

## Modeling the global Pb cycle: from industrial emissions to the bottom of the ocean

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Industrial activities have led to massive increases in the amount of Pb, a toxic heavy metal, released to the environment. The most prominent anthropogenic sources of Pb are high-temperature industrial processes such as the combustion of leaded gasoline, coal burning and smelting. Interestingly, the relative importance of these sources and their contribution to the total Pb cycle (natural + anthropogenic) has been shifting through time and space. For example, the use of tetraethyl lead in gasoline started in 1923 but peaked in the 1970s when a gradual global phase-out was initiated. Northern America and Europe have historically dominated leaded gasoline emissions, but today, leaded gasoline is only used for cars in a few less-developed countries. Coal burning and smelting are the dominant sources of Pb today, with emissions being particularly high in China, Southeast Asia and parts of Africa.

The changing nature of Pb sources and the fact that natural sources and industrial activities produce Pb emissions with distinct isotopic signatures together provide an opportunity to study the dispersion of Pb in the environment regionally as well as globally. These isotopic imprints can be applied in conjunction with the timing of the anthropogenic Pb peak to track the spatiotemporal evolution of regional Pb plumes and, like CFCs and  $^{14}\text{C}$ , to investigate a range of environmental processes. For instance, concentration and isotopic information about Pb could be used to constrain the chemical reactivity of metals and evaluate the large-scale long-term environmental footprint, or burden, of major industrial activities.

The goal of this project is to use and develop a family of models to produce a quantitative framework capable of simulating the evolution of the global Pb cycle. The main aims are to:

- constrain the natural and anthropogenic emissions of Pb globally since the onset of the industrial revolution
- use this information to produce boundary conditions that can be used to run an atmospheric transport model capable of simulating the transnational dispersion of Pb-containing aerosols and the depositional fluxes of Pb over the ocean
- use these depositional fluxes with an ocean model to simulate the transport and residence time of Pb and its isotopes in the sea.

The ideal candidate is comfortable with computer programming; previous experience in either running models or using model data would be an advantage. This project will involve collaborations with other researchers in Imperial College, the University of Oxford and MIT. Do not hesitate to get in touch for further details or to discuss other opportunities ([y.plancherel@imperial.ac.uk](mailto:y.plancherel@imperial.ac.uk)).

### Background reading:

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