The geological significance of man

A recent GSA Today paper (Zalasiewicz et al., 2008) authored by a baseball team’s worth of bright minds (21 by my count; a baseball team usually has 25) considered whether or not the current interval of anthropogenic global environmental change was substantial enough to warrant it’s own stratigraphic Epoch under the rules of geologic nomenclature. In other words, would some future geologist (or group of geologists), ignorant of human history, look back to this time and separate the interval in which we now work and play, from all other intervals based on the geologic record?

And yet, the answer was definitively, unambiguously, yes. We are in a new Epoch, an Epoch that may even mark the end of the Quaternary Period. Further, if one had to define the base of that Epoch, its clear starting point, that base would be the turn of the 19th Century, 1800.

By 1800, human ambition, industry and global impact can be definitively seen in the stratigraphic, and geochemical records, and the biotic assemblages on earth are similarly impacted.

Enter the Anthropocene.

The Anthropocene was a term coined by Paul Crutzen in 2002, the 1995 Nobel prize winner in chemistry, and has been incorporated informally into geological literature. One of the (arguably) best articles written on the subject is co-written with two others, John McNeill and Will Steffen in 2007. McNeill and Steffen have written a brief summary of the Anthropocene and its stages for Island Geoscience readers, and that article makes up the bulk of this issue.

Comments on any of the articles, or the newsletter can be sent to me at: richard.guthrie@gov.bc.ca

Past issues of Island Geoscience are here: http://www.for.gov.bc.ca/hfd/LIBRARY/Island_Geoscience.htm

Enjoy…

Rick

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The Three Stages of the Anthropocene

John R. McNeill and Will Steffen

Humankind has always had some impact upon the Earth and the biosphere. But for most of our career, our numbers were too small and our technologies too modest to have many profound and durable effects. Probably the most important exceptions were the late-Pleistocene megafaunal extinctions, and the use of fire to clear vegetation in arid and semi-arid lands such as East Africa or Australia.

With the transitions to agriculture, of which there were several around the world beginning about 12,000 years ago, our ancestors’ ability to tweak the biosphere grew. Population increased, technological capacity too, and according to one as yet unproven hypothesis (Ruddiman, 2003 – see inset next page) early clearing for agriculture may have added significantly to atmospheric CO2, helping to warm the earth in the Holocene.

...Without any doubt, however, the period since 1800 represents a break with the past...so distinctive, it deserves its own name in Earth history: the Anthropocene...

Without any doubt, however, the period since 1800 represents a break with the past. The human impact on the Earth system ramped up with the widespread adoption of fossil fuels, a gigantic energy subsidy from the geologic past to modern societies. Between 1800 and today, population grew from less than a billion to about 6.4 billion. The size of the world economy increased more than 50-fold, and energy use more than 40-fold. An age of sustained turbulence resulted, with impacts in every corner of the biosphere, from fisheries to forests, and in several central processes of the Earth system, from the nitrogen and carbon cycles to the climate itself. This impact and turbulence is of such magnitude, and its origins in human action so distinctive, it deserves its own name in Earth history: the Anthropocene.

The Noble Savage Myth

There is, in modern society, a persistent myth that prehistoric, early, and indigenous peoples have had a noble, more conservation focussed relationship with the earth and lived in some sort of ecological balance with nature.

Available evidence suggests instead that humans have waged wars, altered landscapes, depleted resources and played the pivotal role in mega-faunal extinctions world wide, limited only by their technology and numbers, throughout the Pleistocene. See: Extinctions in Near Time, published by Springer in 1999 or Constant Battles by LeBlanc and Register, published by St. Martins Press in 2003 for discussions.

-RHG

Figure 1. Fuel and energy consumption from 1850-2000. Note the rapid rise in use particularly following WWII, until, by 2000, about 80% of human energy consumption is in fossil fuels (Figure modified from Steffen et al., 2003).
The Anthropocene, a term gaining use since Paul Crutzen employed it in 2002, has its own trajectory. The First Stage, from its start about 1800 until about 1945, was one of growing human impact.

...By 1945, [atmospheric] CO2 had crept to about 310 ppm...early in the 21st century, CO2 levels surpassed 380 ppm...

Whereas in the past, almost all environmental change had been local or regional in scope, now global-level changes resulted. As a proxy for global change in general, one can consider atmospheric CO2 concentrations (Figure 3), which reflect both fossil fuel use and deforestation. In 1800, CO2 levels were within the natural variation band of the Holocene, under 285ppm, but rising. By 1945, CO2 had crept up to about 310ppm, outside that variation band.

The Ruddiman Hypothesis

William Ruddiman at the University of Virginia proposed that Anthropogenic climate change began 8,000 years ago with Eurasian deforestation and agricultural development. He goes on to say that, based on paleoclimatic evidence, warming in the Holocene of up to 2° in high latitudes (enough to stop Canadian glaciation), a result of increased CO2 and CH4 in the atmosphere, is not explained by natural forcing mechanisms. In the same hypothesis, the little ice age might be a result of forest re-growth over farms abandoned during bubonic plague outbreaks in Europe.

-RHG

After the Second World War, the Anthropocene lurched into a Second Stage, the Great Acceleration (Figure 2). Both population growth and economic growth took off at rates never seen before in human history. New technologies, many of them arising from the War and involving new applications for fossil fuels, helped empower humans to manipulate their environments faster and more fully than ever before. Early in the 21st century, CO2 levels surpassed 380ppm (Figure 3).
people as unwelcome. A deeper and more popular environmentalism arose in many societies. In effect, the Great Acceleration produced the potential seeds of its own demise—or at least deceleration. This may soon inaugurate the Third Stage of the Anthropocene, in which humans in conscious reaction to their impacts, succeed in curtailing it. If we do, it will happen via new low-emissions technologies in the energy sector, through geo-engineering such as carbon sequestration or injecting sun-blocking aerosols into the atmosphere, or through radical changes to economic life and consumptions patterns.

References


Dr. John McNeill is a professor of environmental history at Georgetown University. He is the author of dozens of scholarly papers and several books including the award winning “Something New Under the Sun: An Environmental History of the Twentieth-century World” (New York: Norton, 2000). Dr. McNeill can be reached at: mcneillj@georgetown.edu.

Professor Will Steffen is Director of the Fenner School of Environment and Society at the Australian National University and science advisor to the Australian government Greenhouse Office from 2004 through 2005. Dr. Steffen can be reached at: will.steffen@anu.edu.au.

More on early humans and their impact:

Steven LeBlanc’s book, Constant Battles: the Myth of the Peaceful Noble Savage, explores in detail how humans have continually outgrown the carrying capacity of their environment at almost every turn and warred with one another as a result. He leads the reader on archaeological digs in Turkey, the US and New Guinea, and presents archaeological, ethnographic and historical evidence to show that warfare and ecological destruction has been a primary product of human occupation for millions of years.

He argues that there is a danger in believing the fantasy of the harmonious co-existence with nature when evidence reveals overpopulation and violence. He closes optimistically, however, suggesting that we are at a unique time in history where war has less impact than it did for previous generations, and that we have the technological ability to solve the dilemmas that lead us to conflict.

Recent Publications

Gerry Wieczorek from the USGS and Oldrich Hungr at UBC recently edited a special issue of the journal Landslides focussing exclusively on debris flows. Global experts contributed papers from Italy, Brazil, Spain and the US. It is worth acknowledging, however, the substantial Canadian talent that also contributed their expertise to the topic including: Oldrich Hungr, Ron Arksey, Doug VanDine, Matthias Jakob and Hamish Weatherly, as well as our paper below. The debris flow issue is available now from the Springer site.


http://www.springerlink.com/content/470443ih5457324x/?p=fba650c43fbe4610a226d03e7bcc018c&pi=0
Introducing:

Markus Schnorbus is a Hydrologic Modelling Scientist with the Ministry of Environment, River Forecast Centre in Victoria. His responsibilities include streamflow forecasting, developing forecasting tools and models and providing general hydrology consultation to Ministry staff. He is currently working on a project to investigate the effect of the mountain Pine Beetle infestation on the hydrology of the Fraser River. This project is in collaboration with the Pacific Climate Impacts Consortium (http://www.pacificclimate.org), with whom he is beginning a one-year secondment. Markus earned a Bachelor of Mechanical Engineering degree from the Royal Military College in Kingston Ontario in 1991, which was followed by nine years of commissioned service in the Canadian Armed Forces. He subsequently completed a graduate program in forest Hydrology at the University of British Columbia. Markus joined the Ministry of Environment in 2005.

Markus and his wife live in Victoria where they spend most of their free time trying to keep up with their two young boys. He would love to talk hydrology and can be contacted at (250) 387-9478 or by e-mail at Markus.Schnorbus@gov.bc.ca.

Next issue:

The European Geoscience Union meets in Vienna in April this year. I’ll try to address some highlights next issue. The satellite imagery and change detection issue was once again deferred, in this case to bring you the current discussions around the Anthropocene, and to allow some time for more complete coverage of Vancouver Island. Look for it in an upcoming (next?) issue. If there are special topics that you, the reader, would like to see, send me an Email at: richard.guthrie@gov.bc.ca.

Similarly if you have some recent work or research that you think would fit our format, let me know.

- RHG