Naturally Fractured Tight Gas Reservoir Detection Optimization

**Quarterly Report
July - September 1995**

December 1995

Work Performed Under Contract No.: DE-AC21-94MC31224

For
U.S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

By
Coleman Research Corporation
Golden, Colorado

MASTER

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Morgantown Energy Technology Center
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December 1995

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1.0 3D P-WAVE ALTERNATE PROCESSING

During the third quarter processing continued at Western Geophysical. The processing was closely monitored by Palantir and Blackhawk Geosciences. Meetings were held periodically with Western to review the progress. Also in attendance at these meetings were representatives from Lynn Inc. and the owner/operator.

Early in the processing Palantir determined that the original DMO velocities from the combined data volume were inadequate for performing the azimuthally split DMO. A series of DMO velocity scans were therefore run on each of the data sets and new velocities picked using two work stations simultaneously. This ensured uniform picking throughout the two volumes. DMO on the separated volumes and final migration demonstrated results that showed significantly clearer reflections than the total (all Azimuth) volume for certain intervals. A difference in the two velocity fields showed that the E-W data volume is consistently higher in velocity than the N-S data volume. This result would correspond to dominant, open E-W fractures at depth.

Western Geophysical Research in Houston began work on a separate evaluation of the anisotropy in the data using a new algorithm for amplitude variation with offset and azimuth (AVOA) analysis. This work is not being funded by the DOE project however the results could provide further insight to the DOE data.

Work also began at the Reservoir Characterization Project at the Colorado School of Mines (CSM) to use their approach to AVOA analysis as a QA/QC of the DOE results. A proposal was prepared by CSM and a small sub-contract prepared. Due to the complexity known to exist with AVOA work, an independent review of the processing is considered vital to ensure a correct final interpretation of the data.

2.0 3D-3C ACQUISITION

2.1 Permitting

Permit agreements were obtained with the private land owners and the State of Wyoming for access and potential damage to the land under the proposed 3D-3C. Permit agreements were obtained with the State Road Commission and the State Water Commission for crossing county roads and drawing water for drilling from Bridger Creek.

2.2 Archaeology

Pronghorn completed their field survey in mid June and a final report was submitted to Blackhawk at the end of the month. This report will be included in the environmental documentation to be submitted to DOE for review in the beginning of July. No features eligible for submission for the National Historic Register were found at the proposed field site.

2.3 Environmental Documentation

The environmental documentation to satisfy the National Environmental Policy Act was accepted by DOE in mid August.

2.4 Seismic Acquisition

Subsequent to a kick off meeting between Northern Geophysical, Blackhawk and the owner/operator, surveying of the shot and receiver lines began on August 6. The surveying was accomplished in 8 days using GPS. The new shot-receiver map was then supplied to Don Lawton who had completed the original modeling of the data. Recommendations were made for infill shots to make up for those lost due to cultural (pipe line, power lines, buildings and wells) and topography. These infill shot locations were then placed in the acquisition grid.

2.5 Shot hole drilling

Drilling began on August 14 subsequent to a meeting with Blackhawk, the owner/operator, Northern Geophysical and the State of Wyoming Oil and Gas Commission (Mel James). At this meeting the shot hole drilling program was reviewed to ensure that the holes would be drilled, loaded and plugged in accordance with Wyoming regulations. The drillers and shot hole pluggers bonding was also reviewed at this meeting. The State officials together with BLM visited the site periodically throughout the drilling program and will also visit during the actual acquisition. After the survey it is the Oil and Gas Commission who will release the bond when the field has been successfully shot. During the first stages of drilling the Oil and Gas Commission requested that a test hole be drilled, loaded and shot off to verify that hole blow outs would not be a problem with the proposed charge size of 20 pounds at 60ft. The test was a success with only a small amount of bentonite extruded from the hole after the charge had been set off. Using the new bentonite capsule instead of the loose bentonite is believed to cut hole blow outs to less than 2%. This is not only an improvement for hole completion but also ensures that more of the seismic energy goes into the ground rather than into the air.

Three drill rigs were in operation for the majority of the drilling program. The conventional rig drilled the majority of the holes using air drilling techniques, a buggy rig drilled the difficult access holes and those around the sensitive environmental and archaeological terrain, and an auger rig drilled the majority of holes in the river valleys. The drilling was 95% complete by the end of September. Blackhawk had a representative in the field throughout the drilling and loading of holes to ensure that the program was completed successfully.

Approximately 36, 3-component geophones were prepared for loading with the shot holes over the receiver grid. These will be used to measure static times prior to the main survey. Recording this information, especially that of the shear wave near surface velocity will help greatly in later statics evaluation thus saving time and money in processing.

2.6 Layout

The 3 component geophones arrived at the owner/operators field office in late September in preparation for an early to mid-September acquisition of the 3D-3C. These geophones, which are supplied by OYO GeoSpace Corporation and were used on the DOE Bluebell-Altamont project will be checked for tolerance and polarity by Blackhawk as part of the QA/QC plan prior to deployment

3.0 9C - VSP

Schlumberger completed the tool spin corrections for all source positions. The northeast vibrator location appears to have produced the clearest data after all the traces had been reversed where necessary to produce a consistent wave form character. Once completed, hodograms were plotted for the down going wave. Initial work identified a potential large change in S1 azimuth at 6,990ft to 7,290ft from N110E to N70E suggesting that layer stripping may be necessary before S1-S1 and S2-S2 corridor stacks can be produced.

Once the toolspin had been corrected a discrepancy in amplitudes of the two shear vibrator sources was noted which could invalidate rotation using the Alford method. This is currently under review at Blackhawk using programs that do not require a four component rotation rather requiring only one source for the rotation analysis. The results will be compared to those of the Alford rotation from Schlumberger before S1-S1 and S2-S2 corridor stacks can be produced.

4.0 GEOLOGIC EVALUATION

A review of owner/operator data base for wells and drilling reports was made for information to aid in picking the stratigraphic tops of formations from the 3D p-wave data set. This information will also be used to assess if any directionality can be established for production of gas in the field.

A trip was made to the field in late September with the owner/operator to review the outcrops of the Lower Fort Union around the field. A future study of these outcrops will be made for fracture patterns, densities and attitude.

5.0 TECHNOLOGY TRANSFER

A short presentation of the results of the project to date was made at the annual owner/operator partner meeting in Riverton.

Preparations were also made to present the results of the project to date at the annual Society of Exploration Geophysics (SEG) meeting in Houston in October and the SEG joint Japanese SEG meeting in Japan later in the year.

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