Development of an Advanced Approach for Next Generation, High Resolution, Integrated Reservoir Characterization

Quarterly Technical Progress Report
January 1 – April 30, 2003

Scott R. Reeves

May, 2003

DE-FC26-01BC15357

Advanced Resources International
9801 Westheimer, Suite 805
Houston, TX 77042

U.S. Department of Energy Disclaimer

Advanced Resources International Disclaime r

Abstract

Work during this reporting period consisted of completing the data processing tasks begun in previous reporting periods and beginning the consolidation of results into a comprehensive project database for use in broadband transform construction. The extended attribute set was calculated for depth-converted surface seismic data and processed cross-well seismic profiles. The log clustering model was extended to the full set of non-cored wells and cross-sections were constructed based on those results. Work was begun on converting seismic attribute files into a format suitable for loading into the neural network software database.

Table of Contents

1.0 Work Performed

Task 1: Select Test Site

Task completed. No work was performed on this task during the reporting period.

Task 2: Collect and Process Data

During this reporting period data processing was completed. Data collection was completed in previous reporting periods.

The cross-well seismic data obtained from the acquisition company during last reporting period was processed to yield standard reflection series seismic displays. The data was difficult to process because of large amounts of noise, including guided waves set up by the bounding layers above and below the target interval. At the conclusion of processing only portions of the data were deemed to be of usable quality for moving forward. At least two, and possibly three profiles have good, usable quality data. Final attributes were calculated for these cross-well profiles.

The surface seismic data was accurately converted from time to depth in the vertical dimension. The rough time-depth relationship was refined by tying the data to wells in numerous locations throughout the survey. Because an accurate tie had been difficult to obtain the seismic stacking velocities were used to construct a rough t-D relationship. This allowed the placement of synthetic seismograms constructed from well logs against the seismic data. By repeating this process throughout the survey area a reliable three-dimensional velocity model was obtained and used in converting the seismic data.

Well log clustering was extended from the wells with core data to the remainder of the uncored wells in the study area. When clustering results were complete for the forty-nine uncored wells a series of cross-sections was constructed showing the stratigraphic column resulting from the various log cluster assignments. These cross-sections were analyzed for geologic integrity and appeared to identify geo-bodies in the appropriate depositional setting. The results of well log clustering were incorporated into the engineering model as discussed below.

The rock physics modeling was completed. Final model runs were conducted and the results of all runs were assembled. This data was then analyzed to determine sensitivities of seismic attributes to reservoir parameters of interest. The attributes that were most sensitive to formation thickness, porosity, and fluid saturations were identified and ranked. Final attribute selection based on sensitivity ranking resulted in ten seismic attributes being identified as most appropriate for the project. These ten attributes were calculated for the depth-converted seismic data and for the cross-well profiles, giving a depth reconciled dataset for constructing the broadband transform function.

Task 3: Develop Broadband Seismic Transform Function

A database structure for organizing the various work products was designed. Initial data manipulation to load the database was begun and continues at this time. Incorporating all of the surface seismic data into the database will be difficult because ten attribute files for each seismic trace must be converted to spreadsheet format to facilitate loading the database; there are over 13,000 seismic traces. For this reason, selected seismic lines in the vicinity of the cross-well seismic profiles will be converted and loaded first. This will allow modeling to proceed in the most critical areas while the remainder of the seismic data is converted. This parallel workflow will save valuable project time while also validating the suitability of the proposed database structure.

Task 4: Develop Integrated Engineering Model

Some minor additional processing was conducted during the reporting period on the Integrated Engineering Model relating core data and corresponding well logs. The artificial neural network model constructed during the last reporting period was used to predict core values for all the wells in the study area. Also, the Log Clustering results were incorporated into the Engineering Model to test their effectiveness in model improvement.

Task 5: Reservoir Characterization and Modeling

No work was performed on this task during the reporting period.

Task 6: Technology Transfer

During this reporting period the Project Manager and project participants conducted a Technical Progress Review for NETL staff in Tulsa. The purpose of the review was to apprise NETL staff of project status, highlight some of the technical accomplishments, and point out the remaining tasks for project completion.

2.0 Results and Discussion

At the conclusion of this reporting period the foundational elements of the broadband transform function were complete. Interpretation of the rock physics model identified the extended seismic attributes most sensitive to porosity, formation thickness, and fluid content. The extended attribute set was calculated for surface seismic data. Processing was completed on cross-well seismic profiles and extended attributes were calculated on that data. Well log clustering was extended to the remaining forty-nine study area wells without core data and cross-sections constructed to show the spatial relationship of cluster facies code assignments.

Work was begun to design a comprehensive database schema for assembling the data into a master database for use in transform construction. Data transformation into load ready format was begun and continues at this time. Initially the data in and around the cross-well seismic profiles will be converted and loaded so that work can proceed to tie the surface and cross-well data using neural networks. Parallel to that track the remainder of the surface seismic data will be converted and loaded for use in extrapolation of the characterization model into the remainder of the reservoir.

3.0 Conclusions

The foundational data processing tasks necessary to support creation of a broadband transform function were completed and work was begun on converting the data to a format suitable for use in transform construction.

4.0 References

None.