

Primary and secondary biomass burning aerosols determined by factor analysis of H-NMR spectra

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Discovery of Secondary Organic Aerosol (SOA) formation in biomass burning plumes leads to the question whether oxidized fraction of biomass burning aerosol is rather of secondary instead of primary origin and what are chemical compositions of oxidized biomass burning POA and SOA.

In the frame of EUCAARI project proton-nuclear magnetic resonance (H-NMR) spectroscopy was applied to investigate the functional group composition of fresh and aged biomass burning aerosols during an intensive field campaign carried out in spring 2008 at a Po Valley rural station, Italy. Factor analysis applied to set of NMR spectra was used to apportion wood burning and other OC source contributions, including aliphatic amines. Comparison between NMR results and those from parallel high resolution aerosol mass spectrometry (HR-ToF-AMS) measurements shows only a partial overlap between NMR and AMS factors relating to fresh biomass burning. The comparison between the two techniques substantially improves when adding factors tracing possible contributions from biomass burning SOA. The chemical composition of such secondary combustion aerosols was shown to be markedly different from that of the corresponding POA and, at the same time, was not represented by most common organic tracers used to apportion biomass burning POA. NMR results, in fact, show that fresh wood burning is composed of polyols and aromatic compounds, with a sharp resemblance with wood burning POA obtained from smoke chambers, while aged samples are depleted of alcohols and are enriched in aliphatic acids with a smaller contribution of aromatics. Factor analysis applied to NMR proven to be able to overcome the main drawbacks of methodologies relying on molecular tracer analysis and could be profitably used for the identification of SOA fractions.

Loss of Volatile Elements After the Moon-Forming Giant Impact

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Among the most striking observations made of the Apollo samples is the relative dearth of volatile elements observed in the lunar material [1], including moderately volatile elements that condense from the solar nebula at relatively high ($T > 1,000$ K) temperatures. Although such an observation is generally thought to be consistent with the energetic events associated with a giant impact, no quantitative chemical and dynamical scenario has been put forward to explain it.

The energy released in the Moon-forming giant impact is sufficient to melt and partially vaporize both the Earth and the impactor. The timescale to eliminate this heat by radiation is $\sim 10^3$ years [2]. Hence, the Earth-Moon system is expected to be in a molten, partially vaporized state for the first thousand years after the giant impact. This stage of the evolution may permit the loss of volatile elements via selective partitioning of elements into a vapor phase followed by phase separation of the lunar material. It has been known for decades that H – in molecular form – is gravitationally unbound in the circumterrestrial lunar disk [2]. However, no process is known that can separate the light, unbound vapor species from the heavier molecules of the silicate vapor atmosphere on the relevant timescales.

Here, we investigate a new possibility: redistribution of elements in the proto-lunar disk. Because the Moon accretes from the outermost regions of the proto-lunar disk, it may inherit a composition distinct from that of the inner disk which accretes back onto the Earth. We will present model calculations that explore physical and chemical conditions necessary for the Earth-ward transport of volatile elements in the proto-lunar disk and present the consequences of such a redistribution process. Such an approach has the potential not only to explain the abundances and isotopic composition [3] of lunar volatiles but also to permit the observed abundances to be used to yield insight into the largely unknown processes accompanying lunar origin.

[1]. Ringwood, A.E. (1979), *Origin of the Earth and Moon*. Springer-Verlag, New York. [2]. Stevenson, D.J. (1987), *Annu. Rev. Earth Planet. Sci.* **15** 271-315. [3]. Humayun, M., Clayton, R.N. (1995), *Geochim. Cosmochim. Acta* **59** 2131-2148.