# Leading Resource Company Reduces Risk, Lowers Costs in Mine Planning with EarthStudy 360 Full-Azimuth Imaging

aspentech | Case Study

> "Knowledge of impending hazards is invaluable when planning mines, since it signals to the planners to watch the marked areas to see what the anomalies are, or to avoid those areas altogether. Since this is a mining program, eventually we will be able to see in person what is already evident in the seismic data."
>
> \- Leading Resource Company

## CHALLENGE

Obtain information beyond conventional time and depth migration and improve a mining plan, bearing in mind that fracturing which results in a water inflow during production can be costly.

## SOLUTION

The Aspen EarthStudy 360™ diffraction imaging technology was chosen to recover details not seen in standard time and depth processing. The product's imaging engine is able to both recover and separate specular energy and diffraction energy from the seismic data.

## VALUE CREATED

- Aspen EarthStudy 360 diffraction imaging brought significant added value to the seismic data by revealing new and finer details of the subsurface.
- Having such high-resolution information at an early stage will help in planning the mine and avoiding hazardous areas which could result in costly expenditures.

# Overview

Time processing of 3D seismic data has traditionally been the methodology for mine planning in this part of the world. A leading resource company with global operations in oil, gas and mining, needed to obtain information beyond conventional time and depth migration and to improve the mining plan, bearing in mind that fracturing that results in a water inflow during production can be costly.

The area under study has water-bearing formations above the mining target zone as well as water zones in the fault footwalls. Water inflow into a mine can result in anything from being a nuisance to the mining operation, to a complete closure of the mine. Mining into an undetected fracture system can even result in the loss of a billion-dollar mine. Therefore, detecting fractures that were previously unknown can be very beneficial.

While some image processing techniques can help recover or enhance discontinuities in the seismic data, they cannot recover the high-resolution and lower energy details that have been masked by standard processing and imaging procedures. A significant amount of energy associated with high-resolution features such as small faults, stratigraphic edges and reservoir heterogeneities, is recorded in the form of diffraction energy.

# Add Value to Seismic Data

The Aspen EarthStudy 360 diffraction imaging technology was chosen to recover details not seen in standard time and depth processing. The EarthStudy 360 imaging engine is able to both recover and separate specular energy and diffraction energy from the seismic data.

Figure 1 shows a vertical line in the 3D volume. The main zone of interest is between the orange and purple horizons, where salt solution collapse zones are evident. They are very visible on the time and depth migration and are easily interpretable. Mining is avoided in these collapsed areas.

However, can more detail be extracted from the data that was not previously visible on the time or depth sections? This is where diffraction imaging comes into play.

Figures 3 to 5 show areas that clearly have more detail in the diffraction imaging stack than in the depth migration stack alone. Figure 2 is in a quiet zone where we do not expect any small-scale faulting; as anticipated, the diffraction image appears to be quiet. In each set of images the top image is a vertical stack display of the PSDM. The bottom left is the diffraction imaging depth slice and the bottom right is the PSDM depth slice.

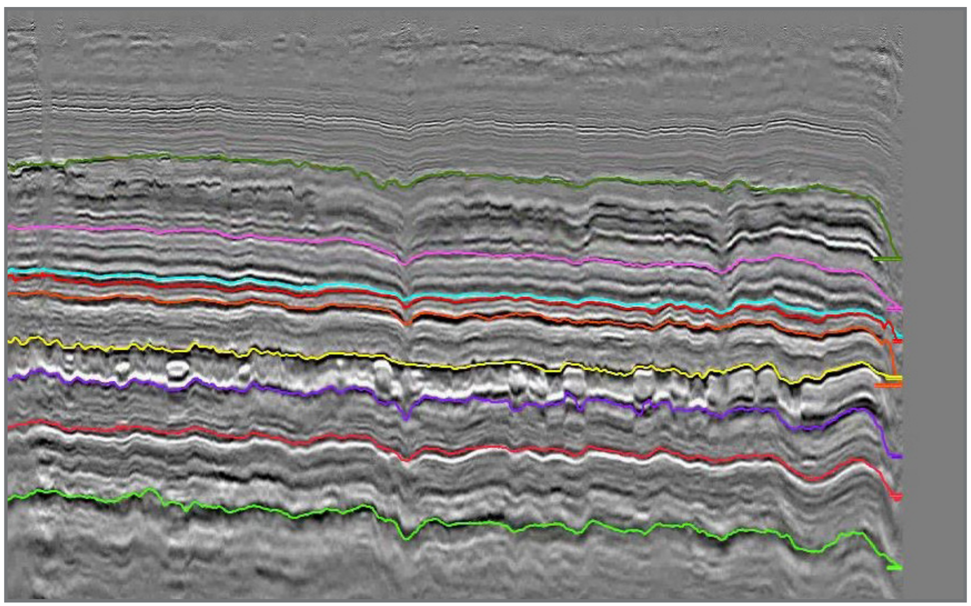

Figure 1. PSDM Kirchhoff depth section. The zone of interest is between the orange and purple horizons. A salt solution collapse is evident.

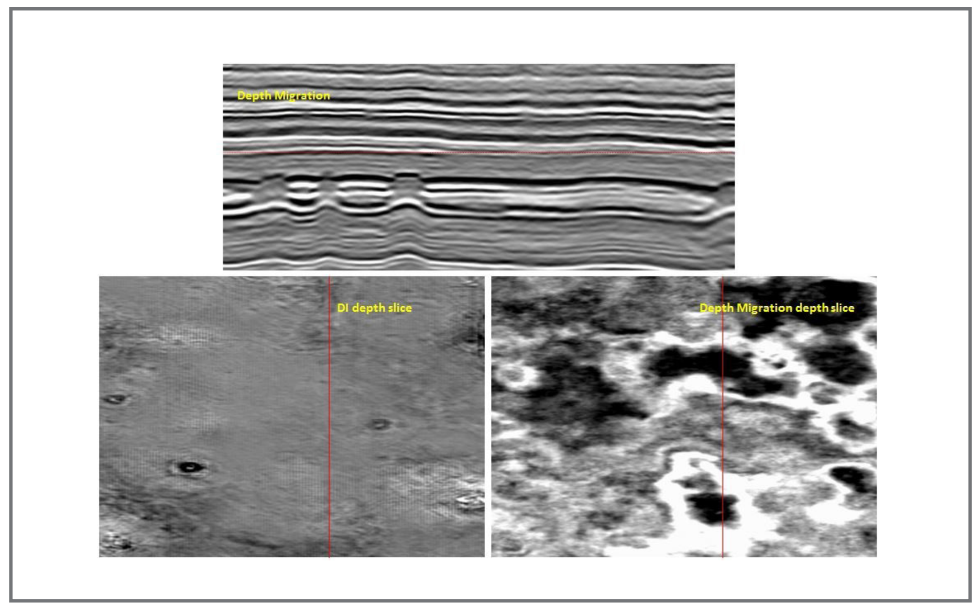


Figure 2. PSDM Kirchhoff depth section (top), diffraction stack depth slice (bottom left), PSDM Kirchhoff depth slice (bottom right). The results show that this is an expected quiet zone for potential fracturing.

# Results

Finer details were seen on the diffraction imaging stacks, in addition to details that were not visible at all on the PSDM slice. The increased resolution, which was not available before the development of Aspen EarthStudy 360 diffraction imaging technology, brings significant added value to the seismic data. Many of the details observed on the diffraction imaging stacks are not currently explained and additional investigation is needed. They are definitely features of interest during mine planning.

# Conclusion

Mines around the world have been lost due to water inflow through unknown fracture systems. Furthermore, millions of dollars are spent controlling water inflows into mines. Knowing about possible small scale faulting systems may help companies avoid these costly measures.

In this case, knowing about impending fracture hazards can be invaluable. Since mining has not occurred yet in this area, having such information early will help in planning the mine. These areas will be watched when mining to see what the anomalies are, or will be avoided altogether.

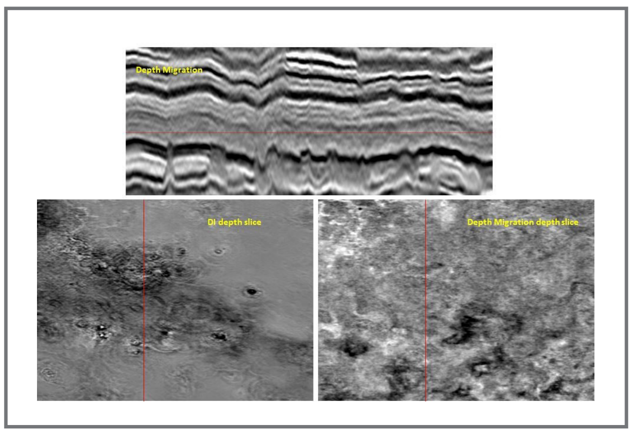


Figure 3. The upper left corner of the diffraction imaging depth slice shows details that are not visible on the PSDM depth slice.

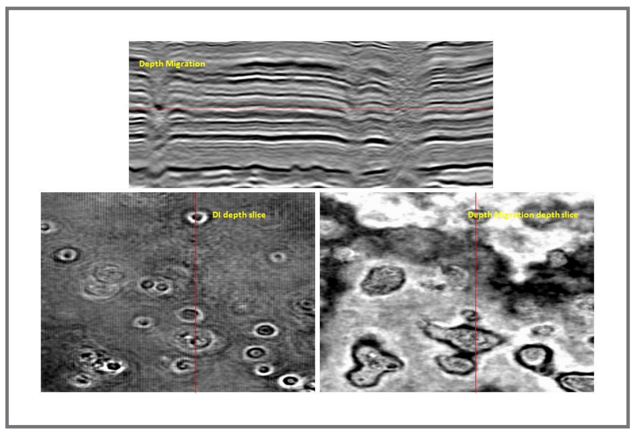


Figure 4. Salt solution collapses are visible on both the PSDM (right) and diffraction imaging (left) depth slices, but the diffraction imaging volume shows much higher resolution.

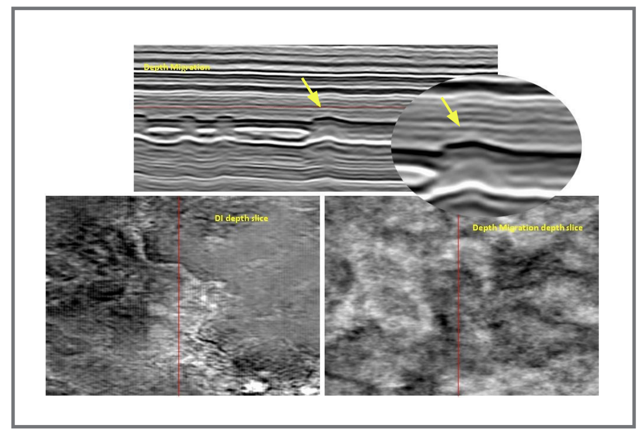


Figure 5. A meandering feature is clearly shown on the diffraction imaging slice but not on the PSDM slice. The yellow arrow on the vertical section points to where the feature is located, and there is no discontinuity on the PSDM stack.

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