Construction of High-Resolution Acoustic Impedance Data for Reservoir Modeling

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The 3-D models of absolute acoustic impedance values were built integrating well, seismic and geologic data utilizing deterministic and stochastic inversion techniques to bet utilized as soft data in reservoir property models to aid the development of the Rotliegend Gas Field, northwestern Germany.

The deterministic inversion process included wavelet estimation and generation of 3-D low-frequency reflectivity balancing and impedance models using geostatistical algorithms for interpolating and integrating associated well and seismic information. Data from 26 wells in the area of interest were used in seismic-well tie, wavelet extraction, and reflectivity-balancing and low-impedance model generation. The deterministic inversion produced pseudo-log of absolute acoustic impedance values at each seismic trace location by spectrally combining the inverted balanced reflectivity trace and the low frequency background model about the transition frequency of 8 Hz.

The stochastic inversion built upon the work performed in the deterministic inversion to create high-resolution acoustic impedance models. The stochastic inversion process generated multiple realizations of the impedance pseudo-logs at each seismic trace location utilizing sequential simulation algorithms and retained the realization whose synthetic seismic response best correlated with the actual seismic trace at that location.

The acoustic impedance models helped in accurately defining and characterizing the Wustrow and Ebstorf reservoirs. The stochastic inversion handled the poor seismic data within the salt influence area by using only well data in simulation. The 3-D stochastic inversion model contained necessary vertical and lateral resolution and was hence utilized as the soft data to construct impedance-dependent facies model and facies-dependent porosity and permeability models of the Wustrow, Ebstorf and Dethlingen reservoirs.

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