

## ***Interactive comment on “Morphological features and mixing states of soot-containing particles in the marine boundary layer over the Indian and Southern Oceans” by Sayako Ueda et al.***

### **Anonymous Referee #2**

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This study provides a careful analysis of individual aerosol particles collected over remote areas of the Indian and Southern Oceans during a long cruise, sections of which could be classified according to the relative amount of anthropogenic influence. The focus is on the concentration and speciation (internal or external mixing) of soot particles, with TEM analysis of intact and water-dialysed samples supplying the core information. (Water dialysis gives an extra angle of individual-particle properties.) Although the identification of individual particle types is based on morphology and water solubility (with no supporting direct compositional information, such as EDS), given the relatively simple composition of remote marine aerosol I believe that the identification of soot, sulfate (with variable degree of acidity) and sea salt is reliable. In all, the re-

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sults are interesting and useful for understanding remote marine aerosols; however, the paper is rather descriptive and leaves the reader in doubt about the significance of the results. My questions and comments below address the points that I think the authors may wish to consider, and perhaps to add some more value to their work.

1) The images of sample regions before and after water dialysis are spectacular - however, the quality of the presented TEM images does not seem to permit the detection of very small (consisting of just a few globules, smaller than about 100 nm) soot particles, begging the question whether a fraction of soot particles could escape attention. Could you please comment on the lower size limit of soot that you think you could still identify? On the other hand, if you are confident that only 1 to 2% soot-bearing particles occur, could you please comment on the possible causes of the difference between your and earlier results that showed a larger fraction of soot-bearing sulfates (for example, Pósfai et al. 1999, cited elsewhere, identified in pristine Southern Ocean air 10 to 45% of sulfate internally mixed with soot).

2) Data screening - periods with contamination from the ship were identified by sudden increases in CN counts. Can you absolutely exclude the possibility of enhanced particle counts from natural sources, such as new particle formation followed by rapid growth? An example: comparing Figs. 4a and 4b, even though the particle volume increased on 08/12/22, absorption remained almost constant.

3) Origin of bare or hardly coated soot seems puzzling (discussion on page 8) - have you considered an upper tropospheric source from aircraft emissions?

4) Towards the end of the Results section I miss some discussion on the significance of your observations - do they change our current understanding of remote marine aerosols and their optical properties? What is the main added information?

Minor issues:

Abstract, lines 19-20: change to “particles were rarely found (2.1%..) containing insol-

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uble residuals..”

The Abstract lists only observations; some interpretation, a statement about the significance of the results is missing from the end.

Introduction, first sentence: it sounds as if atmospheric aerosol were a byproduct of combustion - please reword.

“Information related to mixing states of soot has not been shown” - rather “scarcely shown” - see comment 1) above.

3.3.1 Samples, first line: “13 samples were analyzed using TEM”

3.3.2 Morphological features and mixing states, line 22: “ most aerosol particles. . . were almost water soluble”. Unclear what “almost” refers to - almost completely dissolved in water or almost all particles were water-soluble? same section, line 27: “However, that in sample H was 2%.” Please correct grammar of sentence.

3.3.3 Features of soot-containing particles, line 32: either “externally mixed” or “external mixing”

3rd line from bottom of page 8: “area larger than 60°S” - meaning unclear

Conclusion, line 10: “The origin of bare soot remains unknown.”

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