

# Kirchhoff Wavefront Migration

## For Efficient and Accurate Imaging

### 3D Prestack Depth Migrations Support Multiple Imaging Objectives

Today's seismic processing centers need a broad portfolio of seismic migration technologies to support a wide range of imaging objectives. Complex wave phenomena, target-oriented seismic acquisitions, and extended velocity model descriptions that incorporate anisotropy and converted waves must be supported by prestack imaging solutions.

To meet these objectives, Emerson E&P software solutions include a full range of 2D and 3D prestack time and depth migration methods, with supporting velocity model building technology from the industry-leading GeoDepth™ velocity model building and depth imaging system. These methods include flexible, target-oriented Kirchhoff migrations with high-end imaging options (wavefront reconstruction and Common Reflection Angle) as well as Wave Equation migration solutions (common shot and narrow azimuth). Collectively, these migrations can be applied to solve a wide range of imaging objectives, such as thrust fault, sub-salt and rugged terrain imaging, and accommodate a variety of imaging acquisitions, including wide angle, OBC and other multi-component recordings.

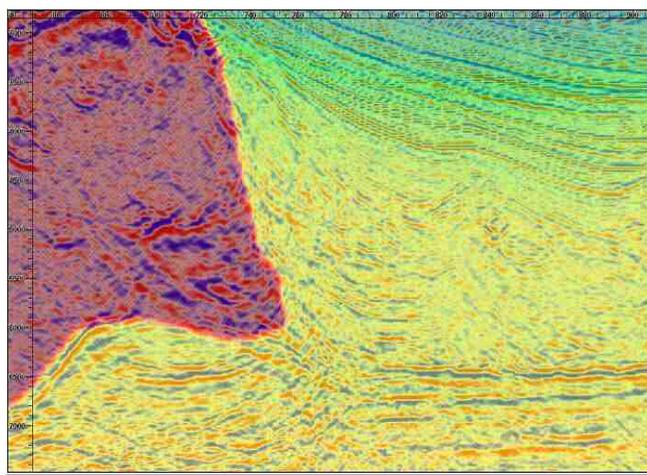


### Kirchhoff Migration Maximizes Efficiency and Flexibility

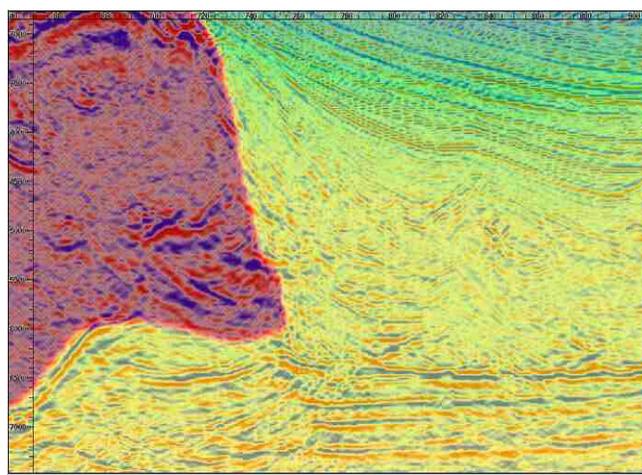
The Kirchhoff migration, the most commonly used migration for depth processing, is particularly attractive due to its speed and target-oriented capability, which enables efficient velocity model building and updating. In addition, the Kirchhoff migration offers adaptability to irregular acquisition geometries, and flexibility in handling anisotropic and converted wave velocity models and surface topography.

The Kirchhoff depth migration incorporates two main operations:

- Computation of traveltimes for waves propagating from sources to subsurface image points.
- Integration of (summing) seismic data within a pre-defined range (migration aperture) using the computed traveltimes.



▲ Eikonal solution



▲ Wavefront solution

# Kirchhoff Wavefront Migration

## Wavefront Reconstruction Assures High-quality Imaging

Use of the first arrival is inadequate for high-quality imaging, especially when dealing with such geological regimes as sub-salts, gas lens, overthrusts and others. Emerson E&P software offers a practical solution to this problem by computing traveltimes using the Wavefront Reconstruction method. This method is able to compute all possible arrivals of waves propagated from sources to subsurface grid points. The Wavefront Reconstruction method propagates rays at equal time intervals. As rays diverge, new rays are added to secure a uniform spatial sampling of the local wavefronts. This enables the system to track all ray arrivals with their corresponding amplitude factors, from the source to any point in the subsurface, including information about lateral continuity along the wavefront.

## Imaging Extensions Broaden Capabilities

The ray tracing used in Wavefront Reconstruction has been extended to handle other earth model parameters, such as anisotropy, and the simulation of converted wave propagation. This enables imaging of converted wave data in both isotropic and anisotropic models.

## High-quality Results Worldwide

Wavefront Reconstruction method supports both land and marine data, including Ocean Bottom Cable recording. In addition to standard offset gathers, 3D OVT (Offset Vector

Tiles) gathers, spiral offset gathers, and “star” (azimuth sector) gathers can be generated. The system offers special support for OVT gathers, for better imaging and additional analysis such as for unconventional resource plays.

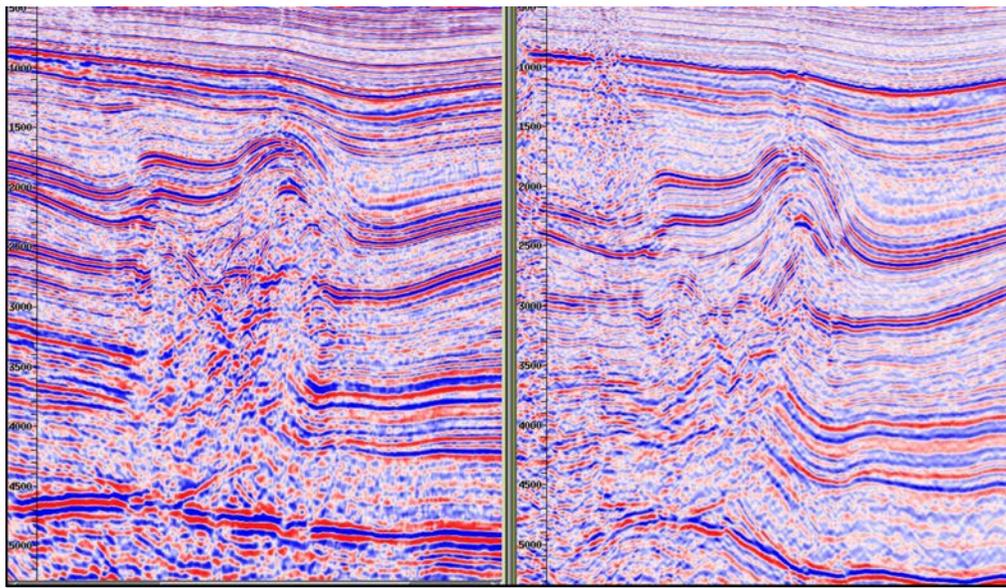
The Emerson Kirchhoff migration has been successfully used in a variety of regions, such as the Gulf of Mexico, the North Sea, Offshore Western Africa, and many others. In these and other complex geological areas, the Wavefront Reconstruction method has led to substantially improved imaging quality and more accurate geologic target selection.

## Benefits

- Seamless integration with the industry-leading GeoDepth velocity model building system
- Multi-imaging algorithms and options to support a broad range of imaging objectives
- Multi-platform support for high-end computing and optimum throughput
- Worldwide experience in solving depth imaging problems

## Platform Support

The Kirchhoff Migration is an add-on to the GeoDepth velocity modeling and imaging solution. It is available on Linux clusters running 64-bit Red Hat® Enterprise Linux® 6.8 and subsequent minor releases, and 7.1 and subsequent minor releases. Linux clusters offer superior price performance and provide a highly scalable solution for migrations.



▲ Poststack depth (left) and prestack depth (right) Kirchhoff migration



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