European Association of Organic Geochemists

The occurrence of high H2S in Clastic hydrocarbon reservoirs: a case study from Oman

Mohammed Al Ghammari[1], Timothy Lee[1], Ashraf Farag[1].

[1]Petroleum Development of Oman

Hydrogen Sulphide (H2S) is a critical contaminant in natural hydrocarbon accumulations, which if not predicted and/or not properly assessed can have devastating consequences to human life as well as to well integrity and production facilities. The understanding and knowledge of its origin (source), concentration and distribution within a reservoir (and accordingly the ability to predict its presence) is important for exploration portfolio ranking and even more critical for field development design and final investment decisions.

The occurrence of H2S in deep carbonates has been the focus of many research efforts and field studies in the last three decades. It is a common phenomenon to encounter high H2S in deep carbonate reservoirs because of the multiple sources of H2S in this setting such as Thermal Suplhate Reduction (TSR), Biogenic Sulphate Reduction (BSR), and oil to gas cracking and the limited availability of the scavenging minerals such as iron. In contrary, H2S is not very common in clastic reservoirs due to the abundant availability of metal scavengers (e.g. iron) and limited source mechanisms. It has been already established based on empirical studies that little to nil H2S is found at temperatures below 105C and beyond that there is an exponential increase with increasing temperature (Håland, Barrufet et al, 1999)

High H2S concentration (0.4 %) was found to be associated with a good productive gas well from Amin deep sandstone reservoir in the Ghaba Basin of Oman. This concentration of H2S was considerably higher than predicted (15ppm) using equilibrium models. Previous wells in the same structure also found high H2S but all of them were non productive and hence H2S concentrations were uncertain. A nearby producing field which is only 10km from this well is producing gas from the same reservoir with H2S content less than 14ppm. This paper will present the results of an integrated study to understand the origin of such high H2S concentration. The results include various data from geology, basin modelling, organic and inorganic gas geochemistry, rock mineralogy, water chemistry, and sulphur isotopes of H2S.

Various scenarios were put forward to explain the H2S anomaly which includes thinner seal, high H2S formation water, in-situ TSR, and migrated H2S from deeper reservoir. Each of these scenarios will be discussed. However, the migrated H2S scenario has more compelling evidence than the other scenarios. The similarity of the geology between this structure compared to the nearby low H2S producing field, as well as the presence of many deep seated faults and absence of salt beneath this structure provide strong arguments for having H2S originating from deeper reservoirs.

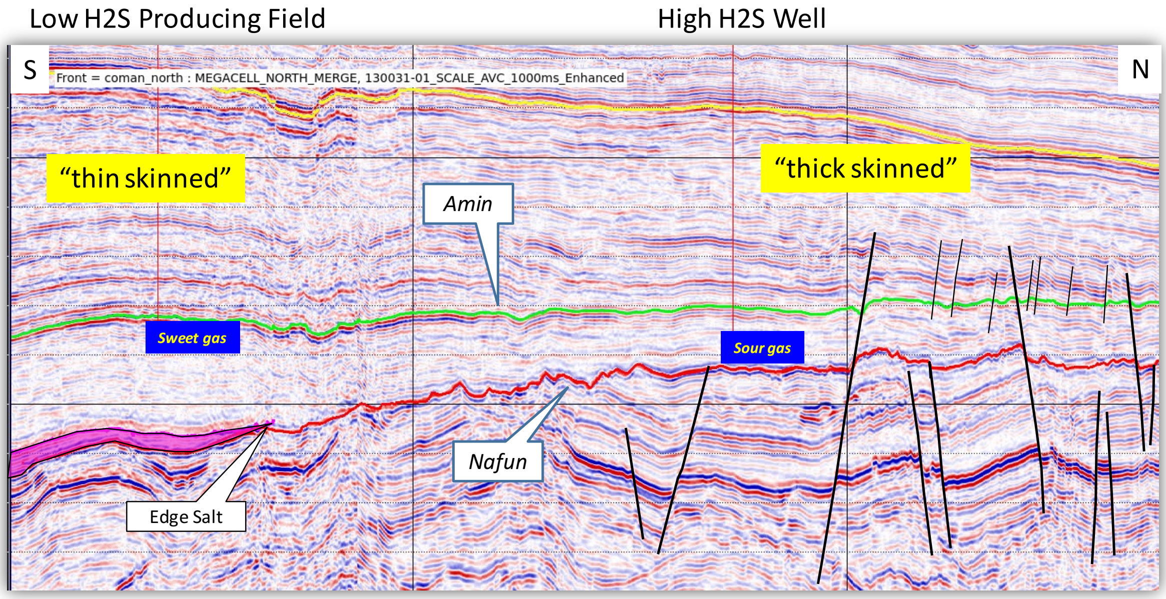

Figure 1 *Cross section between through the high H2S structure and the low H2S producing field.*

References

Håland, K., et al. 1999., An Empirical Correlation Between Reservoir Temperature and the Concentration of Hydrogen Sulfide, Society of Petroleum Engineers, SPE 50763