

COURS DISPONIBLE SUR INTERNET

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—————> TICE

—————> Serveur de Cours

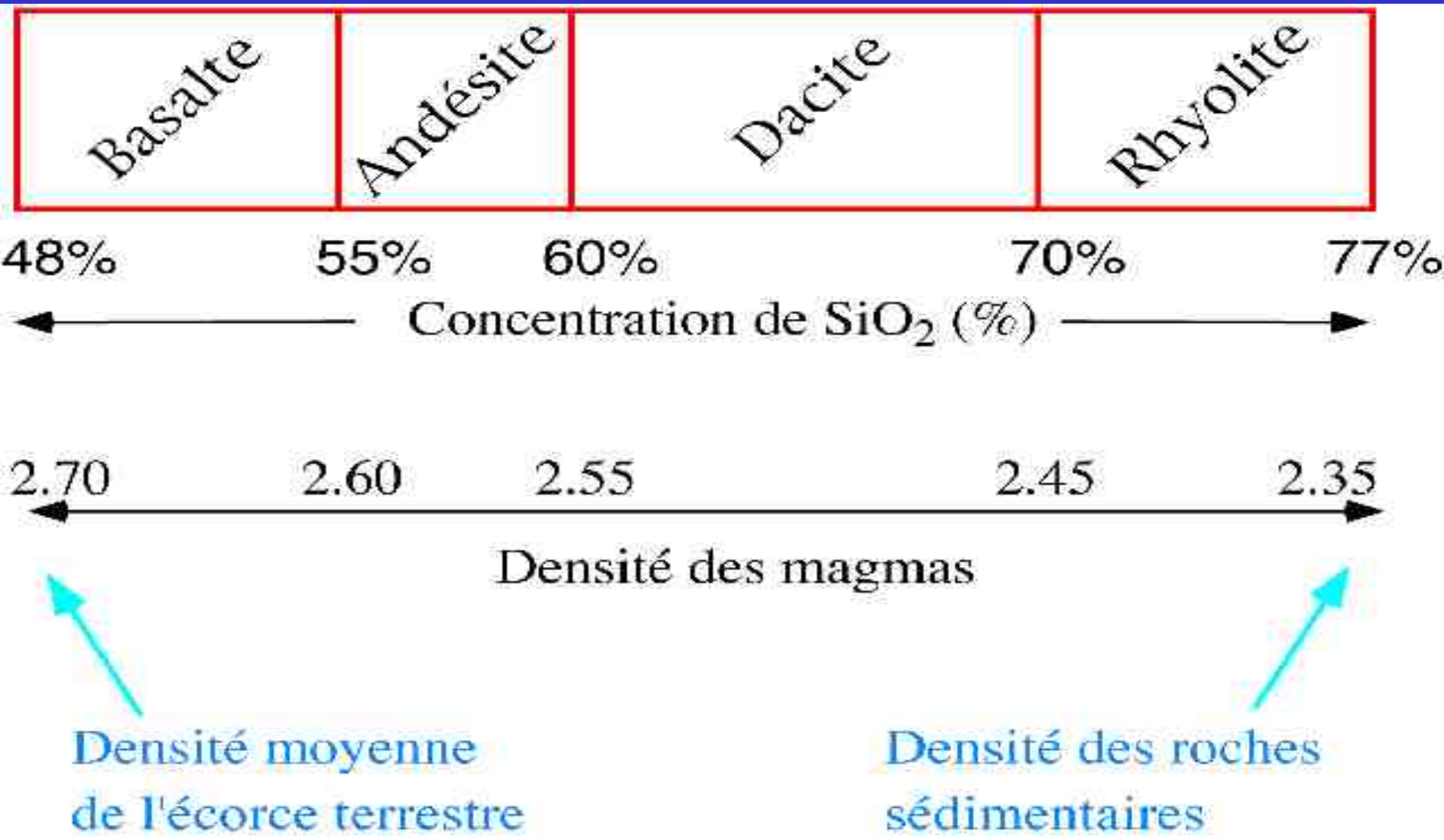
LE DERNIER COURS

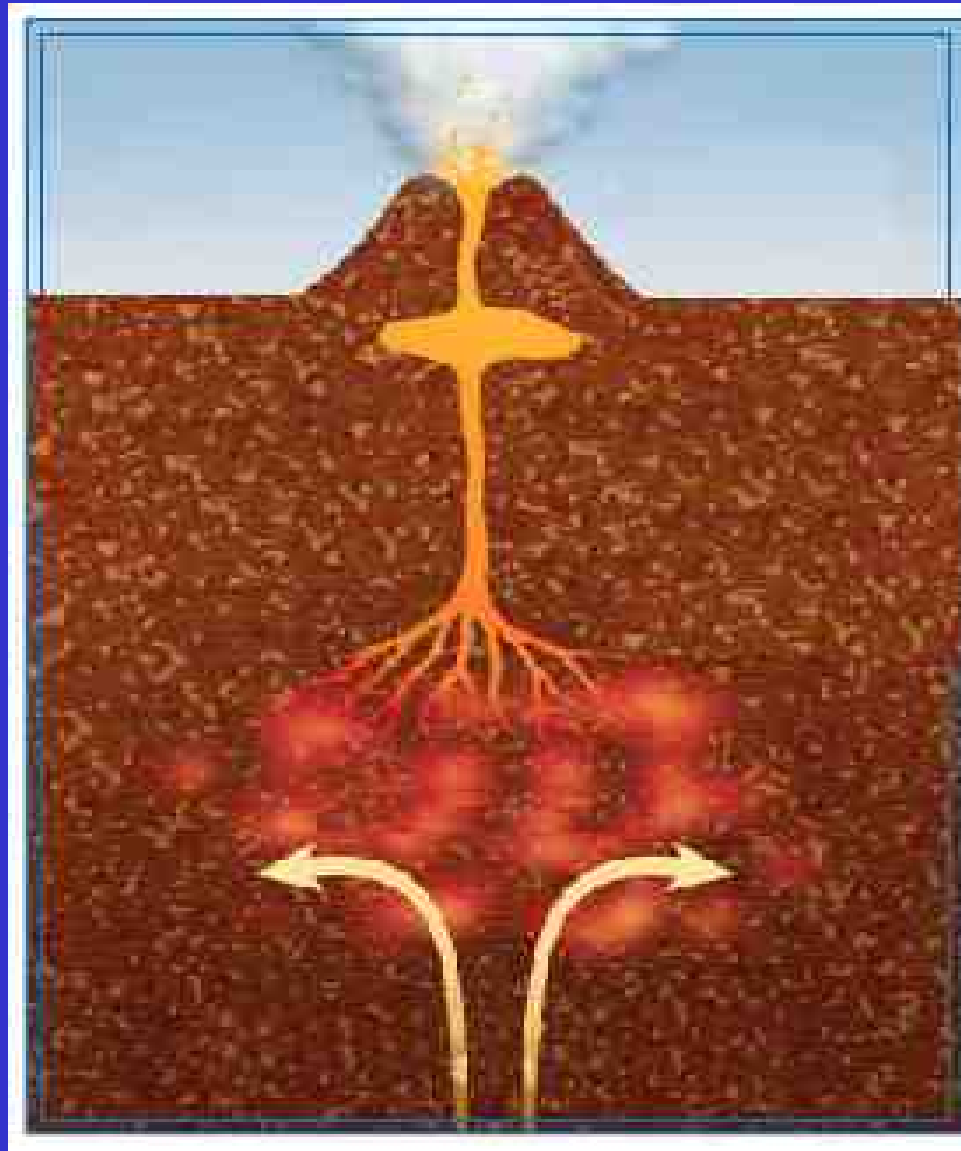
AURA LIEU

AUJOURD'HUI !

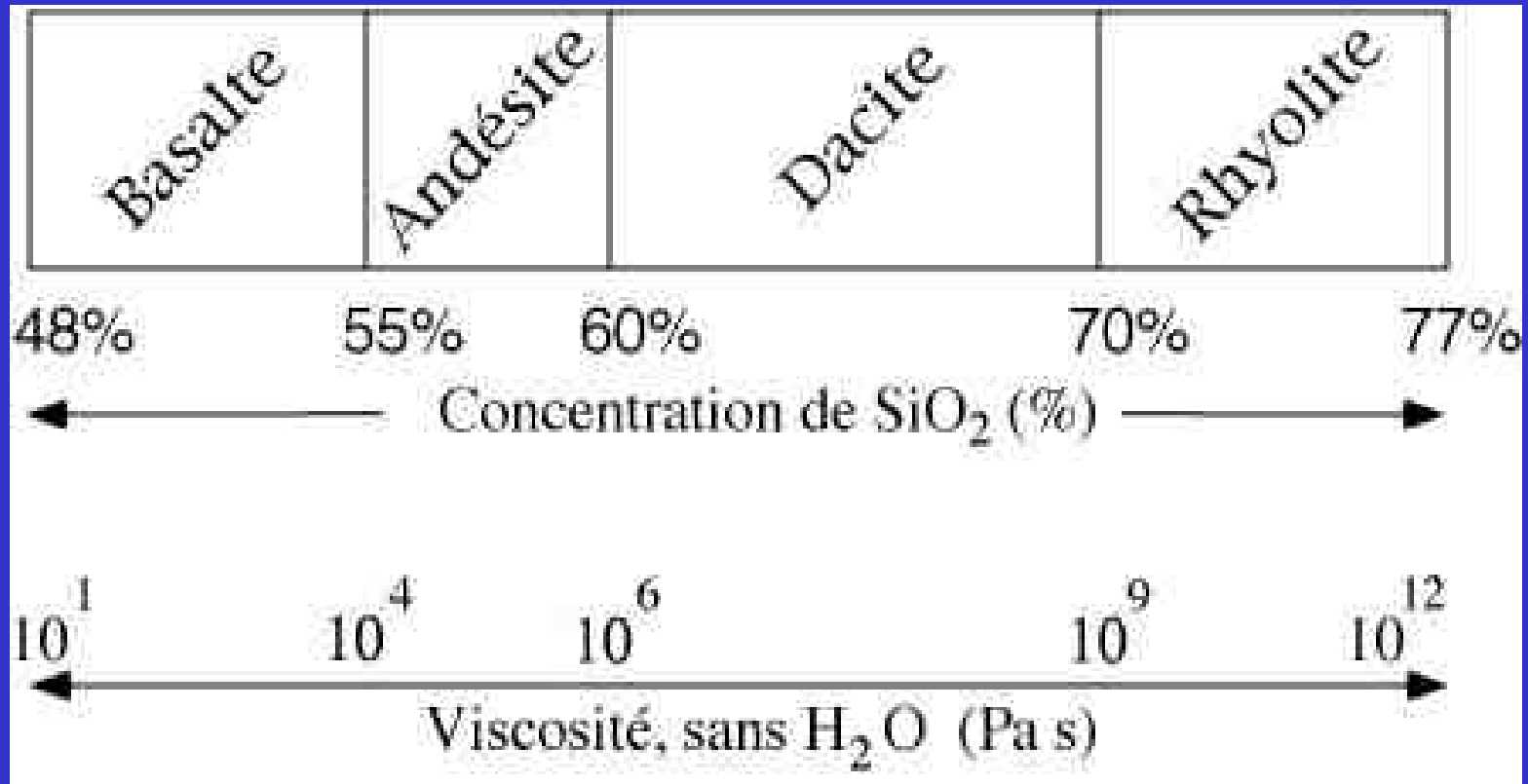
III – Phénomènes Géologiques Méso Echelle

- 8°) Volcanisme
- 9°) Magmatisme
- 10°) Métamorphisme





VISCOSITE





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DOME DU POPOCATEPETL (MEXIQUE)

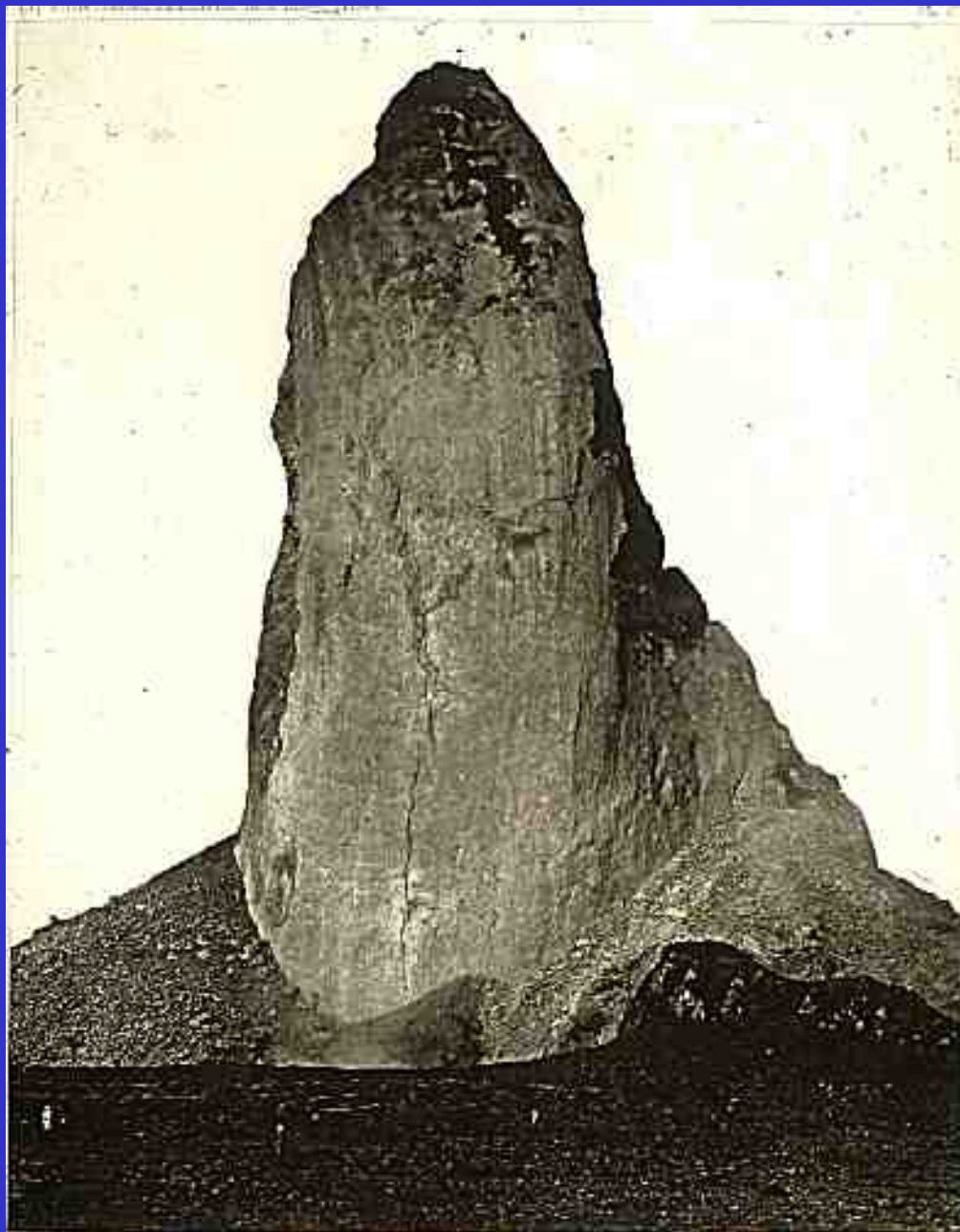


Centre National de Recherche Scientifique et Technologique

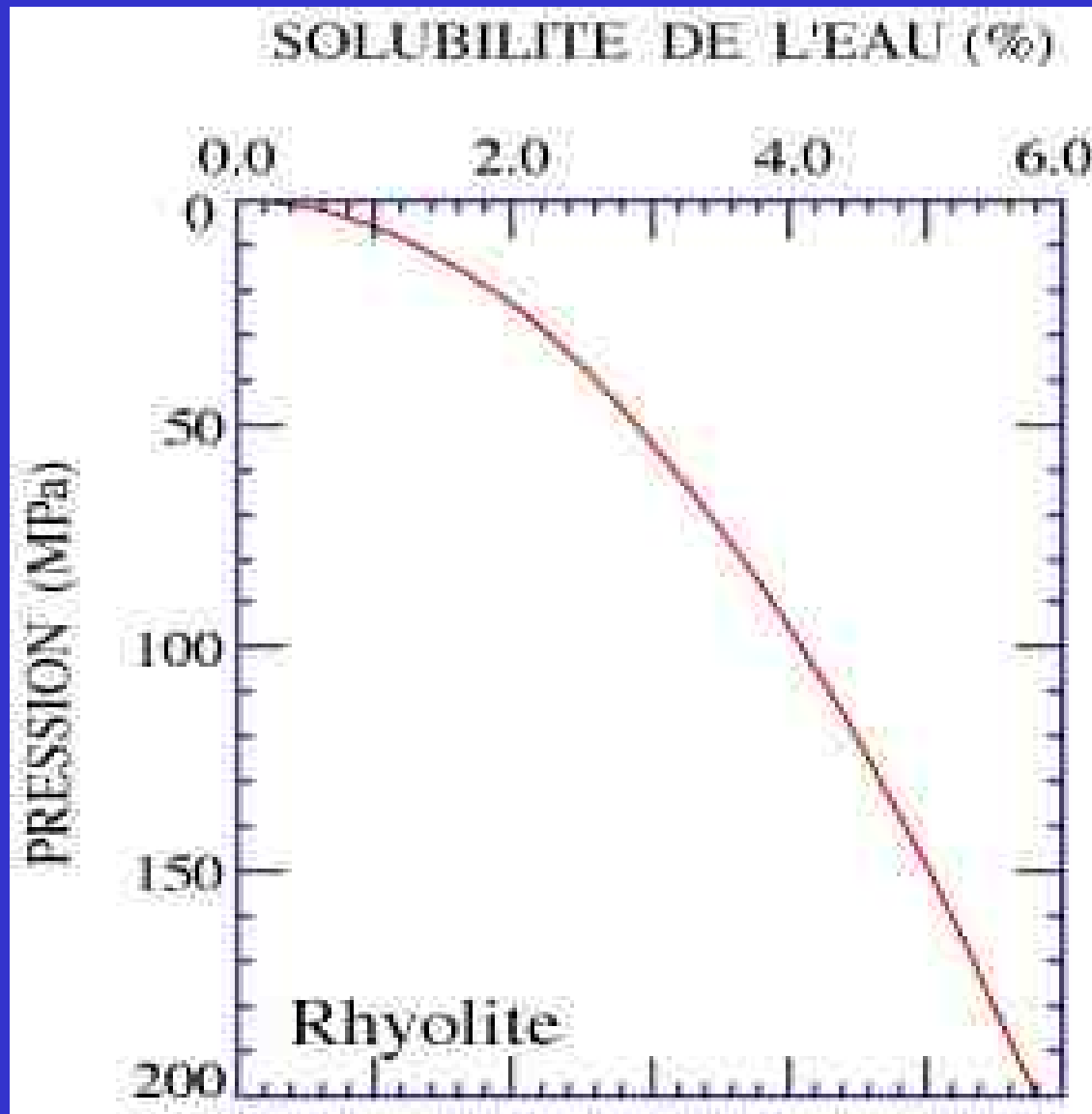
24 1 2002

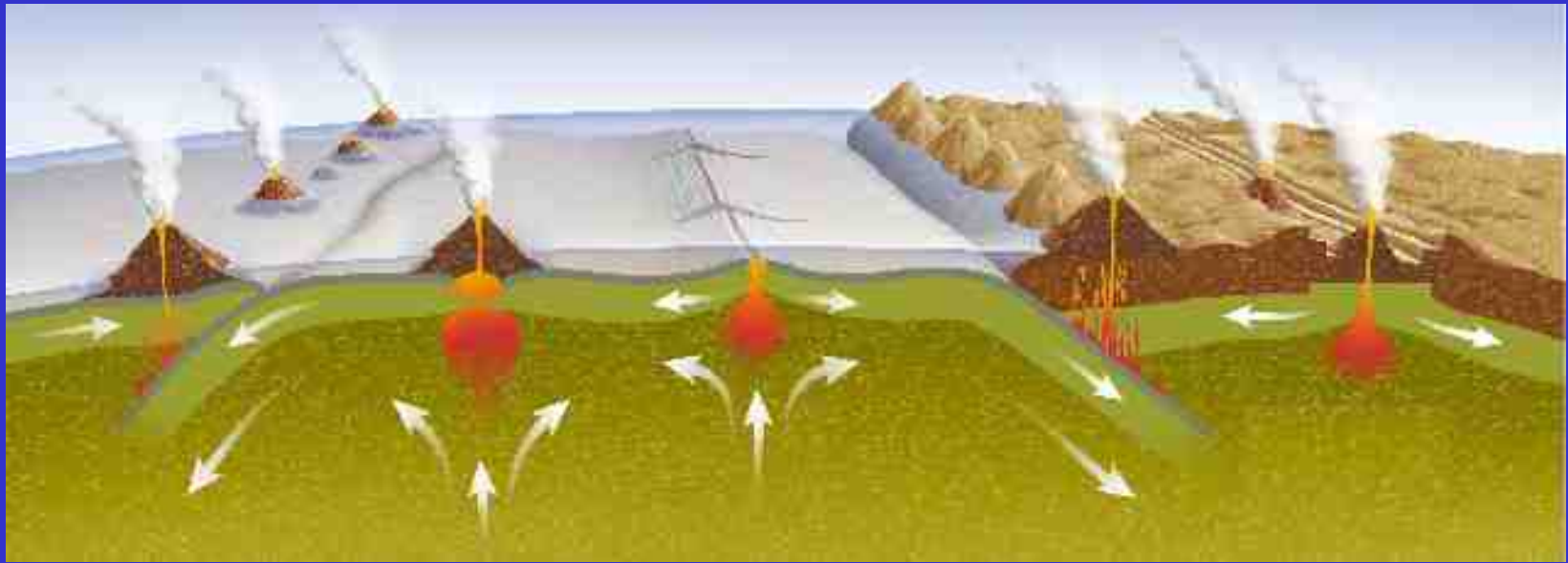


L'AIGUILLE DE LA MONTAGNE PELEE (1902)



GAZ ?





Subduction
(Japon)

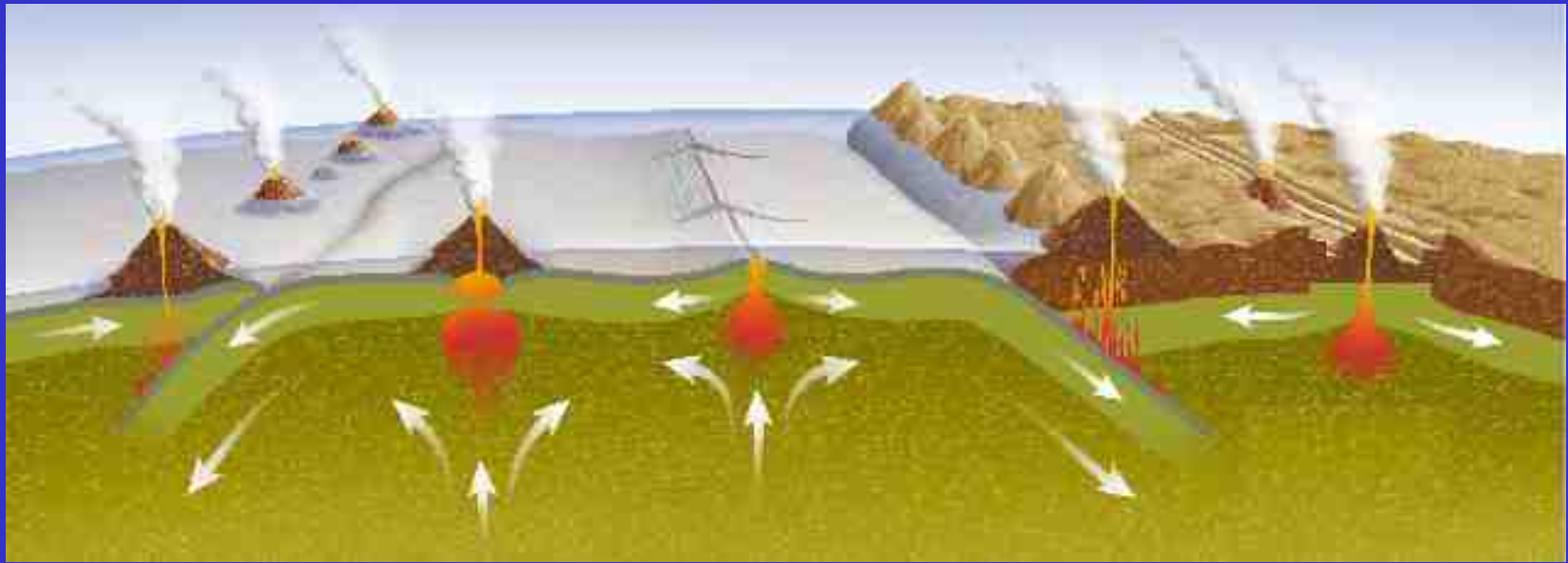
Panache
(Hawaii,
La Réunion)

Dorsale
océanique

Subduction
(Andes)

Extension
(Rhin, rift
Est-Africain)

VOLATILES



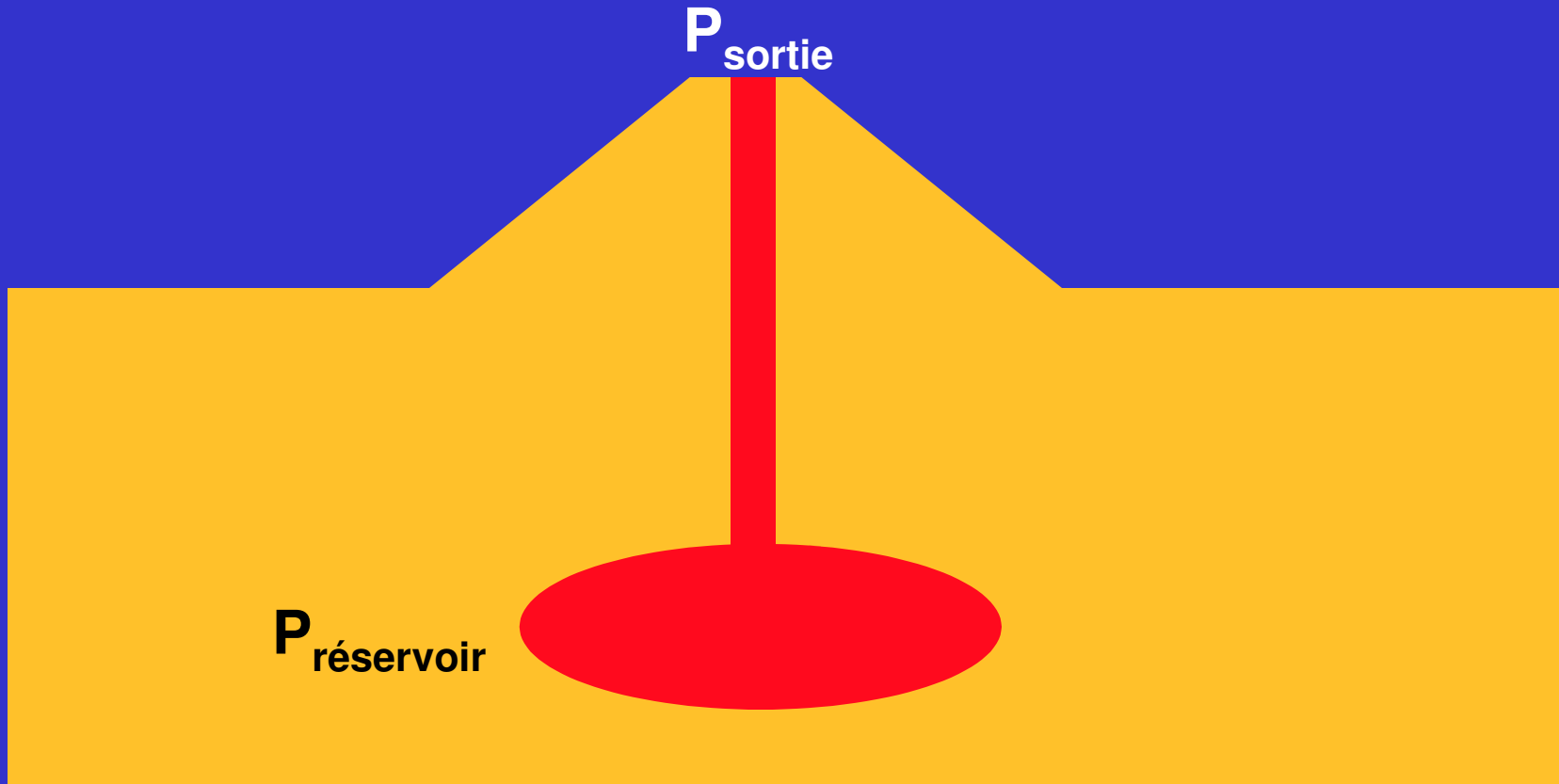
Subduction

Panache
(Hawaii,
La Réunion)

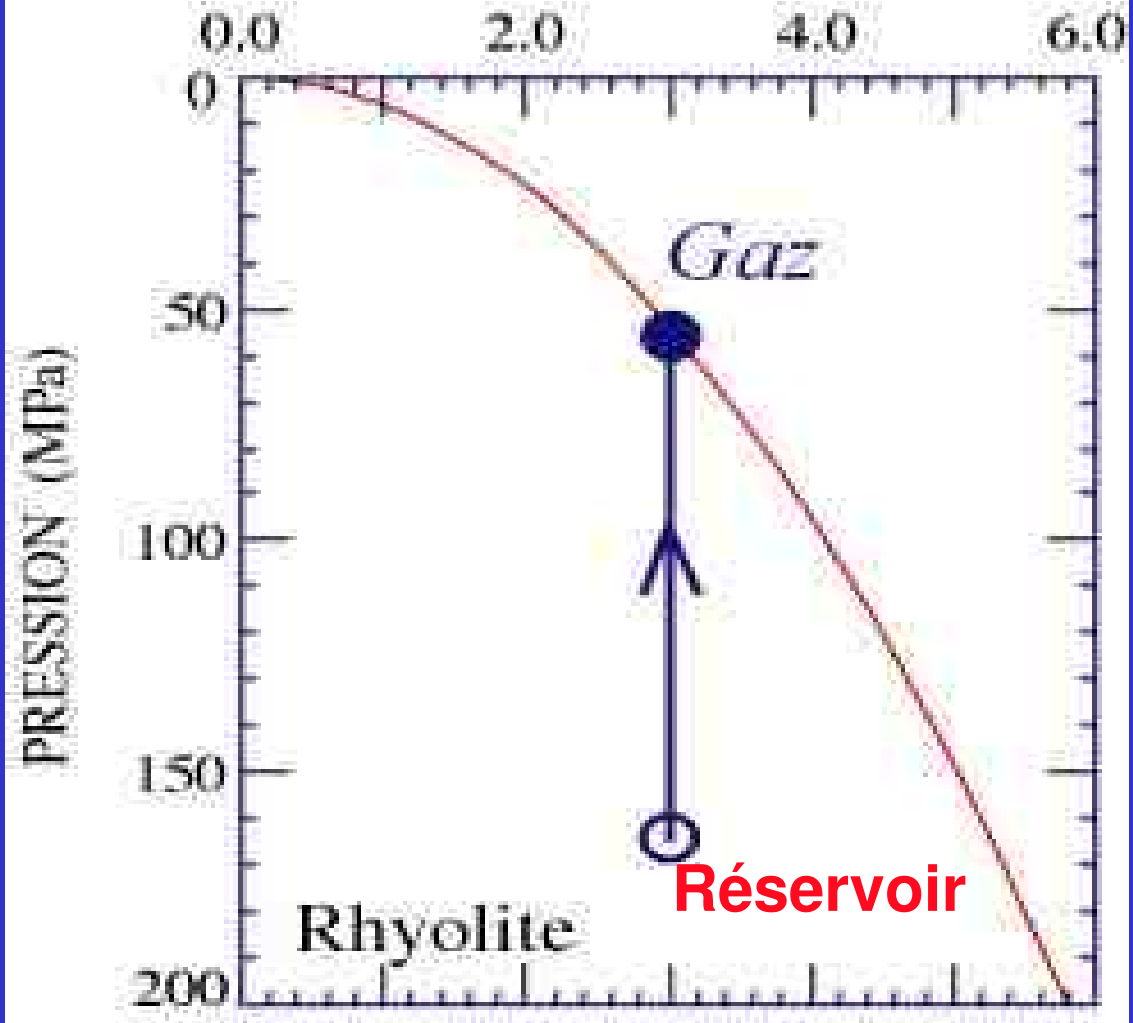
Dorsale
océanique

Subduction

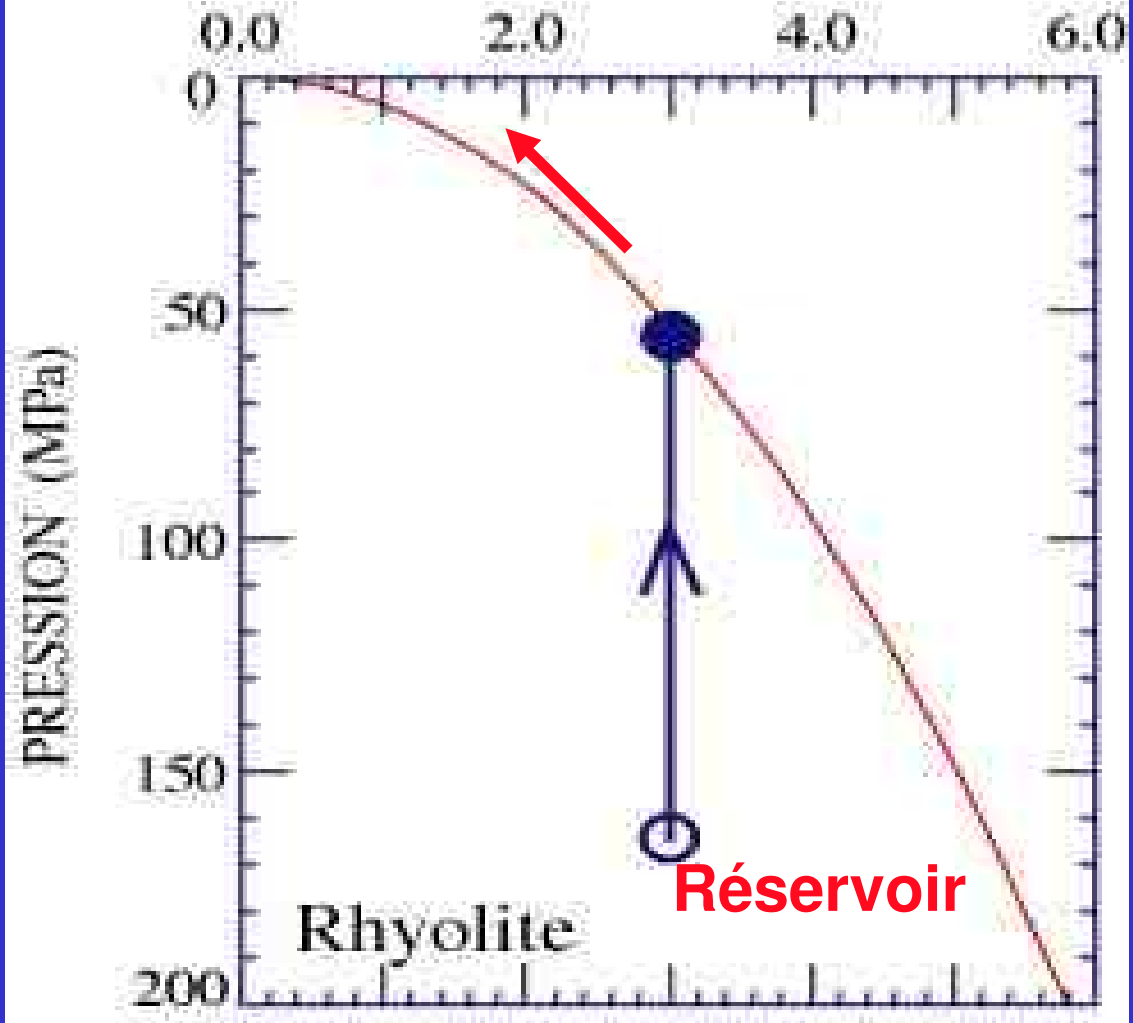
Extension



SOLUBILITE DE L'EAU (%)

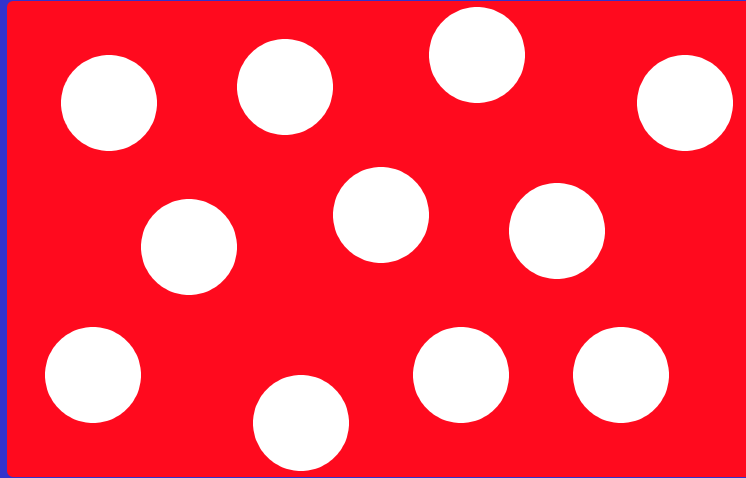


SOLUBILITE DE L'EAU (%)



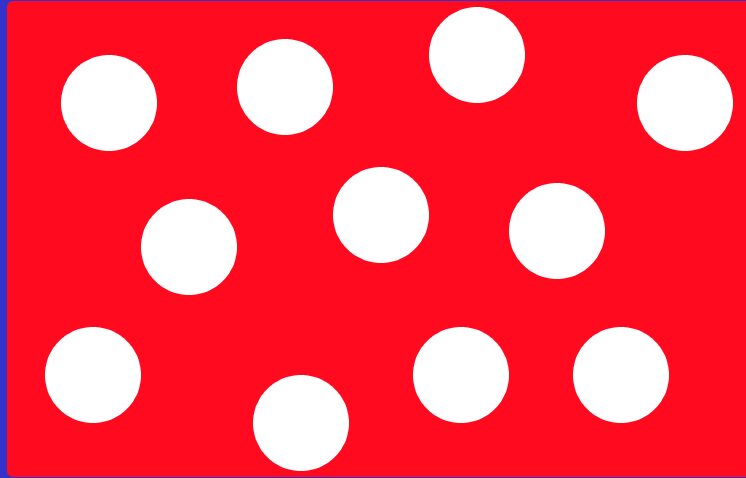
Rhyolite

Réservoir



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

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



$$\rho_g V_g = M_g$$

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

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

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

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

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

$$\frac{1}{\rho_{\text{tot}}} = \frac{X_g}{\rho_g} + \frac{X_m}{\rho_m}$$

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

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

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

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

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

$$\rho_{\text{tot}} \approx \approx$$

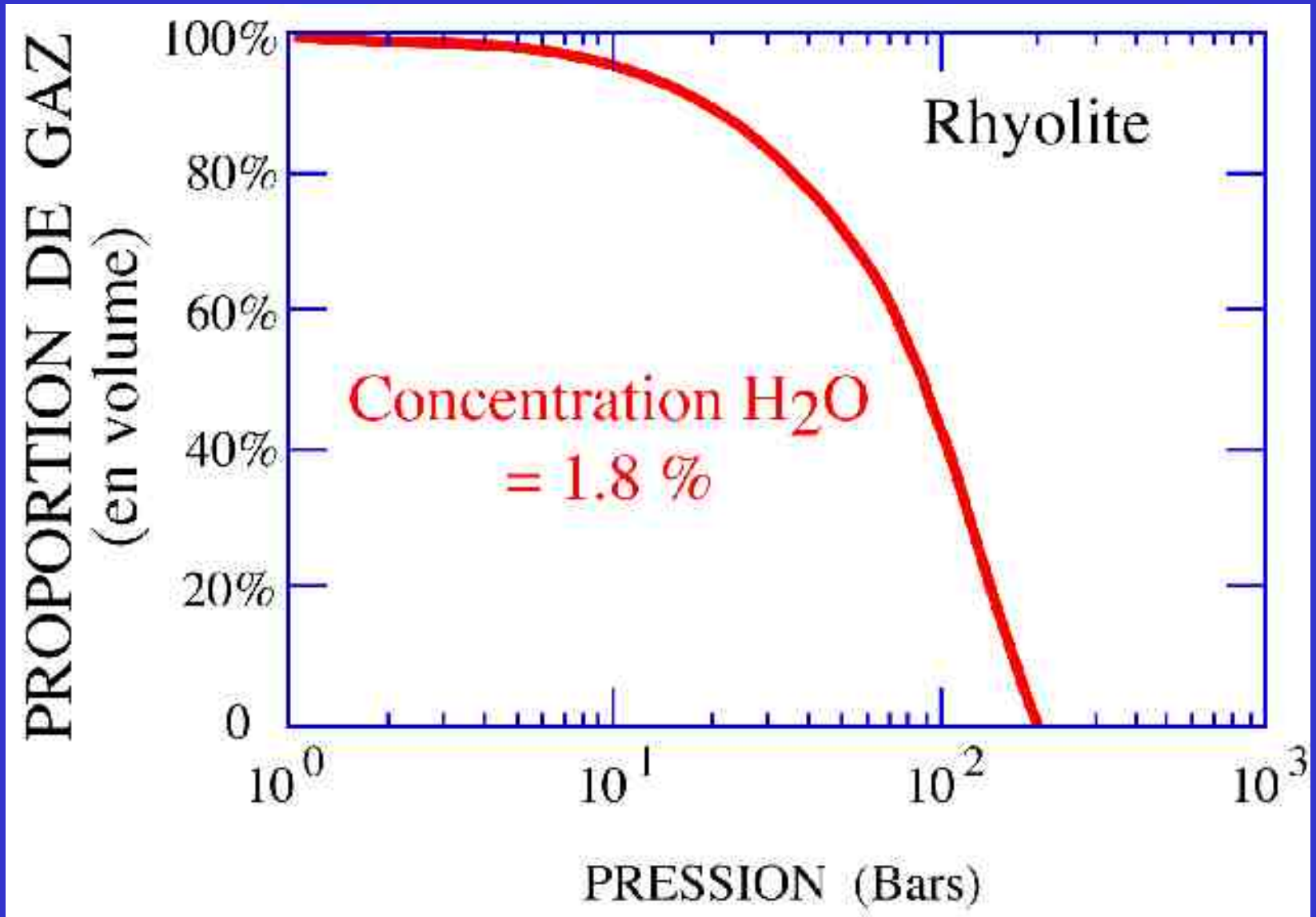
$$V_{\text{total}} = V_g + V_m$$

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

$$1 = X_g \underbrace{\frac{\rho_{\text{tot}}}{\rho_g}}_{\text{Fraction volumique de gaz}} + X_m \underbrace{\frac{\rho_{\text{tot}}}{\rho_m}}_{\text{Fraction volumique de magma}}$$

≈ 1

DECOMPRESSION = EXSOLUTION + DILATATION




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



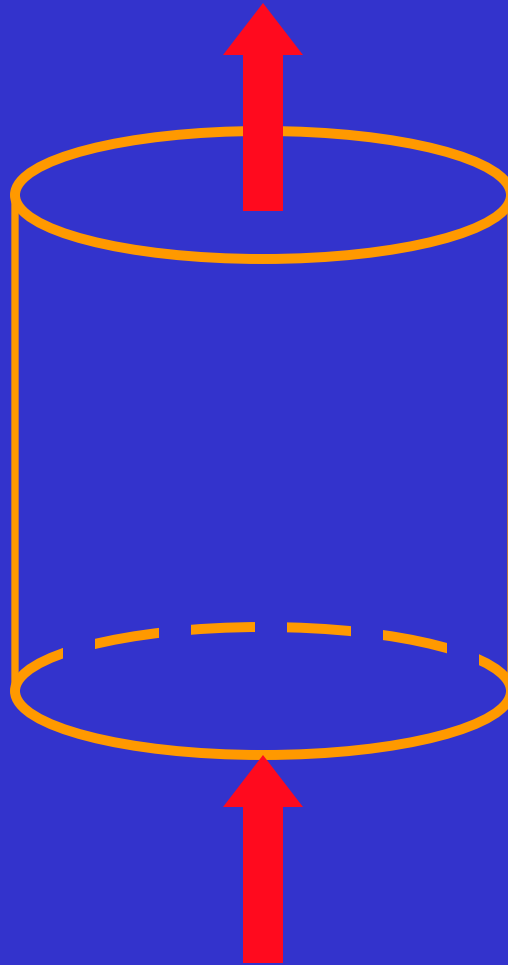




 **USGS**

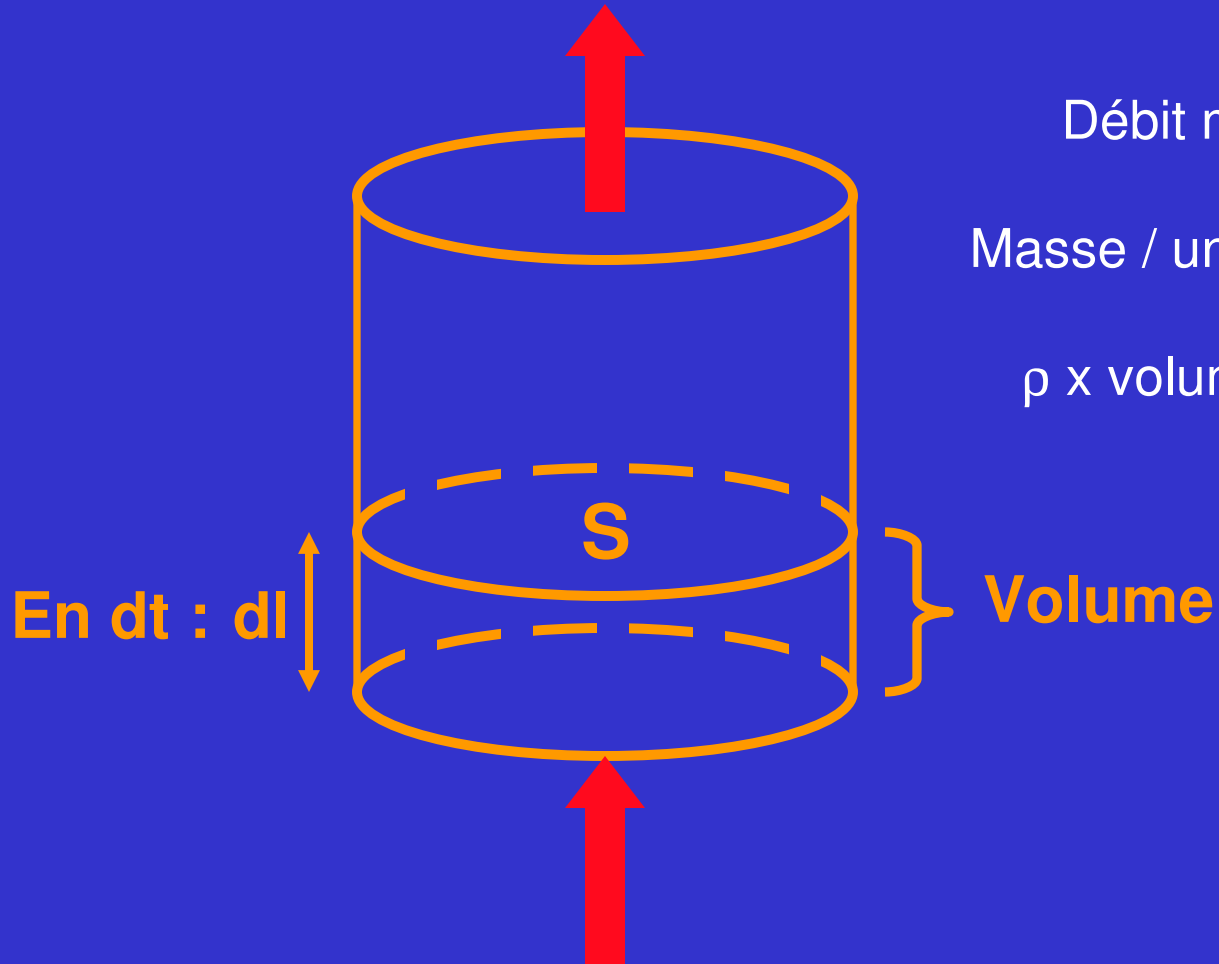
USGS Photo by D.A. Swanson, May 18, 1980

Flux de masse à la sortie



Flux de masse à l'entrée

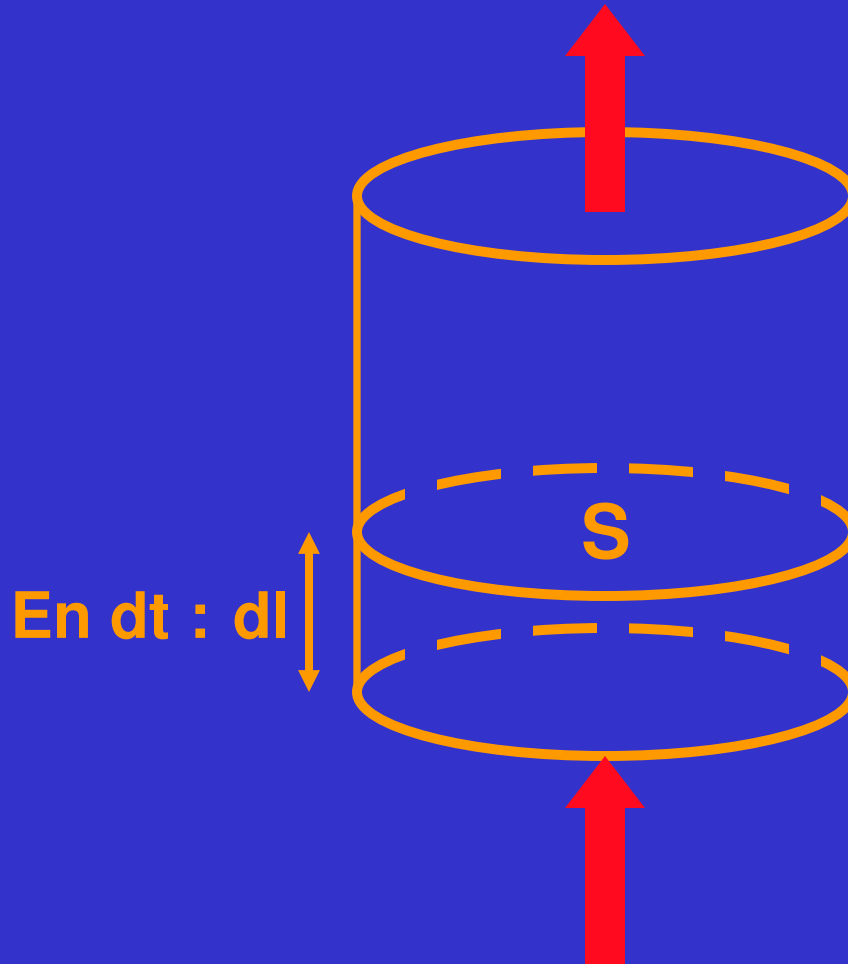
Débit massique à la sortie



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

Débit massique à l'entrée

Débit massique à la sortie

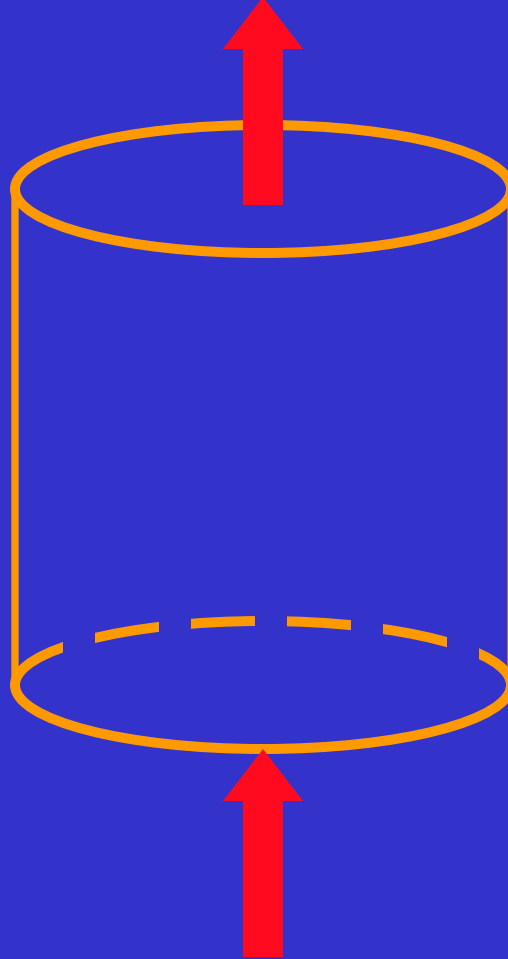


En dt : dl

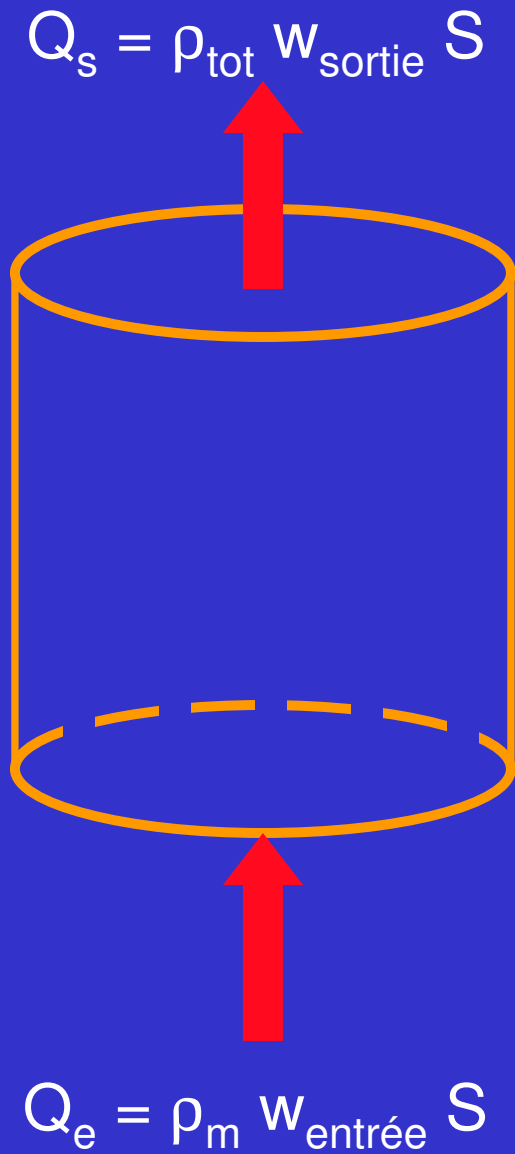
Débit massique à l'entrée

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

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



$$Q_e = \rho_m w_{\text{entrée}} S$$



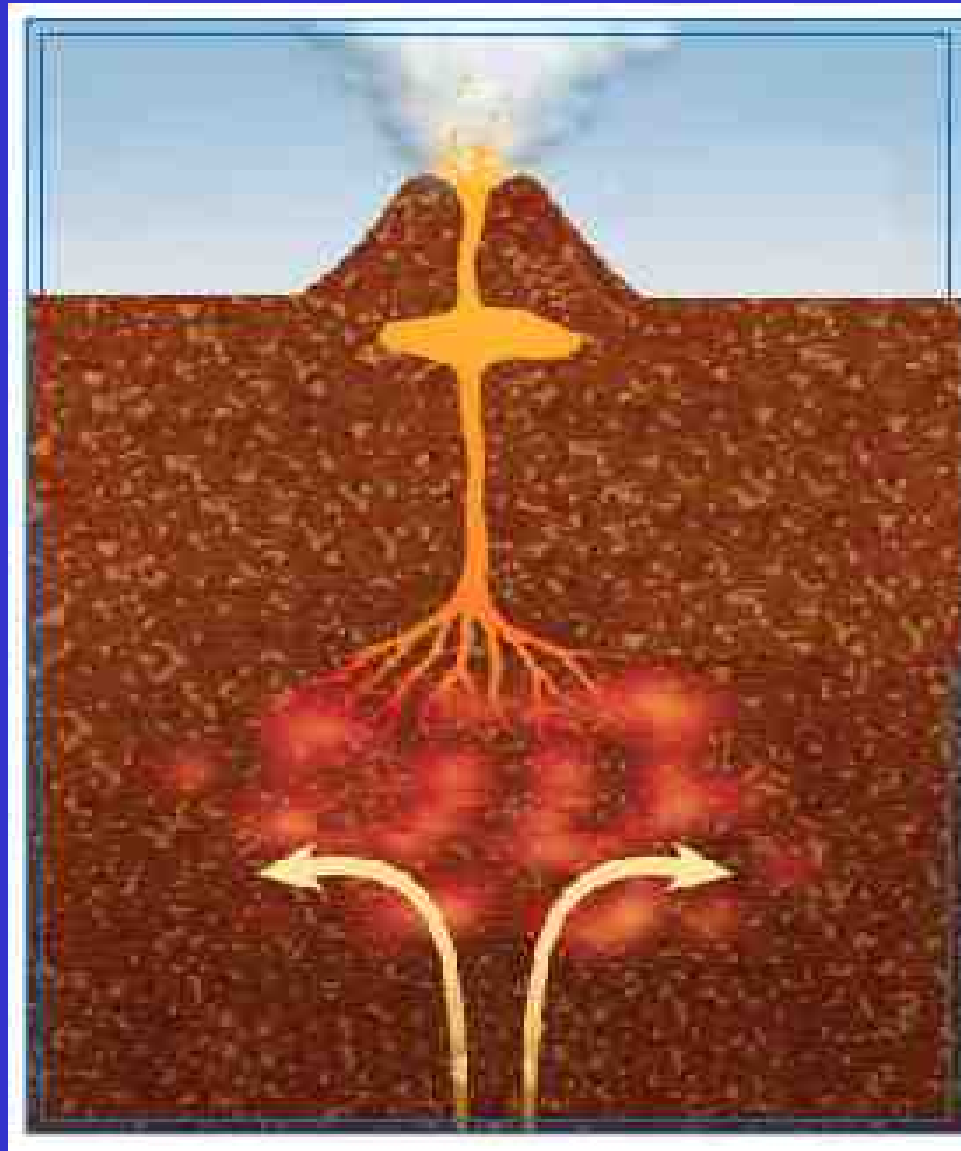
$$Q_s = Q_e$$

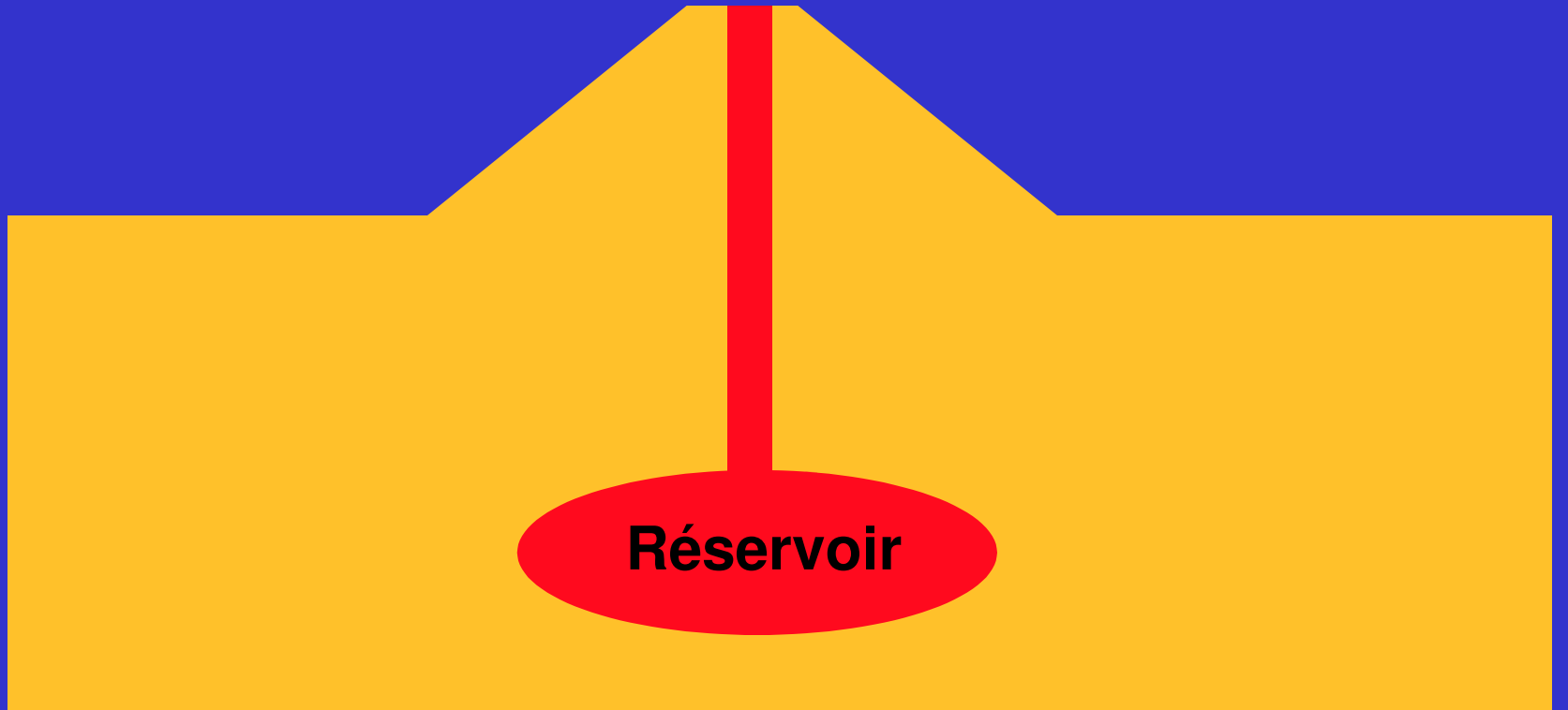
$$w_{\text{sortie}} = w_{\text{entrée}} \times \frac{\rho_m}{\rho_{\text{tot}}}$$

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

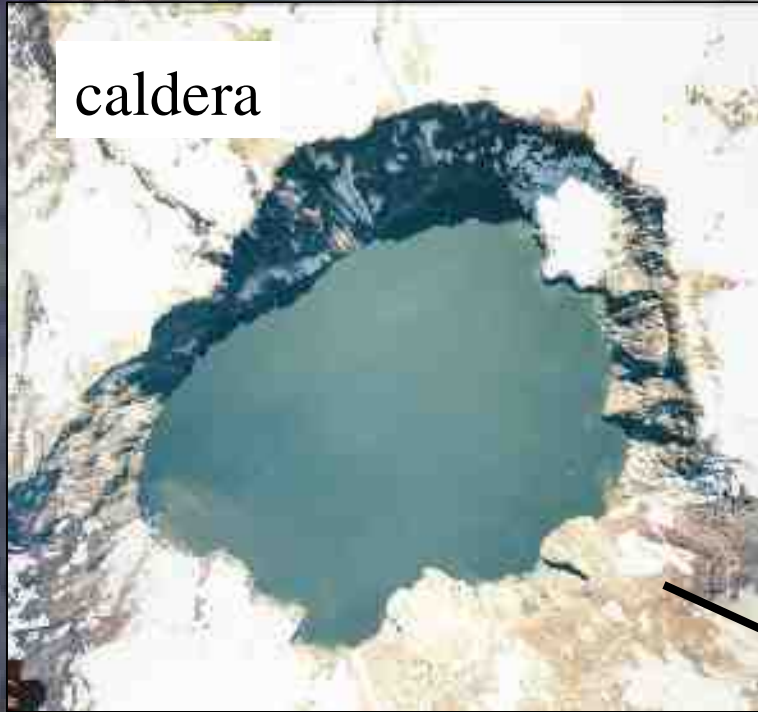
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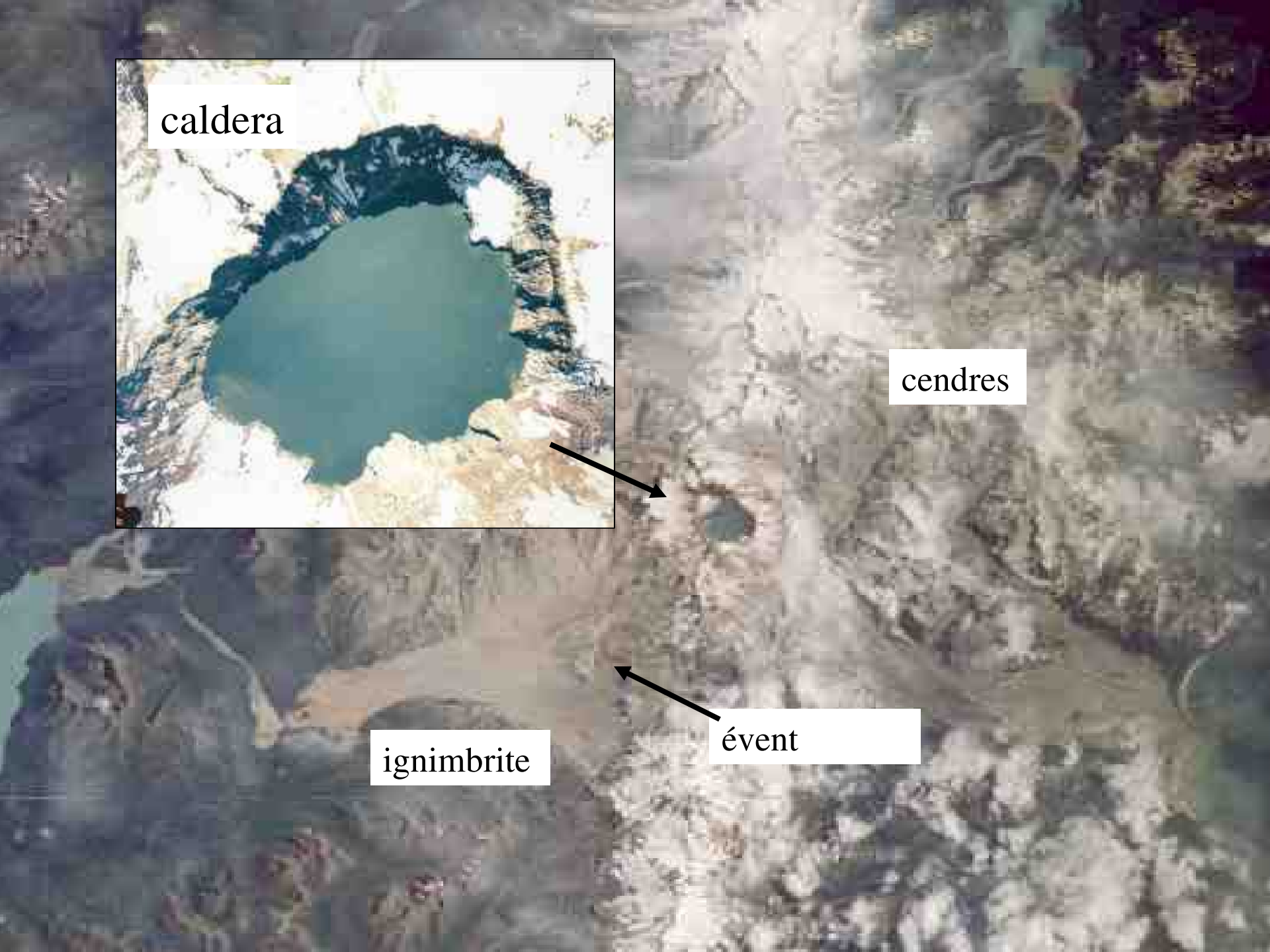




Réservoir



caldera

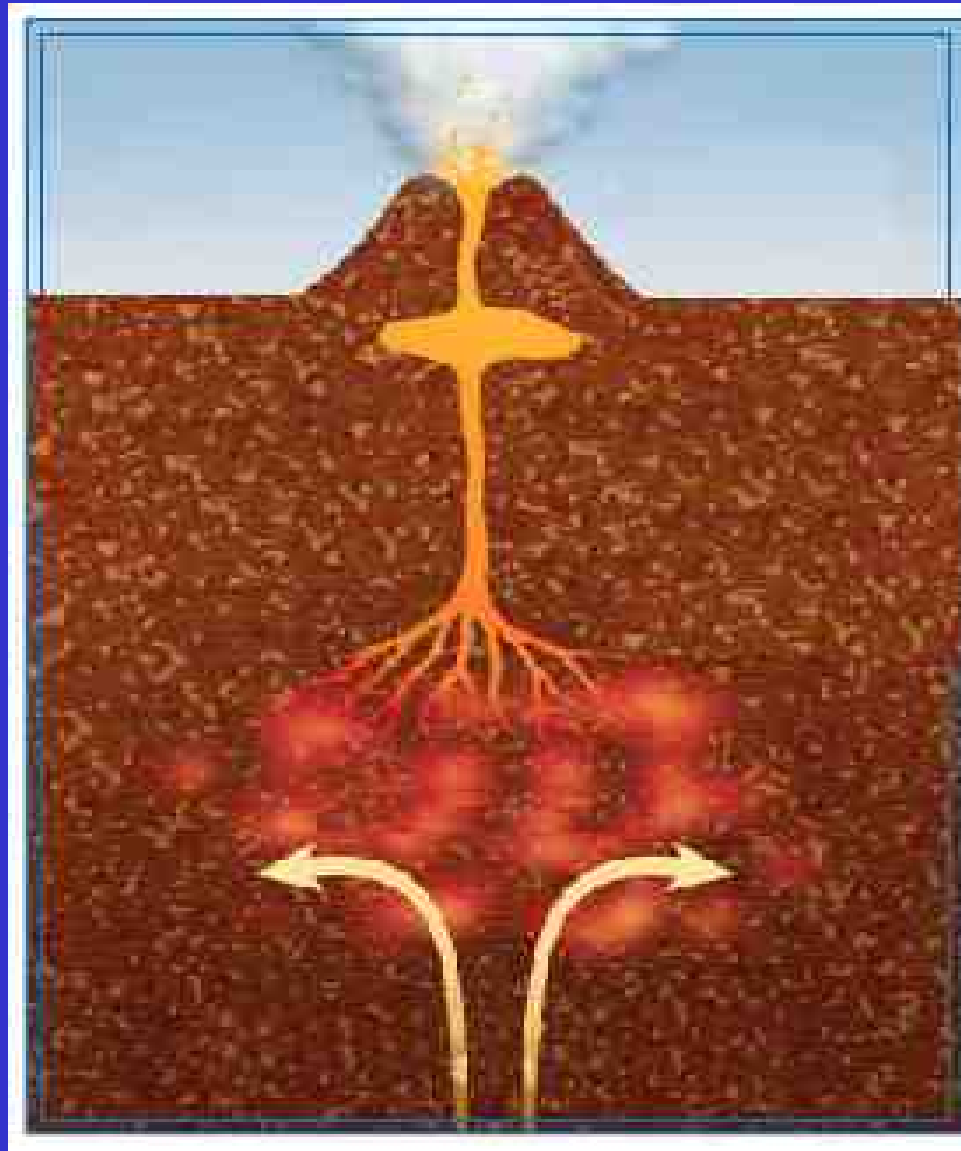


cendres

ignimbrite

évent





Extrusive

Intrusive



Basalte



Gabbro



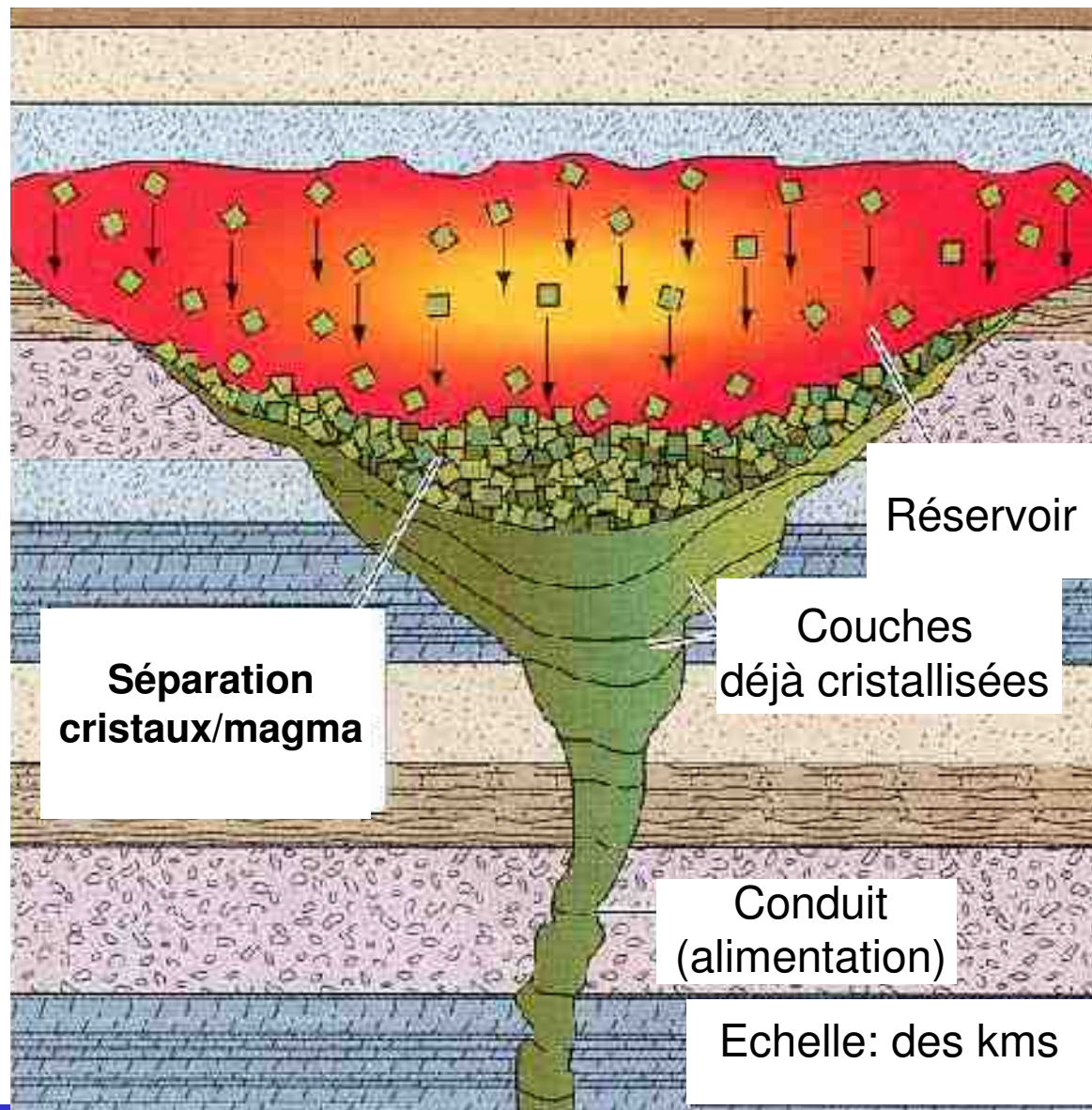
Rhyolite



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



surface

5 km

10 km

15 km

20 km

Séparation cristaux/magma

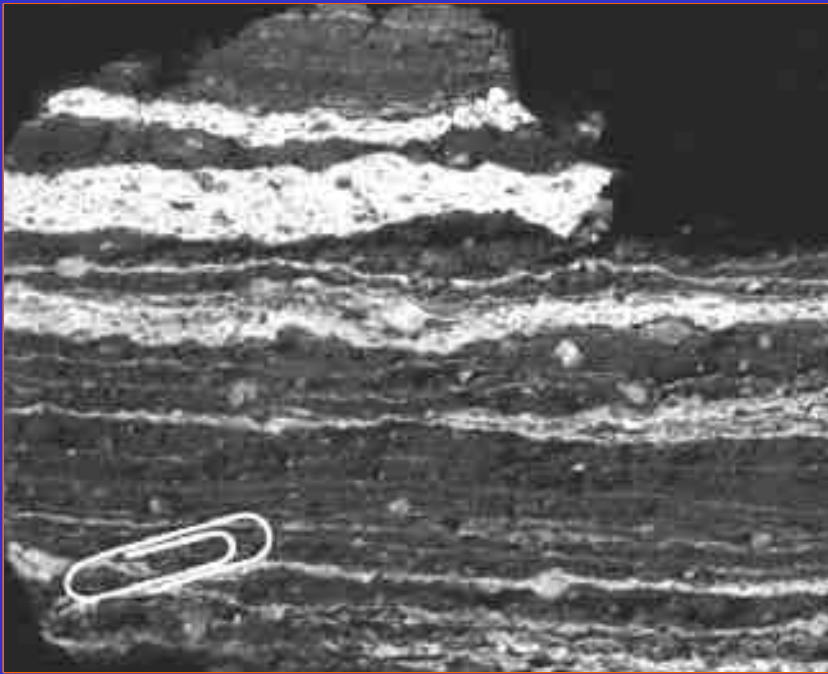
Réservoir

Couches déjà cristallisées

Conduit (alimentation)

Echelle: des kms

Mélange basalte-rhyolite

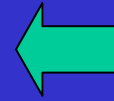


“Coussins” de basalte au
plancher d’un réservoir
rhyolitique
(aujourd’hui un granite)

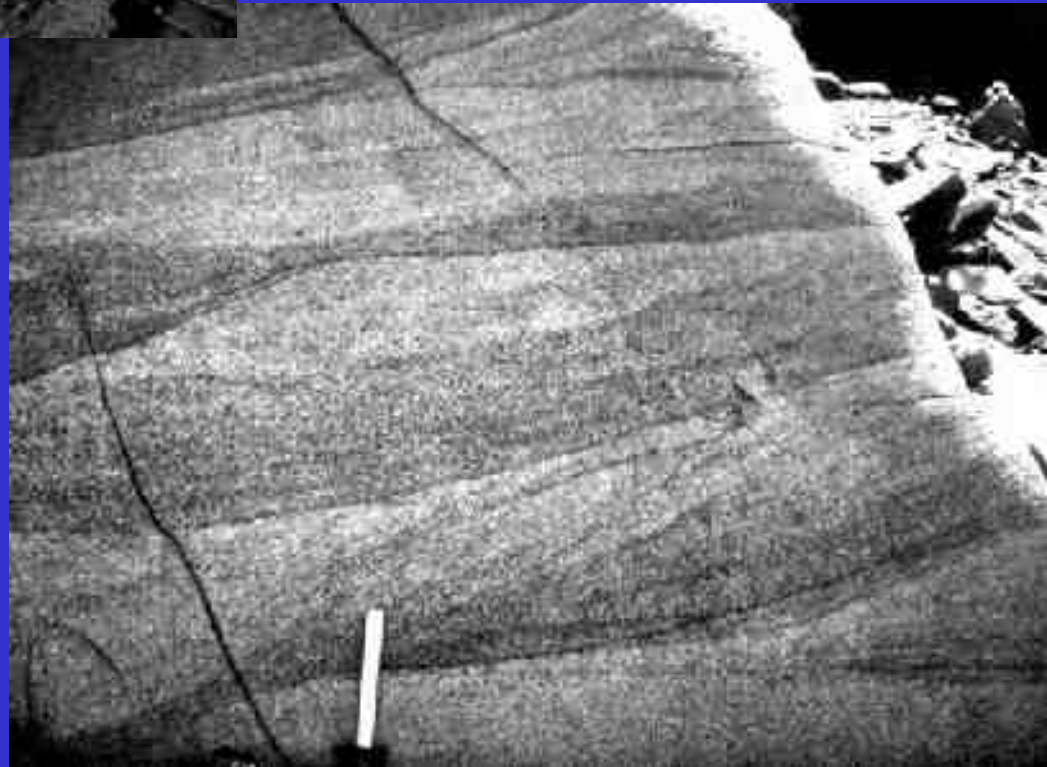
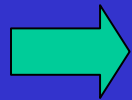




**Litage magmatique:
lits d'olivine et de pyroxène.
Noter les relations discordantes
(indicatrices de mouvements:
analogues aux structures
sédimentaires)**



Stratifications entrecroisées









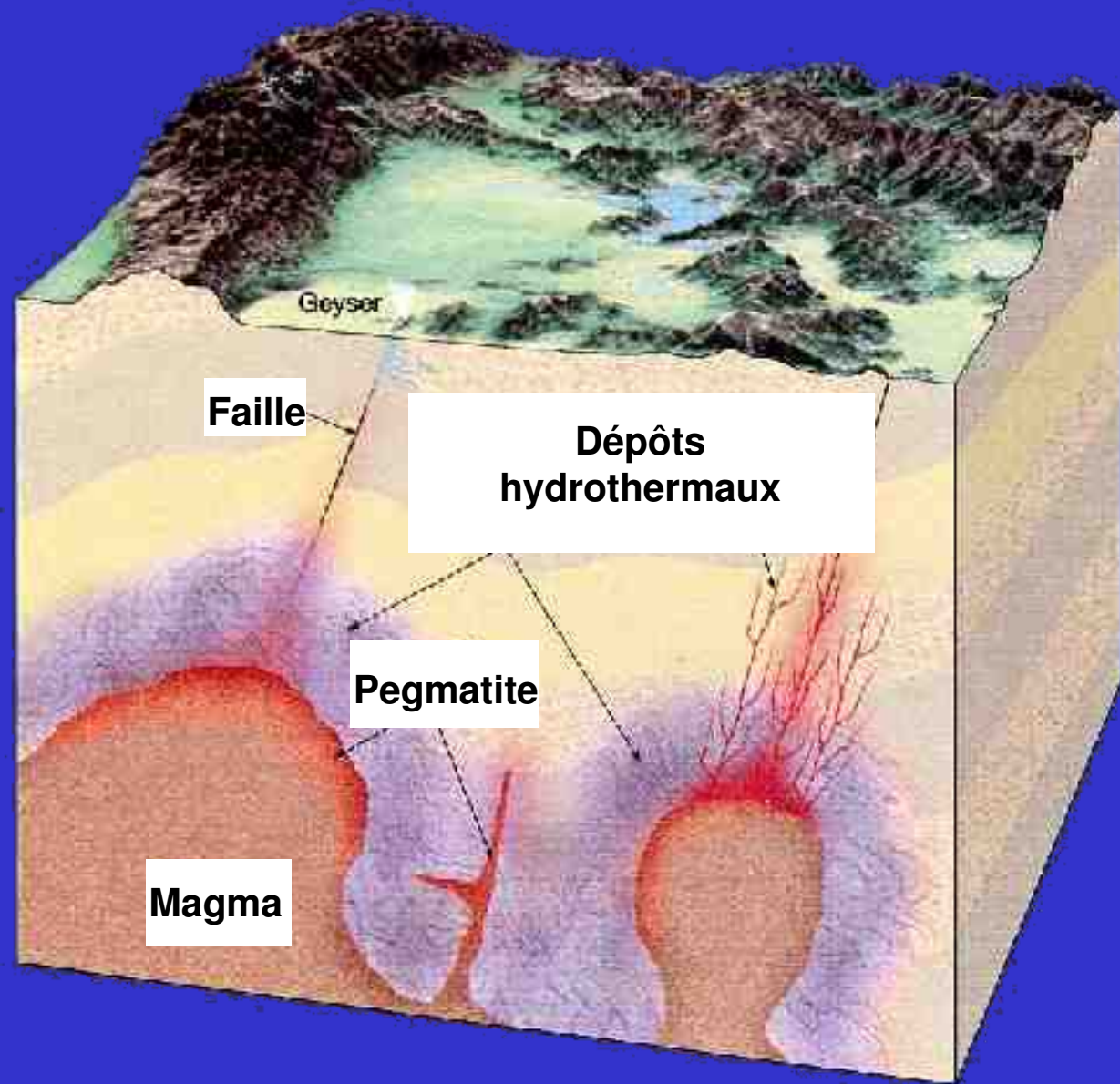
“CHAMBRE” DU SKAERGAARD (Groenland)







La chambre fossile du Skaergaard (Groenland)



Pegmatite : Cristaux de tourmaline (8 cm)

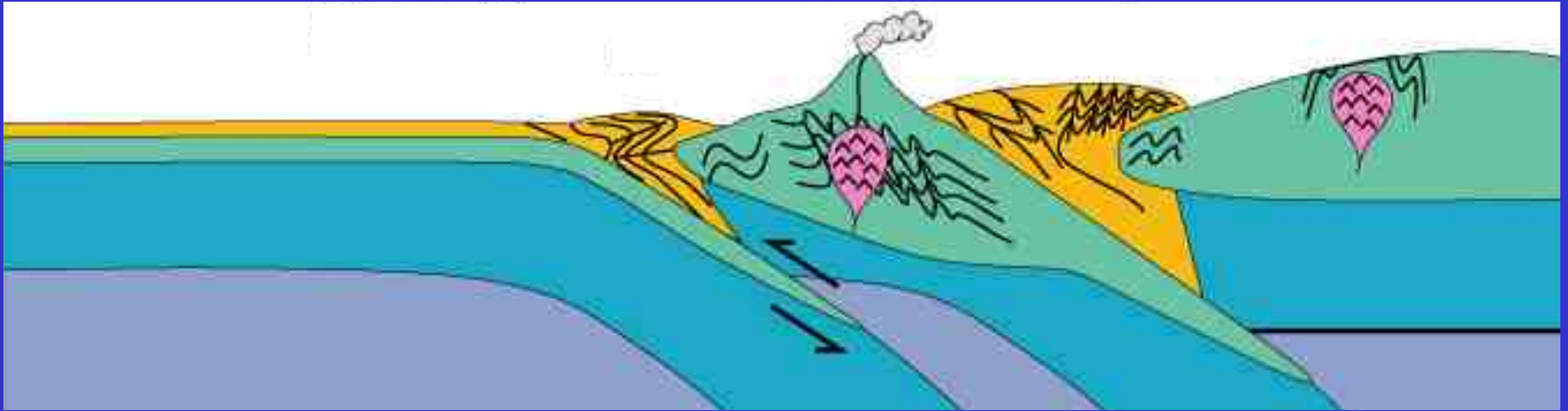


Dépôt hydrothermal : or

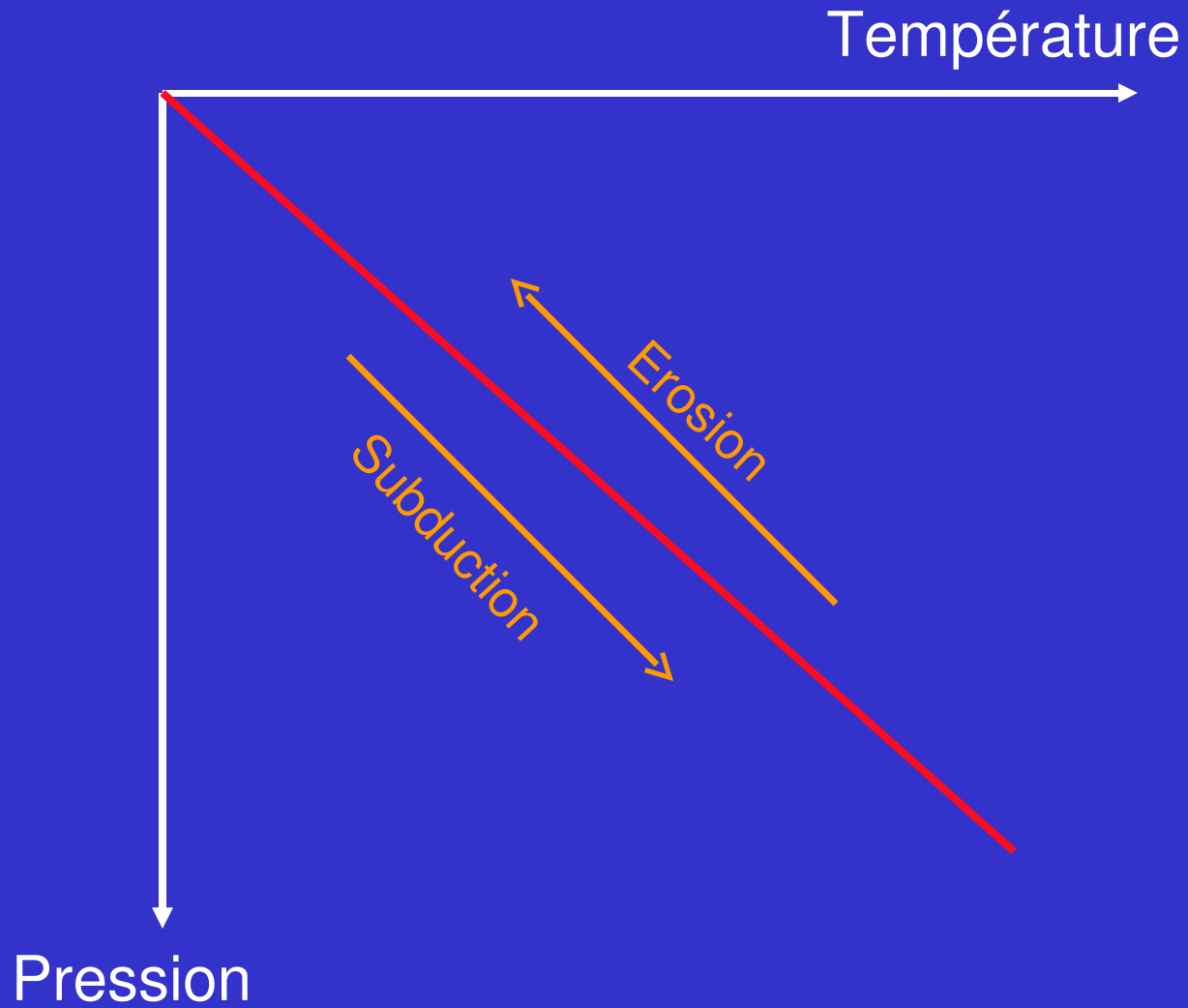
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Déformation, enfouissement et érosion : métamorphoses des roches et des minéraux



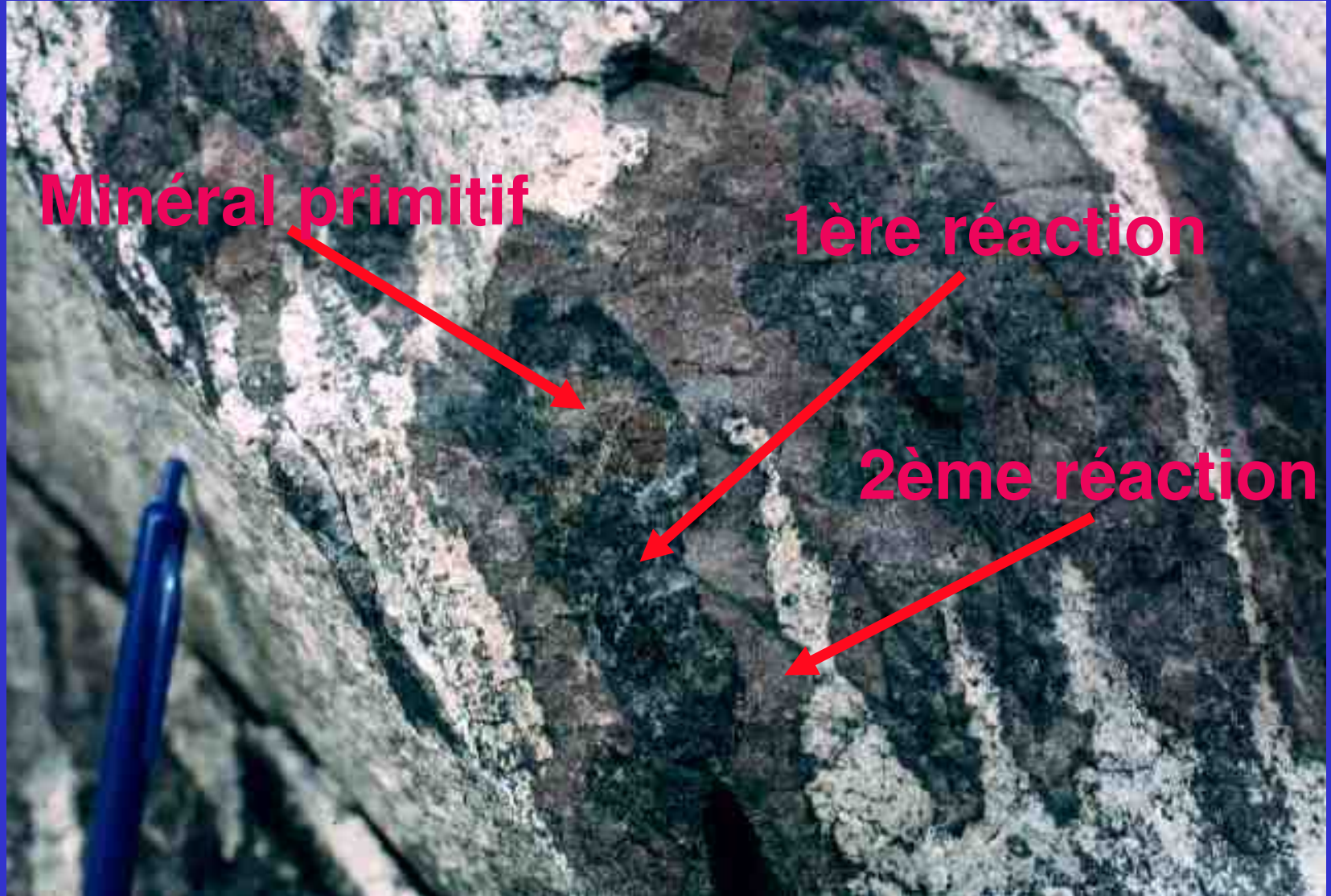
Chemin (P,T)



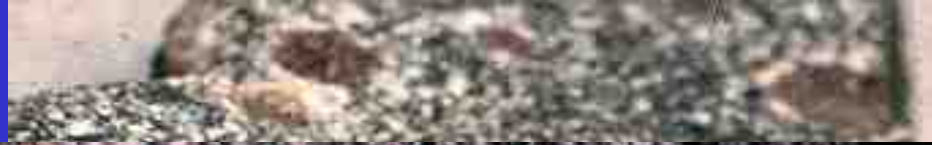
Couronnes de réactions



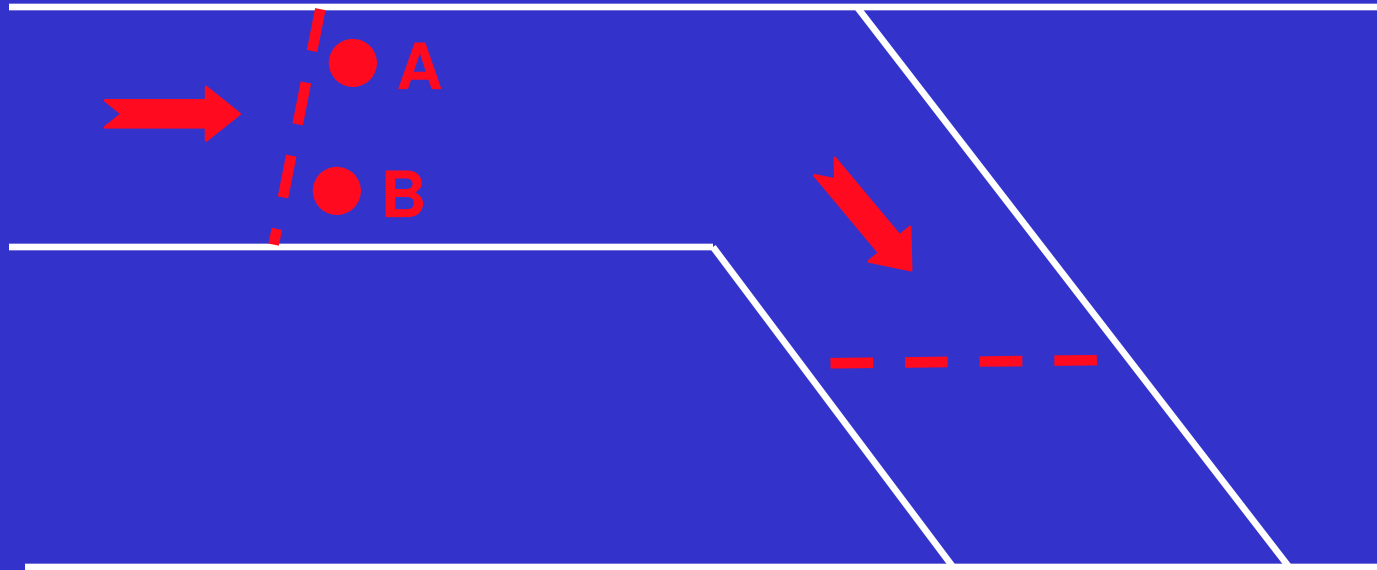
Couronnes de réactions



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

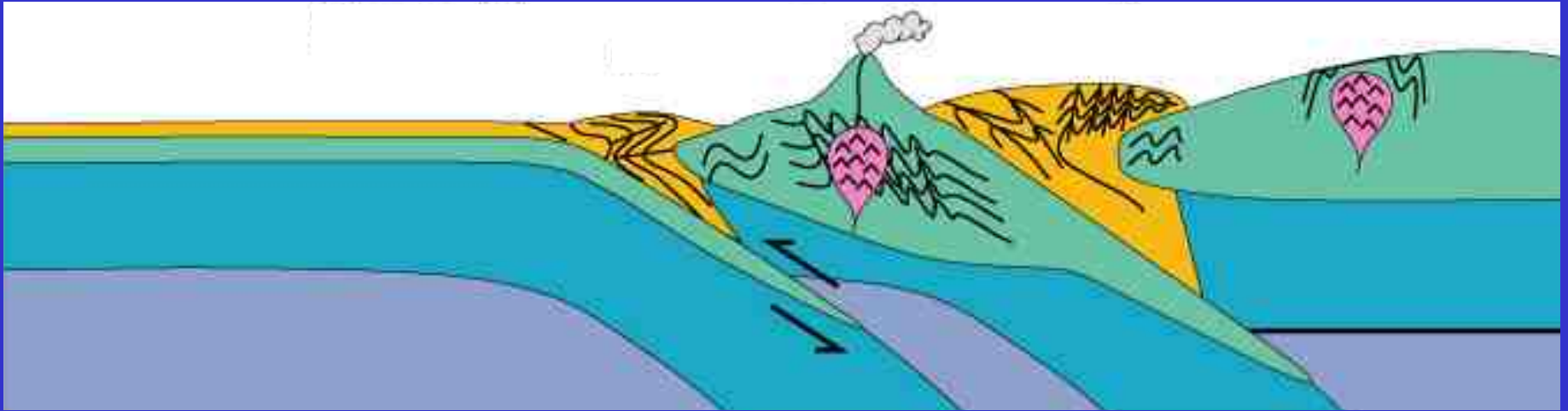


Textures des roches métamorphiques





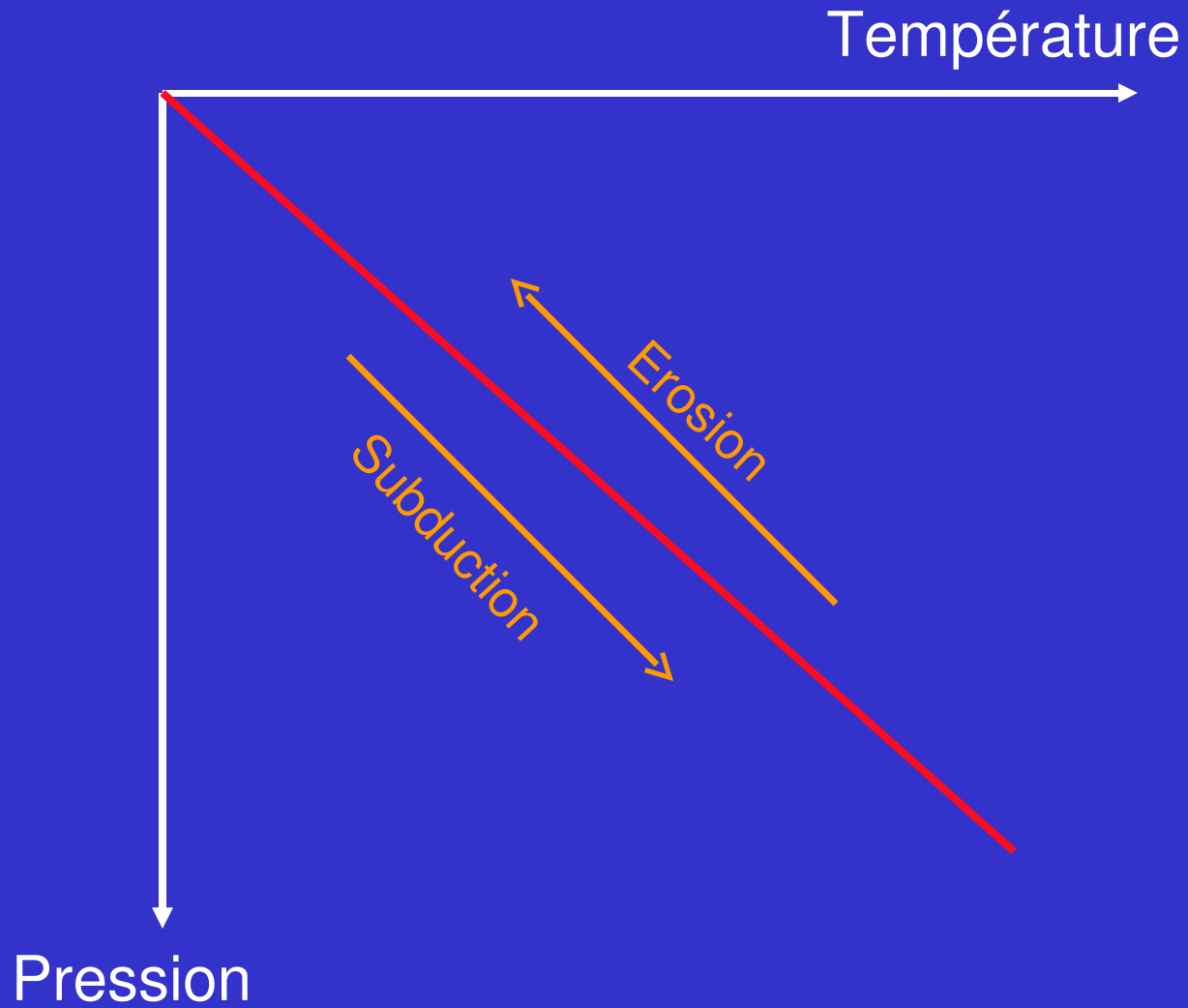
Déformation, enfouissement et érosion : métamorphoses des roches et des minéraux

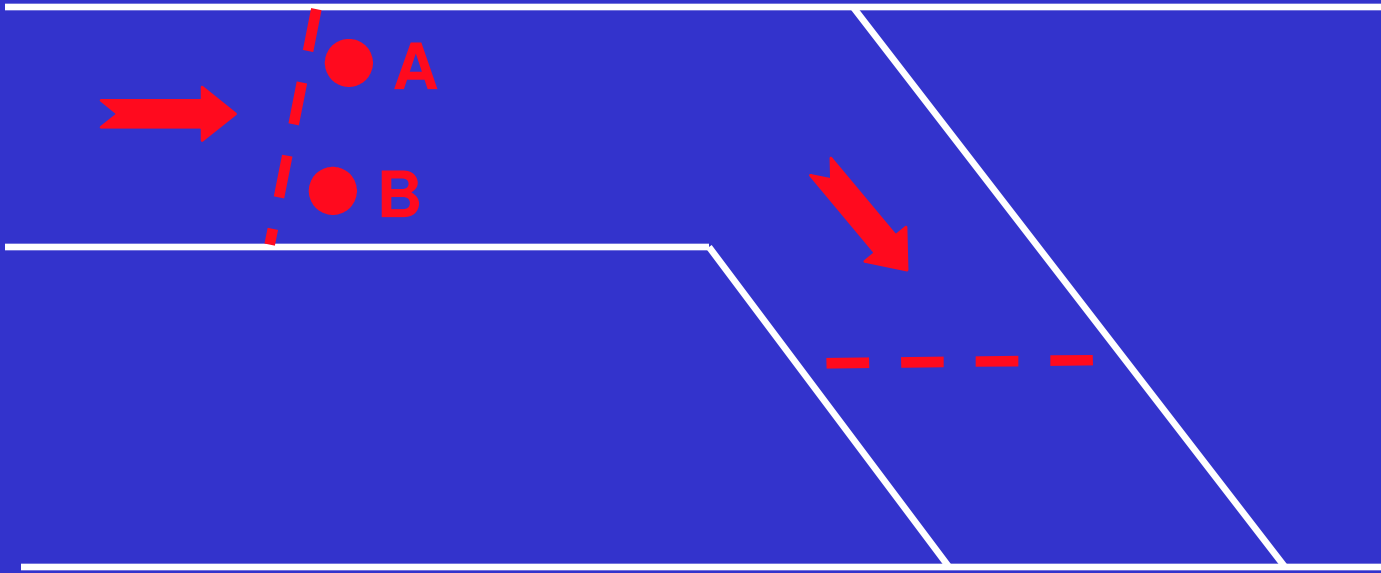


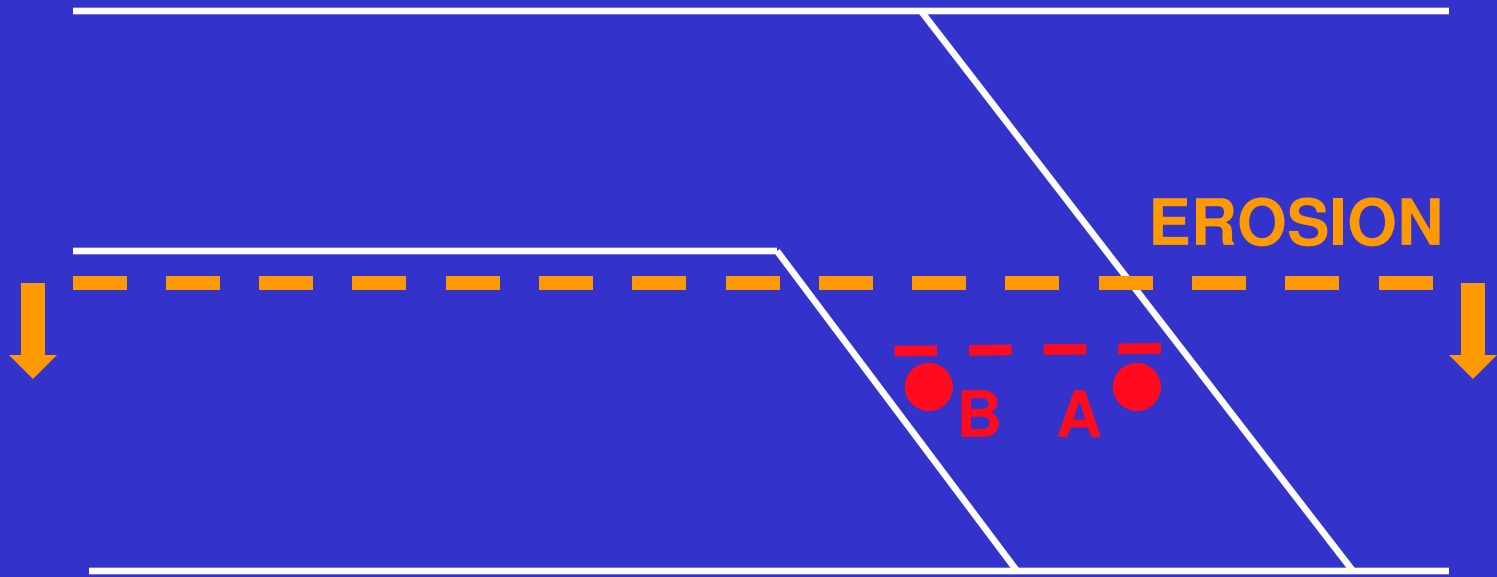
Après érosion



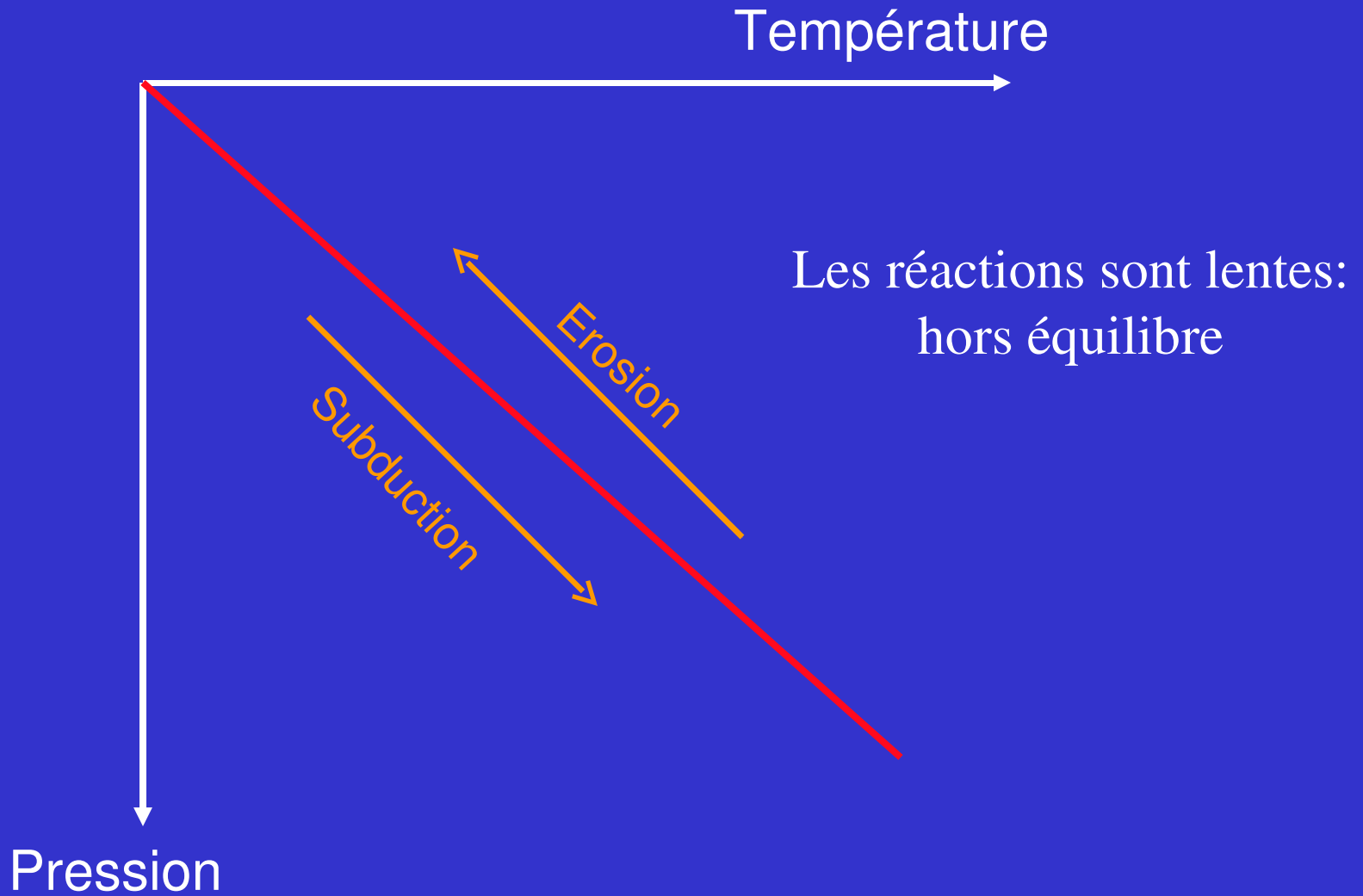
Chemin (P,T)



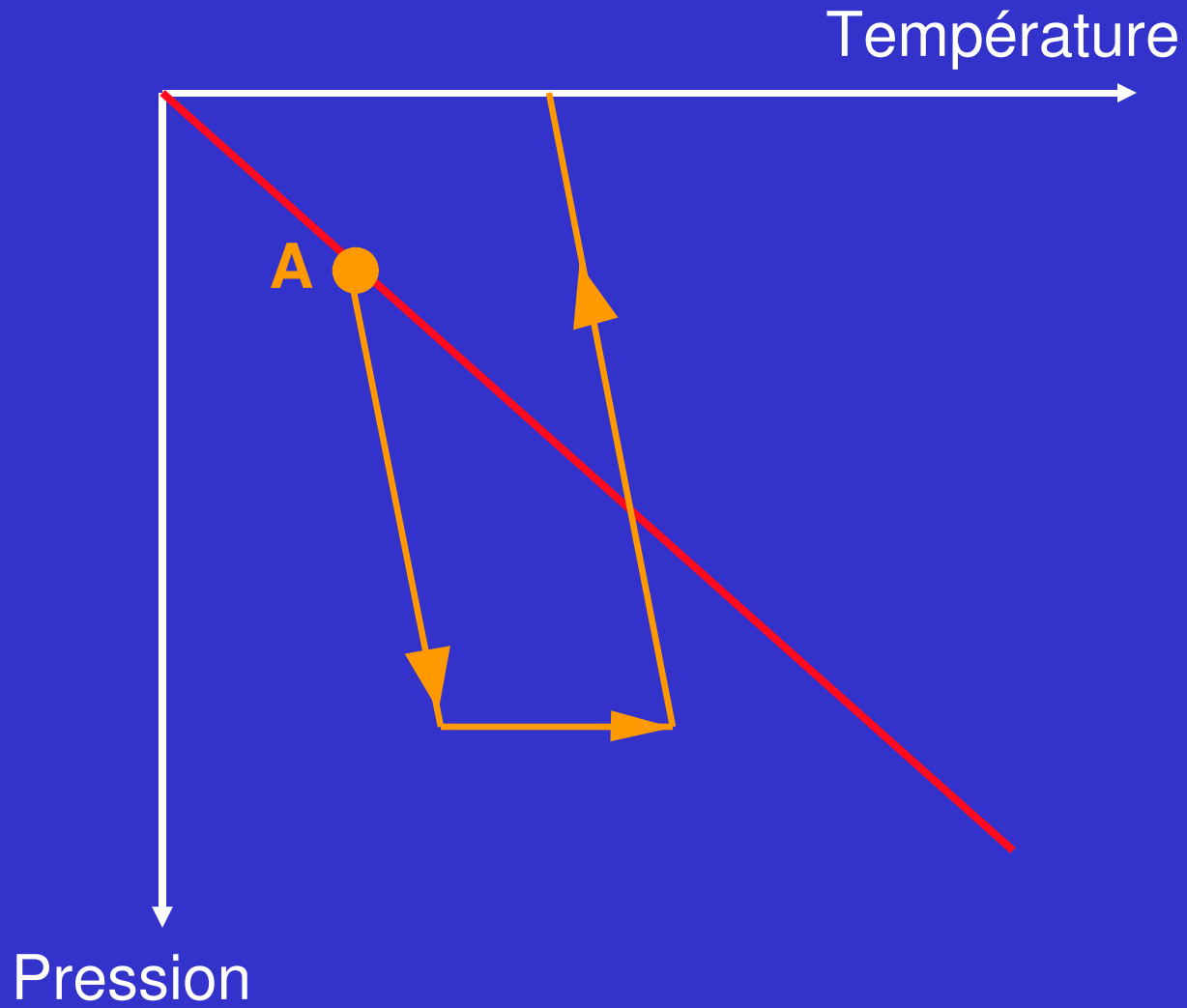




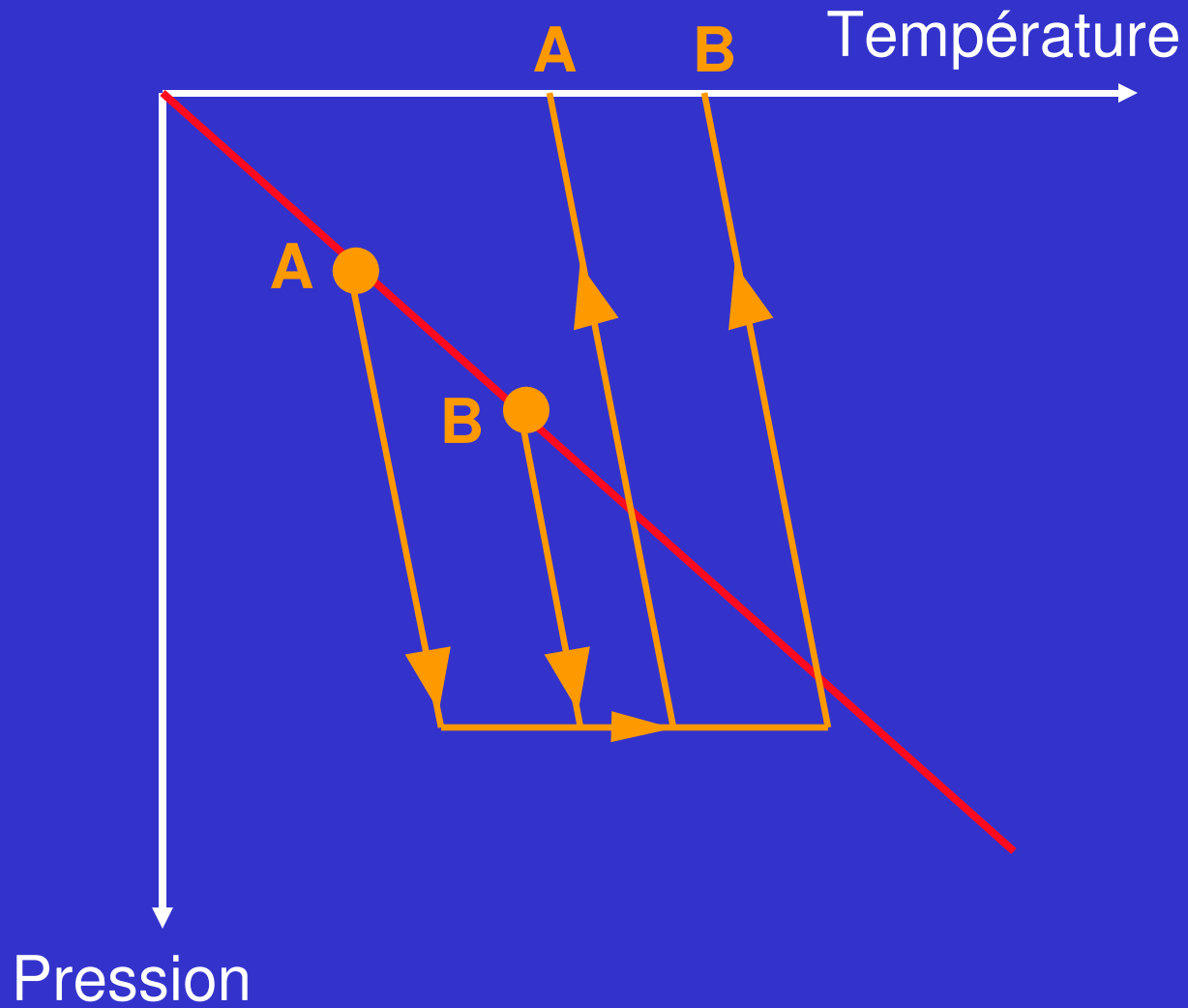
Chemin (P,T)



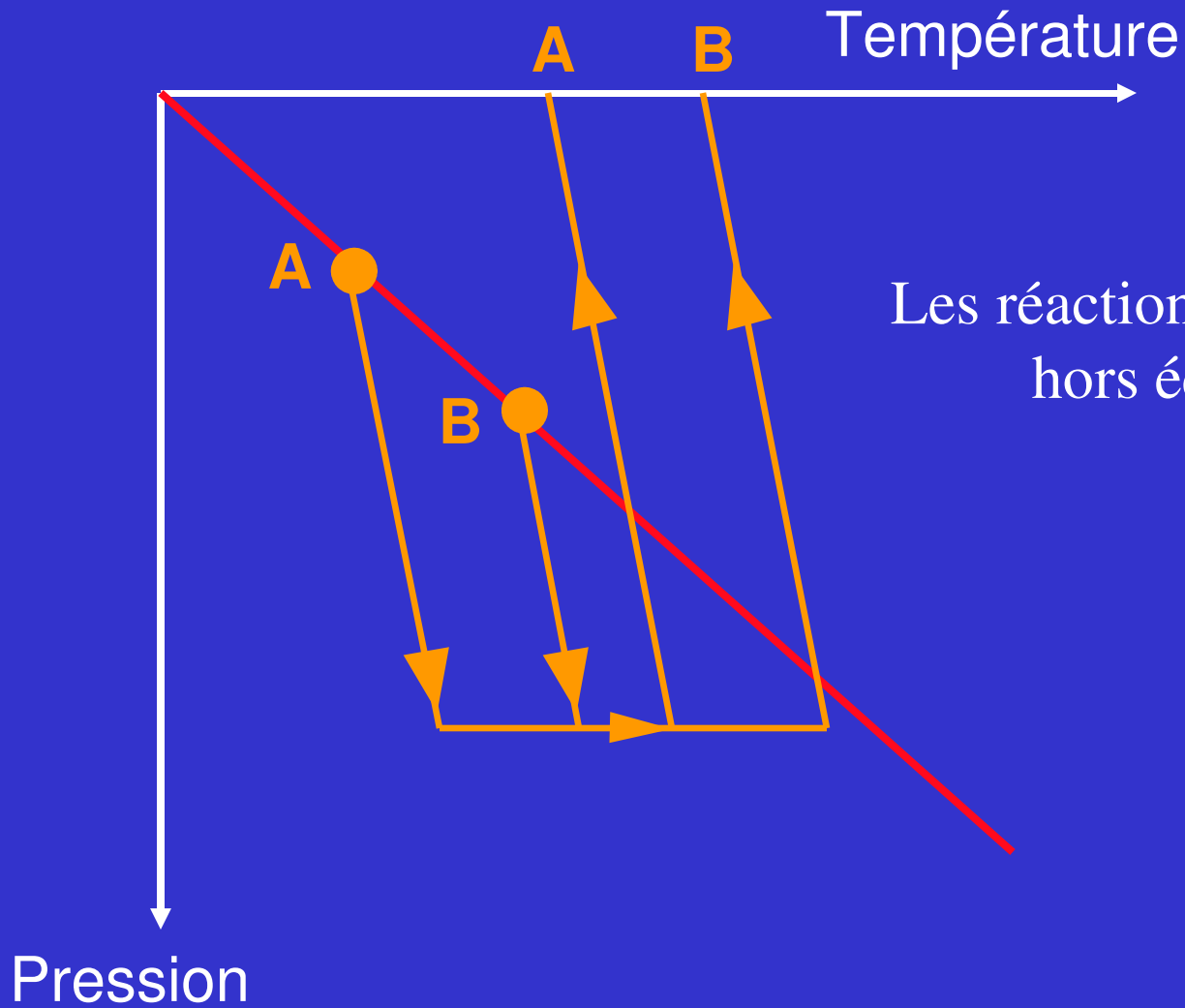
Chemin (P,T)



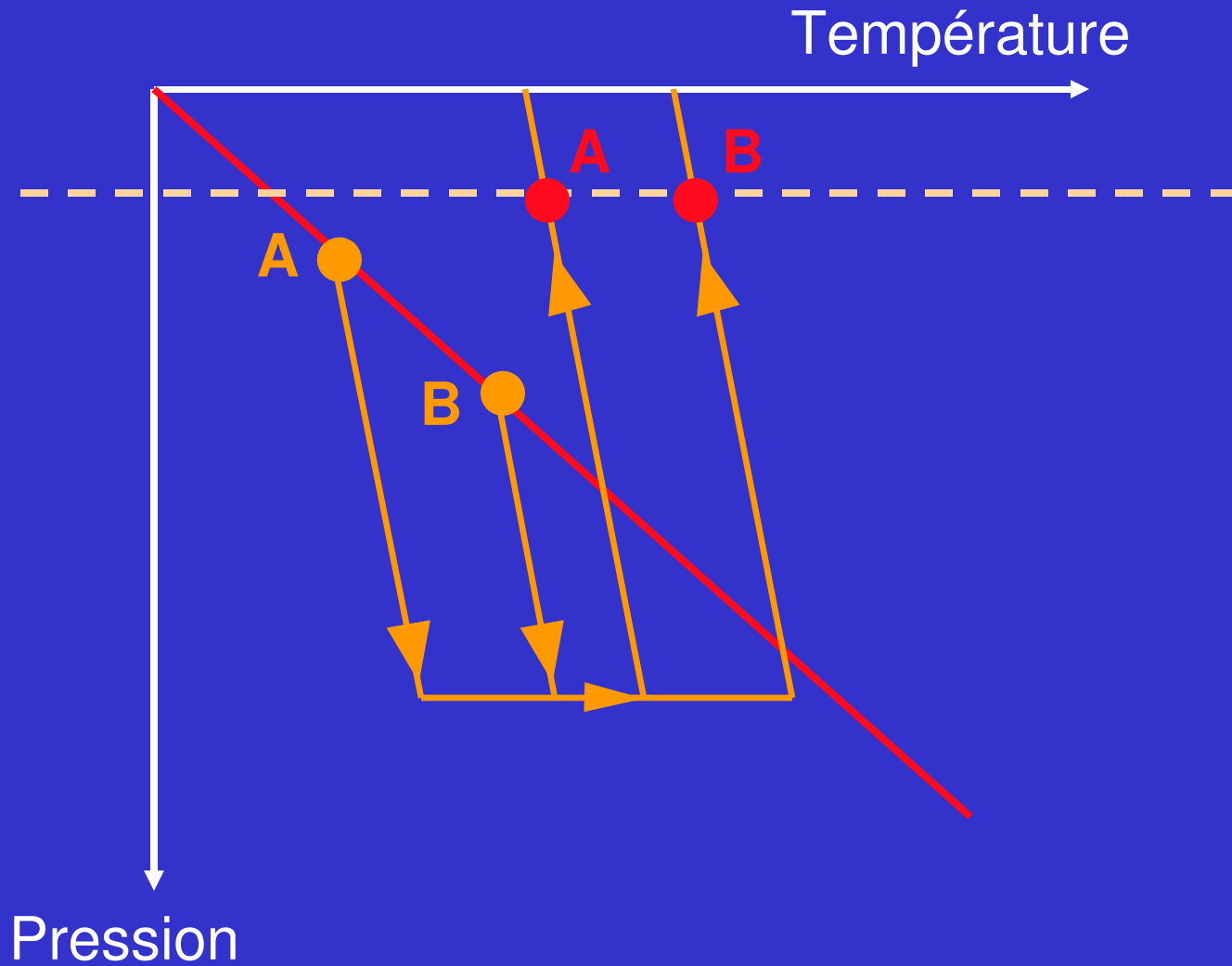
Chemin (P,T)



Chemin (P,T)



Chemin (P,T)



Après érosion



Zonation métamorphique

