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Phyllosilicate-mediated phosphorus cycling in early ferruginous aquatic systems: Implications for Precambrian biogeochemistry

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The phosphorus (P) cycle is a critical link for the co-evolution of biosphere and geosphere. The availability of P is largely controlled by mineral adsorption in surface environments, but the environmental conditions evolved dramatically in geologic history. Here, we combine experimental and theoretical investigations of P adsorption onto common phyllosilicate minerals to evaluate the roles of clays in the early P cycle. We show that the P adsorption is significantly enhanced by common cations, particularly Fe(II), in the early seawater. This enhancement is primarily due to the bridging effect of divalent cations on the mineral surfaces. The clay adsorption might facilitate the riverine transport of bioavailable P but undermine the release of dissolved P for early life in the ocean.

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