Adsorption behavior of MoO_4^{2-} on α -Al_2O_3 and δ -MnO_2

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Introduction

In order to understand the behavior of trace elements in hydrosphere, it is important to investigate their adsorption behavior on ubiquitous minerals. In this investigation, the adsorption behavior of MoO_4^{2-} (Mo) on α-Al_2O_3 (Al_2O_3) and δ-MnO_2 (MnO_2) was investigated. We found that the adsorption behavior of Mo is significantly different between Al_2O_3 and MnO_2 in spite of the same specific surface area.

Discussion of Results

[Adsorption experiment]

The amount of Mo adsorbed on MnO_2 was significantly larger than that on Al_2O_3. The amount of Mo adsorbed on Al_2O_3 decreased with increasing pH in the range of 4.5 – 8, while the amount of Mo adsorbed on MnO_2 was not affected by pH and was almost constant.

[Adsorption structure]

The adsorption structure of Mo on Al_2O_3 and MnO_2 was examined by Mo L_3-edge X-ray absorption spectroscopy. Mo dissolves as a tetrahedral MoO_4^{2-} in aqueous solution with low concentration. The Mo adsorbed on Al_2O_3 and MnO_2 exsited as tetrahedral MoO_4 species and octahedral MoO_6 species, respectively.

[A proposed adsorption mechanism]

Judging from the pH dependence for the adsorption and the adsorption sturacture of Mo, Mo is adsorbed on Al_2O_3 by the electrostatic interaction, called physical adsorption. As a result, there was no stractural change of Mo before and after adsorption. On the other hand, Mn^{2+} was unexpectedly released in solution during Mo was adsorbed on MnO_2. The fact suggests that the adsorption of Mo on MnO_2 may be due to incorporation of Mo into MnO_2 framework structure (isomorphous substitution with Mn^{4+}) as a MoO_6 unit. The difference in the adsorption mechanism of Mo between Al_2O_3 and MnO_2 is considered to reflect the difference in the amount of Mo adsorbed.