Manchester Geological Association
Broadhurst Lectures
Saturday 23 November 2019

Abstracts

"What is the Anthropocene, when did it start and what is the material and geochemical evidence"

Prof Colin N. Waters
School of Geography, Geology and the Environment, University of Leicester

Human activity is leaving a pervasive and persistent signature on Earth and vigorous debate continues about whether this warrants recognition as a new geologic time unit. This presentation outlines the origin of the term within the Earth Systems Science community and subsequent work of the Anthropocene Working Group in gathering evidence to constrain and assess the Anthropocene as a potential new formal chronostratigraphic unit within the Geological Time Scale. Anthropogenic influence on stratigraphic signals commenced thousands of years ago, but the most pronounced inflection in most global trends away from Holocene patterns is in the mid-20th century, which represents the preferred timing of onset for the Anthropocene Epoch.

Evidence presented includes the appearance and rapid dispersal of many new mineral forms (including metals, plastics and industrial fly ash), rock types (including concrete) and sediment bodies including artificial ground, together with sediments released by land use changes. The presentation will attempt to estimate the scale of this rapidly expanding technosphere. For example humans now intentionally move about twenty times more terrestrial sediment across the Earth's surface than all of the natural fluxes of river sediments to the oceans. Chemical signals can provide widespread, sometimes global, and geologically isochronous markers that can be used to characterise the onset of the Anthropocene. These include: changes in atmospheric gas concentrations preserved in glacial ice and isotope patterns altered by perturbations to the carbon and nitrogen cycles at rates and magnitudes unprecedented in Quaternary times; and disseminated heavy metal and persistent organic pollutant and artificial radionuclides traces, many of which are novel signatures. The presentation will also describe ongoing plans for developing a proposal for a formal "golden-spike" section, looking at some of the potential host environments and sites currently being investigated.

"Climate in the Anthropocene"

Dr Colin P Summerhayes
Emeritus Associate, Scott Polar Research Institute, Lensfield Road, Cambridge CB2 1ER

In the Late Holocene decreasing orbital insolation led the climate into a 'neoglacial' period, which led through a brief Medieval Warm Period into a lengthy Little Ice Age. That trend is now flat so our climate should stay cool. Slight variations in solar output are superimposed on this trend, producing warming periodically throughout the Little Ice Age, with high solar activity most recently in the 1780s, 1860s and, more recently, 1980-1990, since when solar activity has been in decline. The 1°C warming since 1970 has taken us past the level of the Medieval Warm Period and back to that of the Holocene thermal optimum, driven mainly by greenhouse gases, modulated slightly by natural cycles (El Nino; the Atlantic Multidecadal Oscillation) and brief volcanic episodes.

Continuing business as usual will take us to levels last seen in the last interglacial, when temperatures were 2-3°C higher than preindustrial levels and sea level was 4-9m higher, and possibly past that to levels last seen in the mid Pliocene, mid Miocene or even mid Eocene, each with progressively higher temperatures and sea levels. We can expect to see a new solar minimum within the next 30-50 years, but that is likely merely to put a slight dent in the continued warming trend, given that solar variability is much less than orbital variability. The next ice age has been postponed to some 50,000 years or more into the future. Progressive warming will change agricultural patterns, forestry, the meat industry, human migration, biodiversity and sea level. There will be winners (expanding grain growth in Canada and Russia) and losers (drowned coastal environments - e.g. Florida, Bangladesh; more arid continental hinterlands - e.g. Mediterranean; and widespread regional flooding e.g. northern Europe).

"The Anthropocene biosphere and its implications for the well-being of all organisms on planet Earth"

Prof Mark Williams
School of Geography, Geology and the Environment, University of Leicester, UK

Most species on planet Earth have ecological ranges defined by factors such as latitudinal changes in surface temperature and rainfall, or geographical isolation. These patterns have evolved over millions of years. This natural pattern is being overprinted by the actions of *Homo sapiens*, which has made the whole Earth its ecological range. The human ancestral pattern of gradually increasing influence on the Earth can be traced in the stratigraphic record for nearly 3 million years, as a time transgressive pattern beginning in Africa, and gradually extending throughout the whole world.

However, in its later and more pervasive stages, particularly from the mid to late 20th century onwards, it provides intercontinental patterns of species distributions with clearly identifiable signatures that may help to define a geological boundary for the Anthropocene. Moreover, these patterns identify a profoundly human-modified biosphere, one marked by the unsustainable consumption of resources that may lead to a major perturbation of the Earth System. Will the near-future geological record of the Anthropocene be marked by a mass extinction, followed by survival and recovery phases that are recognisable over several million years? Or will humans intervene to secure a better future for all of the co-habiting organisms on planet Earth?