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Development Highlights of Laser Ablation Aerosol Mass Spectrometry

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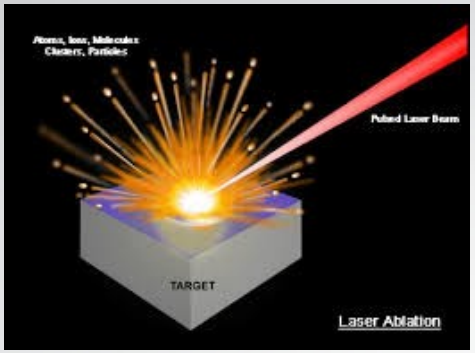
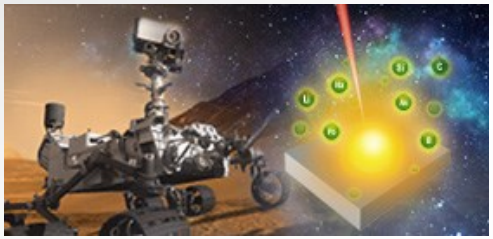
Laser Ablation (LA)

- Concentrated energy → explosive ejection



LA on Mars!



- LA couples with mass spectrometry

Laser ablation inductively coupled plasma mass spectrometry

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LA-ICP-MS

LAESI

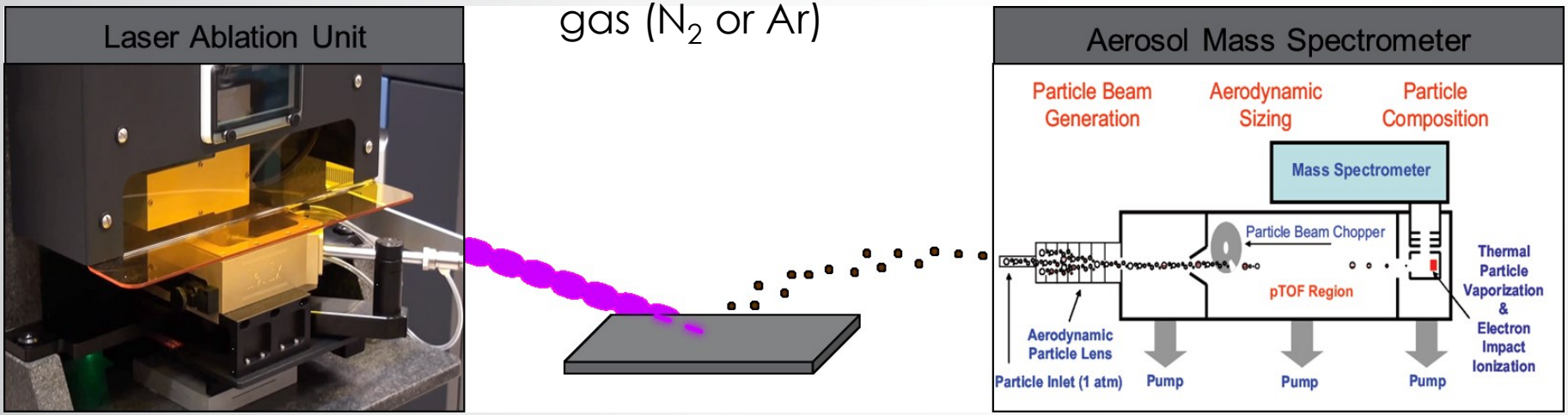
Laser Ablation Aerosol Mass Spectrometry

- LA-AMS consists of 3 processes:

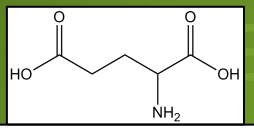
1. Generation of aerosols by LA

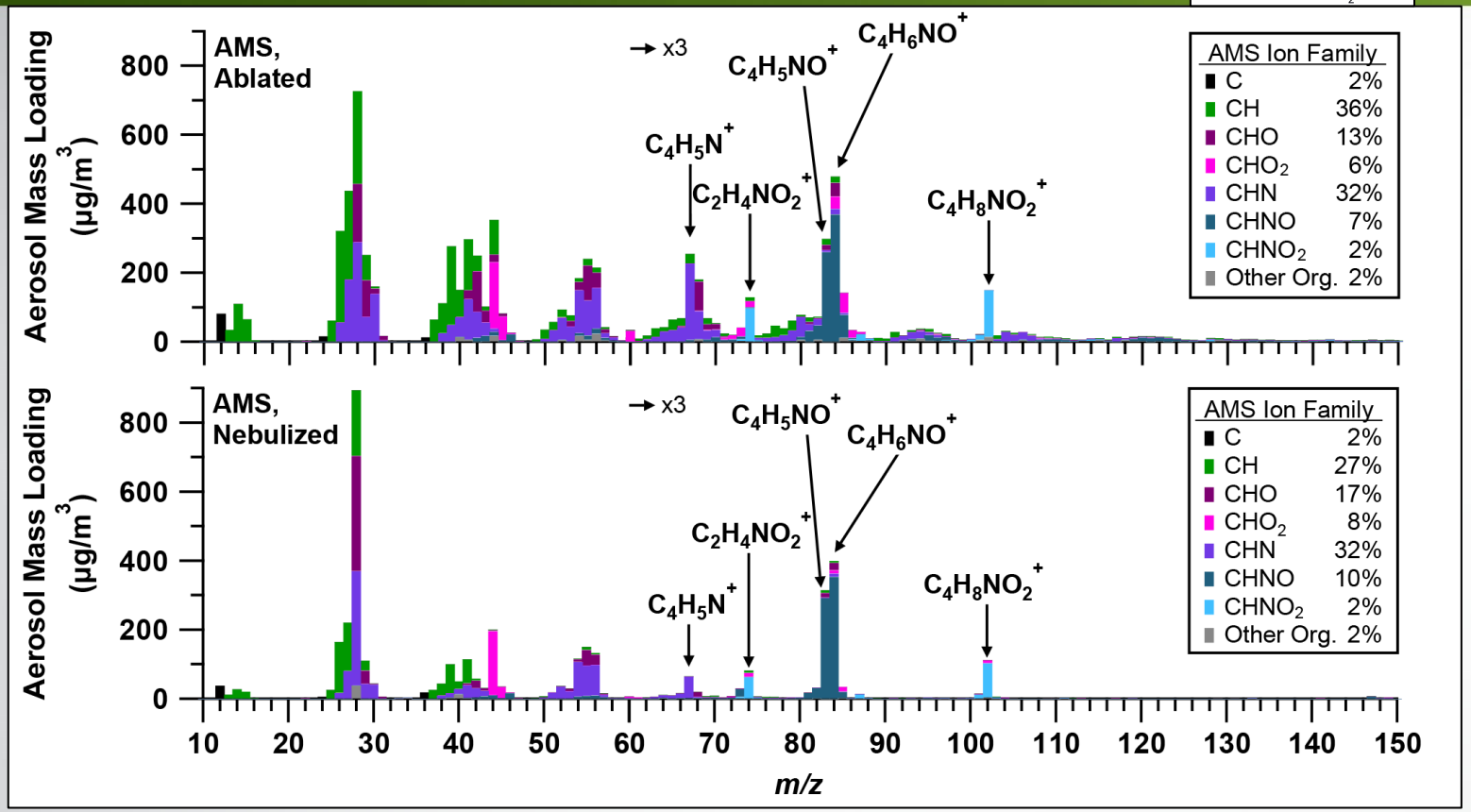
2. Transport by entrainment in a nonreactive gas (N_2 or Ar)

3. Analysis by AMS



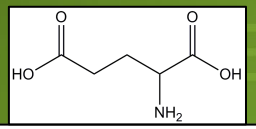
Comparison of Sample Introduction Methods: LA vs. Nebulization of Glutamic Acid

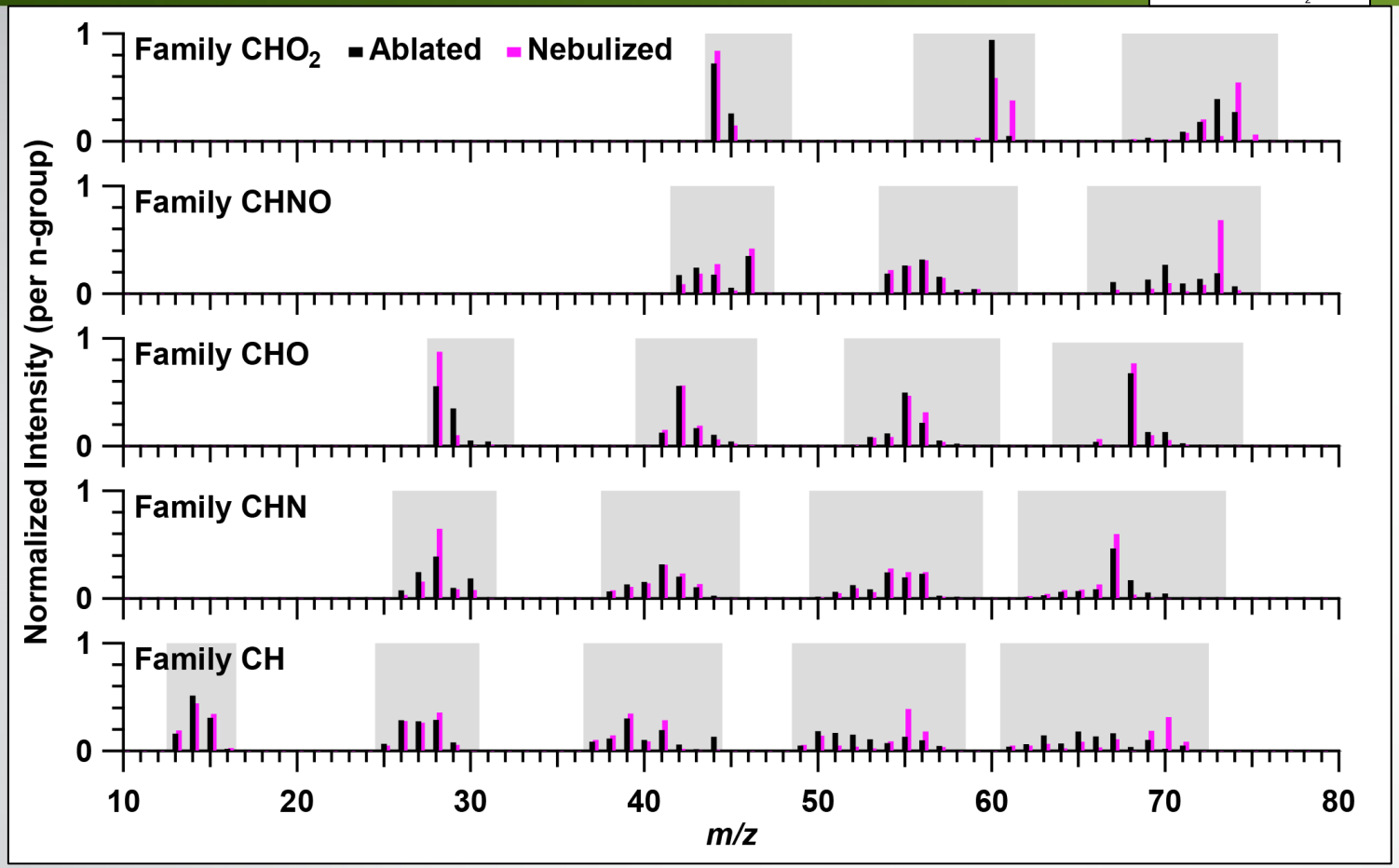




- Methods give similar mass spectra.
- Similar proportions of total aerosol mass are given by each ion family.

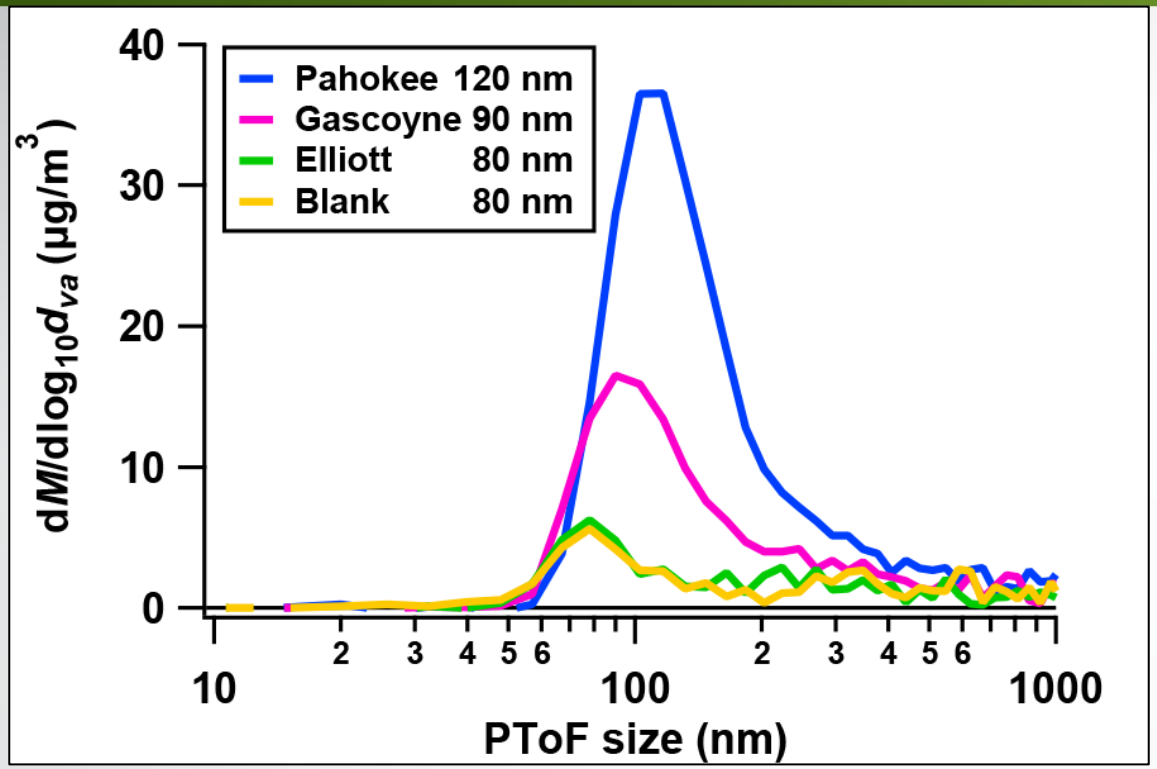
Similar pattern of relative peak heights in LA and nebulized ion families





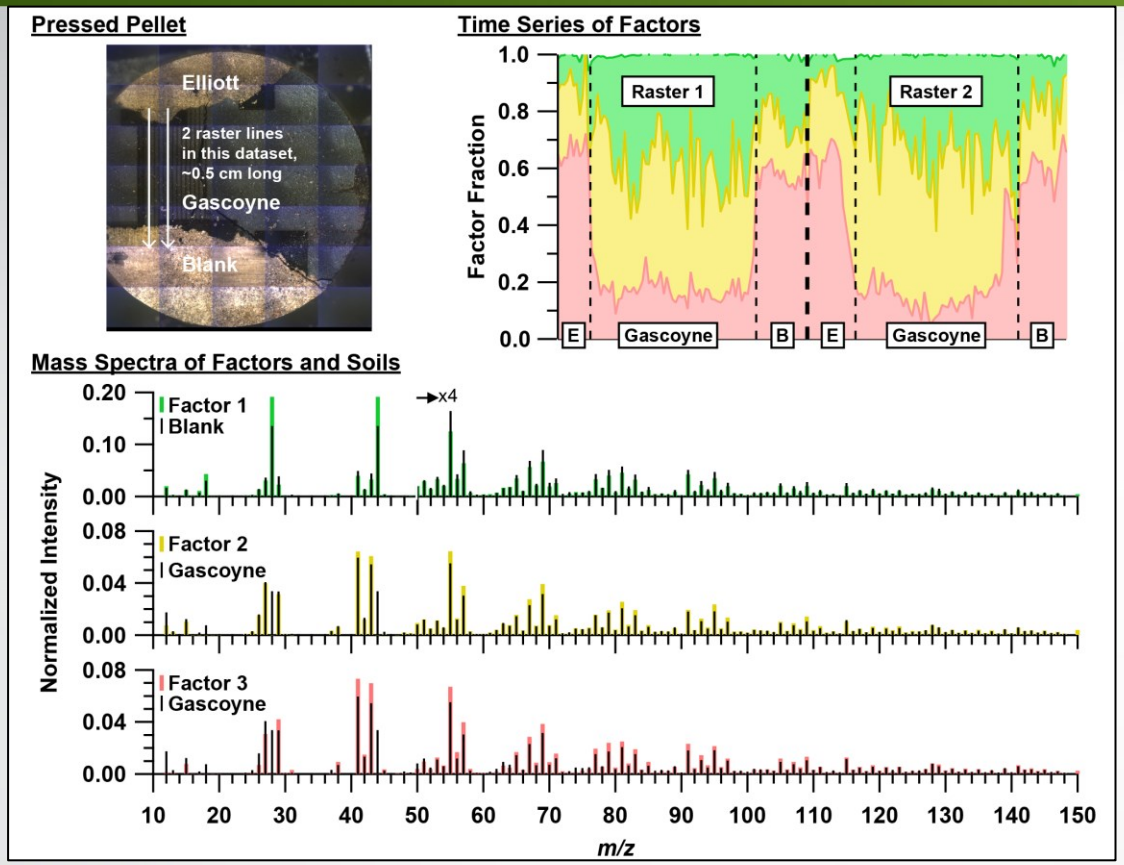
- Ablated and nebulized samples fragment similarly.

Particle Size Distributions of Ablated Soils



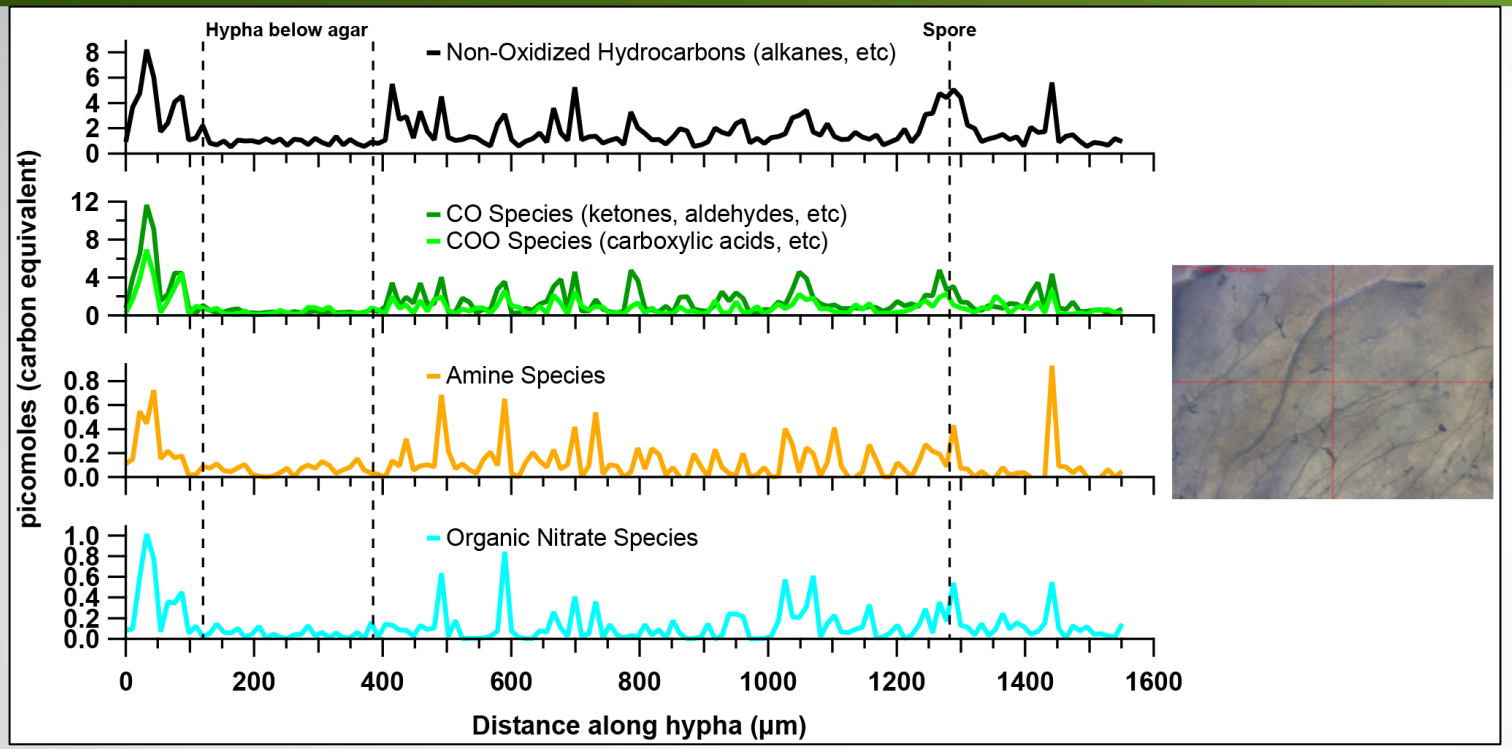
- Laser ablation makes ~100 nm diameter particles.
- Particles with diameter <50 nm may not be detected due to lens transmission issues.

PMF of Model System



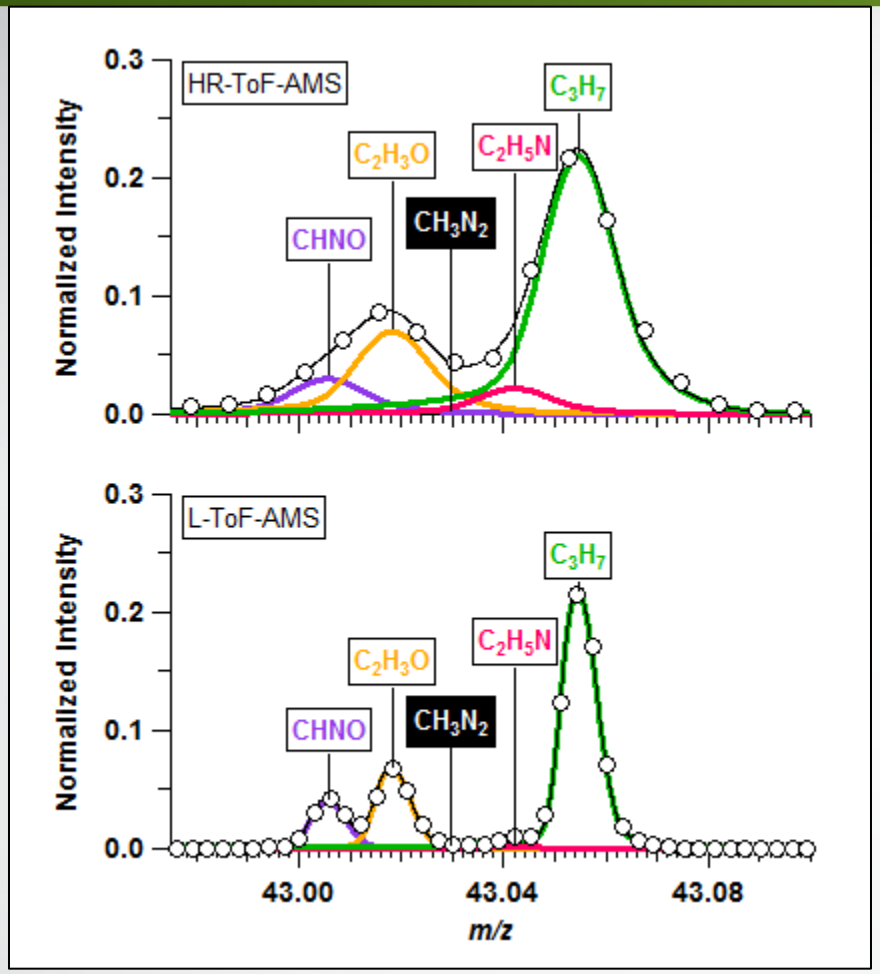
- PMF works on a model system.
- Question: How do we address variability in natural (not model) systems?

LA-AMS of a Fungal Hypha



- LA-AMS can image organic fragments.
- It might be useful to have **% composition by family** in contrast to total loading by family since total loading rises and falls. (Write code w/Donna?)

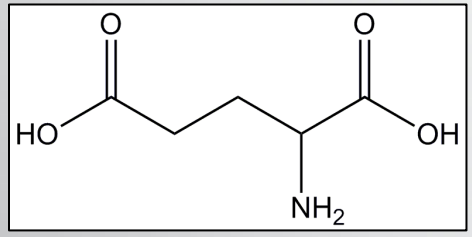
HR-ToF-AMS vs. L-ToF-AMS

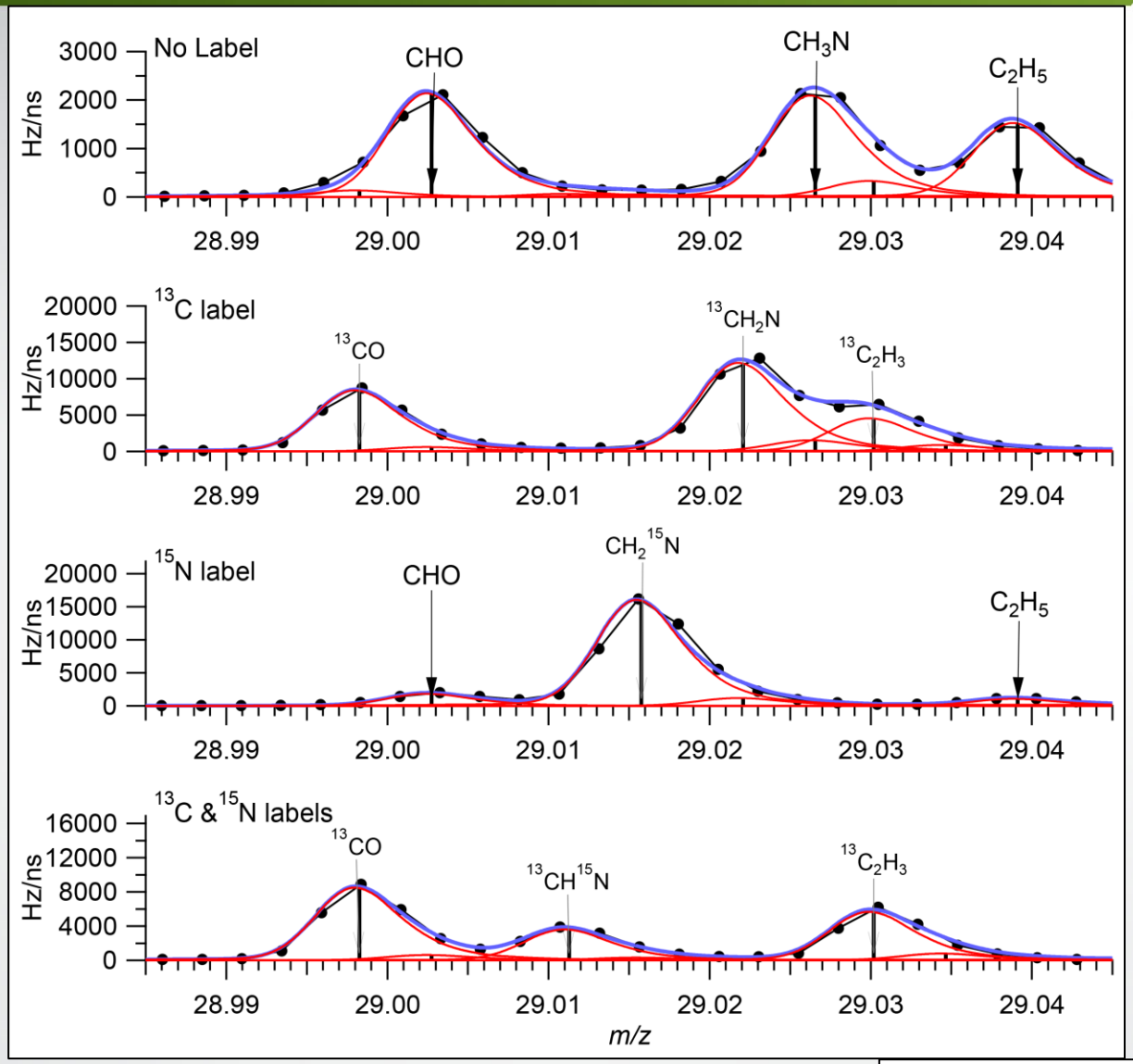


- Longer ion path = easier to assign and rule out ions.

Preliminary Study for Spatially-resolved isotopic imaging and speciation with LA-AMS (L-ToF)

- Microbial mats incubated with ^{13}C-labeled nutrients.
- Isotope ratio sampling of mats reveals nutrient incorporation is diurnally dependent.
- We used 13C and 15N-labeled glutamic acid to test resolving power of L-ToF for this study.





Conclusions

- Laser ablation gives similar compositional information as nebulization.
- Most particles are transported to the AMS.
- PMF works on soils, but questions remain about how to treat variability in natural systems.
- LA-AMS works on native samples (hypha)!
- The L-ToF-AMS enhances speciation of isotopically enriched, laser-ablated samples.

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