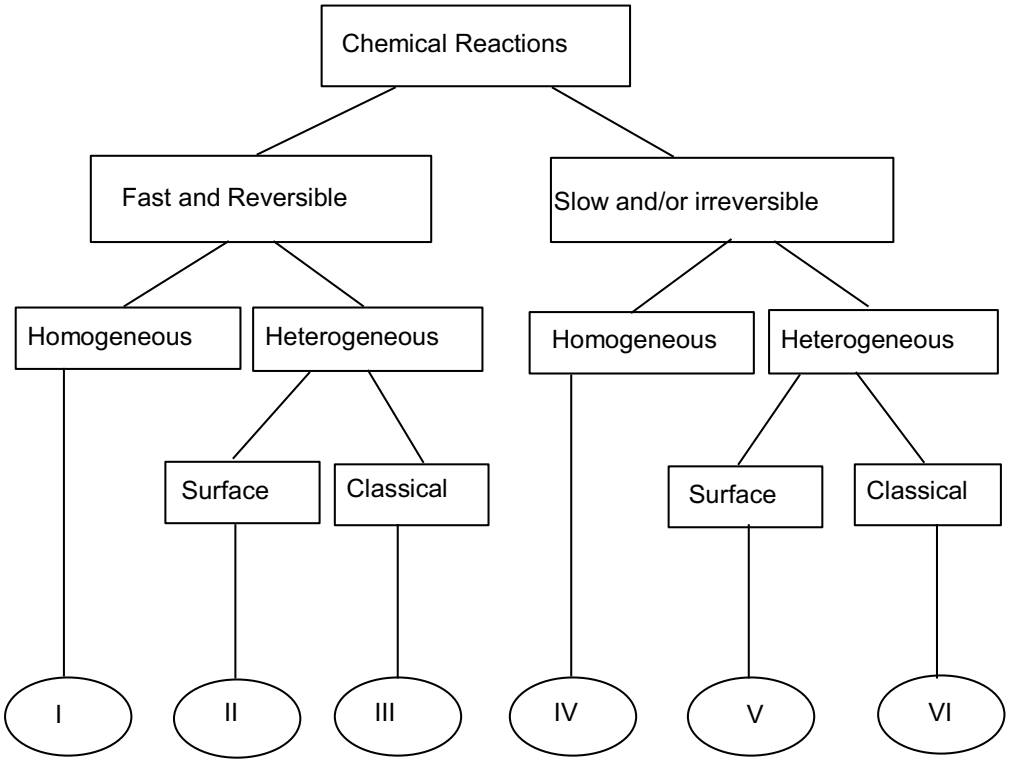
Adsorption



Adsorbtion - solute clings to surface due to various attractive forces - usually electrostatic.

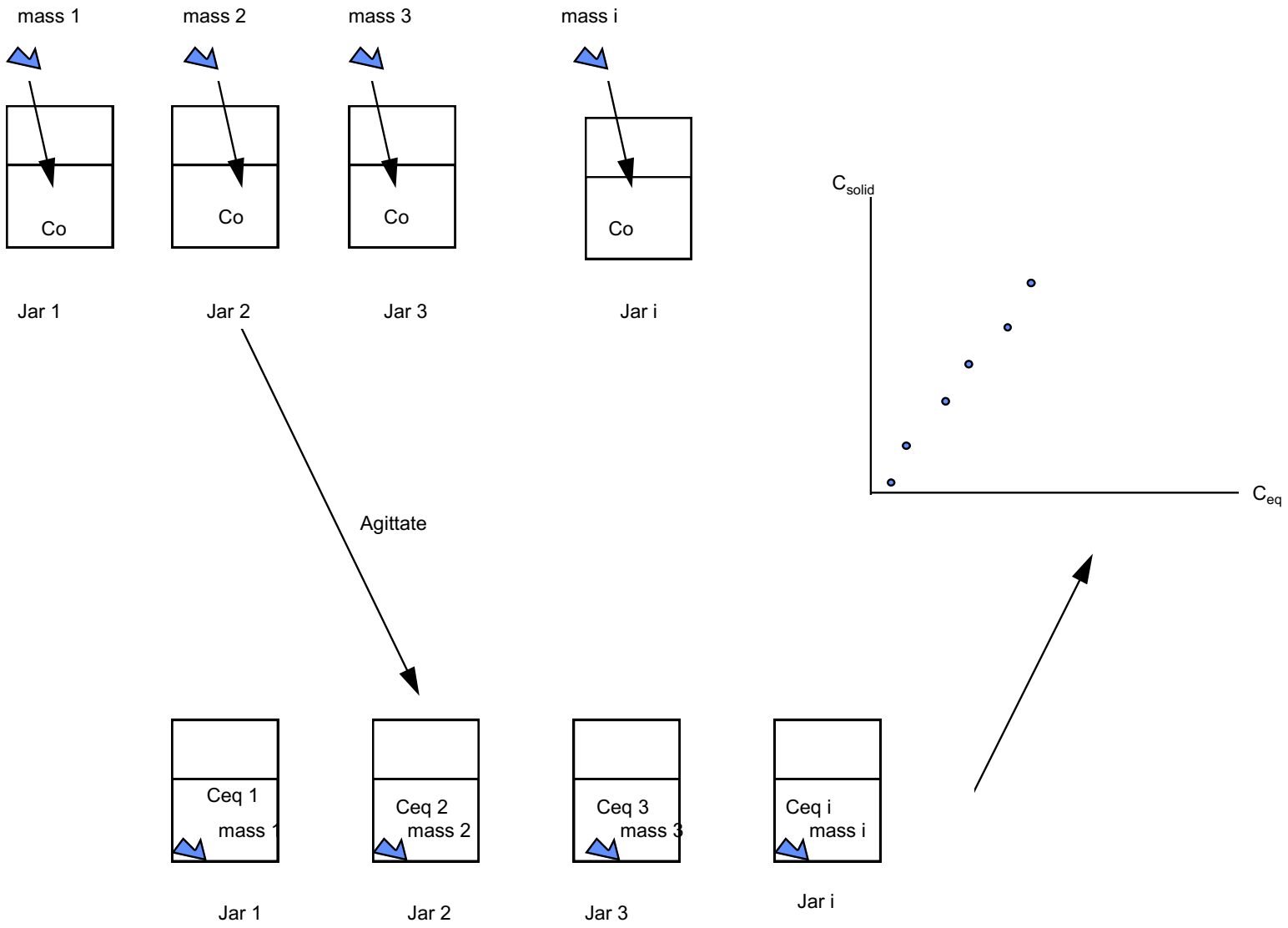
Ion-Exchange - ions are attracted to mineral surfaces substitute themselves into the mineral structure.

Chemisorption - solute is incorporated into a sediment by chemical reaction.

Absorbtion - solute diffuses into solid matrix and clings to interior surfaces.

All these reactions are controlled to a great extent by solution pH, EH, and salinity.

Isotherms


mass 1
mass 2
mass 3
mass i
Co
Co
Co
Co
Jar 1
Jar 2
Jar 3
Jar i
Agittate
Ceq 1
mass 1
Ceq 2
mass 2
Ceq 3
mass 3
Ceq i
mass i
Jar 1
Jar 2
Jar 3
Jar i
C_{solid}
C_{eq}

Linear Isotherm

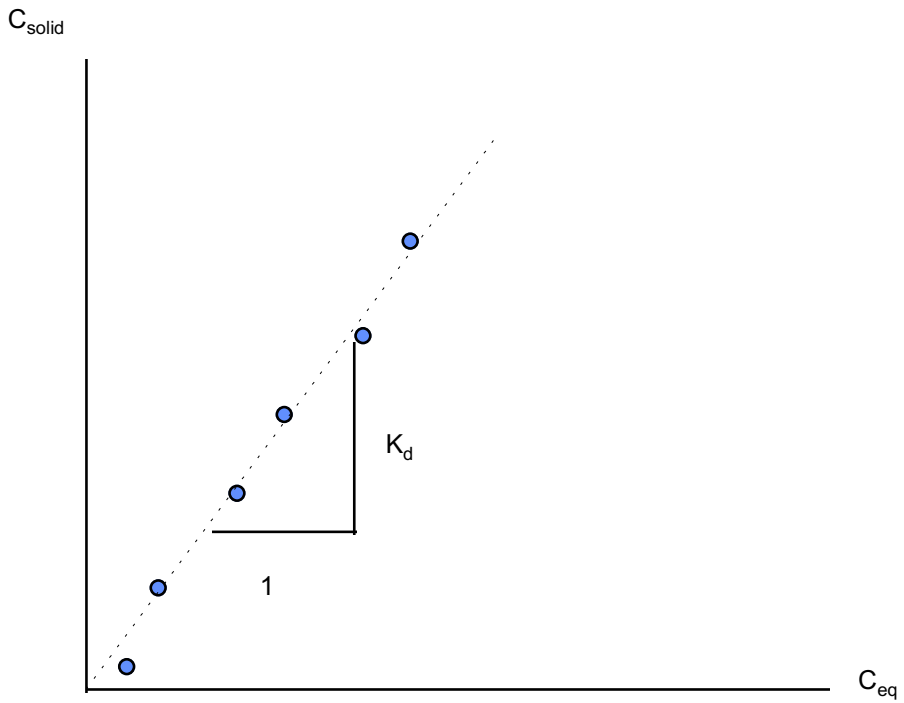
•If the data exhibits a straight-line relationship when plotted on arithmetic graph paper, then the isotherm is called a *linear equilibrium isotherm*.

•If, in addition to the linear relationship, the system assumes new equilibrium conditions very fast relative to the transport processes involved, then the isotherm is called an *instantaneous linear equilibrium isotherm*.

•The slope of the isotherm is called the distribution coefficient, K_d.

•The equation of the isotherm is: $C_{solid} = K_d C_{aq}$

•Expressed as a rate equation: $dC_{solid}/dt = K_d dC_{aq}/dt$



Freundlich Isotherm

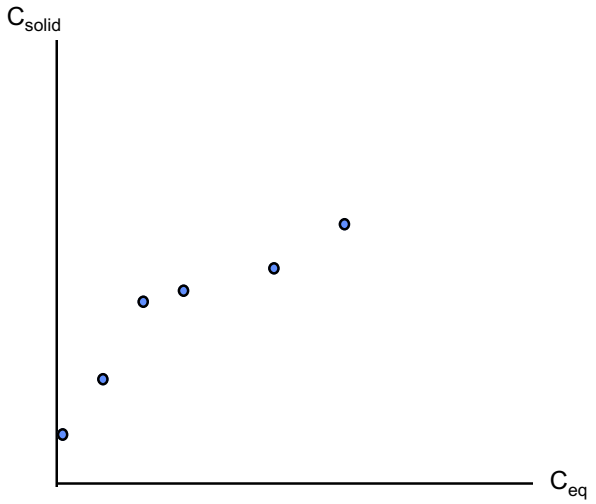
•If the data exhibits a straight-line relationship when plotted on log-log graph paper, then the isotherm is called a *Freundlich Isotherm*.

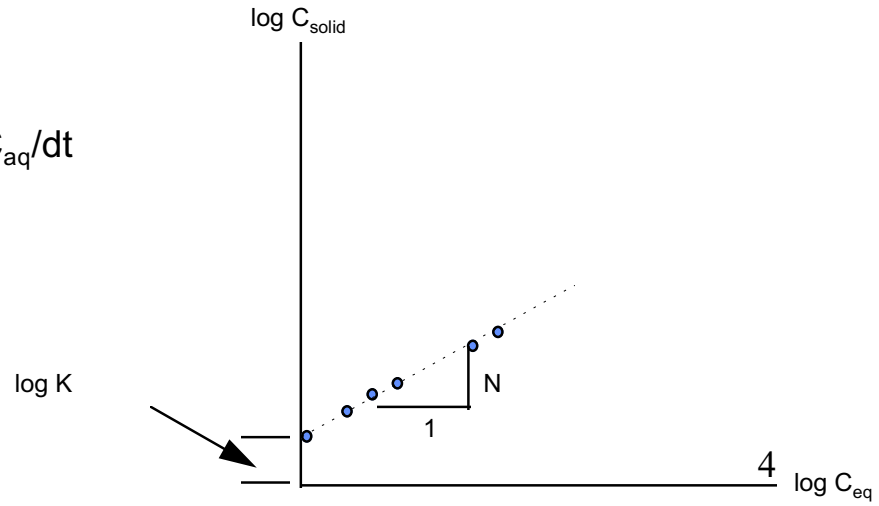
•If, in addition to the log-log linear relationship, the system assumes new equilibrium conditions very fast relative to the transport processes involved, then the isotherm is called an *instantaneous Freundlich equilibrium isotherm*.

•The slope of the isotherm is called Freundlich exponent, N, and the intercept is called the Freundlich distribution coefficient, K.

•The equation of the isotherm is : $C_{solid} = K\, C_{aq}^{N}$

•Expressed as a rate equation: $dC_{solid}/dt = KN\, C_{aq}^{N-1}\, dC_{aq}/dt$





Langmuir Isotherm

•If the data exhibits a straight-line relationship when C_{aq}/C_{solid} is plotted versus C_{aq} on arithmetic paper, then the isotherm is called a *Langmuir Isotherm*.

•If, in addition to the linear relationship of C_{aq}/C_{solid} versus C_{aq}, the system assumes new equilibrium conditions very fast relative to the transport processes involved, then the isotherm is called an *instantaneous Langmuir equilibrium isotherm*.

•The equation of the isotherm is:

$$C_{aq}/C_{solid} = 1/ab + C_{aq}/b$$

where a is an adsorbtion constant related to binding energy and b is the maximum amount of solute that can be adsorbed.

•To express as a rate equation rearrange as

$$C_{solid} = [abC_{aq}]/[1 + a\,C_{aq}]$$

$$dC_{solid}/dt = ([ab]*[1 + a\,C_{aq}]^{-2})dC_{aq}/dt$$