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A finite volume method for fully coupled multiphase flow and chemical processes in porous media-application to CO_2 storage

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SUMMARY

Reactive multiphase flows play a significant role in many applications related to environmental sciences or petroleum engineering. We can mention, non exhaustively, geological sequestration of CO_2 in deep saline aquifers, long term management of nuclear waste or enhanced oil recovery, see for instance [1].

Modelling such problem leads to a highly nonlinear coupled system of PDEs (governing the compositional flow) to algebraic or ordinary differential equations (governing respectively equilibrium and kinetic reactions) requiring a special numerical treatment. In the framework of the free and open source simulator DuMu^X (http://www.dumux.org/), we have developed and implemented a fully-implicit finite volume scheme for the numerical simulation of single and two-phase reactive flows.

In this talk, we will describe in detail the methodology for single phase reactive flows where a direct substitution approach (DSA) is employed. The accuracy and effectiveness of the approach have been demonstrated through 2D and 3D parallel numerical simulations. Numerical results for long-term fate of injected CO_2 for geological sequestration will be presented. Moreover, benefits of the DSA will be highlighted by a comparison with results obtained by a sequential iterative approach (SIA) developed in [2]. The extension to two-phase flows will be discussed and some preliminary numerical results will be presented.

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References

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