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Using 4D Seismic for Understanding Drainage Pattern and Optimizing Infill Wells Placement in a Heterogeneous and Compartmentalised Reservoir - Cases from the Heidrun Field – Extended Abstract

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Abstract

Heidrun is an oil and gas field located in the Norwegian Sea. The reservoir is compartmentalised by a complex network of faults associated with several stratigraphic barriers. Forecasting the drainage pattern of the different reservoir compartments is difficult, as communication across segment bounding faults and across the stratigraphy is hard to predict.

Seismic monitoring has become an important part of the reservoir management plan. Several time-lapse repeated surveys have been acquired using Q-marine technology. In 2006, the entire field was covered for the first time, including all the reservoir formations. The repeatability is quite high and time-lapse inversion has become an important interpretation tool.

Recent work on infill wells has proven the use of 4D at a rather fine scale (500m). Case studies from two well planning processes will be shown.

The first example looks into the placement of a producer that was relying on pressure support from an existing water injector. Measurements in neighboring producers showed no pressure communication with the injector. However, interpretation of 4D data indicated possible fracturing of the injector, leading water into shallower layers and across faults into neighboring segments. This was later confirmed by a temperature log, leading to changes to the planned well. Furthermore, the 4D data indicate the same sort of fracturing in several injectors across the field, which lead to a revision in the way new injectors are designed.

The second example looks at fluid front movement within a reservoir compartment, and how this can help interpreting intra-segment faults. Observations made through dynamic data were not very well matched in the reservoir simulation model for this particular segment. Combining the interpretation of both the 3D and the 4D seismic surveys acquired identified new internal faults which, when implemented in the model, gave a much better result and changed the strategy for the planning process of a new producer.

The Heidrun Field

The Heidrun Field is located on the Halten Terrace in the Norwegian Sea (Figure 1). The field was discovered by Conoco in 1985 and started production on October 18th 1995. Heidrun is developed with a floating concrete tension leg platform (TLP). The northern part (Heidrun North) was in January 2000 included in the Heidrun unit. The part of the field is developed with subsea facilities. Heidrun Unit consist of 2 production licenses, and ConocoPhillips Skandinavia, Petoro, Eni Norge and StatoilHydro hold different shares of the licenses.

Total recoverable reserves for the Heidrun field are 186 million Sm³ of oil and 41.6 billion Sm³ of gas¹. As of 01.05.2008, a total of 123.7 million Sm³ of oil and 8.7 billion Sm³ of gas have been produced. The gas is exported through Haltenpipe to Tjeldbergodden and through Åsgard Transport pipeline to Kårstø. All excess gas is re-injected into the Fangst formation or used for gas lift.