

COURS DISPONIBLE SUR INTERNET

Serveur step.ipgpp.jussieu.fr

→ TICE

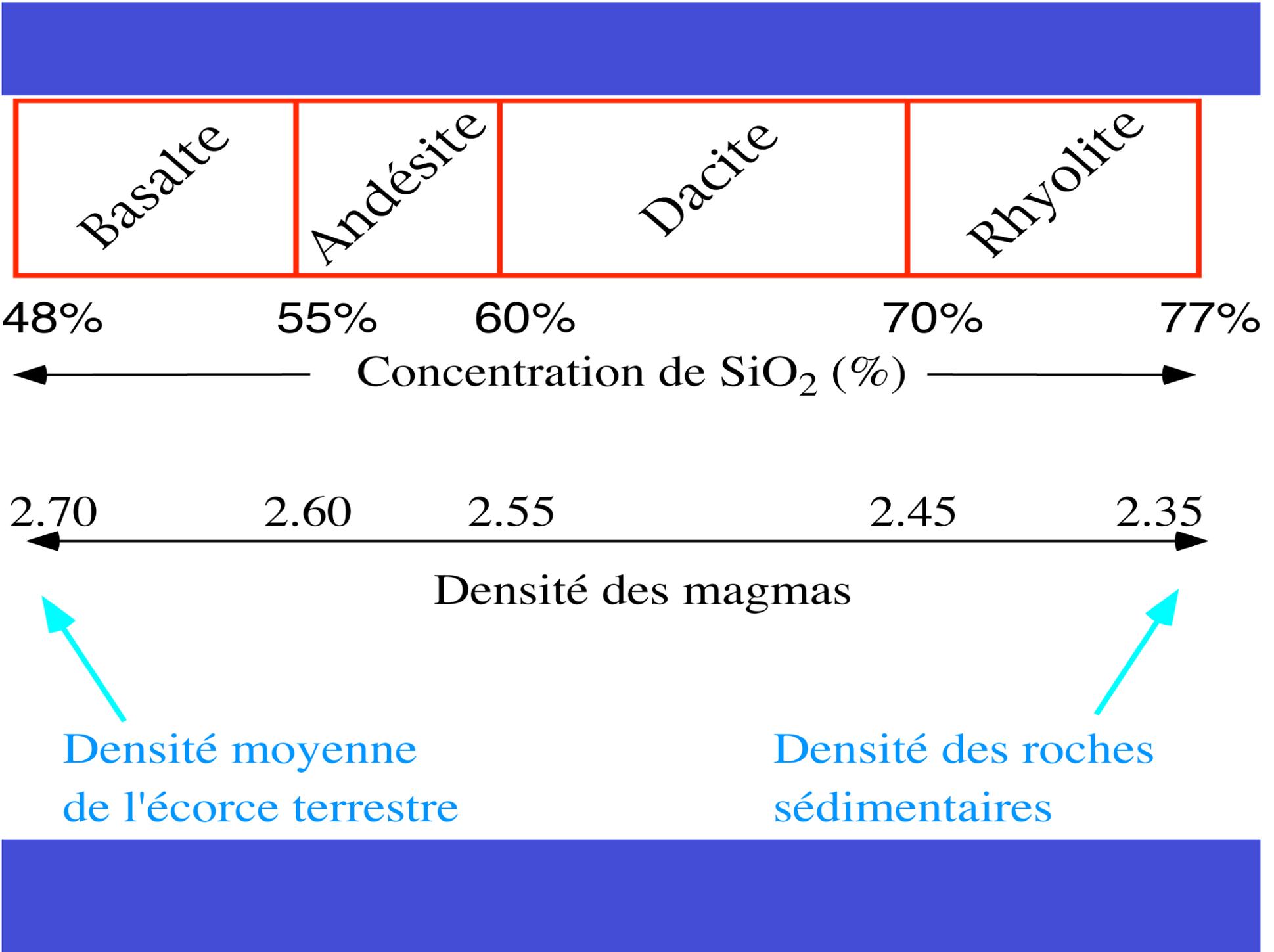
→ Serveur de Cours

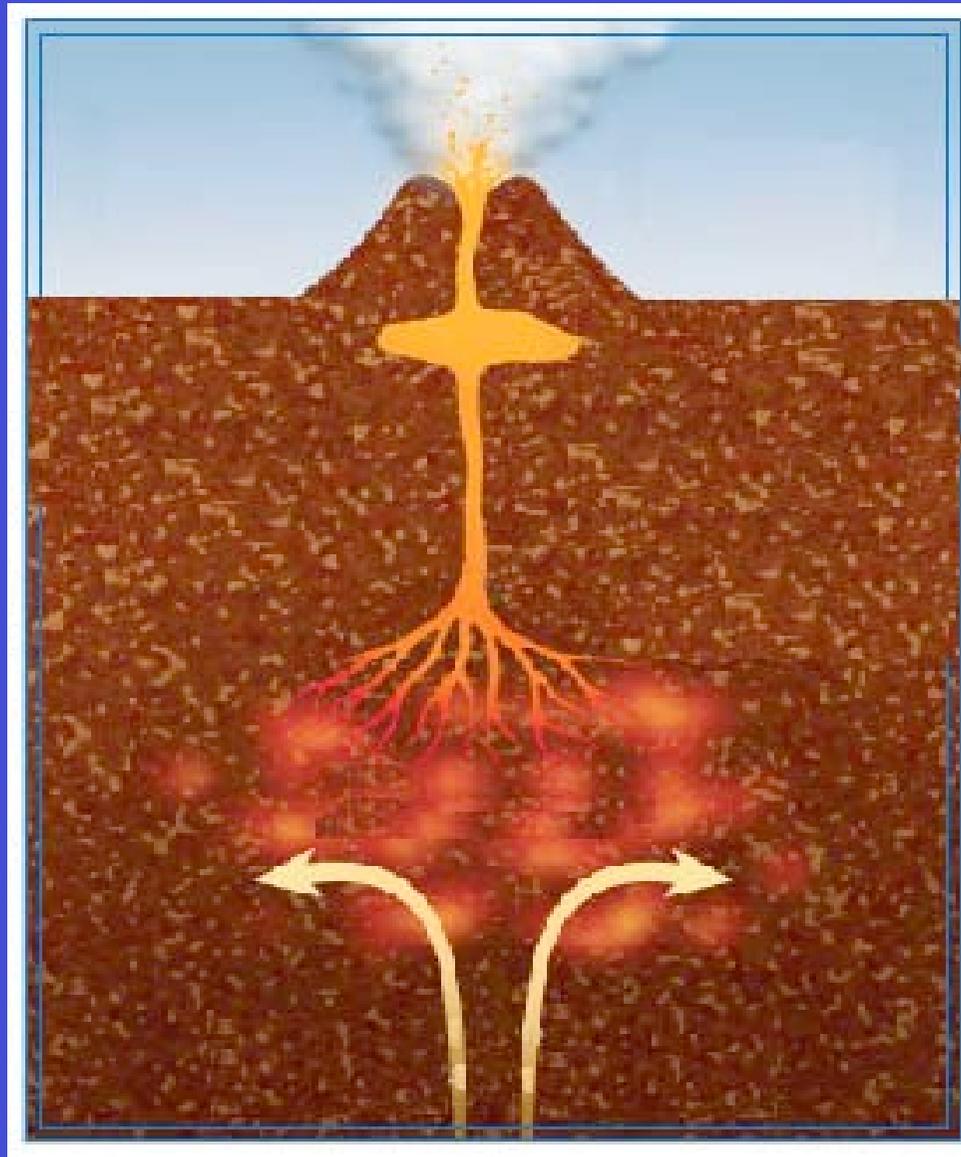
III – Phénomènes Géologiques Méso Echelle

8°) Volcanisme

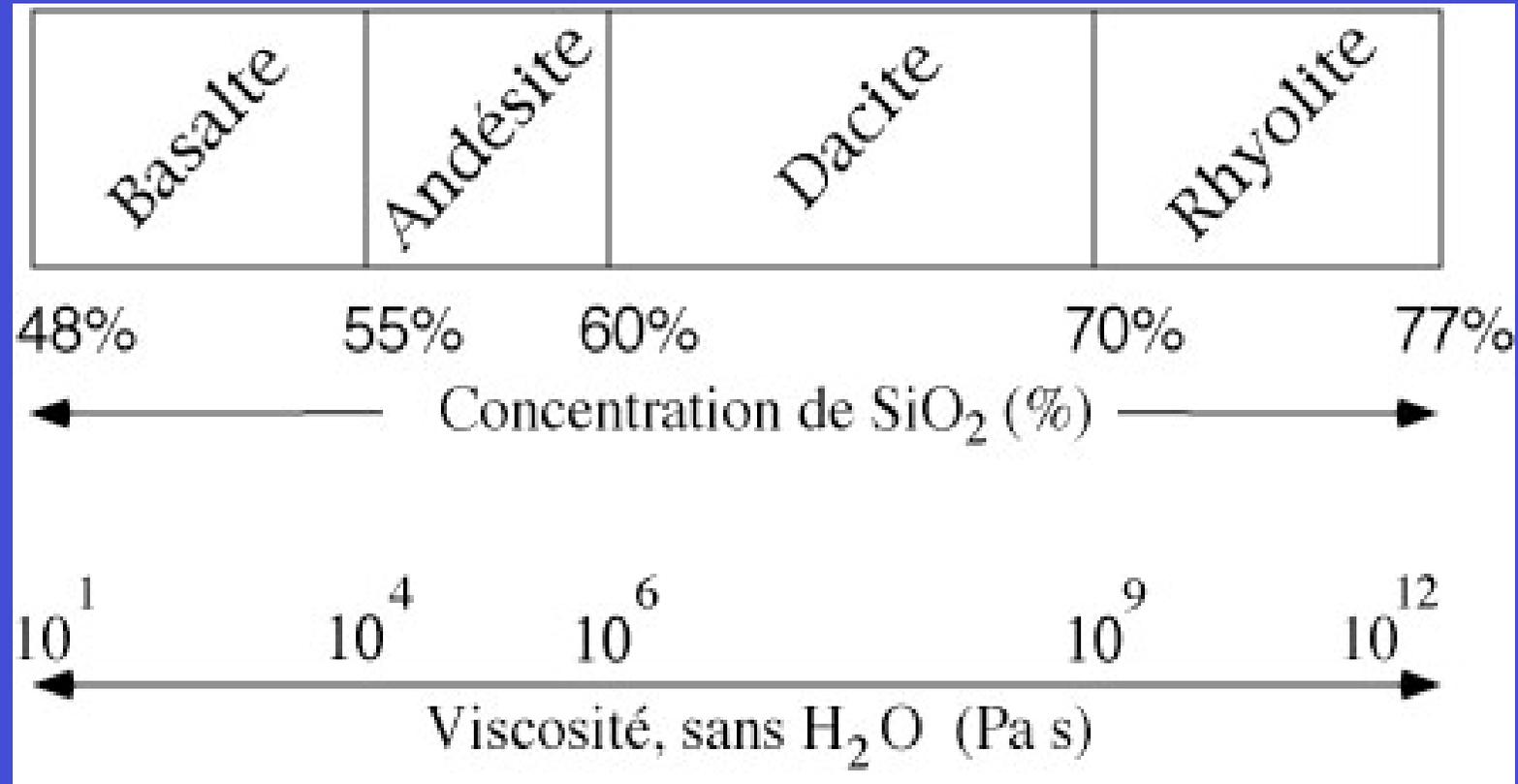
9°) Magmatisme

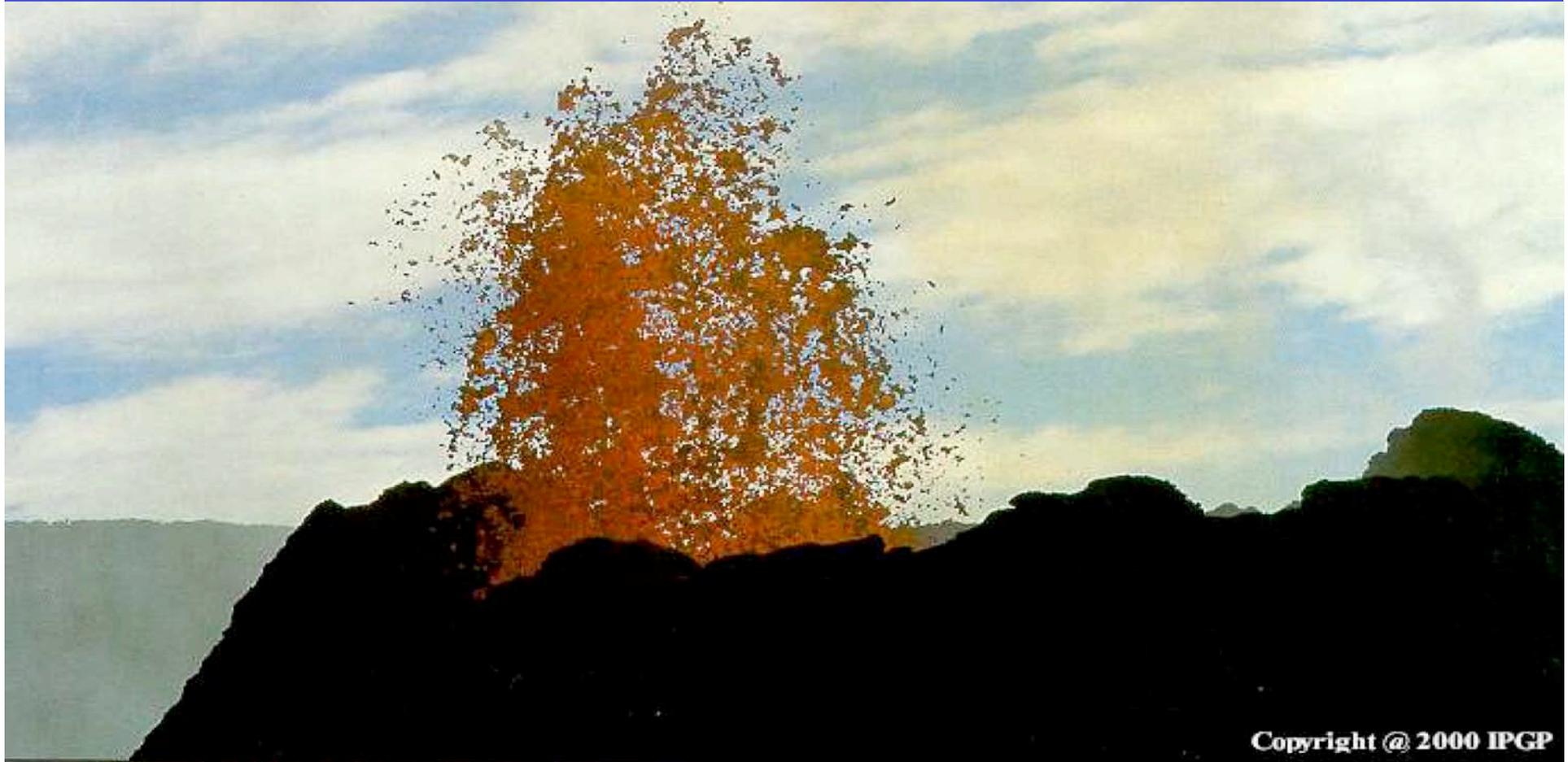
10°) Métamorphisme





VISCOSITE

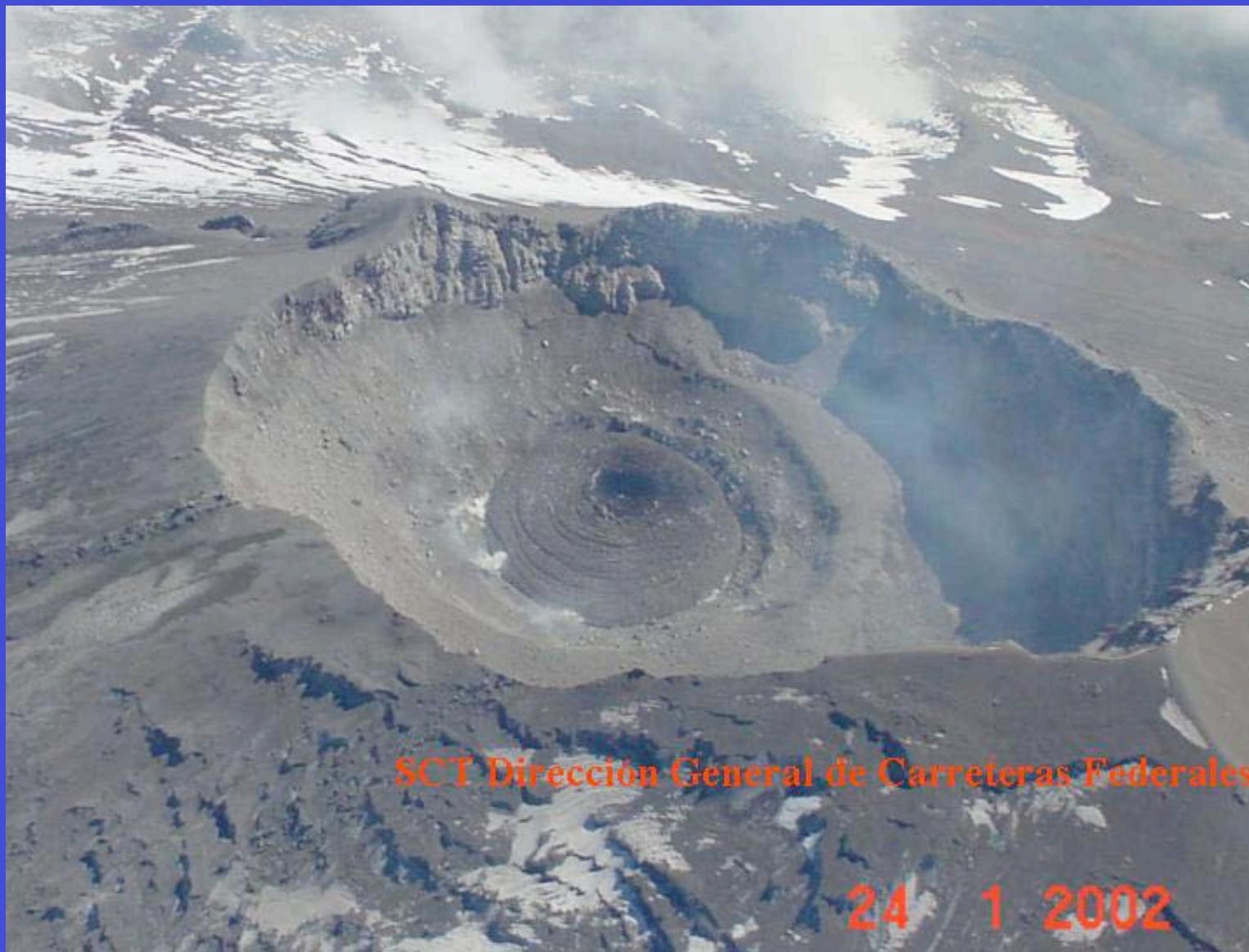




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DOME DU POPOCATEPETL (MEXIQUE)

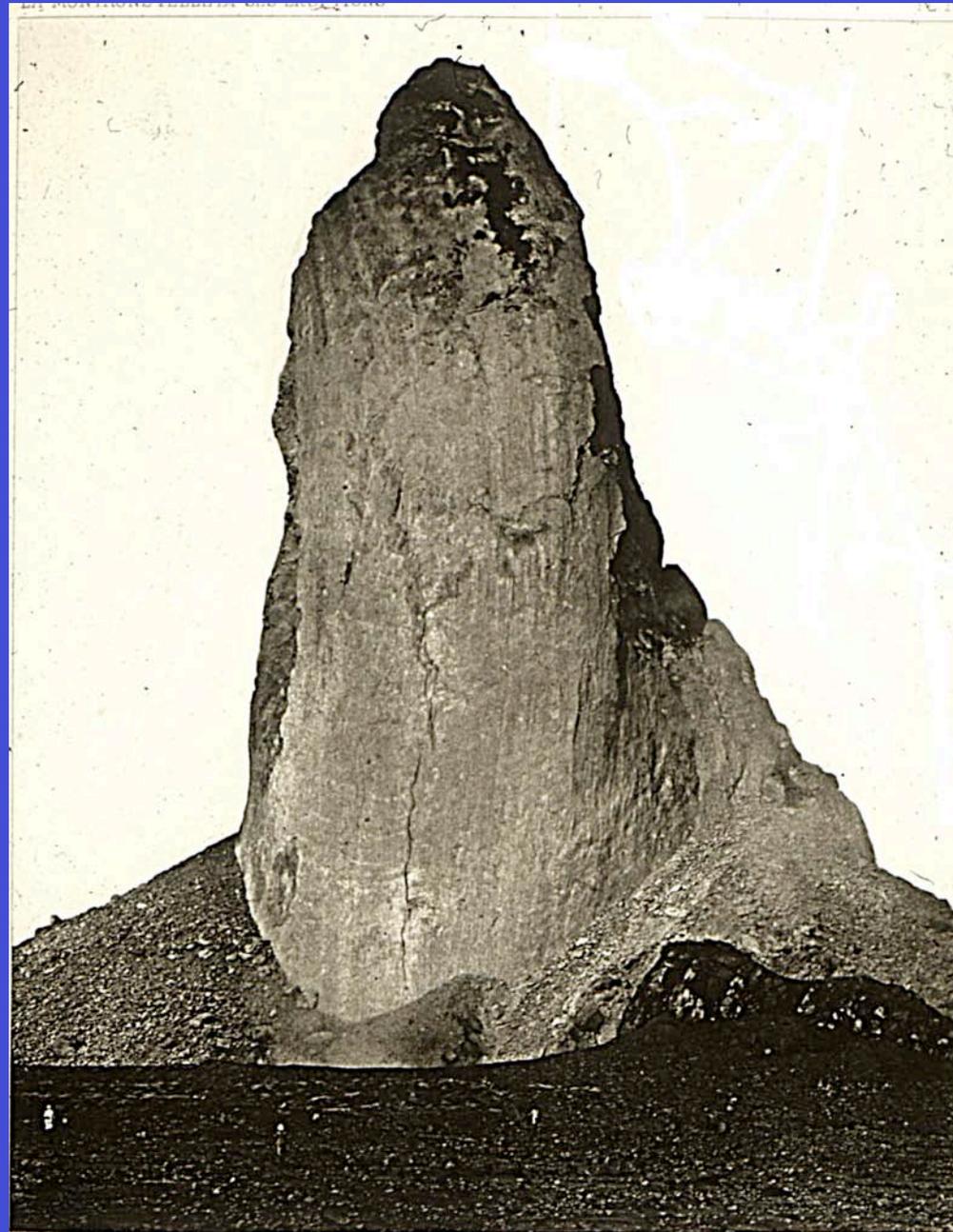


SCT Dirección General de Carreteras Federales

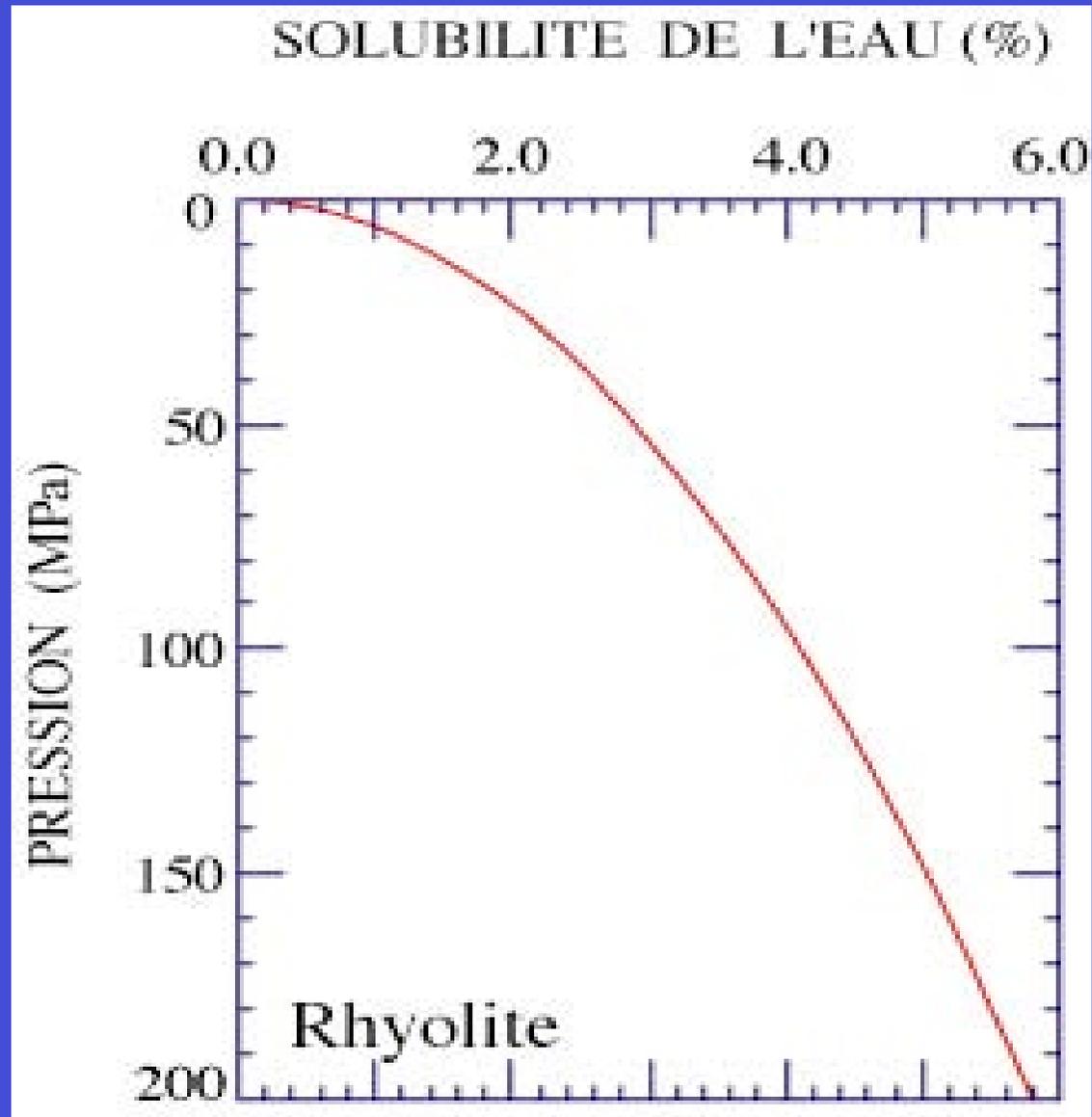
24 1 2002

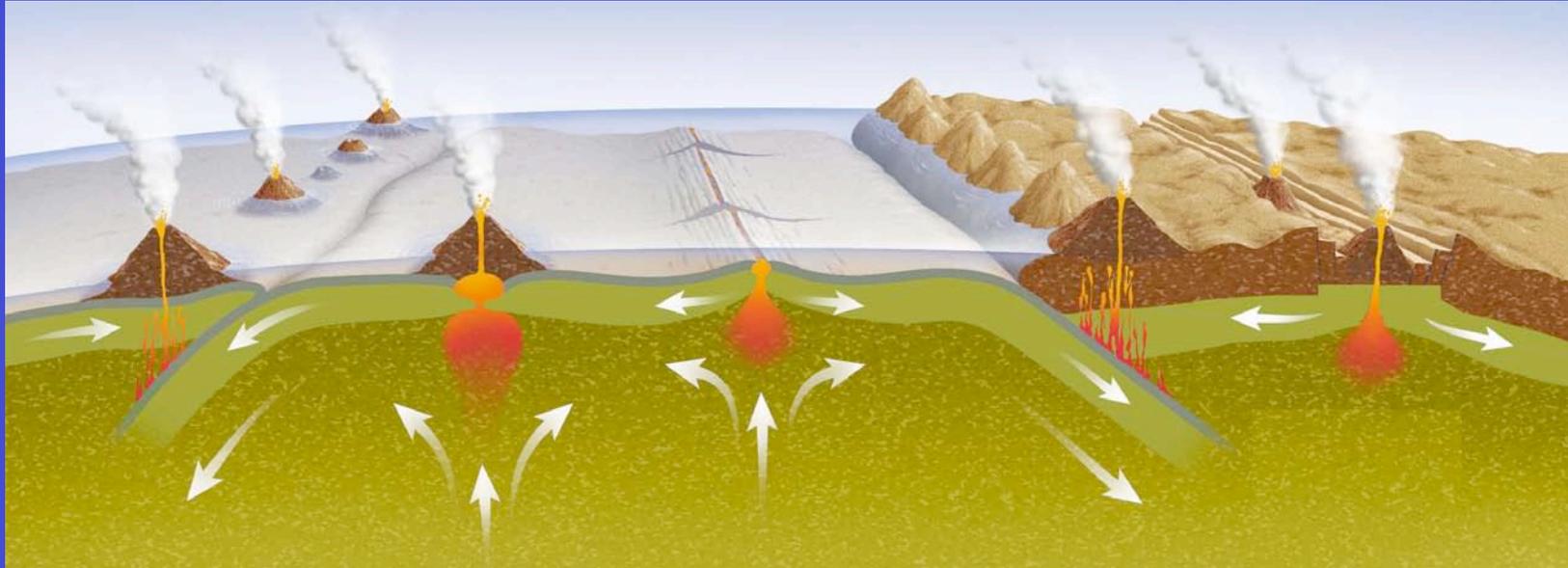


L'AIGUILLE DE LA MONTAGNE PELEE (1902)



GAZ ?





Subduction
(Japon)

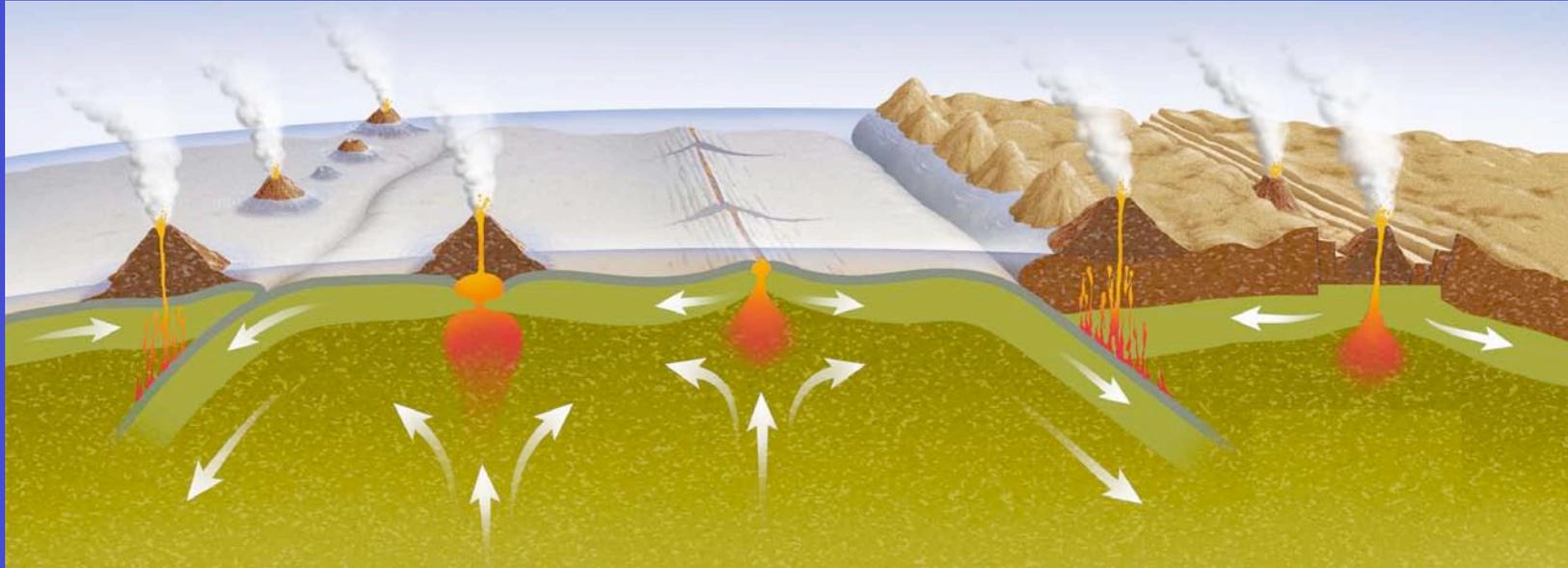
Panache
(Hawaii,
La Réunion)

Dorsale
océanique

Subduction
(Andes)

Extension
(Rhin, rift
Est-Africain)

VOLATILES



Subduction

Panache
(Hawaii,
La Réunion)

Subduction

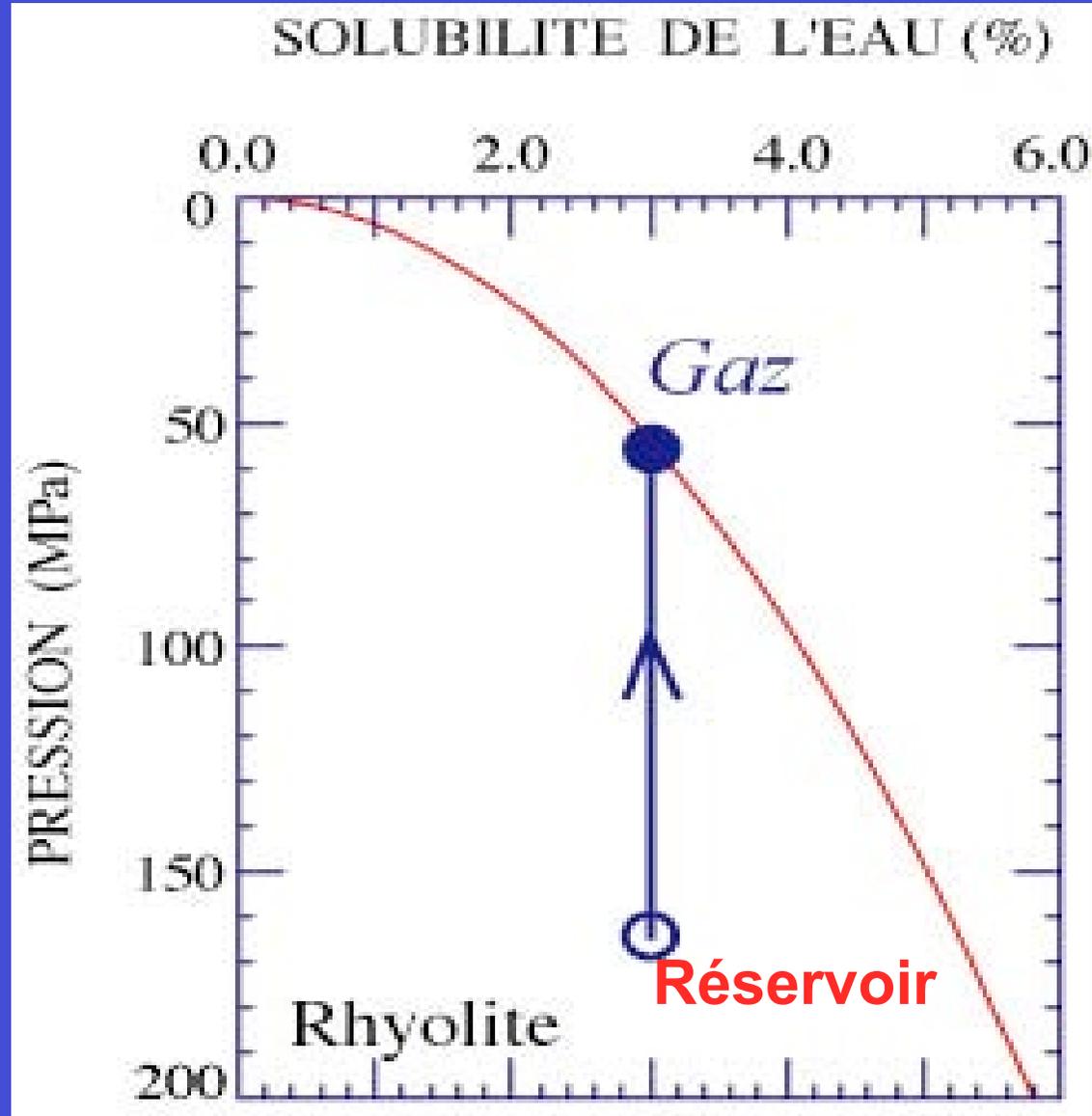
Extension

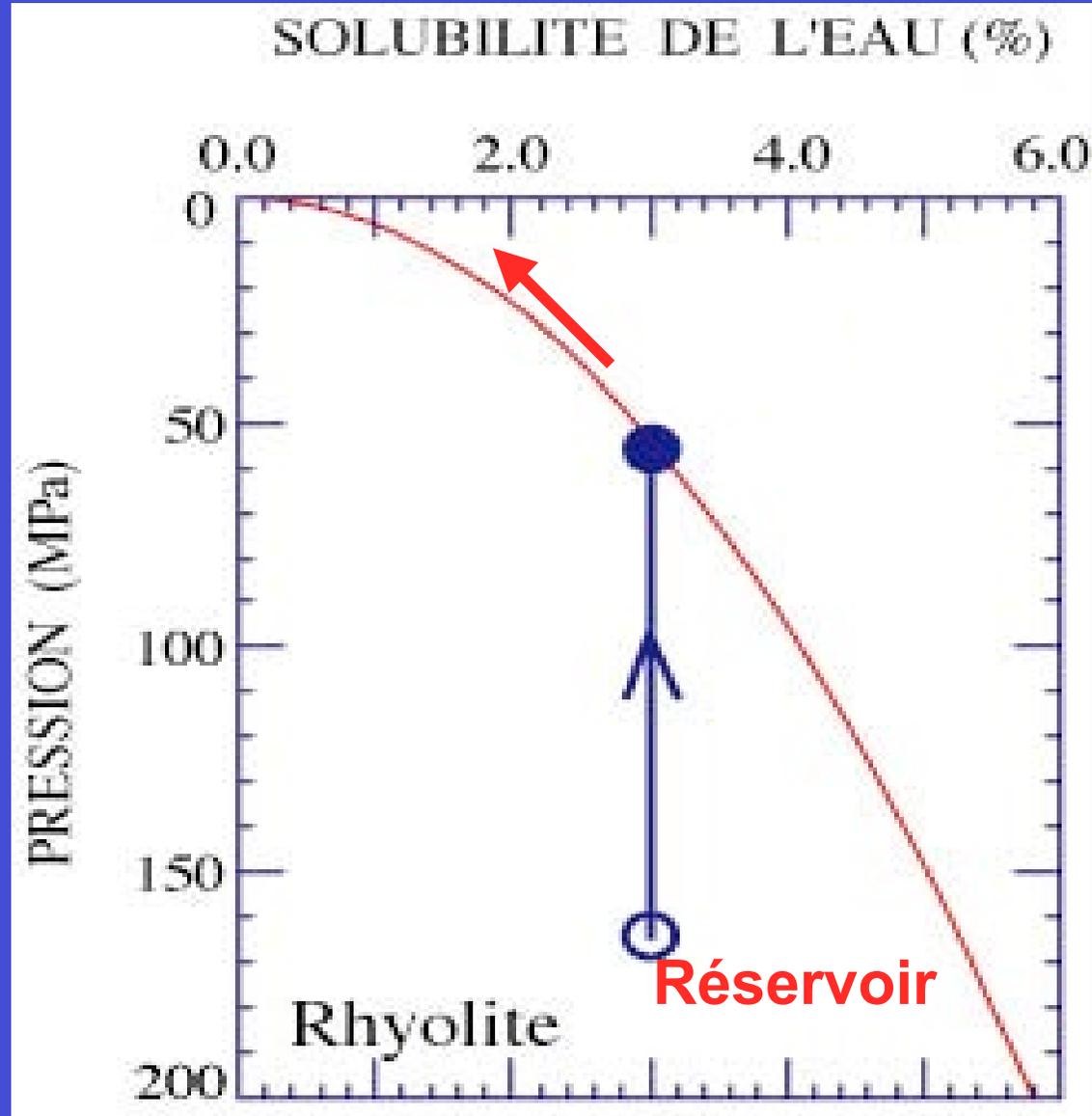
Dorsale
océanique

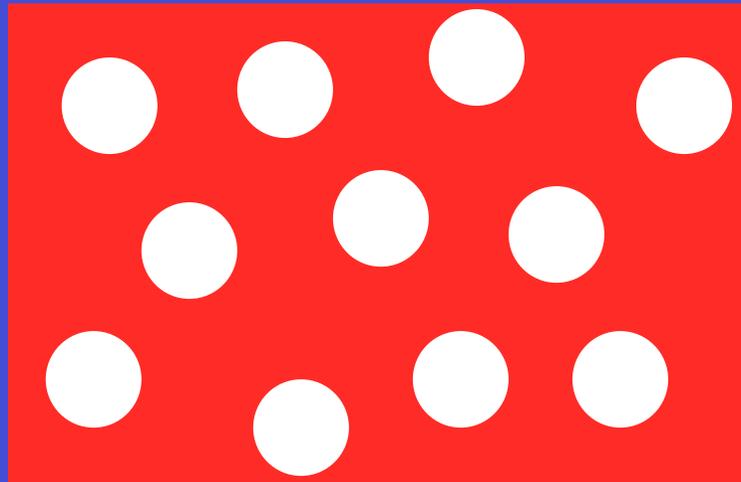
P_{sortie}

$P_{\text{réservoir}}$



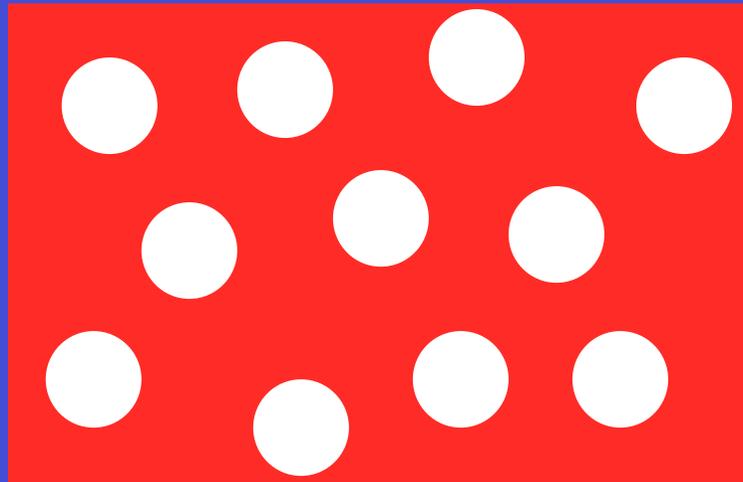






$$\begin{aligned}\text{Masse totale} &= M(\text{gaz}) + M(\text{magma}) \\ &= M_g + M_m\end{aligned}$$

$$\text{Volume total} = V_g + V_m$$



$$\rho_g V_g = M_g$$

$$V_g = \frac{M_g}{\rho_g}$$

$$V_{\text{total}} = V_g + V_m$$

$$= \frac{M_g}{\rho_g} + \frac{M_m}{\rho_m}$$

$$\frac{M_{\text{tot}}}{\rho_{\text{tot}}} = \frac{M_g}{\rho_g} + \frac{M_m}{\rho_m}$$

$$\frac{1}{\rho_{\text{tot}}} = \frac{M_g/M_{\text{tot}}}{\rho_g} + \frac{M_m/M_{\text{tot}}}{\rho_m}$$

$$\frac{1}{\rho_{\text{tot}}} = \frac{x_g}{\rho_g} + \frac{x_m}{\rho_m}$$

$$\frac{1}{\rho_{\text{tot}}} = \frac{x_g}{\rho_g} + \frac{x_m}{\rho_m}$$

$$x_g \approx 0.03 - 0.06 \quad (x_m = 1 - x_g)$$

$$\rho_g \approx 0.3 \text{ kg.m}^{-3}$$

$$\rho_m = 2700 \text{ kg.m}^{-3}$$

$$\rho_{\text{tot}} \ll \rho_m$$

$$\rho_{\text{tot}} \approx \frac{\rho_g}{x_g} \approx \frac{\rho_m}{100} \quad (\text{valeur typique})$$

$$V_{\text{total}} = V_g + V_m$$

$$1 = \frac{V_g}{V_{\text{tot}}} + \frac{V_m}{V_{\text{tot}}}$$

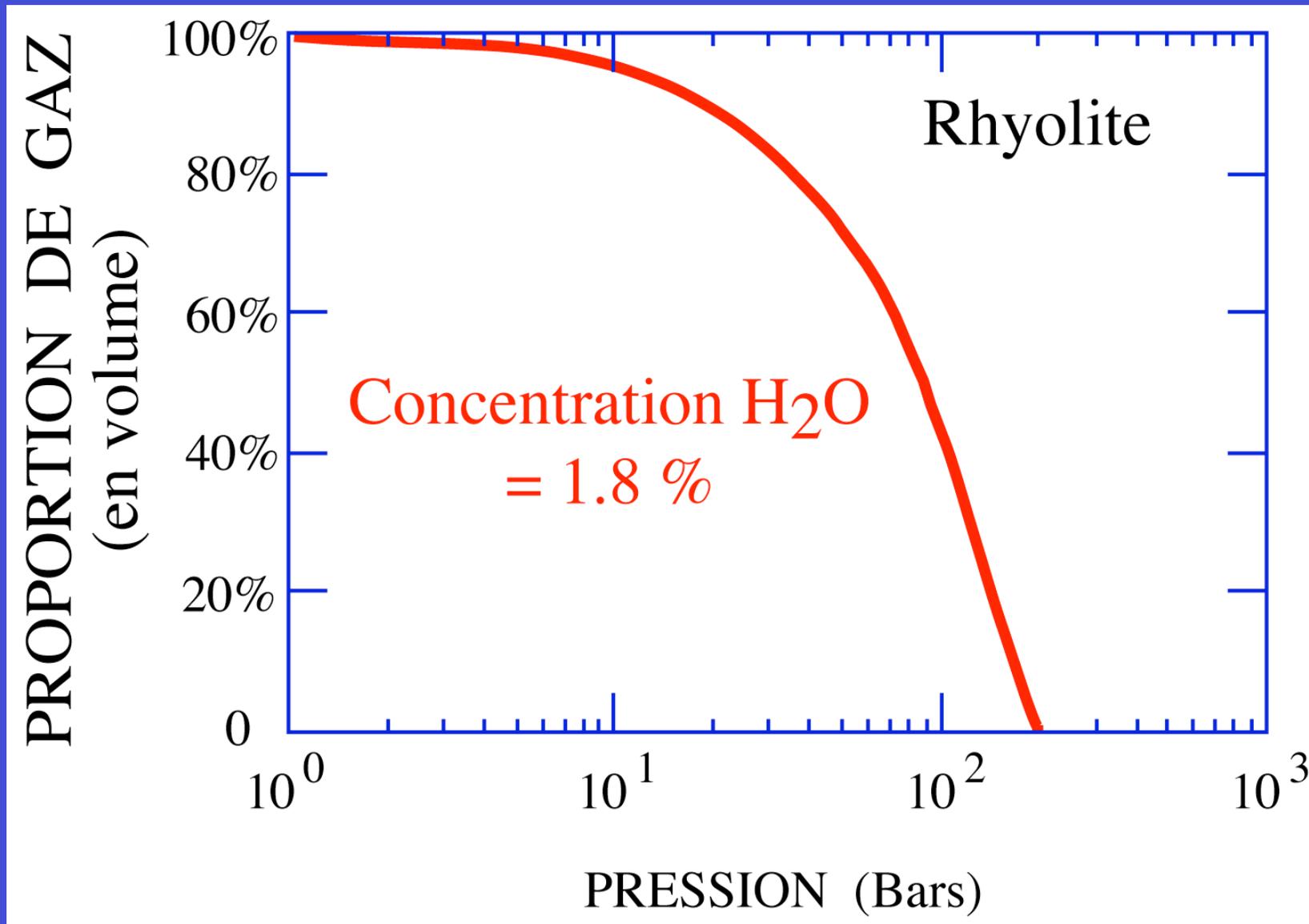
$$1 = x_g \frac{\rho_{\text{tot}}}{\rho_g} + x_m \frac{\rho_{\text{tot}}}{\rho_m}$$

Fraction
volumique
de gaz

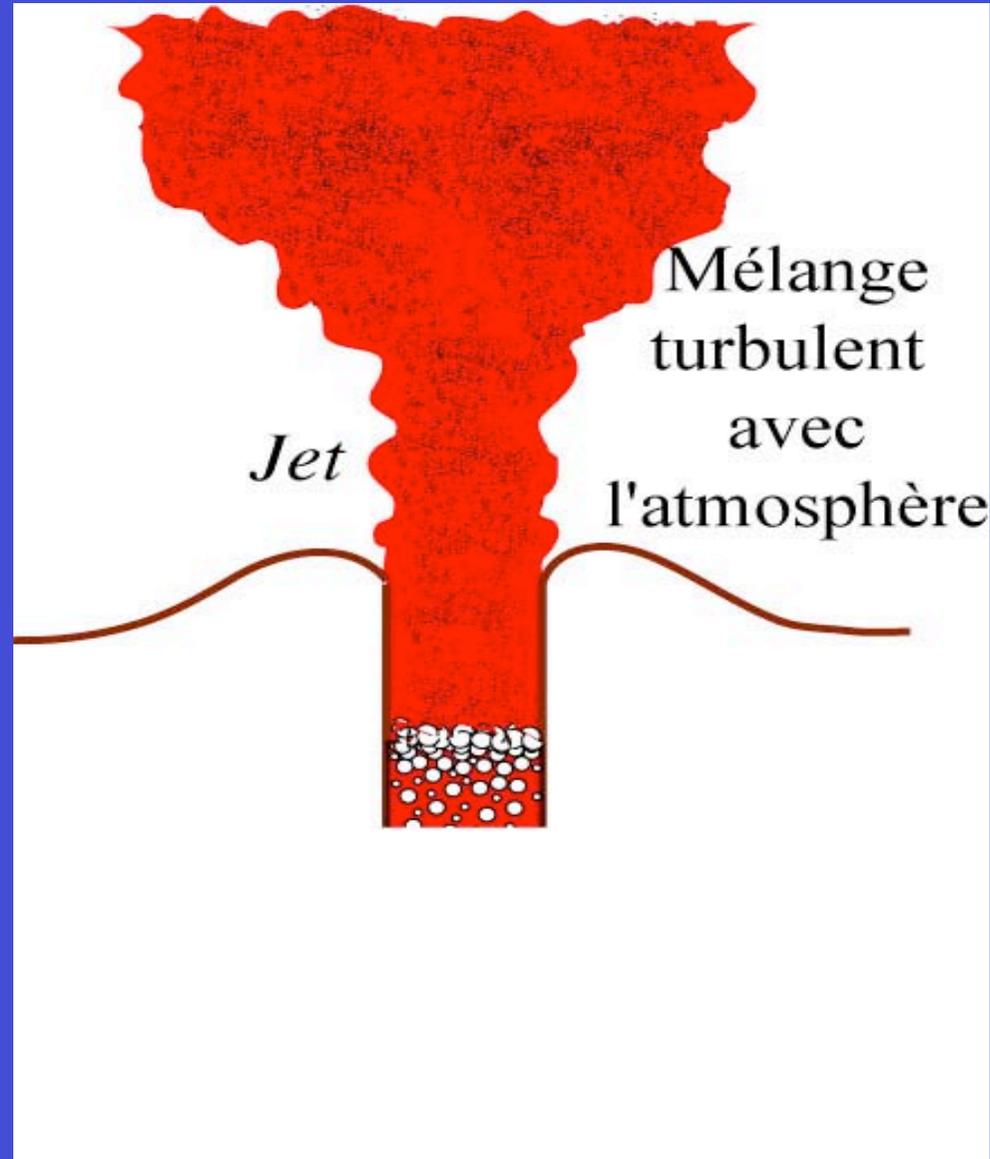
Fraction
volumique
de magma

≈ 1

DECOMPRESSION = EXSOLUTION + DILATATION



1.8% d'eau en poids = 97% de vapeur d'eau en volume à la sortie

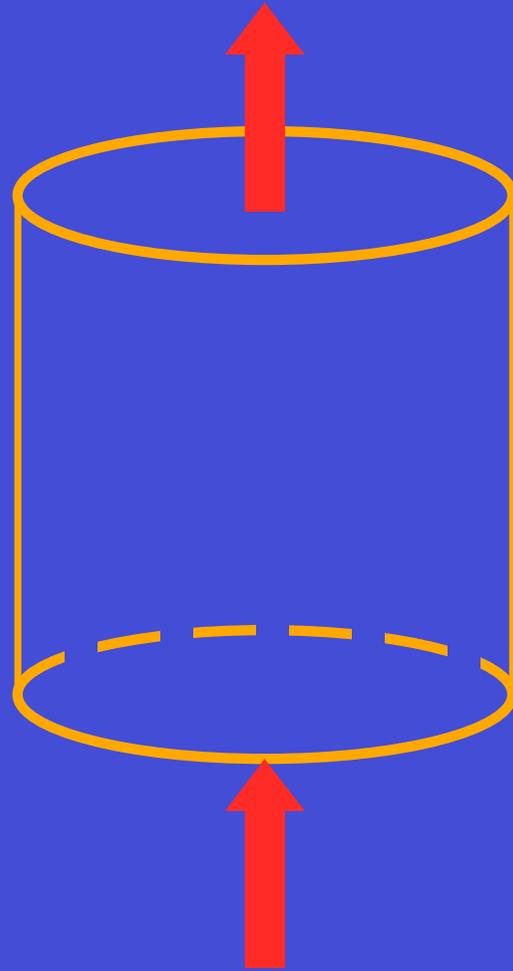






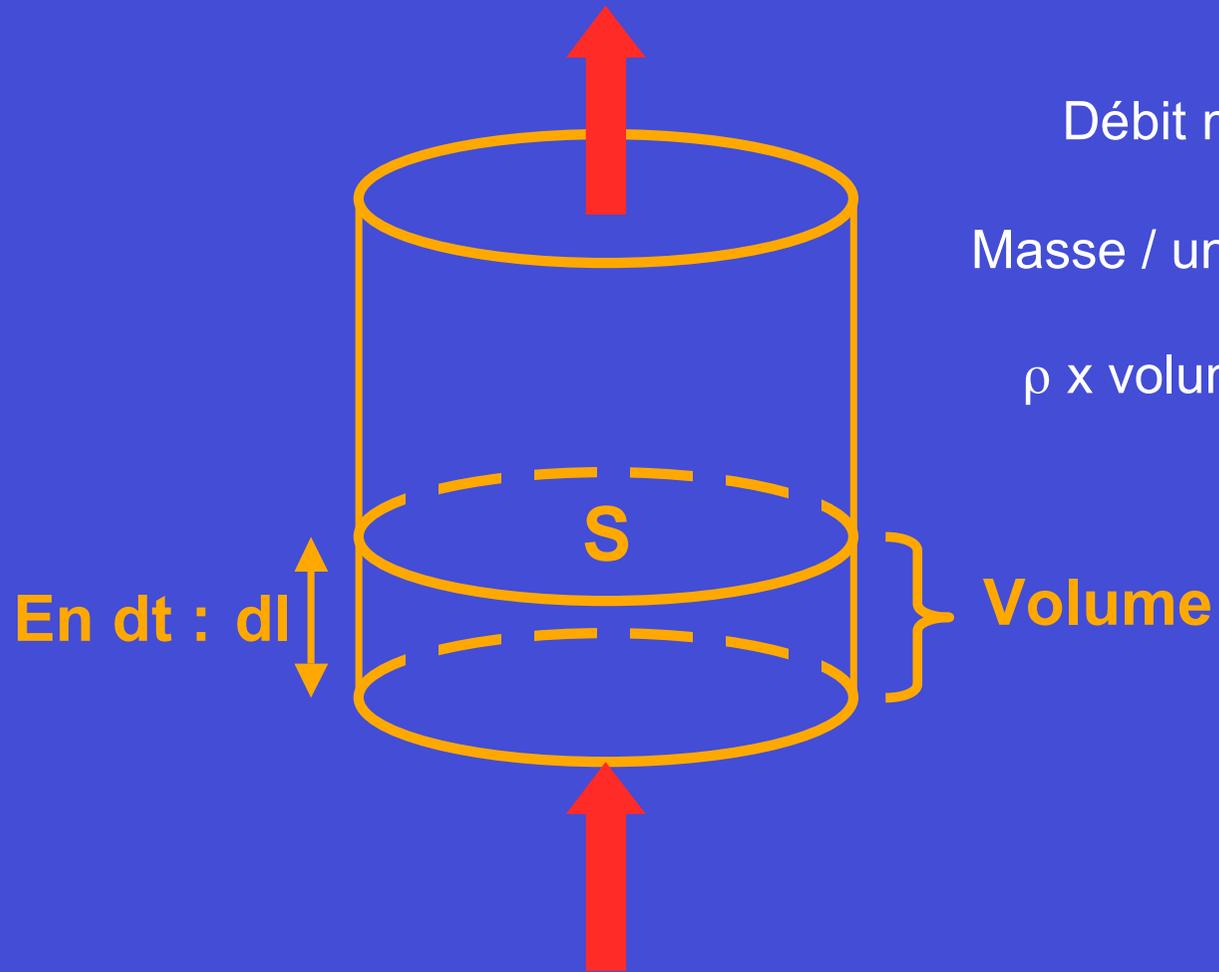
USGS Photo by D.A.Swanson, May 18, 1980

Flux de masse à la sortie



Flux de masse à l'entrée

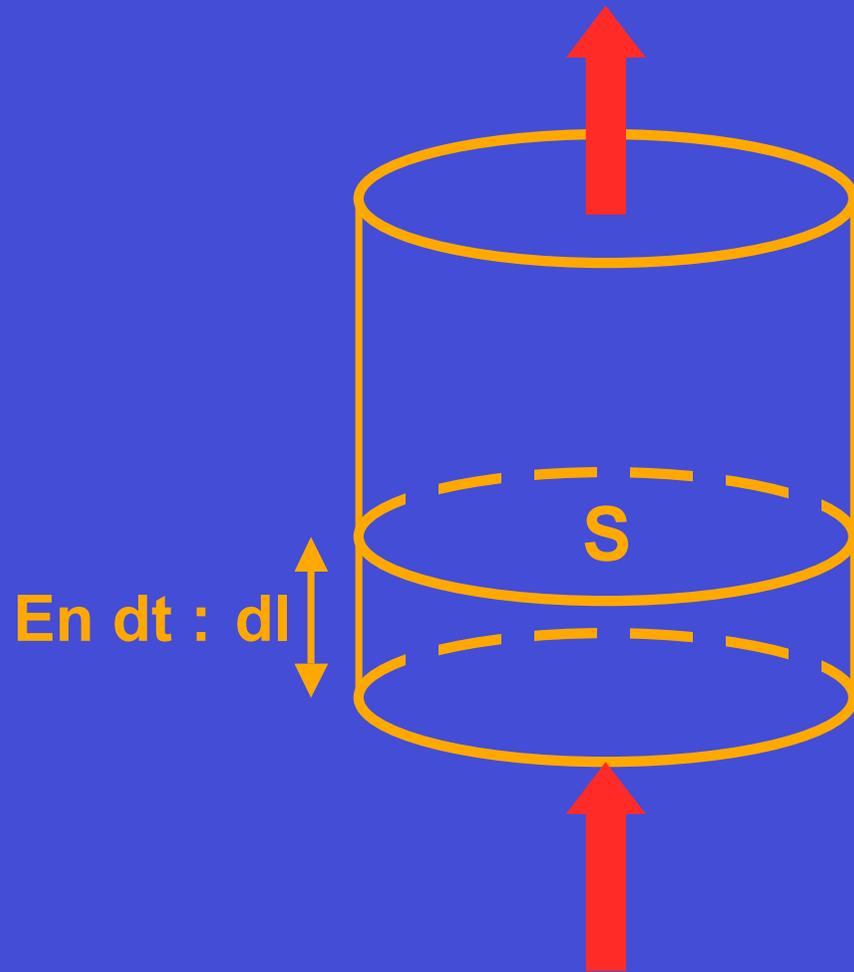
Débit massique à la sortie



$$\begin{aligned} \text{Débit massique} &= \\ &= \text{Masse / unité de temps} \\ &= \rho \times \text{volume / temps} \end{aligned}$$

Débit massique à l'entrée

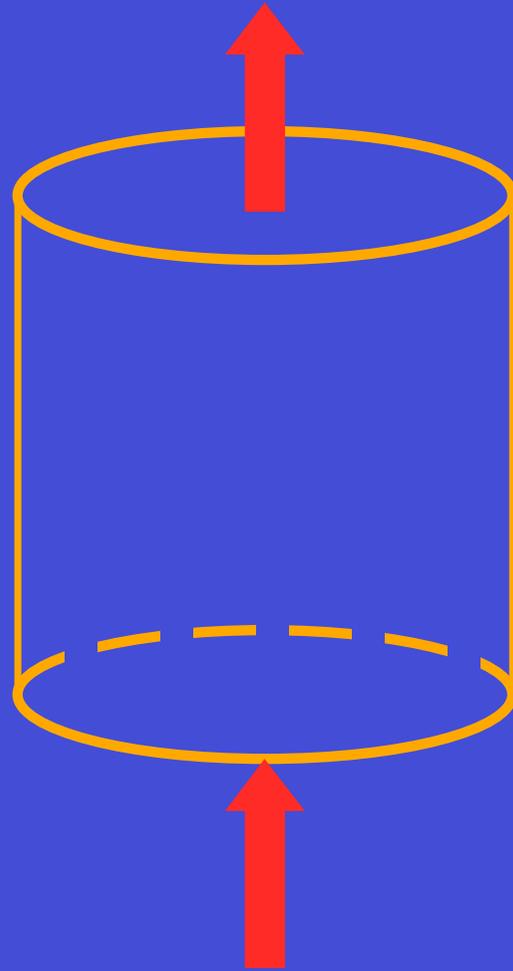
Débit massique à la sortie



$$\begin{aligned} \text{Débit massique} &= \\ &= \text{Masse / unité de temps} \\ &= \\ &= \rho \times \text{volume} / \text{temps} \\ &= \\ &= \rho \times S \times (dl / dt) \\ &= \\ &= \rho \times S \times w \end{aligned}$$

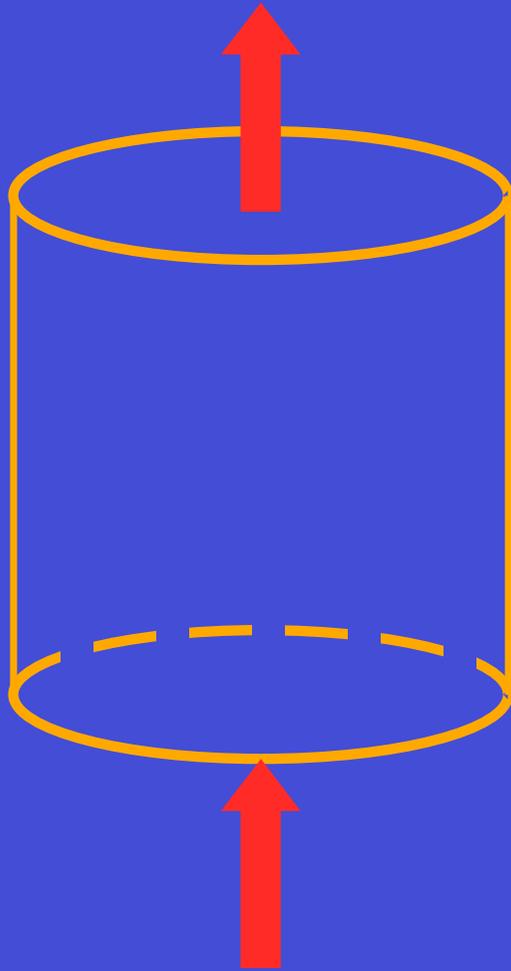
Débit massique à l'entrée

$$Q_s = \rho_{\text{tot}} w_{\text{sortie}} S$$



$$Q_e = \rho_m w_{\text{entrée}} S$$

$$Q_s = \rho_{\text{tot}} w_{\text{sortie}} S$$



$$Q_e = \rho_m w_{\text{entrée}} S$$

$$Q_s = Q_e$$

$$w_{\text{sortie}} = w_{\text{entrée}} \times \frac{\rho_m}{\rho_{\text{tot}}}$$

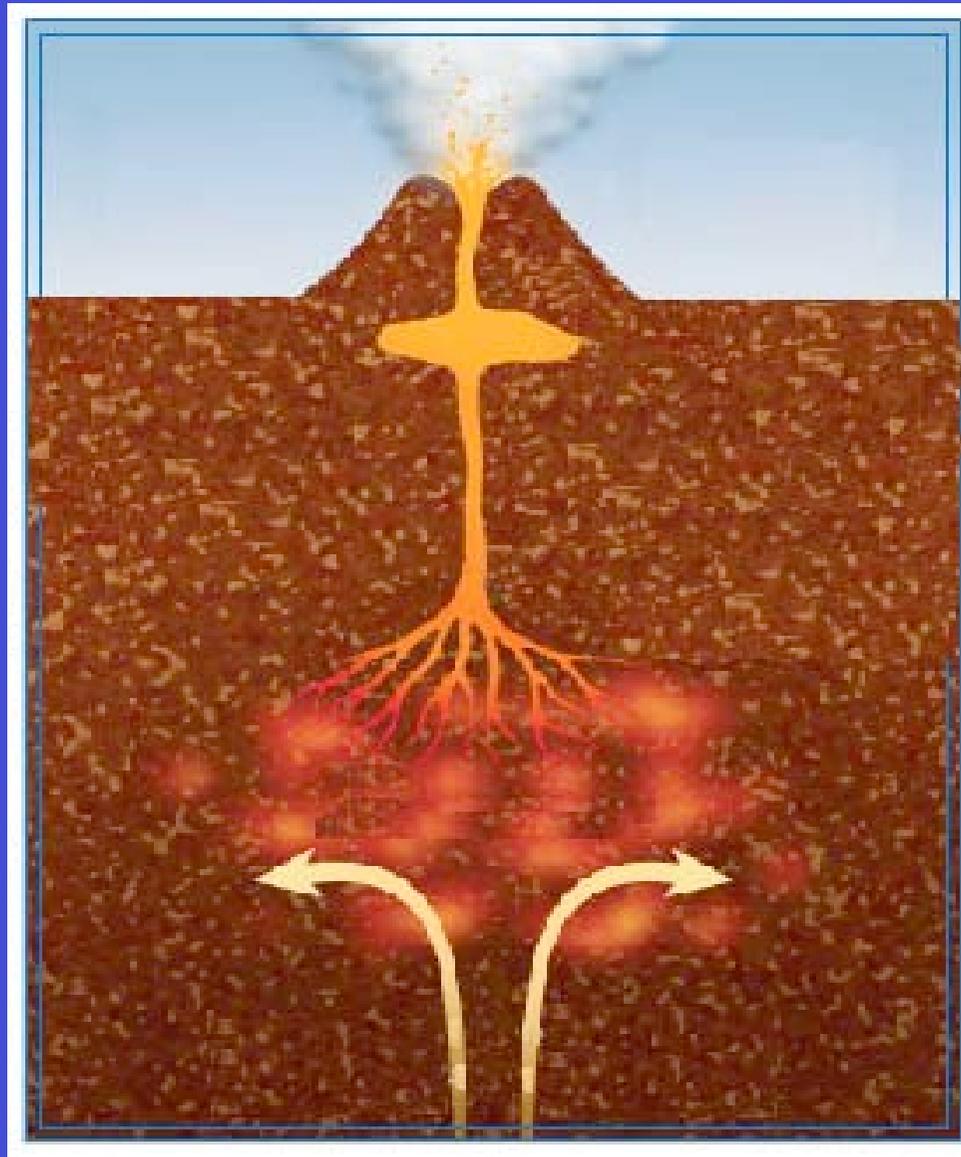
$$w_{\text{sortie}} \gg w_{\text{entrée}}$$

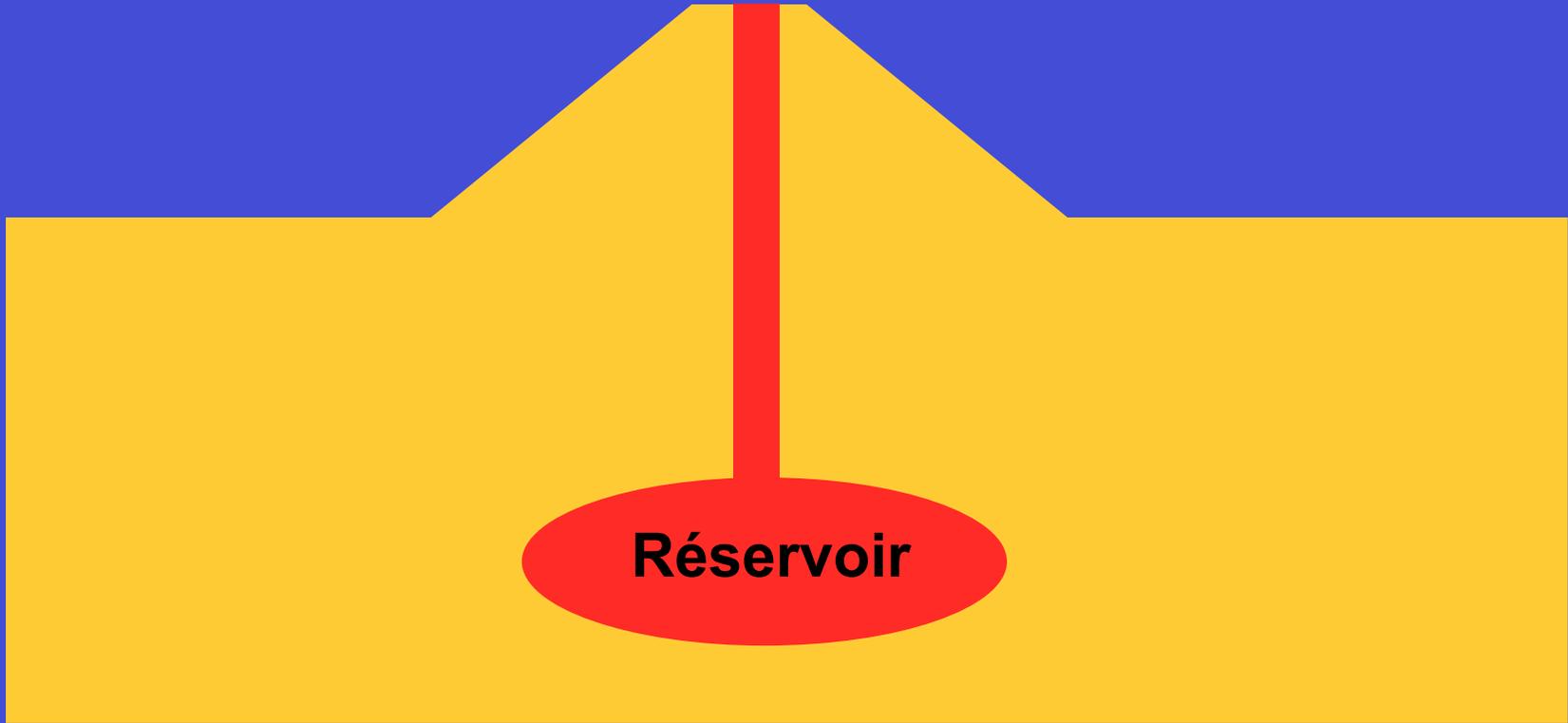
III – Phénomènes Géologiques Mésos Echelle

8°) Volcanisme

9°) Magmatisme

10°) Métamorphisme





Réservoir



caldera

cendres

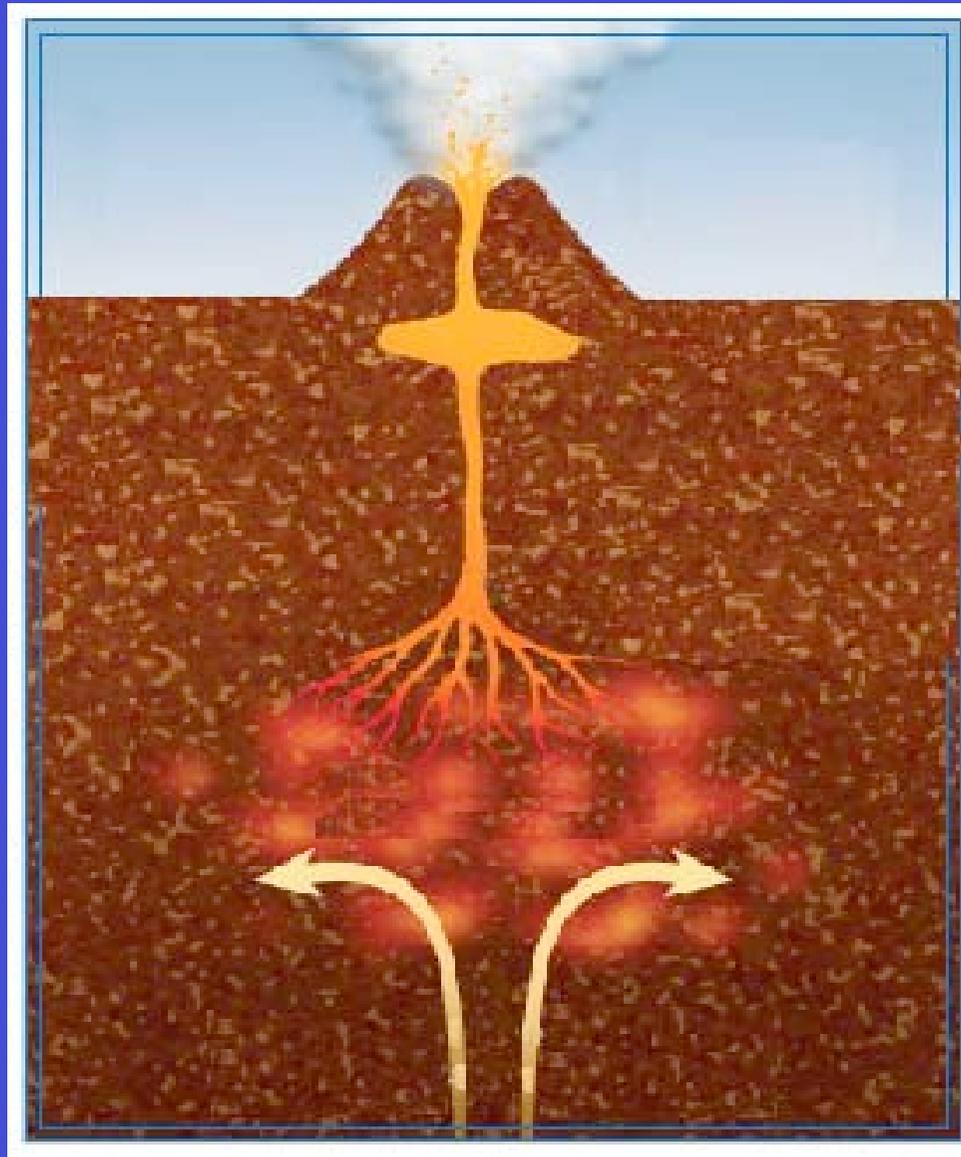


ignimbrite



événement



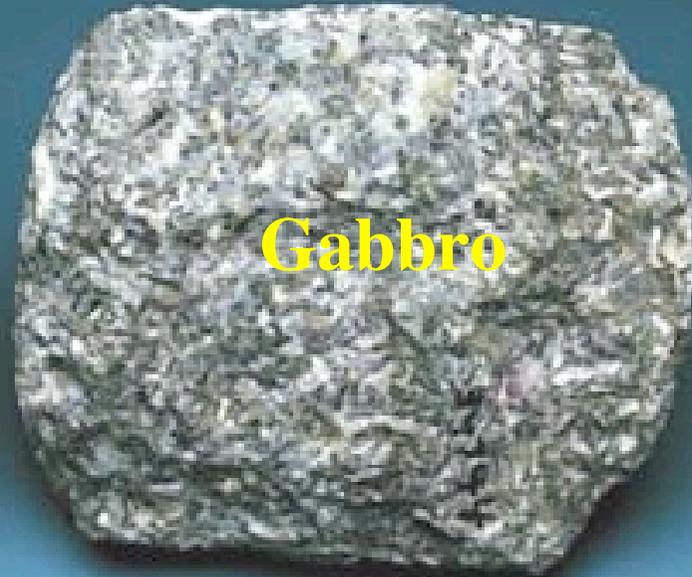


Extrusive

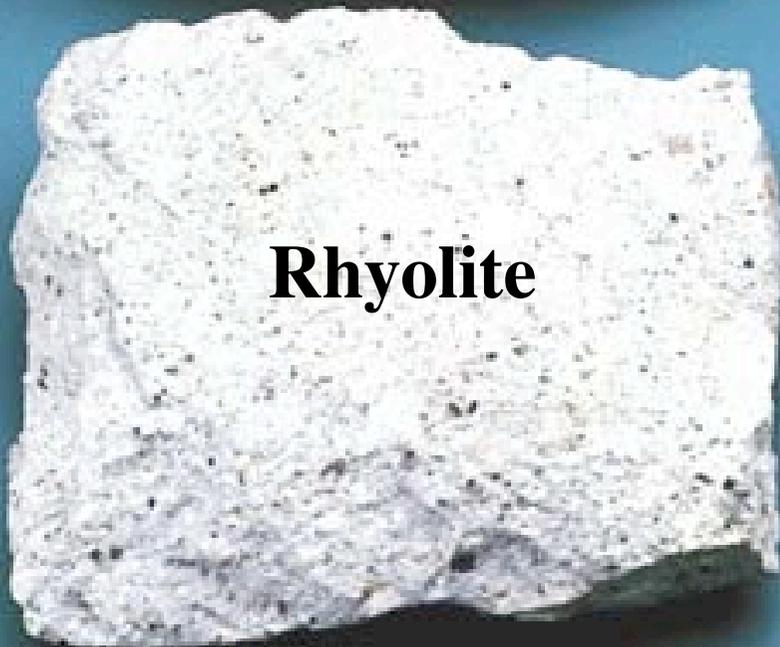


Basalte

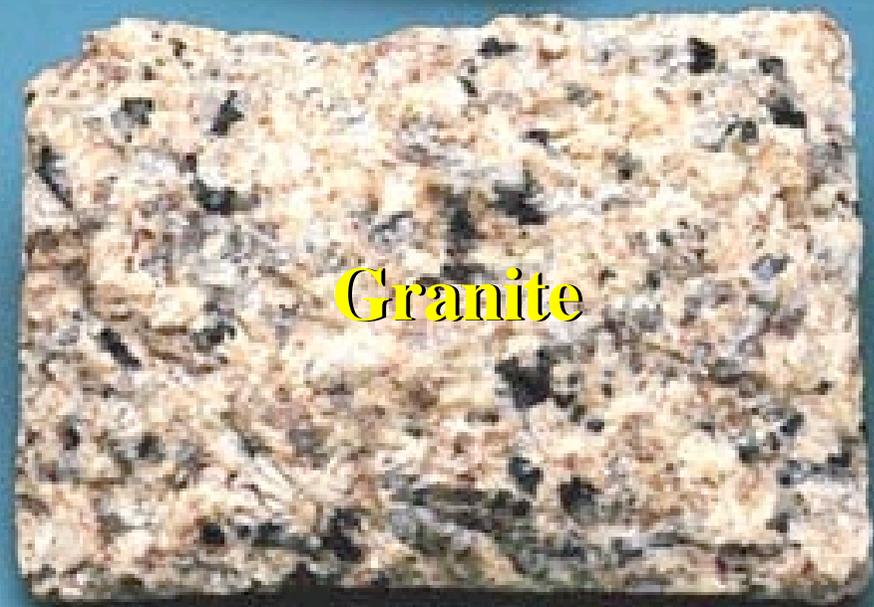
Intrusive



Gabbro



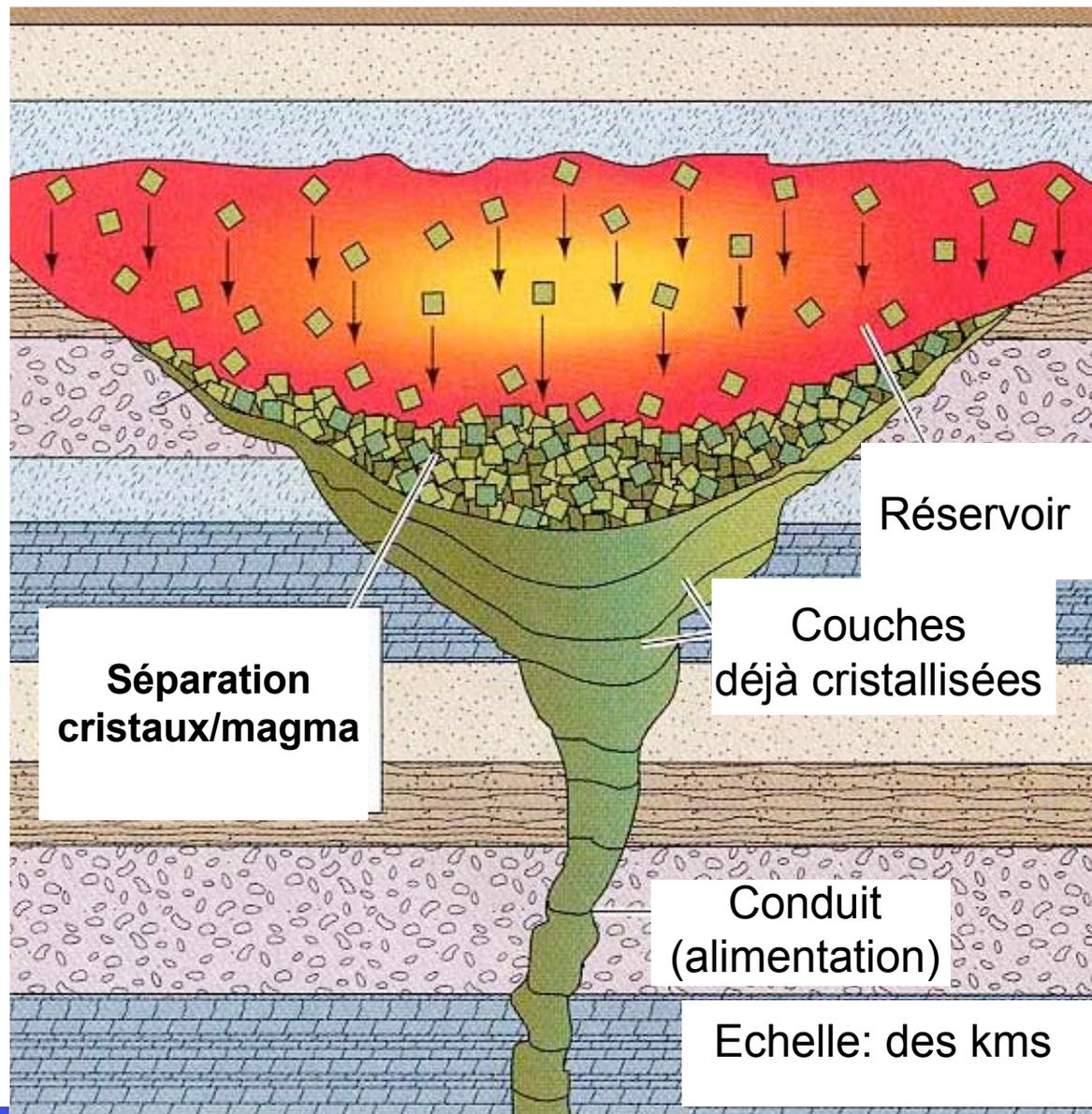
Rhyolite



Granite

Grands complexes plutoniques

Nom	Age	Localisation	Surf. (km ²)
Bushveld	Precambrian	Afrique du Sud	66,000
Dufek	Jurassique	Antarctique	50,000
Duluth	Précambrien	Minnesota, USA	4,700
Stillwater	Précambrien	Montana, USA	4,400
Muskox	Précambrien	Terr.NW Canada	3,500
Great Dike	Précambrien	Zimbabwe	3,300
Kiglapait	Précambrien	Labrador, Canada	560
Skaergård	Eocène	Groenland	100



**Séparation
cristaux/magma**

Réservoir

Couches
déjà cristallisées

Conduit
(alimentation)

Echelle: des kms

surface

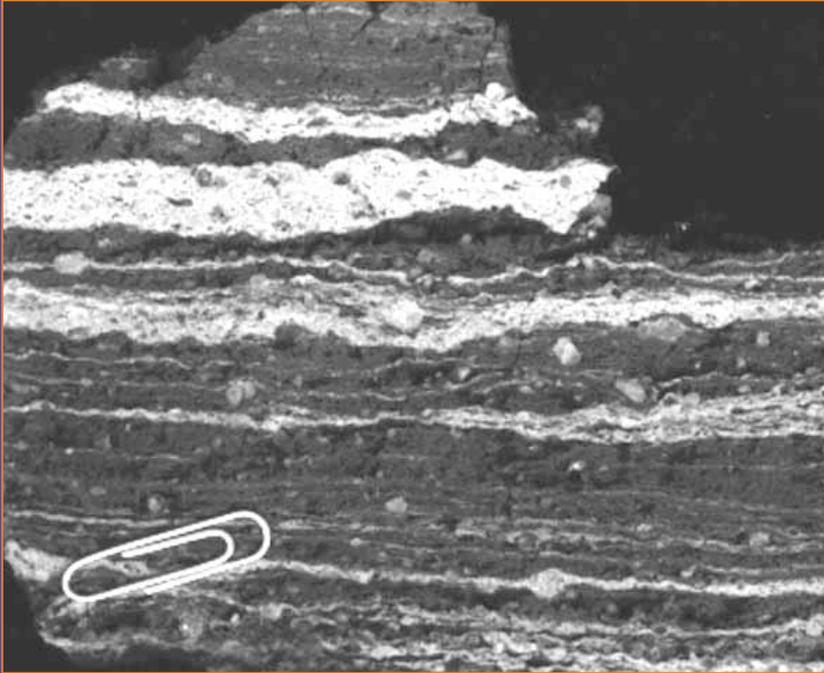
5 km

10 km

15 km

20 km

Mélange basalte-rhyolite

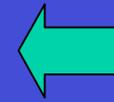


**“Coussins” de basalte au
plancher d’un réservoir
rhyolitique
(aujourd’hui un granite)**

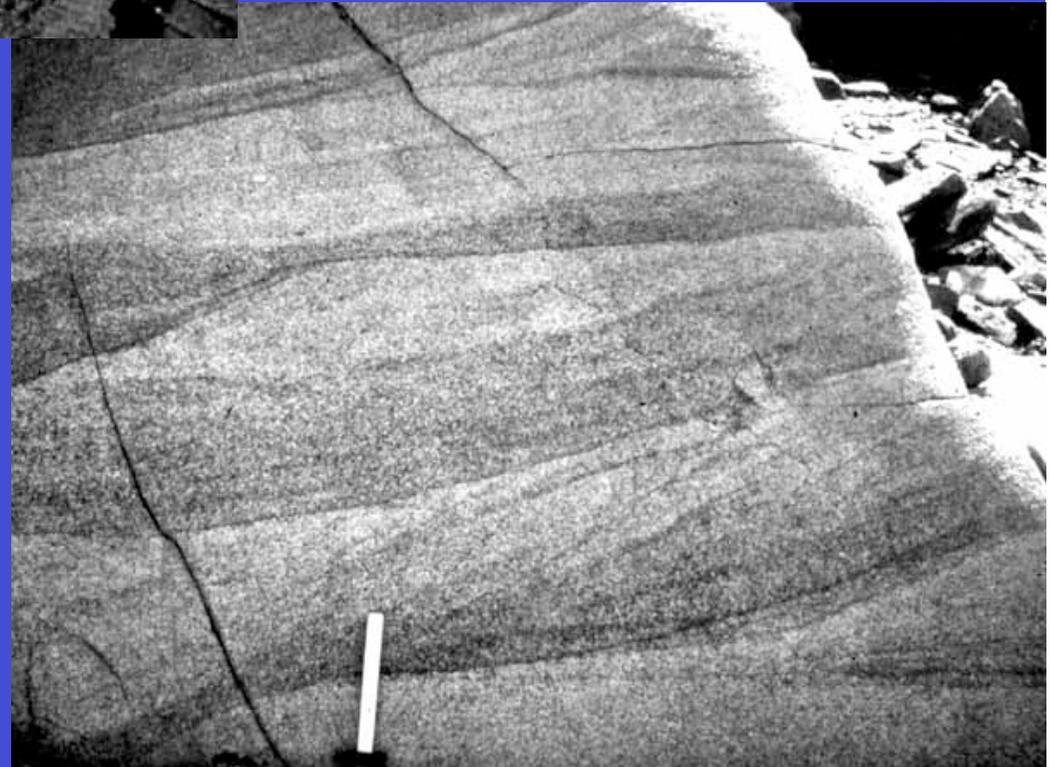
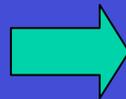




Litage magmatique:
lits d'olivine et de pyroxène.
Noter les relations discordantes
(indicatrices de mouvements:
analogues aux structures
sédimentaires)



Stratifications entrecroisées





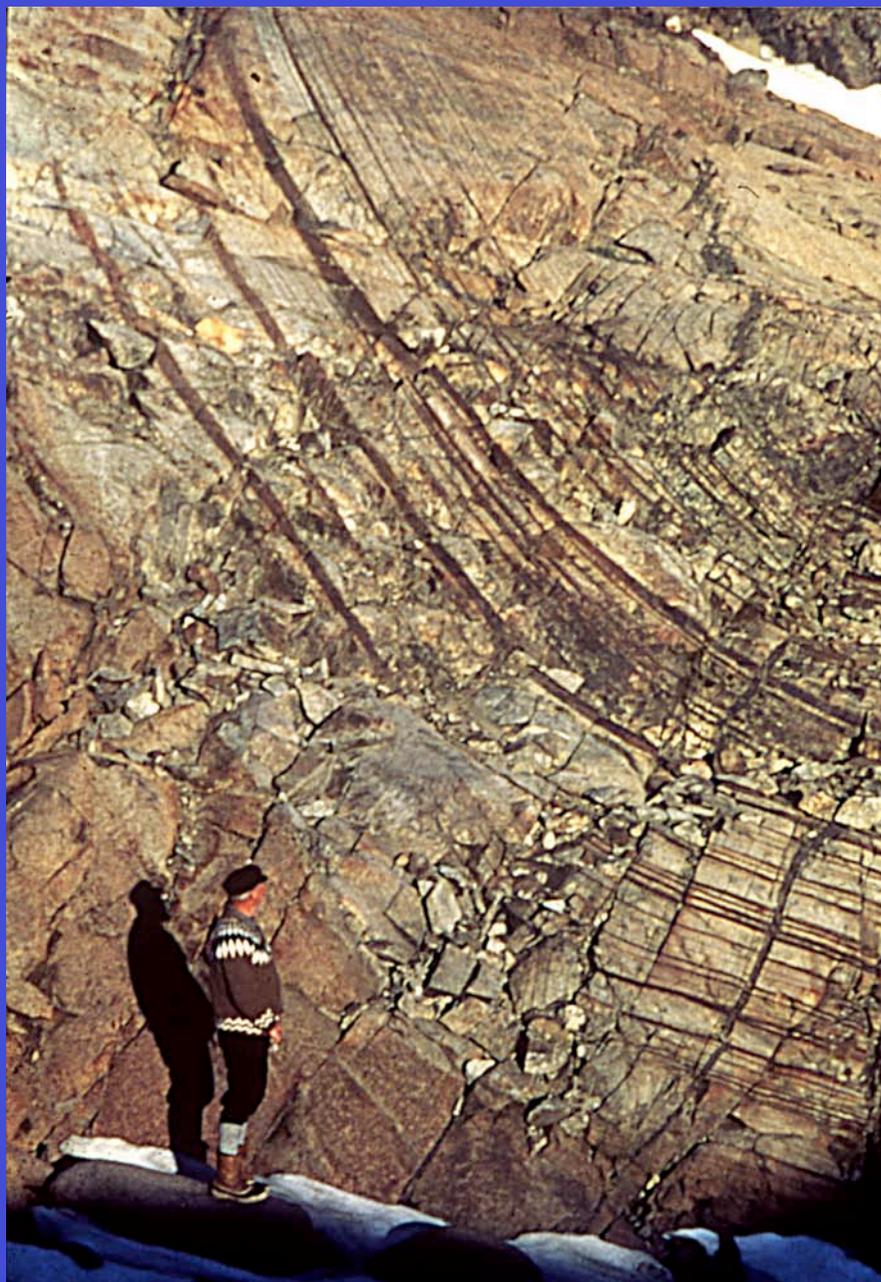




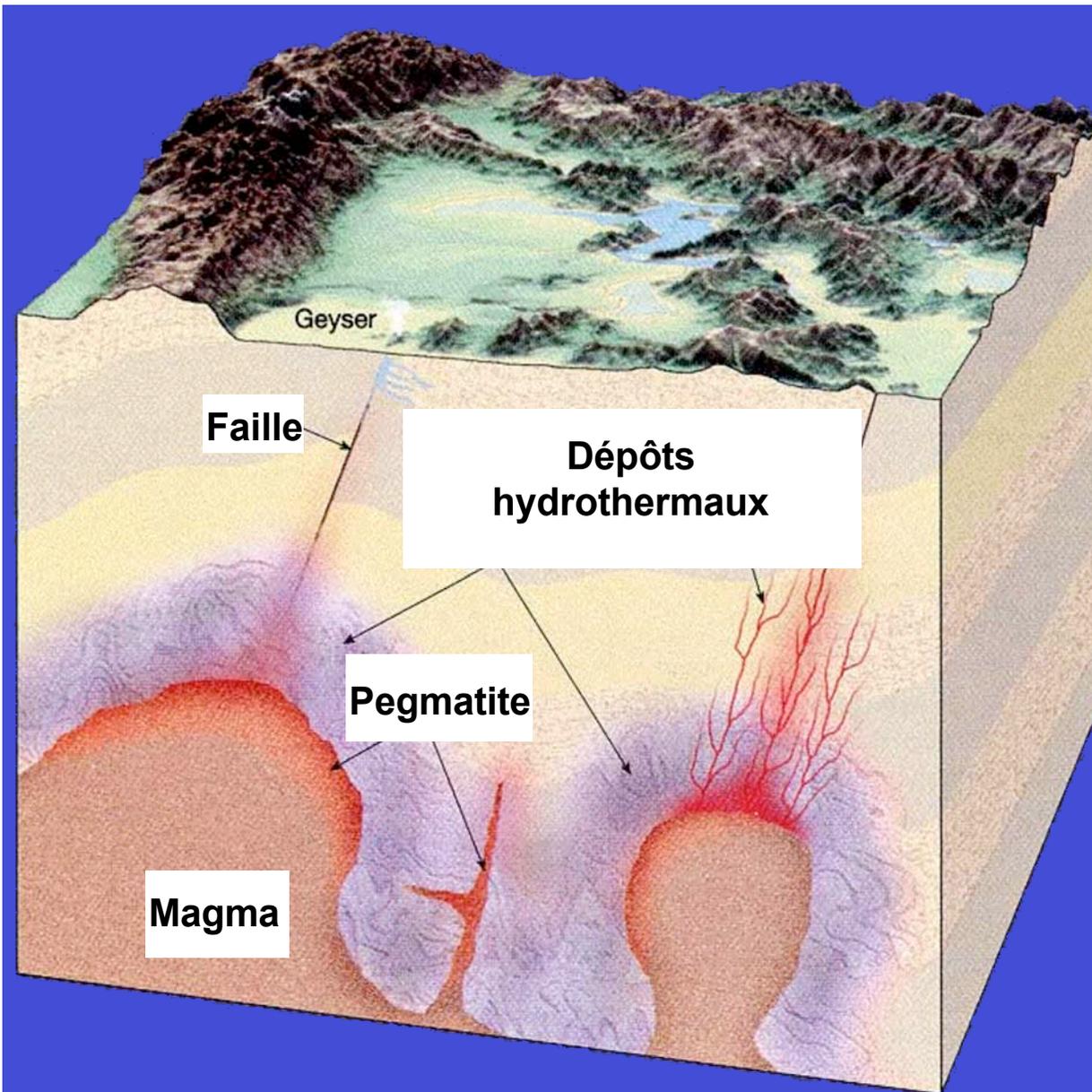
“CHAMBRE” DU SKAERGAARD (Groenland)







La chambre fossile du Skaergaard (Groenland)



Pegmatite : Cristaux de tourmaline (8 cm)



Dépôt hydrothermal : or

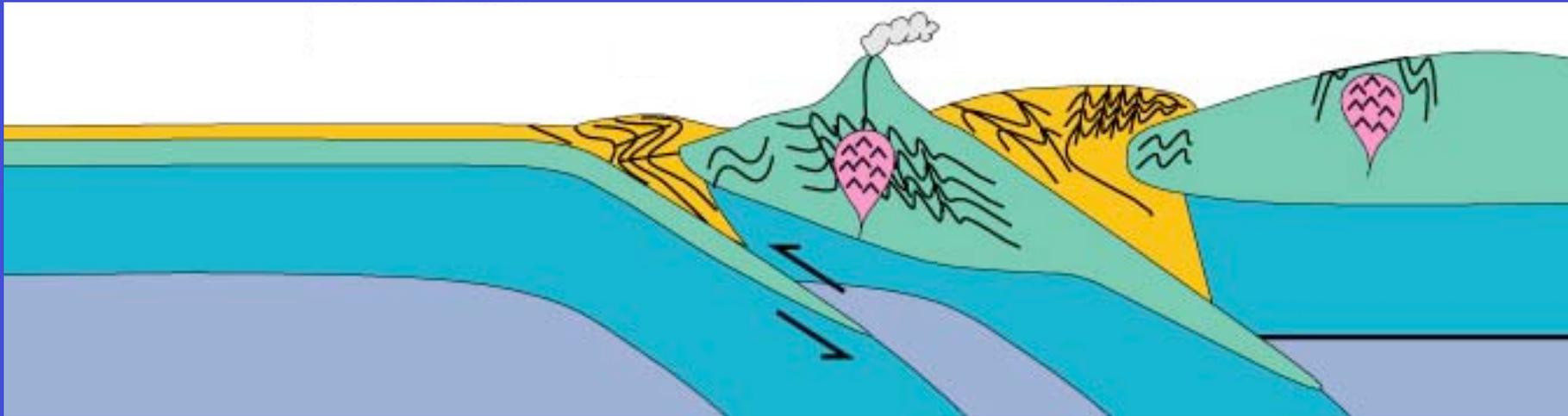
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8°) Volcanisme

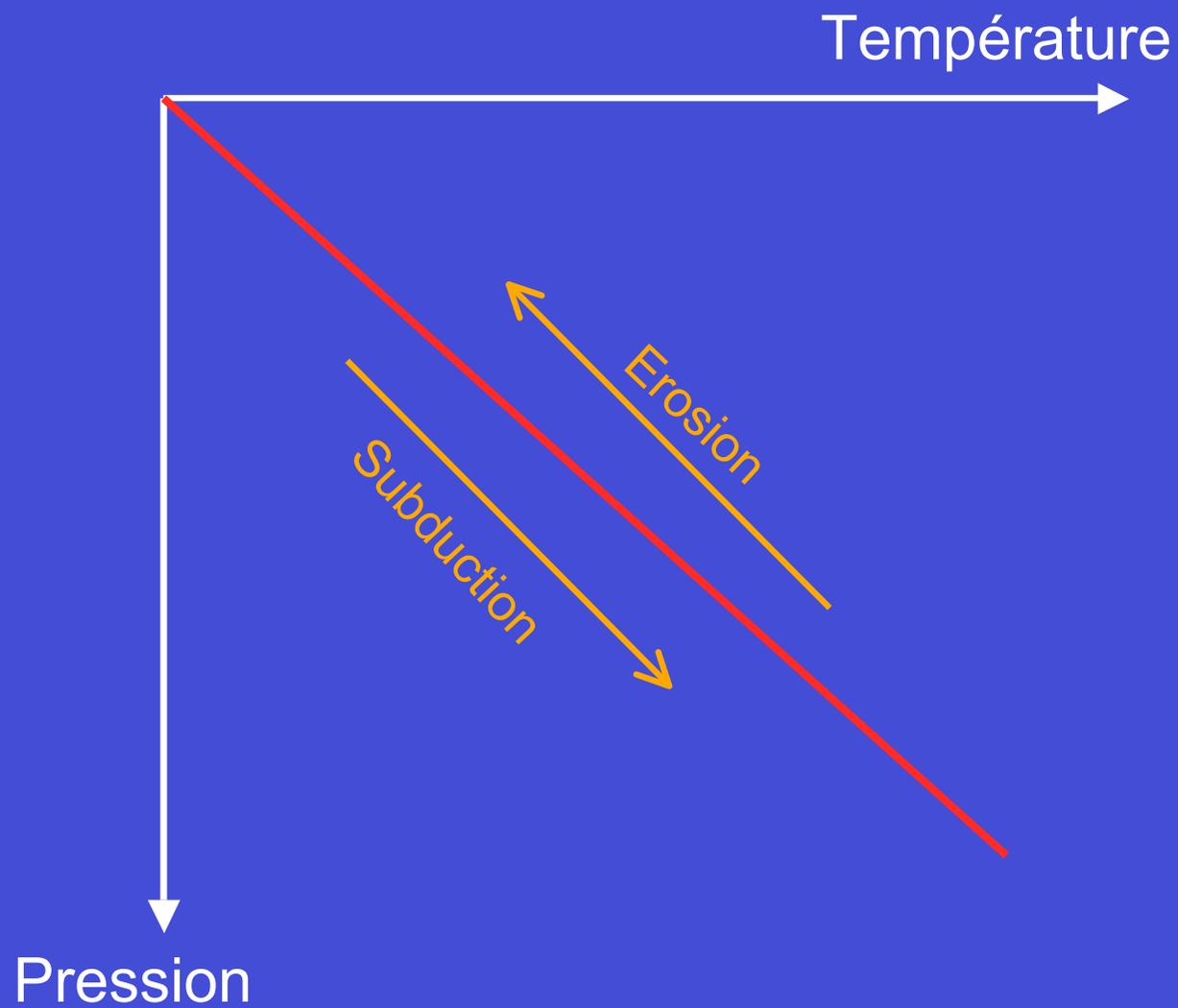
9°) Magmatisme

10°) Métamorphisme

Déformation, enfouissement et érosion : métamorphoses des roches et des minéraux



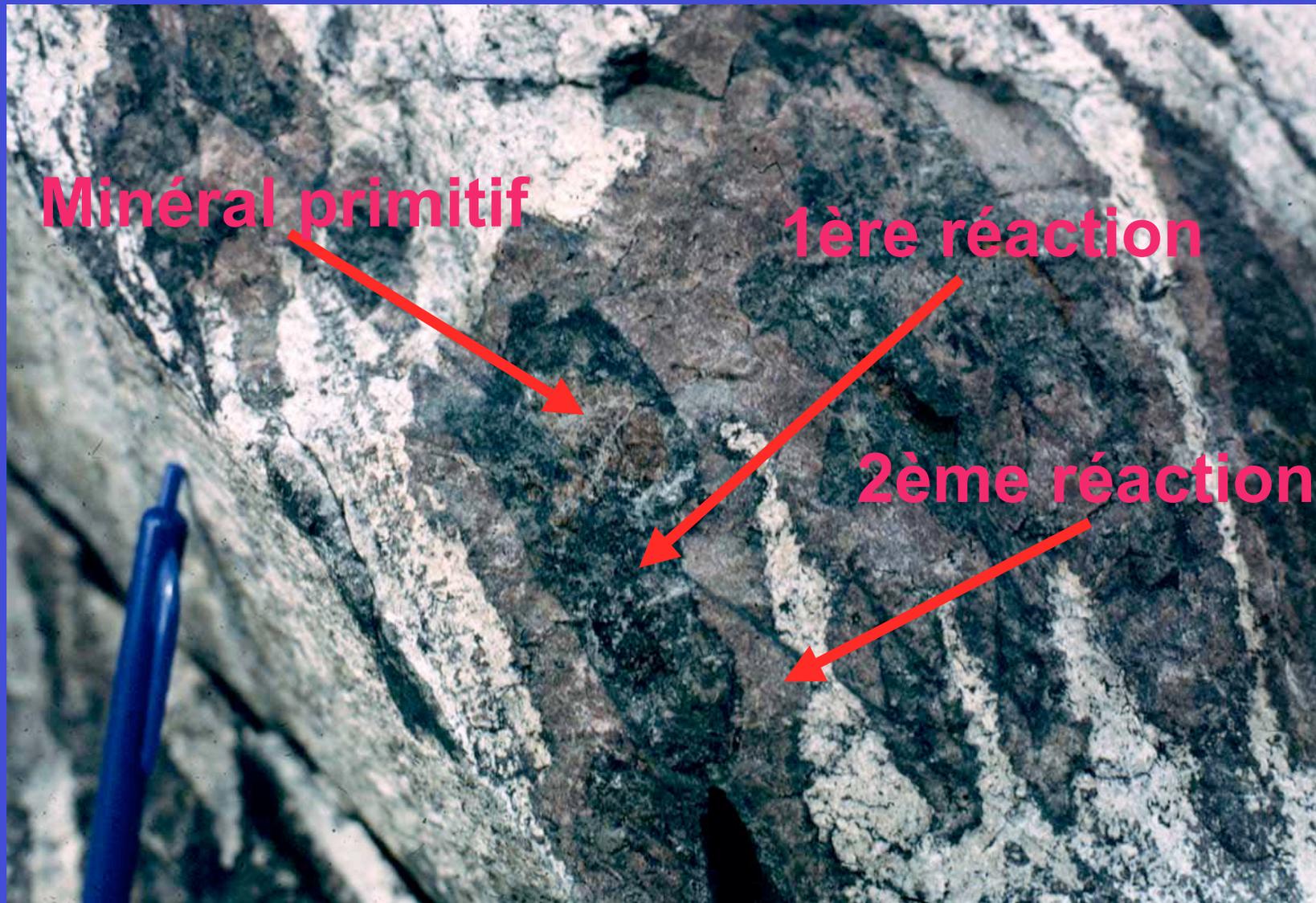
Chemin (P,T)



Couronnes de réactions



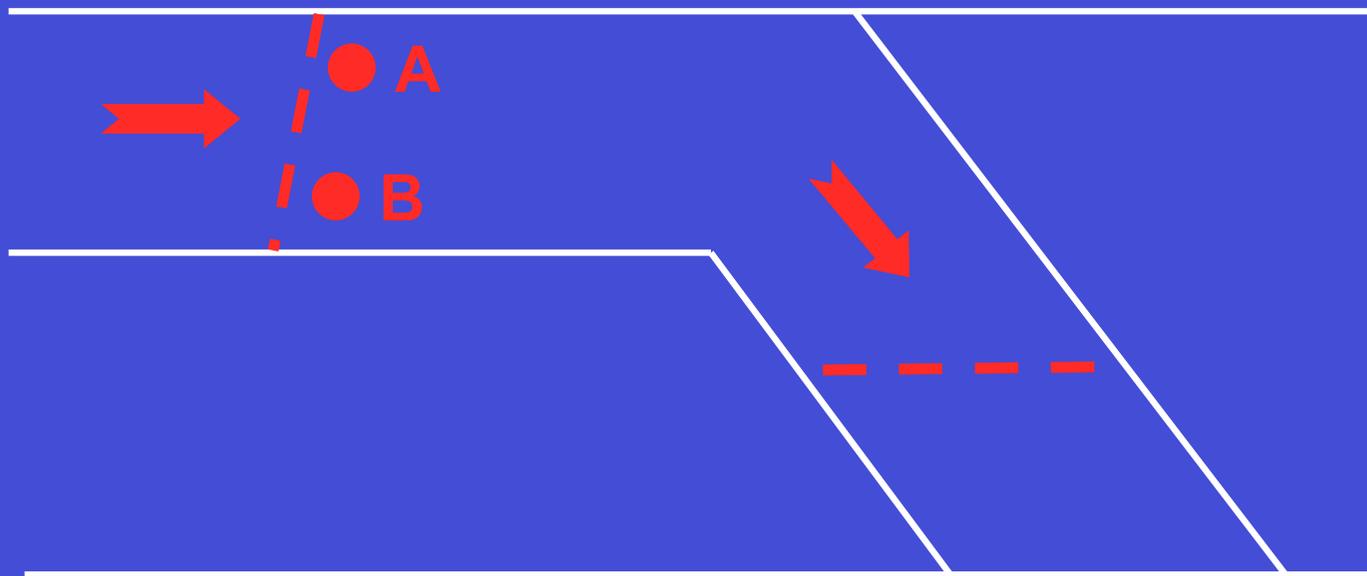
Couronnes de réactions



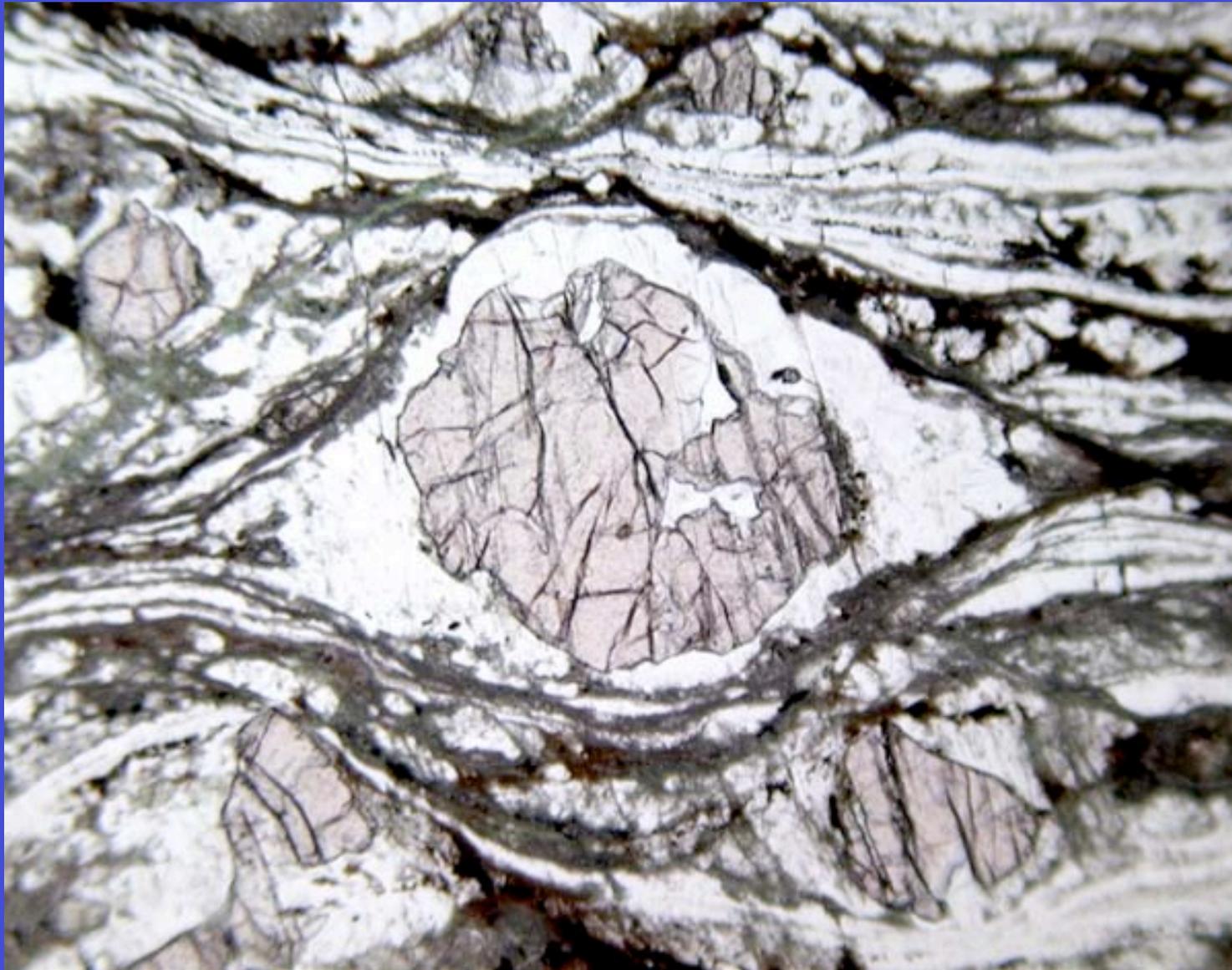
Couronnes de réaction : “pompage” d’éléments par un minéral



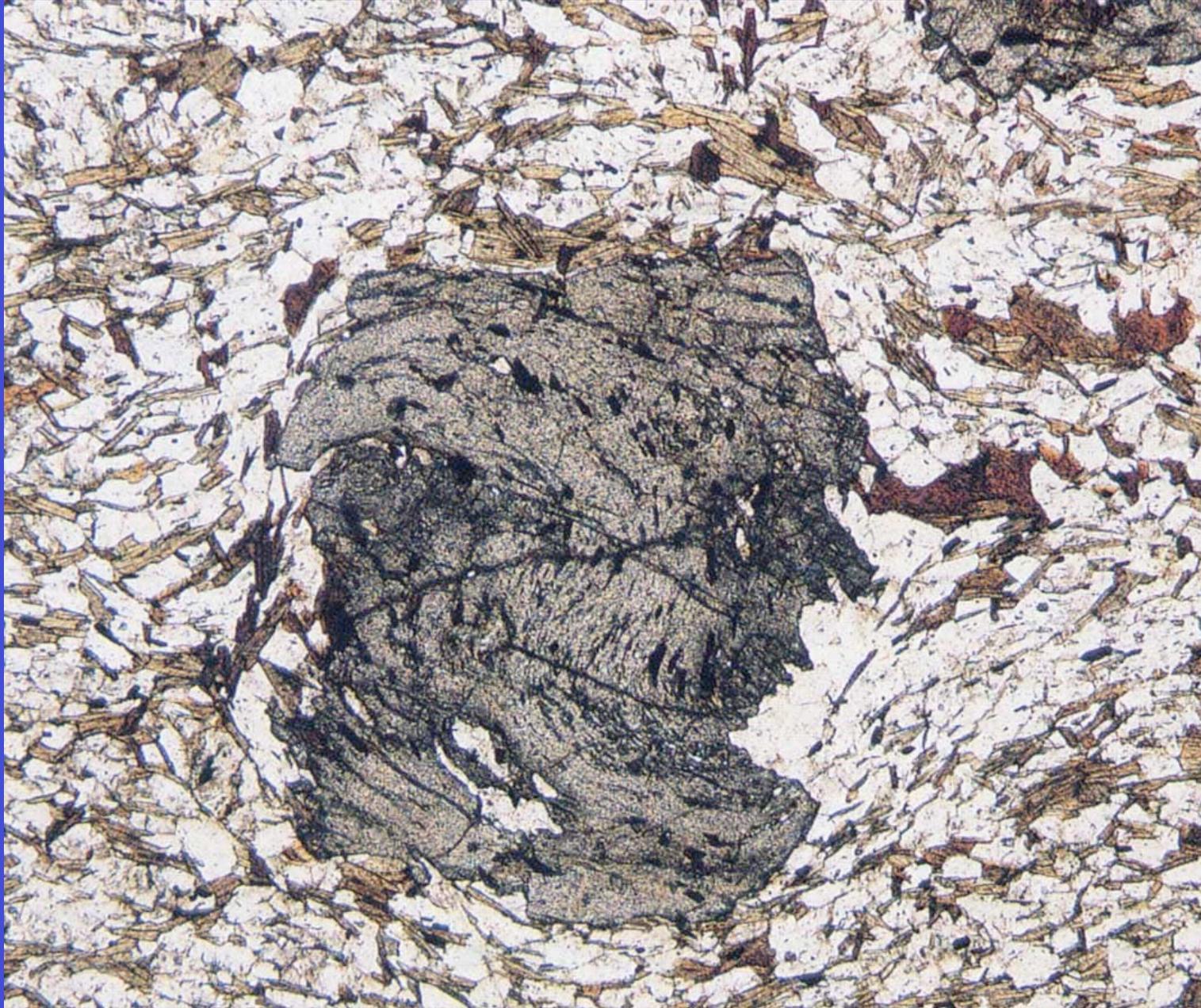
Changement de pression et de température + déformation



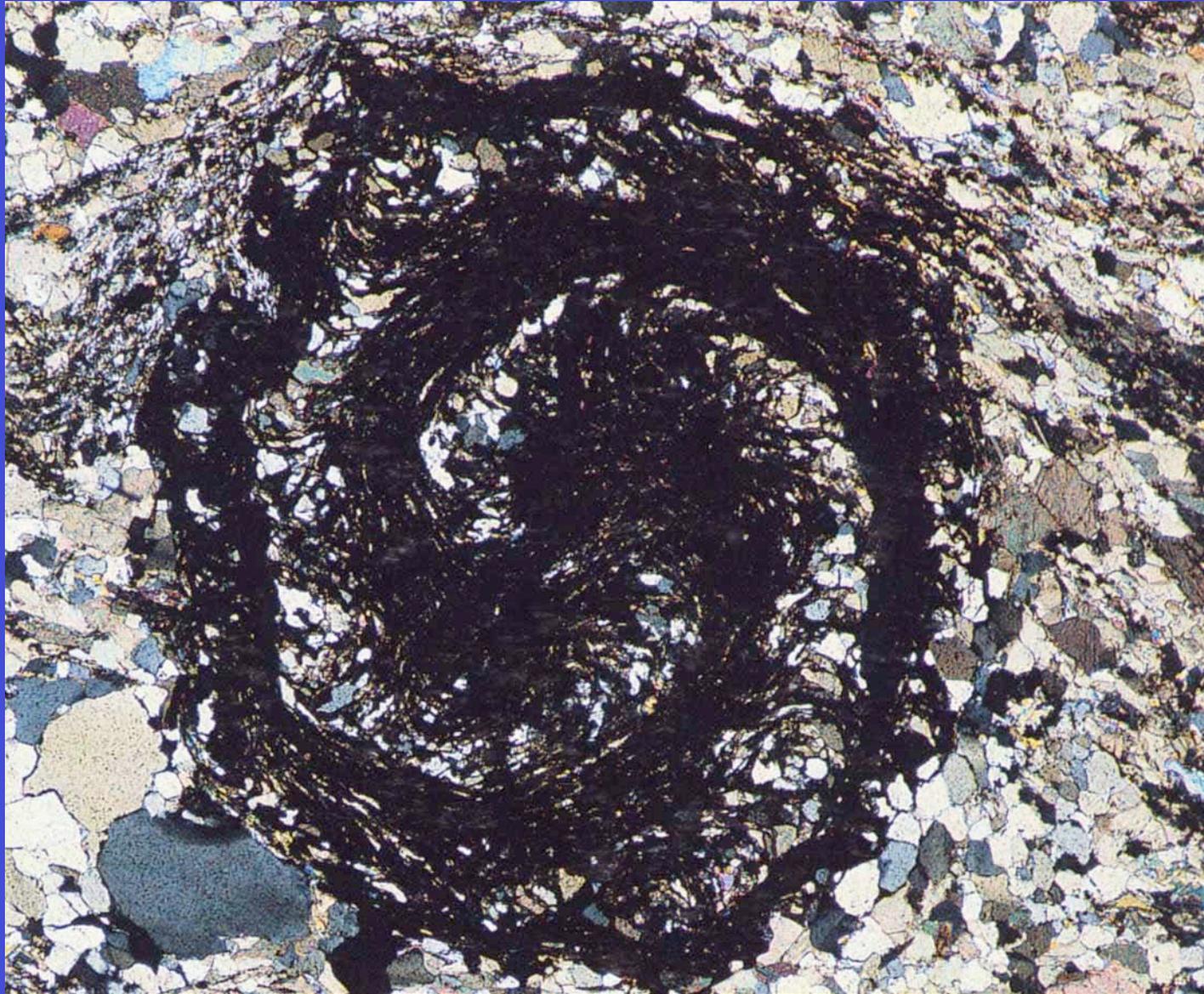
Minéral précédant la déformation



Minéral se formant pendant la déformation



Minéral se formant pendant la déformation

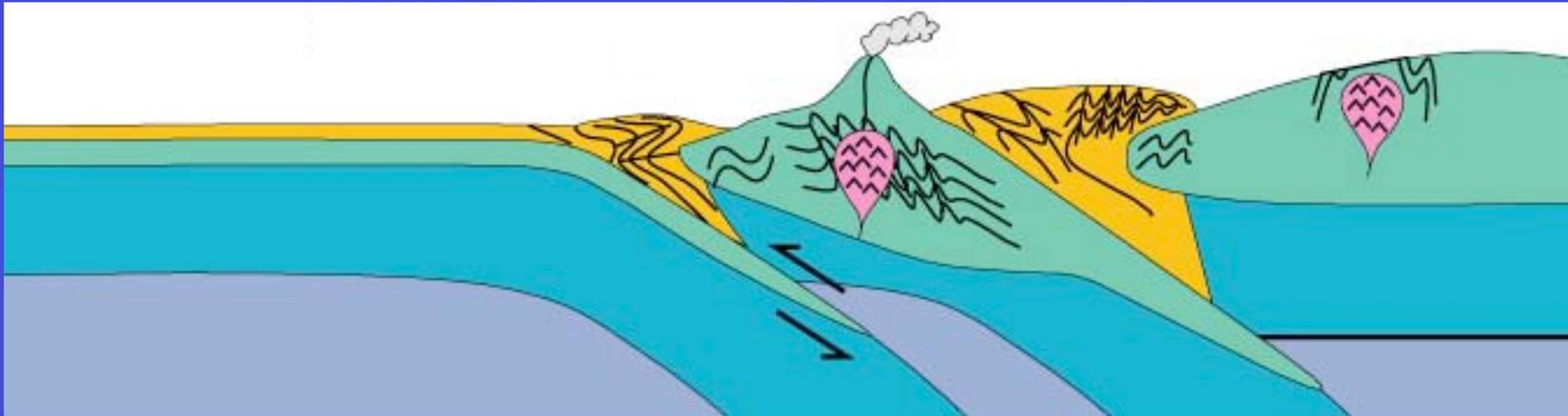


Textures des roches métamorphiques





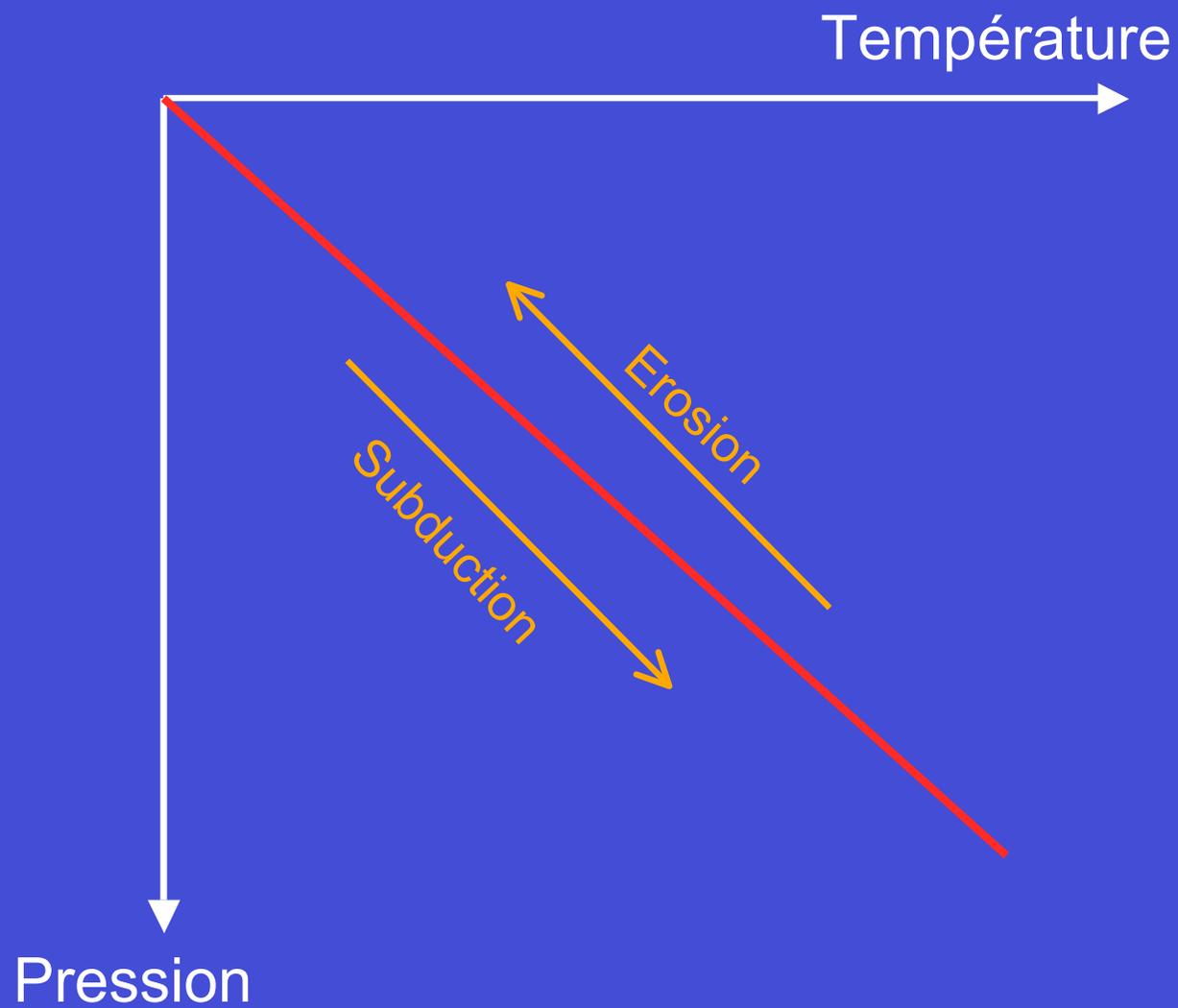
Déformation, enfouissement et érosion : métamorphoses des roches et des minéraux

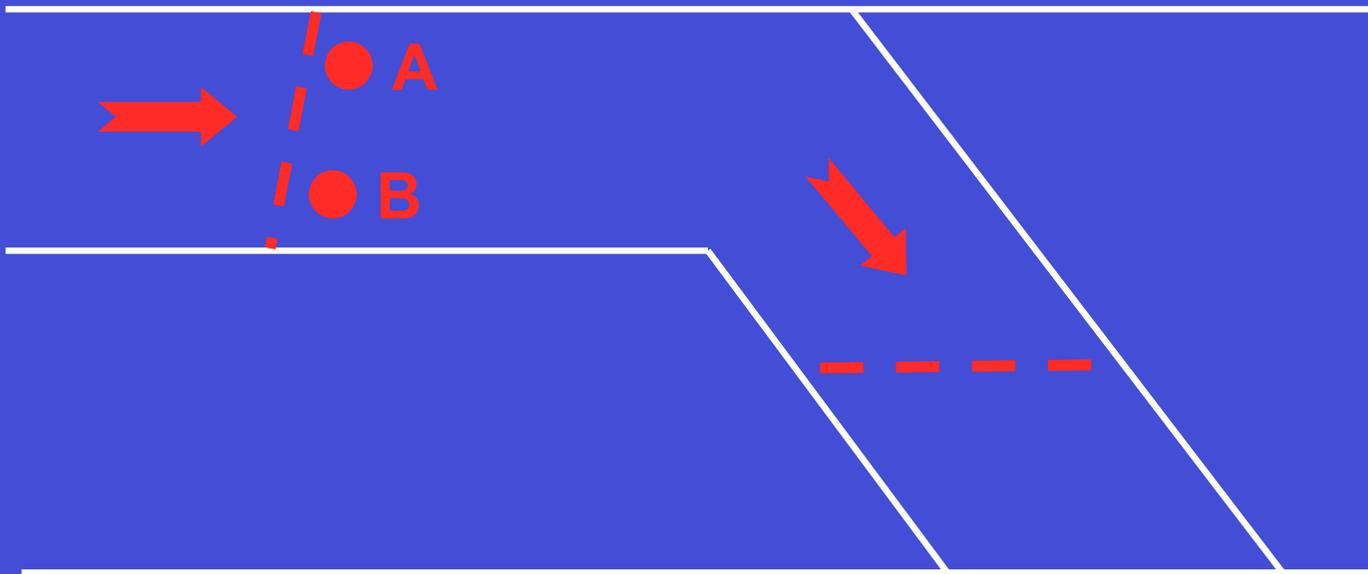


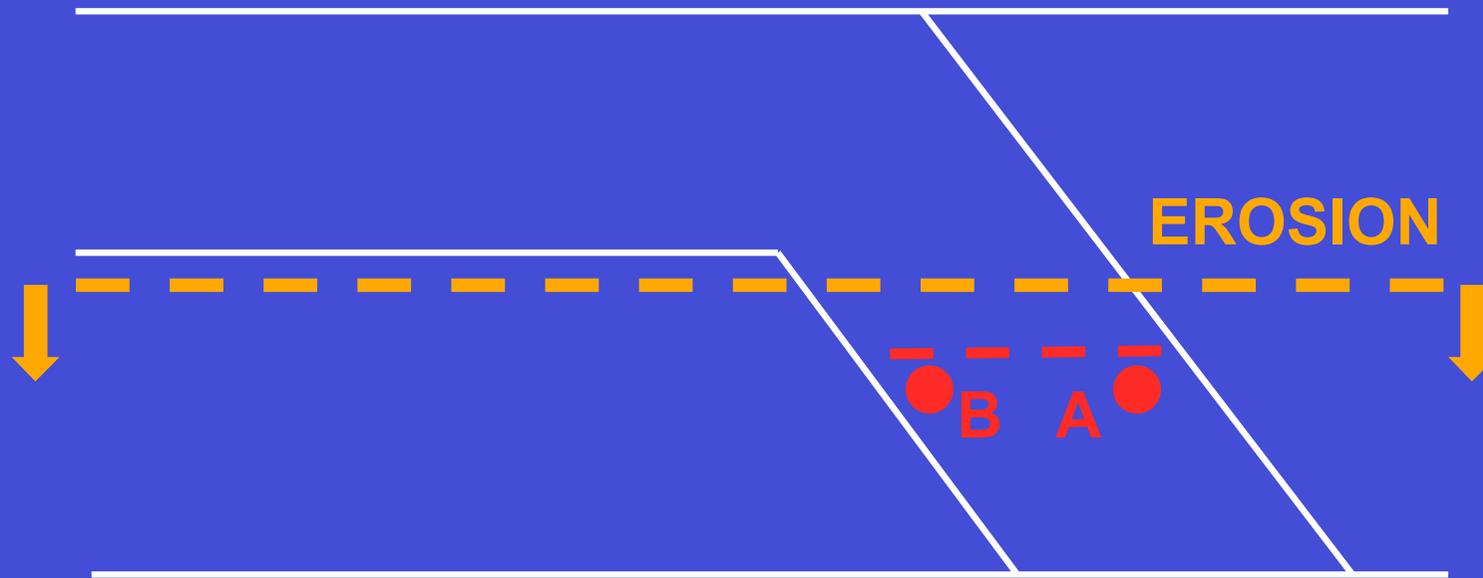
Après érosion



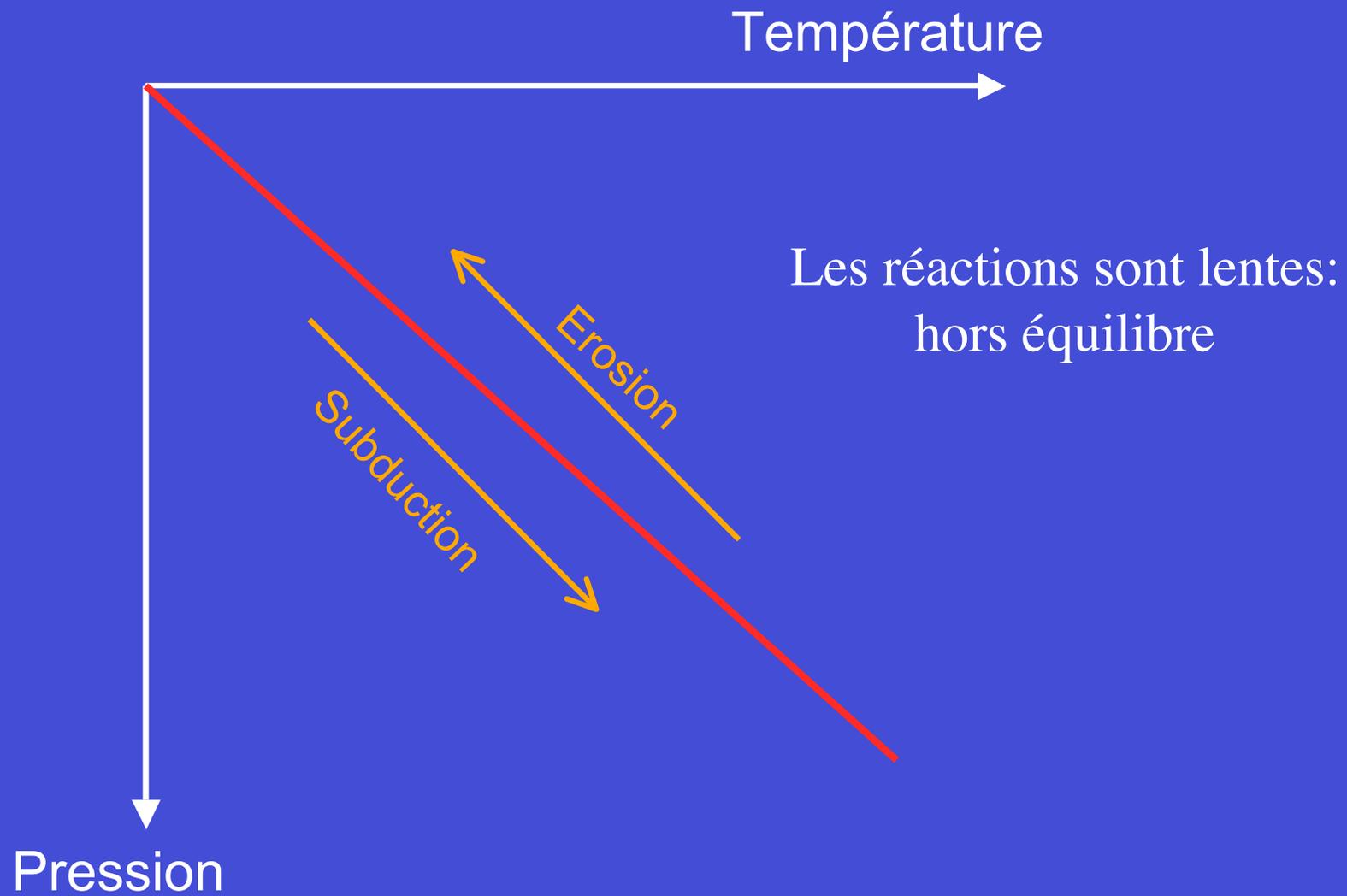
Chemin (P,T)



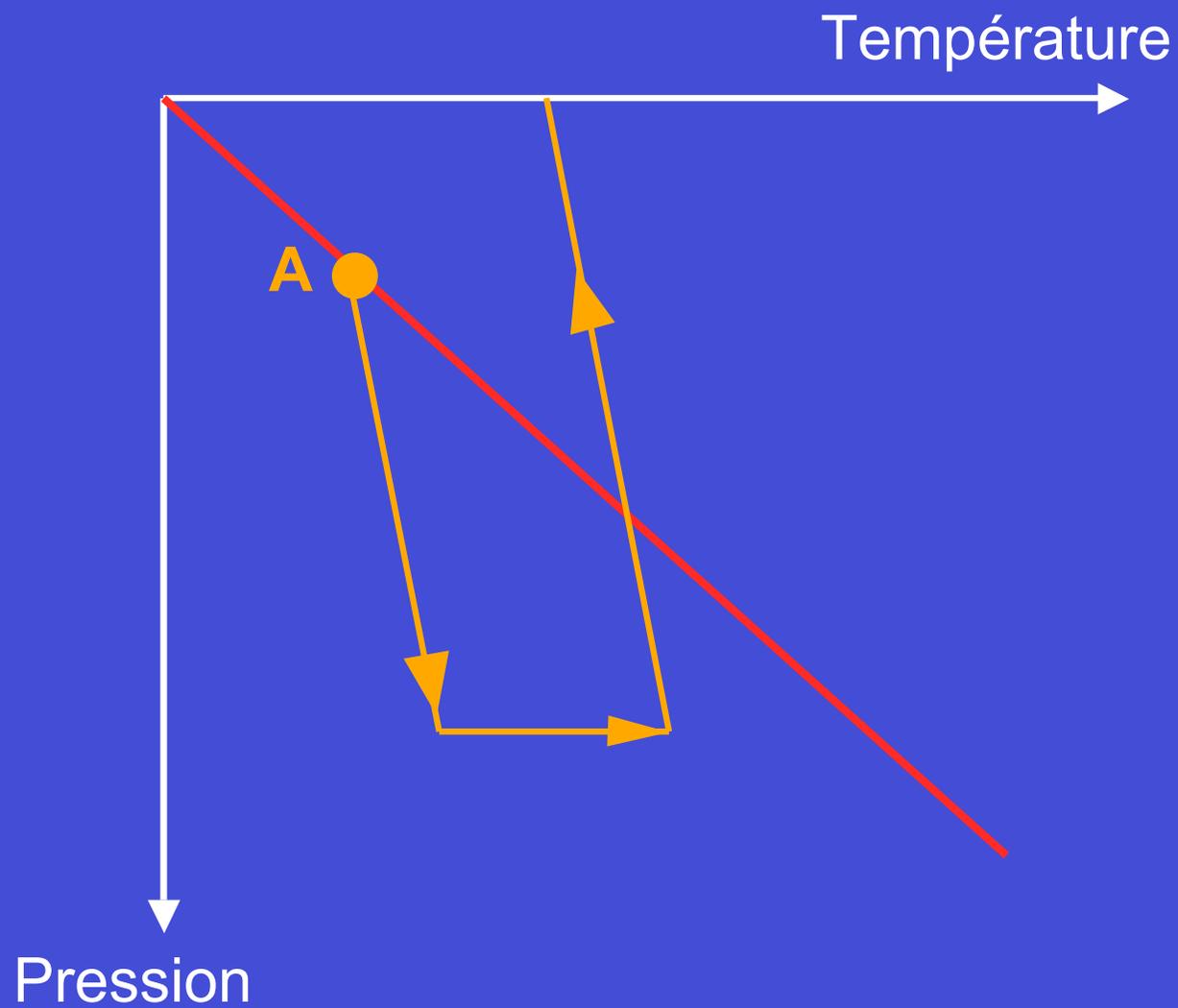




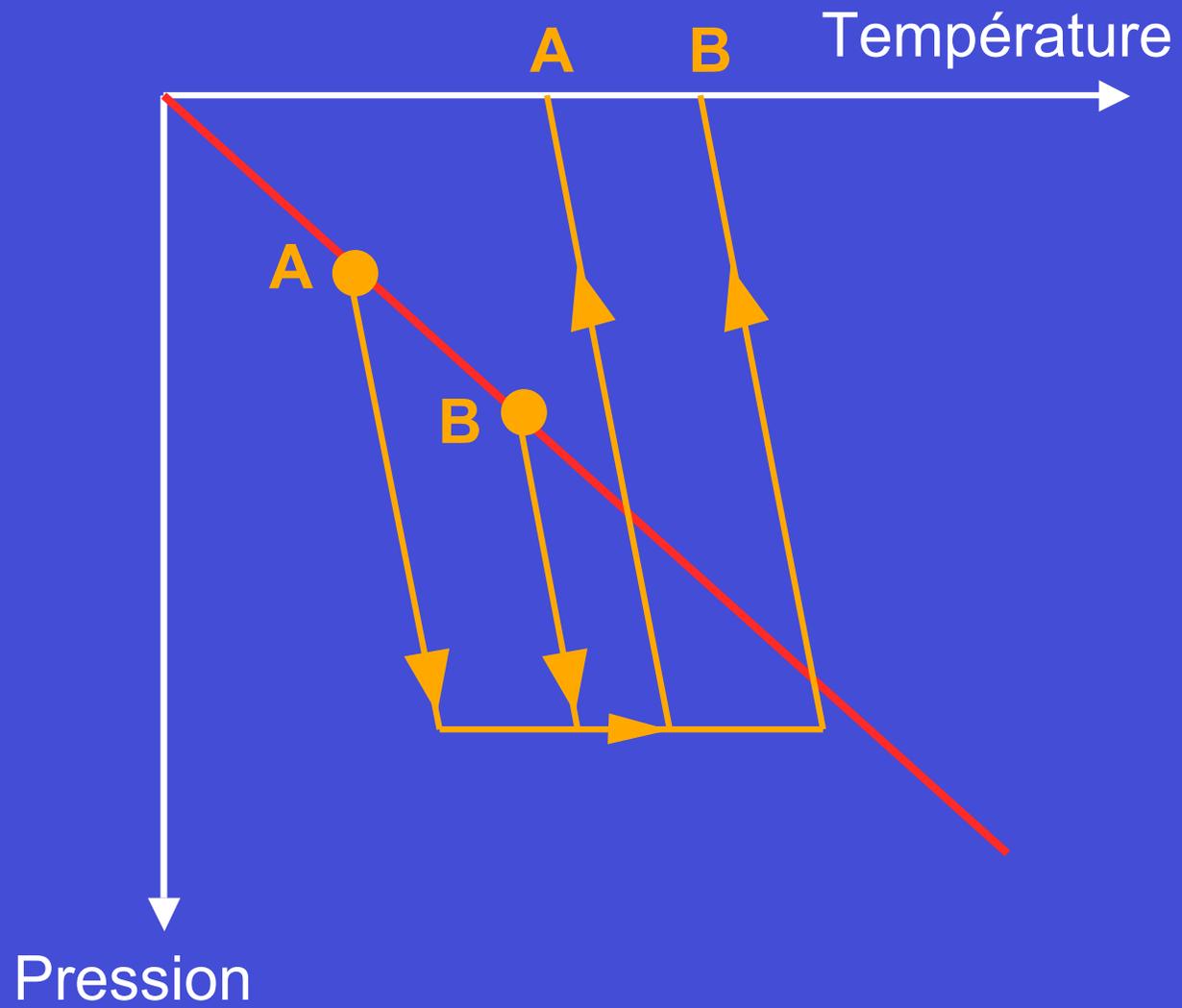
Chemin (P,T)



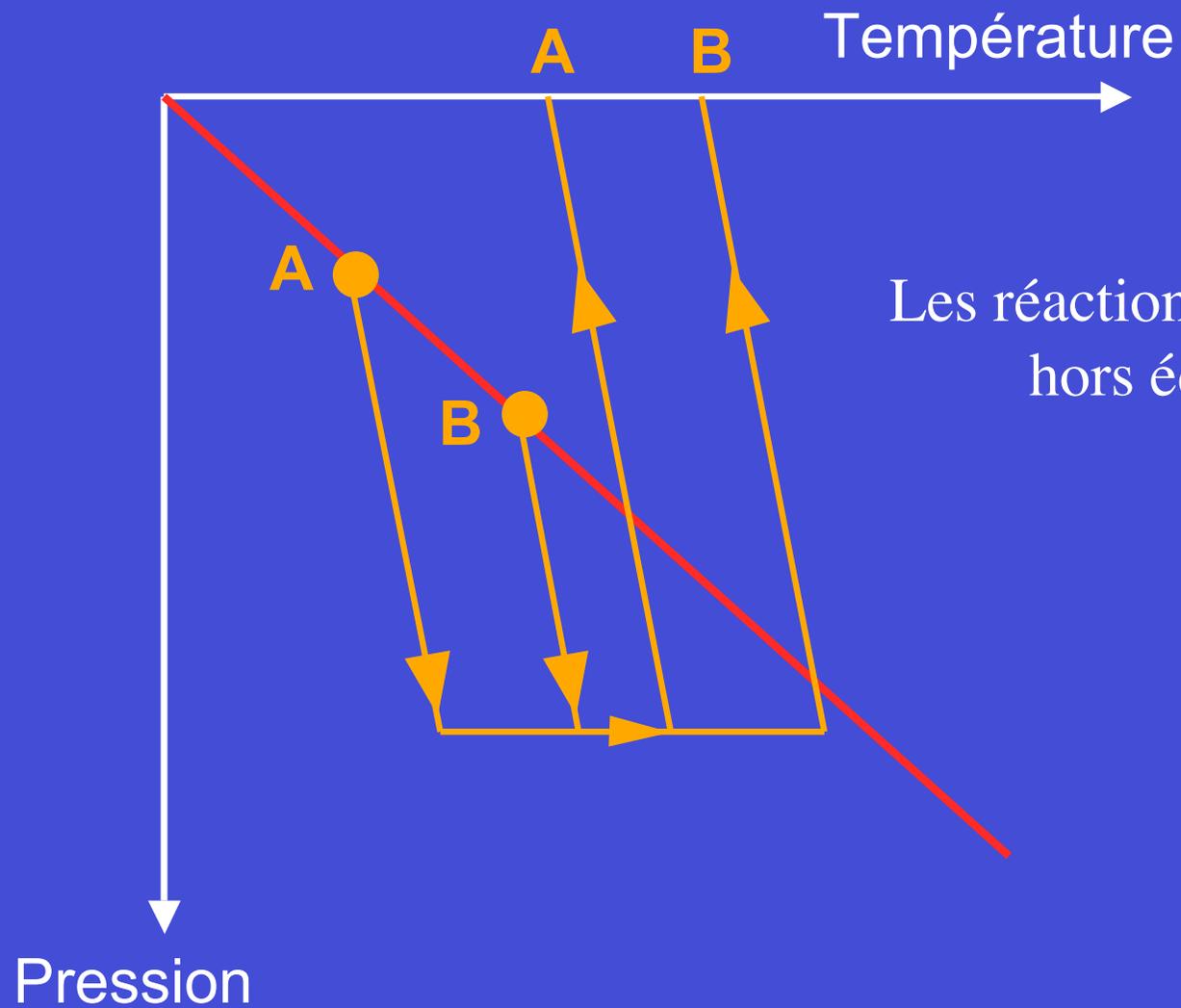
Chemin (P,T)



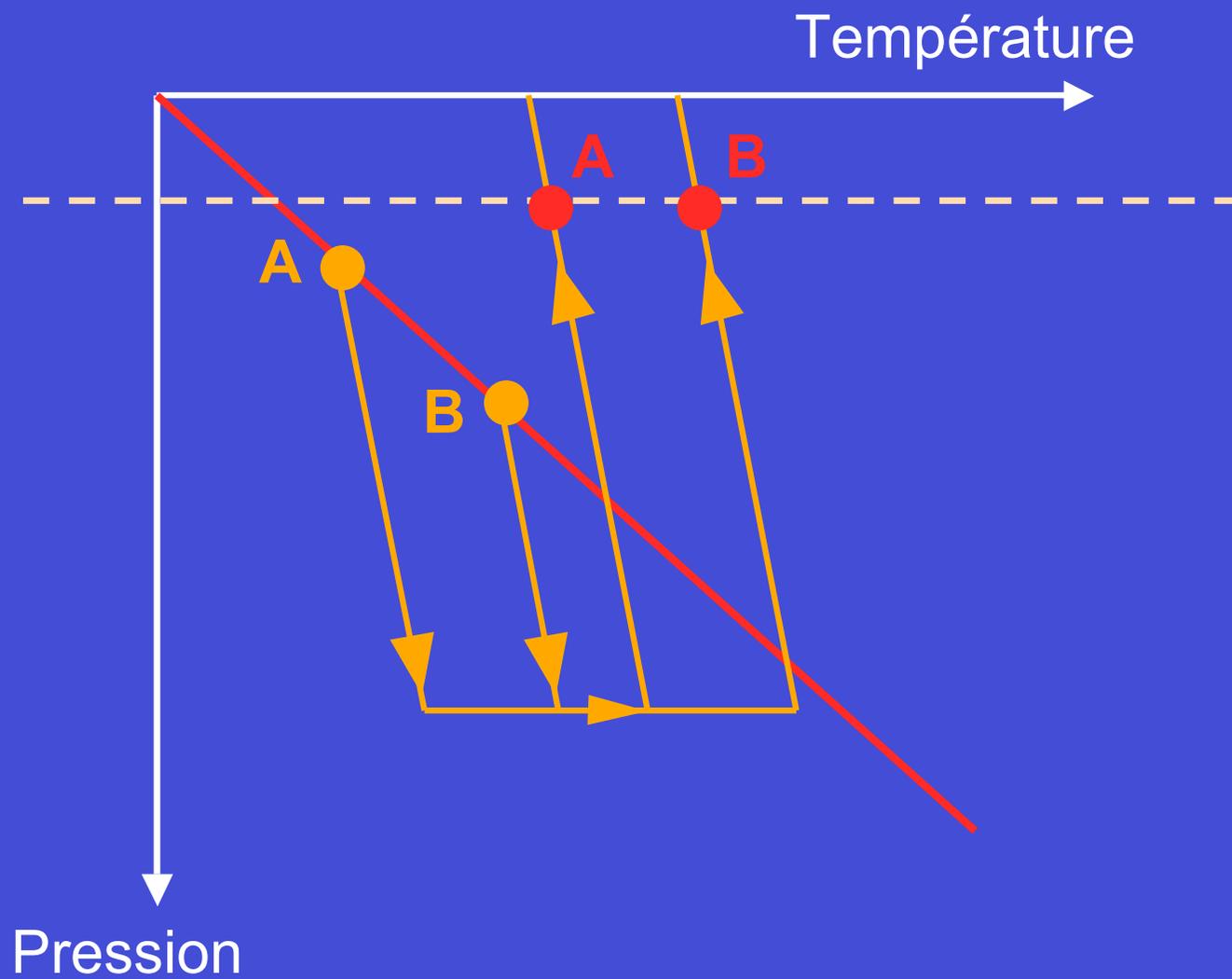
Chemin (P,T)



Chemin (P,T)



Chemin (P,T)



Après érosion



Zonation métamorphique

