**Response to Editor:**

Thank you for arranging for the article review. We would like to share some feedback regarding the reviewers. Having incorporated the comments of the reviewers as best as we can, we would like to point out that:

* Reviewer #1 was not clear in his/her critique of the paper. He/She initially states that our research was meaningful and worthy but then contradicts him/herself later by saying our paper is not very (in)novative. We would also like to point out that within the paper itself, his/her only comments were related to the figures presented, besides 1 tersely worded statement where he/she thinks our results contradicts his/her lab experiments. For the latter, the reviewer provides no evidence as to disprove our results. Are we to therefore accept his/her word? There is also no particular reason why he/she thinks the “paper quaulity is not so high” (We realize the word “quality” is spelt wrongly but we are reproducing the response we are provided verbatim so you can understand what we are dealing with). We think the reviewer expects us to have more data than we do; this is an impossible ask because operations itself dictate data gathering. We also acknowledge this point in our “limitation of study section”. We know for a fact no new data will be collected, nor any new measurements taken. In other words, we have to make do with what we have. However, we feel that this study is still valuable and much can be learnt, as noted by reviewer #1 (and reviewer #2 as well).
* Reviewer #2 was much more effusive in his/her praise and his/her comments were very helpful. He/She did note that our paper is publish worthy, and understood the purpose of the paper, which is fundamentally a case study in nature. There were the occasional comments regarding “lack of scientific language” but we find this odd since we also want the paper to be readable and not jargon heavy necessarily.

**Response to Reviewers:**

**Reviewer #1**

The manuscipt dealt with two special reservoirs, opal reservoir and tuff reservoir, using petrophysical logs. Nowadays these kinds of reservoires take an important role in the oil industry more and more. The following resaerches in the paper are meaningful and worthy to be discussed in detail.

1. Reservoir parameters such as shale content, water saturation, and porosity were calculated with difficulty due to complex minerals. The paper gave useful solution.  
2.The microstructure of the opal reservoirs was analyzed by combining the data from thin sections, scanning electron microscopy etc. By studying its forming mechanism, it was classified as a low resistivity low contrast reservoir.

3.Using core data, the effects of particle size and pore size on the permeability of tuff reservoirs were systematically studied. Meanwhile, the role of pore space on reducing residual oil saturation was investigated.

There are still some points which make the paper quaulity is not so high, and those points are difficuty to deal with in short time. such as:

1. Due to lack some important imformation, shale content, water saturation and porosity of these two reservoirs are derived from the study of unsufficent logging responses.
2. 2.methods and techniques used in the paper are not very novative.
3. 3.After the parameters were calculated, only the density and porosity data of DS wells were compared with the data calculated from the logging curves, and the data of other wells were not verified. Therefore, the reliability of the study results still needs further verification.

**Author Response**

We would firstly like to thank the reviewer for his/her comments. We have noted the views expressed and address them here. First, we address the main points above:

1. We are not sure what the reviewer means by “Due to lack some important information…….”. The entire purpose of the paper is to show that, DESPITE having very poor/little information, that one can still embark on a “reasonable” petrophysical interpretation. Again, and as we reiterate in the paper, the solution we present is fit for purpose. So, yes, we agree, there is insufficient log response. But the innovative part of the paper is how we came to a solution with such limited information.
2. Is the expectation of the reviewer that a new equation or method be created for every novel field we encounter? This is unreasonable to say the least, and the reviewer is flawed in his/her logic. The realm of petrophysics is already inundated with 100s of different equations and methods. Sometimes, if something works and can be applied to an existing petrophysical problem, there is no need to fix it and complicate it further. In this case study, what my co-author and I have done is taken existing methods and chained a process which allows us to investigate properties of a series of interesting reservoirs.
3. We are data limited; we only had 1 well with a unique opaline signature. There are no other wells with data we had access to. If the reviewer has data, he/she is welcome to try our method for themselves. It is also incorrect that we ignored the data from other logging curves; all were analyzed and interpreted, but the well was wet. There is very little you can do with a wet well. This statement by the reviewer is therefore unfair.

(Note that this reviewer has a poor command of English; despite this, we have tried my best to adhere to his/her requests.)

Comment #1: Core porosity can better sign other color, not black, in order to be more clear.

Response #1: Noted. We have address this comment in page 5, figure 1.

Comment #2: grain density should not related with porosity?

Response #2: We are not sure what this comment implies, but if you are questioning if we are surprised by this result, then of course not. Indeed, grain density and porosity are related. What we wanted to highlight with this graph was that you can see the various kinds of opal types have different grain densities, for the similar porosity values. For example, OPAL-CT vs Quartzose Porcelanites. Both are opal types but the structure of the opal and the diagenesis it has undergone has impacted its grain density. Quartzose opals have grain densities close to sandstone or quartz, while opal-CT has a much lower grain density.

Comment #3: what is the color indicate for ?

Response #3: We have added a legend to page 10, figure 7 to explain the colours.

Comment #4: The phrase “grammar”

Response #4: Noted. We have slightly edited the sentence in page 16, line 463-465 of the resubmission.

Comment #5: It is impossible that the irreducible water Swi is too low? Our research of tuff core shows that Swi is much higher!!!

Response #5: This is on the assumption that your tuff samples are the same as ours. Tuffs themselves are not monomineralic nor are they homogeneous in nature. As we have explained in my work, this is from an existing producing field, and has been producing for decades. Additionally, Well CP is only 1 of 100s of wells in this field. There is no water cut or produced water of any kind in this field. We do not agree with the reviewer here and invite them to better illustrate their point with an example or publication that we can review. Perhaps your core samples have been drained to different pressures? In any case if the reviewer is sure about this comment, they are welcome to demonstrate this in a publication of their own, but they dhould not invalidate our results just because it is different.

Comment #6: Y40 SP baseline, show that it is shale. The last track show that Vsh just <30%, It is opposite

Response #6: A few misconceptions to clarify here. Please understand that this is not a shale in the way the reviewer understands i.e. a production baffle or barrier or something that can act as a seal. This is more like a shaly claystone which is different from the tuff facies. We call it a “shale” for simplicity. A few things to clarify - (1) If you look at SGR, the range of values is from 0 to 10 GAPI. (2) We are taking here about differences of a few API where we differentiate between a “shale” and not a shale. Nevertheless, we have added a short note in page 20, footnote 2 clarifying our use of the “shale” term.

Comment #7: the PHIN is 0-6000? It must be the near count in CPM or CPS,

Response #7: This is what we inferred as well. Hence the workflow on page 21, Figure 15 was applied.

**Reviewer #2**

The present study concerns with discussion two case studies relating to the opaline and volcanic sequences; in general the study is interested though some reformulation and organization is needed for the whole structure of the manuscript.

**I highly recommend publishing this study after moderate revision.**

Please check the attached annotated file for detailed comments. Good luck

**Author Response**

We would firstly like to thank the reviewer for his/her comments. We have noted the views expressed and will now address the specific points in the paper

Comment #1: This paragraph needs some rephrasing, it is written in not scientific language. Please polish the writing language through the different sections of the manuscript.

Response #1: Noted. We have rephrased this in page 1, lines 5-12 of the resubmission.

Comment #2: Very interested two case studies

Response #2: Noted and thank you.

Comment #3: How does it come? the presence of Opaline will rise up the resistivity and in turn the contrast with the surrounding beds will increase.

Response #3: This is a misconception; opaline is not a homogeneous rock type. We demonstrate this in our work which shows that microporosity in opaline instead causes a low resistivity response. To the reviewer’s comment, this will only happen if opaline is a non-porous rock (which it is not in our case).

Comment #4: The location of these two case studies and more detailed lithologic information on both should be added to the text and different sections of the manuscript

Response #4: Noted. We have added some of this information to the updated “Case Study Parameters and Settings” section for both opalines (page 4, lines 149-163) and volcanics (page 12, lines 358-364). Note that we have given limited details to maintain confidentiality.

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.

Comment #6: The term “these select basket of minerals” is not scientific expression.

Response #6: Noted. We have edited the phrase in page 2, line 40 of the resubmission.

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.

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, 104049Response #7: Noted.

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.

Comment #9: Please add a section on the geologic and structural settings and nature for both case studies here

Response #9: Noted. We have edited our ‘Case Study Parameters’ section for each example to a ‘Case Study Parameters and Setting’ section which includes more information about the geological and structural settings of the opaline study (lines 149-163) and volcanics study (lines 355-361). Note that we are limited by confidentiality to share only limited information.

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.

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.

Comment #12: Please, pay some attention to using the density values where their increase don't refer to L.S only, but may be dolostone, ferruginated rocks, glauconitic, and/or heavy mineral-bearing rocks.

Response #12: Noted. The terms limestone and sandstone refer to the highest peaks at 2.71 and 2.65 g/cc respectively and we have edited figure 2 to show this better. For this sample, the indicated limestone and sandstone lithologies were interpreted based on core logs for the well. We adjust figure 2 on page 6 to show this better.

Comment #13: I think the density value of the opaline is relatively indicating that they exhausted due to dissolution and leaching out or fracturing

Response #13: Noted. We thank the reviewer for pointing this out and have included a short note of this possibility in lines 184-186, page 5 of our resubmission. For our samples, fractures were rare but there were some instances of mouldic porosity from leaching of microfossils, as seen in figure 6.

Comment #14: These very high porosity and fair permeability values ensure that these opalines are vuggy and should be scanned by CT-Scan technique for revealing the isolated vugs. Or may be associated with high clay content blocking the pore spaces

Response #14: Noted. We do not have access to CT technology unfortunately. As for the argument of high clay content, we have viewed these samples under thin section and SEM and note that clay presence, while noted, is not significant.

Comment #15: Add a legend explaining the colour indication of these points

Response #15: Noted. We have added a legend to page 9, figure 7 to explain the colours.

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.

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.

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

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.

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.

Comment #21: The Indonesian model is recommended to shaly rocks, is it right so why the authors used it here?

Response #21: As we explained in our text, we want to account for the effect of clays. In this tuffaceous reservoir, where clay can be quite abundant, it is an equation we can use to account for some of the clay properties. The other alternatives like Dual-water or Waxman-Smits all serve similar functions, but need parameters that are non-log derived like CEC etc, which we do not have in this study. In a way, the Indonesia equation is chosen as one of convenience.

Comment #22: separates these two sections

Response #22: Noted. We have split these two sections in our resubmission in page 22.

Comment #23: Rephrase of “in for case study”

Response #23: Noted. We have edited this in line 610 to a proper phrasing.

Comment #24: References need some update

Response #24: Noted. This has been addressed.