Heavy Oil-Exploration and Development: A Case History from Alberta, Canada

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SUMMARY

A crossfunctional team effort through an environment of innovation and continuous improvement using basic exploration techniques is presented to develop a significant oil field in the heavy oil region of Western Canada.

INTRODUCTION

Historically, the production of heavy oil has been characterized by low primary recoveries, high operating costs and widely fluctuating prices. Through the use of innovative technologies, these otherwise uneconomic pools are being developed profitably.

The Frog Lake field in the Northeastern Alberta Falls within the boundaries of Cold Lake oil sand area. The primary reservoirs are Lower Cretaceous Shoreface sands (Cummings member of the Mannville group) which sits unconformably on Devonian carbonates. These sands are unconsolidated with porosity of 30% containing 12°API oil and viscosity of 10 000 cps. The pool being developed has 5 - 6 m of pay with an OIP of about 125 MMbbls. Secondary reservoirs (Sparky, GP, McLaren) are regional marine and channel sands varying in pay from 5 - 8 m and have higher deliverabilities.

SEISMIC

2-D seismic data shot in 1985 - 86 defined the edges of the pool and the channel trends. Discovery wells drilled on 2-D and production tested lead to development phase using 3-D seismic. The pool was developed in a very systematic and controlled manner with 3-D interpretation increasing the success rate to 98% for infill drilling.

CHALLENGES

Operating costs have been high since the wells need to be serviced on a regular basis to cleanout sand and replace the worn out pumping equipment. Sand disposal and long distance trucking of fluid added to the operating cost.

Understanding the mechanism by which sand is produced has been a priority. A wormhole model is being developed to explain the phenomenon. A seismic crosswell survey is planned to study the wormhole hypothesis.

Drilling in depleted areas has resulted in loss circulation. Many wells have watered out despite the lack of an identifiable oil/water contact on logs.

ENGINEERING

PanCanadian crossfunctional team has through continuous improvement turned this field into an economic prospect.

Sand is produced with oil resulting in high production. Bold measures have been adopted to reduce capital cost by developing slimhole screw pumps. Wells are drilled with 5.5" rather than 7" casing as is the industry practice. Drilling slant wells from centralized pads has allowed PanCanadian to centralize its operation and reduce land usage cost with a minimum of environmental damage. Adoption of tubing rotators and rod centralizers have reduced the problem in pumping equipment.

CONCLUSIONS

Using 2-D seismic and well data the aerial extent of the pool was defined. 3-D seismic was used for development and to determine the position of drilling pads. Problems unknown until now (sand production, water production) were handled through the joint efforts of the crossfunctional team. The lessons learned in Frog Lake are being used in other heavy oil pools.