**An Advanced Fracture Characterization and Well Path Navigation System
for Effective Re-Development and Enhancement of Ultimate Recovery from
the Complex Monterey Reservoir of South Ellwood Field, Offshore
California**

Quarterly Technical Progress Report

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Progress Report January 1, 2006- March 31, 2006

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Abstract

Venoco Inc, intends to re-develop the Monterey Formation, a Class III basin reservoir, at South Ellwood Field, Offshore Santa Barbara, California.

Well productivity in this field varies significantly. Cumulative Monterey production for individual wells has ranged from 260 STB to 8,700,000 STB. Productivity is primarily affected by how well the well path connects with the local fracture system and the degree of aquifer support. Cumulative oil recovery to date is a small percentage of the original oil in place. To embark upon successful re-development and to optimize reservoir management, Venoco intends to investigate, map and characterize field fracture patterns and the reservoir conduit system. State of the art borehole imaging technologies including FMI, dipole sonic and cross-well seismic, interference tests and production logs will be employed to characterize fractures and micro faults. These data along with the existing database will be used for construction of a novel geologic model of the fracture network. Development of an innovative fracture network reservoir simulator is proposed to monitor and manage the aquifer's role in pressure maintenance and water production. The new fracture simulation model will be used for both planning optimal paths for new wells and improving ultimate recovery.

In the second phase of this project, the model will be used for the design of a pilot program for downhole water re-injection into the aquifer simultaneously with oil production. Downhole water separation units attached to electric submersible pumps will be used to minimize surface fluid handling thereby improving recoveries per well and field economics while maintaining aquifer support.

In cooperation with the DOE, results of the field studies as well as the new models developed and the fracture database will be shared with other operators. Numerous fields producing from the Monterey and analogous fractured reservoirs both onshore and offshore will benefit from the methodologies developed in this project.

This report presents a summary of all technical work conducted during the tenth quarter of Budget Period II.

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Introduction

The Field Demonstration site for this Class III (basin clastic) Program Proposal is the South Ellwood Field located offshore California. The Monterey Formation is the main producing unit in the South Ellwood Field and consists of fractured chert, porcelanite, dolomite, and siliceous limestone interbedded with organic mudstone. This reservoir has an average thickness of 1,000 feet, and lies at subsea depths of approximately -3,500' to -5,000'.

Venoco and USC jointly submitted an application to conduct a DOE co-operative investigation of the Monterey formation at South Ellwood in June 2000. The DOE granted this application in July 2000.

Executive Summary

Venoco and USC prepared a proposal for a DOE sponsored joint investigation of the fractured Monterey formation. It was agreed that Venoco would construct the geologic model for the field and gather new reservoir data as appropriate. USC would then develop a simulation model that would be used to optimize future hydrocarbon recovery. Joint Venoco-USC teams were established to manage the flow of data and insure that Venoco and USC activities remained synchronized. A co-operative agreement was signed with the DOE on July 31, 2000.

During Budget period I, Venoco worked with USC to develop a new geological and engineering model of the Monterey formation. This cooperative work between USC and Venoco has made several contributions to the tech transfer goal of the U.S. Department of Energy. The most significant of these were; the development of an interactive database on the Monterey Formation, a new simulation algorithm for the description of fracture-controlled Monterey Reservoirs, a pattern recognition method for analysis of well log data, enhanced water shut-off techniques and reprocessing of the 1982 3D seismic survey data to improve the geologic structural model. USC no longer participates in the project after the conclusion of Budget Period I activities.

The primary goal of the Budget Period II is to develop the new fault blocks identified as a result of the field re-evaluation conducted during Budget Period I. A Middle Sespe prospect was identified by an exploration well drilled from a jack-up in 1985. We have used the reprocessed 3D to image the South Ellwood structure at Sespe level. 3120-15RD4 was drilled during 2004-2005 to appraise this Middle Sespe structure. A second exploratory well was completed during the Fourth Quarter of 2005 to test the North Flank block of the Monterey. Neither well has produced oil in commercial quantities. Further development of these prospects has been suspended. As a consequence, Venoco has decided not to proceed with the field re-development activities proposed for Budget Period III and will instead begin compiling the final report on the project.

On a more positive note, Venoco completed reconfiguring the Holly production separators and is now separating most of the produced water offshore for re-injection into two Monterey disposal wells 3120-10 and 3242-8RD4. Approximately 9000 BWPD is now re-injected offshore and three high water cut wells have been returned to production.

Experimental

Not applicable for the work performed.

Results and Discussion

Task II – New Data

Core Lab performed X-ray diffraction studies of cuttings from 3120-18. The CT-Quartz transition apparently lies at 4700' MD. The lower part of the hole is in the quartz phase. There is a low percentage of dolomite in the well except just above the CT-quartz transition. A pressure build-up conducted in this well during January 2006 indicated a very low effective permeability of 1 md even after acid treatment. This result is surprising considering that this section of the Monterey contains at least 50% quartz (see Figure 1 below). This prompted a compilation of all XRD data available for the Monterey at South Ellwood and a comparison with DST and pressure transient data for those intervals where compositional XRD data had been obtained.

Figure 1 3120-18 X-ray Diffraction data

As the following series of slides shows, there is no strong correlation between the percentage of quartz in the Monterey and well productivity. This highlights the need to run image logs on new Monterey wells as the primary guide for selecting completion intervals.

Figure 2 3242-9 X-ray Diffraction data

Figure 3 3120-10 X-ray Diffraction data

Figure 4 208-102 X-ray Diffraction data

Figure 5 3242-7RD1 X-ray Diffraction data

Figure 6 3242-13 X-ray Diffraction data

Figure 7 309-8 X-ray Diffraction data

Task IV-1—Produced Water Re-Injection

During March 2006, the first Holly group separator (V-107) was retrofitted with new internals to allow three phase water separation. Upgrades included a new proprietary “Porta Test Revolution” inlet separation device, a higher water weir and new water level control, alarm and shutdown instrumentation. The “Porta Test Revolution” inlet separation device utilizes centrifugal force to separate gas from the liquid without foaming. The higher water weir will allow longer liquid retention time to provide more complete water oil separation. Two new 125 HP positive displacement pumps each capable of delivering 5000 BWPD at 1000 psi were installed and placed in service on April 12th, 2006. Two wells, 3120-10 and 3242-8RD4, were converted to water injection service during the first quarter of 2006. We have been able to shut down the second production separator (V-108) and are currently injecting a total of 9000 BWPD into the two wells. Three wells that had been shut-in for many years due to high water cuts were returned to production for an additional 50 BOPD. Only 4000 BWPD is being separated at Ellwood and injected into the onshore disposal well.

Task IV-2—Downhole Water Separation ESP’s

Venoco conducted a review of Platform Holly modifications that would be required to accommodate additional ESP wells. Holly is run on shore power and the load factor for the subsea power cable must be closely monitored. We have developed a plan to raise primary separator pressure to 200 psi and mothball a 1500 HP sales gas compressor that boosts separator gas to pipeline operating pressure. This would free up enough spare power to supply five new ESP wells. Venoco plans to install four of these pumps during 2006. Since the retrofitted production separators will have sufficient capacity to meet all future production forecasts, we have decided to use conventional ESP’s with no downhole separation capacity.

Task IV-3—Development of New Fault Blocks

Sespe Well 3120-15 RD4

The Sespe well (originally called 3242-19 RD1) was renamed 3120-15RD4 by the California Division of Oil, Gas and Geothermal Resources since the producing interval is located on State lease 3120. The well reached a total depth of 14247’ on January 17th 2005. Excellent gas shows were evident in the Sespe formation. A 2-7/8” completion string was run to test a barefoot section in the massive sands of the Lower Sespe formation from 12965-13650’. This zone tested wet with minor traces of gas. The reservoir pressure was estimated to be 5500 psi. During testing, the tubing plugged with mud. The tubing was cleaned out with coiled tubing and the completion recovered. TCP guns were run and set on a hanger to shoot the Middle Sespe sands. The completion string was rerun but it was not until six weeks later that the completion string was landed due to difficulties running the packer in the oil based mud completion fluid. The guns would not fire due to the presence of 60’ of settled mud solids lying on top of the firing head. It was decided to pull the completion and recomplete the well with Calcium chloride brine. Recovery of the completion string took an additional two months as it required a washover string to clean out settled mud solids in the tubing-casing annulus.

A test was finally completed in October 2005. The Middle Sespe was perforated with TCP guns from 12515-12770’. Unfortunately the Middle Sespe tested at a very disappointing rate of 20

BFPD x 97% WC on gas lift. A set of memory gauges was hung in the well on November 5th, 2005 and a long term build-up was conducted until January 2006. The data indicated that the Middle Sespe was extremely tight with a permeability of 0.001 md.

A paleontological study of the cuttings from this well shows that it penetrated the Rincon and Vaqueros formations three times before finally passing into the Sespe at 10980' MD. The well may have passed through a big thrust fault at 13860 MD'. We are currently preparing thin sections of the Sespe sands to try to understand what may be causing the poor permeability.

The Upper Sespe was perforated through tubing from 11240-75', 11655-75' and 11850-60' during January and April 2006. The well last tested at 13 BOPD and 279 Mcf/d on gas lift.

North Flank Well 3120-18

The Ames 3120-18 was drilled as a sidetrack from the 3242-13. It was renamed 3120-18 as it reached total depth on lease PRC3120. It was planned to test two objectives: The north limb of the South Ellwood field and the north limb of the bordering syncline. The well was spudded on November 18, 2005 and successfully drilled to a total depth of 11,259' MD (-5,210' ss) on December 7, 2005.

The well was drilled smoothly with no mechanical problems and no loss of drilling fluid. Hydrocarbon shows of interest are present from 4,630-4,773' in the M3 and 6,407-6,498'/7,247-7,295' in a repeat section of the M1. The Monterey north of the syncline was encountered at 9,963, MD (5,047' TVDss) below the lowest known oil in the South Ellwood Field. Minor shows were observed from 10,300-11,109'.

Analysis of the Formation Micro Imaging log and dip-meter logs has lead to an enhanced structural interpretation of the northwestern portion of the South Ellwood field. Well 3120-18 penetrated five seismic scale faults: four with normal displacement and one with reverse displacement. Bedding dips encountered ranged from 5° North-east to 88° South-Southwest.

The structural interpretation from logging results obtained in well 3120-18 is represented in Figure 8. After encountering the second normal fault (N2) the well paralleled the Upper Monterey (M1) along strike until it turned back to the northwest and crossed the N3 fault. North of the N3 fault the well entered the Sisquoc Formation and passed through an asymmetrical syncline. In the north limb of the syncline the Monterey section was encountered again with dips of 60°-70° South. The Reverse fault (R1) removed a small section of Monterey (M5). The well then encountered lower Monterey (M6a and M7a) north of the reverse fault with dips up to 88° South-Southwest reaching total depth at the very base of the Monterey. The reverse fault is believed to be part of the Red Mountain Fault complex (Figure 9).

Casing was set to 10,097' in the M1. The open hole Monterey interval below 10,097 was then acidized and put on production on December 30th 2005. It tested 1300 BWPD with no traces of oil or gas. The produced water is the closest to seawater composition of any Monterey well at Holly. A build-up test was conducted that showed the North limb of the syncline is being depleted by production from South Ellwood. The reservoir pressure was determined to be approximately 400 psi less than the initial South Ellwood pressure of 1760 psia. The effective permeability of this 1162' open hole section was estimated to be 1 md. This is a surprisingly low value considering the siliceous material in this section of the well was in the quartz phase and the

beds were dipping at as much as 88 deg. The open hole interval was abandoned with a tubing plug and additional perforations were shot in North limb of the main field in fractured intervals of the M1 from 6,407-6,498' and 7,247-7,295' during January 2006. The new perforations tested 1300 BWPD on gas lift without acid. The interval 6,407' to 7295' MD (4,680-4,700' TVD ss) is above the lowest known oil of -4,800' for the main portion of the South Ellwood field but is down dip from all other producing wells and may indicate a drained portion of the field. The well will be re-completed as a water disposal well.

Figure 9: Top Monterey Subsea Structure Map & Lowest Known Oil

Task V- Project Management

Project review meetings were held on a monthly basis in Carpinteria. Individuals working on the project during this quarter included:

Reservoir Studies:

Steve Horner

Geological/Geophysical Modeling

Ted Carlsen

Project Management:

Steve Horner

Task VI-Technology Transfer

Steve Horner made a presentation about South Ellwood field to a UCSB undergraduate geology class in February 2006.

Conclusions:

This is the final quarterly technical report for Budget Period II. Two appraisal wells were drilled during 2005 to test an anticline in the Middle Sespe and a new Monterey fault block. Neither of

these wells was commercially successful. Venoco has decided not to pursue further development of these prospects. Therefore, Venoco decided not to proceed with Budget Period III of the original proposal that consisted of planning a new series of development wells. Venoco will instead begin preparation of the Final report.

References

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