Predrill prediction of proximal charge from a dry hole: An example from the Barents Sea

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The Johan Castberg area, located NW of Mamerfest, offshore Norway, consists of several oil and gas fields which have been delineated since the Skrugard discovery in 2011. The 7219/9-1 well, located 15 km SW of Skrugard was drilled in 1988 and subsequently abandoned with oil shows in the Jurassic and Late Triassic section. Fluid inclusion analysis of this well in 2005 predicted that oil and gas are reservoired nearby and predicted characteristics of these charges. Bulk trapped volatile analysis of 7219/9-1 by the fluid inclusion stratigraphy (FIS) technique, followed by fluid inclusion petrography and microthermometry, defines a 300-m gross thickness paleo-column of oil in the StØ, Nordmela, and Tubaen formations, with a well-defined paleo-oil-water contact, the position of which indicates that the structure was underfilled. Oil inclusions have measured oil gravity values of 34-36° API, consistent with nearby discoveries. The paleo-oil charge is calculated to have been emplaced and spilled when the reservoir was up to 500 m below current reservoir depth. A separate phase of gas is also recorded in fluid inclusions, some of which migrated as a separate charge from a distinct petroleum system in Triassic time. Both oil and gas appear to have occupied the reservoir near maximum burial; consequently, exsolution during uplift, although an active phenomenon, did not generate the bulk of the gas. Wax precipitation was observed in fluid inclusions, verifying the potential for this process during production from neighboring fields. Hydrocarbon proximity indicators in FIS data indicate the presence of an oil or condensate accumulation within roughly 8 km of the 7219/9-1 well, which requires a filed closer than Skrugard, and may be sensing the Havis or Drivis discoveries. In addition to the Jurassic oil occurrence, a paleo-column of wet gas appears to be recorded in the Late Triassic Snadd formation, and proximity indicators suggest that an accumulation of wet gas may be nearby, probably in tight rock. Finally, FIS data imply that the top seal to the Jurassic system maintained integrity at the wellbore location, and that leakage to nearby structures occurred out of the plane of the wellbore path. Vertical leakage of gas from the Triassic into the Jurassic reservoir does appear to have occurred, however. This example illustrates the potential for using fluid inclusions to address regional exploration risk in areas with limited well control.