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Gas Chimneys—Indicating A Fractured Cap Rock

Several years of research has led to a refined understanding of seismic anomalies related to hydrocarbon leakage processes. The aim of this paper is to present well and seismic data related to gas chimneys and to argue that a fractured cap rock model can explain the observations.

Wells drilled inside gas chimneys have: · higher pore fluid pressure, · higher mud gas readings, · higher mud gas wetness, · more hydrocarbon shows, · lower velocities, and · higher temperatures than wells drilled outside gas chimneys.

Gas chimneys are observed in low-permeable cap rock shales. Fractures must exist here in order to explain the observed oil shows within the gas chimneys. Such fractures can also explain the other observations related to gas chimneys.

Tectonic induced processes can create swarms of fractures, e.g., above salt or clay diapirs. High-pressure fluvials can hydro-fractured cap rocks. The observed gas chimneys in the North Sea exist above either tectonic induced structures or high pressure reservoirs. Seismic modelling shows that irregular, low-velocity distributed patches can create similar noise zones as those observed in gas chimneys on real seismic data. Fractures may distribute the gas into irregular patches within the cap rock.

If the proposed model, that gas chimney reflects a zone of fractured cap rock, is correct it has several implications to the oil industry. E.g., gas chimneys should be interpreted as oil and gas migration pathways and the extent and location of the migration route can be mapped directly from seismic data.