Understanding 'event stratigraphy' in the context of Anthropocene chronostratigraphic definition

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Abstract

The Anthropocene Working Group of the Subcommission on Quaternary Stratigraphy is working towards formally defining an Anthropocene epoch/series, and its associated age/stage commencing in the mid-20th century. The proposal will recommend that the Anthropocene be constrained by a Global boundary Stratotype Section and Point (GSSP) in a sediment core and supported by several Standard Auxiliary Boundary Stratotypes (SABSs) that permit correlation of the base of the Anthropocene into many of the diverse depositional environments in which it is clearly recorded. Global correlation is achieved using the many geosignatures of the Great Acceleration Event Array (GAEA: Head et al., 2022a, 2022b; Waters et al., 2022). We evaluate recent proposals that the Anthropocene should be an informal 'event' characterised as an interdisciplinary, time-transgressive concept extending over tens of millennia and still ongoing, and not based exclusively on the stratigraphic record. We provide analysis of 'events' in geological history and scrutinize their definition.
We investigate how concepts of events and episodes should be more rigorously applied and how events can be used as suitable guides for chronostratigraphic boundaries, using analogous Quaternary and deeper-time examples. We recognise events as associated with rapid rates of process change over brief time intervals and distinguish between global phenomena that represent an Earth System state-shift, e.g. large bolide impacts or Snowball Earth terminations, and local to global phenomena that do not alter the functioning of the Earth System, e.g. tsunamis. Episodes, in the informal use of the term, are by contrast long-lived phenomena, markedly time-transgressive with slow rates of process change. These too can be differentiated between episodes that cause state-shifts (e.g. the effects of very large igneous provinces such as the Siberian Traps on climate, oceans and biota) and those that have more modest and reversible impacts (e.g. changes in orbital parameters amplified by other Earth effects that cause the glacial-interglacial oscillation). Time resolution interacts with perceived suddenness and consequently samples closely spaced in time may reveal events that are embedded within episodes.

In the context of human impacts on stratigraphical successions, we recognise an extensive time-transgressive 'episode' related to the global record of all geologically significant anthropogenic change, termed the Anthropogenic Modification Episode (AME). Nested within the AME are many brief and geologically correlatable events. The most notable is the GAEA, an array of global anthropogenic signals recorded in mid-20th century deposits, e.g.: onset of the radionuclide 'bomb-spike'; appearance of microplastics, novel organic chemicals and fly ash particles; marked changes in patterns of sedimentary deposition, and in heavy metal contents and carbon/nitrogen isotopic ratios; and biotic changes leaving a global fossil record. These events include short-duration signals that returned to pre-1950 levels within a few decades, as well as signals that will persist for millennia or will be permanent (e.g. significant reconfiguration of ecosystems including extinctions).

Given the intensity, magnitude, planetary significance and global isochroneity of the GAEA, it provides a suitable level for recognition of the base of the Anthropocene as a series/epoch (Waters et al., 2023). The chronostratigraphic Anthropocene, defined in strict accordance with ICS approved nomenclature and procedures, provides a clear and stable meaning to stratigraphic use of the term "Anthropocene".

References

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