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Numerical simulation of Thermo-Hydro-Chemical processes for subsurface problems

Etienne AHUSBORDE[1] **Fabrizio CROCCOLO**[2], **Nicolas PILLARDOU**[1,2]

SUMMARY

Reactive multiphase multicomponent flows in porous media are involved in many applications related to subsurface environment and energy issues. We can mention non exhaustively production of geothermal enrergy, geological sequestration of gas (H_2, CO_2, CH_4) or nuclear waste management.
Such flows are governed by Thermo(T), Hydro (H), Chemical (C) phenomena. More precisely they are modelled by a set of highly nonlinear system of degenerate partial differential equations (describing a multiphase compositional flow through mass and energy conservation laws) coupled with algebraic and/or ordinary differential equations (related to geochemical model) requiring special numerical treatment. The numerical strategies for solving this system are divided into two main categories: the global implicit and the sequential approaches. The global implicit approach solves one global nonlinear system gathering all equations at each time step while for the sequential approach, flow and reactive transport are solved sequentially at each time step.
In the framework of the parallel platform DuMu^X [1], we have developed an implemented a sequential [2] and a global implicit scheme [3] to deal with isothermal reactive multiphase flows. In this work, both strategies have been extended to non-isothermal flow and validated by several test cases including High Performance Computing. A comparison between both strategies for a three dimensional scenario of geological storage of CO_2 will be presented.

Keywords: Multiphase flow, reactive, porous medium, finite volume, HPC.

References

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[1]UPPA, E2S UPPA, CNRS, LMAP, Pau
etienne.ahusborde@univ-pau.fr, nicolas.pillardou@univ-pau.fr

[2]UPPA, E2S UPPA, CNRS, Total, LFCR, Anglet
email: fabrizio.croccolo@univ-pau.fr