2.147 Origin of Soluble Iron from Low-emitting Automobile Exhaust.

Early Career Scientist

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Abstract:

Soluble iron has been found to be a limiting reagent for phytoplankton in most of the southern oceans. Phytoplankton is a vital part of the oceans ecosystem as it is involved in CO_2 uptake and nitrogen fixing. Thus, understanding iron geochemical cycle is essential to understanding the earth's oceans and atmospheric interactions. Previous field studies have linked soluble iron over the ocean to combustion sources. To directly test soluble iron emissions from automobiles, PM was collected from tail pipes of 22 low emitting gasoline vehicles at the CARB dynamometer facility using California Unified (UC) Drive Cycle. PM was collected from the exhaust pipe and analyzed for inorganic ions, EC/OC, total and soluble metals, functional groups, and GC-MS was used to quantify the class of 11 to 18 carbon intermediate volatility organic compounds (IVOC), ultimately categorized as alkane (ALK), single ring aromatic (SRA) and general (GEN) for each carbon number. Results showed that the tested automobile emissions have a high fraction of percent iron solubility ranging from 0% - 81.9% with an average of 26.7%, compared to crustal sources where the soluble iron is approximately 1% of total iron. Samples were analyzed by x-ray near edge absorption structure (XANES) spectroscopy, which confirmed that only Fe(III) was present in the samples and, thus, any increased solubility was not due to the emission of the more soluble Fe(II). Correlation of soluble iron to sulfate was insignificant (R^2 = 0.157), as was correlation to every measured chemical component, except one class. Soluble iron was highly correlated to the C11 - C18 IVOCs, with R^2 values as high as .981 for IVOC SRA-C14. These results imply the large driver in soluble iron from gasoline vehicle emissions is related to organic fraction of PM, suggesting that further studies are required to study metal-organic interactions in PM.