

QUARTERLY TECHNICAL PROGRESS REPORT
(37th Quarter)

**ADVANCED OIL RECOVERY TECHNOLOGIES FOR IMPROVED
RECOVERY FROM SLOPE BASIN CLASTIC RESERVOIRS,
NASH DRAW BRUSHY CANYON POOL, EDDY COUNTY, NM**

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ABSTRACT

The overall objective of this project is to demonstrate that a development program based on advanced reservoir management methods can significantly improve oil recovery at the Nash Draw Pool (NDP). The plan includes developing a control area using standard reservoir management techniques and comparing its performance to an area developed using advanced reservoir management methods. Specific goals are (1) to demonstrate that an advanced development drilling and pressure maintenance program can significantly improve oil recovery compared to existing technology applications and (2) to transfer these advanced methodologies to oil and gas producers in the Permian Basin and elsewhere throughout the U.S. oil and gas industry.

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EXECUTIVE SUMMARY

The use of the Advanced Log Analysis techniques developed from the NDP project have proven useful in defining additional productive zones and refining completion techniques. The Advanced Log Analysis program proved to be especially helpful in locating and evaluating potential recompletion intervals, which has resulted in low development costs with only small incremental increases in lifting costs. To develop additional reserves at lower costs, zones behind pipe in existing wells were evaluated using techniques developed for the Brushy Canyon interval. Log analysis techniques developed in Phase I have been used to complete a total of thirteen of the NDP wells in uphole zones. Four wells were recompleted in 1999, which allowed the development of economical reserves during a period of low crude oil prices. An additional four wells were recompleted during 2000, which resulted in 123,462 BO and 453,424 MCFG reserves being added at a development cost of \$1.57 per BOE. Two wells, #29 and #38 were recompleted in 2001 which added 7,000 BO and 18 MMCFG to the reserves at a cost of \$9.70 per BOE. NDP Wells #1, #12, #15 and #20 were completed in uphole zones during 2002-03, which added 128,000 BO and 150 MMCFG to the reserves at a cost of \$1.64 per BOE. Overall, the weighted average development cost is \$1.87 per BOE.

The NDP #36 well toe zone was completed in October 2001, then restimulated in April 2002. During the workover an additional zone in the deviated section of the well was added. In June 2004 the composite bridge plug was drilled out and the toe zone and "H" zone were commingled. Cumulative production through November 2004 is 127,537 BO, 456.803 MMCFG and 79,073 BW.

The NDP #33 well toe zone and "H" zone were completed in December 2002, the heel zone was completed in January 2004 and the composite bridge plug isolating the toe zone was drilled out May 2004. Cumulative production through November 2004 is 72,302 BO, 238.430 MMCFG and 166,883 BW.

Continued interpretation of the original 3-D seismic survey using the results from drilling NDP Well #36 and #33 has resulted in a more complete characterization of the Brushy Canyon reservoir. The new 3-D seismic survey has refined the original interpretation and added at least two (2) targets for additional development.

INTRODUCTION

The Nash Draw Pool (NDP) in Eddy County, New Mexico produces oil and associated gas from the Permian (Guadalupian) Brushy Canyon Formation. The Brushy Canyon is a relatively new producer in the Delaware Basin of West Texas, with most drilling having occurred since the late 1980s and many discoveries occurring in the 1990s. Regionally, the fine-grained sandstones of the Brushy Canyon contain as much as 400-800 MMbbls of oil-in-place; this formation represents a significant reservoir interval in the Permian Basin. However, low permeability and petrophysical heterogeneity limit primary recovery to only 10-16%.

The NDP is one of the project sites in the Department of Energy (DOE) Class III field

demonstration program for slope-basin clastic reservoirs. The objective of the NDP Class III project is to demonstrate that an advanced development drilling and pressure maintenance program can significantly improve oil recovery compared to existing technology applications. A further goal of the project is to transfer these advanced methodologies to oil and gas producers in the Permian Basin and elsewhere throughout the U.S. oil and gas industry.

In the first phase of the NDP project, an integrated reservoir characterization study was performed to better understand the nature of Brushy Canyon production and to explore options for enhanced recovery. Results obtained in the NDP project indicate that a combination of early pressure maintenance (gas injection) and secondary carbon dioxide flooding may maximize production in these complex, laterally variable reservoirs. Because of low permeabilities involved and high water-to-oil relative permeabilities, the use of gas instead of water is suggested as preferable as an oil-mobilizing agent.

Phase II is directed toward enhancing the ultimate recovery from the project. The plan includes directional/horizontal drilling of new wells in order to develop reserves under surface-restricted areas and potash mines and evaluation of prospects of early pressure maintenance.

RESULTS AND DISCUSSION

This is the thirty-seventh technical progress report on this project. Results obtained to date are summarized.

Geology and Engineering

The production database was updated through November 2004. This data was added to the history of each well to update the decline curves and to project ultimate recoveries as well as to assess the effects of interference and production strategies.

Nash Draw #33

In late November the compressor powering the gas lift system was replaced with a slightly larger unit. Production prior to swapping compressors: 83 BOPD, 194 BWPD and 184 MCFGD. Production after swapping compressors (1-14-05): 97 BOPD, 208 BWPD and 232 MCFG. The compressor swap has resulted in an approximate 17 % increase in production. As seen in the daily production plot (Fig. 1), the gas volume and total fluid volume are increasing.

Cumulative production from the Nash Draw #33 through January 14, 2005 is 76,375 BO, 247,436 MCFG and 174,876 BW. Additional production data will be reported in the next quarterly report.

Nash Draw #36

Cumulative production from the Nash Draw #36 through January 14, 2005 is 130,839 BO, 478,040 MCFG and 84,5231 BW. As seen in the daily production plot (Figure 2) the production has stabilized and the G.O.R. has stabilized. Given the results on the #33 a larger compressor has been ordered for #36 and should be available in 45 to 60 days.

Plans are being finalized to complete additional zones in the heel. A composite bridge plug will be set at +/- 2499.36 m (8200 ft) and two zones will be perforate at 2438.40-2439.01 m (8000-02 ft) and 2286.00-2286.61 m (7500-02 ft) with 6 shots per ft. A string of 3.5 in. frac tubing will be run and a packer set at +/-1962.91 m (6440 ft). It is planned to acidize the perforations with 15,141.65 l (4000 gallons) 7.5% NEFE acid with 36 biodegradable ballsealers. The planned hydraulic fracturing treatment is composed of 264,978.82 l (70,000 gal) micellar fluid carrying 45,359.23 kg (100,000 lb) of 16/30 ceramic proppant. After testing the composite bridge plug will be drilled out with coiled tubing and a small motor assembly and all zones will be commingled.

Nash Draw #34

The preliminary interpretation of the second generation 3-D seismic survey has yielded a drilling target in the NE/4 of section 12 and the SE/4 of section 1. A well is being planned from the #19 location to the SE/4 of section 1.

Drilling of the #34 well is planned to be drilled through the NE/4 of section 12-T23S-R29E. The well is designed to be a directional/horizontal well with the directional section intersecting the "L" zone approximately 426.72 m (1400 feet) northeast of the surface location at an azimuth of 51.98°. After intersecting the "L" zone the wellbore will continue horizontally to an approximate BHL at 121.92 m (400 ft) FSL and 121.92 m (400 ft) FEL of section 1. The bottomhole location is projected to be 548.64 m (1800 ft) east and 969.80 m (3181.74 ft) north of the surface location, a total of 1114.05 m (3655 ft) from the surface location at an azimuth of 25.50°. A representation of the proposed wellbore path is presented in Fig. 3.

Targeting is being refined using the offset logs and the structural data from surrounding wells and the 3-D seismic survey. A copy of the Nash draw #19 well log showing porosity and gamma ray response is shown in Fig. 4. The proposed target is the bottom sands in the "L" Zone at a depth of 6852 ft. At the bottomhole location, this sand package should be 10 to 12 ft low to the #19 well as shown by the regional structure map (Fig. 5) and the 3-D seismic structure map (Fig. 6).

Drilling rigs are currently not readily available due to high demand. One rig has been found, but may not be available until April 2005.

Fuzzy Expert Exploration Tool

The Fuzzy Expert Exploration Tool V1.1, developed by Dr. Bob Balch and his team at the Petroleum Recovery Research Center is being used to predict the expected outcome of the drilling of the Nash Draw #34 well. The expert tool uses regional geology, source rock data, offset wells and other parameters to make a prediction of a projects success.

The Expert Tool predicts:

The quality of the source rock is 0.9693 % total organic carbons (TOC).

The thermal maturity of the source rock is in the “oil Window” with PI= 0.1782.

The migration potential at the #34 location – updip from source rock with 1.25 % TOC.

The trap consist of thickening sands with updip pinchouts or thinning, the trap analysis is “very good” with a relative value of 0.823.

Formation Analysis is “very good” with a relative value of 0.897.

Regional analysis is “excellent” with a relative value of 0.971.

General analysis is “very good”, with a relative value of 0.878.

The #34 appears to be a very good to excellent project that will be confirmed by drilling.

Other Applications

Strata has applied the characterization and 3-D seismic technology developed from the Nash Draw Project to two other fields in Eddy County and a new prospect west of the Nash Draw Unit. Another application is being modeled for a Bone Spring prospect in Lea County.

Two wells are being planned in the Forty Niner Ridge Field based on seismic interpretation using the Nash Draw parameters. Preliminary planning includes the drilling of seven wells, which are projected to produce 1,050,000 BO and 5 BCFG. The Forty-Niner Ridge Field is located approximately three (3) miles east of the Nash Draw Unit.

Technology Transfer

Disseminating technical information generated during the course of this project is a prime objective of the project. A summary of technology transfer activities during this quarter is outlined below.

Internet Homepage

The web site for the Nash Draw Project can be accessed at <http://baervan.nmt.edu/nashdraw/>. The site includes a project summary, list of participants, summary of the technical team,

technical transfer including quarterly and annual reports, and future plans and current activities.

Web Site: <http://baervan.nmt.edu/nashdraw/>

Workshop

A Horizontal Well Workshop is being planed for the first week in April 2005. The PTTC will be coordinating the workshop with the Nash Draw Project and other operators and service companies involved in horizontal drilling projects.

EXPERIMENTAL RESULTS

No experiments are associated with this project.

CONCLUSION

The production database was updated through November 2004. Evaluation of the completion, stimulation, and production testing and analysis of the Nash Draw #33 and #36 horizontal wells is continuing. The Nash Draw #36 is producing as expected, the #33 is restricted by high producing BHP and production is predicted to improve when the gas rate starts to increase. The web site for the Nash Draw Project is online and can be accessed at <http://baervan.nmt.edu/nashdraw/>. Technology transfer activities are outlined on this web site.

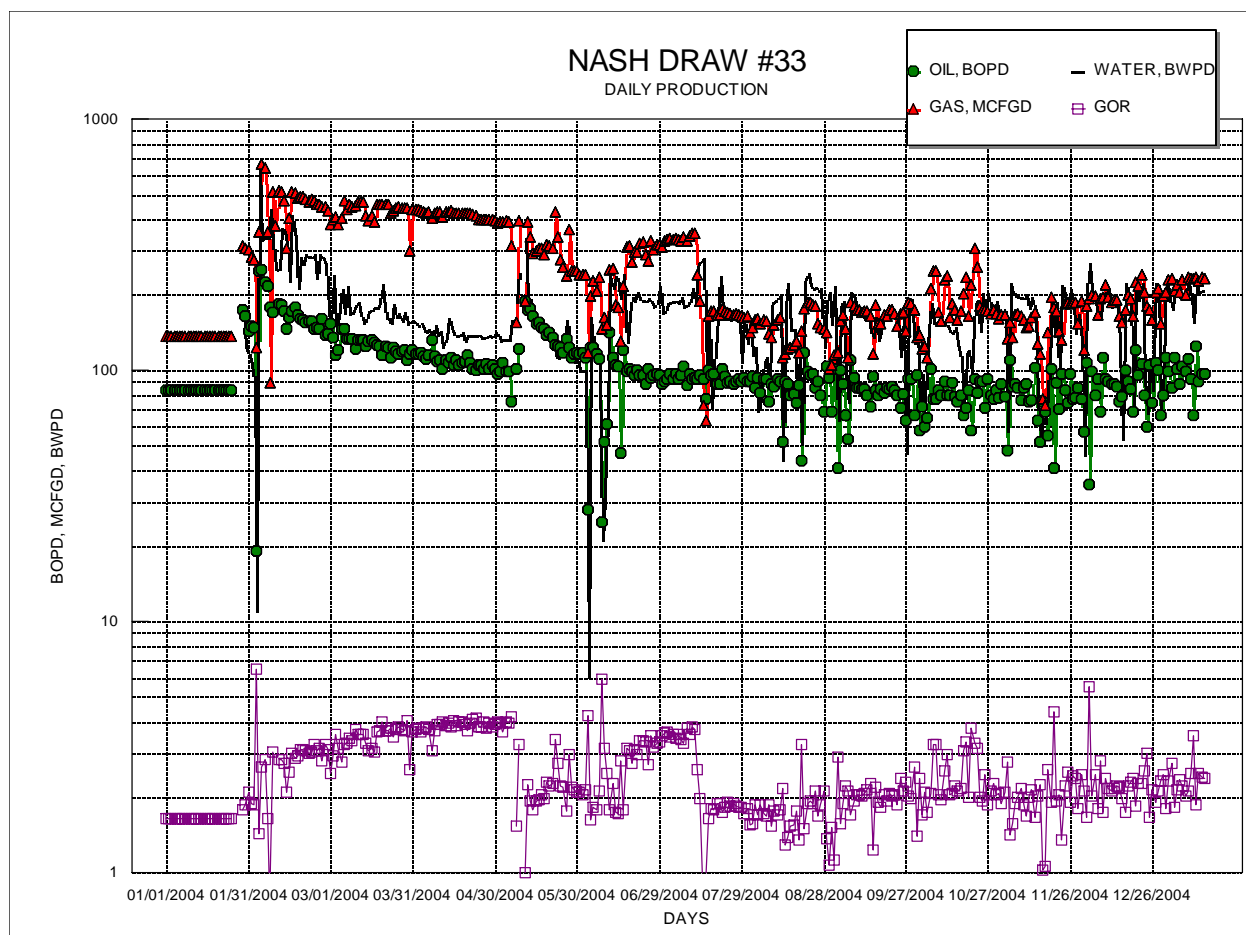


Fig. 1. Nash Draw #33 production through January 14, 2005.

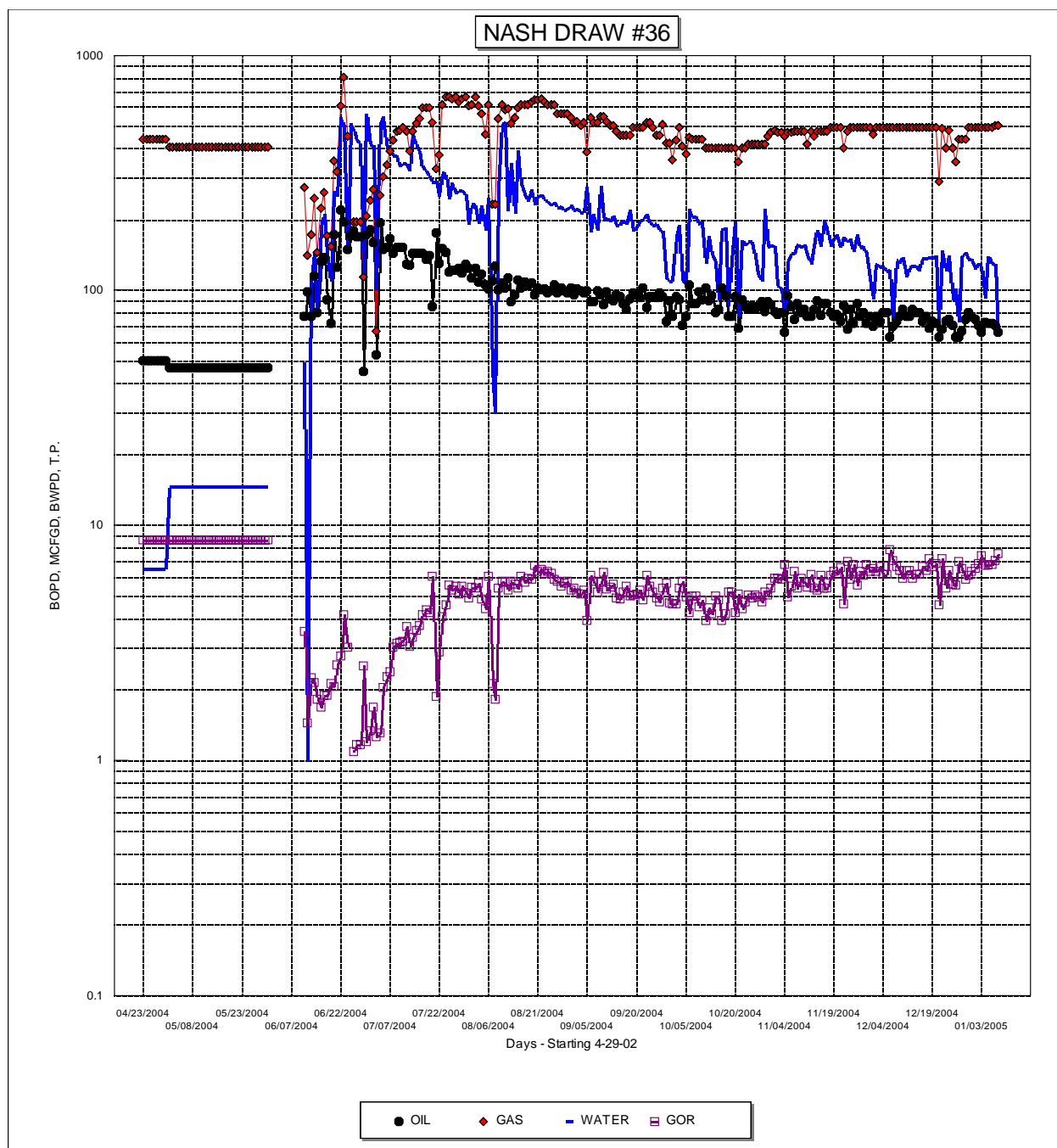


Fig. 2. Nash Draw #36 production through January 14, 2005.

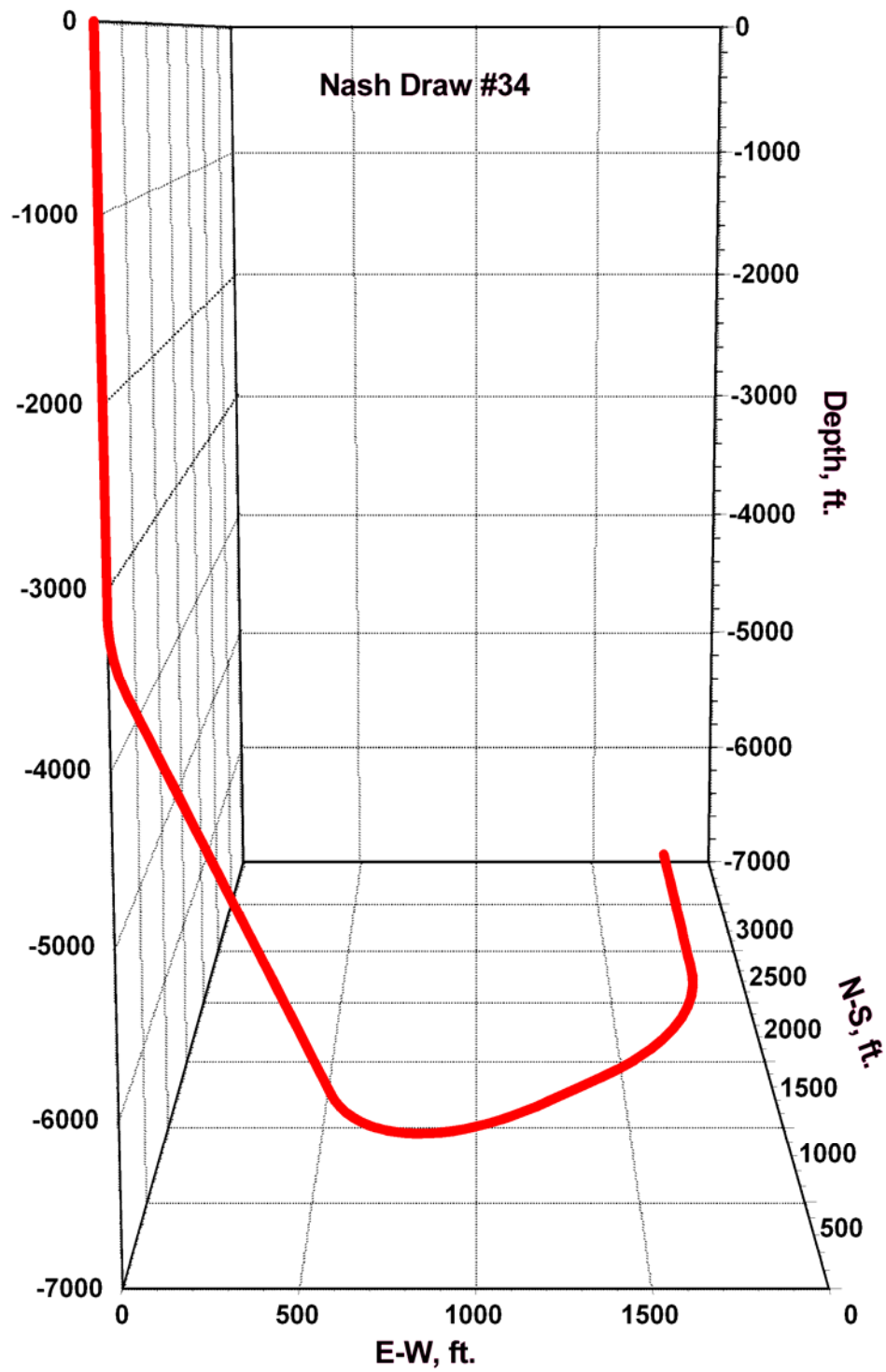


Fig. 3. Nash Draw #34 proposed wellbore path.

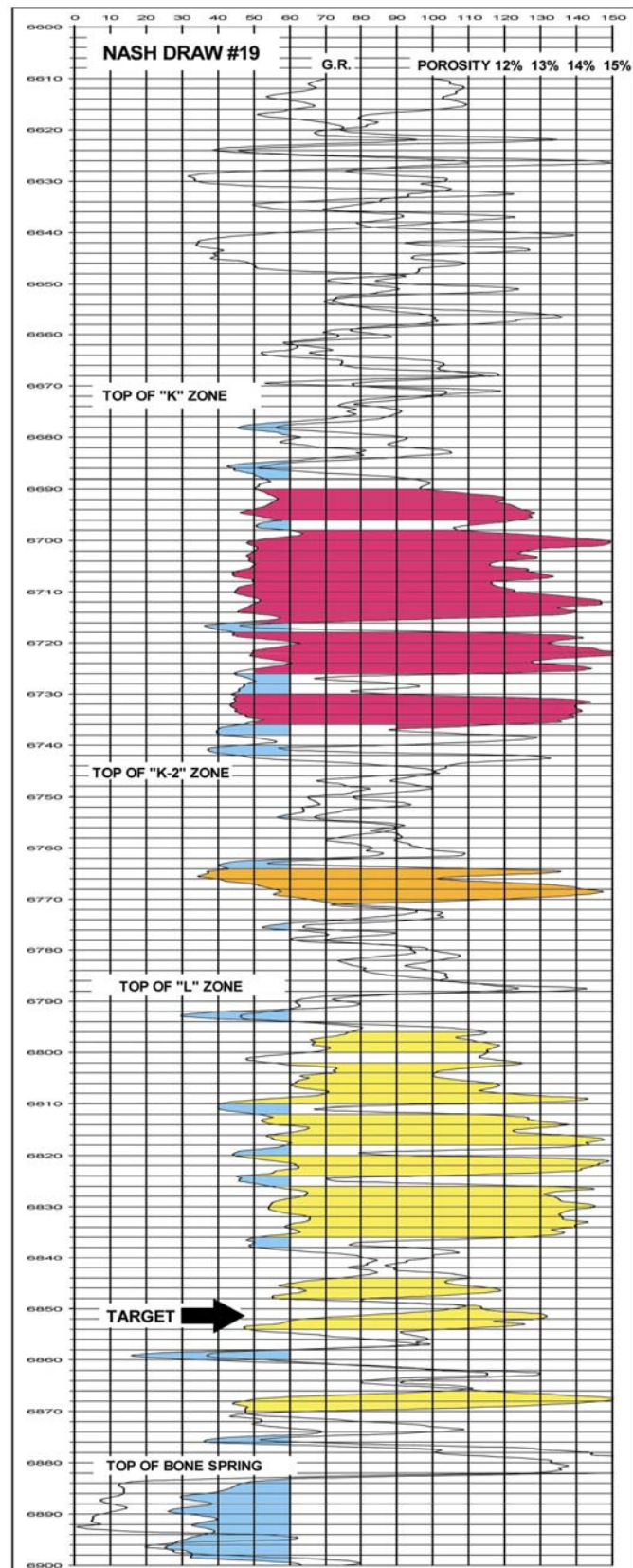


Fig. 4 . Nash Draw #19 log showing target zone at 6852 ft.

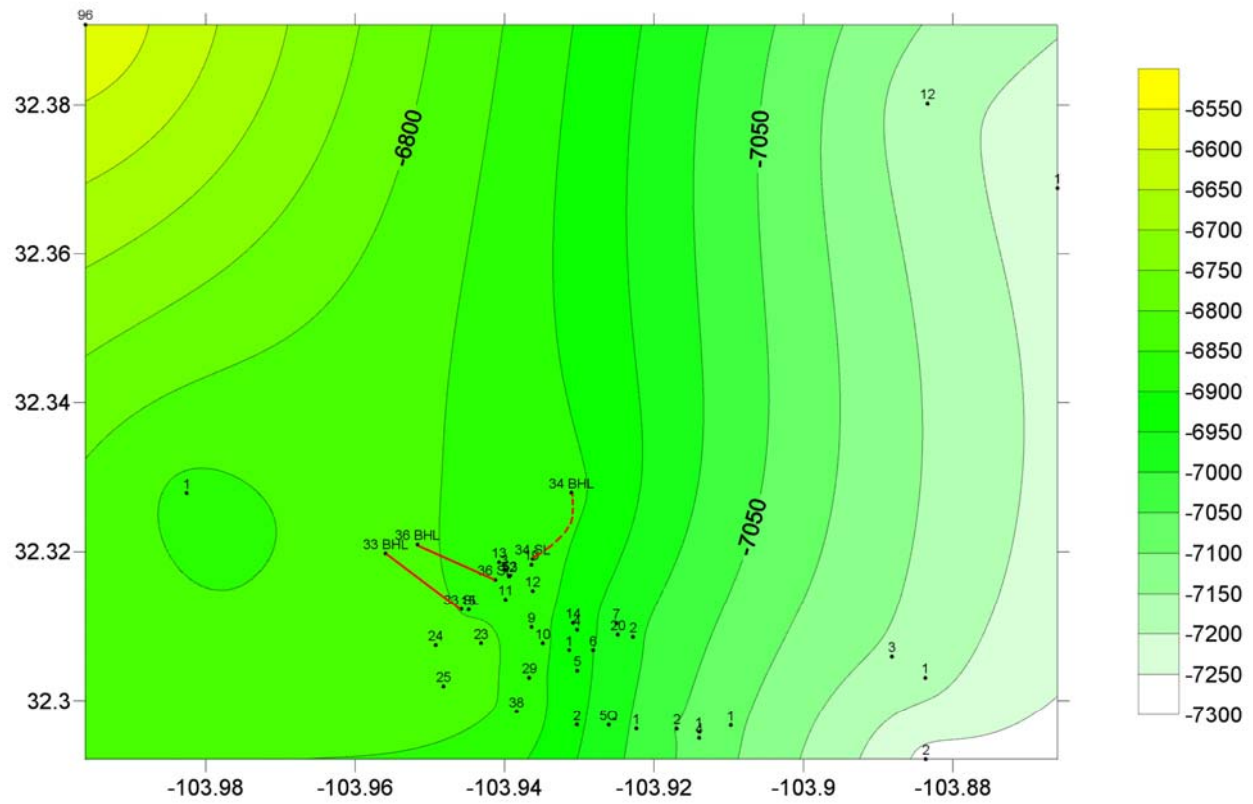


Fig. 5. Top of Bone Spring using subsurface geology and 3-D seismic.

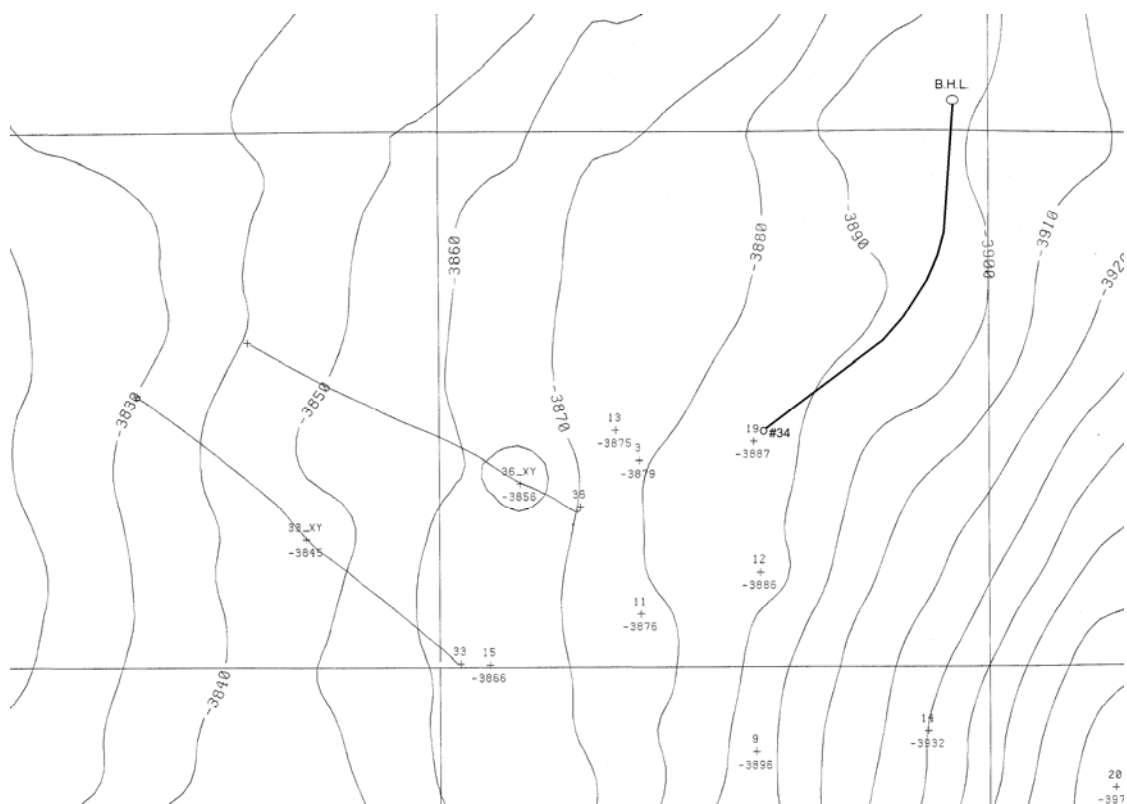


Fig. 6. Nash Draw second generation 3-D seismic structure.