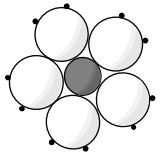
Speciation of cations in aqueous solution II

One simple form of coordination is **hydration**, where the ligands are water molecules and the ligand atoms are the O^{2-}s of the water molecules. The number of water molecules serving as ligands is the **hydration number**, a specific sort of coordination number.

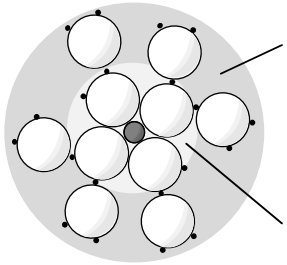
One modification of hydration is for the water molecules to lose some or all of their hydrogen ions (i.e., to be hydroxyls (OH^-) and O^{2-}s.) In those cases **hydroxo-complexes, oxohydroxo-ocomplexes**, and **oxo-complexes** form.

Hydrated cations (aquo-ions):



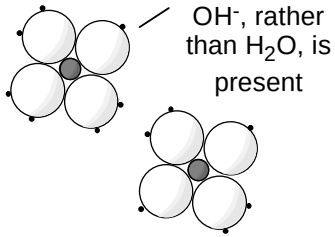
Cation of low ionic potential (e.g., K^+) with low hydration number

Note that the smaller cation has the larger hydrated radius.



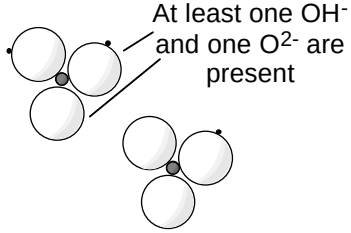
Cation of higher ionic potential (e.g., Be^{2+}) attracts more H_2Os and so has higher hydration number.

Hydroxo-complexes:



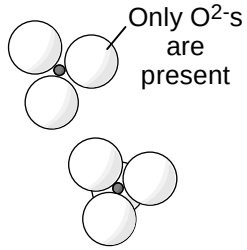
Cation of intermediate ionic potential (e.g., Al^{3+} as $AL(OH)^{2+}$ or $Al(OH)_2^+$)

Oxo-hydroxo-complexes:



Cation of high ionic potential (e.g., C^{4+} as H_2CO_3 or HCO_3^-)

Oxo-complexes:

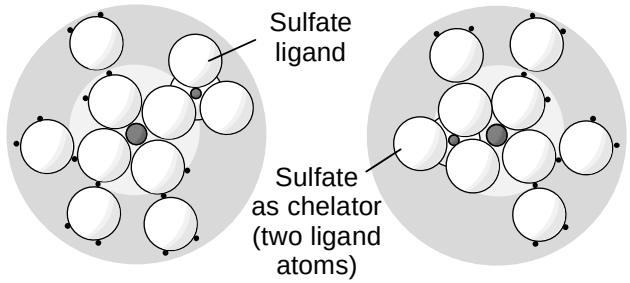


Cation of highest ionic potential (e.g., N^{5+} and S^{6+} as NO_3^- and SO_4^{2-})

Increasing ionic potential of cation (cation increasingly repels H^+ ions) and/or increasing pH (H^+ ions leave complex for solution)
(See "Aqueous speciation of some hard cations across the periodic table")

Ligands other than H_2O must interact with the hydration sphere as they coordinate with a cation. If they penetrate all the way to the cation, they form an **inner-sphere complex**. On the other hand, if they don't break through the inner sphere, they form an **outer-sphere complex**.

Inner sphere complexes:



Outer-sphere complex: