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Identification of Some Chemoporoelastic Parameters of a Reactive Shale from Experimental Data

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This paper is concerned with the experimental identification of some chemoporoelastic parameters of a chemically reactive shale from data obtained in pore pressure transmission-chemical potential tests. The parameter identification is carried out by matching the observed pressure response with a theoretical solution of the experiment. This solution is obtained within the framework of Biot theory of poroelasticity, extended to include physico-chemical interactions. A series of experiments on Pierre II shale (a shale from the Rocky Mountains in Colorado) has been carried out with the Membrane Efficiency Screening Equipment (MESE) in the laboratory of CSIRO Petroleum, Australia. An analysis of the sensitivity of the theoretical solution to the parameters is carried out. The critical parameters are then brought out among all the parameters of the solution, i.e., the transport parameters which are the hydraulic permeability, the chemical diffusivity and, above all, the chemical reflection coefficient (membrane efficiency). Two radically different methods are used for the quantification of these parameters. First, a cost functional is defined by a least square difference between the theoretical solution and the whole set of experimental data. A systematic minimization method (typical inverse problem) is then applied to this functional.The robustness of the algorithm is also estimated through several numerical tests on simulated data. Eventually, a more pragmatic approach is deduced from this approach, e.g., the chemical reflection coefficient is directly correlated with the pressure drop during the chemical loading. Coherence of the results obtained with both methods is shown.

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