For depth conversion the ultimate limiting factor is the accuracy of the interval velocities. This is especially true beneath sea floor canyons where the canyon forming process can create real velocity irregularities due to shale expansion.

Conclusions

The dynamic time correction method can in favourable areas produce results equivalent to other pre-stack solutions but at less cost. It is appropriate in VIC/P 23 due to the absence of steeply dipping events and the extensive nature of the sea floor canyons. Although suitable for locating prospects, we would recommend that comparisons on key lines be made using other methods to validate such results if prospects are being considered for drilling. The method is applicable to areas where lateral velocity variations not near the surface are other than sea floor canyons, such as carbonate reefs, volcanic dykes and salt pillows.

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Depth Conversion Using a Normalized Velocity — Lithology Correlation (Abstract Only)

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In areas where the exploration objectives require a reliable depth conversion algorithm, two methods are commonly used. In the best of the average velocity techniques, the values of average velocity are derived from the seismic velocities. For the "layer cake" method, the values of interval velocity are from either well velocity surveys, seismic times and well depths or seismic velocities. In both methods, the success of the depth conversion is dependent upon the correlation between the interval velocity and the geology of the layer.

Extracting the lithologic component from the interval velocity can be accomplished by the use of the depth normalized interval velocity. For a particular geologic layer, the interval velocity is often expressed as a function of depth. The inversion of the form popularized by E. S. Pennebaker in 1969 is shown in Equation 1:

$$V_{int} = LAP\ (Z_{mid})^{1/n}$$

The conversion of interval velocity into depth normalized interval velocity was published by C. H. Acheson in 1963 as is shown in Equation 2:

$$V'_{int} = (Z_n/Z_{mid})^{1/n}\ V_{int}$$

Since the values of V_{int} and Z_m are available from seismic data in the average velocity method and the well data in the "layer cake" method, only Z_n and 1/n remain to be determined. The Z_n is a constant (usually 1, 10,000 or the mean value of Z_m) and 1/n can be determined from wells, wells and seismic data or seismic data alone.

The depth normalized interval velocity can now be computed at the control points (shot points or wells). Within the same geologic unit the normalized velocity becomes a function of pore pressure and lithology. In the absence of overpressured sediments, the velocity changes between control points reflect changes in lithology. In the presence of overpressured sediments, the changes in the normalized interval velocity indicate variations in the pressure since the lithology is usually pure shale.

Once the lithologic component is isolated, cross plots between the normalized data and the well attributes can be used to study the connection between the interval velocity and geology. The form suggested by E. R. Tegland in 1970 is shown in Equation 3:

$$V_{int} = rV_{ss} + (1\text{-}r)V_{sr}$$

As this correlation improves, the success of the conversion of time into depth will also improve. Both the average velocity method and the "layer cake" method can now be successfully evaluated using the depth-normalized interval velocity.

Since the purpose of depth conversion is to transform seismic times into depths which tie the wells, it is vital that the values of the interval velocity obtained from the seismic velocity analyses or the well velocity surveys converge toward the acoustic velocity of the lithology. The technique of crossplotting the depth normalized interval velocity versus the shale percent is shown to be a simple and quick technique for establishing the velocity-geology correlation.

Measurements made at the surface and measurements made in the borehole are both functions of the lithology of the earth. It is imperative that the velocity values used for stacking, imaging, and depth conversion be consistent with the lithology of the earth to ensure a proper solution for all three of these objectives.