V029 THE EFFECTS OF ATTENUATION AND DISPERSION ON LOG CALIBRATION AND WAVELET ESTIMATION

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Introduction

Many modern interpretation techniques in the general subject area known as seismic lithology are critically dependent on the quality of the tie between the surface seismic data and well data and the consequent estimation of the seismic wavelet. The wavelet estimation scheme assumes that the seismic wavelet is time-invariant over the time interval used for matching the synthetic seismogram with the seismic data. However, any attenuation in the Earth will introduce time-variant effects in the seismic data. The bandwidth of the seismic data will become time-dependent and causality will introduce frequency dependent velocity dispersion. The quality of the wavelet estimate will be reduced unless the attenuation and dispersion is included in the construction of the synthetic seismogram. We present a study of log calibration and wavelet estimation in a well from the southern North Sea where a significant amount of attenuation, which varies with depth, has been measured from a VSP (Harris et al., 1992). We investigate how the dispersion associated with the measured attenuation effects the log calibration and wavelet estimation procedure.

Method and discussion

The construction of the synthetic seismogram involves careful editing of the well data to ensure that the log values represent the true formation properties and calibration of the sonic log to the same interval transit times as a checkshot survey. The measured attenuation estimates from the VSP can be incorporated in the wavelet estimation scheme by apply a time-varying Q filter to the synthetic seismogram. The uncertainties in the VSP attenuation estimates are much smaller than those associated with attenuation estimates from surface seismic data (White, 1992). It is standard practice to use the discrete Hilbert transform to estimate the phase spectrum associated with a Q-filter (Bickel and Natarajan, 1985). However the phase dispersion accompanying the attenuation can also be measured from the VSP waveforms. We estimate the phase dispersion at seismic frequencies from the phase spectrum of the transfer function between VSP waveforms at different depths using the method of Raikes and White (1984). We calculate synthetic seismograms using both the measured dispersion and the dispersion estimated using the discrete Hilbert transform. It is important to ensure that the synthetic seismograms which include attenuation and dispersion still have the same travel times as the VSP traveltimes. Wavelet estimation over

different time intervals down the well shows the results of incorporating the attenuation and dispersion into the synthetic seismograms.

Acknowledgements

We thank the sponsors of the London University Research Programme in Exploration Seismology; Amoco (UK) Exploration Company, Elf UK plc, Enterprise Oil plc, Fina Exploration Ltd., Mobil North Sea Ltd. and Texaco Britain Ltd., for their support of this research.

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