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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Free amino acids in Antarctic aerosol: potential markers for the evolution and fate of marine aerosol" *by* E. Barbaro et al.

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Response to Anonymous Referee #3

REF: Specific comments: Abstract REF * Some amino acids are relatively good CCN also, like l-glycine. Please, if you mention IN ability, you also have to mention CCN ability. This goes for the Introduction chapter as well. There are several papers available on the CCN activity.

A: We agree with referee 3, in the past we cited the articles:

Raymond, T. M. and Pandis, S. N.: Formation of cloud droplets by multicomponent or-

ganic particles, J. Geophys. Res., 108, D15, 4469, doi:10.1029/2003JD003503, 2003.

Huff Hartz, K. E., Tischuk, J. E., Chan, M. N., Chan, C. K., Donahue, N. M., Pandis, S. N.: Cloud condesation nuclei activation of limited solubility organic aerosol, Atmos. Environ., 40, 605-617, doi: 10.1016/j.atmosenv.2005.09.076, 2006.

And

Kristensoon, A., Rosenorn, T., Bilde, M.: Could droplet activation of amino acid aerosol particles, J. Phys. Chem. A, 114, 379-386, doi:10.1021/jp9055329, 2010.

To support the ability of amino acids to act as cloud condensation nuclei. This was heavily contested by the referees when we first submitted the paper into discussion (submission ACP-2014-377) if referee 3 wishes to have a look. As such we felt obliged to remove any reference to amino acids acting as cloud condensation nuclei, as the referees stated categorically that this is not the case. We do not feel able to insert this information now, without the consensus of the other referees and editor. If referee 3 has articles that show that amino acids act as CCN that will be acceptable to the other referees and editor, we will happily insert them. Obviously this subject in more contentious than we originally realized.

REF:* "During the sampling cruise on the R/V Italica on the Southern Ocean, high concentrations of amino acids were found in the total suspended particles, this we attribute to the presence of intact biological material in the sample." Try to be more specific. I don't know what you mean here.

A: To clarify our affirmation, we inserted in the bracket "as microorganisms or plant material" in the manuscript.

REF: Introduction * P 1271, L 12. "is due to", should be "depends on".

A: As suggested by referee 3, we substituted "is due to" with "depends on".

REF: * P 1273, L 28. How can antarctic aerosols give information about formation and

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growth. Think you have to explain this. Which formation, and which growth are you referring to?

A: We agree with the referee on this point, we have changed the phrase to read “Our aim is to study aerosol particle formation and growth in Antarctica because there is minimal interference from confounding anthropogenic sources.” As this is one of the aims of our paper and we hope it becomes self explanatory to the reader.

REF: Experimental section.* P 1279, L 15. "S1-S3, it". Should be "S1-S3. It".

A: We corrected this mistake.

REF: Result section. * "The most likely explanation for this enrichment of amino acids in the coarse fraction, is that the fine fraction has 5 been subjected to processes that increased the particle size of the aerosol. The most likely process is ice nucleation during long-range transport promoted by the intense cold over the plateau and presence of amino acids in the aerosol particles (Szyrmerand Zawadzki, 1997)." I don’t think this should be a likely explanation. i think it is more probable that these amino acids are present in primary emitted coarse mode aerosol particles, which can come from phytoplanktonic sea spray coarse mode particles (Matsumoto and Ueamatsu, 2005), or from soil dust coarse mode particles (Mace et al., 2003). Particles and their chemical constituents can travel for many weeks in the upper troposphere without being lost provided they are not subject to wet deposition, or that the compounds are reacting in the aerosol phase. You are yourselves suggesting that hydrophobic amino acids can survive long range transport. in summary: You can add that these coarse mode amino acids can have both a continental and marine origin, but that you are not sure where they come from. And with continental origin, I mean both Australia, South America, Africa, Antarctica despite that the trajectory is not showing a continental origin within the last week. The coarse mode particles can come from the continents several weeks ago).

A: Thanks to the comments of referees 1 and 2 the phrase has been modified as

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followed.

“These fine aerosol particles can grow during long-range transport, due to condensation of molecules from the gas phase or by collision of small and large particles (coagulation) (Petzold and Karcher, 2012; Roiger et al., 2012). However, this is unlikely in Antarctica due to the very clean conditions. The specific reason for this enrichment is not clear based on the available data. In our future investigations, we will also evaluate the aerosols mass, which is probably a key parameter to measure that will help explain this enrichment.”

We do not believe that primary coarse particles can arrive at the Antarctic plateau because as stated in figure 3.8 of the book “Atmospheric physics”(A. Petzold, and B. Karcher, Atmospheric Physics - Aerosols in the Atmosphere, Springer-Verlag Berlin Heidelberg, Germany, 2012), the coarse particles have a lifetime of 1 or 2 days. And our experimental data do not support such a mode of transport, so we agree with referee3, and as suggested by other reviewers, our experimental observations did not demonstrate this particular mechanism of enrichment. For this reason, we modified the sentence as above.

REF: * P 1288, L 3. This is probably the main source of amino acids in our on-ship samples, this is also supported by the backtrajectory analysis (Fig. S8a–g), where demonstrate only a marine influence for that period. Should read: "This is probably the main source of amino acids in our on-ship samples. This is also supported by the backtrajectory analysis (Fig. S8a-g), which demonstrates only a marine influence for that period."

A: We agree with referee and we modified the sentences as suggested.

REF: * P 1288, L 15. What is "Oceania"?

A: Oceania is a continent that includes Polynesia (including New Zealand), Micronesia, Melanesia and Australia.

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REF: * P 1289, L 5-13. "The back-trajectory analysis (Fig. S8c–e) demonstrated that the air masses came from inland Antarctica, where no vegetation is present. The biological material present in the atmosphere with a size > 10 μm includes pollens which typically vary between 17–58 μm, fungal spores between 1–30 μm, and algal spores between 15–120 μm. Instead bacteria have a diameter between 0.25–8 μm, and viruses have diameters that 10 are typically less than 0.3 μm (Jones and Harrison, 2004). For this reason, we propose that the biological materials that influenced the concentration of the total free amino acids in the shipboard aerosols can probably be attributed to algal spores." Why only algal spores? You should not exclude pollen in this paragraph already, since it is not until the next paragraph where you use Pro to isolate algal spores as the only explanation.

A: We agree with the referee and we modified the sentence as follows: “For this reason, we propose that biological materials influenced the concentration of total free amino acids in the shipboard aerosols.”

REF: Conclusion * "The study of aerosols with diameters > 10 μm indicated that bubble bursting processes can also emit microorganisms that are composed of a higher number of neutral amino acids." I didn’t get this from the result section?

A: This is our conclusion from section 3.3, for the oceanographic cruise to explain the difference between the samples collected using the TSP sampler and the cascade impactor. This conclusion is stated on page 21, lines 501-503 at the end of the appropriate section.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 1269, 2015.