

# Seismic Attribute Analysis for Imaging Caprock Continuity in the San Juan Basin CarbonSAFE Project

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## Introduction

- The San Juan CarbonSAFE project is a commercial-scale CO<sub>2</sub> sequestration project sponsored by the U.S. Department of Energy to address climate change, located in northwestern New Mexico in the San Juan Basin.
- Potential sequestration targets in the basin are the Jurassic Entrada and Bluff sandstone deposits, while the Brushy Basin Member, the Summerville Formation, and the Todilto Formation are the major confining zones.
- A crucial aspect of site characterization in carbon capture, and storage (CCS) operations is demonstrating the sealing capability of the caprock and its effectiveness in permanently trapping injected CO<sub>2</sub> in underground formations.
- In this study, seismic attributes are used to delineate and examine the caprock and its sealing capacity. Seismic attributes are mathematical representations of diverse physical characteristics of subsurface formations in seismic data.
- These attributes play a crucial role in contemporary seismic interpretation processes and can enhance the overall value of Carbon Capture and Storage (CCS) initiatives by offering unique insights that may not be readily apparent in the original seismic data.

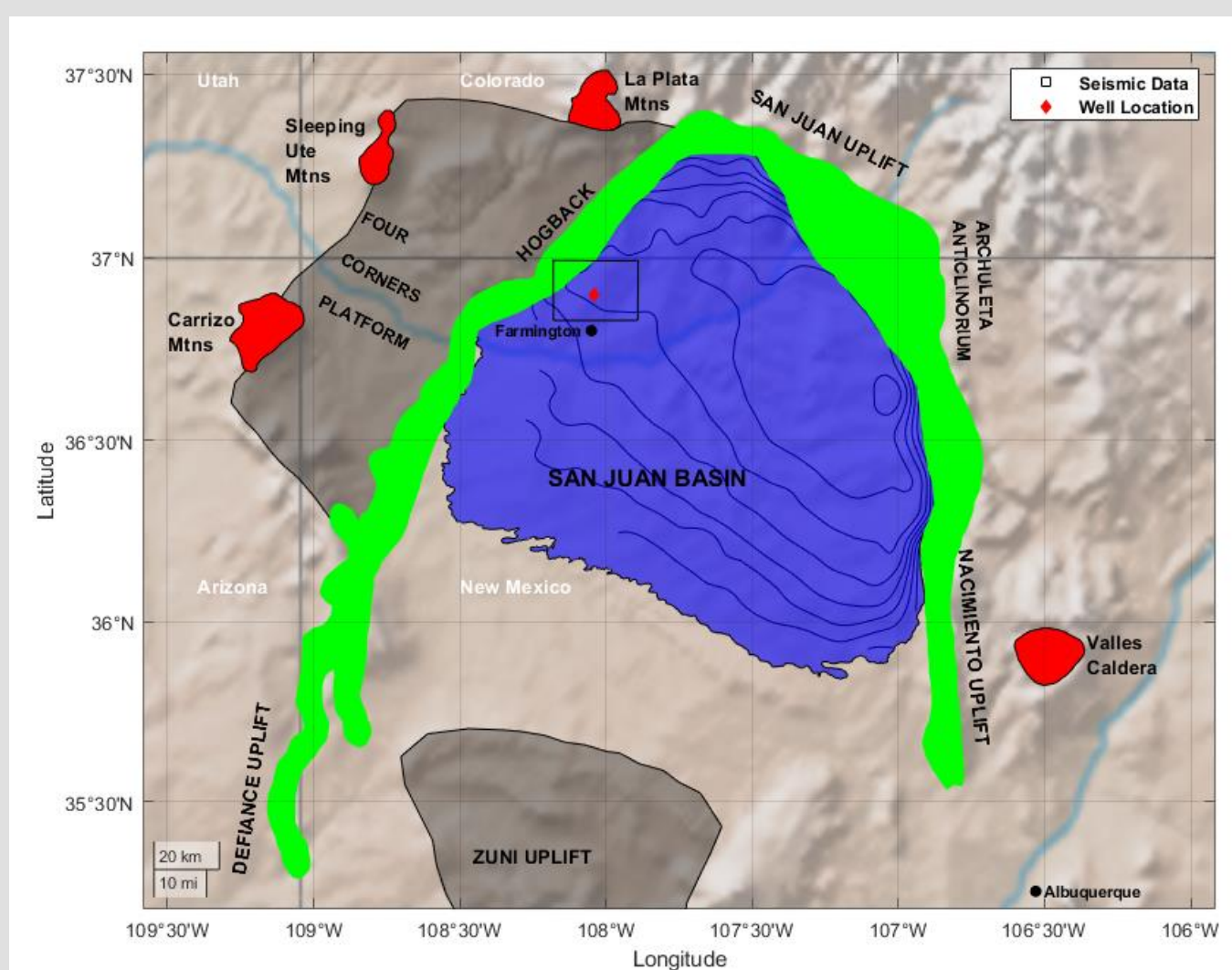


Figure 1. A geologic map of the San Juan.

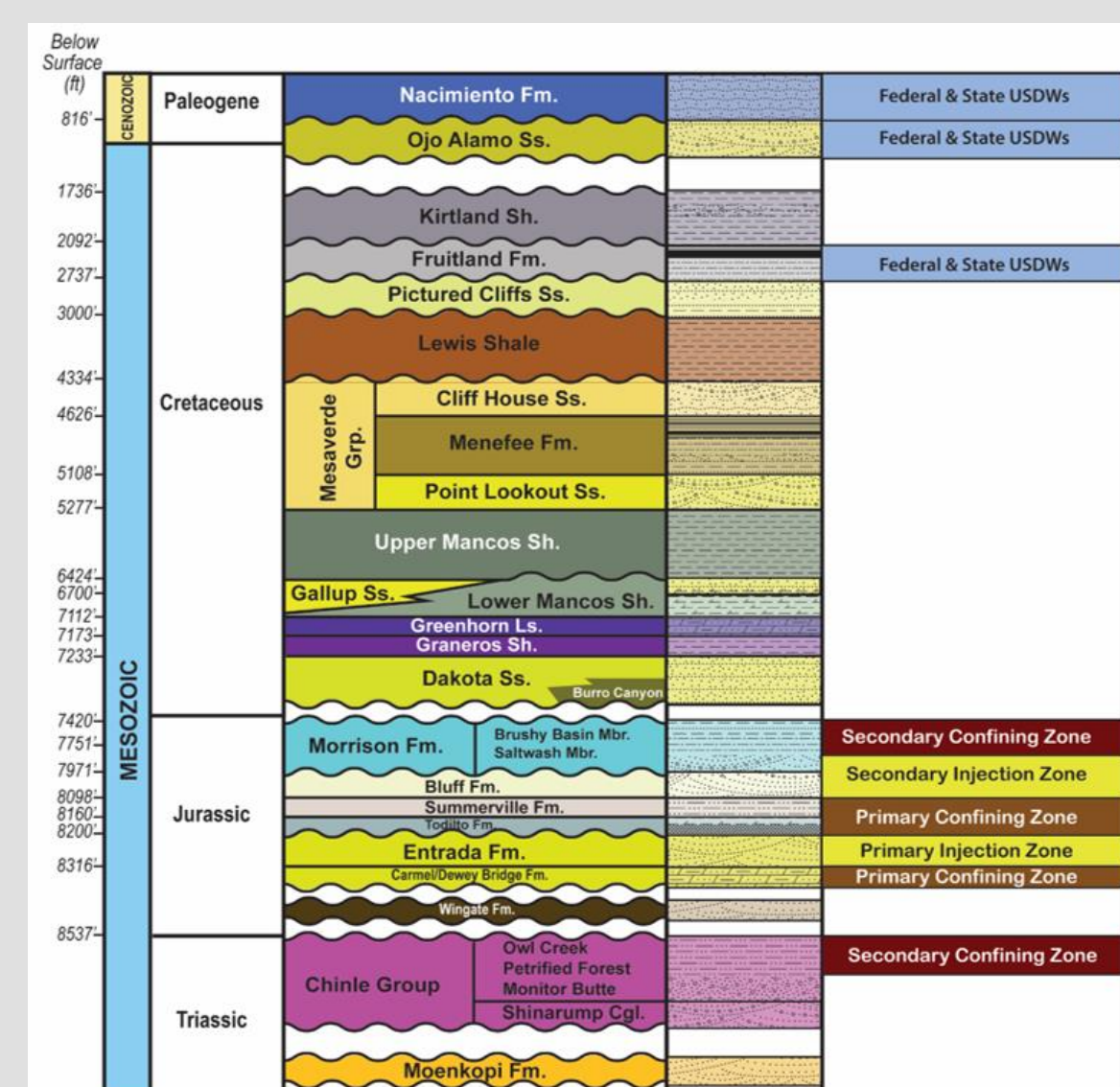


Figure 2: A detailed view of the stratigraphic section for the characterization well (not to scale).

- Faults are formed as a brittle response to stress, when the magnitude of stress exceeds the strength of a rock.
- The interpretation of the fault system is performed using structural and seismic attributes that can emphasize dissimilarity in seismic properties.
- The fault-detection workflow is shown in Figure 3.

Steps:

- Pre-conditioning: structural smoothing and median filter.
- Attributes that measure dissimilarity such as chaos, coherence, semblance, and variance.
- Attributes for edge detection and enhancement.

## Methodology

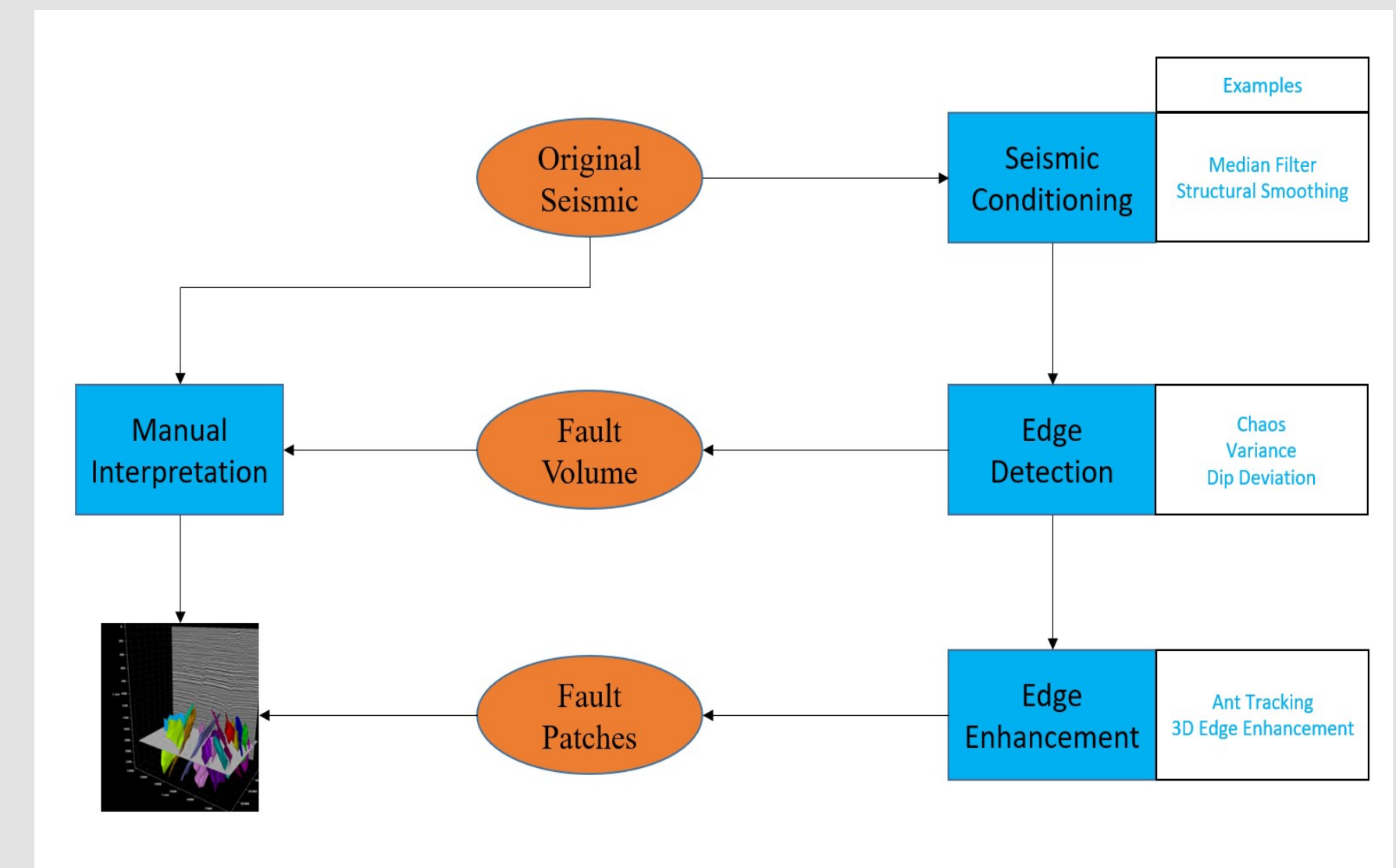


Figure 3. Methodology and workflow for computing attributes and extracting faults

## Results and Discussion

- The Todilto Formation, a basal organic-rich shaly-limestone unit, overlies the Entrada Sandstone and fills in much of the topography developed on the Entrada surface.
- The Todilto Formation is economically unique since it also hosts uranium deposits within limestones in the southern part of the basin.
- The carbonate and evaporite Todilto deposits are the upper seal for the Entrada Sandstone having low porosity and permeability.
- Secondary seals are the Summerville and the Brushy Basin formations.
- Todilto deposits range from 5 to 90 feet in the northwestern part of the basin.
- The Todilto is thin in this region of the basin but its limestone facies are areally extensive.
- Using seismic attributes, we demonstrate the continuity of the Todilto around the CarbonSAFE well location (Figures 4 to 6)
- Modeled geomechanical properties of the Todilto are shown in Figure 5.
- There are no major faults in the caprock around the location of the CarbonSAFE well. Results demonstrate caprock integrity in the study area.

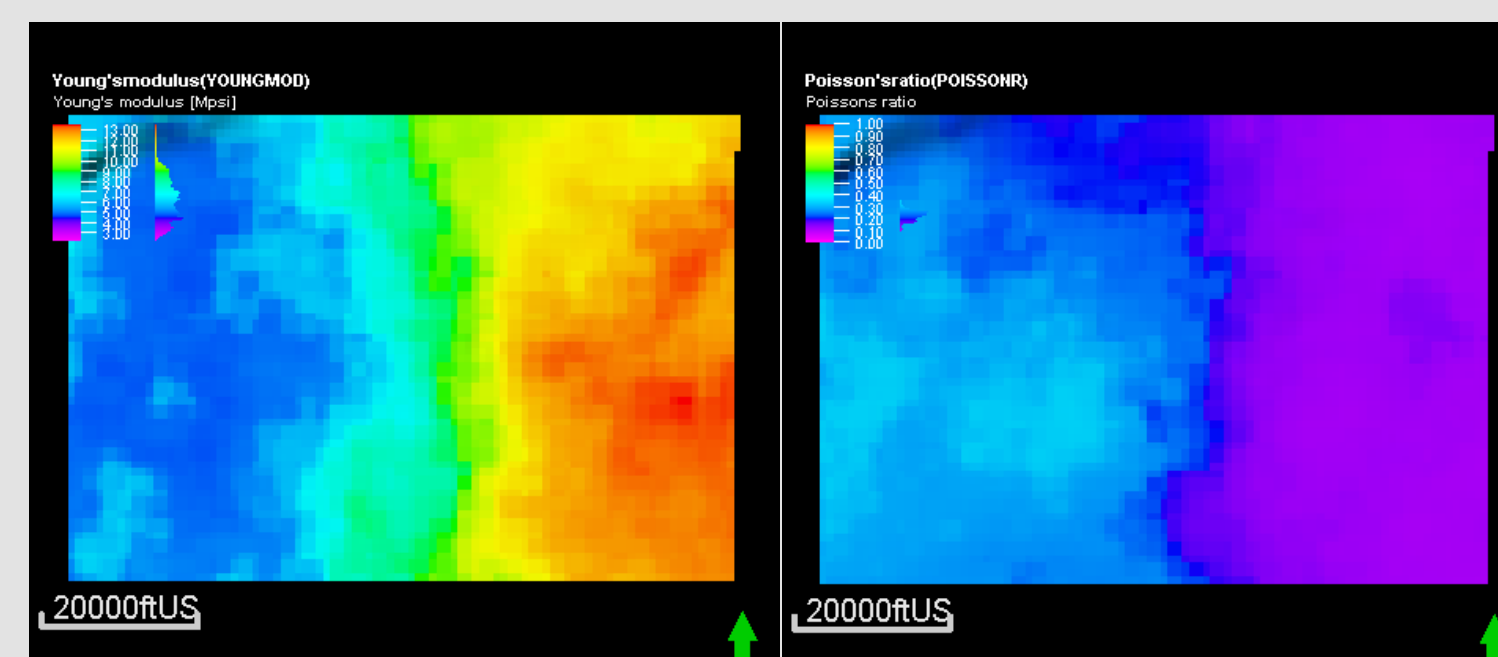


Figure 5. Modeled geomechanical properties of the Todilto.

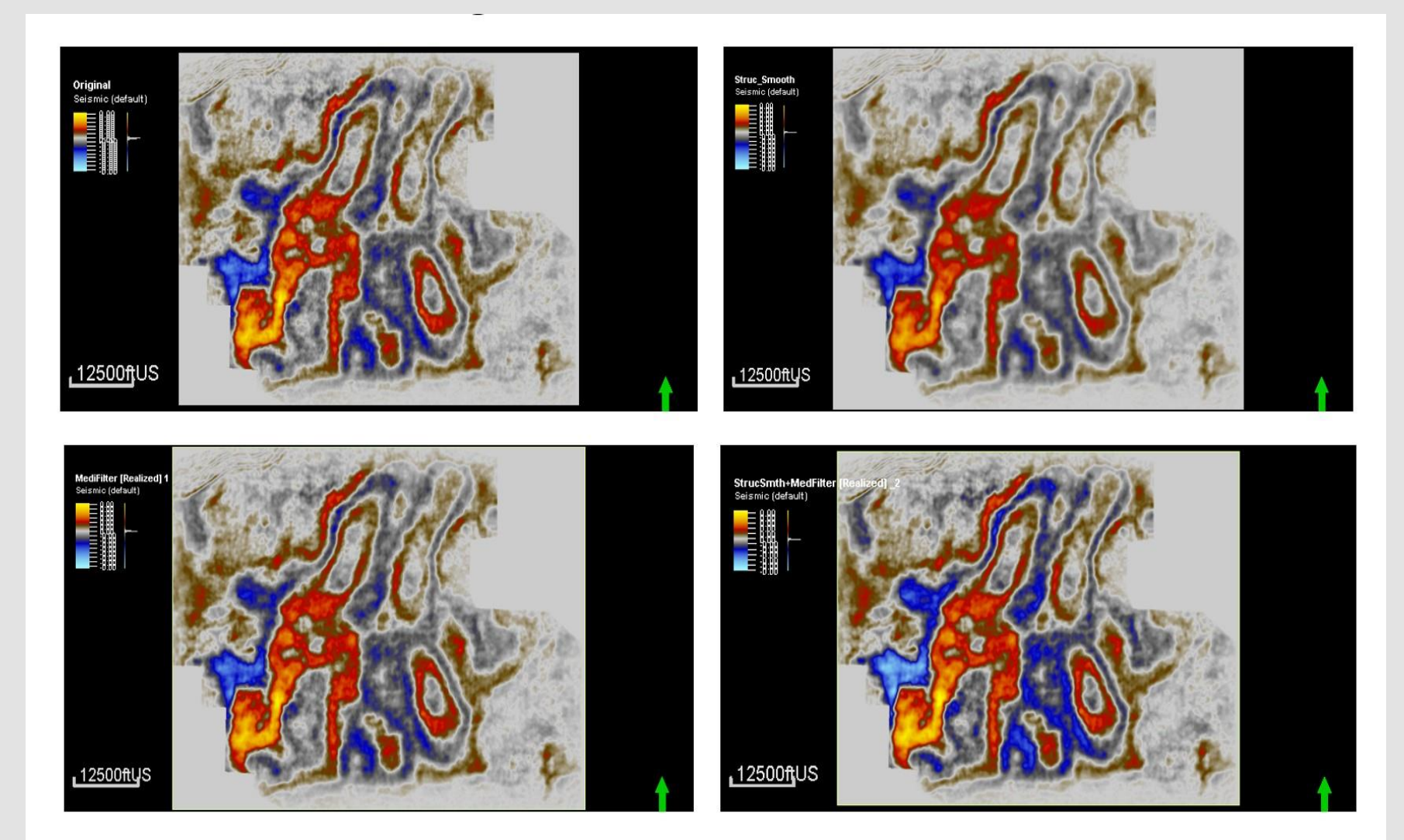


Figure 4. Todilto time slice showing original seismic data and preconditioning seismic attributes.

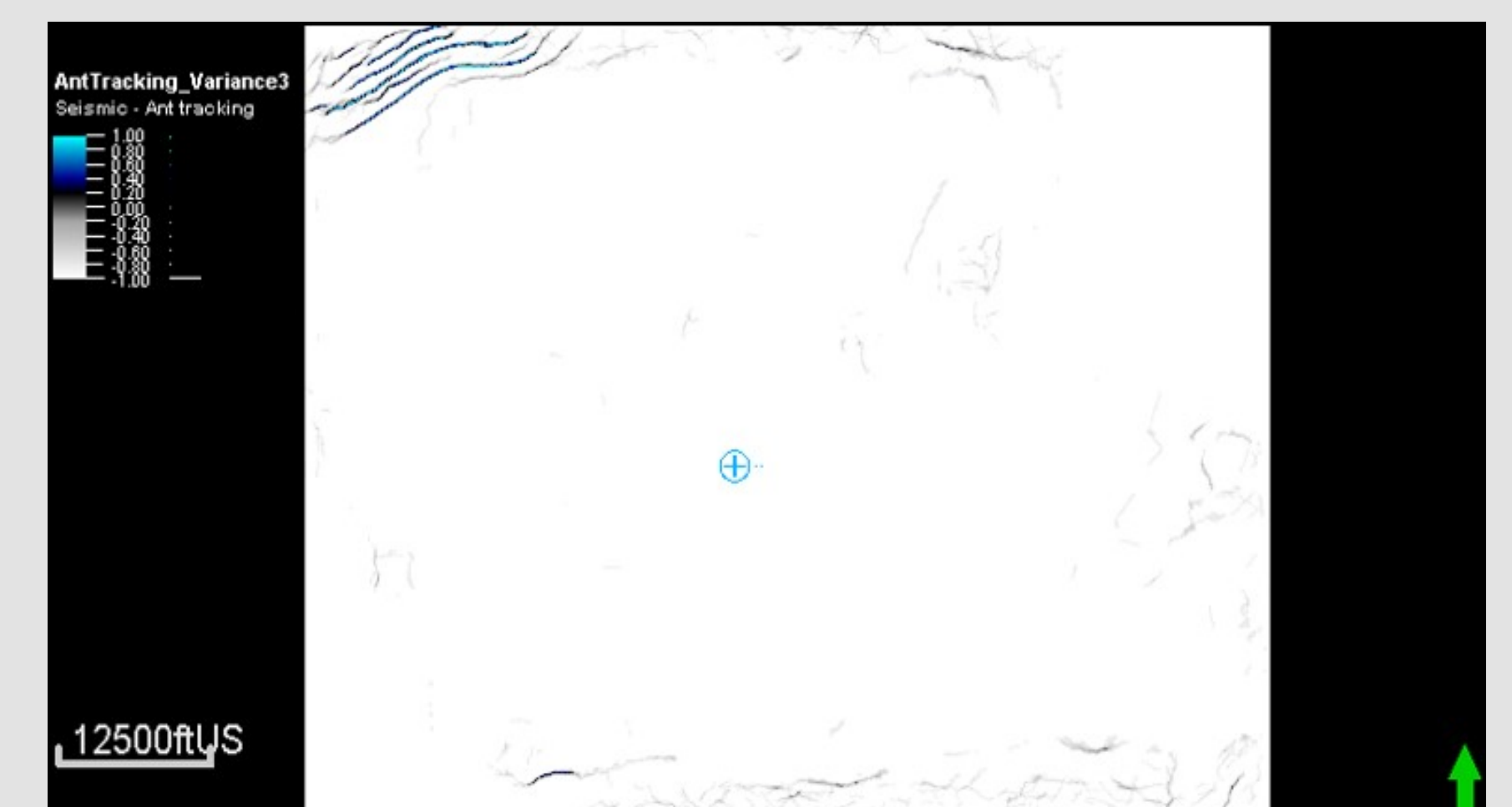


Figure 6. Todilto horizon showing AntTracking applied to the variance attribute.

## Acknowledgements

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