**Response to Editor:**

Thank you for compiling the responses to the initial revision. We have made the moderate revisions requested to the manuscript and addressed the comments from the reviewers individually in this document. We hope this adequately addresses the concerns raised by the reviewers and look forward to hearing back from you.

**Response to Reviewers:**

**Reviewer #1**

There is no more recommendation. It can be published.

**Author Response**

We would like to sincerely thank the reviewer for their time in assisting us with the review of this paper and for their recommendation for publishing.

**Reviewer #2**

The present version of the revised manuscript shows good effort and modifications from the ‎authors; however, the authors did not consider many comments; for example: (see below)

Finally, I try to help the authors to improve the quality of their manuscript, so please do your ‎best to address my comments and don't neglect them

**Author Response**

We would like to thank the reviewer for their comments and helping us improve our manuscript. We would also like to assure the reviewer that their comments have been considered carefully by us and are certainly not neglected. Please see below for our changes/responses to the new comments.

**#5**

Comment #5: The low resistivity low contrast reservoirs terminology refer to highly conductive composition interbedded with similar composition.

Response #5: Yes, this correct. It’s a comparison and contrast of rock texture and pore size. So, shale pore sizes vs opaline pore sizes. If they are similar, then any hydrocarbons present in the opaline get “masked” by the surrounding rocks.

New comment: The authors still did not respond to this comment; how they can differentiate ‎between the low contrast-low resistivity intercalations in this sequence.

Response: For this manuscript, the key takeaway is that the microsphere/lepisphere structure and fracture/matrix-porosity dominated properties of opalines could result in LRLC pay, where microporous and fractured structures allow hydrocarbon intervals to be “short-circuited”, leading to low resistivity values. Methods to differentiate such intercalations would have to be developed independently by first principles depending on the information at hand as rock properties and resistivity values vary greatly across different LRLC sequences.

In this sequence, SEM scans and lowered grain densities allowed us to infer sections of microporous opal microsphere/lepisphere structures with high porosity, which we hypothesized could have suppressed resistivity, leading to possible LRLC pay zones.

**#7**

Comment #7: Pyrite and also glauconite are the main reason for low resistivity reservoirs; sometimes also the detrital clays rimming the grains are another reason

Response #7: Noted.

New comment: So, you should explain the reasons for the low contrast-low resistivity ‎phenomenon.‎

Response: We agree that there should be some write-up here about other contributors to LRLC so we have included a short explanation of how pyrite and glauconite might explain such phenomena in lines 50-57 of the revised submission.

**#8**

Comment #8: You may support this section by some case studies from Egypt, Sudan, New Zealand, and Algeria

* Nabawy, B.S., Lashin, A.A., Barakat, M.K., 2022. Implementation of lithofacies and microfacies types on reservoir quality and heterogeneity of the Late Cretaceous Upper Bahariya Member in the Shurouk Field, Shoushan Basin, North Western Desert, Egypt. Journal of Asian Earth Sciences 224, 105014
* El Sawy, M.Z., Abuhagaza, A.A., Nabawy, B.S., Lashin, A., 2020. Rock typing and hydraulic flow units as a successful tool for reservoir characterization of Bentiu-Abu Gabra sequence, Muglad basin, southwest Sudan. Journal of African Earth Sciences, 171, 103961
* Radwan, A.A, Nabawy, B.S., Abdelmaksoud, A., Lashin, A., 2021. Integrated sedimentological and petrophysical characterization for clastic reservoirs: A case study from New Zealand. Journal of Natural Gas Science and Engineering 88, 103797
* Baouche, R., Nabawy, B.S., 2021. Permeability prediction in argillaceous sandstone reservoirs using fuzzy logic analysis: A case study of triassic sequences, Southern Hassi R'Mel Gas Field, Algeria. Journal of African Earth Sciences 173, 104049

Response #8: Noted. We have referenced the case study of Egypt in page 2, line 47 of our resubmission as we feel it was relevant to this study.

New comment: The mentioned references will support the scientific statements of the ‎introduction; however, the authors did not care for supporting their introduction by the ‎mentioned references. Please, adding the references to your introduction should give a ‎weight for your study not to reduce your scientific innovation. ‎

Response: Noted. Three of the mentioned references have been incorporated into the introduction. One more of the mentioned references was placed as a reference for rock typing above figure 11 instead. We have also supported this paper with a few other additional references.

**#10**

Comment #10: What do you mean by opal-CT, take care the term CT is widely used for computer tomography X-ray. So, this term is misleading and confusing here.

Response #10: Noted. We have clarified the use of this term in page 3, lines 105-107 of the resubmission. Note that opal-CT is commonly used to refer to a diagenetic phase of opal consisting of disordered Cristobalite and Tridymite, hence the “CT” name.

New comment: Can you replace it by opac-C-T?‎

Response: We understand the reviewer’s concern here that the term could be confusing. However, we are reluctant to replace it as it seems that the “opal-CT” term is what is most used in other academic papers such as those cited in the manuscript. Furthermore, even the Wikipedia page for Opal uses the term Opal-CT to refer to microcrystalline opal, showing the term is quite widespread and well-understood.

**#11**

Comment #11: I don't agree, where the opaline is hard and seals should be ductile. On contrary the hardness of the opaline increases its ability to be fractured by tectonism, i..e., improve its ability to serve as reservoir in the future.

Response #11: The thing to understand here is that opalines are not monomineralic. There can be opals that have poorer properties (seal facies) in contrast to opals which are more porous (reservoir facies). Indeed, if you are in a tectonically active zone, then both can be potential reservoirs. Alternatively, they may also not act as reservoirs/seals if all the hydrocarbon leaks out due to poor seal. In any case, I note your point but point to evidence in Yurihara Field in Japan, which has “tight” opal as a sealing facies and more porous opal (porcelanites) which are reservoirs.

New comment: The authors didn't respond to this comment; the hard opaline has hard and brittle ‎properties in contrast with the seal rocks, please explain or remove this statement.‎

Response: As mentioned in our earlier response, the opalines can act as seal rocks due to their low porosity, low permeability, and high clay content. We refer the author to one of our references titled “New hydrocarbon trap models for the diagenetic transformation of opal-CT to quartz in Neogene siliceous rocks” by Tsuji, Masui, and Yokoi (2011) for more information on this.

Nevertheless, we have edited lines 132-139 in the revised manuscript to qualify our statement and acknowledge your point on fractures from tectonism, which was not seen in this referenced example but is possible.

**#16**

Comment #16: It is better to present this plot as a cumulative frequency plot, you may check, it will be more representative and can be ranked, please check:

* Abuamarah, B.A., Nabawy, B.S., 2021. A proposed classification for the reservoir quality assessment of hydrocarbon-bearing sandstone and carbonate reservoirs: A correlative study based on different assessment petrophysical procedures. Journal of Natural Gas Science and Engineering, 2021, 88, 103807

Response #16: Noted. We have taken a look and tried to do so, but since we have two unique samples with unique pore size distributions, we think this would not work with our data and have kept the figure as it is – which we think still conveys the data well.

New comment: please check this comment; it is better to use this presentation and to support your ‎explanation by this reference.‎

Response: We have made the suggested edits to figure 10 in the revised manuscript with a short explanation in lines 459-462. We recognize that the publication you provided also ranked the plots, but we have not done so given our limited data on only 2 samples. The changes simply make for a cleaner presentation of data as you mention.

**#17**

Comment #17: Rock typing based on the grain size seem to be poor; rock typing should be based on the petrophysical parameters themselves

Response #17: Noted. We have added in a RQI vs normalized porosity plot in figure 11, page 17.

New comment: Rock typing is not based on grain size only; rock typing in this figure is failed as ‎shown by the authors, please do it based on porosity and permeability. ‎

Response: We understand the reviewer’s comments, however our aim is simply to show the heterogenous nature of the rocks, which this current plot exemplifies well with the “poor” rock typing. Our aim is not to conduct accurate reservoir characterization, at least for this study.

Nevertheless, we have mentioned that it is possible to obtain better rock typing in heterogenous zones through other methods, referencing a case study for Sudan in lines 492-494.

**#18**

Comment #18: Please estimate the Archie's parameters for this plot

Response #18: Noted. We will note this in the text of the submission in page 17, figure 11

New comment: Please estimate these parameters; i.e., to say a = ??, and m = ?? not to mention the ‎empirical equation.‎

Response: Noted. We have addressed this in the caption to figure 11(c) where we have mentioned the parameters and equation used in the revised submission.

**#19**

Comment #19: Residual oil should be trapped in micro pores or attached to the pore walls, but not free like this. These hydrocarbons are movable by water flooding

Response #19: This is a simple 2D drawing of a 3D process. We are illustrating the process of snap-off. Please refer to my numerous publications which shows this in more detail e.g. “SCA2009-A05 - Visualizing and quantifying the residual phase distribution in core material.” That said, we have adjusted figure 13, page 19 to show this in a clearer light.

New comment: this figure is not correct and should be modified to indicate the residual oil in ‎correct manner.‎

Response: We have adjusted figure 13 to more closely resemble other published diagrams of snap-off while also clarifying the process of residual oil snap-off at pore-throat type B in our scenario.

**#20**

Comment #20: This section should be moved early to methods and techniques section.

Response #20: We disagree with the reviewer here. It needs to stay where it is to ensure that the paper reads smoothly, as this illustrates the process and logic of the resulting interpretation.

New comment: the response of the authors to these two comments is not convinced, theoretical ‎equations and applied methods should be moved to the methodology. The Indonesian ‎equation should be applied to highly clayey reservoirs which are the present case studies. ‎

Response: We have considered the reviewer’s viewpoint and understand that in a typical template, these equations would be in the methodology section. However, we still believe that this section should stay where it is as we aim to illustrate the entire process of the workflow. These steps were part of our petrophysical evaluation and were formulated only after identifying issues with the well log (no density log present etc.). Hence, readers should first be introduced to the petrophysical logs before they can fully understand why we employed these methodologies in calculating PHIN. We are confident that this will increase the flow and readability of the paper.

As for the comment on the Indonesia equation, yes, as mentioned previously we have applied the Indonesia equation to account for the high clay content of these tuffaceous reservoirs. Other equations (Dual-water, Waxman-Smits) were not suitable for use as they required parameters derived from non-log data, which we did not have for this study.

**#24**

Comment #24: References need some update

Response #24: Noted. This has been addressed.

New comment: Please consider this comment; updating and supporting the citation references list ‎by more references will enrich the study. ‎

Response: Noted. We have incorporated additional citations from previous comments as well as from other sources.