

Stable carbon isotope analysis of airborne particulate matter using a carbon aerosol analyzer and a cavity ringdown spectrometer

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Particulate matter affects more people than any other ambient air pollutant, leading to increased risk of cardiovascular and respiratory diseases. Levels of PM10 and PM2.5 in the developing world, especially southeast Asia and the Indian subcontinent, routinely exceed World Health Organization guidelines, often by a factor of 10 or more. Despite their importance to poor air quality in urban areas in the developing world, the mechanisms that lead to heavy particulate loading are not well understood. Consequently, there is great interest in developing new tools for understanding the pollution sources and mechanisms that drive the formation of harmful aerosols. Stable isotope analysis of the carbon contained in the aerosols promises to provide important information about the sources and processes that govern aerosol formation and transport. We have coupled a Sunset Laboratories organic and elemental carbon (OC/EC) analyzer to a cavity ringdown spectrometer (CRDS) to create a system that provides hourly measurements of the $d_{13}C$ content of PM in the ambient air. The OC/EC system executes a sequence of temperature and oxygenation steps to create distinct CO_2 pulses of organic carbon, carbonate carbon, and elemental carbon, which are subsequently analyzed by the CRDS instrument for $d_{13}C - CO_2$. We present laboratory measurements with this system, including calibration, precision, and drift, demonstrating that a system of this design can deliver aerosol stable isotope analysis at sub-permil accuracy and precision. This system can be operated unattended, and is thus suitable for remote field deployment.