

# Anthropocene Working Group of the Subcommittee on Quaternary Stratigraphy (International Commission on Stratigraphy)

## Newsletter 1, December 2009

Dear all

Welcome to the Anthropocene Working Group, the remit of which is to examine the status, hierarchical level and definition of the Anthropocene as a potential new formal division of the Geological Time Scale. This is our first Newsletter, designed to:

- bring everyone up to date with who their colleagues on the Working Group in this are, listing the membership to date. We will likely need to bring in other members, to cover areas of expertise or geographical regions that we might regard as necessary but so far unrepresented. These areas of expertise will need – uniquely for an ICS Working Group – to cover fields of research in both ‘deep time’ and contemporary environmental change (if you have any suggestions for new members, please forward them: the membership should not grow so large as to be unwieldy, but it does need to be of sufficient scope).
- propose the broad outlines of activities that we might develop to examine the concept of the Anthropocene, suggest how those activities might then be eventually translated into reports, papers or recommendations to the ICS, and indicate timescales and deadlines.
- give news of current and planned WG ventures, and of related or relevant activities.

The background to this, as you are aware, is the suggestion of this term (Crutzen, 2002) proposing that we are now living in a new geological interval of time – the Anthropocene - that is dominated by human activities. Since then, the term (currently informal) has been widely used by a range of Earth and environmental scientists, and the concept has been further examined (e.g. Steffen *et al.* 2008). Recent assessment by the Stratigraphy Commission of the Geological Society of London (Zalasiewicz *et al.* 2008) suggested a case for formally incorporating the term into the Geological Time Scale. The rationale behind this suggestion was recognition of the wide-ranging effects of anthropogenic influence on stratigraphically significant parameters: global atmospheric composition and temperature, cryosphere stability, ocean chemistry (e.g. acidification, anoxia) and sea level, biodiversity, landscape processes and near-surface sedimentation. The resulting anthropogenically driven changes – it was suggested - will almost certainly be reflected in a distinctive geological record.

Hence, we are assembled to critically consider the case for a formal Anthropocene, and to make recommendations to our parent body (the Subcommittee on Quaternary Stratigraphy (SQS) of the International Commission on Stratigraphy (ICS), through them to the ICS itself, and then on to its parent body, the International Union of Geological Sciences (IUGS). A further body to be (at least) consulted and kept informed is the International Union of Quaternary Studies (INQUA), a body equal in rank to the IUGS.

**Membership to date:** The Working Group is ideally to be composed of Earth scientists with worldwide representation and familiar with deep time stratigraphic history (Cenozoic and older), with Quaternary (including Holocene) stratigraphy, and with relevant aspects of contemporary environmental change (including its projection by modeling into the future). Listed here are names

of members to date and their contact details. If you could send a brief indication (a couple of lines) of relevant expertise this will be added to the listing on future newsletters.

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JZ is currently Chair (at the suggestion of PG, who chairs the SQS), while MW is Secretary for reasons including practical ones (having the office next door to JZ). These roles will rotate among the Working Group over time.

**Programme of work:** In general, we have to critically compare the current degree and rate of environmental change, caused by anthropogenic processes, with the environmental perturbations of the geological past, to assess the scale of current global change in geological terms. The following parameters may fall within our area of interest:

- **Atmospheric chemistry**, notably the anthropogenic rise in greenhouse gases, vis-à-vis rises in the geological past, both in the Quaternary (at glacial phase terminations) and in earlier events such as the Paleocene-Eocene Thermal Maximum. Current literature suggests that contemporary rise is approaching the same order of magnitude as the geologically earlier events, but is happening much (an order of magnitude?) faster. Factors to be considered here include the suggested pre-industrial modification of greenhouse gas levels and climate by early human agrarian activity (Ruddiman, 2003).
- **Surface warming amounts and rates**, present and in the geological past. Given that temperature rise likely lags greenhouse gas increases, for the former we will need to take into account both elapsed global temperature trends and predicted (modeled) rises over the coming century.

- **Sea level trends**, resulting both from thermal expansion and from exchange with ice (and so consideration of changes in the cryosphere need consideration). As regards contemporary and near-future trends, the ‘lag’ effect also needs to be considered, and in addition the evidence from the geological record that many past sea level rises have been geologically abrupt, resulting from ice sheet ‘collapses’. The study of Rahmstorf (2006) linking long-term sea level trends relative to global temperature (suggesting a ca 10 m long-term sea level rise for each 1 degree C of temperature increase) needs to be critically considered, as does the meaning of ‘long term’ in this instance.
- **Biodiversity trends**. This is complicated by the different approaches of palaeontologists and biologists in assessing biodiversity (with the focus by the former on skeleton-bearing organisms, for instance); by the combined effects, today, of habitat loss, of predation (by humans); of global temperature change (expressed more quickly in the sea, where organisms typically live within a narrower temperature range than on land); and of geochemical perturbations such as the ongoing pH decrease in the oceans and its effect upon calcifying organisms (and of the spread of anoxic ‘dead zones’, though the impact of these currently seems local rather than global). There is furthermore, the influence today of large-scale trans-global alien species introduction, a phenomenon only seen in the geological past by the breaching (through plate tectonics) of geographic barriers. Through all this, we have to reach some conclusion as to what extent (for instance) the world is in the throes of an extinction event comparable with the ‘Big Five’ of geological history.
- **Sedimentation trends**. This includes considering estimates of global anthropogenic versus natural baseline erosion/sedimentation; of ‘selective erosion’ (of metal deposits, for instance); and of the creation of the ‘human stratum’ of urban landscapes and their substructures.

There are likely other broad categories that need consideration – please feel free to suggest modifications or additions to this list. Once these are more or less settled, then a sensible approach may be to set up sub-groups from among us to examine and provide overviews of these topics, suggesting further work as necessary.

### **In the longer term...**

We need, in sum, to establish whether meaningful comparisons of this type can be made, and whether the scale and rate of past and current global change – biological, physical, chemical can be established and preferably quantified, sufficiently to justify (or deny) the formal use of the term ‘Anthropocene’. We need also to consider the question of utility: whether more precise definition and formalization of the term ‘Anthropocene’ would serve a useful purpose for Earth scientists.

If a formal Anthropocene was justified, consideration should be made of its **hierarchical level** (Age/Epoch/Period). If it is to be an Age, then it would be a component unit of the Holocene; if on the other hand it is to be an Epoch or Period we would be suggesting that the Holocene as a geological unit had terminated – a decision with considerable scientific and likely political implications (see below). Decisions on this question by us (and, up the line, by other ICS/IUGS bodies) need perhaps be guided by a combination of geological comparison (estimated scale of change) and utility to working Earth scientists – i.e. essentially within the scientific domain. We should be aware of wider implications, though (arguably) not influenced by these.

We need to consider, too, the potential **boundary level**. Possibilities include the beginning of the Industrial Revolution (ca 1800), coincident with a rapid increase in population together with

hydrocarbon-driven industrialization, and the ‘Great Acceleration’ in human activity of the 1950’s (Steffen *et al.* 2008). A potential Anthropocene boundary might be defined either by a physical level in a stratal section or an ice core (Global Stratigraphic Section and Point - GSSP – familiarly termed ‘golden spike’) or by a numerical date (Global Standard Stratigraphic Age – GSSA).

**Relevant dates and deadlines:** A preliminary report of this Working Group – basically to establish its existence – will be given at an ICS meeting to be held in **Prague, May 2010**. A more important deadline is the **International Geological Congress, Adelaide 2012**, for which we should provide a considered overview (even if interim) on the Anthropocene.

**Mode of work:** in common with most other ICS working groups we do not have a budget, for travel or otherwise. Work will be largely conducted by e-mail, with occasional ad hoc meetings whenever a sufficient number (two or more) members find themselves at, say, the same conference. ‘Official’ distribution of results, news and so on may best be done through Newsletters circulated to all of us at regular intervals – perhaps quarterly (and copied to the SQS, ICS and INQUA) with information collated centrally by Chair and Secretary. In addition, an annual report needs to go to the SQS/ICS. Correspondence between any members of the Working Group on any topic is encouraged (exhorted, even), though for practical reasons (we all get too much e-mail), this is probably best circulated as appropriate for the particular task in hand, rather than everything going as blanket e-mails to everyone.

### Relevant activities and news

- An account of the Anthropocene for the *Encyclopedia of Earth*, authored by Erle Ellis, has been published online (<http://www.eoearth.org/article/Anthropocene>), and a paper on the Anthropocene (attached) by Erle Ellis and Peter Haff has just appeared in *Eos*.
- An Anthropocene Foundation is being proposed by Richard Brenne (based in the US) as a means of informing the public about global change.
- Summary papers on the Anthropocene have been invited by the editors of the forthcoming volume *Geological Time Scale 2010* (ed. Gradstein and Ogg) and by *Environmental Science and Technology* (a journal of the American Chemical Society). The former is by Zalasiewicz, Crutzen & Steffen and the latter by Zalasiewicz, Williams, Steffen & Crutzen; both are now in press.
- The Royal Society of Great Britain have accepted a proposal for a thematic set of papers on the Anthropocene, to appear in their *Proceedings* journal. This thematic set (editors: Zalasiewicz, Williams, Haywood, Mike Ellis) will examine in detail aspects of the Anthropocene, and papers have been invited as follows:
  1. Historical perspectives and concept of the Anthropocene
  2. Stratigraphic context to the Anthropocene
  3. Historical and predicted anthropogenic modification of sedimentation
  4. Historical and predicted anthropogenic modification of climate
  5. Historical and predicted anthropogenic modification of land cover
  6. Historical and predicted anthropogenic modification of the oceans (including ocean acidification, marine anoxia)
  7. Historical and predicted anthropogenic modification of the cryosphere (glaciers, tropical high altitude ice caps, sea-ice, major ice sheets and sea-level)

8. Historical and predicted anthropogenic modification of global biodiversity (oceans and land)
9. Deep time analogues to the Anthropocene
10. Societal responses to the Anthropocene

Members of this Working Group are among the invited authors, and the papers are to be submitted for review by May 2010 and submitted to the Royal Society by September 2010, with publication anticipated for January 2011. The results of this exercise should feed usefully into our discussions.

- The Smithsonian Institution (American National Museum of Natural History) is planning a major re-organisation of its main geology exhibition, to focus on the Earth in the context of deep time. The planning is at an early stage, but the consideration of the Anthropocene in concept and perhaps in name has been included in these early discussions.
- Appendix 1 below comprises correspondence regarding the potential significance of the Anthropocene for maritime law. This case highlights some of the implications of a formalized Anthropocene, and Dr. Vidas has joined the Working Group to advise on such wider societal implications.

Crutzen, P.J., 2002, Geology of Mankind. *Nature* **415**: 23.

Rahmstorf, S. 2006. A Semi-Empirical Approach to Projecting Future Sea-Level Rise. *Science*, **315**: 368-370

Ruddiman, W.F., 2003, The anthropogenic Greenhouse Era began thousands of years ago. *Climate Change* **61**: 261-293.

Steffen, W., Crutzen, P.J. & McNeill, J.R., 2007, The Anthropocene: are humans now overwhelming the great forces of Nature? *Ambio* **36**: 614-621.

Zalasiewicz, J., Williams, M., Smith, A., Barry, T.L., Bown, P.R., Rawson, P., Brenchley, P., Cantrill, D., Coe, A.E., Cope, J.C.W., Gale, A., Gibbard, P.L., Gregory, F.J., Hounslow, M., Knox, R., Powell, P., Waters, C., Marshall, J., Oates & Stone, P. 2008. Are we now living in the Anthropocene? *GSA Today* **18** (2): 4-8.

## APPENDIX 1

From: Davor Vidas [Davor.Vidas@fni.no]

Sent: 28 August 2009 14:29

To: jaz1@leicester.ac.uk

Subject: Inquiry related to the Anthropocene - epoch or age?

Dear Dr. Zalasiewicz,

I am writing to inquire about the status of a proposal (if any submitted) for the adoption, or ratification, by the International Commission on Stratigraphy of the Anthropocene epoch, or age.

I read an article published in GSA Today, Vol. 18, No. 2, 2008, where you are the lead author, and have tried for some time to find out whether there were further developments following the publication of that important article. (I also just wrote to one of your co-authors, P. Bown, to inquire about the status.)

My inquiry is not out of pure curiosity, rather I consider the findings published in your article of wider, though possibly indirect importance for other disciplines, also with implications to our perspectives for the development of the international law of the sea, which is the subject of my work and research interest.

I look forward to hearing from you.

Sincerely,

Dr. Davor Vidas  
Director, Marine Affairs and Law of the Sea Programme  
Senior Research Fellow  
The Fridtjof Nansen Institute  
Norway

Dear Dr. Vidas

thanks for your enquiry. The paper that we (members of the Stratigraphy Commission of the Geological Society of London) wrote simply made the point that a reasonable general case could be made for considering the Anthropocene as a formal unit. The term is not yet formal, but the next step has been taken: that is, an Anthropocene Working Group of the Quaternary Subcommission of the International Commission on Stratigraphy has been established, and over the next few years this will examine and weigh the geological evidence (pro and con) and the utility (primarily to the Earth sciences) as regards potentially formalizing the unit. Other initiatives are also in progress (such as proposing a Royal Society volume to look at the evidence in more detail).

If the Working Group decides in favour, that decision will then be debated (and will need to be ratified) by the "Quaternary Subcommission, then by the International Commission on Stratigraphy, and finally by the International Union of Geological Sciences. It is quite a long process, always, to make changes to the Geological Time Scale, and the end result is always in doubt.

I would be glad to discuss the wider implications, though, to your field of study, because while we are aware of the general societal implications of this term, the possible practical implications for international law would be of considerable interest in our examination of this term

with best wishes

Jan Zalasiewicz

From: Davor Vidas [Davor.Vidas@fni.no]  
Sent: 28 August 2009 20:49  
To: jaz1@leicester.ac.uk  
Subject: RE: Inquiry related to the Anthropocene

Dear Dr. Zalasiewicz,

Many thanks for your prompt response today afternoon, which I appreciate very much.

As to the international law of the sea, our concepts also need some time to develop. Our current law of the sea regulation, as contained in the 1982 UN Law of the Sea Convention, is a result of gradual development, especially in the course of the past four centuries. An important trigger in that development was a book published in 1609 – *Mare Liberum*, by Hugo Grotius; it elaborated on the concept of the 'freedom of the seas', which still today retains its place among major principles of the law of the sea, as reflected in the 1982 UN Convention.

In our time, however, we increasingly see the need for fundamentally new approaches to be developed in the law of the sea, to enable us to respond more adequately to the challenges resulting from our current level of uses of seas and oceans. I trust that, in the near future, we may have to give the main emphasis to a new concept, such as the 'responsibility for the seas'.

The main development of the law of the sea after the Second World War drew on a geological basis – on the continental shelf as a submarine prolongation of the state territory, and hence the extension of sovereign rights under the sea. The concept was introduced in 1945 by the USA, and today we see its final outcomes, in setting the outer limits of the continental shelf, also through the work of the UN Commission for the Limits of the Continental Shelf (composed, by the way, of geologists). This, now 65-year old 'cooperation' between international law and geology has had a clearly defined purpose: extending sovereign rights (to exploitation of minerals/oil and gas) of some coastal states to new, distant borders – defined, more or less, by the continental margin.

Today, however, it seems that joining forces of geologists and lawyers could be done more usefully on a broader level, by considering proposals for concepts such as the 'responsibility for the seas' and evidence in support for a new epoch, the Anthropocene, as being mutually reinforcing – with these concepts being of general interest, not only regarding particular concerns.

Now, to be more practical: while affirmation of a concept such as the 'responsibility for the seas', like the proposal for a new age/epoch, such as the Anthropocene, are long-term processes – and with no success guaranteed – everything must start from somewhere.

A year ago, our Institute organised a major international conference, on "The World Ocean in Globalisation", for which I served as the Program Chairman. Some 200 leading law of the sea experts and decision-makers on ocean issues, thus both practitioners and scholars from many countries, took part. (Key information is available at: <http://www.fni.no/conference/index.html> ).

In the follow-up of the conference, we engaged a group of around 70 experts to work together as contributors in preparing a state-of-the-art assessment of the law of the sea challenges posed by globalisation. This work will result in two books, to be published around mid-2010.

The first book, titled "Law, Technology and Science for Oceans in Globalisation", by 34 authors under my editorship, is currently under finalisation, soon to be submitted to the publisher (Martinus Nijhoff / Brill in The Netherlands).

In my introductory chapter to that book, I intend to suggest some linkages between the 'responsibility for the seas' and the Anthropocene 'age/epoch' proposal, while reviewing also driving forces for the development of the law of the sea so far.

At this stage, all that is indeed at the level of theory and awareness-raising. However, in the affirmation of such concepts and proposals – and of their mutually reinforcing linkages – the next steps could be proposals for resolutions by professional associations, and possibly some NGOs, from where developments over time might lead further, including instruments by more formal bodies.

It might sound this may be worth some efforts.

I would be happy to keep you up-dated on the progress of our work in future, and would also be interested in hearing from you about the Anthropocene age/epoch 'project' developments.

With best regards,

Davor Vidas