# Timing of oil expulsion from source rocks and a revitalization of the pre-1970 model

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**Abstract**
New data from North Sea Upper Jurassic source rock samples show no decline in the total amount of organic matter (TOC) within the oil expulsion window between 120 and 150°C which is a key prediction by today’s model for oil expulsion. However, today’s model for oil expulsion is not consistent with either subsurface source rock TOC data or chemical attributes of shallow oils. Instead, these data are more consistent with oil expulsion occurring at much lower temperatures and shallower depths, more similar to models advocated by most oil explorers prior to 1970 where the oil was assumed to have expelled at burial depths less than *~*2km.

In this paper, main oil expulsion has been determined to be take place at burial depths less than 1km and approximately 30°C. The oil is mobilized by CO2 gas which is generated from decomposing organic matter and is predicted to migrate out of the source rock and into nearby high-permeable rocks via horizontal fractures that originate from loadbearing swelling organic lamina and in a direction towards decreasing overburden.The thermally immature (heavy) oil is then converted to light crude within the reservoir oil starting at 60-70°C by hydrogenation. Hydrogen gas is common in subsurface fluids and is provided to pooled oil from coalification of organic matter in mudstones. Thus, if the supply of hydrogen is limited, in-reservoir thermal upgrading will be hampered. In this model, most of the heavy oil accumulations encountered are immature rather than due to biodegradation of mature oil at low temperatures.

**Per Arne Bjørkum** has been with Statoil/Equinor since 1990 where he served as chief researcher for exploration (2000—2006). Since he came back from a dean position at University of Stavanger in 2011, he has worked on issues related to oil and gas generation and migration.   He holds a professor emeritus  position in geology at UiS. For the last 20 years Bjørkum has been teaching courses in Theory and history of natural sciences  at UIS and NTNU.