Application and Limitations of Seismic Attributes on 2D Reconnaissance Surveys

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Introduction:
Currently, seismic attributes are primarily computed on 3D seismic data volumes. However, 2D seismic lines are more widely available in more mature basins, and 2D lines are often acquired first in exploratory basins.

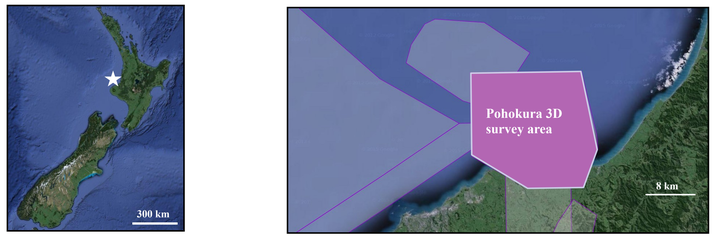
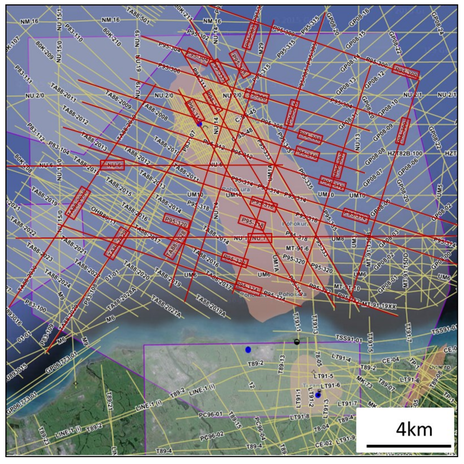


Figure 1a) (left), 1b) (right) and 1c) (below): Respectively, location of the Pohokura survey, the general shape of the survey, and the available 2D lines.

The focus of my study will be to test the effectiveness of a variety of attributes on 2D seismic lines.

The data used in this survey was provided by NZPAM (New Zealand Petroleum and Minerals). The company provided over 10 3D seismic surveys for our use. I settled on using the Pohokura survey to the high density of 2D lines overlaying the survey. Additionally, we have access to 3 wells in the survey region.



Previous work:
In 1992, Bahorich and Bridges investigated the possibility of using 2D data to create horizon based maps for use in seismic stratigraphic interpretation. In the Seismic Sequence Attribute Map (SSAM) method, Bahorich and Bridges present computations, averages, and ratios of the data in map form.

As recently as 2015, Garcia and Halpin, considered the differences of attributes and noise filters on a 2D padded volume in search of a workaround for computing attributes in software that only accepts 3D data.

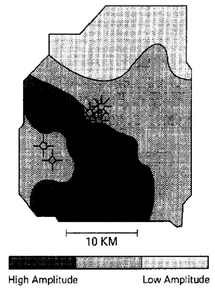


Figure 2: Average absolute amplitude from Bahorich and Bridges (1992).

Initial 2D/3D Inline Comparison

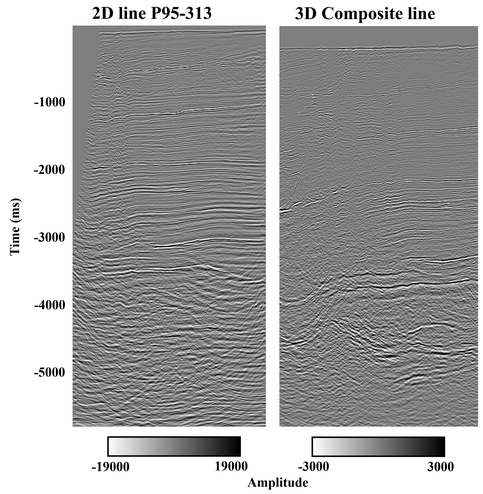


Figure 3a): The seismic amplitudes of a 2D and composite 3D line shown side by side.

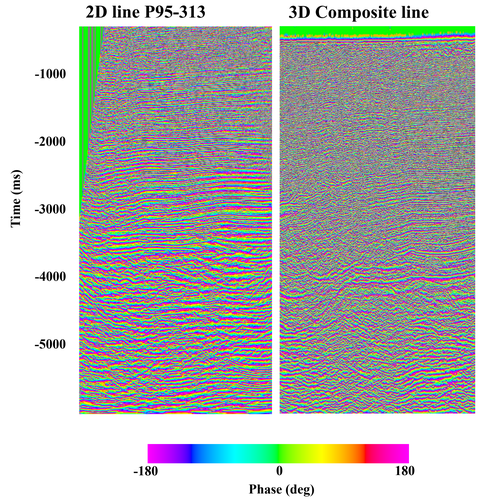


Figure 3b): The instantaneous phase of a 2D and composite 3D line shown side by side.

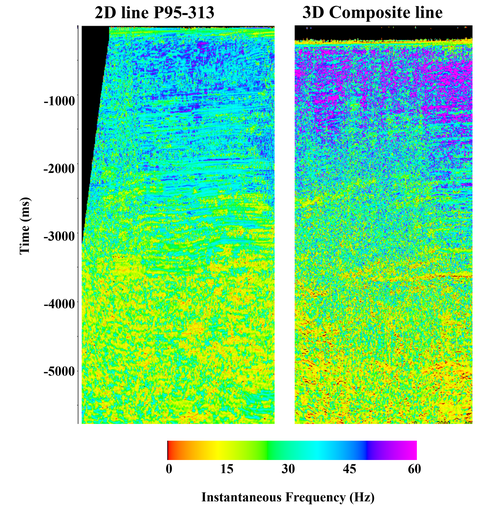


Figure 3c): The instantaneous frequency of a 2D and composite 3D line shown side by side.

Initial 2D/3D Interpreted Surface Comparison:

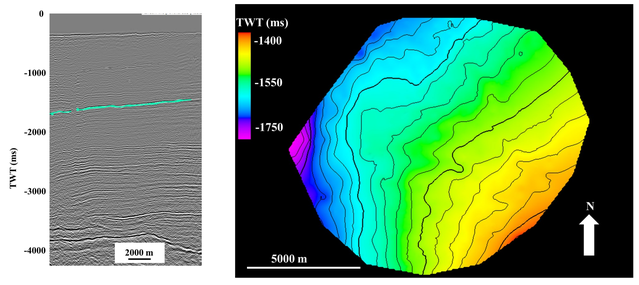


Figure 4a): Composite line through 3D survey and time structure surface from interpreted horizon.

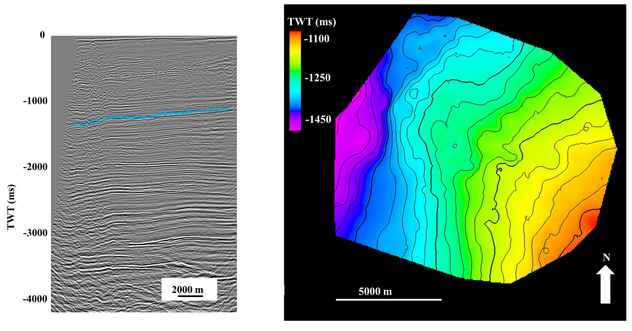


Figure 4b): 2D line P95-313 and time structure surface from interpreted horizon through 2D data.

Each map displays a similar structural trend. However, the 3D data is shifted roughly 300 ms deeper than the 2D data. This could be caused by human errors in the set up of the coordinate systems for the 2D and 3D data sets.

This is an encouraging result showing that similar maps can be created from 2D and 3D data, at least in the time structure domain.

Data Quality:
Upon closer inspection of the seismic volume, there does not seem to be a match with the generalized survey image shown in Figure 1b.

Pohokura appears to be comprised of several surveys merged together. Data quality is slightly more chaotic around the edges of the merged surveys.

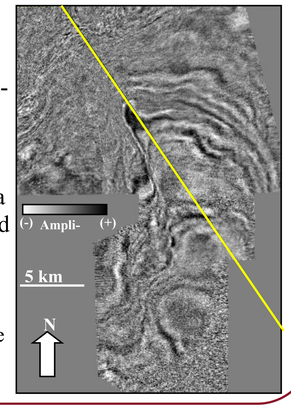


Figure 6: Timeslice through the seismic amplitude at t = -3000 ms. The yellow line represents 2D line P95-313.

AASPI Sponsor Questions:
How do you extract an attribute along a horizon picked on a 2D line? Software? Workflow? Workaround?

Time structure maps can be made from horizon picks on 2D lines. However, current software limitations will not allow for extraction of attributes along surfaces created from 2D data.

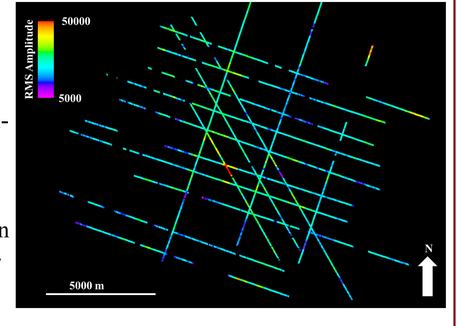


Figure 6: Grid of extracted RMS amplitude along 2D lines in the Pohokura survey. Interpolation between these lines is the next step.

References:
Bahorich, M. and Bridges, S. Rutts, 1992. Seismic Sequence Attribute Map (SSAM). Case Histories 1: Seismic Stratigraphy.
Garcia, H. and Halpin, M., 2015. Analysis of a pseudo-3D volume derived from a 2D line using 3D volumetric attributes, Seg Technical Program Expanded Abstracts 2015. 5634.
Gunther, R. H., Klemper, and Goodliffe, 2005. Modeling sideswipe in 2D oceanic seismic surveys from sonar data: Application to the Mariana arc. Tectonophysics 420, 333 - 343.

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