Title: Novel insights into deep groundwater exploration by geophysical estimation of 1 hard rock permeability

In general, this is a detailed and well-structured research paper that presents a novel application of the CSAMT method. The following comments are a critical analysis of the revisions needed.

1. **Comments in the Research Paper and Proposed Solutions**

The paper is strong methodologically but has several limitations, primarily related to data, validation, and certain assumptions.

Comments points	Description	How to Address
Limited & Shallow Borehole Calibration	The entire empirical model (the core of the study) is built on 116 core samples from only 6 boreholes, all within 0-200 m depth. The model is then extrapolated to 1300 m without direct validation at those depths.	Acknowledge this more explicitly as the primary limitation. Future work must include deep boreholes (>500 m) for sampling and pumping tests to validate the extrapolated k-values. Use probabilistic modeling to show the uncertainty increases with depth due to a lack of calibration.
Uncertainty in Deep Fluid Properties	The paper assumes that low resistivity at depth is due to fresh water in fractures. However, without hydrochemical data from deep aquifers (>1 km), high salinity could also cause low resistivity, leading to an overestimation of permeability.	State this as a key assumption and limitation. Recommend future studies including deep fluid sampling to measure salinity. A brief sensitivity analysis could be presented: "If fluid resistivity (ρf) were halved (due to salinity), the inferred k would change by a factor of X."
Storage Parameters Neglected	The study focuses exclusively on permeability (k) for "water-bearing capacity." A complete aquifer assessment requires storage parameters (storativity, specific yield). The potential volume of water, not just its transmissivity, is critical for resource management.	Explicitly state that the study characterizes transmissivity/flow potential, not storage capacity. Recommend that future work integrate methods to estimate porosity (e.g., from geophysical logs, nuclear magnetic resonance) to provide a more comprehensive resource evaluation.
Scale Discrepancy	There's an inherent scale difference between a small core plug (cm-scale) used for lab k-measurements and the CSAMT resolution (10s of m). A core sample might miss a major fracture right next to it, while CSAMT would detect it. This can lead to scatter in the k-ρ relationship.	Discuss this scale effect as a reason for the observed scatter in the empirical data (Fig. 5). The readers know that the lab k represents the "matrix" property, while CSAMT-derived k represents a larger "effective" property that includes fractures.

Model Extrapolation & Edge Effects	The 3D model is built by interpolating 2D lines. The reliability of the model decreases significantly in areas between lines and at the edges, where there is no data constraint.	The black dots on Figs. 10/11 are a good start. **Strengthen this by discussing the interpolation method (e.g., kriging parameters)** and explicitly stating that the model is most reliable near the boreholes and survey lines and should be used with caution elsewhere.
Site-Specific Empirical Relationship	The derived equation k = 15.373(e)^0.002(p) is highly specific to the Jinji area's unique geology and mineralogy. Applying it directly to other regions without calibration would be invalid.	Emphasize this more strongly in the abstract and conclusion. The key contribution is the *methodology*, not the specific equation. The paper should recommend that the approach be followed—collecting local calibration data—rather than using the provided constants.
Justification for CSAMT over MT/TDEM	The justification for choosing CSAMT over other deep EM methods like MT or TDEM is somewhat brief and could be more quantitative.	Expand the comparative analysis in the introduction/discussion. Include a table comparing depth, resolution, cost, and cultural noise immunity for VES, ERT, CSAMT, TDEM, and MT to visually justify the choice of CSAMT for this specific purpose.

2. Grammatical and Linguistic Errors and Improvements

The paper is generally well-written but has occasional errors in article usage, word choice, and sentence flow. Here are some specific examples and suggestions for improvement.

Category 1: Missing Definite/Indefinite Articles (a, an, the)

This is the most frequent issue.

1. Original (P2, L24): `Deep groundwater exploration in hard rock terrains is critical in regions where deep aquifers may offer long-term water security amidst increasing scarcity.`
   Suggestion: `...amidst an increasing scarcity.`
2. Original (P2, L28): `Conventional borehole-based methods for measuring k are invasive, costly, time-consuming, and limited to sparse, point-scale observations...`
   Suggestion: `...limited to sparse, point-scale observations...` (This is actually correct. An example of an error is below).

3. Original (P4, L68): `Its strategic importance is increasingly recognized, particularly in geologically and environmentally constrained settings'.
   Suggestion: `...in geologically and environmentally constrained settings.` (The hyphens are needed here).
4. Original (P9, L184): `This research integrates inadequate drilling information with the geophysical data...`.
   Suggestion: `This research integrates limited drilling information with geophysical data...` ("Inadequate" is judgmental; "limited" is factual. Also, "the" is not needed before "geophysical data").

Category 2: Awkward Phrasing and Word Choice

1. Original (P5, L102): `Their ability to image both vertical and lateral subsurface variations makes them particularly effective in heterogeneous terrains.`.
   Suggestion: `Their ability to image subsurface variations in both vertical and lateral dimensions makes them...` (More fluid).
2. Original (P15, L309): `In the present work, initial k data from the Jinji region were limited to six boreholes.`.
   Suggestion: `In this study, initial k data...` ("The present work" is slightly stilted).
3. Original (P18, L362): `To estimate permeability across the entire study area, we implemented a multi-stage approach...`
   Suggestion: `...we employed a multi-stage approach...`, ("Employed" is more common in scientific writing for describing methods).
4. Original (P39, L625): `...pore connectivity and higher saturation, often enhanced by structural features or thermal alteration.`
   Suggestion: `...often associated with structural features or thermal alteration.`, ("Enhanced by" implies improvement; "associated with" is neutral and more accurate).

Category 3: Minor Punctuation and Typographical Errors

1. Original (P10, L197): `Jiangmen Underground Neutrino Observatory (JUNO) (Hasan et al., 2025).`.
   Suggestion: `Jiangmen Underground Neutrino Observatory (JUNO) (Hasan et al., 2025).`, (The double closing parenthesis is a typo).
2. Original (P16, L321): `where ΔP shows the pressure differential... Q denotes the volumetric flow rate`.
   Suggestion: `where ΔP is the pressure differential... Q is the volumetric flow rate` ("Is" is standard for defining variables; "shows" and "denotes" are less direct).
3. Original (P20, L387): `k = 15.373(e)^-0.002(p)`.

Suggestion: `k = 15.373  e^-0.002ρ`, (The multiplication sign `` is often used for clarity. Use `ρ` (rho) instead of `p` for resistivity to avoid confusion with pressure).

4. Original (P34, L539): `Percentage Matching = ( Ns / Nl )  100`.
   Suggestion: `Percentage Match = ( min(k, k') / max(k, k') )  100` (The formula is correct but the explanation using `N_s` and `N_l` is confusing. Using `min` and `max` is clearer. Also, "Matching" -> "Match" is sufficient).

Category 4: Improving Clarity and Flow

1. Original (P8, L160): `This study builds on prior hydrogeophysical research and introduces a novel application of the CSAMT method for volumetric k modeling...`
   Suggestion: `This study builds on prior hydrogeophysical research by introducing a novel application of the CSAMT method for volumetric k modeling...` (Connects the ideas more smoothly).
2. Original (P40, L668): Section Title: `Addressing the borehole–CSAMT depth discrepancy`
   Suggestion: `This is a good section title. The content within it is an appropriate response to an obvious weakness.`.

General impression: The grammatical issues are minor and do not hinder comprehension. The paper would benefit from a thorough proofread focusing on articles (`a`, `an`, `the`) and prepositions. The scientific content is excellent, and polishing the language will enhance its clarity and professionalism.

Signature

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