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Pore scale modelling of elastic properties of hydrate bearing sediment based on high resolution synchrotron x-ray computed tomography imaging

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Gas hydrate contains abundant methane and is expected to be a promising energy supply to mitigate the influence of climate change in the future, in addition, it is also relevant to geological hazards. Understanding the effect of fluids-solid-hydrate spatial distribution on elastic properties of hydrate-bearing sediments benefits the interpretation of the Bottom Simulating Reflection and acoustic logging data.

The elastic properties of gas hydrate-bearing have been investigated with various approaches, such as labbased measurements and analytical models. But these methods fail to capture the influence of detailed pore structure and phase distribution on elastic properties. Alternatively, pore-scale imaging technologies (e.g., Sahoo, et al., 2018), has been used to understand the detailed pore-scale fluids-solid-hydrate distribution on the elastic wave properties. But pore-scale numerical simulation of elastic properties based on high resolution detailed fluids-solid-hydrate images is still rare.

In this work, effective elastic properties of gas hydrate-bearing were simulated by the finite element method based on high-resolution synchrotron x-ray computed tomography imaging. The results show that the dominant hydrate morphology experiences a transition from pore-filling to pore-bridging and to cementation during the hydrate formation process. Remarkably, some hydrate forming in small pores can cement adjacent granules and form local pore-bridging, which increases the rock elastic moduli and sonic wave velocities significantly even when hydrate saturation is low.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

Reference:

Sourav K. Sahoo, B. N. Madhusudhan, Hector Mar'ın-Moreno, Laurence J. North, Sharif Ahmed, Ismael Himar Falcon-Suarez, Tim A. Minshull, and Angus I. Best. Laboratory insights into the effect of sediment-hosted methane hydrate morphology on elastic wave velocity from time-lapse 4-d synchrotron x-ray computed tomography. Geochemistry, Geophysics, Geosystems, 19(11):4502–4521, 2018.

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