

Interactive comment on “Introducing the bromide/alkalinity ratio for a follow-up discussion on “Precipitation of salts in freezing seawater and ozone depletion events: a status report”, by Morin et al., published in Atmos. Chem. Phys., 8, 7317–7324, 2008” by R. Sander and S. Morin

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We would like to thank Eric Wolff for his honest and non-anonymous review.

> In this sense, the present paper is cast in a rather odd
> way: the two papers do not need reconciling (as the
> present paper suggests); they are already perfectly

C6024

> reconciled if both sets of authors accept that ikaite
> precipitation is what occurs, so that the calculations for
> calcite are irrelevant.

We agree that in some sense, the paper is “cast in a rather odd way”. Instead of the usual comment and reply, both authors have come to a common conclusion and decided to present it in a shared publication. While we agree that the calculations for calcite by Sander et al. are probably irrelevant, the improved calculations for ikaite by Morin et al. do not contradict the hypothesis that carbonate precipitation triggers bromine explosions. This is what we refer to when using the expression reconciliation. However, we are open to suggestions for rephrasing this expression in the final version of the paper.

> The main point of the current paper though is that the
> alkalinity is not what is important but rather the ratio
> of Br⁻ to alkalinity, which does increase with decreasing
> temperature even for ikaite precipitation. However, the
> importance of this ratio is simply stated, with no
> discussion of why it is important. If this paper is to go
> ahead, the authors need to explain why they think the
> ratio matters.

We apologize for the insufficient description of why we think that the bromide/alkalinity ratio is important. We hope that the description given here explains it better:

BrO mixing ratios around 30 pmol/mol are often measured during ODEs. It is generally assumed that the ultimate source of bromine is sea water. The scientific question that needs to be answered is how 30 pmol/mol of bromine can be released from a liquid phase (e.g., aerosols, brine on snow or frost flowers, ...) which is based on initially

C6025

alkaline sea water via an acid-catalyzed bromine explosion mechanism when only a small amount of acidity is available. Assuming the normal sea-water bromide/alkalinity ratio of about 0.5, these 30 pmol/mol Br⁻ correspond to about 60 pmol/mol HCO₃⁻ in the liquid phase. Thus it is necessary to scavenge 60 pmol/mol of some acid from the gas phase to neutralize the liquid phase. It is irrelevant if these 60 pmol/mol HCO₃⁻ are in a small volume of concentrated brine or if they are in a larger volume of a less concentrated solution. In both cases 60 pmol/mol HCO₃⁻ must be neutralized to activate 30 pmol/mol of bromine. However, if some fraction (*x* percent) of the carbonate has been removed, then accordingly *x* % less acid is needed to activate a given amount of bromide. That's why we think the bromide/alkalinity ratio is the important factor.

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> A minor grammatical point: page 20767, line 2 ``therefore  
> deemed potentially powerful'', replace with ``and is  
> therefore considered potentially capable of explaining  
> the...''
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Changed as suggested.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 20765, 2009.

C6026