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THERMOGENIC WET GAS AS INDICATOR OF CAPROCK LEAKAGE AND LEAKAGE MECHANISM IN NORTH SEA RESERVOIRS

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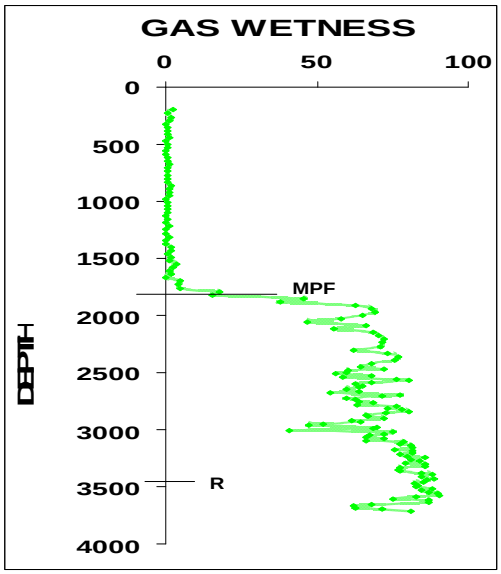
Many geological settings indicate the migration of petroleum through large volumes and thick sequences of mudstones. This observation lends credence to the fact that leakage of petroleum through reservoir caprocks is possible; most leakages had been evidenced by the presence of thermogenic wet gas in the immature caprock of petroleum reservoirs. In the light of this, questions that need be pondered upon are of rates, mechanisms and flow paths of leaking petroleum. These could contribute to decisions on CO_2 storage and sequestration. The potential for risking leakage may be deduced from the leakage rate.

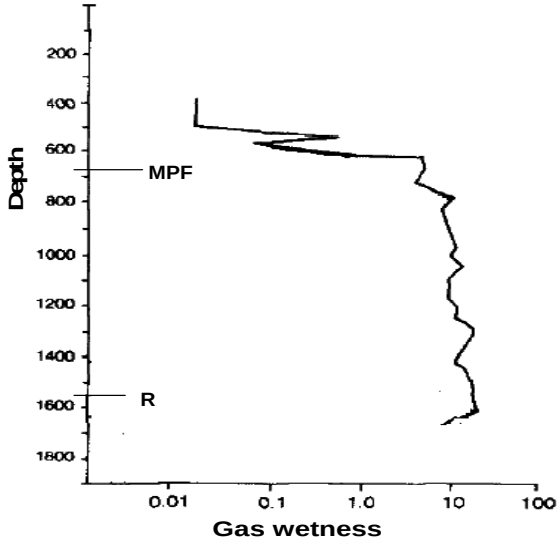
In this study, the presence of thermogenic wet gas in the caprock of petroleum reservoirs in the North Sea is assessed and an attempt is made on using the profiles of the wet gas, as an aid to unravel the possible leakage mechanism of these leaking reservoirs. Headspace gas data for 48 wells across 39 oil fields were studied in both the UK and Norwegian sectors of the North Sea. The study indicates that all the fields were leaking but that the rate may differ. Summary statistics indicates that about 80% of the reservoirs had pore pressures, which equaled about 60% of their lithostatic pressure, while about 50% of the wells had wet gas height $\geq$ 1000m above the reservoir – caprock interface.

The profiles of the wet gas showed similar trend for most of the wells, while a few had different trends. These profiles by observation were classified into vertically near straight flow trend out of the reservoir to the migratory petroleum fronts. This profile is observed to be exhibited by most high pressure reservoirs ($\lambda \geq 0.8$, pore pressure – lithostatic pressure ratio). The slanting trend is observed to be exhibited by most moderate to low pressure reservoirs ($\lambda \leq 0.6$, pore pressure – lithostatic pressure ratio). The observed spikes may indicate the presence of thin tight zones, which momentarily allows for the built-up of appropriate petroleum column for flow into overlaying formations.

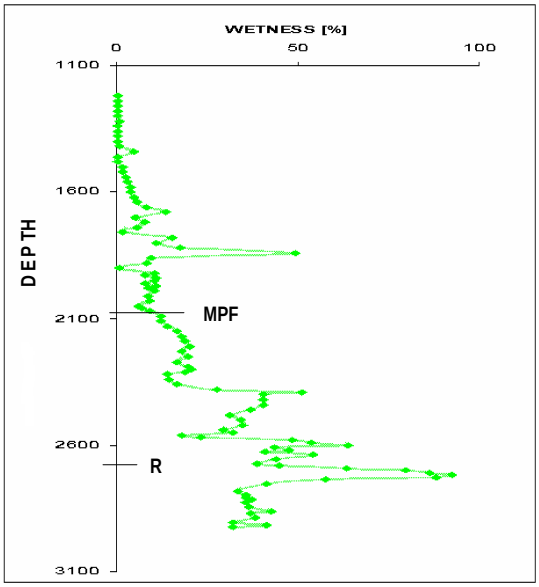
Some referral studies indicates that reservoirs with high pore pressure normally have fast and localized leakage while low pressured reservoirs leak via capillary failure with low intensity but pervasive; some examples cite were valhall for high pressure while Snorre, Drake and 30/6 discovery are cite for capillary leakage. The trend of the wet gas between the reservoir – caprock interface and the terminating petroleum fronts is the point of interest.



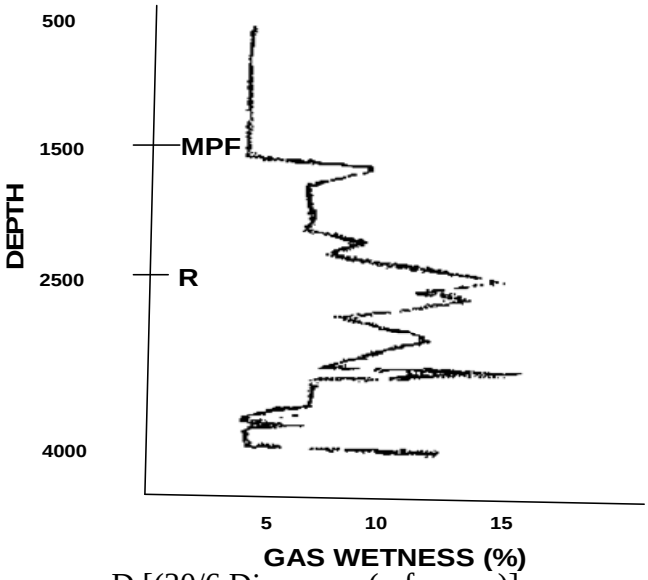
A (Huldra 30/3 – 1)



B [Diapir 1/ 6 – 5 (reference)]



C [Vidgis 34/7–295]



D [(30/6 Discovery (reference)]

Figure 1. Profiles of wet gas, A &B high pressure wells, C&D low-pressured wells.

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