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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Amino acids in Antarctica: evolution and fate of marine aerosols" *by* E. Barbaro et al.

Anonymous Referee #3

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The study is very important, since it reports on the availability of amino acid compounds in aerosol particles at Antarcita and the southern Ocean, which has never been reported before. The disposition of the paper is very clear.

However, the paper needs significant language improvements, and the text needs to be more coherent and the "flow" of the text needs to be improved. A native English speaker must be consulted. Also, some major changes, for example in the abstract, introduction, and some speculative information need to be addressed as explained below before this paper can be accepted for publication.

Abstract page 17068

Lines 4-6: This part of the sentence should be changed. The CCN activity refers to

the amino acid part of the aerosol particle, while in reality the entire aerosol particle activates and not only the amino part (language correction in other words).

Lines 7-9: This is a non-specific statement of the objectives. What is the role of amino acids in this statement, what does four austral summer campaigns got to do with aerosol transformations, and what is the real objective?

Line 10: "the Italian coastal base". Which Italian coastal base? I suggest to give the name of the station in the abstract, or where it is positioned.

Lines 11-12. "The main components were ïňĄne fractions, establishing a local marine source." What is the reason to attribute the source as a local marine source, just based on the fine fraction (this is not 100% sure, please avoid writing that it is a local marine source)? This sentence also needs to be changed due to errors in the language.

Lines 12-16: I am sorry: The reader does not understand what the coarse fraction has got to do with the background values of amino acids (this is written later in the text, but cannot be understood on its own here)?

Lines 17-19: What do you mean with biological?

Lines 11-16: Please avoid to include the speculation about the photochemical transformation and coagulation as reason for the change in amino acid composition.

Introduction page 17068-17069

Lines 21-25 (page 17068), and lines 1-23 (page 17069). In my opinion, the authors mention in too much length the general formation and properties of marine aerosols. This section could be shortened substantially in favor for a more detailed description of amino acid aerosol particles and their sources, which the authors do later in the introduction.

Introduction page 17069

Line 25: Please mention in what form the amino acids appear in the aerosol form;

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dissolved combined amino acids (proteins and peptides) (Kuznetsova et al., 2005; Ge et al., 2011), dissolved free amino acids from the hydrolysis of the combined ones (Mopper et al. 1987; Milne et al. 1993; Sommerville et al., 2001), and particulate amino acids (solid microorganisms and debris particles inside the liquid aerosol phase) (Kuznetsova et al., 2005).

Lines 25-27. Many more studies have reported amino acid concentrations. Please refer to the review by Ge et al. (2011) instead.

Line 29: Please consider also to refer to other references on the CCN activity of amino acid particles, e.g. Huff-Hartz et al., 2006; Kristensson et al., 2010; Raymond and Pandis 2002. These references will show that in general, they are not very effective CCN. However, the small amounts normally found in aerosol samples (maximum few weight percent, Ge et al., 2011) will not decrease the CCN activity of aerosol particles in a major way (Kristensson et al., 2010).

Introduction page 17070

Line 6-12: Many more references are important, which report the measurements of amino acid composition of aerosol particles. Maybe you should focus on those ones reporting the marine or Antarctic and sub-Antarctic measurements, and skip the discussion on the continental amino acids (lines 13-22)? However, you can mention (as you already have done) that even at remote marine locations, continental amino acids can be major sources of amino acids in marine aerosols (Matsemato and Ueamatsu, 2005). The marine and sub-antarctic references are for example: McCarthy et al. 1998, Wedyan and Presteon 2008, Mace et al. 2003, Matsumato and Ueamatsu, 2005, Gorzelska and Galloway, 1990, and the one suggested by one of the referees; Schmale et al., 2013.

Lines 27-28: Do you have a reference to strengthen this statement about the importance of marine aerosols in the southern ocean?

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Lines 23-28, and Lines 1-2 (page 17071). I find it hard to understand what you are trying to mediate in these sentences. Please clarify.

Introduction page 17071

Lines 3-19. The aims are stated in a somewhat incoherent way. Would it be possible to make it more coherent? Maybe it is also somewhat vague. Would it be possible to specify instead exactly what you were doing? Experimental section pages 17072-17075 Please put the text about station measurements on page 17072, lines 28-29, and page 17073, lines 1-6 directly after the station description at line 6 on page 17072. All the periods of station measurements should be mentioned together, and then you should mention the ship cruise at the end. And why is the DOME C measurements mentioned twice in the experimental section? Please make this more coherent.

Page 17072: Please mention that you are doing TSP measurement for the ship cruise. And, why do you mention in several places that the sampling is of particles larger than 1 um diameter? Shouldn't the TSP measurements also include the submicron fraction?

Page 17073: Please avoid using emotional expressions like "precious".

Page 17075: Mean-clustered trajectories? What is this? Please explain. In general, please discuss which amino acids compounds you are sampling in the experimental section. For example, you do not mention if it is dissolved combined or dissolved free amino acids that you are measuring, or if you also measure solid amino particles inside liquid aerosol particles. Many, like me who are not familiar with the sampling techniques do not have the competence to conclude which types of compounds you are measuring. And, please also discuss if your sampling method is "soft" or "destroying" the chains, dissolves the solid amino acids, or hydrolyses the combined amino acids into free amino acids.

Results and discussion page 17075.

You mention L-, and D-amino acids in the results section. For those not familiar with

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the chivalry of these compounds, please explain in the introduction that the L-types come predominantly from phytoplankton material in the oceans, and the D-types come predominantly from bacteria (Kuznetsova et al., 2005). Please also explain in the Instrument analysis section that you are analyzing both types. I recollect that L-types dominate in coastal-near environments (Kuznetsova et al., 2005), and that D-types are found at off-shore marine environments. I don't think that bacterial amino acids are below detection limit at off-shore locations. Please consult: McCarthy et al., 1998, and Wedyan and Preston, 2008 again. Please discuss the potential difference between you not finding D-amino acids, and the other studies finding these D-types.

Result chapter 3.1

Page 17076, Line 1: Please explain what the first sample is.

Result chapter 3.2

Page 17078. First paragraph of section 3.2. Consider to remove it entirely. All the stations and ship cruises in this study are remote. This does not have to be mentioned here again.

Page 17078, second paragraph of section 3.2. In general you are repeatedly mentioning in the introduction of several result sections which periods you are measuring at the different sites. This has been communicated once before, and is clearly seen in Figure 2, why you can remove this text, and also in other places where it is not needed.

Page 17079. "very aged "background aerosols". Should rather be "very remote"?

Page 17080-17081. Very rarely do particles from the fine mode grow into the coarse mode, especially if most of the fine mode particles are found well below 1 um diameter. This happen only if the coagulation is very strong (high particle concentration), or if the condensation growth is strong (many condensing vapors). But, the remote areas of the southern ocean, does not really allow for this. Since, coarse mode amino acid aerosol particles sometimes have a continental origin, couldn't this be the explanation (if you

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look further back in time on the trajectories to find a continental origin)? Or if you are sampling large marine particles during conditions of favorable sea spray production of coarse mode particles at the same time as micrometer sized amino acid debris solid particles are also collected? Please consider to change this entire discussion. Please mention in the results and discussion section, how large fraction of the WSON the amino acid compounds take up, or the fraction of the total aerosol mass when comparing with other studies reporting measurements of the total mass or WSON mass at Antarctica.

Conclusions

Please avoid to discuss the coagulation and photochemical transformation with regards to the ageing of compounds in the aerosol particles, since theis is almost ruled out (see previous comments), and since it is only a speculation. Please focus instead on the results that are certain (the average and median concentration of amino acids in the particles, and the range of concentrations, from minimum to maximum, and the difference in composition and concentration between the coastal, dome c, and ship board measurements). Please leave the speculation for the discussion section.

References

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