

Effect of monovalent cations on the distribution of Sr²⁺ adsorbed at the mica (001)–water interface *

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Ion adsorption on mineral surfaces plays a crucial role in controlling the fate and transport of heavy metals in natural waters. Determination of adsorbed ion distribution at the molecular scale can provide direct insights into adsorption mechanisms at mineral–water interfaces. Here, we show how background electrolyte (BE) cations (Rb⁺ and Na⁺) influence adsorption of Sr²⁺ at the negatively-charged muscovite mica (001)–water interface. The experiments were conducted with various Sr concentrations (0.1 to 20 mM) at fixed BE concentrations (none, 75 mM NaCl, and 3 mM RbCl, respectively.) Changes in adsorbed Sr²⁺ distributions were measured using *in situ* resonant anomalous X-ray reflectivity.

In situ observations revealed critical impacts of competitive adsorption on adsorbed cation speciation at the mica–water interface. In the absence of BE cations, Sr²⁺ adsorbed on the mica surface as coexisting inner-sphere (IS) and outer-sphere (OS) species whose coverages were approximately equal [1]. In the presence of BE cations, the amounts of these Sr²⁺ species decreased significantly, indicating a direct impact of the BE cations on the adsorbed Sr²⁺ species. In particular, almost no IS Sr²⁺ adsorption was observed in 3 mM RbCl solution, indicating site-specific competition between Sr²⁺ and Rb⁺. In both BE solutions, a new sorbed Sr²⁺ species was observed at distance farther from the surface than the adsorbed IS and OS Sr²⁺ species [2]. As a result, adsorbed Sr²⁺ became more OS dominant in the presence of BE cations than it is in the absence of BE cations.

References: [1] Park *et al.*, (2006) *Phys. Rev. Lett.* **97**, 016101. [2] Lee *et al.*, (2020) *in review*.

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