by William C. Ross,
Vice President, Integrated Solutions,
A2D Technologies/Interpretive Imaging
Lakewood, Colorado

High resolution sequence stratigraphy on a geologic workstation: hunting for sub-seismic resolution features in mature basins

Abstract

Sequence stratigraphy, pioneered in the 1930s and revitalized with the seismic tool in the 1980s, represents a powerful approach to the interpretation of geologic systems. By applying the discipline of careful time-line correlations and unconformity recognition it becomes possible to identify genetically related packages of rock that are most appropriate for subsurface mapping.

Sequence stratigraphy and time-stratigraphic correlations require tracing time lines from either outcrop, well log, or seismic data.Continuous outcrop and seismic data offer opportunities to trace time lines and observe stratigraphic discordance directly. Well-log data require the careful correlation of "marker events" in the log character, interpreted as time lines, over broad areas of the basin in order to reconstruct the time-stratigraphic basin-fill geometries of the subsurface.

Well-log correlation and sequence stratigraphic methodology are enhanced through the use of computer workstations capable of working with large numbers of well logs. By harnessing the power of well-designed software and inexpensive raster well-log images, geologists have the capability to correlate very detailed regional correlation frameworks established on the basis of log character.

Examples of high-resolution sequence stratigraphy are offered from the Almond, Lewis and Fox Hills formations of the eastern Green River Basin, where hundreds of well logs were correlated with as many as 50 correlations per five-hundred foot interval. The results delineate subtle unconformities, faults and basin-fill geometries that are below the resolution of seismic in the area. Techniques for overcoming computer screen size limitations and for simulating paper-based log correlation techniques on a geologic workstation are illustrated in a live software demonstration.

While much of what is possible on the computer workstation is possible using paper well-logs, the sheer volume of well logs and the inefficiencies of paper-based methodologies prohibit stratigraphic studies of this detail by most workers. By leveraging the power of the computer, low-cost raster images and the established methodologies of sequence stratigraphy, the industry has an opportunity to revisit mature basins to explore the resolution of geologic features on a sub-seismic scale. Such features may be the basis for a new wave of discoveries in old basins.

Biographical Sketch

William C. Ross began his career with Shell Development Company in 1979. As a senior research geologist, he worked in seismic and sequence stratigraphy, basin analysis and stratigraphic modeling until 1984, at which time he joined Marathon's Geological research center in Littleton, Colorado, working with field to basin-scale stratigraphic studies, stratigraphic modeling and training. In 1995, Ross founded Interpretive Imaging. He is currently Vice President of Integrated Solutions for A2D Technologies/Interpretive Imaging.

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