Seismic Sedimentology for High-Resolution Reservoir Imaging

Zeng, Hongliu, Bureau of Economic Geology, Jackson School of Geosciences, The University of Texas at Austin, Austin, TX

The interpretation of 3-D seismic data is vital for depositional facies analysis and reservoir imaging in many petroleum basins. One of the major difficulties facing high-resolution (reservoir or 10-m scale) facies and reservoir interpretations using seismic data is that at fourth- and higher order scale, sequence boundaries are typically not resolved. As a result, sequence correlation and systems tract imaging can be a great challenge. Fortunately, the problems caused by the lack of vertical resolution can be largely overcome by using the horizontal resolution power of 3-D seismic data.

Horizontal reflection patterns can resolve thin geologic/depositional features that otherwise could only be detected on vertical seismic sections. Classic seismic facies analysis can thus be supplemented through the study of horizontal imaging of depositional forms and the spatial relationships between reflection patterns. A step beyond classic seismic stratigraphy, seismic sedimentology is the study of sedimentary lithology, geomorphology, depositional architecture, and depositional history by using the relationships between seismic amplitude (attributes) and lithology and between spatial reflection patterns and the preserved morphology of depositional elements.

Key techniques include (1) 90° phasing of seismic data or seismic inversion to tie seismic traces and log-lithology profiles, and (2) seismic stratal slicing to image seismic attributes on approximate depositional surfaces. Examples from multiple projects will be presented for application of seismic sedimentology in revealing a basin's depositional history, correlating high-frequency (fourth- and higher order) sequences and systems tracts, identifying subtle reservoirs and new play opportunities, and assisting infield drilling.