Norphlet Reservoir Degradation by Salt Plugging: The Vile Beast Within the Berry

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Abstract

The nightmare of any petrophysicist arises when a prolific sweet spot suddenly turns sour. This can occur for example when an excellent reservoir like Norphlet aeolian sandstone turns to be locally tight due to salt plugging. Salt layers, diapirs, canopees are classical structures identified on seismic interpretation which form boundaries of many structural traps: either top, lateral or bottom seal. The halite can also be remobilized thanks to dissolution and precipitated locally in reservoirs, in that case likely not detectable on seismic. Its effect on reservoir quality can be dramatic like a beast nibbling the porosity. It is very difficult to predict halite reservoir degradation and even challenging to evidence halite presence with standard log acquisition. Not being able to detect that the halite cement in aeolian sandstone is the reason for the drastic porosity reduction can lead to erroneous interpretation on the original sedimentary facies and puzzle the understanding of the facies distribution over the field (or even over a larger scale). A robust data acquisition is the key which integrates basic log curves (GR, NEUT; DENS; DTC, RES), plus NMR together with the Spectroscopy data. Obviously, benefits of having reservoir core or plugs to reduce the uncertainties in all petrophysics interpretation does not need to be de-emphasized. In addition, core remains the only way to ascertain salt presence in reservoir. The basic logs are limited in their usage for identification of interbedded / dispersed halite in a reservoir, hence requires additional information. The key log of essence is the sigma ∑ log. The use of the sigma ∑ log is under-utilized in the industry for this purpose but has shown immense value for identification of embedded halite within a reservoir. On the example shown, the sigma ∑ log together with the NMR log has been used consistently to effectively

identify and narrow down intervals where the halite downgrades reservoir properties. A Multimin model permits identification of porosity discrepancy between the NMR porosity versus the Density derived porosity. Multiple scenarios can explain this type of differences but addition of the sigma ∑ log allows to assess the presence of halite (nature of the mineralogy), the distribution of halite cement through the entire reservoir and to quantify porosity reduction effect associated to salt presence. A calibrated Multimin model can then be propagated to surrounding wells drilled through the same reservoir (even without sigma ∑ log) and allows detection of possible reservoir degradation zones of initially highly porous reservoirs invaded by salt. This original methodology should be generalized in clastic reservoirs where halite plugging is suspected.