Utilizing Seismic Inversion to Reduce Uncertainties in a Central Oman Saline Aquifer CO_2 Storage (CCS)

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Abstract

Challenge:
Selecting a suitable storage site for a Carbon Capture and Storage project (CCS) has several challenges. One key consideration is minimizing the number of well penetrations in the anticipated CO2 plume area, which could impose leakage risk. Additionally, the site should be located away from faults and existing fields. These factors contribute to increased uncertainties in the geological properties (porosity and permeability) of the storage tank, which directly affect the sink capacity, CO2 injectivity, and the number of injectors required. These uncertainties have significant implications for the project's feasibility and economics.

Methodology:
Seismic Inversion was used to Reduce uncertainties of the reservoir properties in the injection area. First, a detailed petrophysical work was carried out to condition the well logs, which were used to extract a stable multi- well wavelet from seismic (Well to Seismic Tie). Then, horizons and wells were used to build 0-6 Hz Low Frequency Model.
The 3D Wide Azimuth Seismic (WAZ) was inverted, and the inverted P-Impedance volume successfully matched the blind test wells. This inverted P-Impedance volume was transformed into a Porosity volume.
Both the inverted P-Impedance volume and the porosity volume were utilized to probabilistically predict the facies volume within the injection area.

Outcome and Conclusion:
An RMS porosity map was then extracted over the target interval, demonstrating consistency with the structural trend, dynamic behavior of wells, and geological understanding.
The RMS porosity map and the facies probability volume served as useful guides for the property distribution during the construction of the geological model.
In conclusion, selecting an appropriate QI workflow and adapting it to suit the objectives of the study significantly adds value to the project by reducing uncertainties. However, it is crucial to ensure rigorous quality control of the input data, select appropriate parameters, and validate the inversion results using well data and geological understanding.
The chosen approach addressed the challenges associated with site selection by reducing uncertainties and planning mitigations. This study contributes to the overall feasibility and economic viability of the Carbon Capture and Storage project in this area.