

## **DISSOLUTION AND DEPOSITION IN POROUS MEDIA: DETERMINATION OF THE PETROPHYSICAL PROPERTIES CHANGES USING PORE NETWORK MODELING (PNM)**

**L. Algive, S. Bekri and O. Vizika**

IFP, 1 et 4 avenue de Bois-Préau, 92852 Rueil-Malmaison Cedex, France  
e-mail: samir.bekri@ifp.fr, web page: <http://www.ifp.fr>

**Summary.** A PNM is an efficient tool to account for phenomena occurring at the pore scale. Its explicit 3D network of pores interconnected by throats enables to consider easily the topology and geometry effects on upscaled and homogenized petrophysical parameters. In particular, this approach is appropriate to study the rock/fluid interactions. It can provide quantitative information on both the effective transport properties modifications due to the reactions and the structure modification resulting from dissolution/deposition mechanisms. The model developed is based on the resolution of the macroscopic reactive transport equation between the nodes of the network. As with the permeability calculation in the classical PNM, where the hydraulic conductivity of each pore-throat and pore-body of the network must first be determined using Poiseuille's solution, the macroscopic parameters of the reactive transport equation are determined first for each unit cell of the network, using the moment theory. Analytical functions of the macroscopic parameters that have to be implemented in the PNM tool are provided for each basic geometry used in PNM and for different range of the reactive regime. The growth/diminution of the pores diameters caused by the dissolution/deposition is calculated from the disequilibrium at the rock/fluid interface. In this work, the dependency of the structural modification patterns on the reactive and flow regimes was described. Its impacts on the effective transport properties such as permeability and porosity, and the macroscopic coefficients of the transport equation, were investigated. It has been observed that the mean reactive solute velocity and dispersion can vary up to one order of magnitude compared with an inert tracer values because of the concentration profile heterogeneity at the pore scale resulting from the surface reactions. As for the reactive apparent coefficient, when the kinetics is limited by the mass transfer, it can decrease by several orders of magnitude with regard to that calculated by the usual perfect mixing assumption. Regarding the permeability variation versus the porosity evolution, both extreme tendencies are established: small porosity variation coupled with a strong permeability one and reciprocally. As an immediate consequence of this result, a single relation of the porosity-permeability is clearly insufficient to describe the phenomena at reservoir scale. This work contributes to improve the understanding of surface reactions impacts on reactive flow on the one hand, and on permeability and porosity modifications on the other hand. Using the PNM approach, the macroscopic parameters of the reactive transport equation and permeability versus porosity relations can be determined for various rock-types and reactive flow regimes. Once integrated as inputs in a reservoir simulator, these relations form a powerful and convenient means to enhancing the modeling accuracy of the change in petrophysical properties during injection of a non-inert fluid such as CO<sub>2</sub>-rich brine.