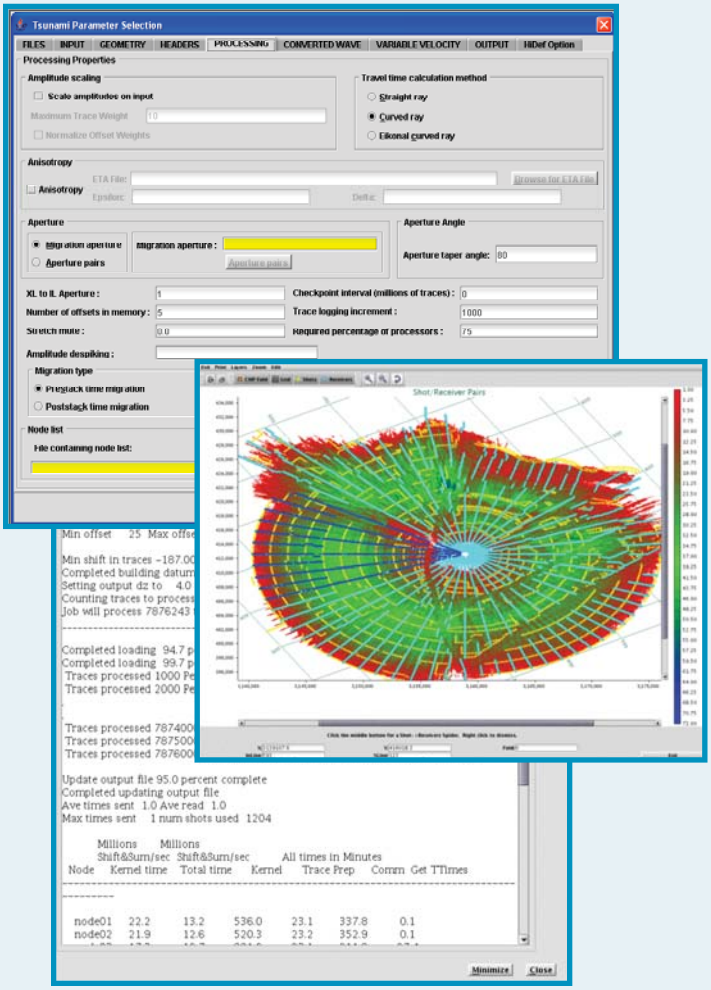
TSUNAMI *2D/3D Kirchhoff Migrations*

Pre-stack Time and Depth Migration

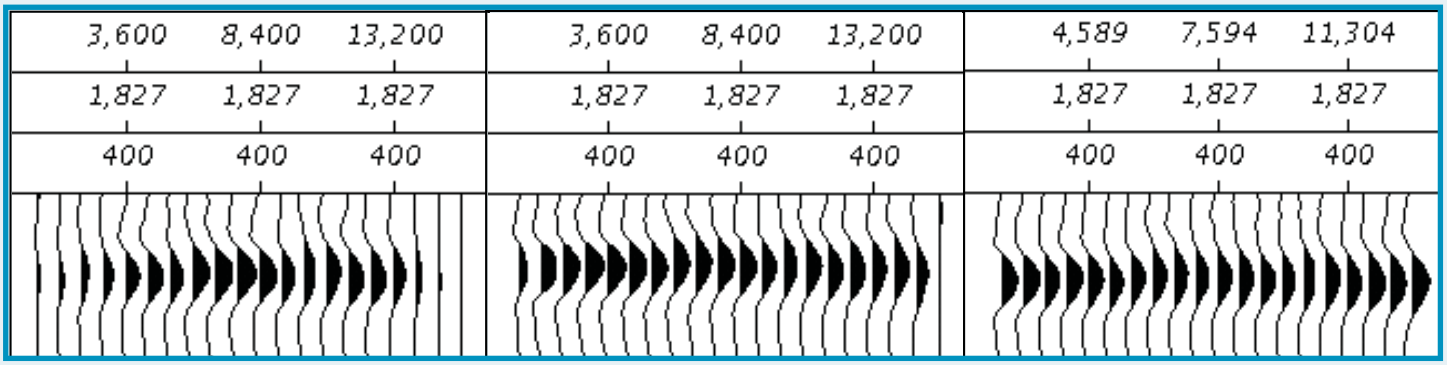
Easy to Use

- The intuitive graphical user interfaces make job setup easy and quick
- New users can become productive within days
- Comprehensive job log provides a powerful tool for tracking progress and diagnosing errors
- Fold maps, trace offset and azimuth histogram displays



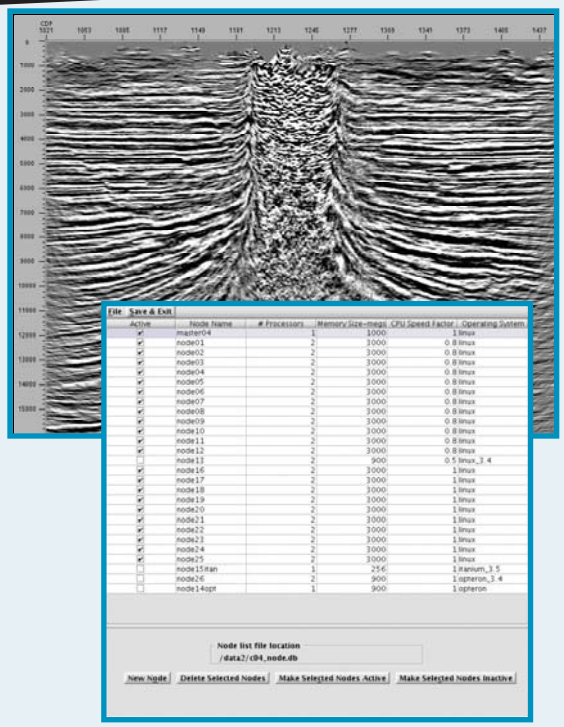
Superior Imaging Quality

- Handles steep dips
- Capable of imaging beyond 90°
- Curved ray travel times use either 6th order NMO or eikonal methods for PSTM
- Paraxial ray tracer uses wave front reconstruction method for PSDM
- Amplitude preserving for AVO
    - Sophisticated trace weighting to compensate for irregular acquisition
    - Trace offset balancing



Left – migrated gathers with no weights. Middle – migrated gathers with weights applied and normalized. Right – migrated gathers with weights applied and normalized, and balanced offset bins. The gathers on the right are compliant for AVO analysis.

The Fastest in the Industry



Scalability and Performance

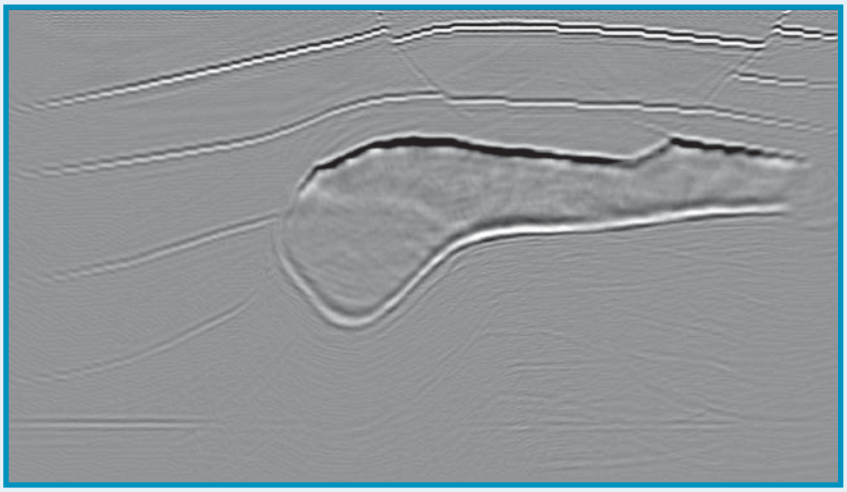
- Patented I/O method for Linux clusters (see U.S. Patent 6,915,212)
- Heterogeneous operating environment
  - Intel, AMD and SGI nodes
  - Different speeds, memory amounts and CPUs
  - Does not use NFS, MPI or PVM
  - Does not require disk space on the compute nodes
  - Low memory requirement
  - Flexible licensing
  - Only commercial imaging software on IBM Blue Gene® Supercomputer

Compatibility

- Input data can be sorted in any order
- Reads SEG-Y seismic and velocity data
- Reads Focus®, ProMax® and SeisUP® formats

Special Processing

- S-wave migration
- Variable velocity migration
- Variable eta migration for anisotropy
- Azimuthally dependant migration
- Huygens HiDef migration



Pre-stack Kirchhoff depth migration of the SEG C3-NA Salt Model.

Customer Support

- Submit support ticket via online help desk
- Reputable, dependable support staff
- Customized programming

Tsunami Development
10111 Richmond Ave Suite 230
Houston, TX 77042
713.783.1435
www.tsunamidevelopment.com

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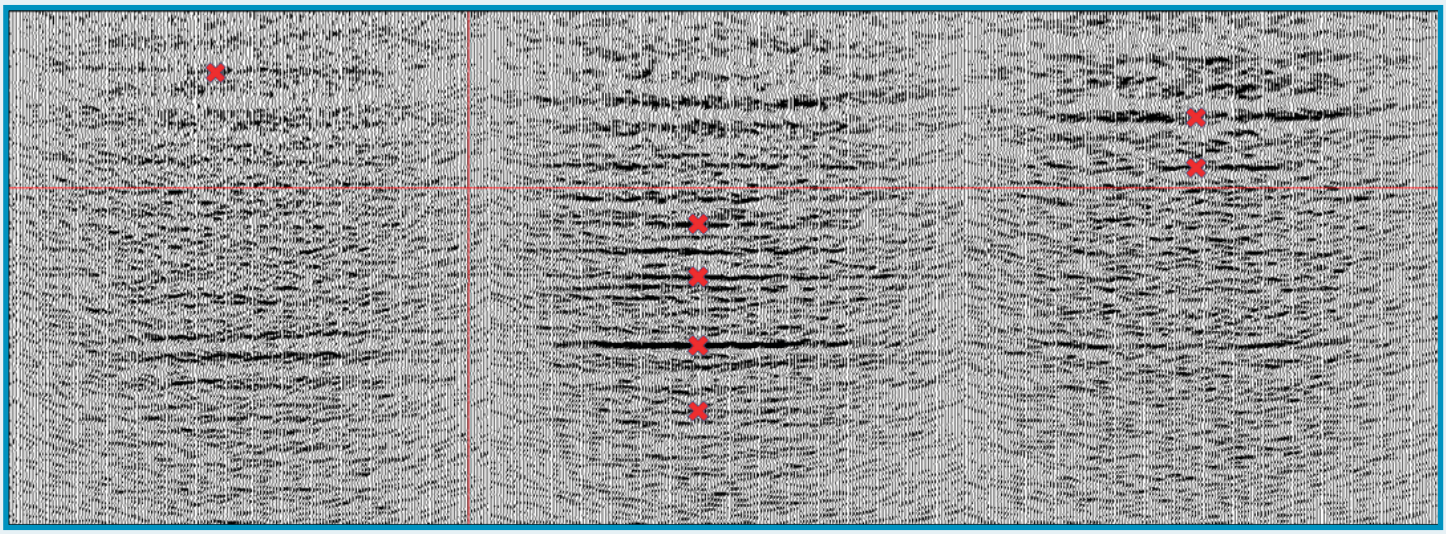
TSUNAMI DEVELOPMENT

TSUNAMI *PSTM Converted Wave Migration*

Target difficult plays with mode converted shear wave data

Hydrocarbons or Lithology?

- Distinguish amplitudes associated with hydrocarbons from those caused by localized stratigraphic changes
- Have the confidence to explore under gas clouds and chimneys
- Succeed in unconventional plays with anisotropic and fracture detection challenges



Converted wave migration test panels. The data in each panel above was migrated (and stacked) with varying s-wave velocities. The velocities varied by 5% from the central function. The correct imaging velocity can be picked from these panels as illustrated by the red Xs.

Easy to Use

- Only additional parameters from conventional PSTM are time-gamma pairs and the s-wave velocities
- Use variable velocity testing to derive accurate s-wave velocities

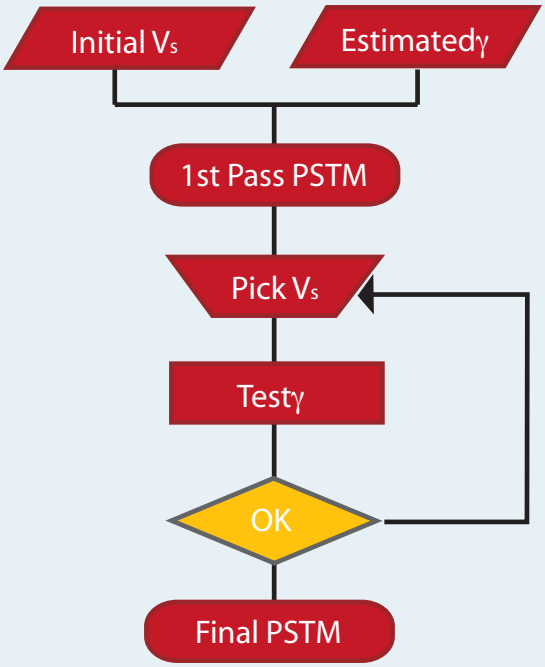
No Additional Charge

- Unlike our competitors, this option does not require a separate license, nor additional fees

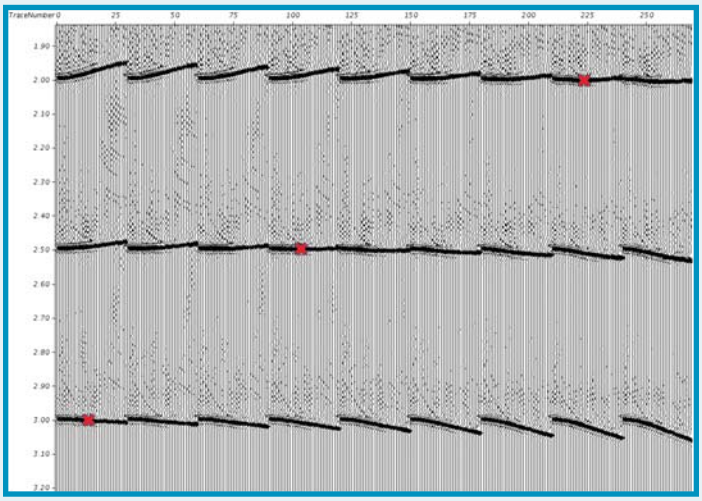
Solve the S-Wave Challenge

Variable S-Wave Velocity Migration

- Solve the problem of deriving accurate s-wave velocities
- Define any number of panels and an s-wave velocity increment
- Calculate from constant or time-varying velocities
- Define a robust and accurate velocity field by picking from the migration panels. The red Xs (see figure) mark the velocity that best images the data at that time



Workflow to properly define gamma and s-wave velocities for converted wave migration.



Migrated synthetic gathers using variable s-wave velocities. The central time-variant s-wave velocity function, and each subsequent panel, was adjusted by 2%. The red picks represent the best s-wave migration imaging velocity. The picks were made in Tsunami's interactive velocity modeling software.

Converted Wave Processing Sequence

- To get the most value out of converted wave data one must have a good handle on:
  - P-wave velocities
  - Anisotropy, or eta
  - Gamma to correlate P to PS data
  - S-wave velocities
- Use of variable parameter migration is helpful
- S-wave sequence:
  - Estimate gamma
  - Migrate with initial s-wave velocities
  - Pick Vs
  - Test veracity of gamma
  - Iterate previous two steps
  - Migrate with final s-wave velocities

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Houston, TX 77042
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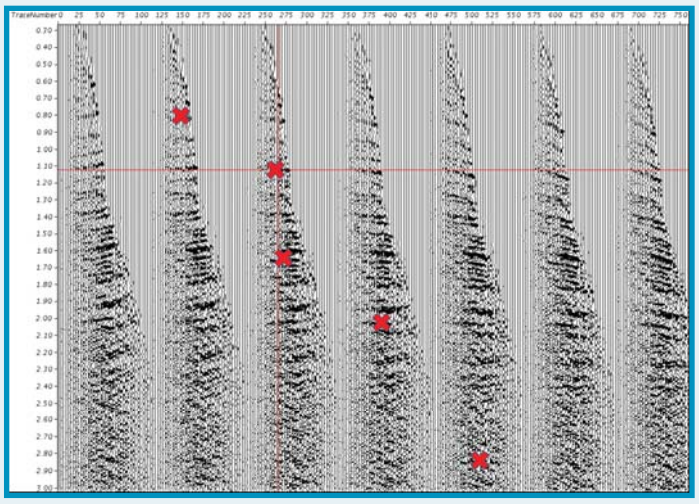
TSUNAMI *Variable Velocity Migration*

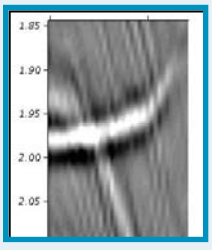
Better results in areas of bad signal



Migrated gathers using variable velocities. The central time-variant velocity function, and each subsequent panel, was adjusted by 1%. The red picks represent the best p-wave migration imaging velocity. The picks were made in Tsunami's interactive velocity modeling software.

Variable P-Wave Velocity Migration

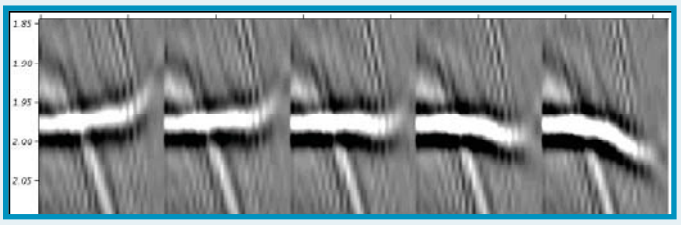
- Pick the best velocities using migration
- Define any number of panels and a p-wave velocity increment
- Calculate from constant or time-varying velocities
- Define a robust and accurate velocity field by picking from the migration panels. The red Xs (see figure) mark the velocity that best images the data at that time



The gather to the left is the original raw gather. The panel below is the same gather migrated with different settings of eta.

Variable eta for Anisotropy

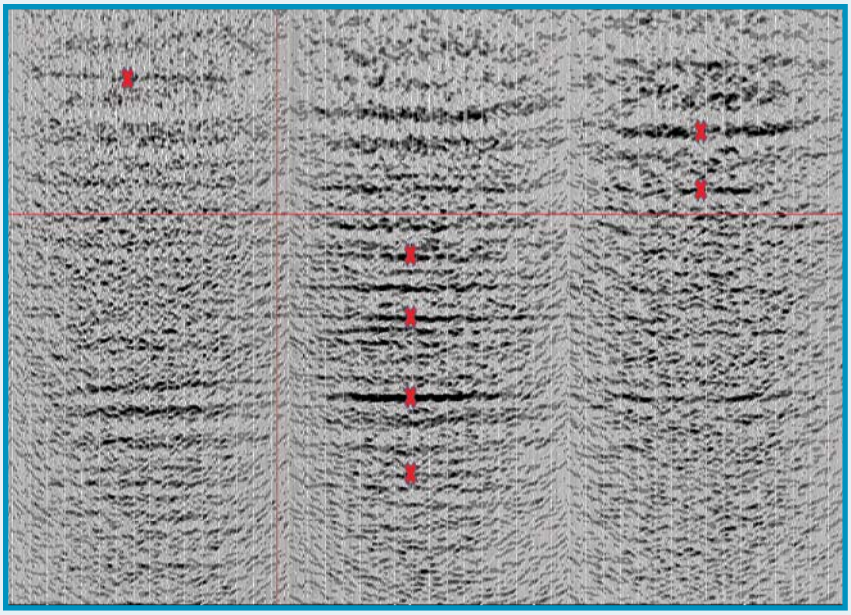
- Eliminate the effects of anisotropy
- Pick the best eta to flatten the gathers
- Solved from analysis of p-wave data



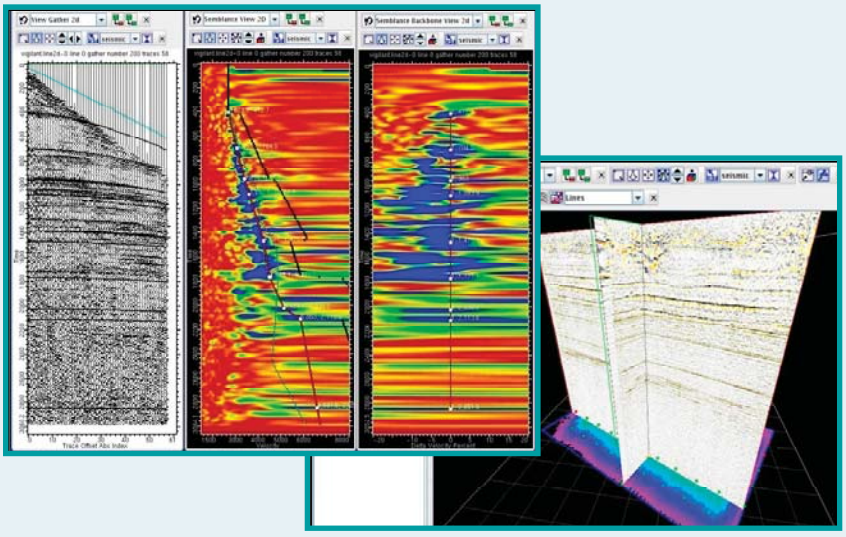
No Additional Charge

- Unlike our competitors, this functionality does not require a separate license, nor additional fees

Solve the Velocity Challenge



Converted s-wave migration test panels. The data in each panel above was migrated (and stacked) with varying s-wave velocities. The velocities varied by 5% from the central function. The correct imaging velocity can be picked from these panels as illustrated by the red Xs.



Displays of the interactive velocity modeling software illustrating the 3D visualization space, CDP gather and velocity semblance tools.

Variable S-Wave Velocity Migration

- Solve the problem of deriving accurate s-wave velocities
- Define any number of panels and an s-wave velocity increment
- Calculate from constant or time-varying velocities
- Define a robust and accurate velocity field by picking from the migration panels. The red Xs (see figure) mark the velocity that best images the data at that time

Interactive Velocity Modeling

- Pick RMS and residual velocities for converted wave time migration
- Pick from velocity semblances or variable velocity migration panels
- QC moveout corrected gathers and dynamically updated stacks
- Construct complex velocity models

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