Cap Rock Failures in Petroleum Systems-Case studies from the Snorre Oilfield, Tampen Spur, North Sea and Taglu Gas field, Beaufort Mackenzie Delta

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Abstract
Petroleum generation remains the rate-limiting factor in the formation of a petroleum system but competent cap rocks are vital for commercial accumulations of petroleum in basins. We present results from integrated studies of cap rock petrophysics and geochemistry in constraining the mechanism, timing and quantity of petroleum leaked through cap rocks. Pore pressure modeling of the cap rock mudstones is carried out using an artificial neural network based program “Shalequant” with wireline data as basic input while reservoir pressures were obtained from RFT data.

In the Snorre oilfield, geochemical data suggests petroleum leaked from the 14 MPa overpressured Triassic-Jurassic reservoirs into the hydrostatically pressured Cretaceous mudstone cap rocks of the Shetland Group. A 300m petroleum column height is observed in the reservoir, which is in equilibrium with predicted column heights derived from pore size distribution analyses for the Shetland Group mudstones. However, geochemical evidence of tertiary petroleum leakages of up to 600m into the cap rock is established. Our results also suggest that up to 25% of the initial volume of the oil in place in the Snorre oilfield has leaked into the cap rock through capillary flow. Basin modeling results suggest that the leakage could have occurred in the last few Ma. Similarly, in the Beaufort Mackenzie province of northern Canada, geological

evidences suggests that petroleum has leaked from the underlying pressure compartmentalized Reindeer Formation into the silty-mudstone dominated Richards Formation cap rock.