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► To cite this version:

Joachim Tremosa, Hélène Gailhanou, Christophe Chiaberge, Arnault Lassin, Francis Claret, et al.. Coupling clay dehydration to THM processes to calculate fluid overpressures in sedimentary basins. CouFrac - International Conference on Coupled Processes in Fractured Geological Media: Observation, Modeling, and Application, Nov 2018, Wuhan, China. hal-01880612

HAL Id: hal-01880612

<https://brgm.hal.science/hal-01880612>

Submitted on 25 Sep 2018

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Coupling clay dehydration to THM processes to calculate fluid overpressures in sedimentary basins

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Diagenetic smectite dehydration and smectite-to-illite transition in clay-rich sediments can contribute to the generation of overpressure in sedimentary basins, because of the release of water associated to these mineralogical reactions. However, evaluating the contribution on fluid pressure of smectite dehydration and illitisation amongst other mechanisms generating overpressure necessitates considering jointly the different mechanisms being in play. We present here a THMC code developed to calculate the overpressure generation in a sedimentary pile because of sediment compaction during its burial, temperature increase, water flow and water release from clay dehydration and illitisation. In that purpose, smectite dehydration is described by an advanced thermodynamic model based on a solid solution approach and is considered together with the different thermo-hydro-mechanical processes occurring in sedimentary basins. The resulting THMC coupled code is applied to a case study in an overpressured passive margin where thick shale layers are encountered. In this geological scenario, the simulated smectite dehydration process explains 10 to 30 % of the present day overpressure (Figure 1), in addition to compaction disequilibrium.

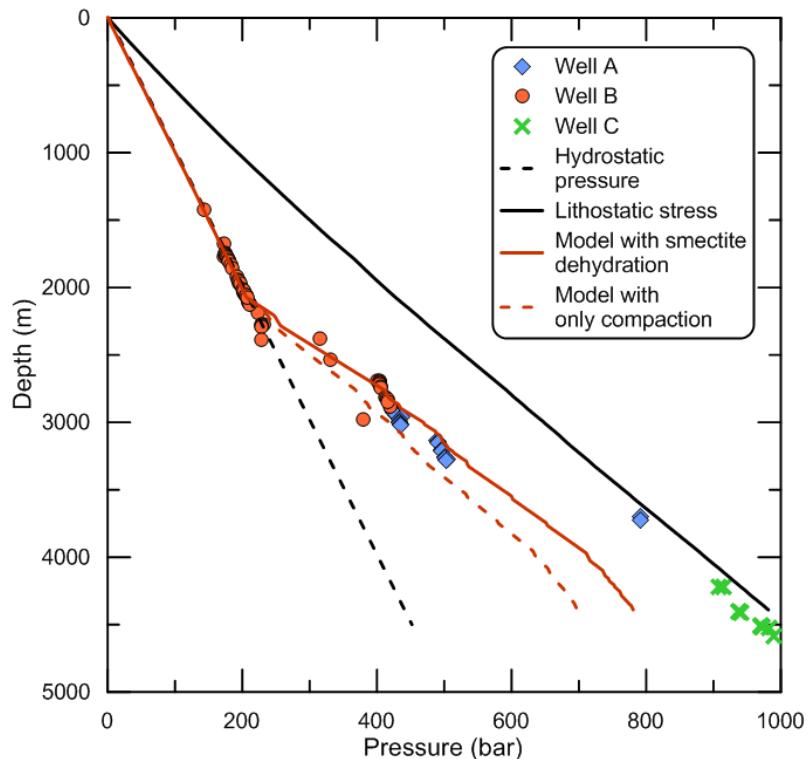


Figure 1. Present day modelled and observed pore pressure profile in the considered application case. The comparison of the two models accounting or not for the chemical processes allows evaluating the effect of the release of water by smectite dehydration and illitisation on fluid abnormal pressure.