

## Known and unexplored organic constituents in the Earth's atmosphere

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Recent research, when considered as a whole, suggests a substantial fraction of both gas phase and aerosol atmospheric organics have not been, or have very rarely been, directly measured. Even though our knowledge of them is limited, the compounds we refer to clearly influence the reactive chemistry of the atmosphere and the formation, composition, and climate impact of aerosols. A review of the global budget for organic gases shows that we cannot account for the loss of approximately half the non-methane organic carbon entering the atmosphere. We suggest that this unaccounted for loss largely occurs through formation of secondary organic aerosol (SOA), indicating a much larger source for this aerosol than current bottom up simulation estimates. A major current challenge in atmospheric chemistry research is to elucidate the sources, structure, chemistry, and fate of these clearly ubiquitous yet poorly constrained organic atmospheric constituents.

We will review current knowledge about atmospheric organic constituents through the following questions:

I) What atmospheric organic compounds do we know about and understand?

II) What organic compounds could be present as gases and in aerosols?

III) What evidence exists for additional organic compounds in the atmosphere?

IV) How well do we understand the transformations and fate of atmospheric organics?

V) What are the most promising opportunities for future research directions?

## Exogenic control of Pb enrichment in Trans-Mexican Volcanic Belt lavas

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One of the several Pb paradoxes is the observation that Pb behaves like the light rare earth elements Ce and Nd during melting to form oceanic basalts, but is enriched in the continental crust compared to the LREE by nearly an order of magnitude. One of the several mechanisms suggested to mediate this enrichment is hydrothermal circulation at ocean ridges, which preferentially transports Pb compared to the REE from the interior of the ocean crust to the surface. We confirm the importance of hydrothermal processes at the EPR to mediate Pb enrichment at the Trans-Mexican Volcanic Belt (TMVB) by comparing Ce/Pb and Pb isotope ratios of TMVB lavas with sediments from DSDP Site 487 near the trench.

The lavas in the TMVB include "high Nb" alkali basalts (HNAB), which lack the trace element subduction signatures and reflect the composition of the sub-Mexican upper mantle. Ce/Pb and Pb isotope ratios of calcalkaline lavas from volcanoes Colima, Toluca, Popocatepetl, and Malinche are bounded by the HNAB and hydrothermally affected sediments from the DSDP 487. The HNAB represent the high Ce/Pb and high Pb-isotope end-member. The hydrothermal sediments have Pb isotopes like Pacific MORB but Ce/Pb ratios an order of magnitude lower than MORB. No analyzed calcalkaline lavas are have compositions outside of the bounds formed by the HNAB and the hydrothermal sediments. The Ce/Pb and Pb isotope ratios show that the calcalkaline lava compositions are inconsistent with contributions from HNAB and EPR MORB. The data confirm the two step process of Pb enrichment in the TMVB lavas: exogenic (hydrothermal) processes at the EPR preferentially transport basaltic Pb to surface sediments, and later, during subduction, these provide the main source of asthenospheric mantle Pb to the lavas. The data also confirm the importance of subduction contributions to the Quaternary Mexican arc, despite the >40 km thick continental crust.