

4-D Seismic Reservoir Surveillance and Business Impact – Dan Field Examples

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ABSTRACT

After more than 40 years of production there is still significant remaining oil potential at the Dan field located in the Danish North Sea. Production in the chalk reservoir started in 1972, initially on primary depletion and since 1989 using water flooding to maintain pressure and improve sweep efficiency. The field may continue to produce for many years to come if the remaining oil can be produced in a cost efficient manner. 4D seismic is considered a key technology to achieve this goal. 4D seismic is used to monitor production and injection performance and to locate the remaining oil. Specifically, 4D seismic proved to be very useful to identify, mature and derisk infill drilling, redevelopment and well- and reservoir management (WRM) opportunities. The resolution is good enough to monitor the performance of specific completion zones in the long horizontal wells. Reservoir modeling and production data are used in conjunction with 4D seismic to interpret the data. Water swept zones are often characterized by an acoustic impedance increase due to the replacement of oil with water. This hardening signal clearly correlates with the water injectors and can be used to track the water sweep and identify pockets with remaining oil. While there is less appetite on costly drilling in a low oil price environment, execution of well interventions at attractive costs is key to access remaining reserves. Such opportunities include the opening or closing of water injection or production completion zones and their potential re-stimulation. 4D helps to identify, derisk and prioritize such opportunities to maximize benefit. In this presentation we intend to discuss how 4D data impact business decisions based on a range of examples from the Dan field. We compare actual drilling results with 4D predictions and show how 4D data are used to identify and mature well intervention and field redevelopment opportunities. Acknowledgement: The authors would like to thank Maersk Oil and their partners in the Danish Underground Consortium (DUC), A.P. Møller-Mærsk AS, Shell Olie- og Gasudvinding Danmark B.V. (Holland), Chevron Denmark Inc. and the Nordsøfonden for permission to publish this material.