Introduction

Evidence of fault planes in seismic data is frequently associated with open systems and can be a good indicator of fluid migration and leakage features. Rift basins with salt layers, salt evacuation, and diapirism processes can enhance the tectonic history. The sediment load intensifies the slope-related salt movement, and depending on the amount of sediment deposited, it will determine the scale of salt movement and the resulting shape of the salt features.

Salt diapirism and tectonics can produce different salt features, such as salt domes, salt anticlines, salt sheets, salt sills, and salt canopies, as the salt moves up into shallower, younger stratigraphy. These shallow salt structures create an imprint on the sediments, resulting in different fault types and traces. These fault traces commonly function as a conduit for migration from deep basin layers to shallower layers.

In addition to the challenge of the structural complexity of rift basins with salt layers, there is the issue of seismic data availability. The different types of seismic data available, which vary from 2D to 3D with different migration types and resolutions, can affect the understanding and property evaluation of the existence of potential leakage features. Carbon storage in complex areas is challenging but still feasible, and the proposed work aims to provide a tool to identify areas with the potential risk of leakage associated with pre-existing structures.

Method and/or Theory

One of the main concerns associated with carbon storage in the subsurface is the leakage risk. New techniques are being developed constantly to minimize this risk and ensure the safety of these activities, which is extremely valuable for de-risking the subsurface targets for carbon storage.

Rift basins with salt tectonics present an extra challenge. To assist in the detection of discontinuities in seismic data, a workflow for the identification of potential leakage features is proposed. The results of the workflow were performed on different data types, including 2D and 3D seismic data with varying migration and resolution, over the same area. Figure 1 illustrates a comparison of full-stack seismic data with various migration schemes.

This workflow includes a suite of different seismic attributes: average energy attribute, RMS amplitude, reflection strength attribute, sweetness attribute, chaos, and variance attribute. These attributes are computed for the purpose of identifying fluid migration and leakage features, and present the results and the differences observed when applied in the 2D and 3D data with different migration and resolution.

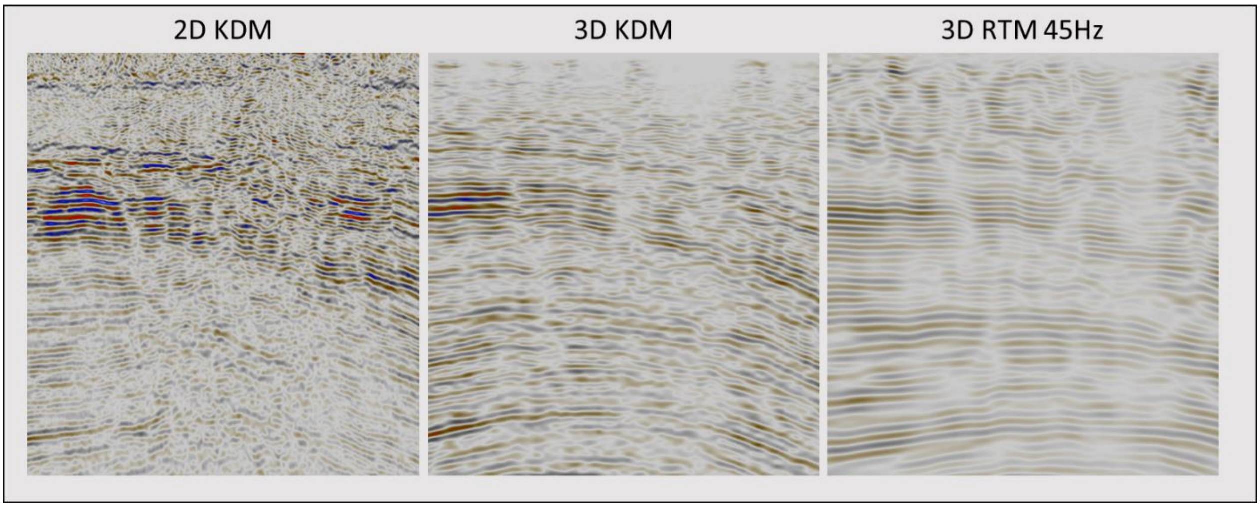

Figure 1 Full stack seismic data comparison, 2D Kirchhoff Depth Migration, 3D Kirchhoff Depth Migration and 3D RTM Depth Migration.

Conclusions

This work presents the results and observations from the comparison of 2D and 3D seismic data. The comparison aims to evaluate if the workflow can be performed on both 2D and 3D data sets and, therefore, can be used to assess areas in rift basins with salt tectonics that have a higher probability of fluid migration and leakage features occurrence.

The identification of these features supports site selection for carbon storage and the placement of injection wells, highlighting areas that need to be avoided due to the potential risk of leakage.

References

Integrating Coherence Cube Imaging and Seismic Attributes (Satinder Chopra, 2001)

Seismic curvature attributes for mapping faults/fractures, and other stratigraphic features (Satinder Chopra and Kurt Marfurt, 2007)

Curvature attribute applications to 3D surface seismic data (Satinder Chopra and Kurt Marfurt, 2006)