the results of which are seen in radionuclides in ice cores and lake cores. The radionuclides in cores can be taken as the stratigraphic signal that most closely coincides with what has been termed the great acceleration of human impact on the Earth system (Steffen et al., 2007). That stratigraphic signal first becomes evident in deposits from 1952 to 1960, the years of extensive atmospheric testing of nuclear bombs (Waters et al., 2015). Clearly, much of the human impact used as evidence of the Anthropocene predates 1945 (e.g., Zalasiewicz et al., 2011; Waters et al., 2014b). The same would be the case with the term Renaissance, if it was arbitrarily but objectively defined by the year 1500, when the influence of the Renaissance spread from Italy to the rest of Europe. It would result in the first works of the Renaissance being relegated to the Middle Ages. In this vein, Ruddiman et al. (2015) questioned whether or not it makes sense to define the start of the human-dominated time long after deforestation and agriculture changed the landscape and after greenhouse gases had been rising due to agricultural and industrial emissions. Proponents of the Anthropocene are thus left with the question of whether or not a beginning of the Anthropocene should be set and, if so, when. They must also consider how this affects the utility of the term as used not just by stratigraphers but also by other geologists, archaeologists, biologists, atmospheric chemists, and social scientists. Finally, it must be noted that with 1945 as the beginning, it would be a geologic time unit that presently has a duration of one average human life span.

POLITICAL STATEMENT

When we explain the fundamental difference of the Anthropocene from the chronostratigraphic units established by the International Commission on Stratigraphy to proponents for its recognition, they often reply that the human impact on the Earth system must be officially recognized, if for no other reason than to make the public and governmental agencies aware of that impact. Or, as the editorial in *Nature* (2011) argued, official recognition would encourage cross-disciplinary science and a "mindset" to understand and to take control of the current transformation. However, it is political action that is required to meet the ultimate goals of ameliorating human impact, which raises the question of the ICS making a political statement. Pope Francis has spoken out about the human-induced impact on the Earth system—so too have leaders of many nations, the United Nations, and numerous non-governmental organizations. In California, Governor Jerry Brown has initiated and promoted many legislative actions with the goal of ameliorating human-induced impact. Is the role of the ICS to make such a political statement? Would official recognition of the term Anthropocene as a unit of the ICS Chart realistically have any effect on promoting cross-disciplinary science or recognizing that we are in the driver's seat as *Nature* editorialized? Or, is that not already the case?

The evolution of vascular land plants and their spread across the continents from late in the Devonian to early in the Permian completely altered Earth's surface, left a significant stratigraphic record, and dramatically altered CO_2 and O_2 concentrations in the atmosphere and oceans far greater than humans are projected to do (Berner and Canfield, 1989; Berner, 1998). Yet there is no drive to name a unit in the ICS Chart that formally recognizes that profound and irreversible change to the Earth system. Perhaps promotion of the Anthropocene is anthropocentric as well as political?

The "Atomic Age," a term coined by *The New York Times* journalist William L. Lawrence in September 1946, has an identical boundary and content to the Anthropocene proposal of Zalasiewicz et al. (2015). By rights, the Atomic Age has nomenclatural priority. If the Anthropocene is not a political statement, those who value priority should prefer the Atomic Age.

CONCLUSIONS OR THE WAY FORWARD

No formal, written proposal has yet been submitted by the Anthropocene working group to the ICS Subcommission on Quaternary Stratigraphy. Until that happens, the ICS and the Quaternary Subcommission have nothing to consider, in spite of all that has been published by the members of the working group and by others in the scientific and public media. Assuming a formal proposal is made that recommends approval of an Anthropocene unit and boundary definition, that proposal will have to provide a detailed description of the stratigraphic content of the unit and show correlation of the lower-boundary GSSP to lake cores, ice cores, and other stratigraphic records from geographically widespread locations. It should also address questions on the concept, basis, and stratigraphic utility of the unit, such as those raised here and by Finney (2014), Head and Gibbard (2015), and Walker et al. (2015). It must consider the rank of the unit in light of the fact that its duration is that of an average human lifespan. Lastly, such a proposal should recognize that events of a proposed Anthropocene are those directly observed and precisely dated with human chronometers and calendars, and would not be interpreted from its marginal and impoverished stratigraphic record. The fundamental question that should be addressed in the proposal is this difference between the character of the Anthropocene and that of the chronostratigraphic units of the ICS chart.

Consideration of a proposal by the ICS Subcommission on Quaternary Stratigraphy and possibly then by the entire ICS will involve extensive discussion among voting members. Such discussions educate the voting members as they study the proposal, and such discussion can and should be open to those who are not voting members. Indeed, this was the nature of the discussion in 2008–2009 that preceded the ICS vote on definition of the Quaternary System and redefinition of the Pleistocene series. It is hoped that the audience of this article becomes interested and contributes to the discussion. All opinions are welcome, but all positions and arguments are subject to challenge. It is in this manner that the ICS will give careful consideration to a formal proposal when submitted.

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