

1. Does the paper address relevant scientific questions within the scope of SE?

Yes, it does. The exploration of new methodologies based on hyperspectral data that allow the prediction of petrophysical properties beyond the mineral-mapping traditional approach is highly relevant within the earth sciences.

2. Does the paper present novel concepts, ideas, tools, or data?

The paper presents a novel processing workflow to predict petrophysical properties from hyperspectral core data.

It might be worth the authors reading and possibly citing the PhD thesis from Rocio Vargas Soto, which achieves similar things using hyperspectral imaging to extract comminution properties (<https://espace.library.uq.edu.au/view/UQ:c0c45d3>)

3. Are substantial conclusions reached?

They are substantial as part as a broader development to see if we can use hyperspectral data to extract petrophysical properties

4. Are the scientific methods and assumptions valid and clearly outlined?

The methodology is clearly covered, discussing the data acquisition, co-registration and processing. However:

- In section 3.1 “Hyperspectral data acquisition”, although is mentioned that the details of the dataset can be found in a previous work from “Thiele et al. (2024)” it would be worthy to mention the spectral resolution and/or number of bands in each spectral region (VNIR-SWIR, MWIR, and LWIR). It will allow to better understand the further section 3.4 “Spectral processing”, specially when it is mentioned that the first and last 10 bands of the MWIR and LWIR data were removed. Similarly, in section 3.8, reference is made to the relevance of the spectral sampling resolution for the configuration of the convolutional neural network model.
- In section 3.3, "Data Co-registration," the spatial resolution of the slowness and hyperspectral data is mentioned. It may also be useful for the authors to include the spatial resolution of the density and gamma-ray properties to provide a clearer understanding of the downsampling method
- The first heading in Fig 4 only references SWIR, however in the text in section 3.6 the heading is described as VNIR-SWIR. Can you please update the figure?

5. Are the results sufficient to support the interpretations and conclusions?

Yes, they are. The interpretations and conclusions are based on the model's performance in predicting each petrophysical property

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?

Yes, it's well described, and the inclusion of the Shapley analysis provides insights into how the model is learning, which gives confidence in generalizing the model to other experiments

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Check

8. Does the title clearly reflect the contents of the paper? Check

9. Does the abstract provide a concise and complete summary? Check

10. Is the overall presentation well structured and clear?

It is well-structured. The paper presents a clear methodology for data acquisition, processing and analysis.

11. Is the language fluent and precise? Check

Lines 254 onwards: Slightly convoluted sentence. REWRITE "This indicates that there is a sensitivity to the fundamental mechanical and petrophysical properties of the rock, and it suggests that the model could be generalised on more diverse data."

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Check

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

The paper is extremely well-written and there is no text to be eliminated, reduced or combined. The paper could benefit from adding more detail on the data used, rather than simply referencing Thiele et. Al 2024 as mentioned above.

It may also be useful for the authors to be slightly more explicit about the challenge of generalisation in the paper. In line 250, the authors address this problem by discussing the implications of the results from the Shapley analysis. However, for readers who do not have much knowledge about CNNs it may be useful to add the following sentence at the beginning of the paragraph:

"A common challenge for deep learning models based on CNNs is whether or not they can be generalised. In this study, training and applying the model to 3 drill cores from the same geological sequence does not mean that similar results could be attained in different geological sequences. However, given the results from our Shapley value analysis, we suggest ... "

14. Are the number and quality of references appropriate? Check

15. Is the amount and quality of supplementary material appropriate? Check