Geophysical Research Abstracts
Vol. 21, EGU2019-4228, 2019
EGU General Assembly 2019

Which metals and organic pollutants are the best signals of the Anthropocene?

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There are numerous inorganic and organic pollutants that are emitted from industrial sources. Theoretically, they all can be used as indicators of anthropogenic activity. However, good signals of the Anthropocene should meet certain criteria. Their distribution should be: (i) geographically extensive, preferentially in a global range; (ii) their intensity should be synchronous and exhibit a clear change around the starting date of the Anthropocene (the mid-20th century), and (iii) they should prove a permanent record. The chemical signals in the Anthropocene strata are closely related to industrial pollution.

A major disadvantage of the use of pollutants as signals of the Anthropocene is that they are emitted from industrial sources and usually deposited in the vicinity of industrial facilities, so their distribution in the environment depends on the number of pollution sources in a given area and on measures undertaken to prevent pollution. Another important drawback is that many industrial pollutants can show natural chemical abundances similar or even higher than those recorded in industrial areas. A global dispersion of pollutants occurs in the atmosphere. Thus, the pollutants, which are potentially useful as signals of the Anthropocene, should either be volatile or tend to be adsorbed on particulate matter in order to be transported to the remotest sites located far away from industrial sources.

It has been estimated that lead (Pb), mercury (Hg) and tin (Sn) are three metals whose biogeochemical cycles show the global-scale change caused by anthropogenic pollution. Common constituents of airborne pollutants are: chromium (Cr), copper (Cu), nickel (Ni) and zinc (Zn). Of these metals, lead shows all features of a good Anthropocene signal. Its concentrations in dated sediments and ice-cores collected in Northern and Southern Hemispheres show a global, near-synchronous distribution with a distinct peak level from 1960s to 1980s, mostly related to the use of leaded gasoline. The signal of Pb in sedimentary records should be persistent since lead is a non-essential element to living organisms and is relatively immobile. Additionally, Pb stable isotope ratios can be used for tracking pollution sources.

Organic pollutants that have been considered useful in the Anthropocene chemostratigraphy include: polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCs), polychlorinated biphenyls (PCBs), dioxins, polybrominated diphenyl ethers and fluorinated compounds. Of these compounds, PCBs are the best signals of the Anthropocene because: (i) they do not occur in nature; (ii) their production and use was worldwide and left a clear change in sedimentary records from the onset (during 1940s-1950s), through the peak (1960s–1980s) to the decline (post-1980s), being well correlated with the formal beginning of the Anthropocene Epoch; (iii) a long-range atmospheric transport of PCBs caused a global dispersion of these pollutants in the remotest regions of the globe; (iv) they show a very high persistence in the environment and their affinity with sediments will provide a detectable signal over a long period of time. More information is needed about behavior of PCBs during diagenesis because these compounds undergo degradation, but they are amongst the most stable compounds known as persistent organic pollutants.