Cycles biogéochimiques et disponibilité des nutriments.

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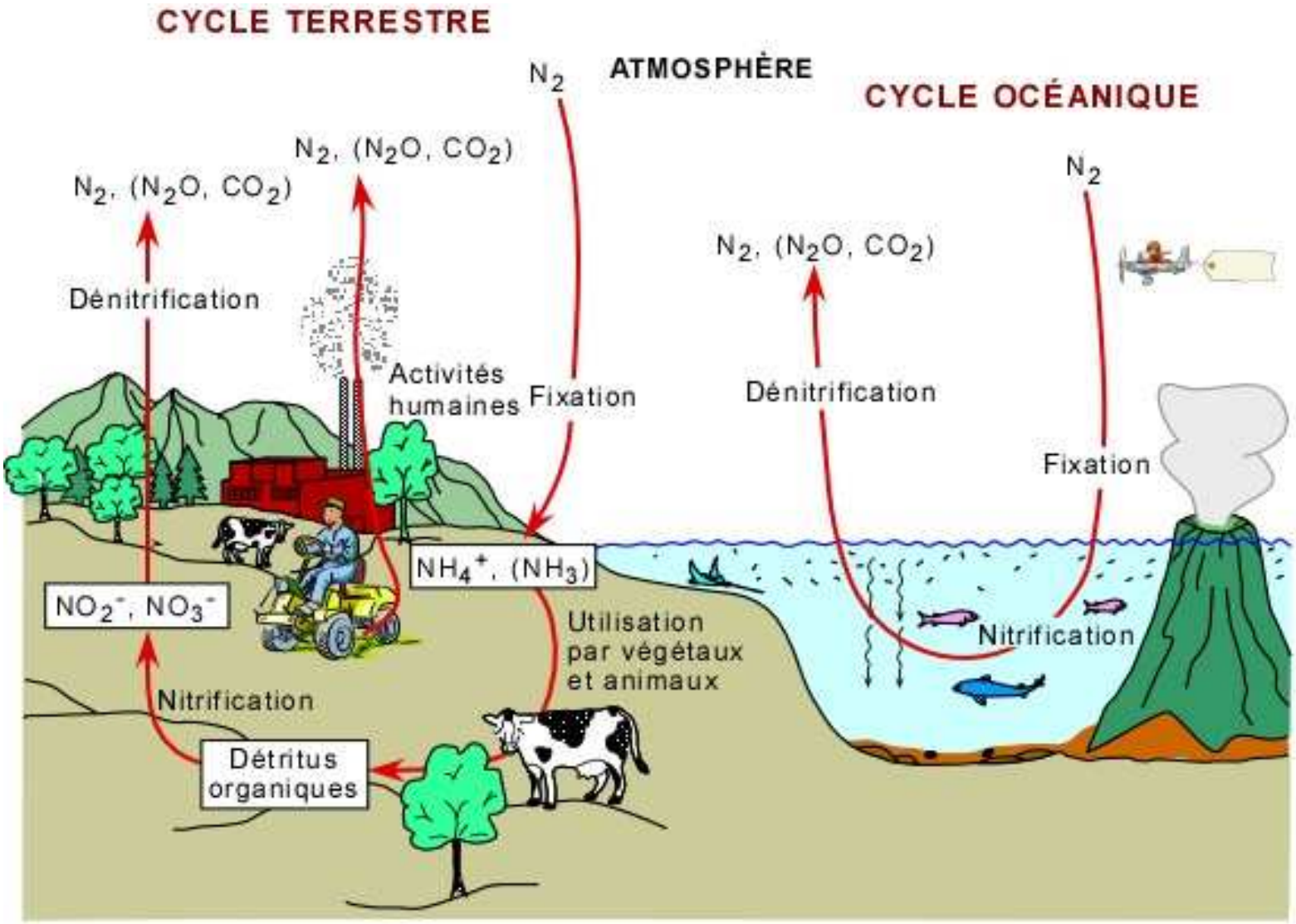
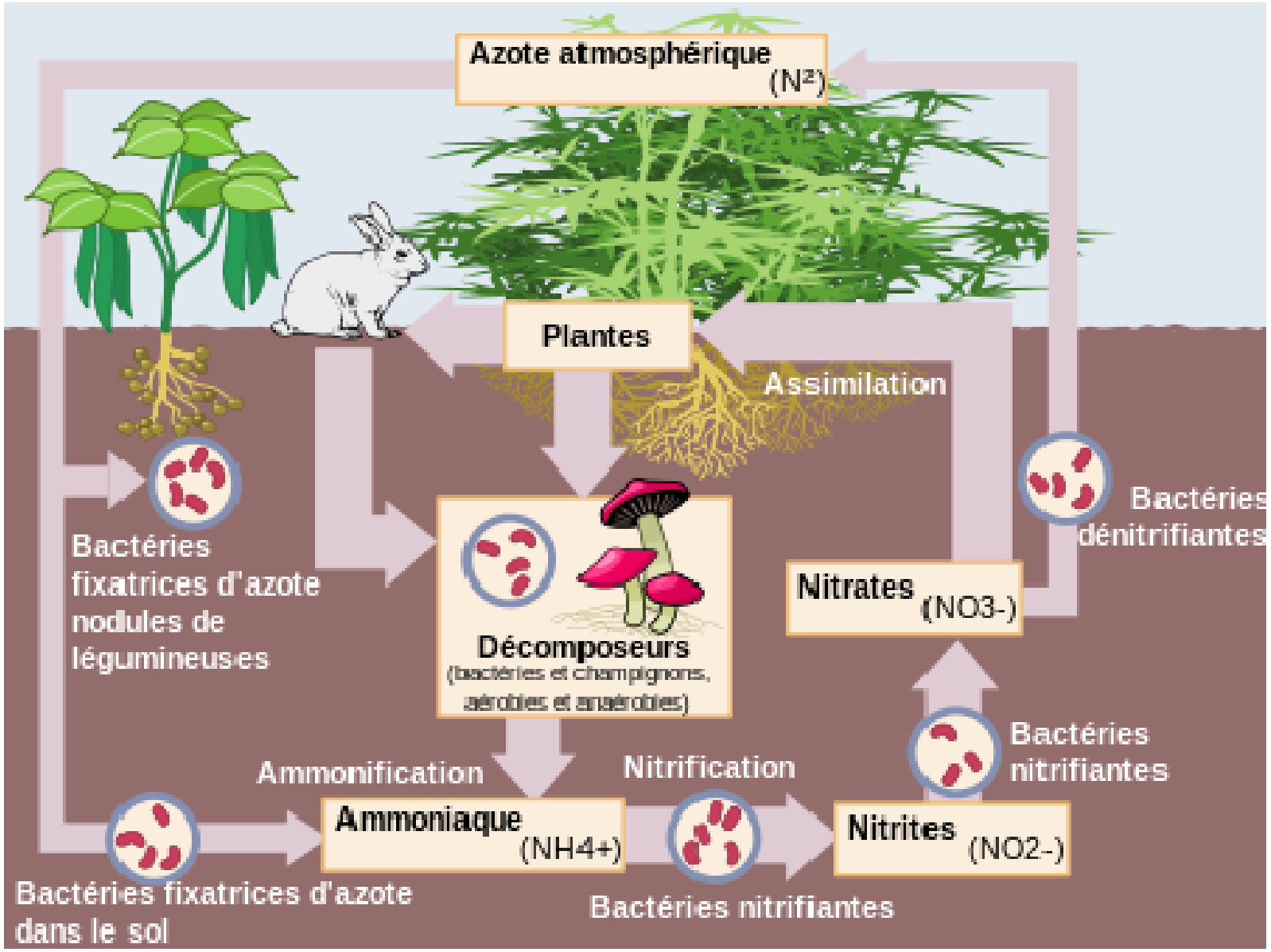
UMR Eco&Sols, INRA, Montpellier

Cycles des nutriments : cas de l'azote (1).



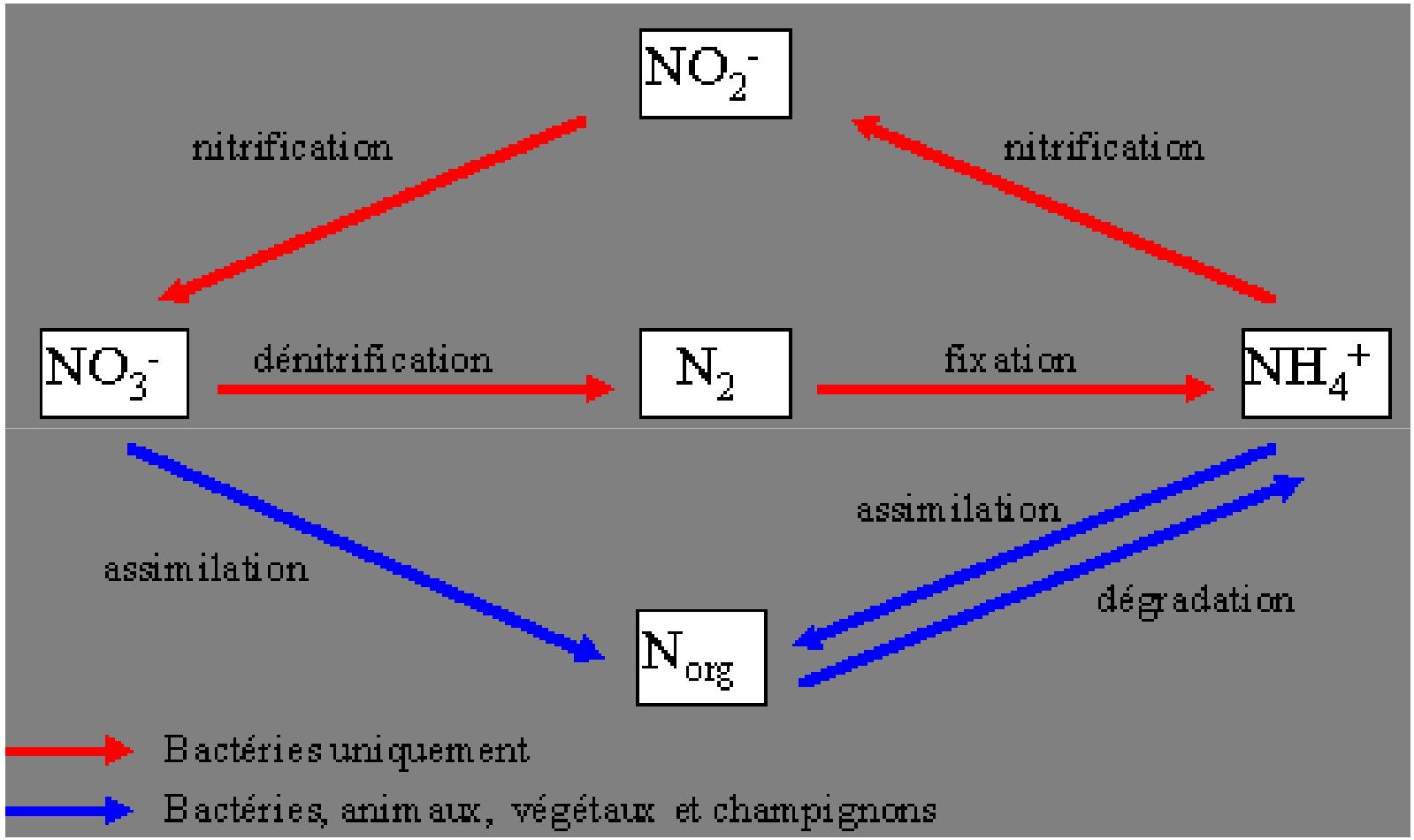
http://ecoloyolo.weebly.com/cycle-de-lazote.html

Cycles des nutriments : cas de l'azote (2).



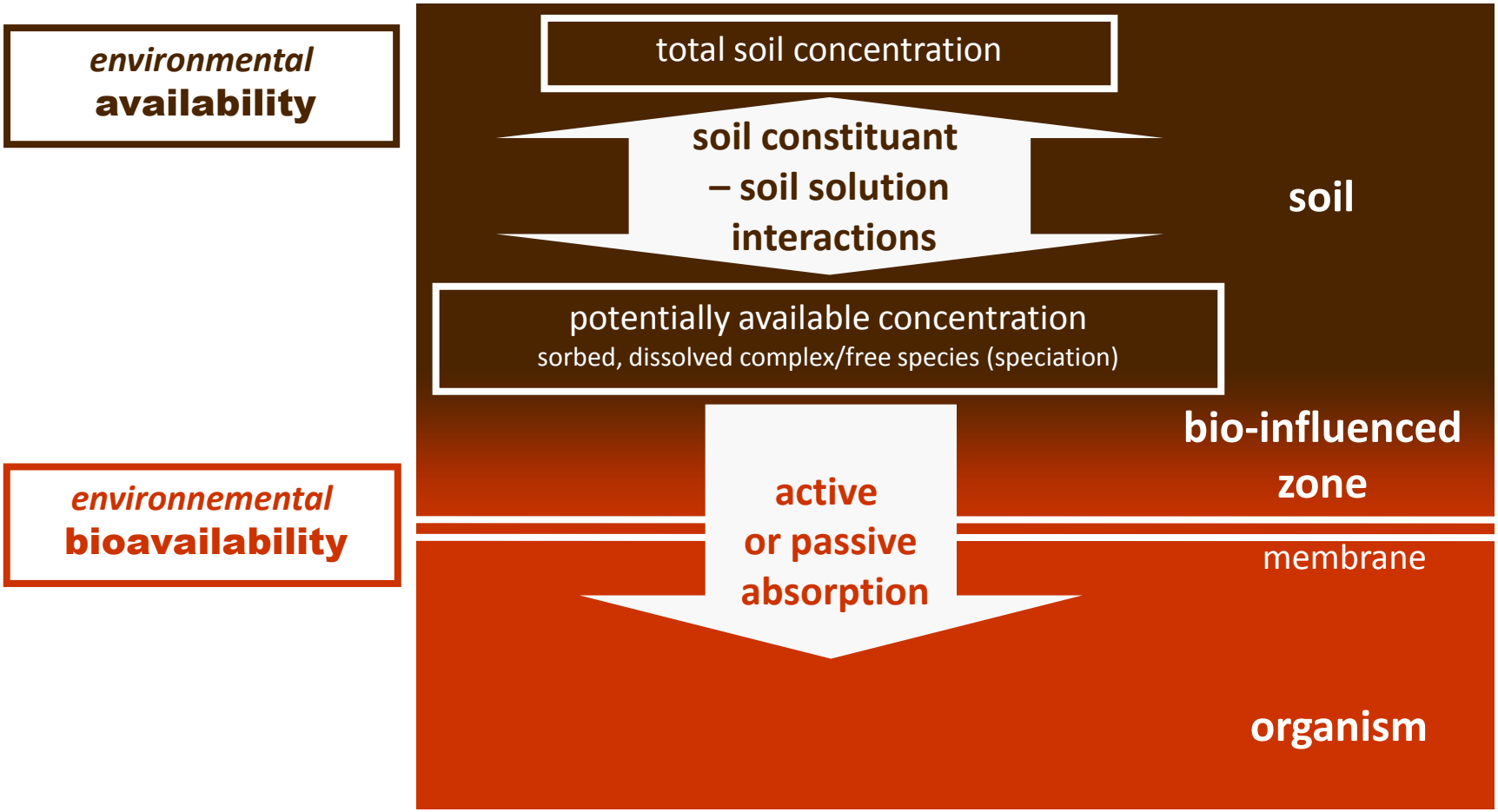
http://fr.wikipedia.org/wiki/Cycle_de_l'azote

Cycles des nutriments : cas de l'azote (3).



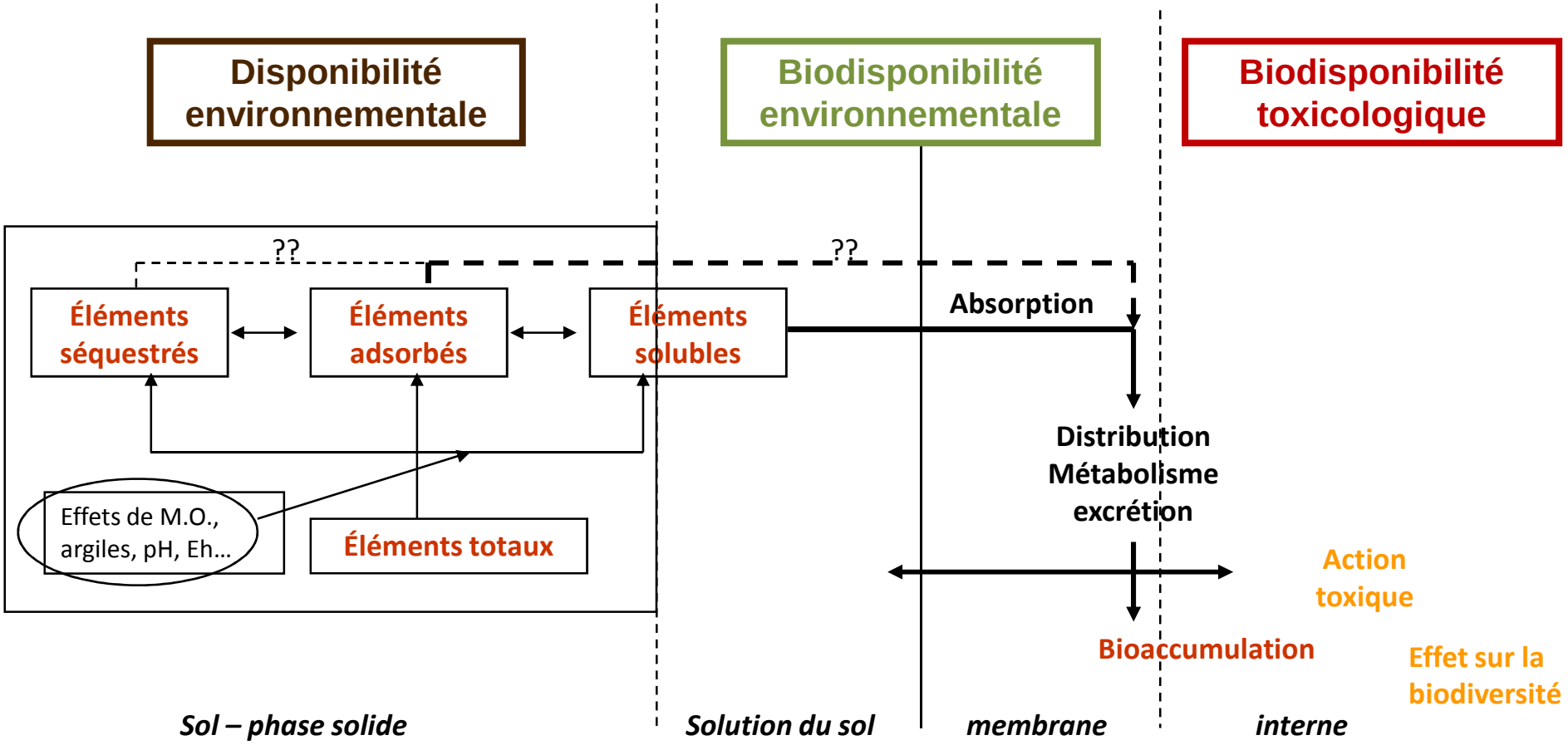
http://ecoloyolo.weebly.com/cycle-de-lazote.html

Biodisponibilité.



→ **availability is changing in the bio-influenced zone !!!**

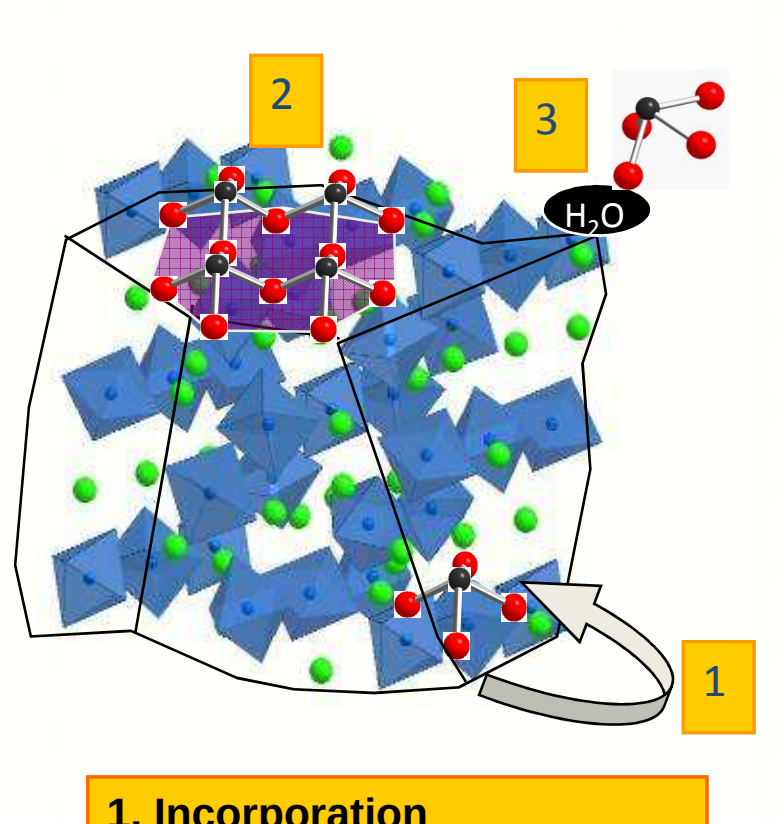
Biodisponibilité.



Becquer, 2005, HDR.

Adapté d'après Peijnenburg et Jager, 2003 et Lanno et al., 2004

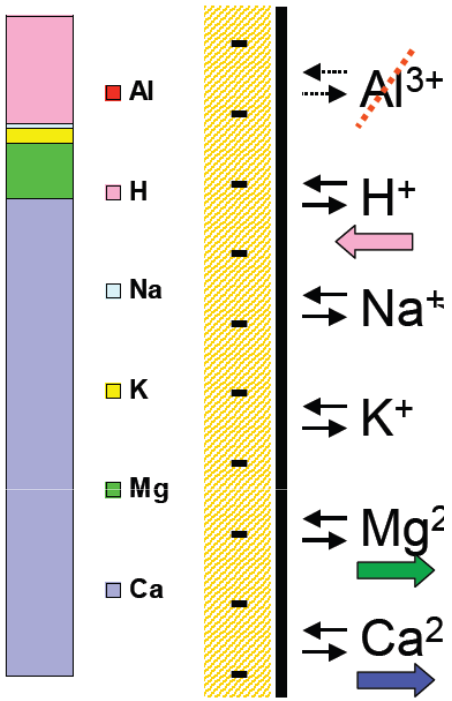
Biodisponibilité environnementale.

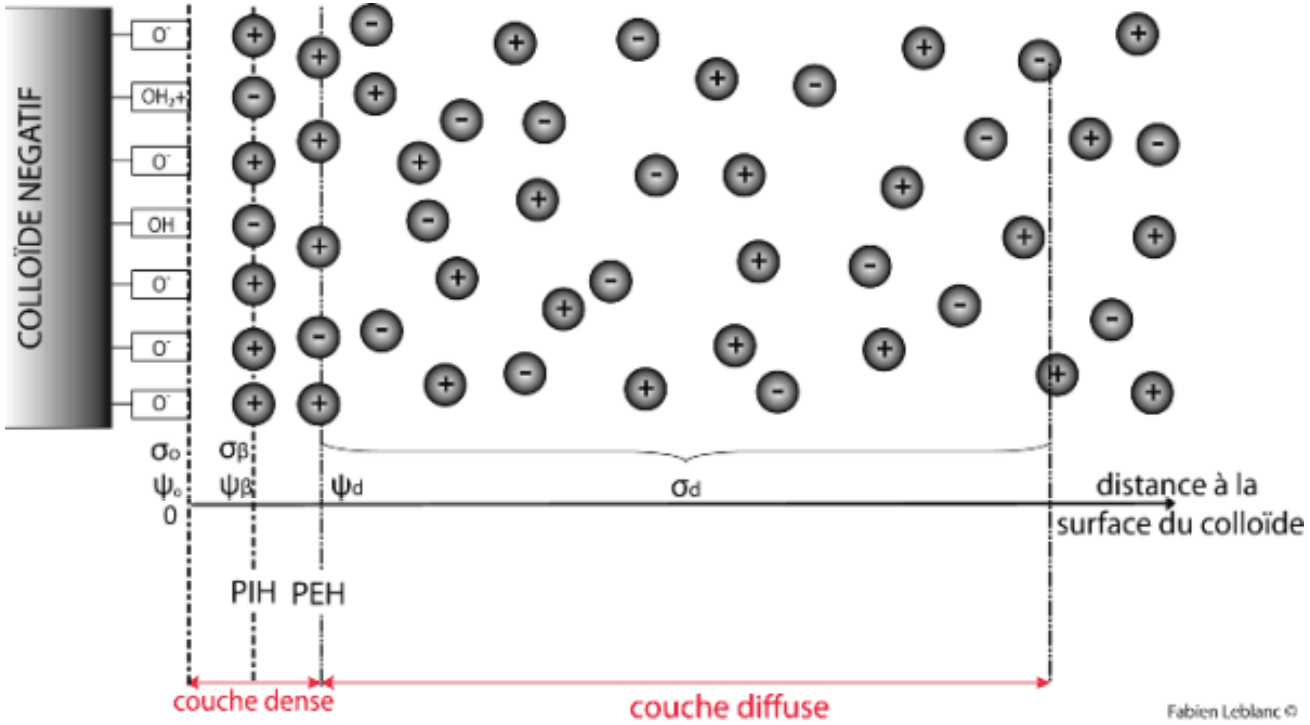


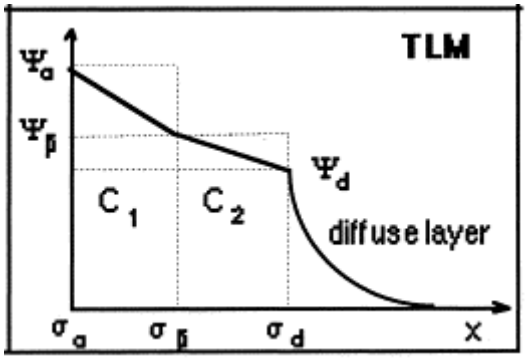
1. Incorporation
2. Précipitation de Surface
3. Échange ionique
Etc…

- **Spéciation des éléments dans les sols**
  - Formes chimiques des éléments
  - Localisation au sein des composants du sol
- **Rétention des éléments dans les sols**
  - **Réactions d'adsorption-désorption (échange ionique)**
  - Réactions de complexation
  - Réactions de précipitation
  - Mobilisation biologique

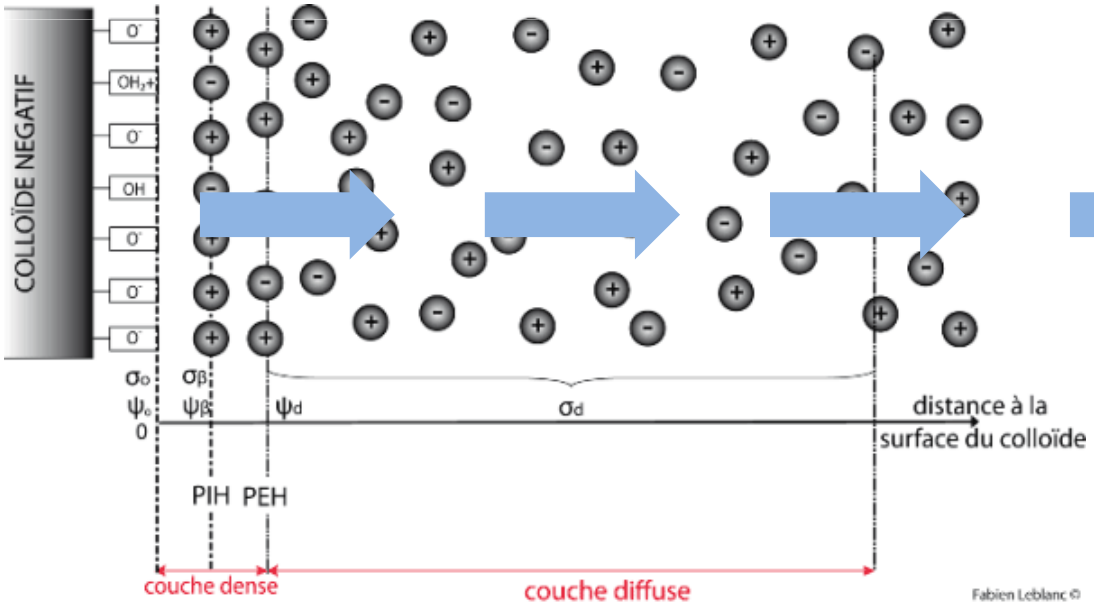
Capacité d'échange.



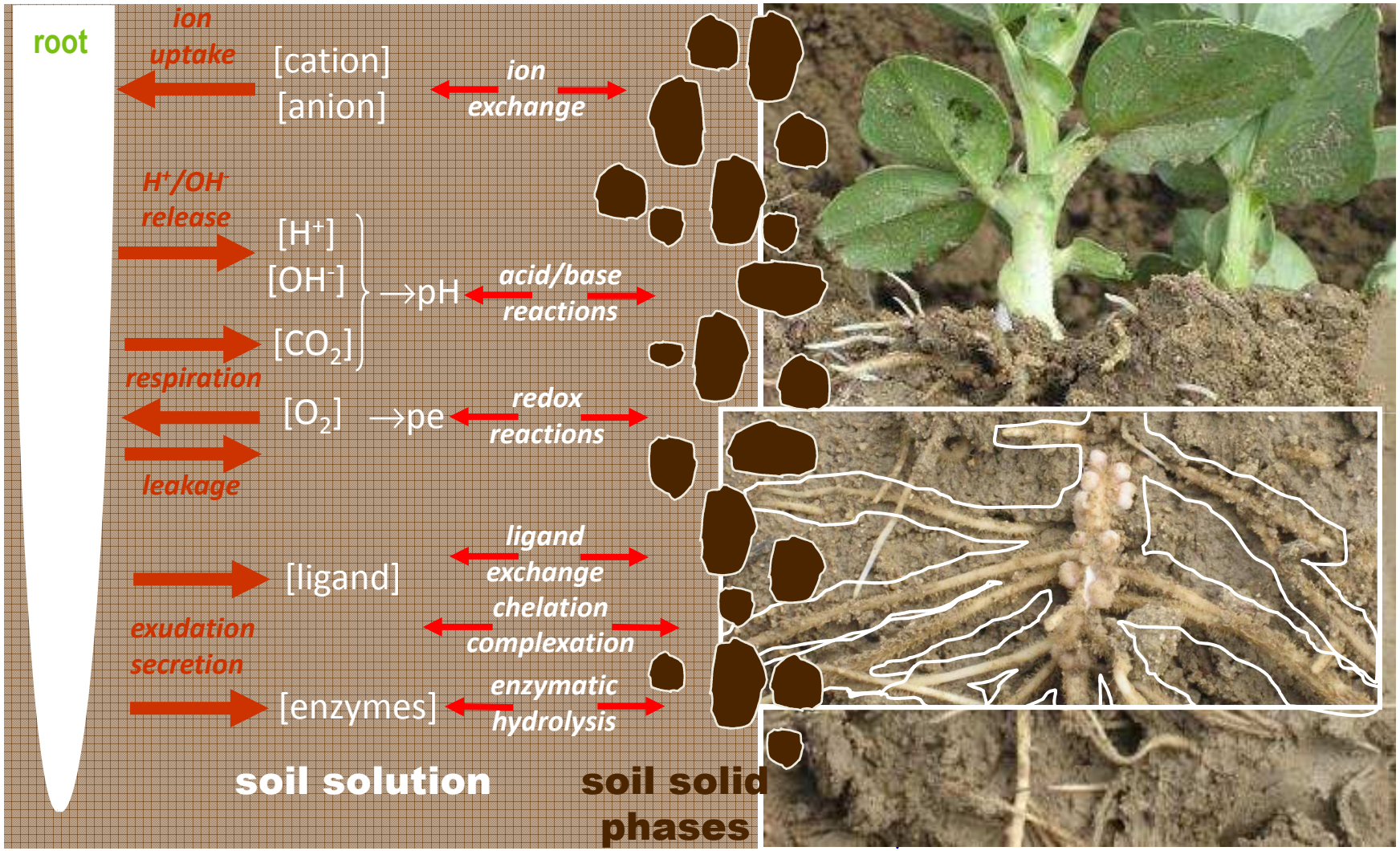




Transfert sol-plante.

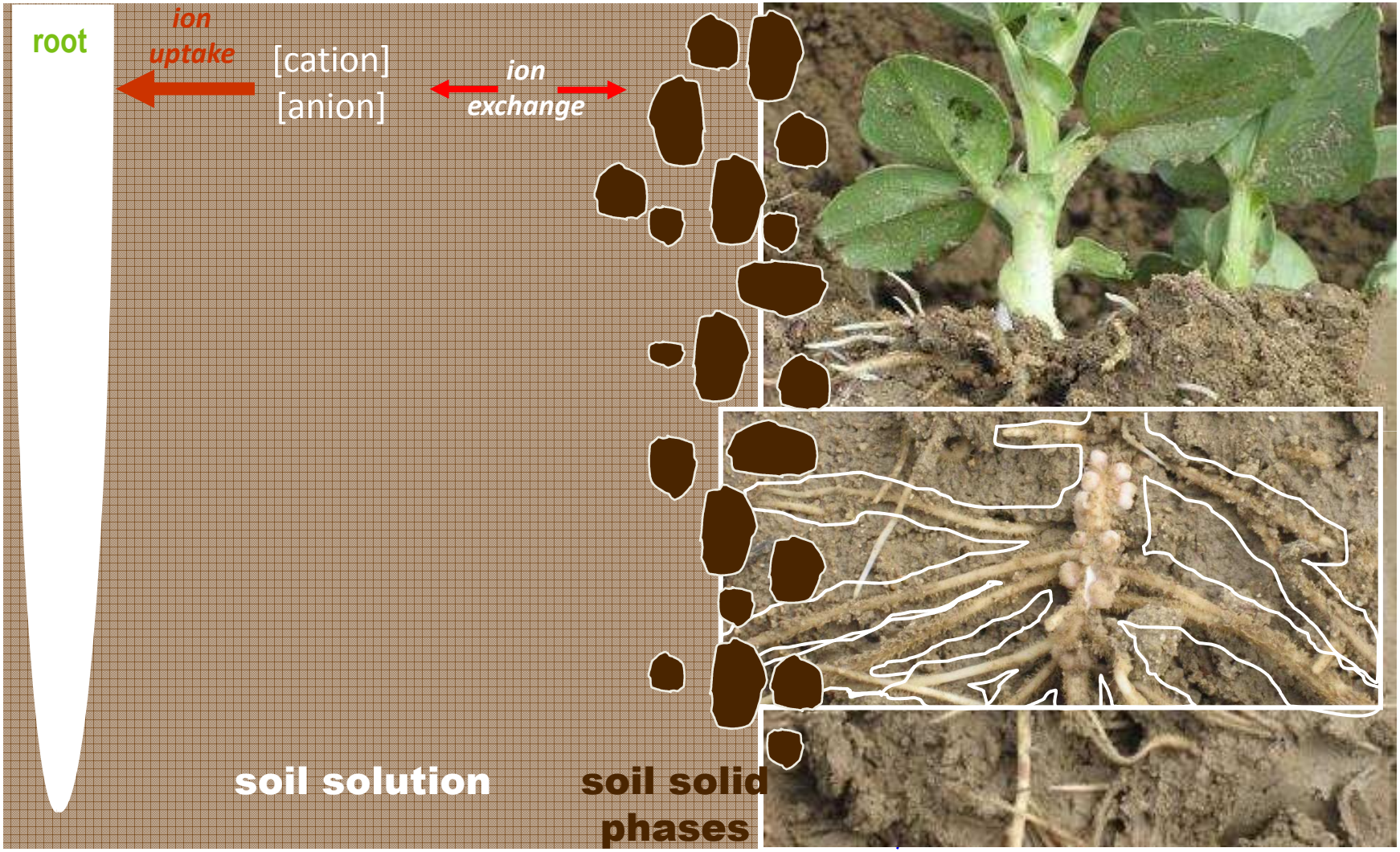


Processus déterminant la disponibilité du P dans la rhizosphère.

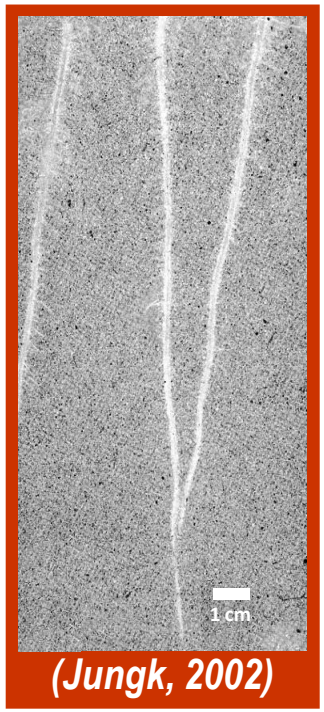


Major biogeochemical processes determining P bioavailability in the rhizosphere

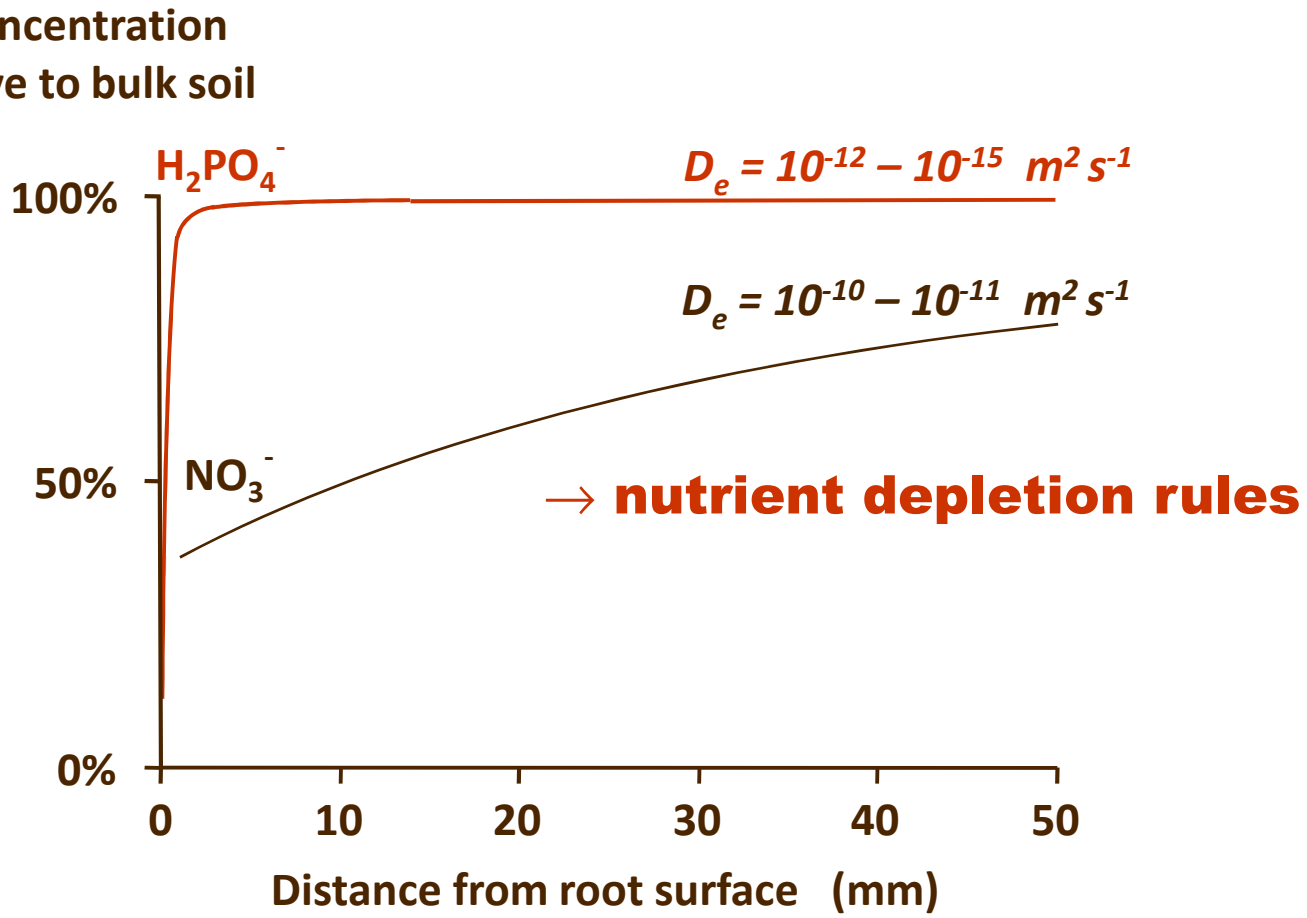
*(**Hinsinger, Gobran, Gregory & Wenzel, 2005** – New Phytol. 195*
***Hinsinger, Jaillard, Le Cadre & Plassard, 2007** – Oceanis 33)*


root
ion
uptake
[cation]
[anion]
ion
exchange
soil solution
soil solid
phases

Diffusion.



(Jungk, 2002)

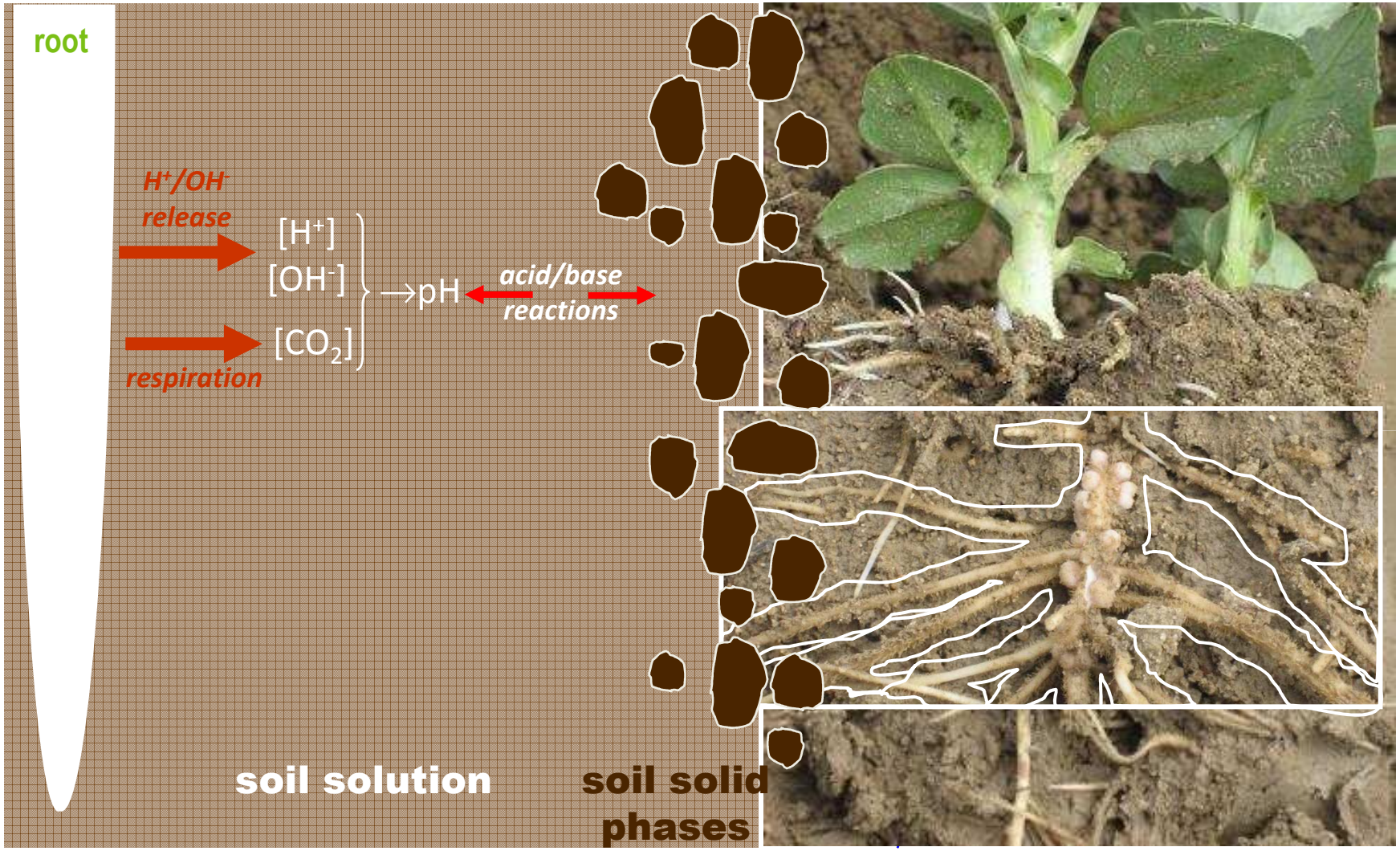


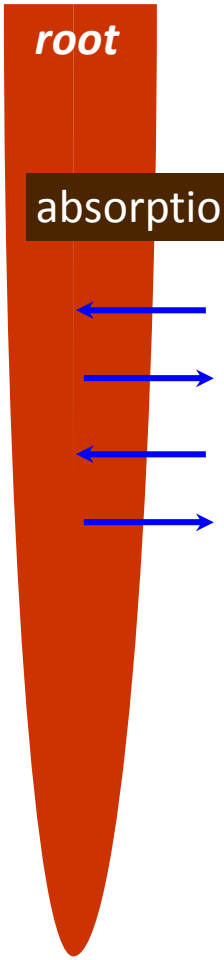
Rhizosphere P is depleted to a lesser extent than mobile nutrients such as N

***(Hinsinger, 2004 –** Encyclopedia Plant Crop Sci.)*

because of its lower diffusion coefficients in soils - D_e

***(Jungk, 2002 –** In : Plant Roots The Hidden Half)*


root
H+/OH- release
[H+]
[OH-]
→pH
acid/base reactions
[CO2]
respiration
soil solution
soil solid phases



C^+ Cation (K^+, NH_4^+, Ca^{2+}, …)

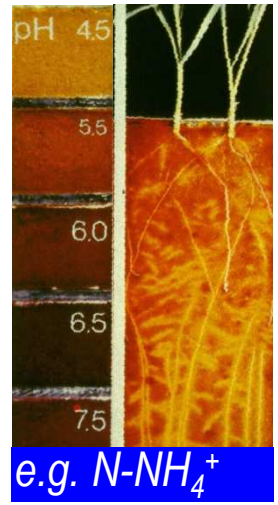
H^+

A^- Anion (NO_3^-, $H_2PO_4^-$, …)

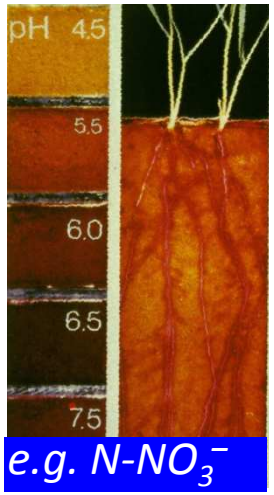
OH^-

pH changes in the rhizosphere of wheat

(Römheld, 1986)



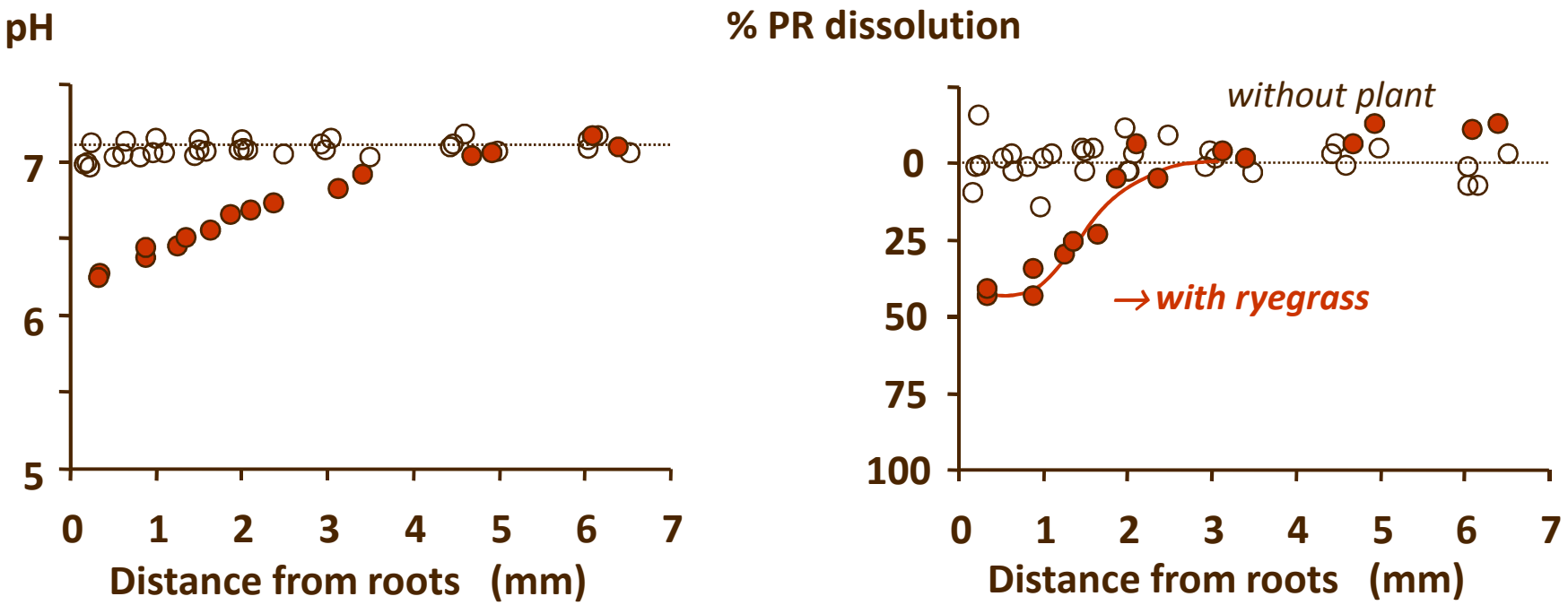
if $\Sigma C^+ > \Sigma A^-$



if $\Sigma C^+ < \Sigma A^-$

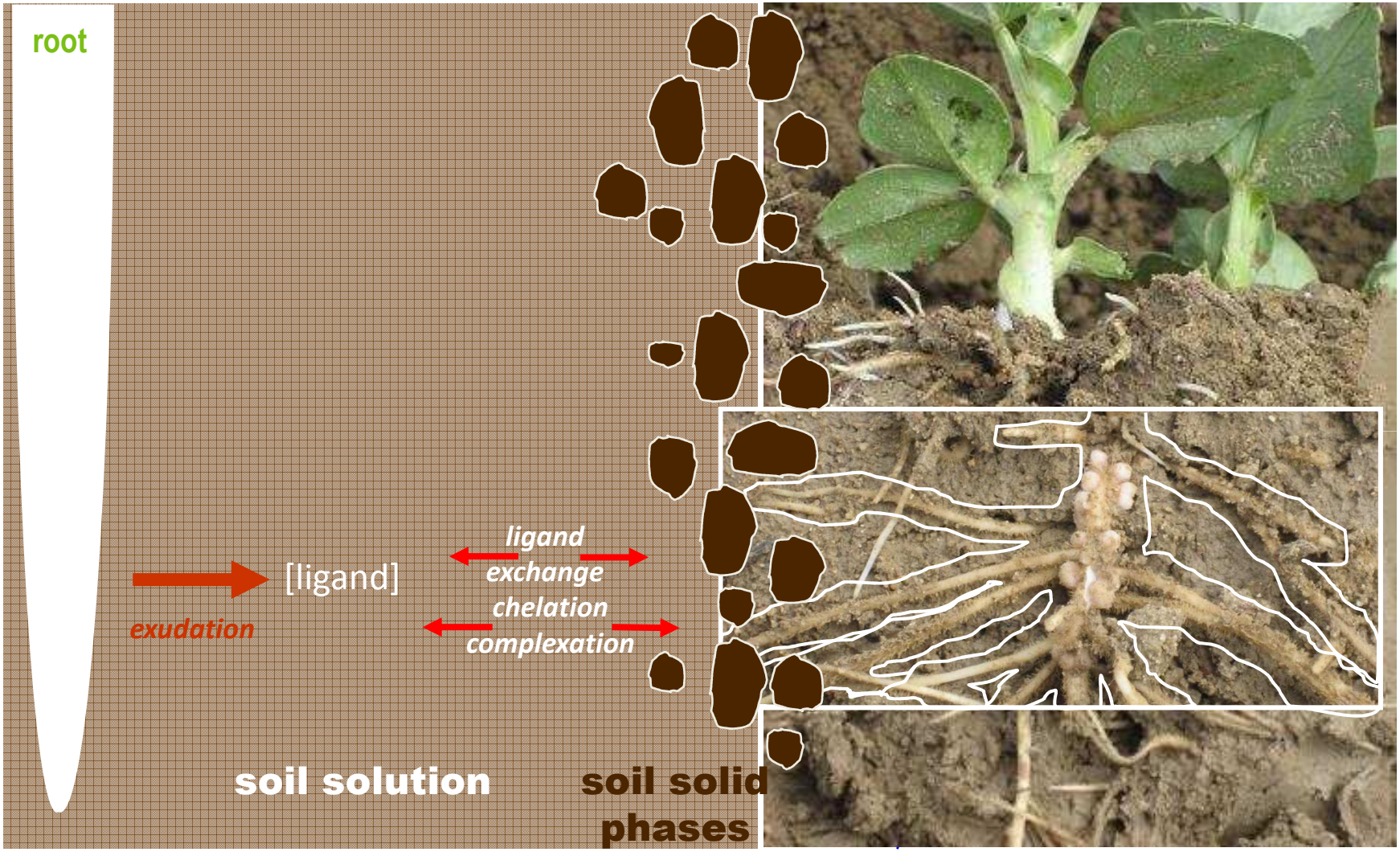
Major origin of pH changes in the rhizosphere – balancing the exchanged charges

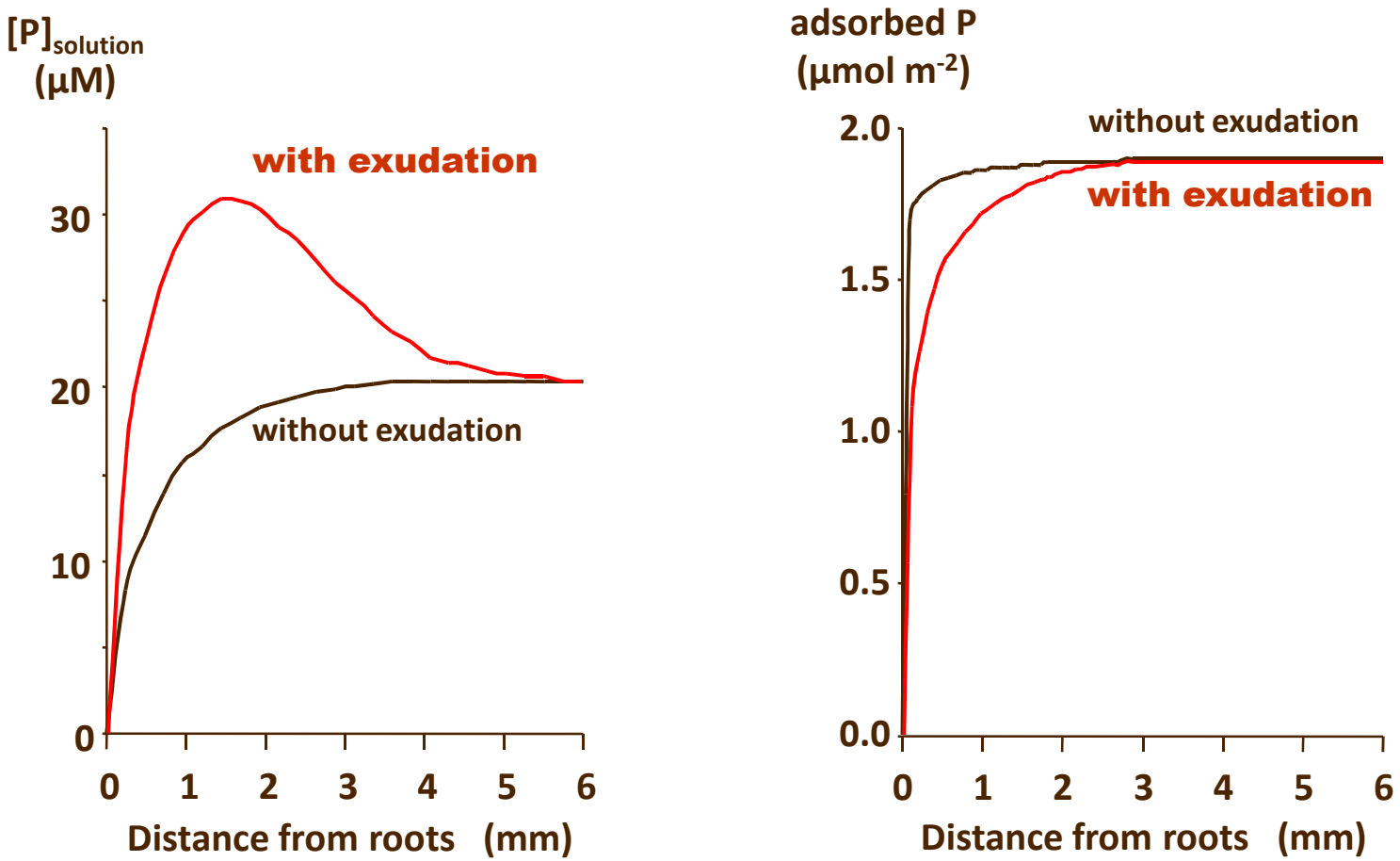
***(Hinsinger, Plassard, Tang & Jaillard, 2003** - Plant Soil 248)*



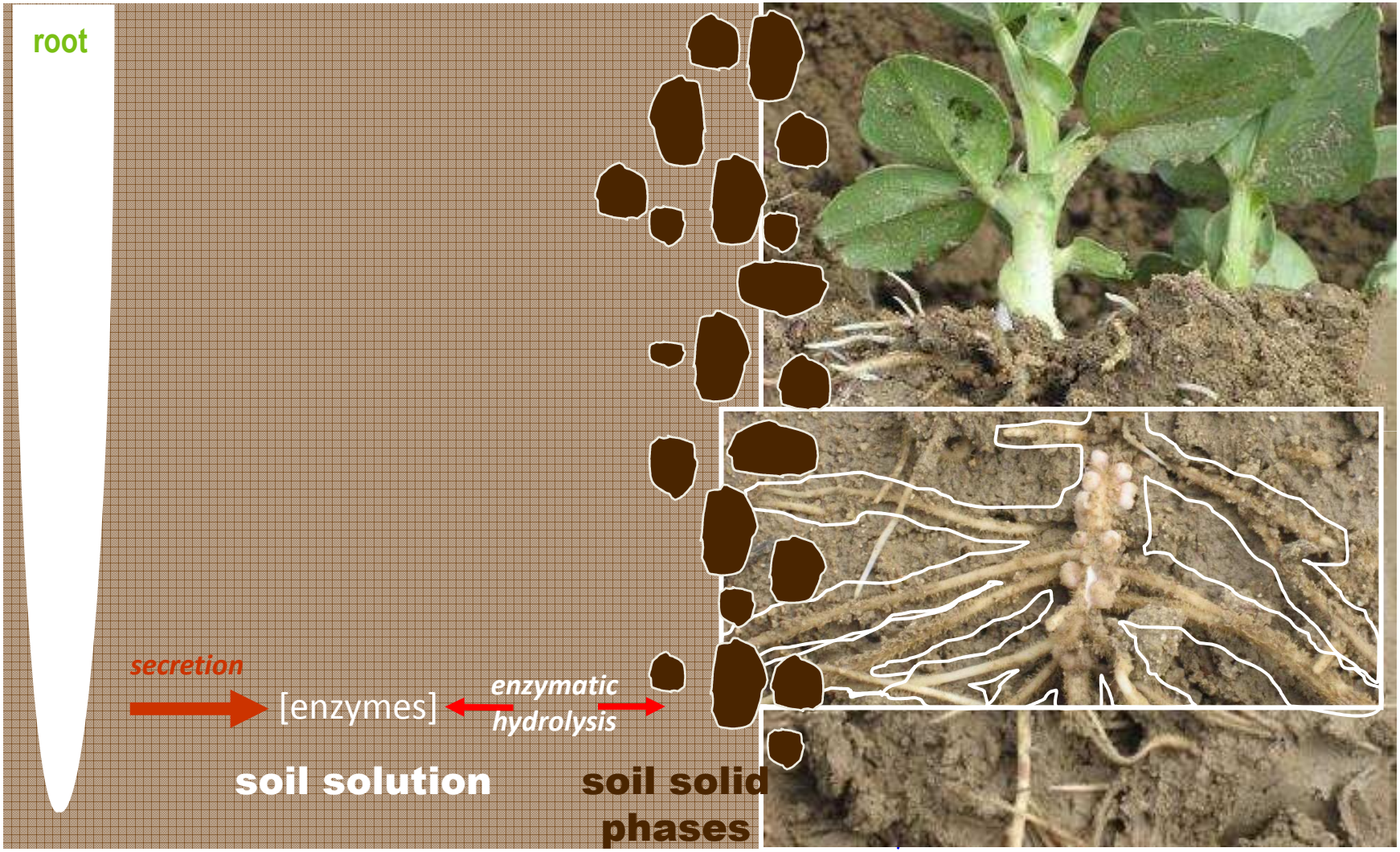
Root-induced acidification and dissolution of phosphate rock (PR) in the rhizosphere of ryegrass (*Lolium rigidum*) supplied with ammonium

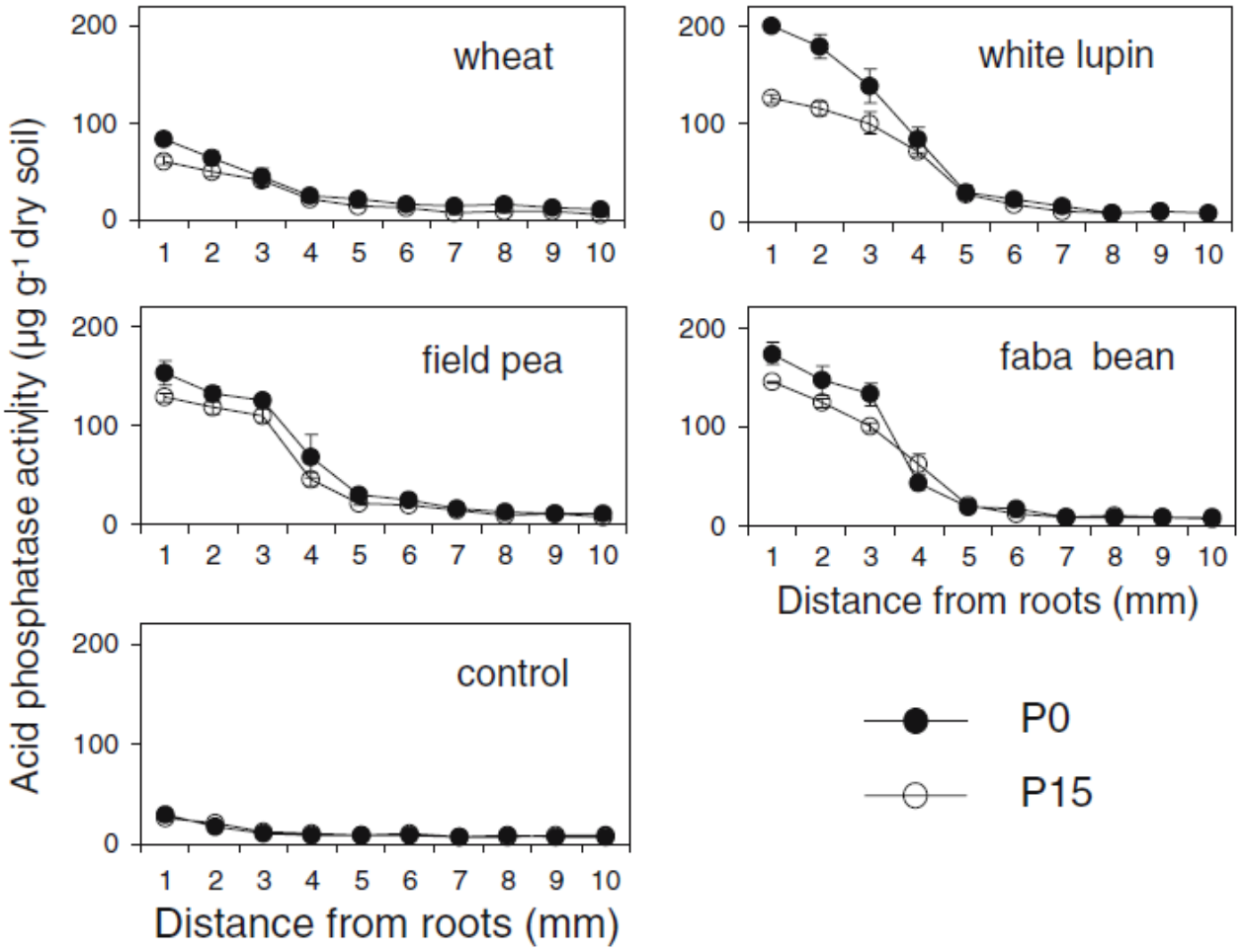
***(Hinsinger & Gilkes, 1996 –** Eur. J. Soil Sci. 47)*


root
[ligand]
exudation
ligand exchange
chelation
complexation
soil solution
soil solid phases



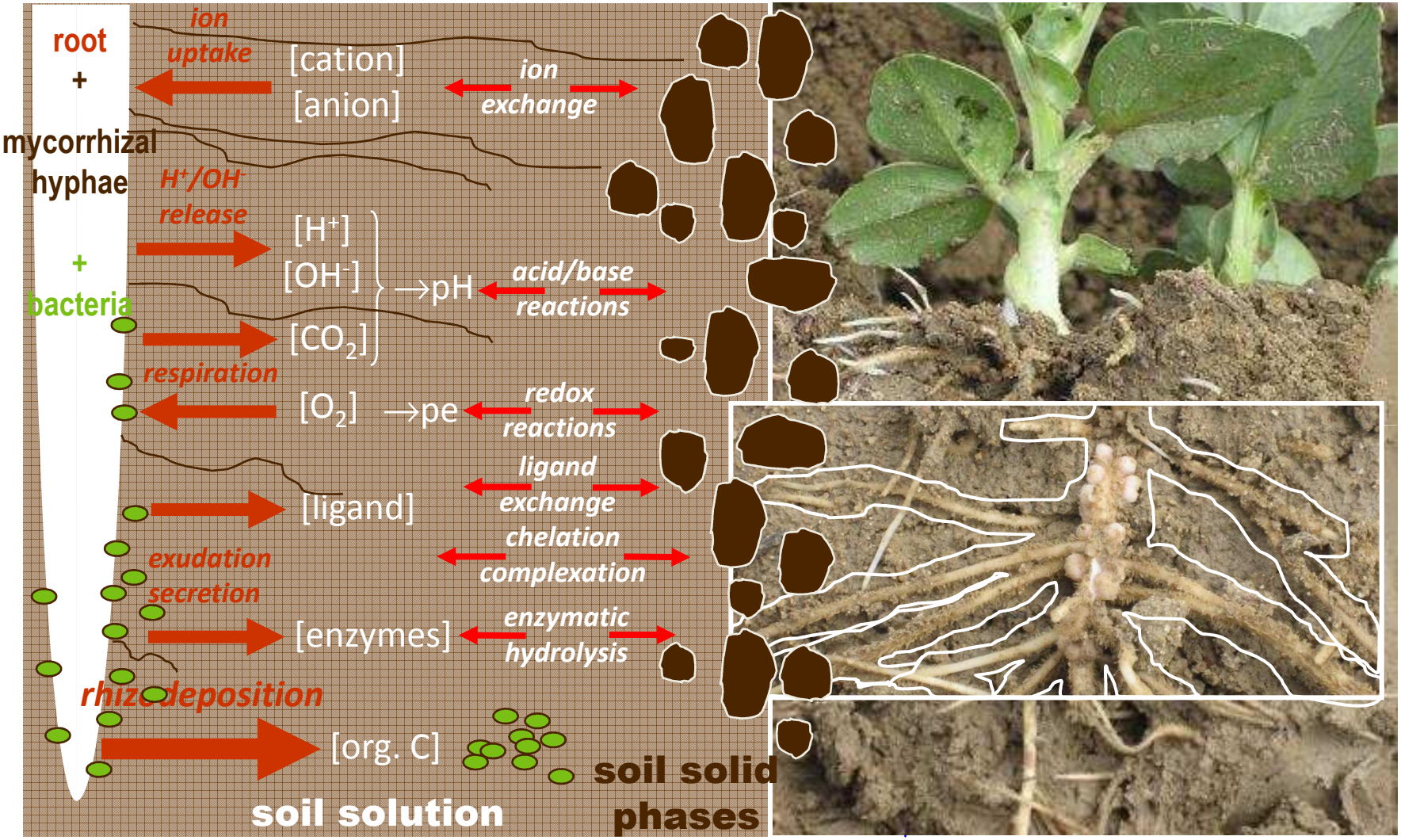
Solution P concentration and the desorption of goethite-P increase as a result of citrate exudation in the rhizosphere of maize according to model simulations ***(Geelhoed, van Riemsdijk & Findenegg, 1999*** *– Eur. J. Soil Sci. 50)*


root
secretion
[enzymes]
enzymatic
hydrolysis
soil solution
soil solid
phases



Acid phosphatase activity is consistently increased in the rhizosphere for a range of crop species, relative to unplanted control soil

***(Nuruzzaman, Lambers, Bolland & Veneklaas, 2006** – Plant Soil 281)*


root
+
mycorrhizal
hyphae
+
bacteria
ion
uptake
[cation]
[anion]
ion
exchange
H+/OH-
release
[H+]
[OH-]
→pH
acid/base
reactions
[CO2]
respiration
[O2]
→pe
redox
reactions
ligand
exchange
chelation
complexation
[ligand]
exudation
secretion
[enzymes]
enzymatic
hydrolysis
rhizodeposition
[org. C]
soil solution
soil solid
phases