Geophysical Research Abstracts
Vol. 19, EGU2017-13564, 2017
EGU General Assembly 2017

On the complex conductivity signatures of calcite precipitation

Philippe Leroy (1), Shuai Li (2), Damien Jougnot (3), André Revil (4), and Yuxin Wu (5)

(1) BRGM, Orléans, France (p.leroy@brgm.fr), (2) Imperial College, London, England, (3) METIS, Pierre and Marie Curie University, Paris, France, (4) ISTerre, Chambéry University, Le Bourget du Lac, France, (5) Lawrence Berkeley National Laboratory, Berkeley, USA

When pH and alkalinity increase, calcite frequently precipitates and hence modifies the petrophysical properties of porous media. The complex conductivity method can be used to directly monitor calcite precipitation in porous media because it is sensitive to the evolution of the mineralogy, pore structure and its connectivity. We have developed a mechanistic grain polarization model considering the electrochemical polarization of the Stern and diffuse layer surrounding calcite particles. Our complex conductivity model depends on the surface charge density of the Stern layer and on the electrical potential at the onset of the diffuse layer, which are computed using a basic Stern model of the calcite/water interface. The complex conductivity measurements on a column packed with glass beads where calcite precipitation occurs are reproduced by our surface complexation and complex conductivity models. The evolution of the size and shape of calcite particles during the calcite precipitation experiment is estimated by our complex conductivity model. At the early stage of the calcite precipitation experiment, modeled particles sizes increase and calcite particles flatten with time because calcite crystals nucleate at the surface of glass beads and grow into larger calcite grains around glass beads. At the later stage of the calcite precipitation experiment, modeled sizes and cementation exponents of calcite particles decrease with time because large calcite grains aggregate over multiple glass beads, a percolation threshold is achieved, and small and discrete calcite crystals polarize.