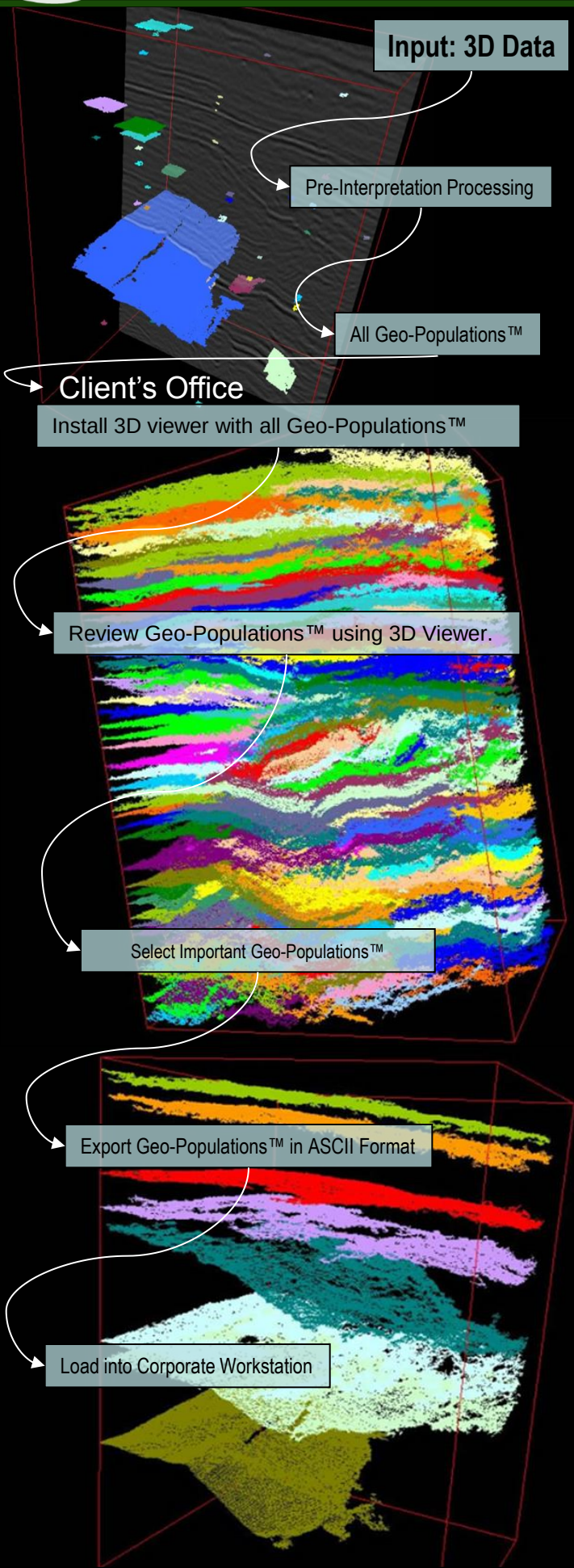
# Pre-Interpretation Processing Services:
## Genetic Segmentation




**Key Points:** Total Depth Pty Ltd uses patented genetic segmentation technology to provide pre-interpretation services using a remarkable new methodology that delivers an unbiased extraction of virtually all surfaces from 3D seismic volumes. Without human intervention, the volume is automatically segmented and organized into populations of genetically related waveforms. These populations, referred to as Geo-Populations, consist of Trough and/or Peak surfaces. The process is independent of and complimentary to all workflows currently undertaken by professionals interpreting 3D seismic data regardless of which seismic interpretation tools are used.

**Key Objectives:** The rapid extraction of high-quality pre-interpretation surfaces from 3D seismic volumes will enable more focus on understanding the significance of the results; thereby reducing risk, accelerating the decision making process and better utilization of resources, time and corporate assets.

This technology has applications in the many areas: Interpretation, Processing QC, Time-Lapse (4D) and Model building (e.g. Basin, Structure, Depth, Velocity and Migration Pathway analysis).

The process has been successfully applied to the following seismic volumes: ***Time Domain***: Full-Stack, Angle Stacks, Spectrally Enhanced, Pseudo-Impedance and Reflectivity.

***Frequency Domain***: Estimated Wavelet Spectra, Residual Wavelet Spectra and Normalised attenuation spectra.

**Requirements**

Copy of 3D data (i.e. processing Archive SEGY format)

Loading Parameters and X,Y co-ordinates.

**Workflow**

Load seismic data,

Start processing

Review Geo-Populations in 3D viewer

Export desired surfaces (Inline, Xline, TWT, Fitness, Amplitude).

**Typical Deliverables**

- Project file containing queryable spatial database of all Geo-Populations.
- Pre-Interpretation Processing Report.
- Workshop/Installation/Training demonstrating use of free specialized 3D viewer to enable the review and output by client of desired surfaces.

**Pricing:** The cost of processing is calculated from the number of gigabytes (GB) of 32 bit seismic data processed. Pricing is based upon a non-linear power function, so the more GBs processed, the lower the cost per gigabyte. For example increasing the number of GBs volume(s) by a factor of four only increases the processing cost by a factor of two.

**For a quotation** please provide the following information:

– Project Name, Number of Inlines, Number of Xlines

– Trace Length (seconds) , Zones of Interest (seconds).

– Sample Rate (seconds) , Bin Size, Coverage (sq km)

– Several images showing a Xline and Inline showing the zones of interest would also be helpful.

**Estimated Completion:** Usually within one or two weeks upon receipt of a purchase order and the 3D seismic volume(s).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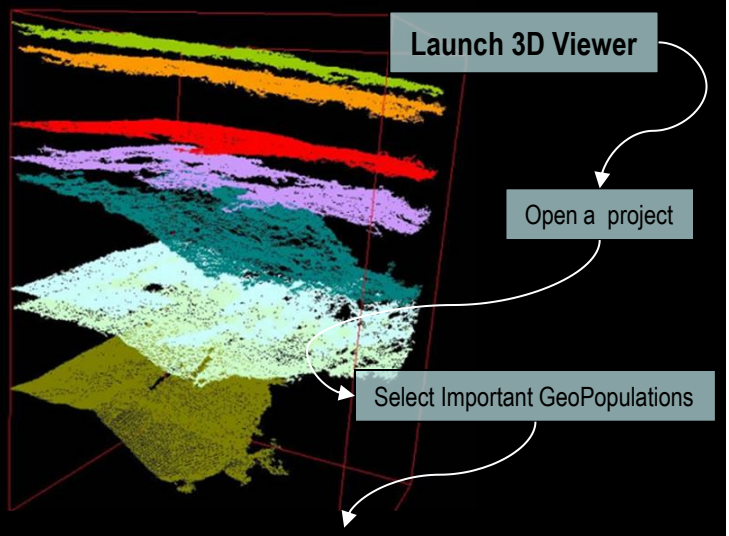
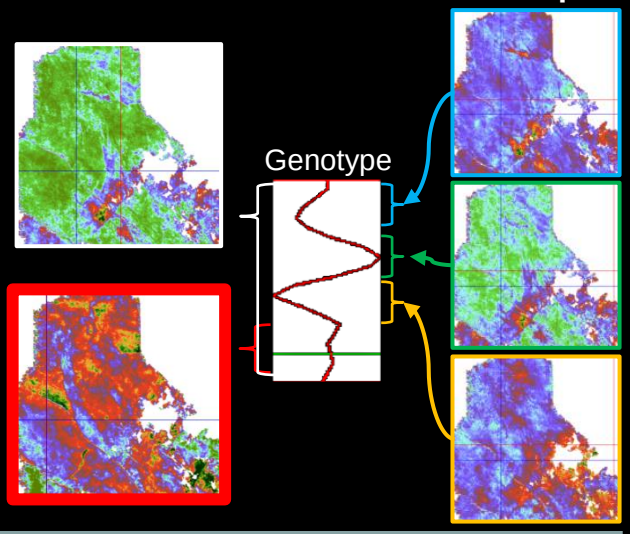
# Pre-Interpretation Processing Services:
## Genotype Sequencing: Sub-Waveform Analysis




### Generate Sub-Waveform Fitness Maps




Analyse Geo-Populations sub-waveform fitness attribute maps in the 3D viewer.

**Key Points:** All of the GeoPopulations identified by pre-interpretation processing consist of genetically and spatially related waveforms. This relationship (fitness) can be captured by measuring the genetic similarity of each individual in the population against the common waveform (genotype). The genotype waveform for each population has evolved independently over thousands of generations during Seisnetics pre-interpretation processing.

Since many of the surfaces associated with GeoPopulations coincide with chrono-stratigraphic events, they often mark boundaries between very different geological sequences. Examining lateral and spatial variability within a population of waveforms can reveal additional insights.

**Genotype Sequencing:** Within the specialized viewer delivered with every project is the ability to segment and process waveforms from any GeoPopulation. The resulting sub-waveform fitness maps help to unravel the variations of the waveform associated with each Geo-Population™. Since the analysis is confined to a population of genetically similar waveforms, the results are often more meaningful than information extracted from larger windows.

By examining the portion of the waveform above and below a particular surface, information about its consistency and variability can reveal insights about structure, stratigraphy and provide an indication about the suitability for certain types of attribute analysis. Geologically, this analysis technique enables the user to discover different depositional domains captured within a single seismic waveform.

**Workflow:** Launch your project.

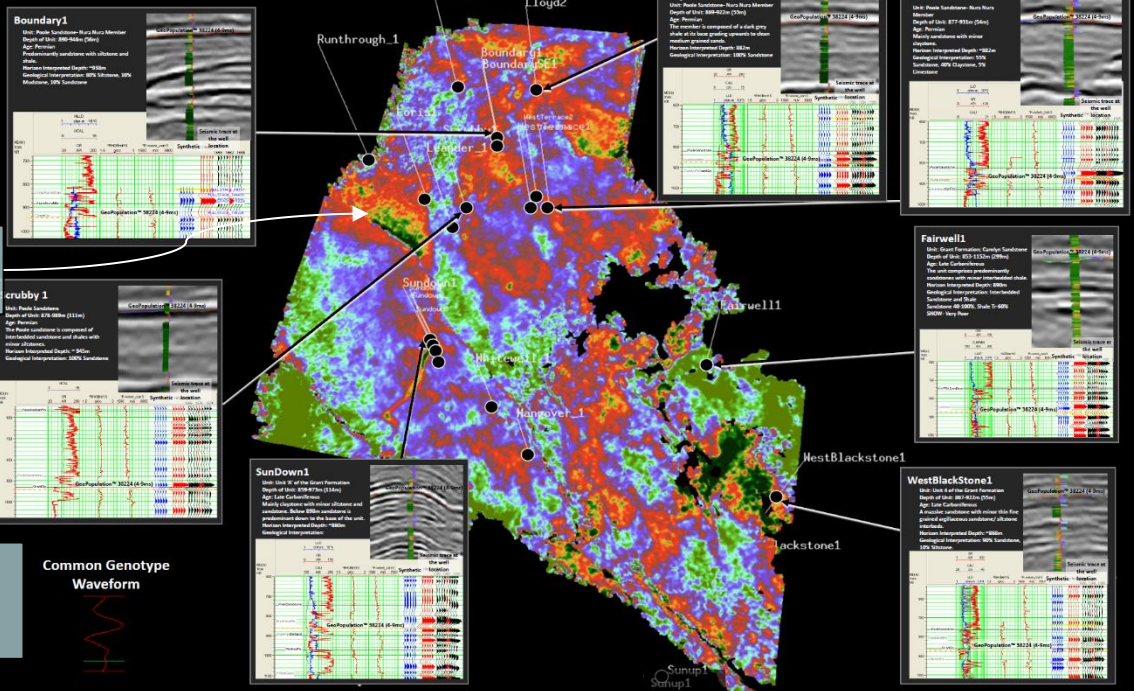
- Open the database and select the GeoPopulation to analyse.
- Process in real time the GeoPopulation.
- Review Geo-Populations™ sub-waveform fitness attribute map in the 3D viewer
- Export ASCII files (Inline, Xline, TWT, Fitness, Amplitude).

By integrating the petrophysical logs, the seismic facies maps become geological facies maps.

Build Facies Maps

Generate new prospects

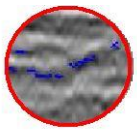
Export to your favorite Interpretation Workstation software



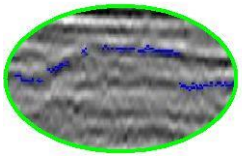
# Auto-Trackers vs Genetic Segmentation

## Auto-Trackers

Auto-trackers have been in use for more than a decade and use a large variety of more or less sophisticated algorithms. However, miss-picks and poor accuracy remain problematic. These problems are inherent to the methodology itself since all auto-trackers use local information to decide how to continue tracking, one track at a time, and therefore will always be unable to find a globally coherent solution.



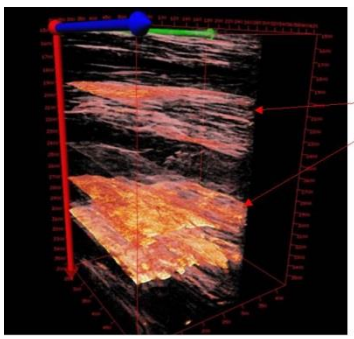
Locally the picking seems to be accurate.



Globally the picking is obviously not accurate.

### Limited approach: Highlighting

Volume interpretation techniques use seismic data and derived attributes to highlight features by applying thresholds on their values. This approach works best when the chosen combination of attributes provides enough discrimination to keep visible only the features of interest. Without apriori knowledge about the best attribute along with the value range needed to highlight a given type of feature, this approach is often a very lengthy trail-and-error method with no guarantee of finding a solution either local or global.



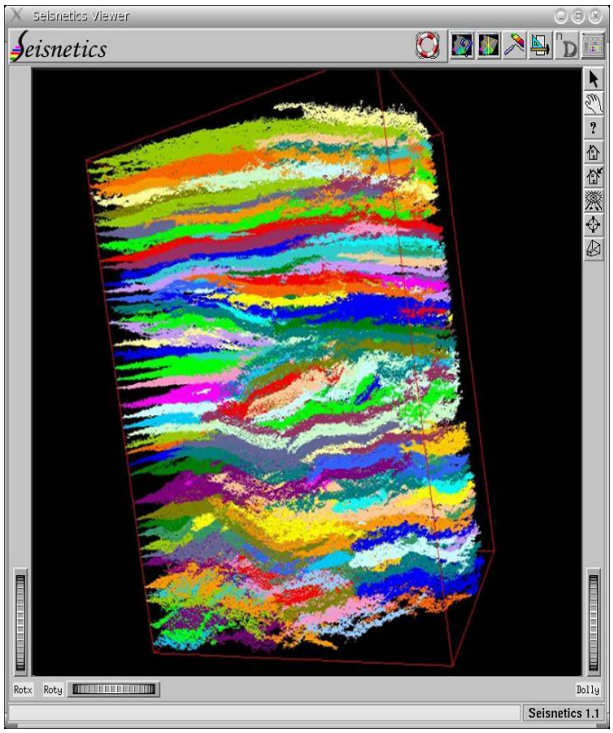
Information is highlighted but is difficult to extract from the surrounding environment.

- One feature at a time using local tracking:
  - ✓ Guided local picking that requires a preliminary idea of what has to be found,
  - ✓ Fragmentary information about the subsurface which does not enable the geoscientist to fully understand the geology of the subsurface,
  - ✓ Lengthy process a lot of time is spent picking very few to the detriment of the true geological interpretation.

## Genetic Segmentation

This technique considers seismic pre-interpretation processing as a data analysis problem, where the objective is to segment (break down) the whole “seismic data” into segments (geological features). The automated segmentation of a 3D seismic data volume is an optimization problem, where the objective is to find sets (horizons, faults, channels …) of samples with the highest level of similarity and spatial organization.

In order to perform the seismic data segmentation, a genetic algorithm is used that looks for a global solution for each input volume. The evolutionary algorithms operates on a population applying over all generations, the principles of natural selection and "survival of the fittest" to produce a better solution. The processing algorithm provides an accurate and robust method for imaging the more significant ("the fittest") geological features (Geo-Populations) within the seismic volumes.




- All the features at the same time using global segmentation:
  - ✓ Unbiased full segmentation delivering all coherent geological features,
  - ✓ The entire structure of the subsurface is determined enabling the geoscientists to fully understand the geology of the subsurface,
  - ✓ Rapid interpretation all the features including the very subtle details are immediately available for a better interpretation.

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