# IPTC 13995

# Hydraulic Fracturing Improvement Based on Advanced Acoustic Logging in the Complex Geology of the Kamennoe Field

Yuri Masalkin and Dmitry Bazhenov, TNK-BP, Maxim Oparin, Dmitry Gromakovskiy, and Almaz Sadykov, Schlumberger

This abstract was prepared for presentation at the International Petroleum Technology Conference held in Doha, Qatar, 7–9 December 2009.



## Primary Category: Well Stimulation and Damage Removal

### Introduction

Kamennoe field is one of the most valuable assets and one of the major development projects of TNK-BP in Western Siberia. Most of the production in Kamennoe comes from the shallow VK formation of Neocomian age. Most of the reserves are attributed to the upper VK-1. Typically, the underlying VK-2 formation is water- saturated with a relatively weak barrier toward VK-1.

### Stimulation Practices Overview in Kamennoe Field, Western Siberia

Hydraulic fracturing is being successfully used to uncover the reserves of Kamennoe field and sustain production growth. One of the major challenges is placing the desired volume of proppant into the target formation (VK-1) without breaking into the water-bearing VK-2 through the weak barrier. To address this challenge, the series of techniques has been successfully introduced to assist proppant placement into the target zone while reducing the risk of breakthrough:

- artificial barrier placement
- linear fracturing fluid at the pad stage (as opposed to conventional X-linked fluid) to reduce the net pressure developed during the fracturing treatment
- low-viscosity viscoelastic surfactant fluid treatment.

### Modeling Approach

Until recently, the hydraulic fracturing simulation model was based on a conventional set of logs (GR, SP, NKT, GZ, PZ, etc,) and the gut feeling of the engineer. Over time, we learned that such an approach can lead to an inadequate model that could overpredict the strength of the lower barrier and result in fracture breakthrough to the water zone (current breakthrough rate in the new pads is 32% based on 50% WC cut off, Fig.1). To address this issue, the advanced acoustic logging of VK formation in Kamennoe field was done by running DSI log in one well and waveform sonic logs in six other wells. Formation mechanical properties as established from acoustic logs, have been associated with lithofacies, based on the conventional set of logs and extrapolated throughout the field for further usage in simulation modeling.

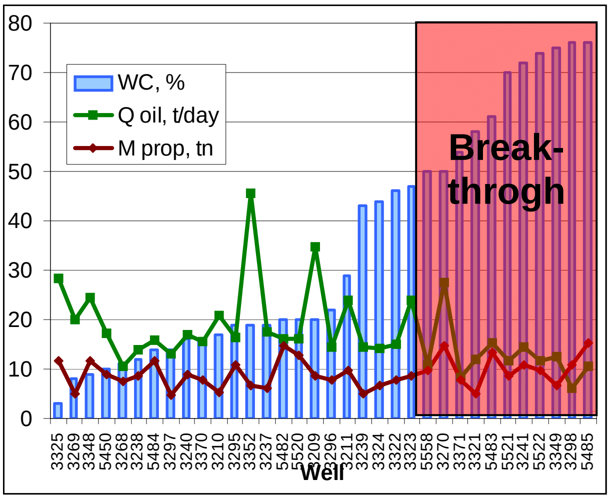


*Fig.1 – Post-frac performance based on the conventional modeling approach*

First, to confirm the credibility of the suggested approach, the advanced planar 3D hydraulic fracturing simulation was performed for the wells that showed no breakthrough based on conventional model (Fig.2), but that have been put on production with the postfracturing WC>50 % (Table 1).

*Table 1 – Production parameters of the well that did not show any breakthrough to VK-2 according to the conventional model.*

| WEL L | Q liquid (m3/day) | Q oil (m3/day) | % water |
|---|---|---|---|
| 5485 | 78.1 | 26.4 | 66.2 |

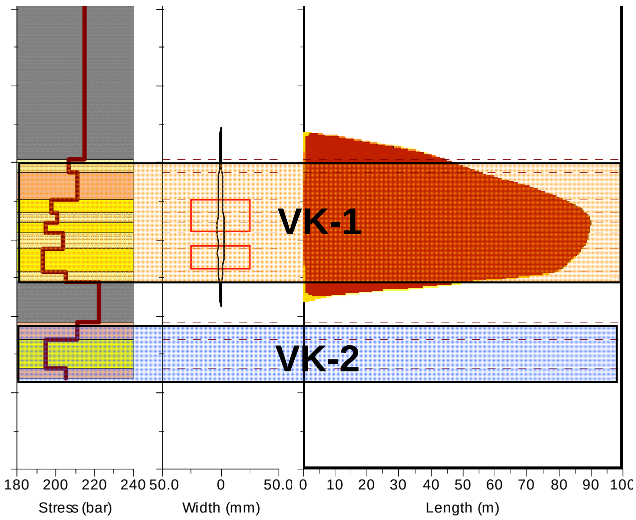


*Fig.2 – Conventional model for the well 5485 does not show breakthrough to VK-2.*

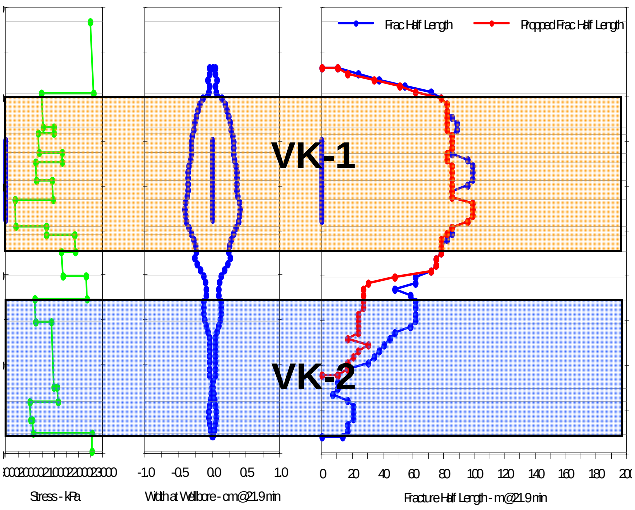


*Fig.3 – Planar3D model shows breakthrough.*

The fracture geometry obtained from the planar 3D model has been aligned with the postfracturing production results (Fig. 3).

Second, the input for the conventional simulation was adjusted accordingly and the conventional model was put in agreement with the advanced model and postfracturing production results (Fig.4).

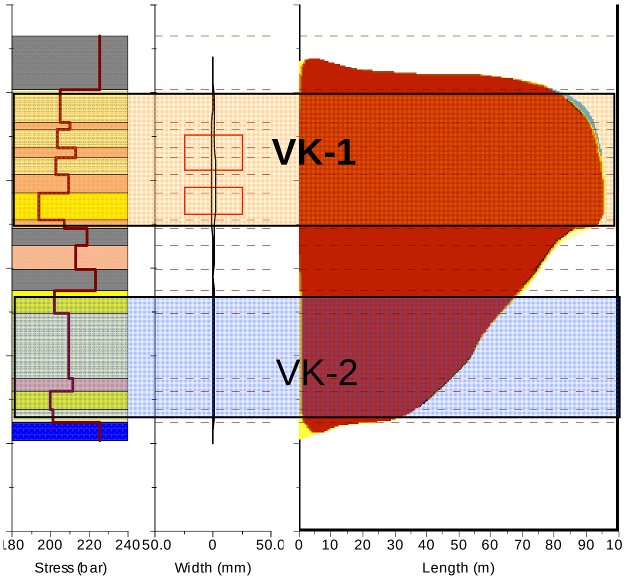


*Fig.4 – Conventional model aligned with the planar 3D simulation, and production results showing breakthrough.*

Third, the modified input for the conventional simulation is now being used routinely to model new fracturing jobs.

**Results**

As a result, the process developed on the basis of this study shows improvement in both geometry prediction accuracy and postfracturing water cut (Fig.5).

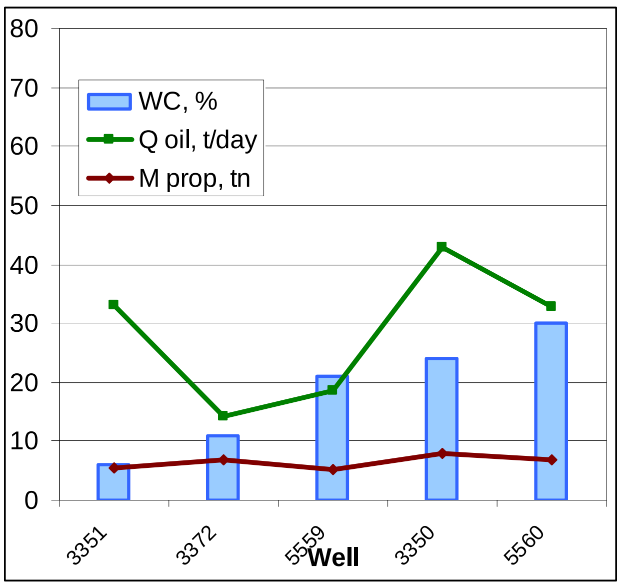


*Fig.5 – Post-frac performance based on the new modeling approach*

## Conclusion

Production water cut is one of the most important economic parameters of the Kamennoe field development project because of water lifting/handling cost in the environmentally sensitive area. The current study showed that the risk of breakthrough to water-bearing formations can be reduced by using advanced acoustic logging and fracturing simulation technologies in the high-profile development project.

## Acknowledgements

Authors would like to thank TNK-BP and Schlumberger for permission to publish the paper and for continuous cooperation and knowledge sharing.