Multi-2D Reprocessing of Seismic Data for Structural Interpretation in the San Juan Basin

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Abstract

- The San Juan Basin in New Mexico is currently undergoing site characterization efforts for carbon sequestration.
- Several 2D seismic are being reprocessed and interpreted to characterize the structure of the northwest corner of the basin including the Hogback monocline, a distinct geological feature which is the surface expression of a deep reverse fault.
- Multi-2D seismic processing is being implemented. Data is processed to ensure that amplitude fidelity is preserved. Novel processing techniques for noise removal are applied.
- The latest processing techniques are applied to the 2D seismic, including the appropriate depth imaging algorithm. Statics correction was applied to the data and the geometry of the data was reconstructed. Velocity analysis was carried out and both pre-stack and post-stack depth imaging were applied.
- The final processing data will be interpreted for improved structural characterization of the northwest San Juan Basin and the Hogback monocline.

Introduction

- The San Juan Basin covers 7,500 mi^2 (square miles) primarily in New Mexico but also extends into Utah, Colorado, and Arizona (Figure 1).
- The region is highly favorable for CO_2 sequestration; sources, storage reservoirs, and confining units coexist.
- The San Juan Basin contains a thick sedimentary section, ranging from Cambrian to Eocene-aged rocks. In the deepest part of the basin, there is over 15,000 feet of sedimentary fill.
- Target formations for carbon sequestration are the Saltwash member of the Morrison Formation, the Bluff Sandstone and the Entrada Sandstone. The primary confining zones are the Brushy Basin member of the Morrison Formation, the Summerville Formation, the Todilto Formation, and Carmel Formation.
- Seismic characterization will help to identify the main risks associated with the feasibility of carbon sequestration.

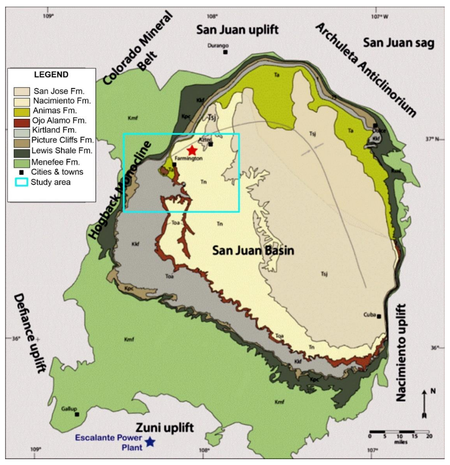

Figure 1. Regional geological map of the San Juan Basin modified from Pecha et al. (2018)

Data and Processing

- Ten 2D seismic lines were licensed for multi-2d seismic processing and interpretation.
- Spherical divergence correction was applied to compensate for loss of amplitudes due to spherical wave front spreading.
- First-break picks associated with the refracted arrival times are used to study the near-surface velocity zones and subsequent determination of static corrections.
- Denoising was conducted using Continuous Time Frequency Domain (CTFD) filter that more effectively removes airblast without removing shallow data was applied.
- The processing steps result in cleaner gathers and helps with subsequent reprocessing steps such as velocity analysis, residual statics and imaging.
- Surface consistent scaling and velocity analysis were implemented.

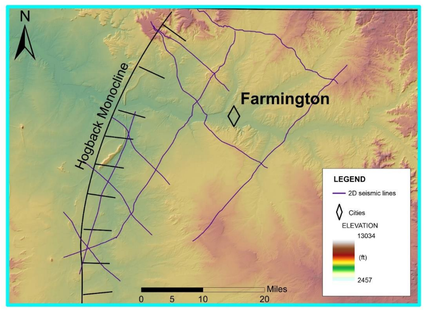

Figure 2. Location of the study area that contains the 10 2D seismic lines licensed for the seismic processing see location in Figure 1.

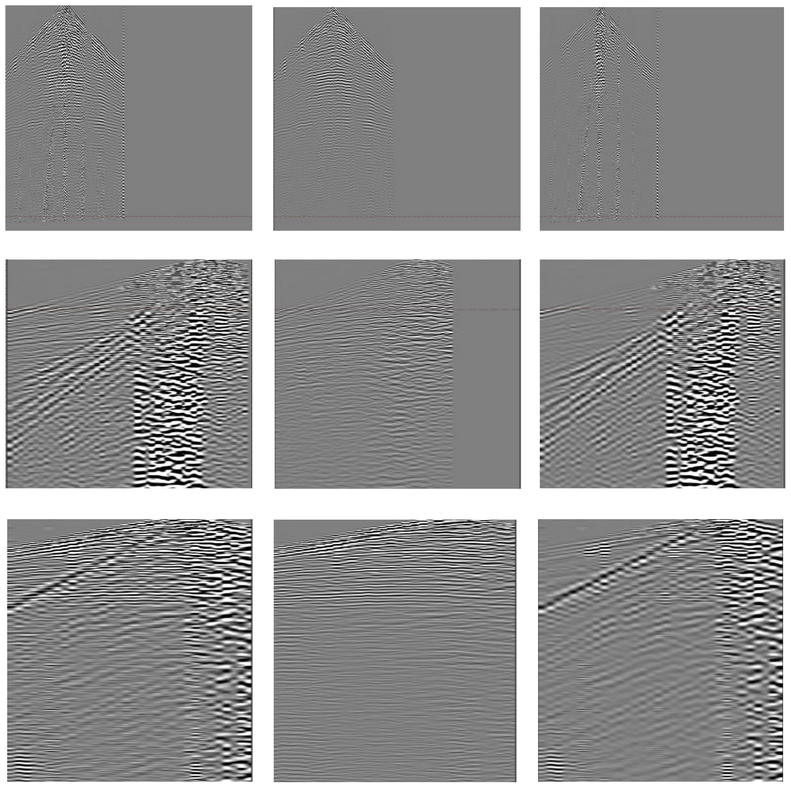

Figure 3. Denoising of seismic gathers. Original seismic (left), denoised seismic (middle), and subtracted noise (right) for lines AYH-1, GDX-7, and GBQ-12 top to bottom respectively.

Seismic Imaging

- Kirchhoff PSTM has been applied and PSTM stacks tied.
- Other processes to be carried out
  - Kirchhoff PSDM
  - Reverse Time Migration (RTM)
  - Gaussian Beam Migration (GBM)
  - AVO Analysis: Offset stacks, Angle stacks, Intercept and Gradient stacks.
  - Creation of Pseudo-3D PSTM, PSDM and RTM stack volumes by 3D interpolation of Multi-2D PSTM, PSDM and RTM stack profiles.

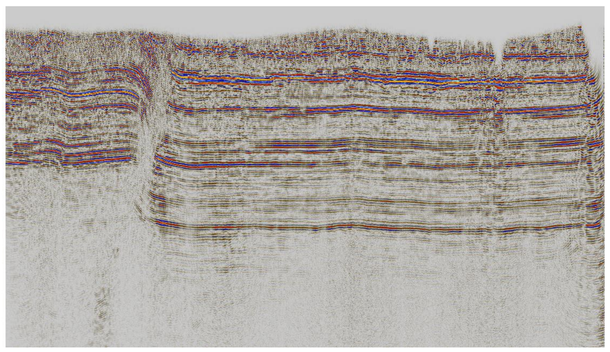

Figure 4. PSTM stack for line AYH-1.

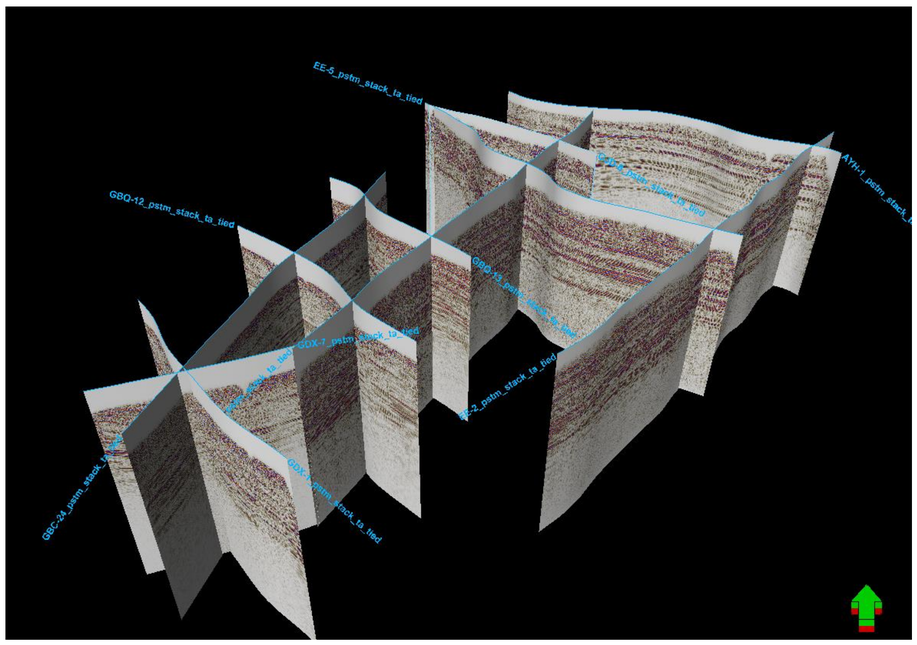

Figure 5. Tied PSTM stacks of the 2D lines.

Acknowledgements

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