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Early mining geochemical anomalies at around 3000 years BP as a potential stratigraphic marker for the base of an early Anthropocene

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The Anthropocene, since its conceptual formulation in 2000, has been the subject of intensive discussions. Besides major issues and challenges in defining the Anthropocene as a formal chronostratigraphic unit, the questions of how and when to define the base of the Anthropocene are one of the major tasks of the Anthropocene Working Group of the Subcommission of Quaternary Stratigraphy (AWG) of the International Commission of Stratigraphy. The problem of a formally defined base in terms of a chronostratigraphic unit is closely linked to the wider and extremely diverse discussion of the Anthropocene. This discussion centers on if and when the influence of humans on the Earth system, and especially on geological processes, started to be significant and fundamental to substantiate the definition of a new geological time unit that terminates or replaces the Holocene (Waters et al., 2016). The AWG published recently on the usability and stratigraphic optimal placement in the midst of the 20th century (Zalasiewicz et al., 2014).

Three possible time frames are in discussion for a base of a stratigraphic Anthropocene: (1) an early Anthropocene, beginning more than 2 millenia BP; (2) the onset of globalization and the Industrial Revolution, including dates from 1500 to 1850; (3) a mid-twentieth century beginning related to the Great Acceleration after WW II. In addition, a diachronous beginning was put forward by some authors.

An alternative definition for the Anthropocene in respect to early human influence may be around 3000 BP, with the onset of mining-induced trace metal pollution, as defined by (relative) lead enrichment and lead isotopes. Although this event signal so far is limited to the Northern hemisphere, potential correlations and secondary markers may be present in the Southern hemisphere, using, e.g., climate events (the 2800 BP climate-insolation event), and magnetostratigraphy (low in dipole latitude and peak in dipole moment at 2700-2550 BP, the European 'f-event').

Such an early Anthropocene definition has advantages such as:

- It encompasses significantly more time, allowing a considerably larger quantity and better quality of Anthropocene stratigraphic records in a larger variety of archives to have been established, i.e. a larger quantity of anthropogenic deposits, man-made ground and legacy sediments.
- It allows a definition of the base of the Anthropocene by applying the GSSP concept, as used for most of the Phanerozoic boundary definitions yet, i.e. setting the GSSP in an Arctic ice core.
- It is still in line with definitions of the Holocene and proposed subdivisions in the Holocene, i.e. with a late Holocene base at 4200 BP.
- Some global (solar radiation), regional (e.g. volcanic, magnetostratigraphic) and southern hemisphere (e.g. climate) events may be related and correlated to the suggested primary marker, giving secondary marker events in auxiliary reference sections around the globe.

References:

Waters C et al. (2016) *Science* 351 (6269): aad2622

Zalasiewicz J et al. (2014) *Quaternary Intern* 383: 196-203

