Reprocessing the "Marine" Mackenzie River Line, NWT

Michael Enachescu*
MGM Energy, Calgary, AB
Michael.Enachescu@mgmenergy.com

Paul Price and John Cody
MGM Energy, Calgary, AB, Canada

Andy Dyke, Josef Heim, Doug Bogstie and Steve Whidden
WesternGeco, Calgary, AB, Canada

Rob Vestrum and John Gittins
Thrust Belt Imaging, Calgary, AB, Canada

Summary

Oil and gas deposits of the Northwest Territories (NWT) are of considerable size and they will become of increasing importance for North America resource supply. However, without an improved grid of modern seismic, an increased level of drilling activity and pipeline access, the area will remain underdeveloped when compared to other petroleum rich Nordic areas. While the logistic, operational, environmental and regulatory challenges for exploring in the north are many, seismic work and drilling activity were carried out in the area since the 1960s and numerous basins and sub-basins with petroleum potential were identified. To overcome the environment challenges, innovative seismic acquisition techniques are being constantly tested in the Arctic where traditionally data collection takes place during the winter, on the frozen tundra.

After numerous environmental tests were completed, a relatively continuous, long seismic line was recorded down the Mackenzie River during the summer season of 2002. Using an air source array and a variable length streamer with hydrophones, this typically "marine" acquisition lay out applied along a river course was a "first ever" event for Canada. The purpose of the survey was to obtain a long tie line across various sub-basins stretching the NWT from the Makenzie Corridor in the south to the Mackenzie Delta in the north. Unlike parallel land based lines, the Mackenzie River line is high fold, had great coupling with the shallow beds and was recorded with minimum environmental impact.

This regional seismic line was recently reprocessed using new techniques of multiple suppression and pre-stack time and depth migration. Reprocessing efforts focused on two main areas for improvement: - multiple attenuation and imaging. The data was riddled with obvious short period water column multiples particularly in the shallow section and short-medium period peg-leg multiples in the deeper section. Water column multiples were modeled and subtracted in XT space

before the longer period peg-leg multiples were modeled and subtracted in the TauP domain. These demultiple routines created a superior input for the other processing challenge, imaging.

Anisotropic depth migration was applied on this project because the river data show: a) vertical velocity variation through the shallow section; b) lateral velocity variation associated with stratigraphic changes along the line and c) evidence of structural deformation and dense faulting. From the initial velocity model building, we observed improvements in imaging of shallow reflectors on the depth section as compared to the prestack time migration. Depth migration more accurately corrects for the complex raypaths required to image fault blocks and dipping beds.

Current reprocessing also included a geological model-based multiple elimination routine and real formation velocities to guide the selection of migration velocities. With this better imaging, the Mackenzie River line becomes an important tool for deciphering the NWT petroleum geology and for directing regional prospect generation.