6. RETARDATION & ATTENUATION

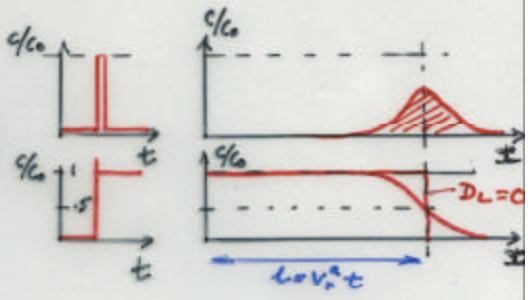
Reversible — Non-reversible

Advection, Dispersion } mechanisms of propogation of a "conservative" solute.

$$\frac{\partial c}{\partial t} = D_L \frac{\partial^2 c}{\partial x^2} - v \frac{\partial c}{\partial x}$$

Consequences:

1. Center of mass moves at velocity, V_a
2. $C/C_0 = \frac{1}{2}$ moves @ V_a



Potential for retardation:

Changes in concentration due to "reactions":
- Within aqueous phase
- With solid grains
- With gas in unsaturated zone.

Reactions grouped:

Sorption (Removal).

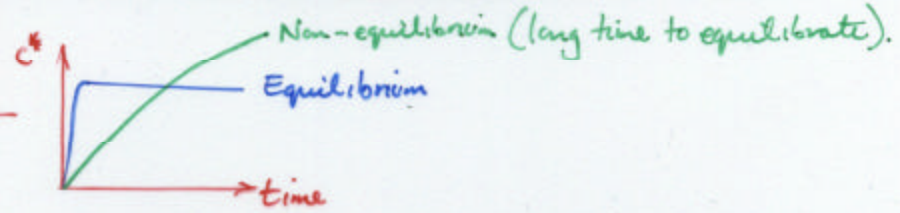
1. Adsorption - desorption
   eg. Organic solvents sorbing onto organic matter

Reactions (transformation)

2. Acid - base reactions. eg. AMD on limestone/carbonate
3. Solution - precipitation reactions. eg. Silica dissolution/feldspar in HDX
4. Oxidation - reduction reactions. eg. Oxidation of Fe in AMD
5. Ion-pairing and complexation reactions
6. Microbial cell synthesis reactions: eg. Biodegradation of gasoline and solvents. → methane

+ Radioactive decay

CLASSIFICATION OF CHEMICAL REACTIONS



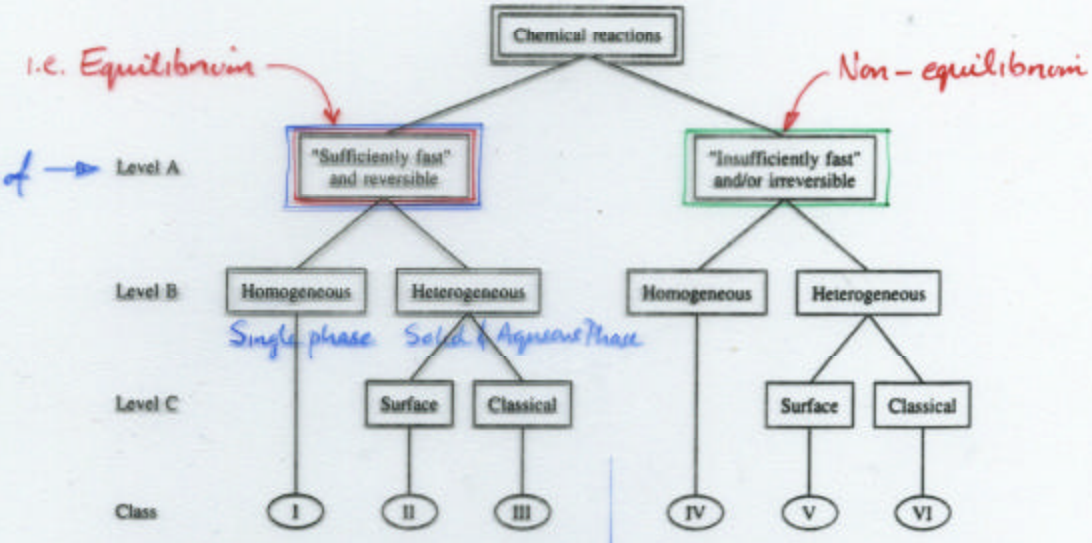


FIGURE 3.1 Classification of chemical reactions useful in solute transport analyses. Source: J. Rubin, *Water Resources Research* 19, no. 5 (1983): 1231–52. Published by the American Geophysical Union.

SORPTION PROCESSES

NON-EQUILIBRIUM REACTIONS

All these reactions accommodated by simple retardation type models.

Use

$$\frac{\partial C}{\partial t} = \frac{D_L}{R}\frac{\partial^2 C}{\partial x^2} - \frac{V}{R}\frac{\partial C}{\partial x}$$