On the quantification of OC and EC and their isolation for radiocarbon measurement by a modified thermal/optical method

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Carbonaceous aerosols, which comprise the large fractions of elemental carbon (EC) and organic carbon (OC), badly affect climate and human health. However, there is a large uncertainty about detailed apportionment and quantification of its sources due to the large number of origins and chemical compounds associated with the aerosols. Radiocarbon (^{14}C) measurements of EC and OC allow an improvement in carbonaceous aerosol source apportionment, leading to a full and unambiguous distinction and quantification of the contributions from non-fossil and fossil sources (Szidat, 2009). The principle technique of thermal-optical analysis (TOA), which employs laser light absorption to distinguish EC from the pyrolyzed OC, is widely accepted for determination of OC and EC concentrations. However, the challenge of TOA methods lies in physically differentiating the OC and EC. Early removal of EC in the inert phase (He) and the formation of char due to pyrolysis of OC can lead to large errors in ^{14}C measurements of OC and EC, if using the conventional protocols such as IMPROVE, EUSAAR-2 and NIOSH. Here, we present a new protocol including four-stage thermal treatments optimized for isolating OC, mixture of refractory OC and non-refractory EC and refractory EC for ^{14}C measurement. In our protocol, the charring was found to be significantly reduced to less than 5% when analyzing the water-extracted filters under pure O_2 mode (65ml/min) for summer and winter filters from Gothenburg (Sweden), Moleno and Zurich (Switzerland). And both charring carbon and refractory OC could be evolved completely before native EC throughout the analysis. OC and EC together with other carbonaceous fractions could be isolated for ^{14}C measurement by the present TOA method. Furthermore, a new TOA protocol for OC/EC determination including pure O_2 pre-treatment was developed to reduce the uncertainty in EC determination from charring and light-absorbing organic compounds (also called "brown carbon") compared to other protocols.

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Degassing history of Earth

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"*Once upon a time, there were few data but many models. Now, there are many data but no models*."

Noble gas isotopes have provided much of our understanding of Earth's early history [1-3]. Various degassing models have been developed, including degassing of the whole mantle, degassing of all gases at similar relative rate [1], solubility-controlled degassing [2], and steady-state degassing models [4]. This report will evaluate various degassing models with recent data. For example, helium outgassing flux has been lowered by more than a factor of two based on sophisticated ocean general circulation models [5], which also impacts on the estimated degassing flux of carbon. Years of measurements and progress have allowed isotopic ratios of various mantle reservoirs being pieced together [6]. For example, $^{129}Xe/^{130}Xe$ in OIB mantle is found to be lower than that in MORB mantle [7]. Missing Xe has been found to be a non-issue [8]. Nucleogenic ^{21}Ne production rate relative radiogenic ^{4}He has been revised [9-10], which leads to an interesting neon paradox that nucleogenic ^{21}Ne production in the whole silicate Earth is barely enough to supply nucleogenic ^{21}Ne in air. Although non-nucleogenic mantle neon is solar, nonradiogenic mantle argon is atmospheric [11]. Nonradiogenic mantle helium is commonly thought to be similar to Jupiter. For Kr and Xe, the jury is still out. I will address what the new data mean in terms of Earth's degassing, whether the new data can be modeled consistently, or whether we are now suffering from too many data.

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