CC1: 'Comment on egusphere-2024-2692', Giacomo Medici, 30 Sep 2024

General comments

Very good research in the field of geophysics with insights on geothermal energy. Please, consider the minor points to improve the manuscript.

Author reply:

Dear Giacomo,

Many thanks for your positive feedback and comments!

Please see our point-by-point response to your specific comments below.

Specific comments

Line 6. "We systematically analysed density and velocity data from 41 boreholes". Using...please specify the technique/tool, this point needs to be clear in the abstract.

➔ *We completely revised the abstract to add more detail, which was also a major suggestion by both reviewers.*

Lines 35-37. "Acoustic wave velocity through rocks or its inverse, the acoustic slowness, correlates well with density and porosity of different rock types. Several authors have investigated this correlation and established relationships that are widely used in geophysics and rock physics applications". Please, add review papers that describes the geophysical techniques that contribute to determine the porosity and storage properties in deep aquifers:

- Medici G., Ling F., Shang J. 2023. Review of discrete fracture network characterization for geothermal energy extraction. Frontiers in Earth Science, 11, 1328397.

- Zhang, J. (2011). Pore pressure prediction from well logs: Methods, modifications, and new approaches. Earth-Science Reviews, 108(1-2), 50-63.

➔ *We added the suggested references.*

Line 42. "reduction of porosity". Are you talking about the porosity of the matrix or the fractures? Please, specify. Indeed, in some sedimentary basins and rocks the fractures can still play a role on flow and storage of fluids at relatively elevated depths.

➔ *We agree, but here we refer to matrix porosity, which we added as suggested*

Line 57. Please, clarify the specific objectives of your research by using numbers (e.g., i, ii, and iii).

➔ *We restructured the last paragraph of section 1 in three bullet points as suggested*

Line 138. "78 deep oil and gas wells". Please, specify the depth range. How deep are the wells?

➔ *We added this information: depth range between 650 mTVD to 4800 mTVD*

Lines 425-432. I can see 4 bulletin points. Therefore, your specific objectives should be 4.

➔ *We agree and structured the objectives in the introduction accordingly*

Lines 454-560. Please, integrate relevant literature on the use of geophysics in deep aquifers.

➔ *Done as suggested.*

Figures and tables

Figure 1. Vertical scale is unclear.

➔ *Figure 1 was replaced with an improved version.*

Figure 5. Make the letters "a", "b", and "c" larger.

➔ *Agreed and implemented.*

Figure 5c. The density profiles are noisy. But, I can see an unreal spike at 4100 TVD(m) that should be deleted from the dataset

➔ *Agreed, the spike is likely unreal, but we followed a clear and reproducible approach to filter density data. This approach does not include manual removing of data points, but remaining outliers are discounted by application of a 30m moving average window. We describe/discuss this in the paragraph where Figure 5 is referenced and would therefore not remove these outliers from figure 5 to maintain transparency.*