

Peer Review Report

Review Report on A critical geological evaluation of the hydrogen storage potential in the Cousland Gas Field, Midland Valley of Scotland

Original Research, Earth Sci. Syst. Soc.

Reviewer: Cees Van Der Land

Submitted on: 26 Jul 2023

Article DOI: 10.3389/esss.2023.10076

EVALUATION

Q 1 Please summarize the main findings of the study.

The authors review existing historic subsurface data of the Cousland field in light of utilising this structure for cyclic hydrogen storage. Their main findings are that the quality of the subsurface seismic data is low and thereby unreliable, in addition acquiring new seismic data comes with substantial challenges due to surface mining and housing across the area of interest. This would also be an issue if permanent seismic monitoring would need be set up to track hydrogen plume migration over time. Wireline data supports that there is capacity to store hydrogen in this depleted gas field, but detailed data on the lateral extent and variability of reservoir horizons is lacking. Furthermore, the temperature and salinity ranges for the field promote microbial activity and therefore geochemical reactions resulting in alteration to the gas and porewater composition and formation of biofilms. The authors therefore conclude that the Cousland gas field would not make a good test-site to study the behaviour of hydrogen into a heterogenous depleted clastic gas reservoir

Q 2 Please highlight the limitations and strengths.

The authors have done an excellent job in utilising the existing historic data. However, some of the old figures from those publications should be combined/redraw into clearer figures (see detailed review document). The main limitation of this study is a lack of detailed comparison with two previous studies (Heinemann (2018) and Scafidi (2022) that concluded that the Cousland site would be suitable for cyclic hydrogen storage. The study by Scafidi is much more detailed than the review presented in this manuscript. The authors present all the geological, geochemical and operational factors that should be taken into consideration very well. However, the manuscript could benefit from discussing in more detail why previous authors came to a different conclusion.

Q 3 Please comment on the methods, results and data interpretation. If there are any objective errors, or if the conclusions are not supported, you should detail your concerns.

This is largely a review article, evaluating existing data so no specific method section. The conclusions are largely supported by the data/results, see review document for details.

Q 4 Check List

Is the English language of sufficient quality?

Yes.

Is the quality of the figures and tables satisfactory?

No.

Does the reference list cover the relevant literature adequately and in an unbiased manner?

Yes.

Are the statistical methods valid and correctly applied? (e.g. sample size, choice of test)

Not Applicable.

If relevant, are the methods sufficiently documented to allow replication studies?

Yes.

Are the data underlying the study available in either the article, supplement, or deposited in a repository? (Sequence/expression data, protein/molecule characterizations, annotations, and taxonomy data are required to be deposited in public repositories prior to publication)

No.

Does the study adhere to ethical standards including ethics committee approval and consent procedure?

Not Applicable.

If relevant, have standard biosecurity and institutional safety procedures been adhered to?

Not Applicable.

Q 5 Please provide your detailed review report to the editor and authors (including any comments on the Q4 Check List):

No answer given.

QUALITY ASSESSMENT

Q 6 Originality	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q 7 Rigor	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Q 8 Significance to the field	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Q 9 Interest to a general audience	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Q 10 Quality of the writing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Q 11 Overall quality of the study	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>