

Reply to Comment on *essd-2022-446* by Malte Willmes (Referee)

Referee comment on "A strontium isoscape of northern Australia" by Patrice de Caritat et al., *Earth Syst. Sci. Data Discuss.*, <https://doi.org/10.5194/essd-2022-446-RC2>, 2023

General comments

The manuscript "A strontium isoscape of northern Australia" by Caritat et al. presents a new large-scale $^{87}\text{Sr}/^{86}\text{Sr}$ isotope dataset for Northern Australia based on archival fluvial sediment samples. The scope of the study is very impressive, and the data are going to be very useful for the science community. The analytical methodology and statistical evaluation of the data are appropriate and provide confidence in the provided results. Specifically, the use of archived sediment samples that should represent a mixture of the varied geology is very interesting and overcomes the lack of samples from Northern Australia. Overall, I believe this is a very important contribution and it is great to see that the authors have chosen to make this data available.

Thank you for the comments.

Specific comments

I think it would benefit the reader to make it very clear that the data presented here are total Sr and not bioavailable Sr. This does get mentioned in the manuscript, but I think it should be front and center to avoid any potential confusion and incorrect use of the data. I am also interested in why the bulk Sr extraction was chosen rather than bioavailable? I think elaborating on this in the discussion would be useful and interesting. Is there any use in getting bioavailable Sr out of these samples?

The fact that we use total Sr, which was already made several times, has been emphasised in the text (e.g. italicised *total/bioavailable* in Abstract, Introduction and Conclusions). The reason we chose this method is because our focus is on geological processes rather than bio-mediated processes. The following sentence was added at the end of the Introduction:

The choice of total rather than bioavailable Sr as the focus of this work was driven by an emphasis on geological sources and processes.

In the quality assessment section (Line 222-228): To confirm the data are interpreted based on the 3rd decimal place because the within sample variability was high? Why is that so? Is that a result of the total Sr extraction method, the type of these sediments, or another process? This should be elaborated on in the discussion. For example, would you recommend analyzing more sediment samples to get a better handle on this? Or a different extraction method? Or a different sample type?

We clarified this by modifying the sentence in Subsection "3.3 Quality Assessment":

This relatively low precision obtained for field duplicates is attributed to heterogeneity of the alluvial deposits

Analysing more samples will improve results, but there has to be a balance between extent of coverage and density of sampling because resources are always finite. In the NGSA the choice was made to favour the former and we have to live with this when working with these archive samples. Perhaps the only thing that could be made differently in a future survey is to collect field duplicates much closer than 80 m apart, perhaps within 10 m of each other. So in many ways the NGSA sampling represents the worst case scenario in terms of representing the homogeneity of the target landform.

Technical corrections

Abstract

I focused on the abstract as this is the most widely read part of the paper. The following comments are all suggestions that I hope improve clarity.

Line 8: Maybe add “useful as a tracer” or something similar. Just useful seems not very informative.

Done.

Line 10: I think it should be “archived”.

Done.

Line 11: Suggest removing the reference style (last accessed) from the abstract (here and at the end).

Removed.

Line 12-14: This is a lot of method detail for an abstract. Since the paper is open access and the method section will be available to all to read I suggest to condense this to a single sentence. “Total Sr was extracted and measured...”

We understand the viewpoint, however, as our methods are dissimilar to those employed by e.g. anthropologists (as emphasised by this and other Reviewers), we prefer to leave this amount of detail in the Abstract. If deemed excessively long (we don't think so), we're happy to cut this down somewhat at final stage.

Line 16: Why preliminary?

Removed.

Line 21: Can you add a range to the carbonate units. Also, the word “signature” at least to my ears implies some type of unique value so maybe the word “range” or “ratio” is better here.

Done, ‘signature’ changed to ‘values’ and medians for carbonate and mafic/ultramafic rocks added. A corresponding paragraph has been added in the Discussion (Subsection 5.3):

The floodplain sediment Sr isotopic values recorded in areas dominated by sedimentary carbonate and mafic/ultramafic igneous rocks are usually within an intermediate range between the more radiogenic and unradiogenic end-members discussed above. Indeed, samples sited within 0.1 degree (~10 km) of lithologies recorded as sedimentary carbonate and mafic/ultramafic igneous rocks have median values of 0.7387 (n = 96) and 0.7422 (n = 42), respectively.

Line 27: How should these data be used in archaeological, forensic, and ecological studies? The sentence from Line 76 might actually be a good fit here. “The present study affords an opportunity to further redress this deficiency and will reduce the northern hemisphere bias in future global $^{87}\text{Sr}/^{86}\text{Sr}$ models.”

We don't think this needs to be spelt out in the Abstract any more than it is, as the words ‘future models derived therefrom’ are sufficiently explicit. The details are now covered by the added sentence in Subsection 5.21:

Indeed, through contemporaneous data analytics, including artificial intelligence and machine learning, it is likely that the relationships between bioavailable and total Sr isotope values and a host

of other environmental variables (including from climatic, topographic, biotic and geoscientific categories) can be teased out and high-spatial resolution models/predictions of bioavailable or total Sr isotope distribution can be derived (e.g. Bataille et al., 2020).

Introduction

Line 40-70: I don't believe all these references are needed or useful for the reader. Maybe focusing on 2-3 key references per statement would improve this intro.

As recent reviews of Sr isotope work in the geosciences are rare, we find this short review (~1 page) has merit, and since other Reviewers have not raised an issue with it, we prefer to leave it in.

Figure 1: Great figure but small in the pdf and symbology is hard to distinguish (maybe different symbols could improve this). Actually all figures could be larger (full width).

We have redone Figure 1 for clarity, as Reviewer 1 also raised that point. We leave it to the **Editor** and the production team to ensure Figures are of an appropriate size.

Data analysis

Line 230: Why choose Excel rather than R or python for the data analysis? One of the main benefits of using a scripting language would be that others could reproduce the results (and figures) directly.

That was the tool available to us at the time. The raw data are released so future researchers can manipulate and record their analysis with R or python if they wish.

Figure 4: Remove one of the legends to save space and as before make the figure larger

The legends refer to points and catchments, respectively. We prefer to leave them as is, and leave it to the **Editor** and the production team to ensure Figures are of an appropriate size.

Table 1: Really useful compilation! Thank you.

Thank you for the comments.

Conclusions

Line 373-381: This could be removed to provide more focus in the conclusion. The number of samples and the range could be incorporated into the following sentences.

We feel that many readers may only read the Abstract and then perhaps the Conclusions, and so believe that it is important that the main parameters of the research are repeated in the latter.

Also again be very specific about how these data could be applied in provenance studies in archaeology/forensics.

The words '*and modelling derived therefrom*' have been added.