Investigating Slope-Parallel Processes in Mud-Dominated Depositional Systems through Seismic Stratigraphic Mapping of Contourite Drifts: Newfoundland Ridge, Offshore Canada*

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Search and Discovery Article #30343 (2014)
Posted July 24, 2014

*Adapted from oral presentation given at 2014 AAPG Annual Convention and Exhibition, Houston, Texas, April 6-9, 2014

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Abstract

Down-slope processes have long been considered the primary control on deep-sea sedimentation. More recently the contribution of slope-parallel processes in deep-sea sedimentation have been highlighted. Slope-parallel processes, such as bathymetric contour parallel currents driven by thermohaline forcings, are capable of reworking and depositing significant volumes of oceanic sediment in mud-dominated accumulations known as contourite drifts. Forcings controlling deposition vary in intensity and focus through time with a record of these dynamics being recorded in the morphologic character of the drifts.

The J-Anomaly and Newfoundland Ridges, offshore eastern Canada, intersect the Deep Western Boundary Current (a slope-parallel current), providing the necessary conditions for significant and long-lived deposition of contourite drifts. A grid of 56 2-D seismic-reflection profiles combined with nine drill sites from IODP Expedition 342 facilitates the ability to link seismic-scale stratal geometries to a robust chronology and information about sediment character. This integrated dataset affords the ability to map the volumetric sediment distribution of these drifts and hence the dynamics of the Deep Western Boundary Current through time, providing insight towards the dynamics involved in slope-parallel depositional systems. Seismic stratigraphic mapping indicates distinct changes in contourite morphologies and depocenters, which are interpreted to reflect changes in current energy and path through time. Seismic facies characteristic of contourite drifts vary from low amplitude transparent reflectors to moderate amplitude concordant wavy reflectors, and are interpreted to reflect changes in current energy. Generating isochron maps identifies lateral shifts in depocenters, with unit thickness on the hundred to thousand of meter scale, which are interpreted to reflect changes in bottom current focus and path. Linking sediment cores to seismic stratigraphic interpretations also enables calculation of volumetric sediment accumulation rates, which more accurately describe contourite depositional history than do linear rates obtained from core alone. Increased understanding of the dynamics involved in mud-dominated depositional systems influenced by the activity of bathymetric contour parallel currents will prove beneficial when developing more accurate depositional models for unconventional hydrocarbon plays.