Impact of Variable Microbial Growth Yields on Reservoir Souring Simulations

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Seawater injection into oil reservoirs has been employed for the past few decades to maintain pressure and increase oil recovery. Despite the demonstrated benefits, many questions remain about how seawater injections alter reservoir microbiomes through changes in reservoir temperature and the introduction of new microorganisms, energy substrates and nutrients. In particular, seawater injection can result in reservoir souring, a process in which sulfate reducing microorganisms (SRM) are stimulated and produce H_2S.

Accurate prediction of reservoir souring is essential in order to develop mitigation strategies. The common approach to simulate reservoir souring involves calculating the growth rate of SRM using the Monod growth equation. The growth rate is then coupled to the consumption/production rates of substrates/products via the growth yield (Y) of the SRM. Usually, Y is assigned an empirical and constant value. However, Smeaton and Van Cappellen (2018) recently proposed a thermodynamically consistent framework to account for variations in microbial growth yields caused by physical-chemical changes in the environment surrounding the cells.

Here, we analyze the impact of including a variable yield coefficient on reservoir souring predictions. To this end, we compare the results of variable and constant Y simulations of reservoir souring processes using both a batch model and a reactive transport model. Our results show that imposing a constant (average) Y value can underestimate reservoir souring by up to 40%. The exact degree of underestimation depends on the assumed growth characteristics of the SRM community, as well as the substrate availability.

Reference:

Smeaton, C. M. & Van Cappellen, P. Geochimica et Cosmochimica Acta, 2018, 241: 1-16.