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Presenter: Shuai Li

AUTHORS

Shuai Li (1), Philippe Leroy (2), Nicolas Devau (3)

1. BRGM, 3 Avenue Claude Guillemin, 45100 Orléans France, 45100, Orléans, FR
2. BRGM, 3 Avenue Claude Guillemin, 45100 Orléans France, 45100, Orléans, FR
3. BRGM, 3 Avenue Claude Guillemin, 45100 Orléans France, 45100, Orléans, FR

ABSTRACT

Carbonates are very reactive minerals that are used in many engineering applications like substance remediation and CO2 geological storage. Surface complexation reactions on calcite have significant effects on transport processes in carbonates. Zeta potential is a critical parameter to characterize the mineral surface electrochemical properties. The zeta potential is defined as the electrical potential at the shear plane between quasi immobile and mobile water at the mineral surface. The electrostatic surface complexation model in the calcite-water system determines the surface potential profile and ions distribution along the mineral surface; therefore, it provides precious information on the value of the zeta potential. In streaming potential experiments conducted on core sample composed of calcite materials, the magnitude of the apparent zeta potential calculated from Helmholtz-Smoluchowski equation can be largely inferior to the magnitude of the surface potential at the beginning of diffuse layer computed by an electrostatic surface complexation model. Heberling et al (2011;2014) introduced a slip plane to account for the discrepancy between the computed zeta potential and the apparent one. However, the distance of the slip plane to the mineral surface varying with the electrolyte concentration is not a reasonable and physical acceptable assumption. In our study, a Triple-Layer surface complexation model is applied to calculate the surface potential and ions distribution at the calcite-water interface. By considering the effects of surface electrical conductivity on streaming potential measurements, the computed zeta potentials at the beginning of the diffuse layer have a perfect agreement with the experimental and corrected zeta potential data without any additional parameter. The selected 'intrinsic' zeta potential, electrostatic surface complexation and electrical conductivity models can be directly served as an input to explicitly determine the electrokinetic coupling coefficient in hydrogeophysics.

REFERENCES

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