

Trends in the adsorption of cations on mineral surfaces

Adsorption on SiO₂

Schindler et al. (1976 *Jo. Colloid. Interfacial Sci*); James & Healy (1972, *Jo. Colloid. Interfacial Sci*)

Adsorption on ferrihydrite

Stumm (1992, *Chemistry of the Solid-Water Interface*), as shown in Langmuir (1997, *Aqueous Environmental Geochemistry*)

Adsorption on hydrous ferric oxide

Dzomback & Morel (1990, *Surface Complexation Modeling*)

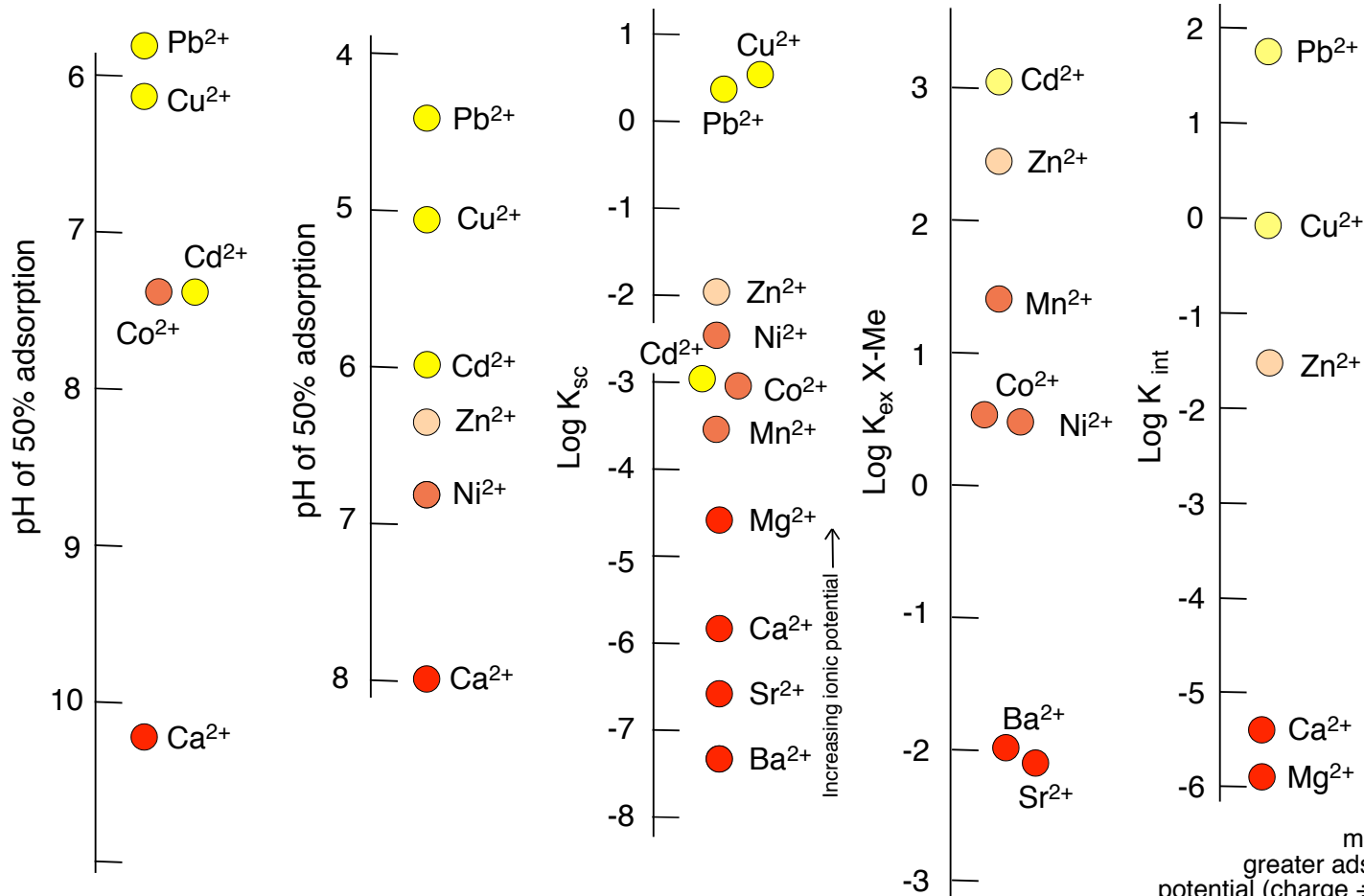
Adsorption on calcite

Zachara et al. (1991, *Geochimica et Cosmochimica Acta*)

Adsorption on birnessite (δ-MnO₂)

Smith & Jenne (1988, 1991), as reported in Langmuir (1997, *Aqueous Environmental Geochemistry*)

Greater Adsorption ↑
Less adsorption ↓



One process important in Earth-surface geochemistry is adsorption of cations on surfaces of minerals. The extent of adsorption of any one cation (e.g., Zn²⁺) on any one surface (e.g., that of TiO₂) is commonly shown as a function of pH with trends called isotherms.

Another way to express the extent of adsorption of a particular cation is with an equilibrium constant for its stability on that surface or its exchange with other cations on that surface.

This diagram makes an unusual attempt to compare the adsorption behavior of different 2+ cations. Because of the different ways these behaviors are reported, as noted above, one risks comparing apples and oranges, or at least apples, pears, and peaches. Thus the comparison at left comes with the warning that the four plots are arbitrarily arranged relative to each other, and the rightmost three vertical axes represent data that are very different in nature. All four plots are arranged to reflect less adsorption lower and greater adsorption higher on the diagram.

With the above caveats in mind, one can see some trends in this diagram. Most notably, hard cations (red filled circles) are adsorbed less than intermediate to soft cations (orange to yellow filled circles).

Among the hard cations, the most complete set of data suggests greater adsorption of cations of greater ionic potential (charge ÷ radius). Among the intermediate to soft cations, adsorption is generally greater for softer cations. One speculative explanation of the latter trend is that the softer cations dehydrate more readily and thus adsorb more sustainedly.