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Pore Scale Simulation of Biogenic Gas Formation and Migration in Porous Media

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The biogenic gas behavior in porous media, which includes bubble nucleation and growth, migration, coalescence and trapping is affected by the gas generation rate, distribution of reactive sites and the pore scale characteristics of the sediment. In this study, experiments are performed using a micro-fluidic chip in which different gas bubble behavior mechanisms in the porous media are observed. Secondly, the behavior of biogenic gas is simulated using a pore-network model extracted from the 3D X-ray image of an in-situ sediment. The formation of biogenic gas bubbles is modeled using the classical gas nucleation theory. Several numerical algorithms and criteria developed for the expansion of gas bubbles during the biogenic gas formation, size-dependent rising velocity of gas bubbles, bubble coalescence, slug formation and movement, escaping, and trapping in the pore space. The amount of produced gas bubbles, residual gas saturation and hydraulic conductivity are calculated during the simulations. Results of the simulation are qualitatively compared with the microfluidic chip experiments.

References

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