Seismic depth imaging of structures with complex overburden in offshore Ukraine

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Of the 96 geologic provinces that contain almost all the world's known petroleum reserves, four lie in whole or part within Ukraine: the Dnieper-Donets, Pannonian, Azov-Kuban, and North Carpathian basins. According to the ranking of the U.S. Geological Survey World Petroleum Assessment 2000, they are 45th, 71st, 81st, and 82nd, respectively, in importance. In such a situation, one may wonder why Ukrainian oil and gas potential does not shine more brightly on the petroleum industry's radar screen? We connect this fact with various reasons, two of which are considered here. First, 2D seismic data acquisition still overwhelmingly predominates over 3D in Ukraine. Even though it is now well established that subsurface models resulting from structural mapping and reservoir quality evaluation with 2D seismic lack the detail provided by the 3D method. Second, basically, seismic data processing in Ukraine is still being performed in the time domain, and prestack depth migration (PSDM) has as yet not become quite commonplace for the Ukrainian seismologist. Meanwhile, in Ukraine, many hydrocarbon resource exploration and development plays in different tectonic settings involve rather thick sedimentary sequences with considerable lateral velocity variations; these in many cases lie above the reservoir or target zones. This gives rise to errors in positioning and shape estimation in seismically imaged deformational or sedimentary structures when using simplified poststack time migration procedures. The magnitude of these distortions is not well appreciated by many Ukrainian interpreters working in areas where the phenomenon occurs. The only way to overcome this shortcoming is to use PSDM much more widely in geologically complex areas with dramatically changing overburden. PSDM, specifically combined with 3D data acquisition, minimizes the pitfalls of interpreting structures from time sections and yields a geologic section better correlated to well depths. The data processing examples from a variety of structural settings in offshore Ukraine detailed here illustrate the improvements in seismic imaging and structural positioning when we stop ignoring lateral overburden velocity heterogeneity and begin to correct for it in depth migration.