# 3-D Seismic Visualization of Shelf-Margin to Slope Channels Using Curvature Attributes

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## Summary

Shelf-margin deltas are the main mechanism for the transport of sediment from the shelf to the slope and deep-water environments.

Recent advances in 3D seismic visualization have provided valuable insight into the processes associated with the formation of deep-water reservoirs.

To date very few examples of 3D seismic visualization from the shelf-margin has been published.

We found the curvature attributes were particularly effective in delineating continuous channels extending to the edge of the shelf.

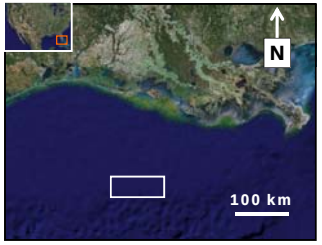
Other attributes including amplitude, coherence and amplitude gradients indicate the presence of gas-charge, pockmarks, and debris flows.

Together these attributes allow us to interpret subtle channel features in the appropriate structural and depositional framework

Acknowledgements: We gratefully acknowledge PGS for the data contribution and Janok P. Bhattacharya professor at The University of Houston.

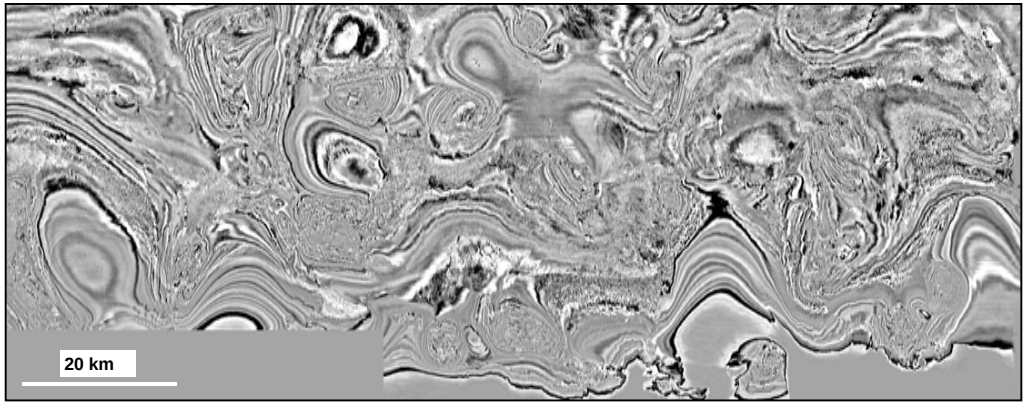
## STUDY AREA

### Gulf of Mexico




The study area covers about 8,000 sq-km located along the shelf edge of the Gulf of Mexico that was acquired to image deeper objectives.

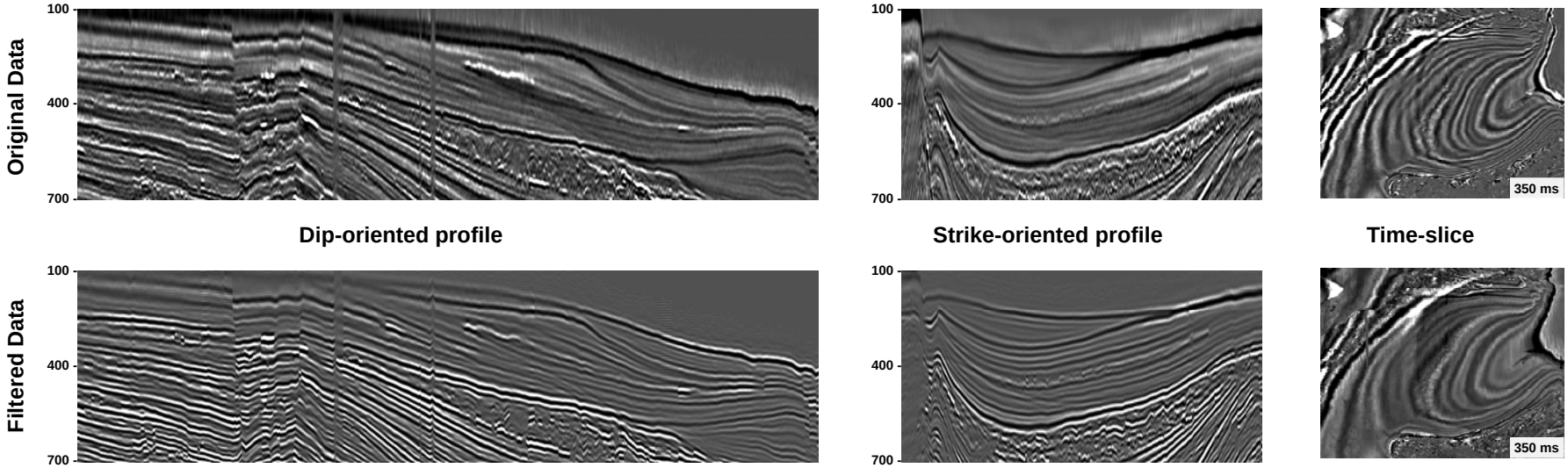
### Time-slice 500 ms




The study data correspond to a high-resolution 3D seismic survey located along the shelf edge of the Gulf of Mexico that was acquired by PGS to image deeper objectives. The upper 600 ms of the seismic show the presence of acquisition footprint that needed to be removed due to the sensitivity of the seismic attributes to noisy data .

A time-slice at 500 ms show the complexity of the study area.

## Data Filtering




Several filters (mean-, median-, principal-component -, and structure-oriented smoothing) were tested in order to suppress this noise. After applying the best possible filter to the seismic, we computed 3D seismic attribute volumes including coherence, amplitude gradients and curvature to provide alternative images of the stratigraphic features of interest. Time slicing of the seismic through the volumetric seismic attributes revealed the presence of channels that developed at the slope of the basin around 350 (ms), Pleistocene age.

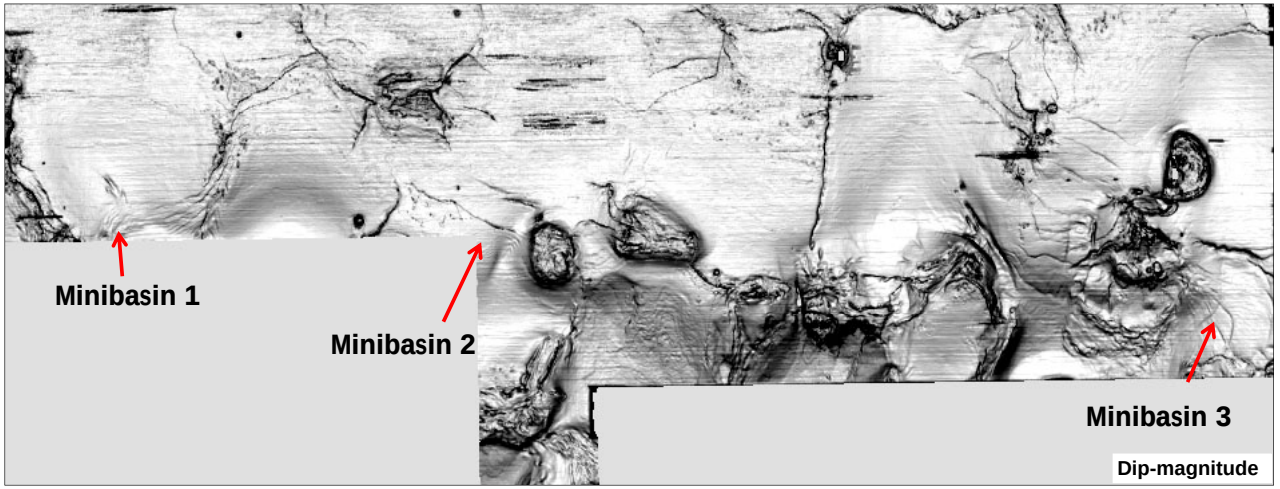
# Sea-floor Geomorphology

The actual sea-floor geomorphology is visualized using dip-magnitude attribute that reveals the presence of slope channels, faults and diapirs.

Three salt-withdrawal minibasins located at the edge of the shelf are the base of this study.

These minibasins are being filled by sediment transported by prograding shelf-margin deltas.

The shelf-margin deltaic system produce prograding clinoforms observed on dip-oriented profiles of the seismic data. These shelf-margin deltas are associated with shelf to slope channels that can be detected using geometric attributes.

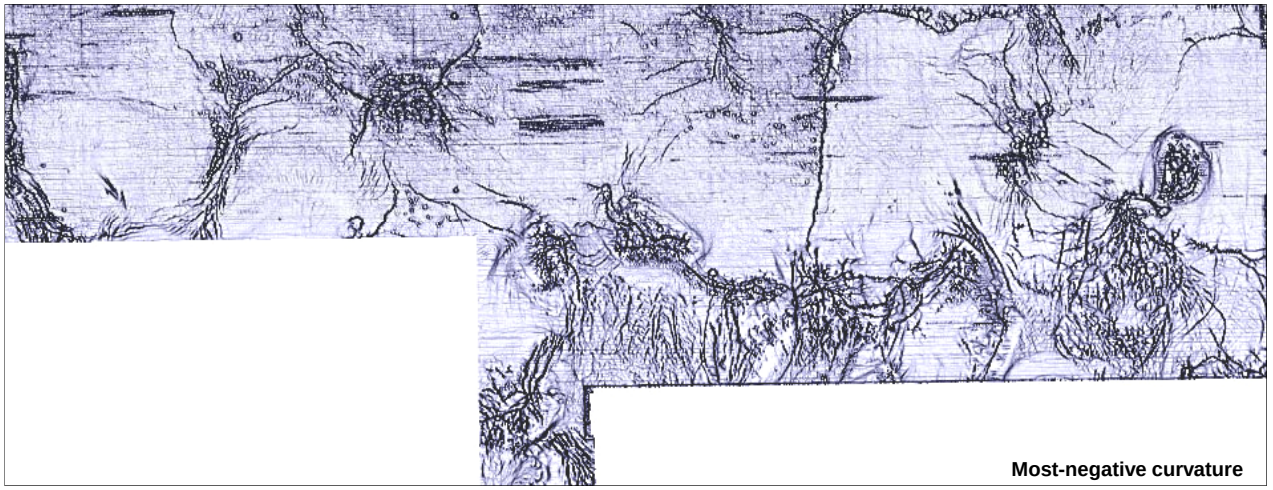


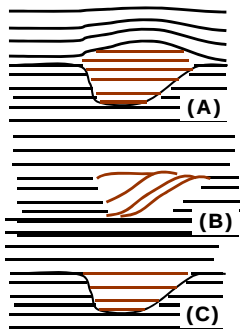

## Curvature Attributes

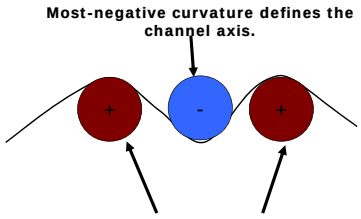
This poster is focused on volumetric seismic curvature attributes that can be interpreted as the reciprocal of the radius of a circle that is tangent to the given curve at a point (Roberts, 2001).

Most-positive and most-negative curvature attributes have been demonstrated to be very helpful in fracture prediction, distribution and orientation (Blumentritt, 2006), carbonate collapse chimneys (Sullivan et al., 2006), and channel delineation (Chopra and Marfurt, 2007).

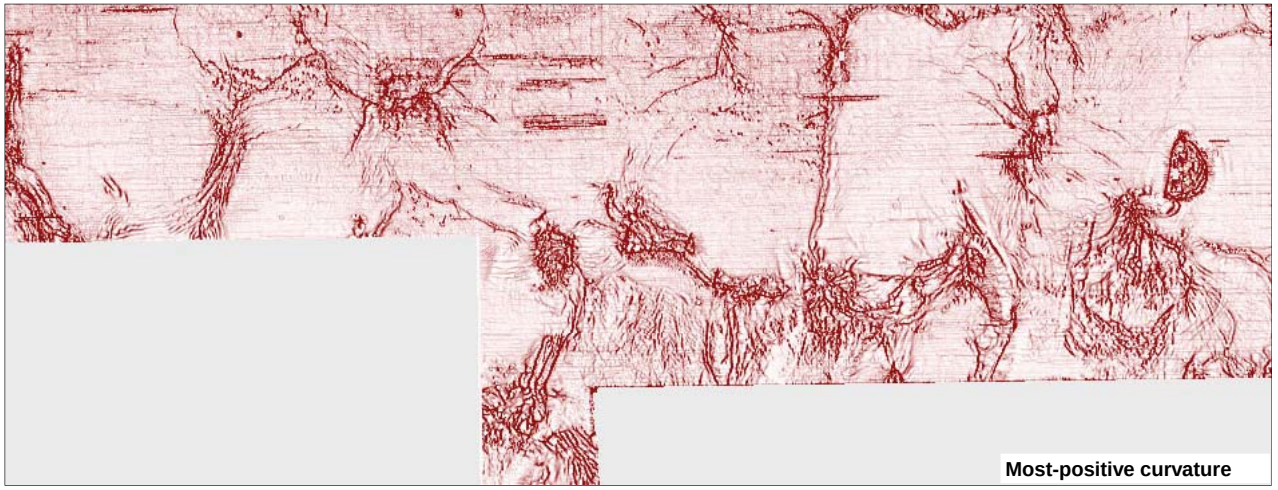
In this poster we demonstrate the value of the curvature attributes in delineating subtle channel features in the shelf-edge to slope environment.



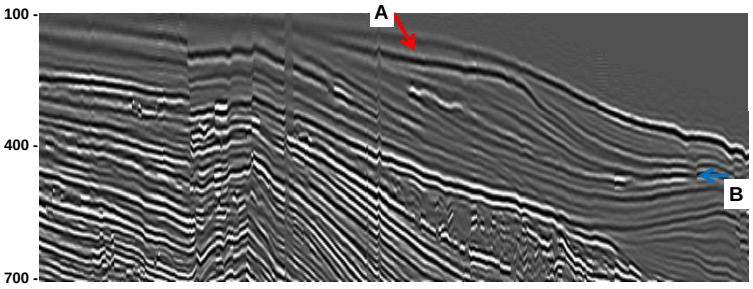



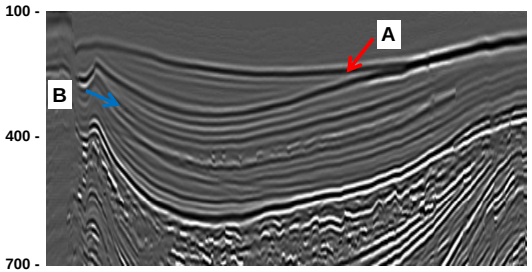

Channels could be observed with curvature if they have differential compaction (A) or aggradational features (B). Channels without change on dip or differential compaction (C) could not be observed with curvature



# Minibasin 1




Dip-oriented profile



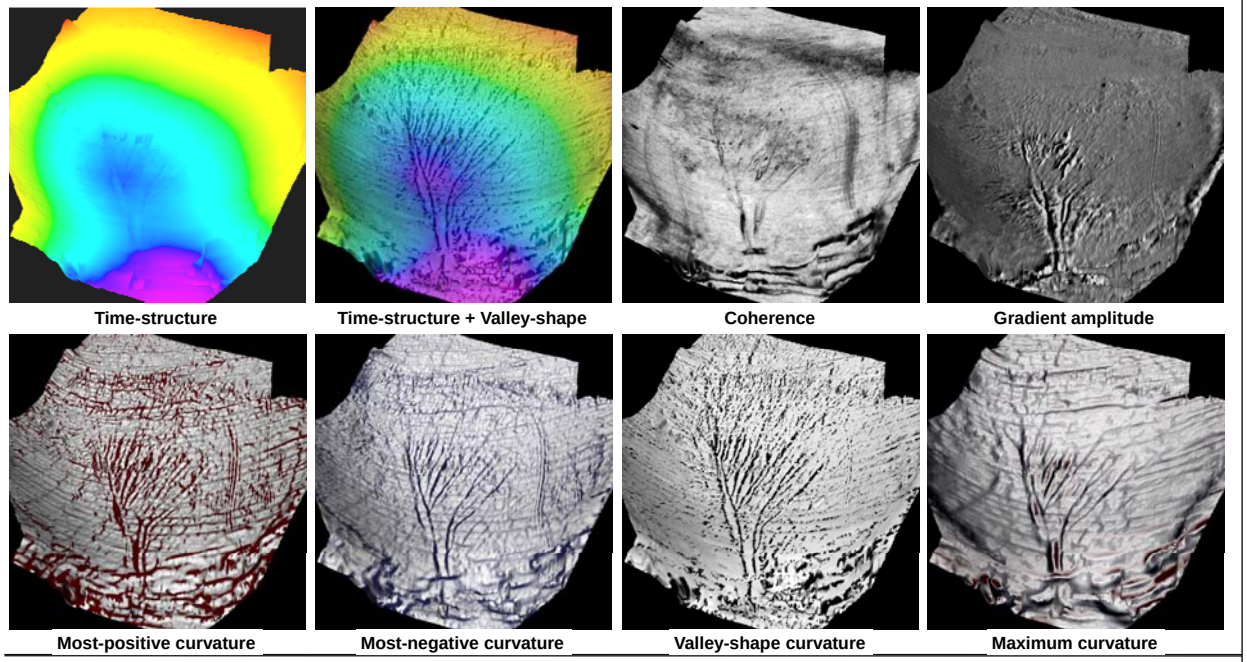

Strike-oriented profile

**Dip-oriented profiles of the seismic show clinoform geometries interpreted as a shelf-margin deltaic system prograding from the shelf to the slope. The strike oriented profile shows the undulations produced by the slope channels in the minibasin. The time –structure maps shows a bowl-shape minibasin that has a general direction of deposition from NW to SE.**

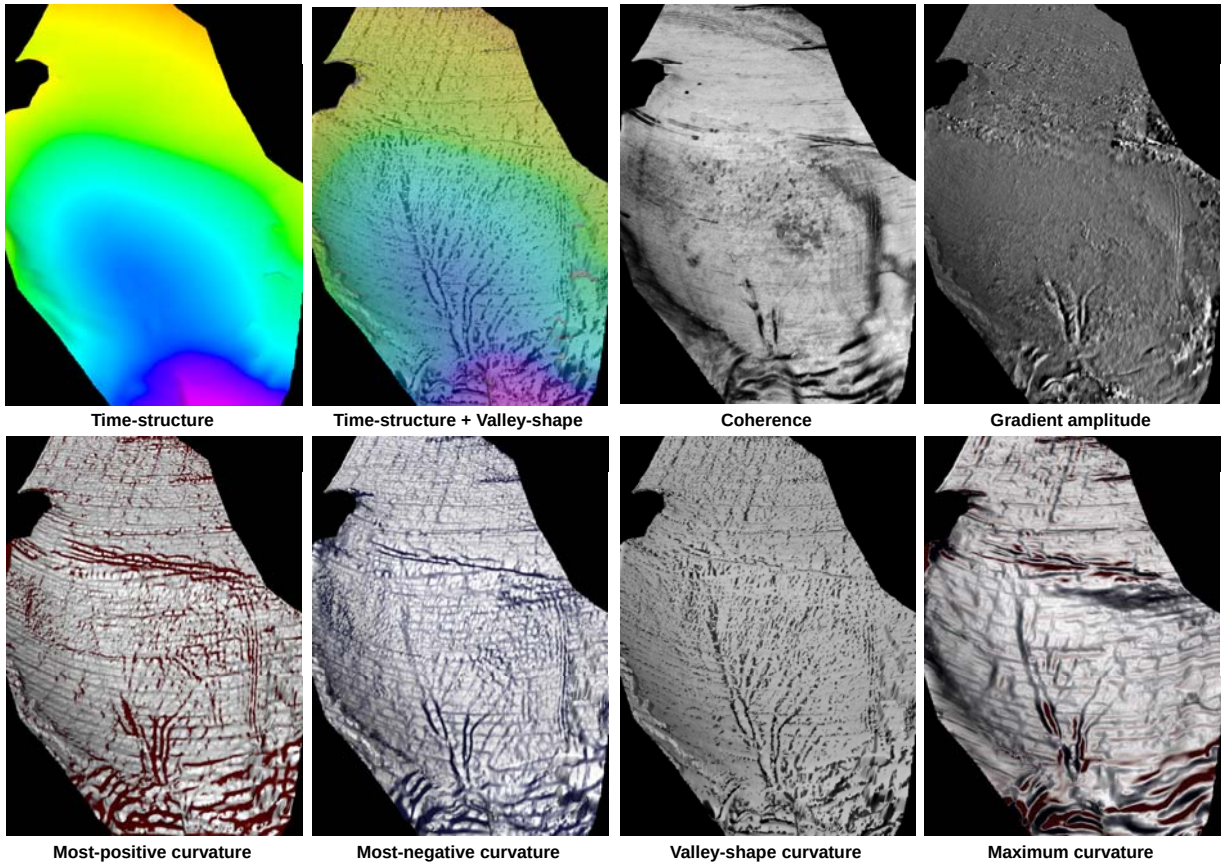
**Attribute extraction such as coherence and amplitude gradients along the interpreted horizons indicate the presence of a system of slope channels that converge into two main channels at the axis of the minibasin that then continue to the base of the slope. The minibasin was lately affected by later faulting at the base of the basin.**

**Seismic curvature attributes illuminated a continuous channel system extending to the edge of the shelf. Curvature also reveals the presence of more slope channels coming from the east side of the minibasin feeding the main axis channels. The better visualization of this channel system on curvature attributes is directly related to differential compaction of the channels versus the surrounding facies in the slope of the minibasin. Thus in this case the most-negative curvature delineates the channel axis meanwhile the most-positive curvature defines the overbank deposits.**

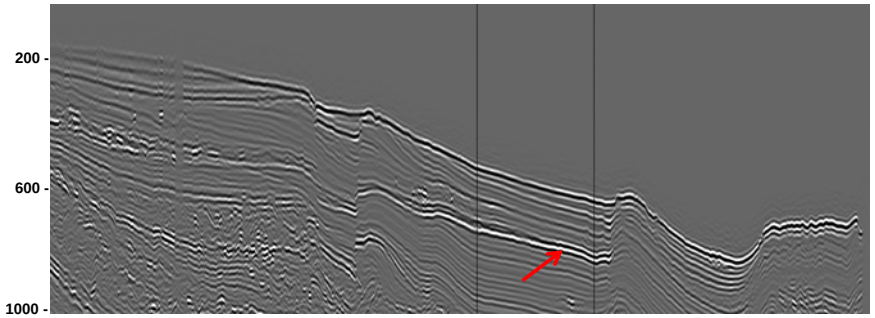
## Stratal-slice A (Red arrow)



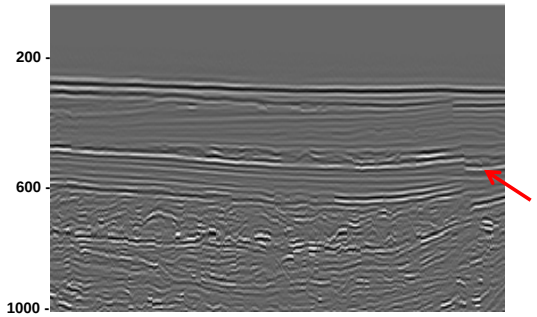

## Stratal-slice B (Blue arrow)



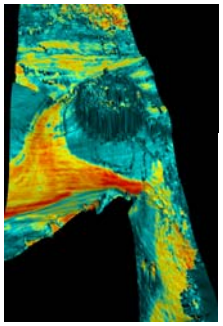
## Minibasin 2



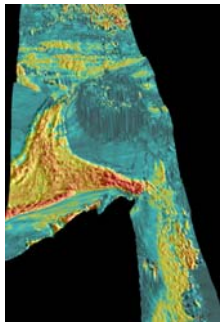

Dip-oriented profile



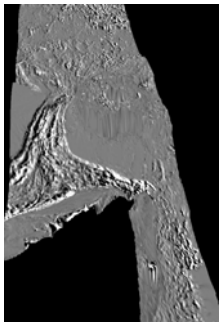

Strike-oriented profile



Amplitude

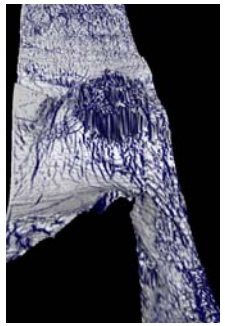


Amplitude + Gradient-amplitude

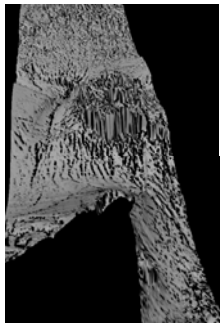


Gradient amplitude

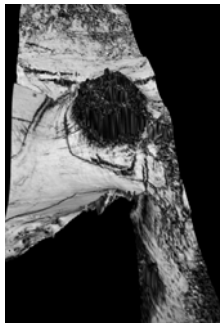
Most-positive curvature



Most-negative curvature

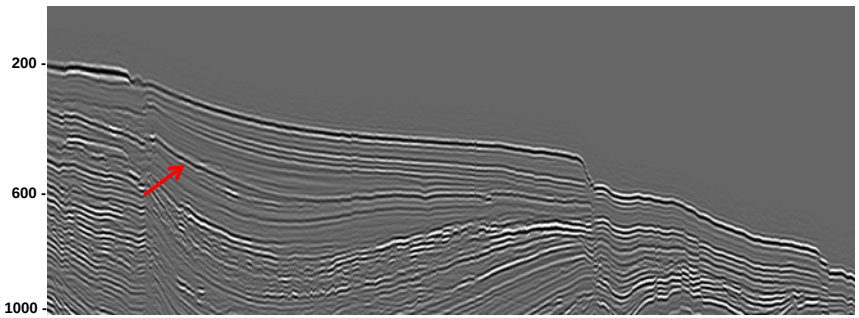


Valley-shape curvature

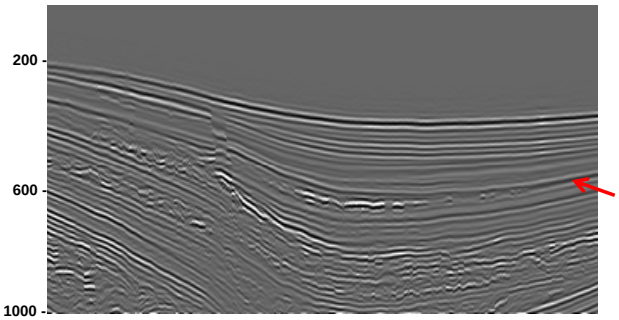


Coherence

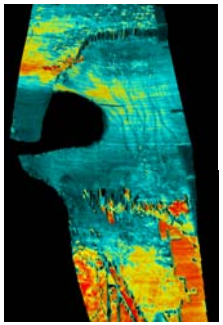
## Minibasin 3



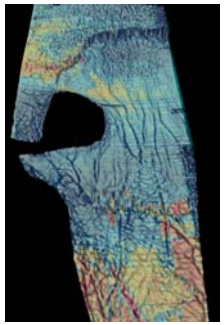

Dip-oriented profile



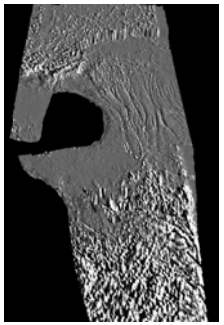

Strike-oriented profile



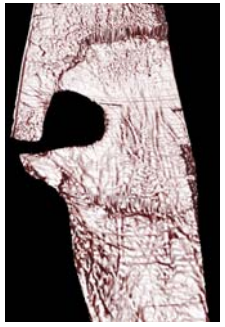
Amplitude



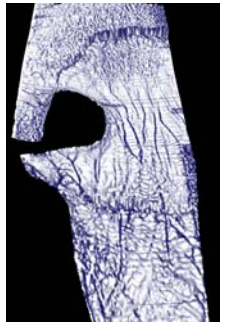
Amplitude + Gradient-amplitude



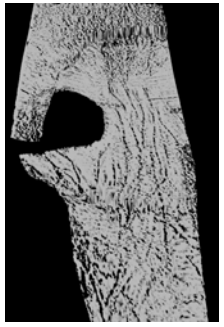
Gradient amplitude



Most-positive curvature



Most-negative curvature



Valley-shape curvature

Coherence