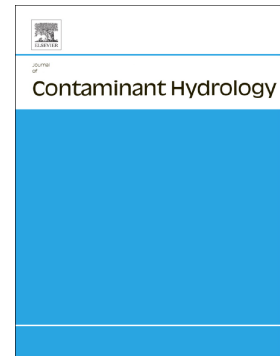


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Chromatographic analysis of the acidity-salinity transport system

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Abstract

The effects of acidity and salinity on solute transport in porous media are important to a diverse range of fields from seawater intrusion to nuclear waste storage. Recent transport experiments in quartz sand show the difficulty in capturing the coupling of acidity and salinity under acidic conditions for this system. Here we study the ability of different surface complexation models to capture this coupling, through an analysis of the reactive transport equations in the limit of no diffusion. This chromatographic analysis leads to a graphical representation of the full set of solutions in the phase plane, thus allowing a comprehensive comparison of the transport behavior arising from different SCMs. The analysis shows that the predicted coupling is improved by including amphoteric behavior of the quartz surface. The inclusion of a secondary proton sorption reaction increases the magnitude of surface charge under acidic conditions strengthening the acidity-salinity coupling. This suggests that even though the overall surface is negative above the point of zero charge, positively charged sites play an important role in the reactive transport of acidity and salinity.

Keywords: reactive transport, chromatography, electric double layer, hyperbolic theory, surface complexation, triple layer model

1. Introduction

To first-order the surface charge and therefore chemical behavior of reactive media is determined by aqueous acidity and salinity. These variables are coupled through the effects of ionic strength on the activity of aqueous species, and the electrical properties of the diffuse layer, as well as competitive sorption of ions for surface sites [1]. Much work has been done in the development of surface chemistry models which can mechanistically

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