

## ***Interactive comment on “Influence of intense scavenging on Pa-Th fractionation in the wake of Kerguelen Island (Southern Ocean)” by C. Venchiarutti et al.***

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We would like to thank the reviewer #2 for the fruitful comments and for giving a positive recommendation for the publication of our manuscript in BG.

Authors' Response (AR) to the Reviewer's detailed comments

- P. 4874 L5: I am not convinced that 231Pa is always linear with depth in the upper 1000 m, see e.g. the profiles of (Edmonds et al. 2004) in the Arctic, or structures in many profiles closer to the sea surface. Please re-phrase.

AR: MODIFIED. It is now mentioned in the manuscript that this linearity may be ob-

C2567

served below the euphotic layer to around 1000 m depth, i.e. in the “intermediate and deep clear waters”.

- P4877 L13-14 Can you name the water mass that is being advected?

AR: MODIFIED. The water masses are now named and detailed more clearly in the text in Section II.1 and indicated in Figure 5 showing the representation of the dissolved Pa concentrations as function of density. References to Roquet et al., 2009 and McCartney and Donohue, 2007 were also given to get a more detailed hydrography of the Kerguelen area, in addition to the already published hydrographic data of the KEOPS cruise (Park et al., 2008a).

- P4879 L5 and following It would be better to address first the co-precipitation, then the column, assuming that this was the sequence of events. Can you swap the first and second paragraph of section 2.3.1?

AR: MODIFIED following the reviewer's comment.

- P4879 L12. Is this value (97.9%) required for further calculations? When you really have just two values, better report the individual data than the standard deviation, which doesn't make real sense for just two data points.

AR: The chemical yield was not used in the calculation of the Pa concentrations (not even for the three stations that were not analysed using Isotope Dilution). The authors had mentioned this value to attest of the general good recovery obtained for Pa standard solutions with this chromatographic separation, thereby suggesting that loss of Pa during this step was insignificant. Only the reference to Jeandel et al., 2011a is given now in the text. Moreover, the overall procedural recoveries (given in table 1) show that Pa loss occur at other steps than the co-precipitations and chromatography steps, likely during the leaching step or when the presence of silica gel implied to carry out centrifugation of the samples before loading onto the column.

- P4880 L12 It seems that for some of the samples, there was effectively no yield tracer.

C2568

If this is correct, which error did you add to the final data to take this into account?

AR: Reviewer #1 also commented on this part of the manuscript. Indeed the dissolved Pa concentrations at the 3 stations A3-33, A11 and Kerfix were not determined by Isotope Dilution and we could not determine any procedural yield for these samples. These concentrations were determined by external standard calibration with a  $^{231}\text{Pa}$  standard solution (extensively used within the Geochemistry Group at LEGOS). Therefore, we had applied, in the previous manuscript, the corresponding error propagation to the determination of the final Pa concentrations, i.e. propagating errors on the use of the  $^{231}\text{Pa}$  standard and error on the initial contribution of the  $^{233}\text{Pa}$  spike introduced before the expedition. Finally, the authors decided to remove the dissolved Pa data for these 3 stations without Pa yield tracer from the manuscript and this paragraph was therefore deleted in the revised manuscript.

- P4880 L 24-26 To which samples does this statement apply? Just the particulate samples?

AR: In order to clarify the Section II.3 "Analytical procedures" in the revised manuscript, we focus on the Pa analysis only. This part was re-phrased and is now reads: "After the chromatographic separation, both particulate and dissolved  $^{231}\text{Pa}$  purified fractions were measured within 24h".

- P4890 L1 and following: Please remove the statement about Fig. 8, see comments below.

AR: Figure 8 and Figure 6 were both removed from the manuscript, following the reviewers' comments, since these Figures did not give satisfying representations of the possible relationship between the KPa and BSi in the Kerguelen area (with high KPa for high BSi concentrations). This relationship is now demonstrated/highlighted by comparing the KEOPS data with KPa and BSi data from the literature. Please see also Reviewer #1 comments and our response to these comments.

C2569

- P4893 L13 Again, it would be useful to know which water mass is advected, and which concentration of  $^{231}\text{Pa}$  it might carry.

AR: See as well answer to above comment P4877 L13-14. In this manuscript, in order to show the effect of an open-ocean water mass ( $^{231}\text{Pa}$ -rich) advected on the plateau, we used the station B11, the only relevant off-plateau/open ocean station for this KEOPS study. However, as suggested by other publications (Chever et al., 2010, Zhang et al., 2008, van Beek et al., 2008 and Park et al., 2008), it is more likely that this water mass will have a southern origin, likely coming from further South than Heard Island. Unfortunately, we do not have any information on the Th and Pa concentrations from this area.

- P4894 L8 and following: An important result. Maybe strengthen this part in the introduction?

AR: This is now mentioned in the introduction in the paragraph dedicated to the summary of the results of Venchiarutti et al., 2008 and now reads: "This suggested that advection of waters from the open ocean could bring other trace elements as well and impact on the budget of these elements over the plateau".

- Figures While the profiles together with the map actually give the full information, it may be more intuitive to present oceanographic data as sections. Consider presenting the data as three sections. If it proves to be difficult, maybe because of the scatter of the data, don't feel obliged to do it, but it could really help the reader to understand the structures. This is particularly true as BGD/BG is well suited to provide extra colour figures.

AR: The authors acknowledge that this kind of plots may be of benefit in studying the evolution of concentrations with respect to water masses and topography. However, the authors are not convinced that such sections plots would give here further insights on the representation of the dissolved Pa concentrations with respect to the Kerguelen hydrography. Indeed, it is not really possible to draw section plots for KEOPS along the

C2570

3 transects because of the poor resolution of the data. Plotting the Pa data along ODV sections for KEOPS would lead to a high interpolation that may hinder and modify the interpretation of the results.

- Figure 8 should be removed or changed substantially. None of the data points shown here has a KPa significantly different from zero. Both regression lines are being almost entirely determined by a single data point, with a huge error. The apparently good correlation is purely a consequence of this situation, and it conceals the fact that within the analytical error, completely different relationships would be possible.

AR: Figure 8 was removed from the manuscript as explained in the answer to the above comment.

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C2571

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C2572