







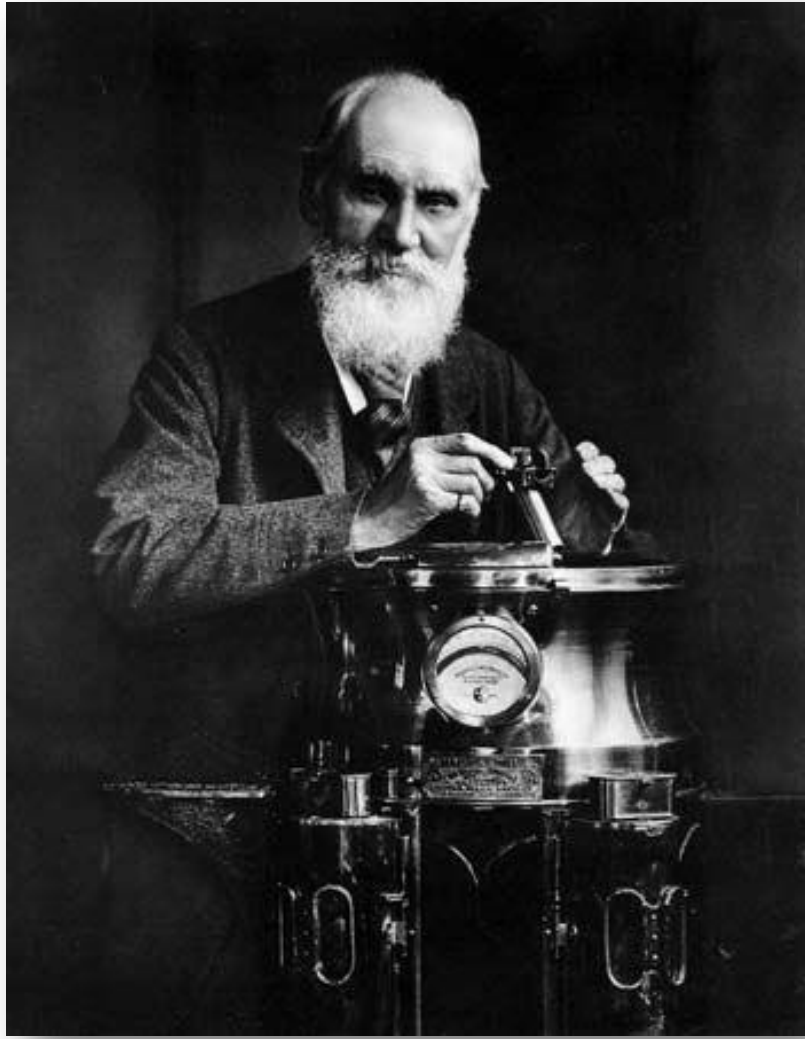
La dynamique du manteau quoi de neuf depuis 1930 ?

Nicolas Coltice

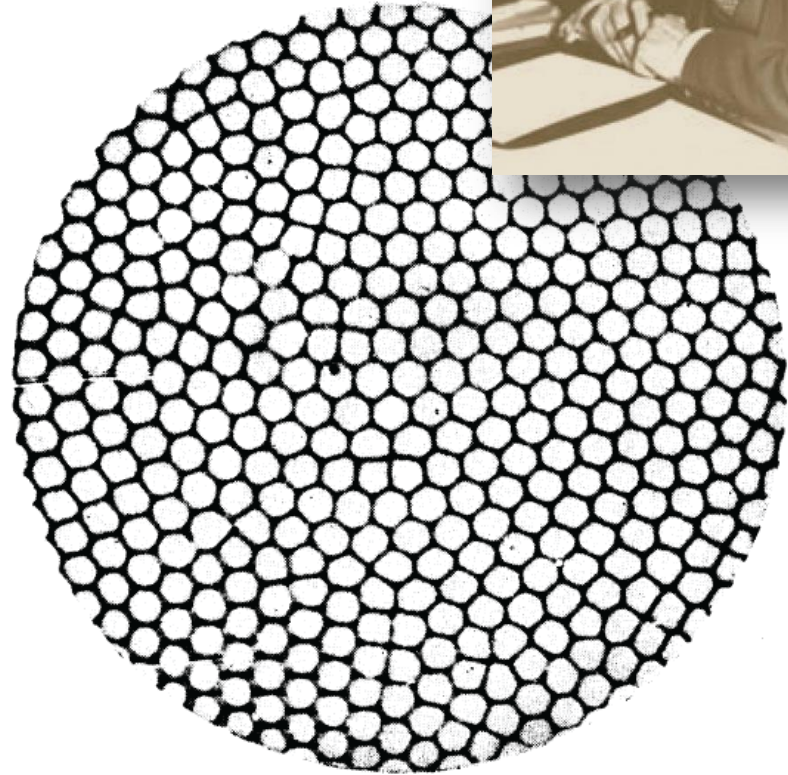
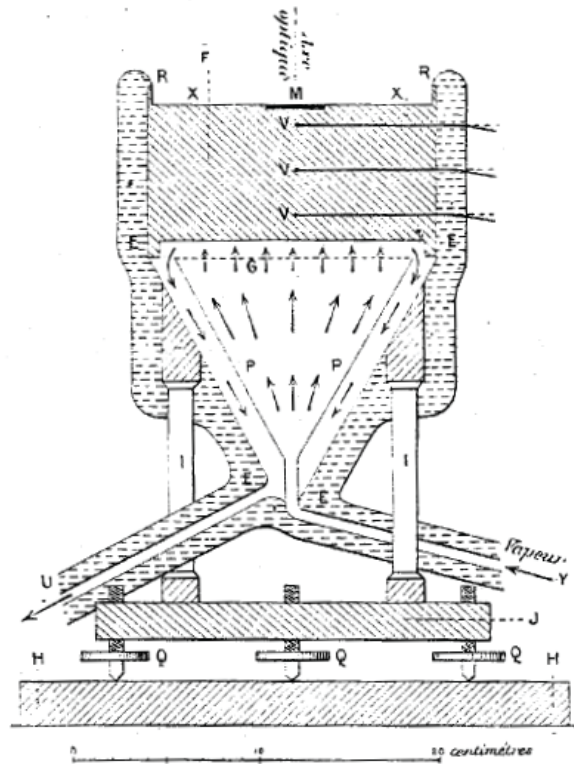


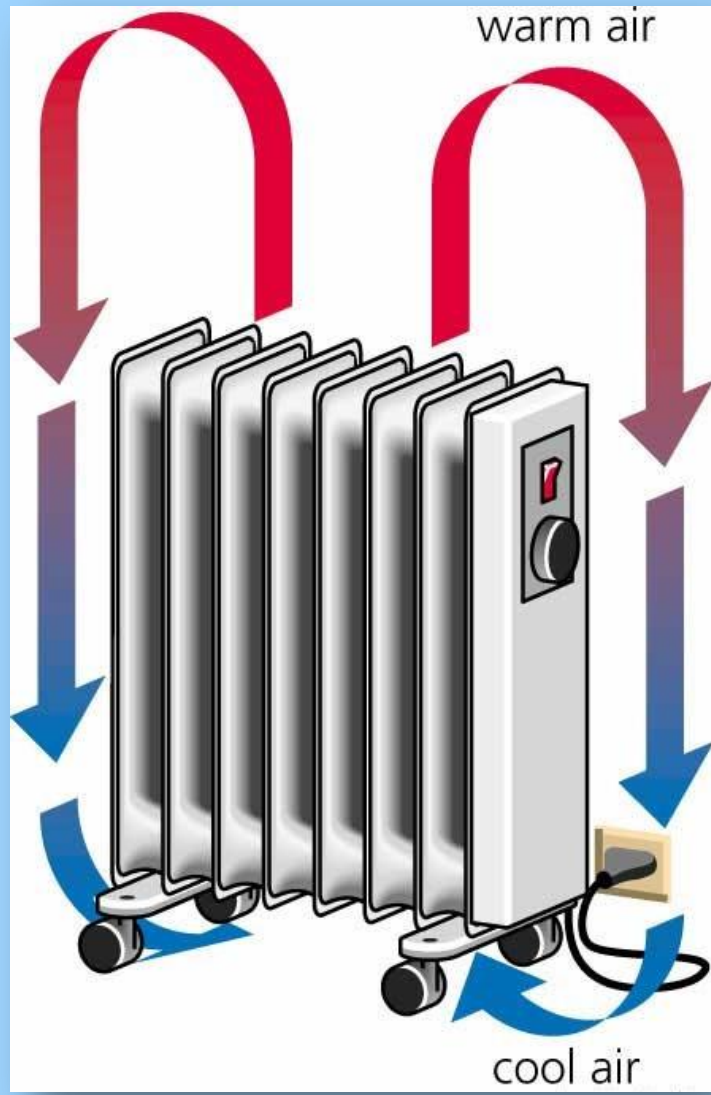
VUE DE LA VILLE DE EXON.

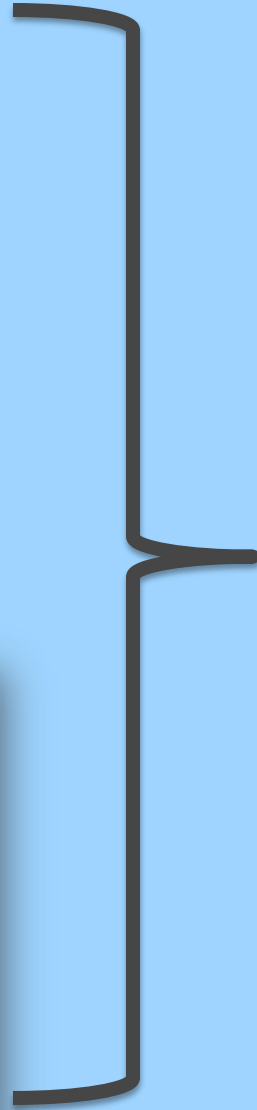
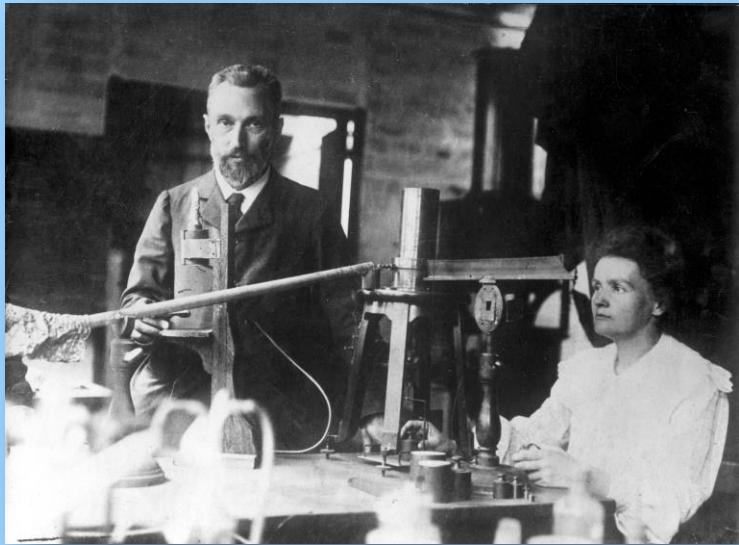
Jean de la Tour d'Auvergne

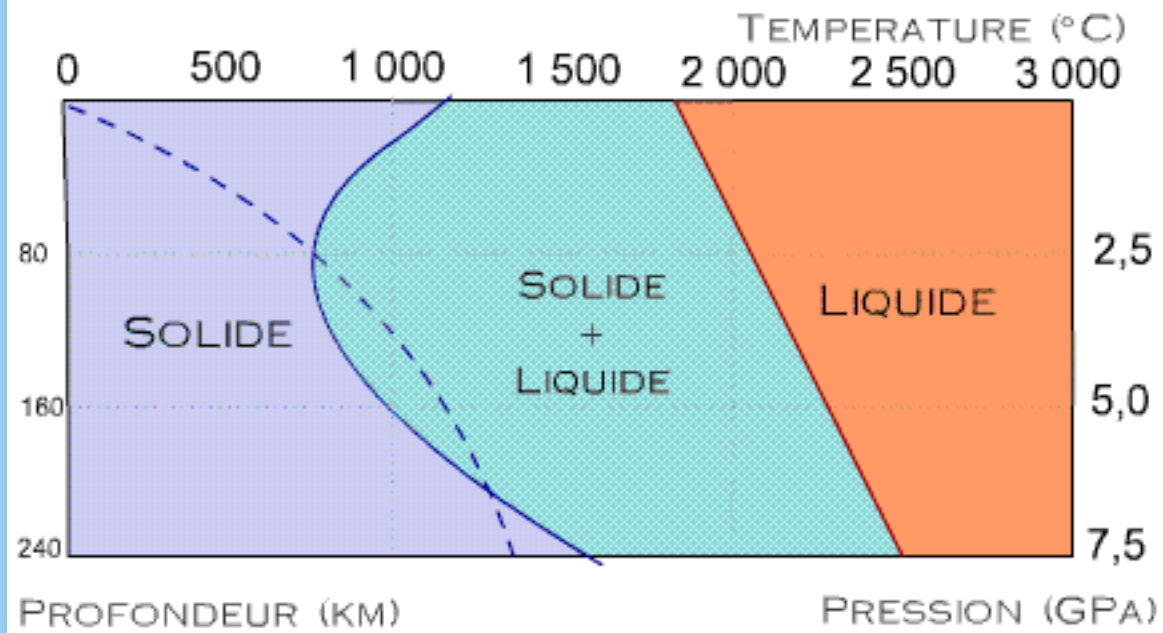
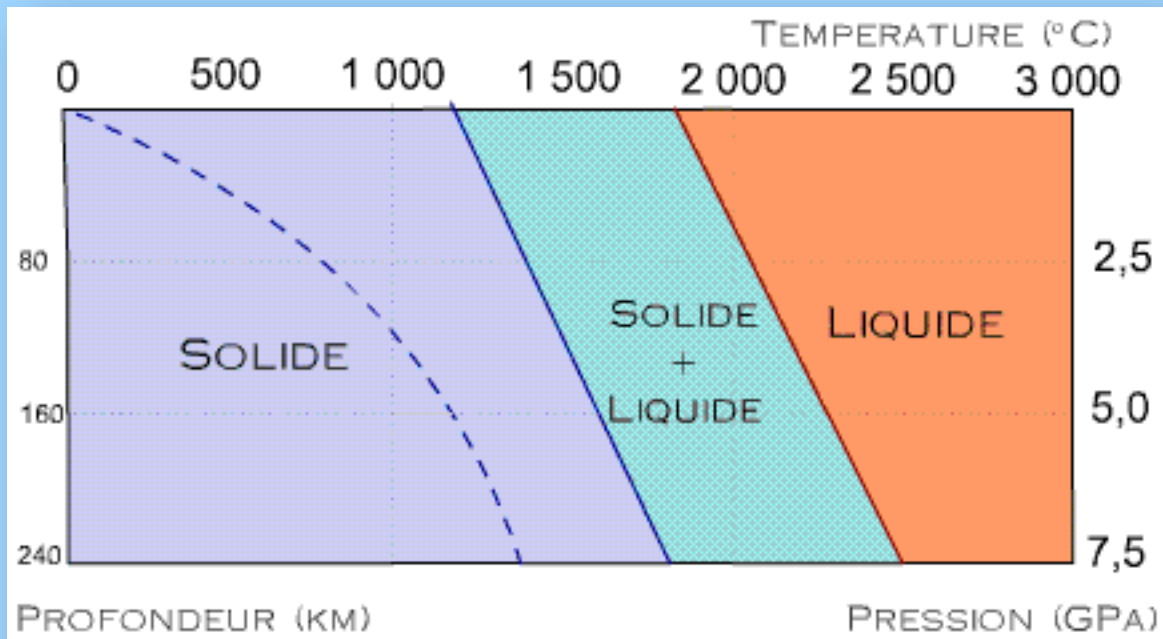










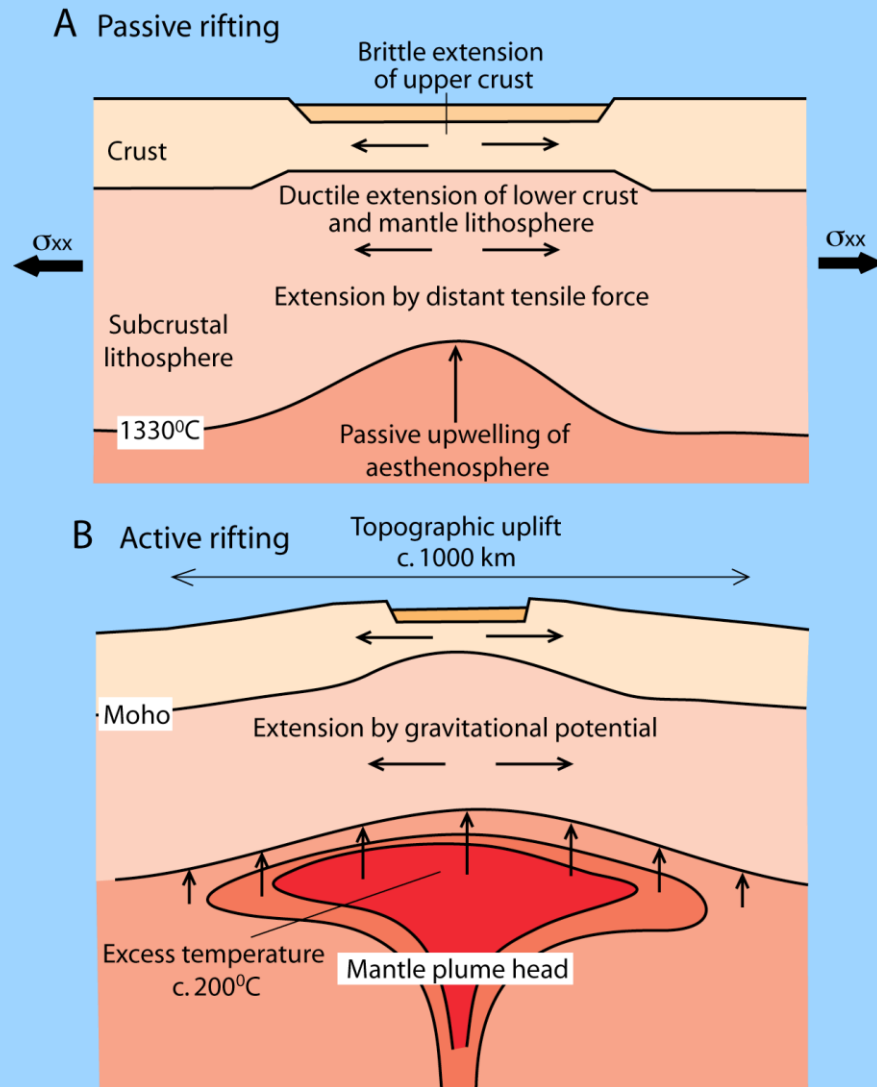


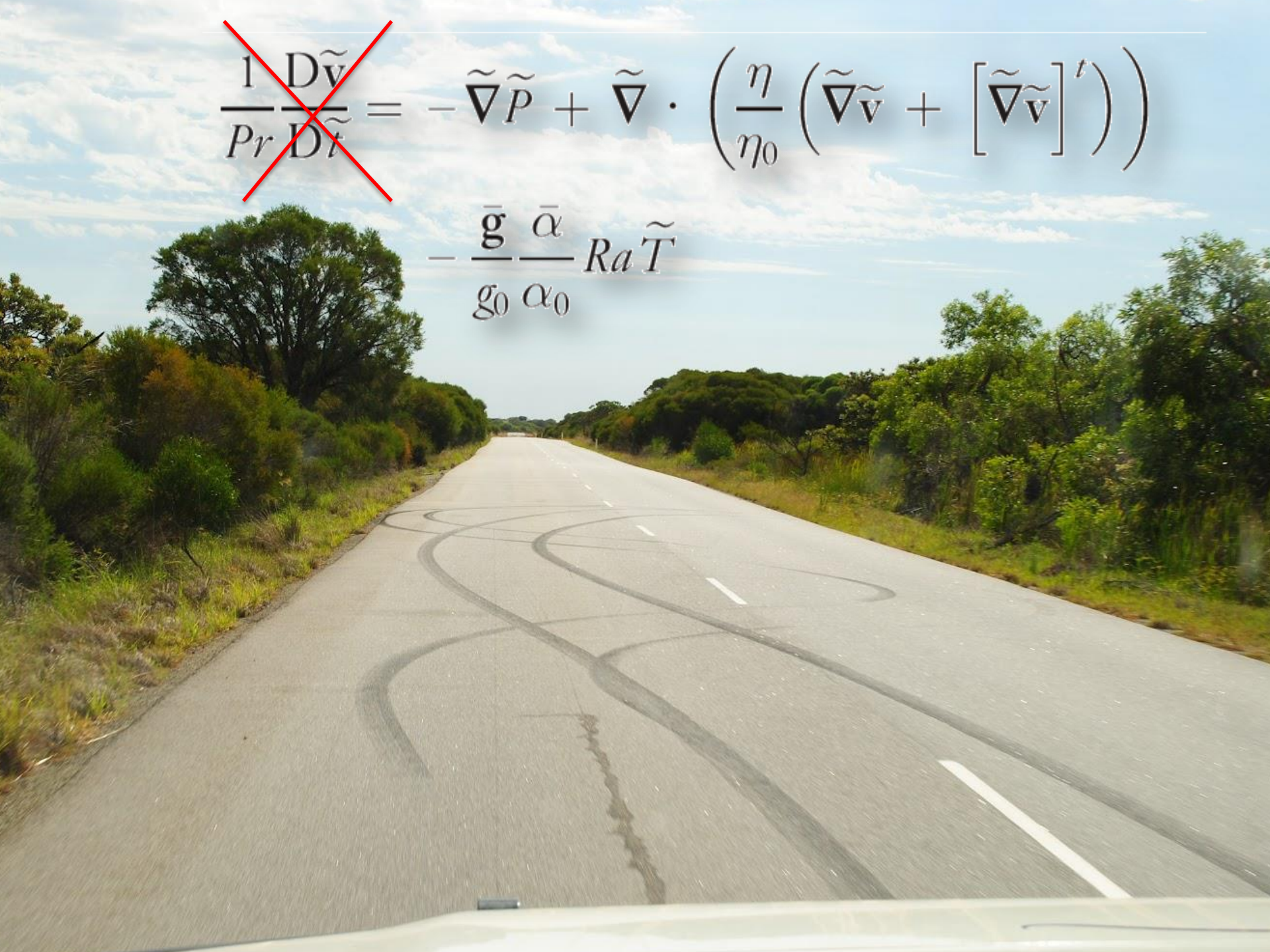
$$\tilde{\nabla} \cdot \tilde{\mathbf{v}} = 0$$

$$\frac{1}{Pr} \frac{D\tilde{\mathbf{v}}}{D\tilde{t}} = -\tilde{\nabla}\tilde{P} + \tilde{\nabla} \cdot \left(\frac{\eta}{\eta_0} \left(\tilde{\nabla}\tilde{\mathbf{v}} + [\tilde{\nabla}\tilde{\mathbf{v}}]^t \right) \right) \\ - \frac{\bar{\mathbf{g}}}{g_0} \frac{\bar{\alpha}}{\alpha_0} Ra \tilde{T}$$

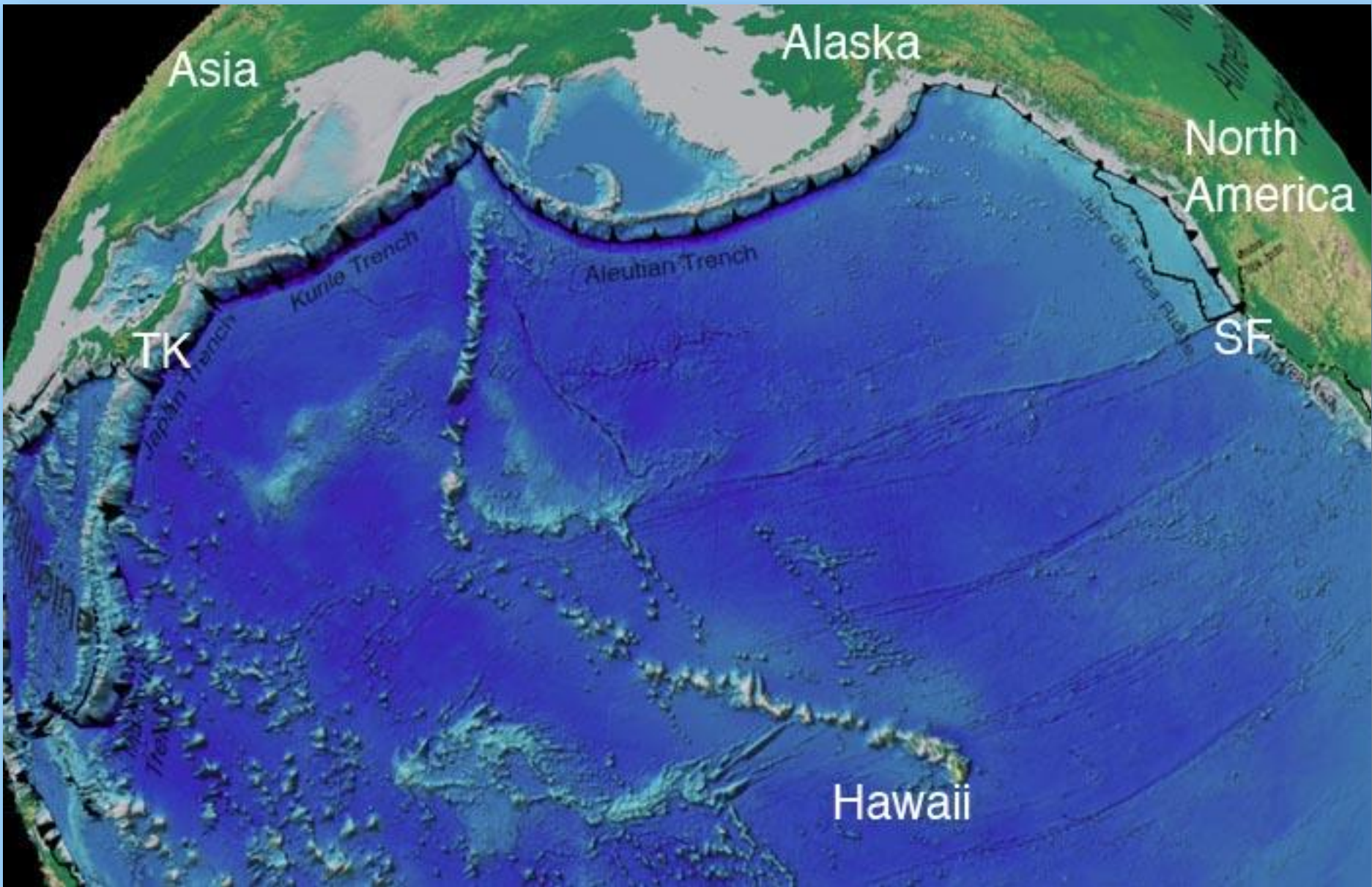
$$\frac{D\tilde{T}}{D\tilde{t}} = \tilde{\nabla} \cdot \left[\frac{\bar{k}}{k_0} \tilde{\nabla}\tilde{T} \right] + \frac{1}{Ra} \frac{\rho_0 Ha^2}{k_0 \Delta T}$$

$$\tilde{\nabla} \cdot \tilde{\mathbf{v}} = 0$$

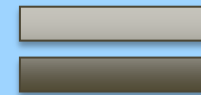



$$\frac{1}{Pr} \frac{D\tilde{\mathbf{v}}}{Dt} = -\tilde{\nabla}\tilde{p} + \tilde{\nabla} \cdot \left(\frac{\eta}{\eta_0} \left(\tilde{\nabla}\tilde{\mathbf{v}} + [\tilde{\nabla}\tilde{\mathbf{v}}]^t \right) \right)$$

$$- \frac{\bar{\mathbf{g}}}{g_0} \frac{\bar{\alpha}}{\alpha_0} Ra \tilde{T}$$

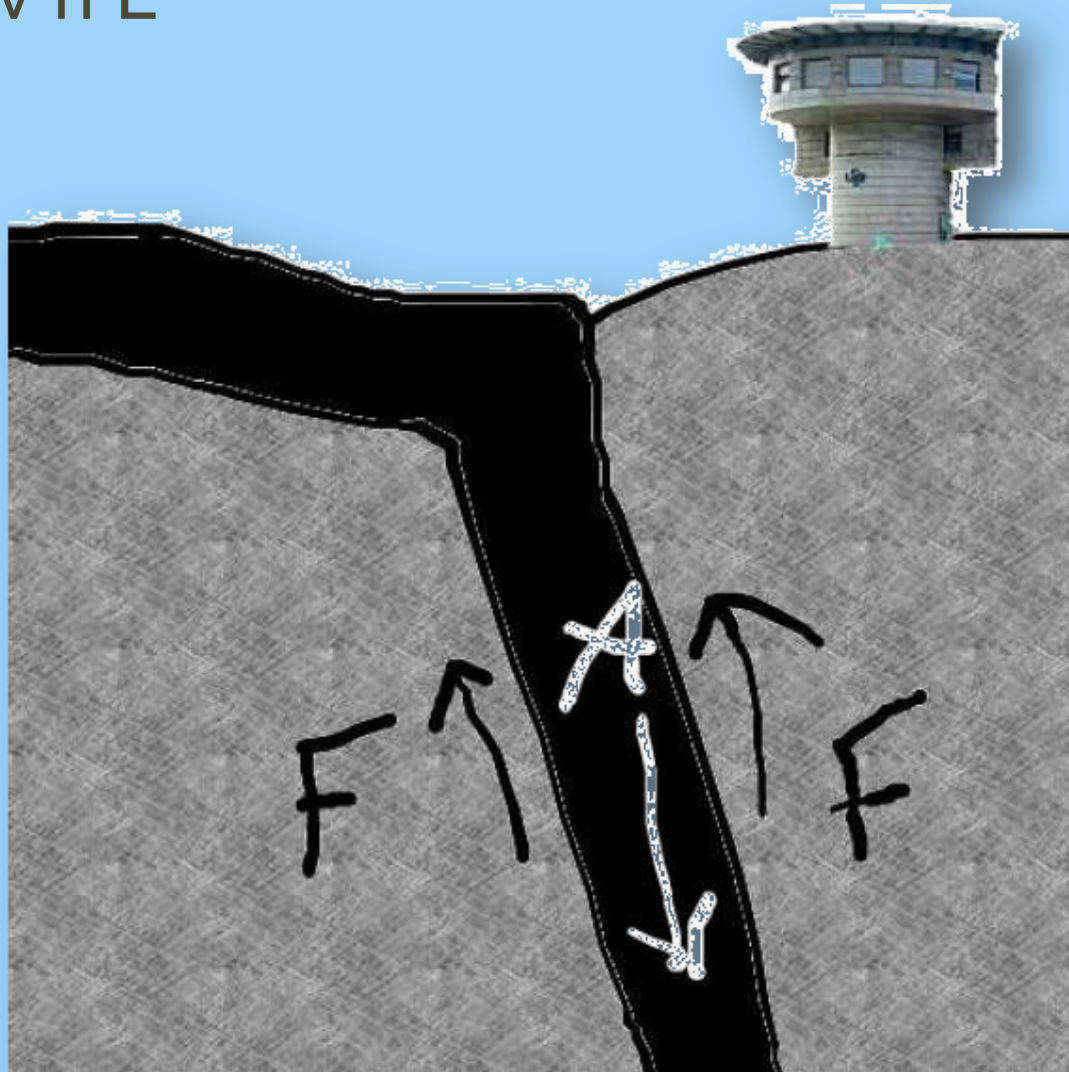


$$\cancel{\frac{1}{Pr} \frac{D\tilde{y}}{Dt}} = -\tilde{\nabla}\tilde{P} + \tilde{\nabla} \cdot \left(\frac{\eta}{\eta_0} \left(\tilde{\nabla}\tilde{v} + [\tilde{\nabla}\tilde{v}]' \right) \right) - \frac{\bar{g}}{g_0} \frac{\bar{\alpha}}{\alpha_0} Ra \tilde{T}$$



$$A \sim h e L \delta \rho g$$

$$F \sim 2 \mu v h L$$



$$\frac{D\tilde{T}}{Dt} = \tilde{\nabla} \cdot \left[\frac{\bar{k}}{k_0} \tilde{\nabla} \tilde{T} \right] + \frac{1}{Ra} \frac{\rho_0 Ha^2}{k_0 \Delta T}$$

CAUTION
ATTENTION



Substituting (33) into (17) and solving for u gives the mean dimensionless velocity on the horizontal boundaries

$$u = 0.142R^{\frac{1}{2}} \quad (34)$$

Substitution of (34) into (33) gives

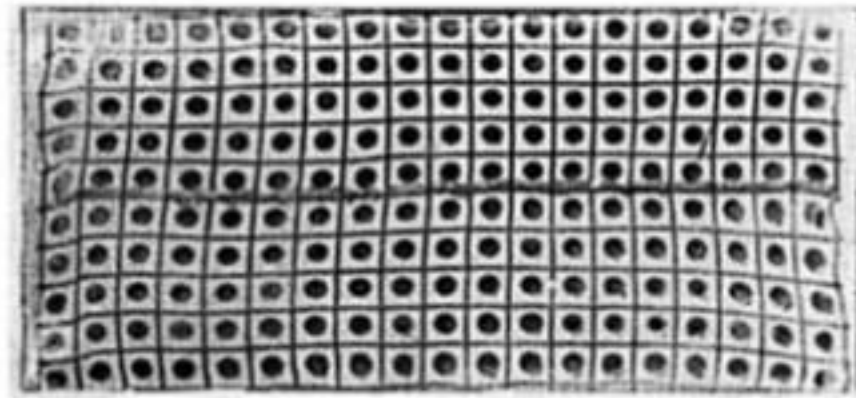
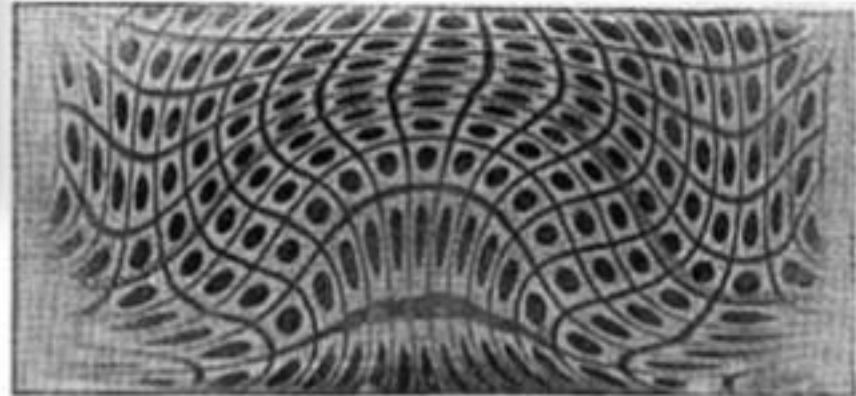
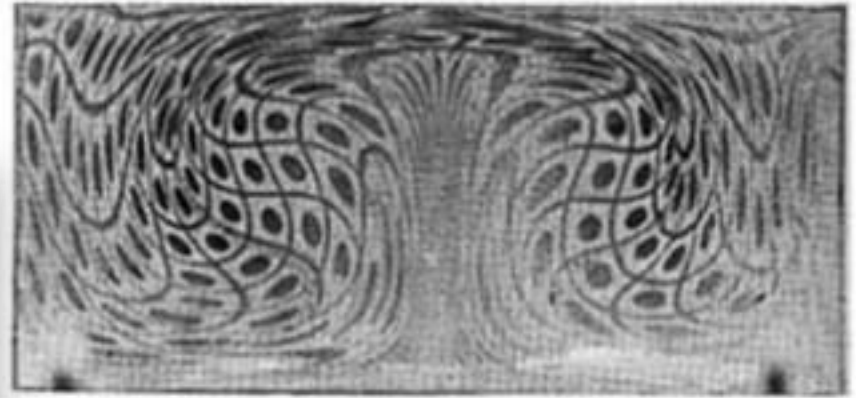
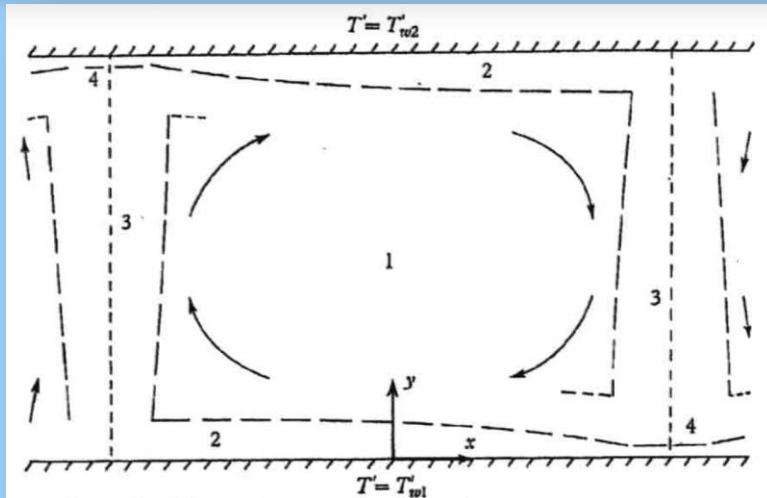
$$\gamma = 1.78R^{\frac{1}{2}}, \quad (35)$$

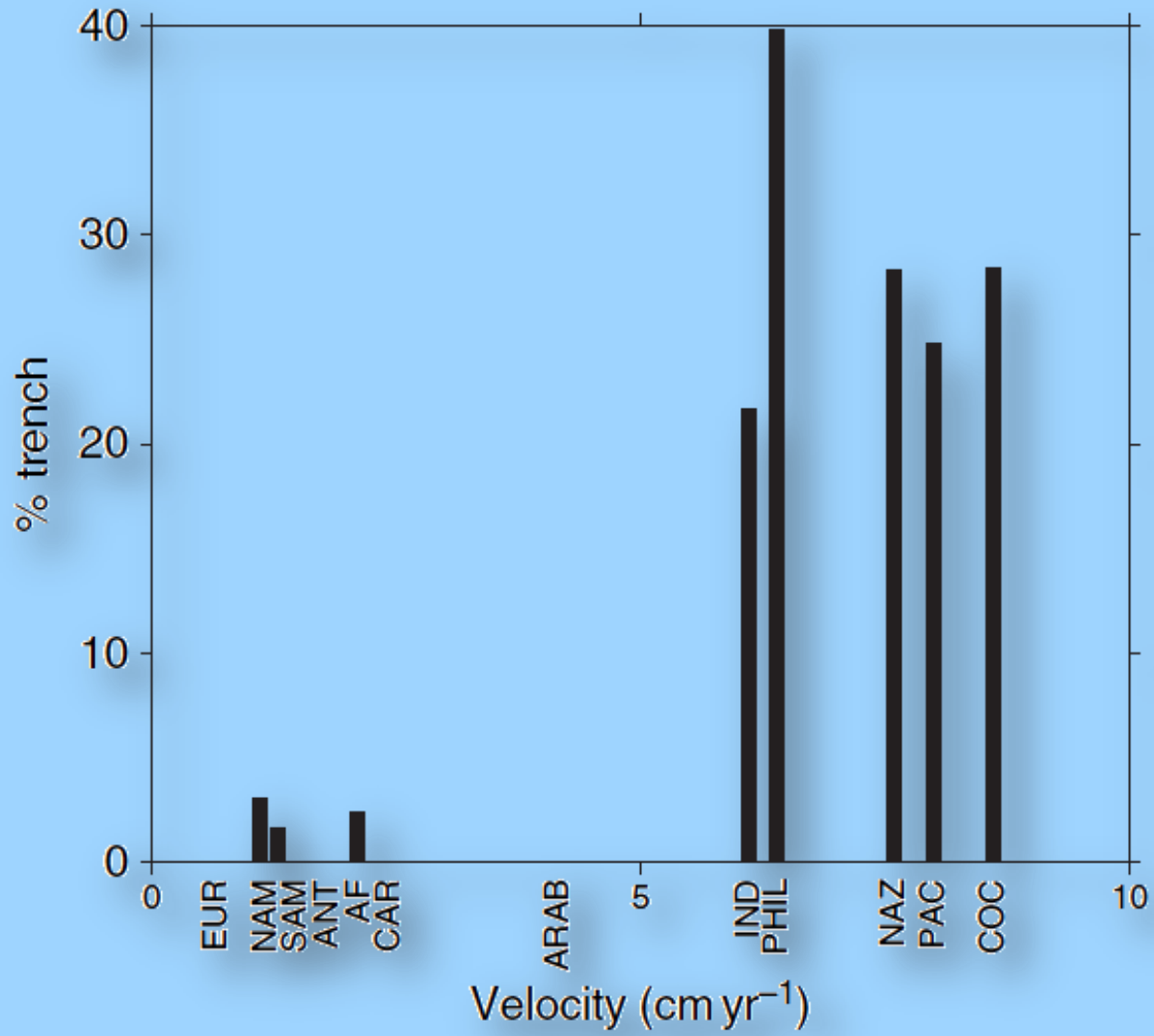
and substitution of (35) into (16) gives the mean dimensionless vertical velocity on the boundaries between cells

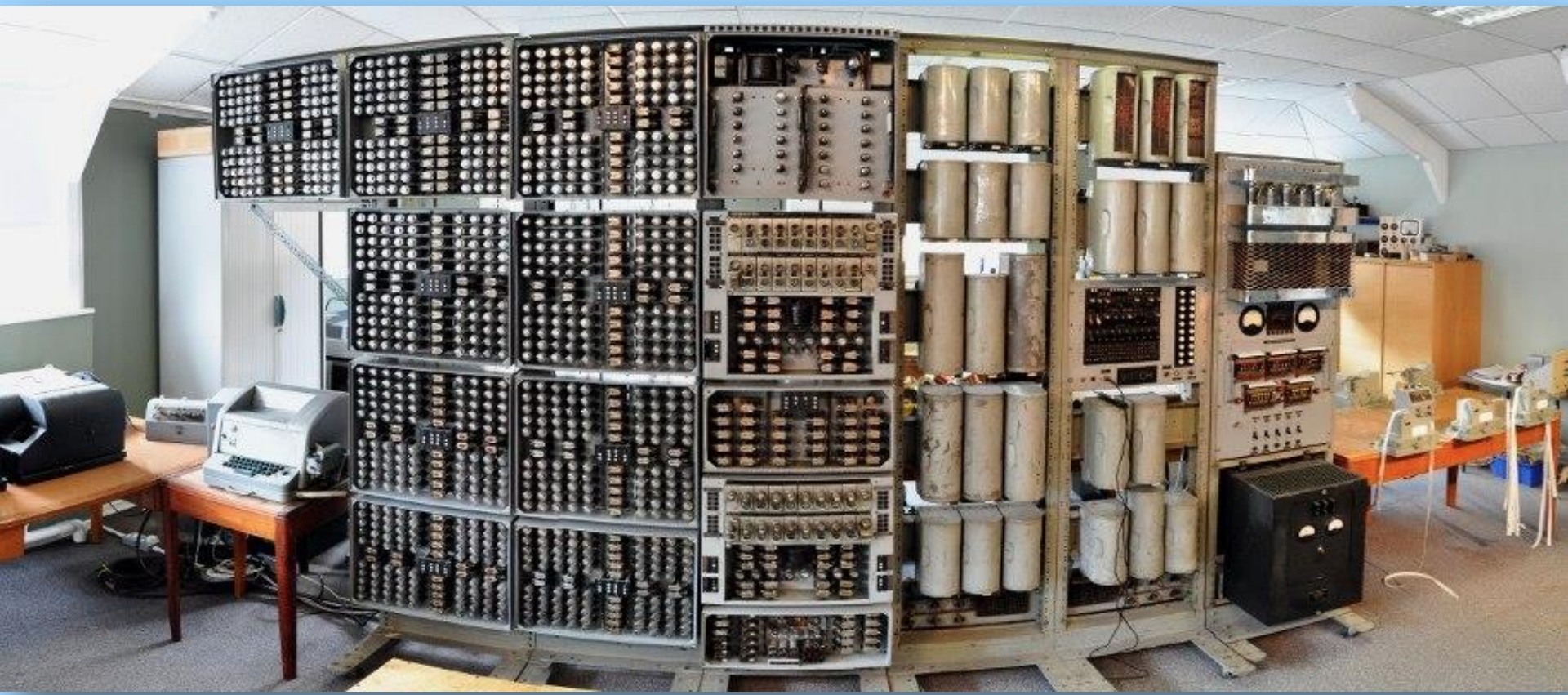
$$v = 0.250R^{\frac{1}{2}} \quad (36)$$

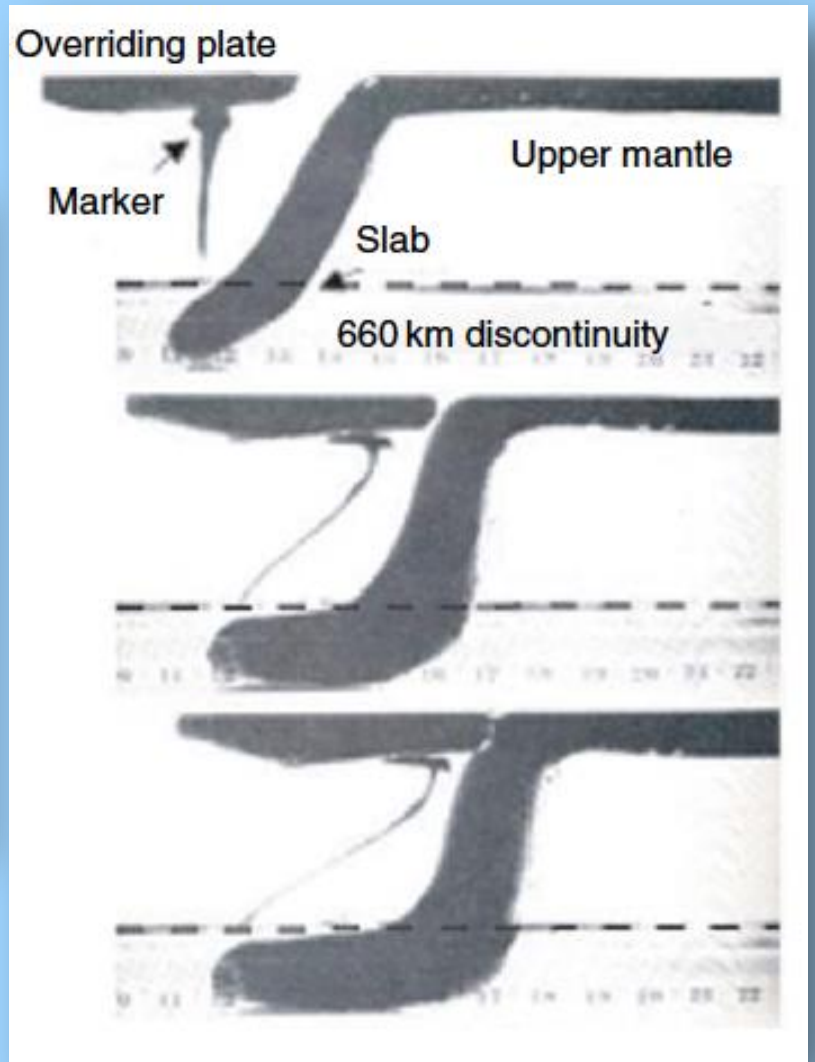
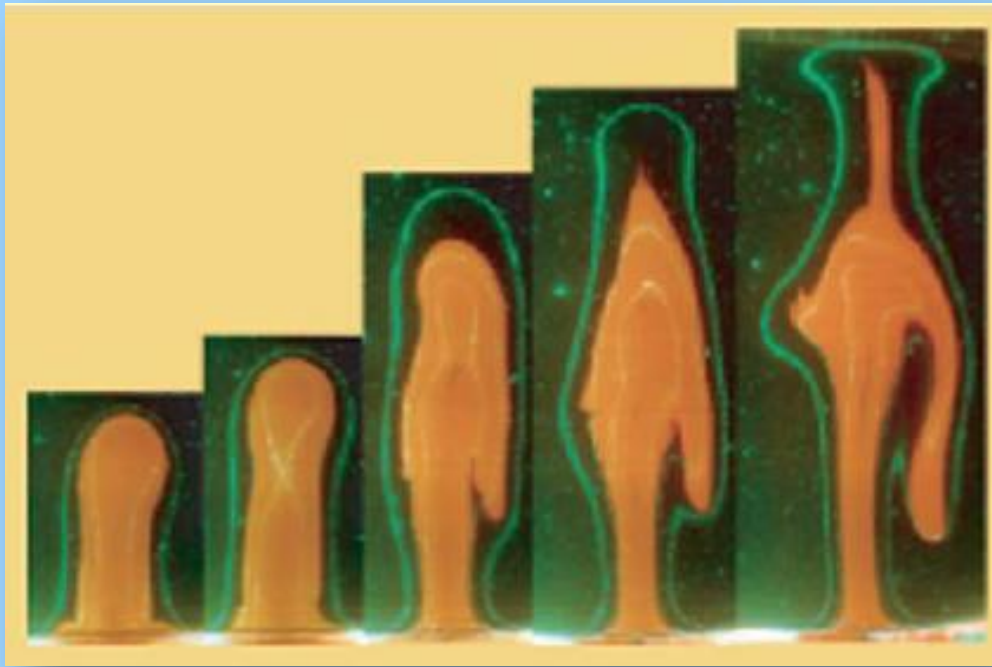
Having obtained the dimensionless velocities, it is now possible to determine the local heat flux to the boundaries expressed in terms of a local Nusselt number. The local Nusselt number of the thermal boundary layers is obtained by substituting (34) into (20)

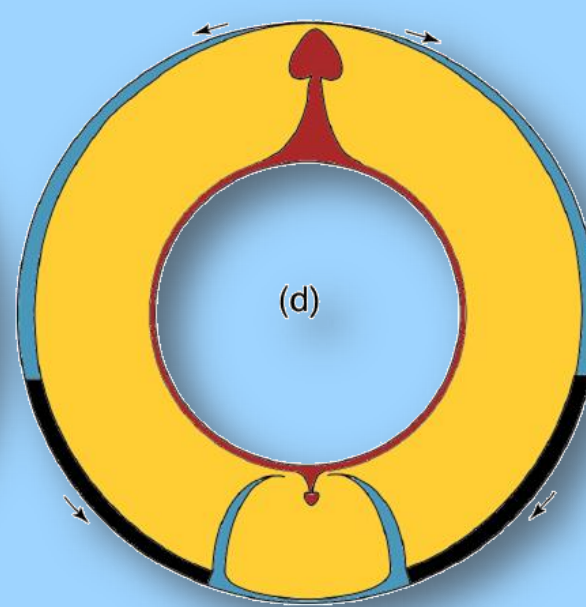
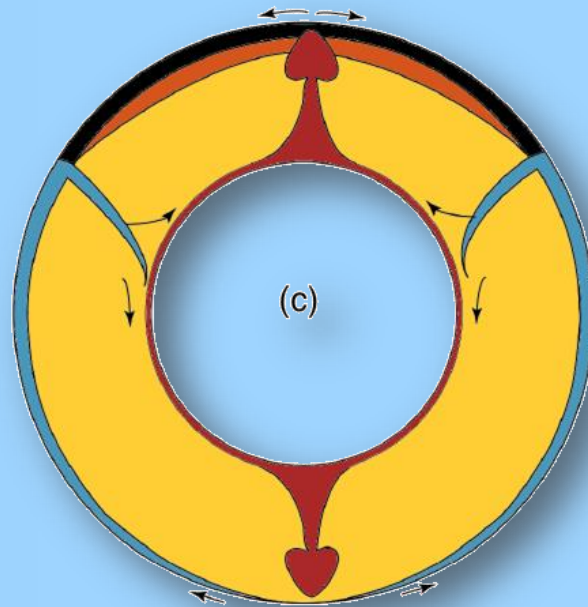
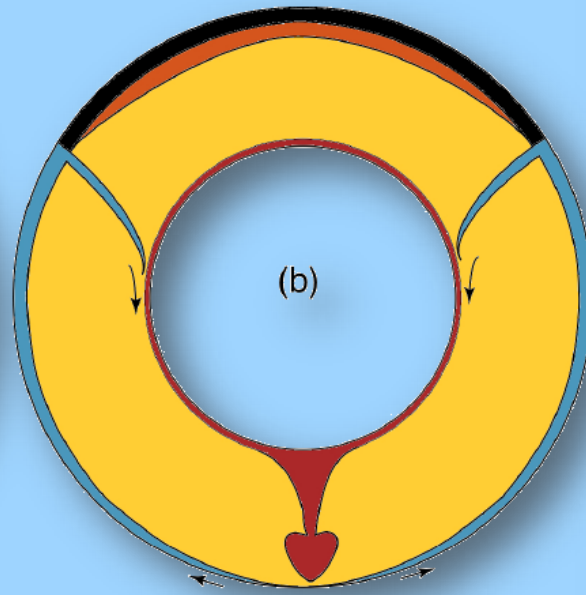
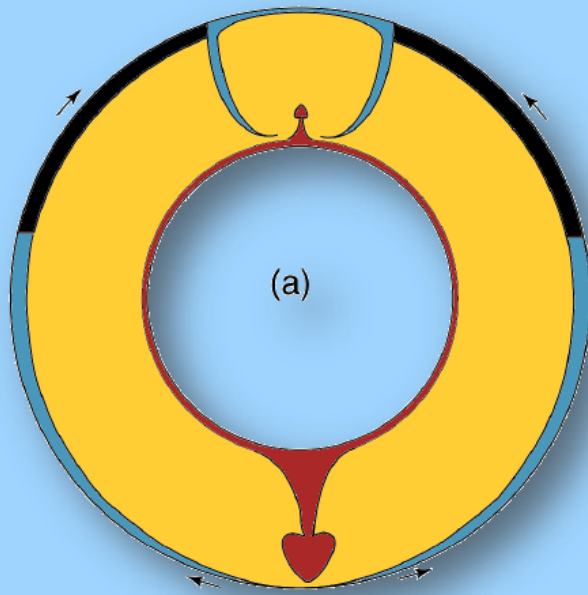
$$Nu_1 = 0.106(R^{\frac{1}{2}}/z^{\frac{1}{2}}) \quad (37)$$

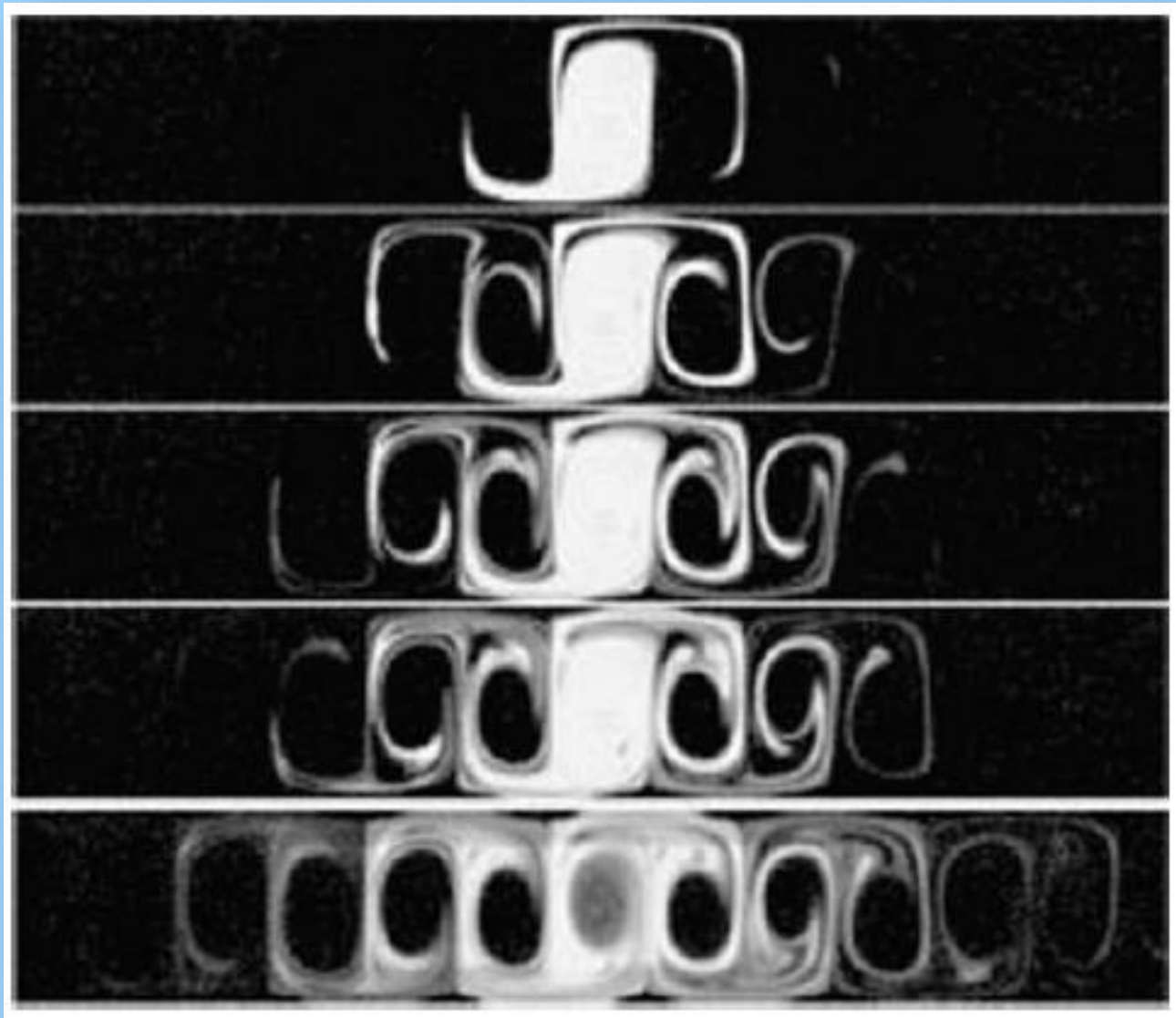






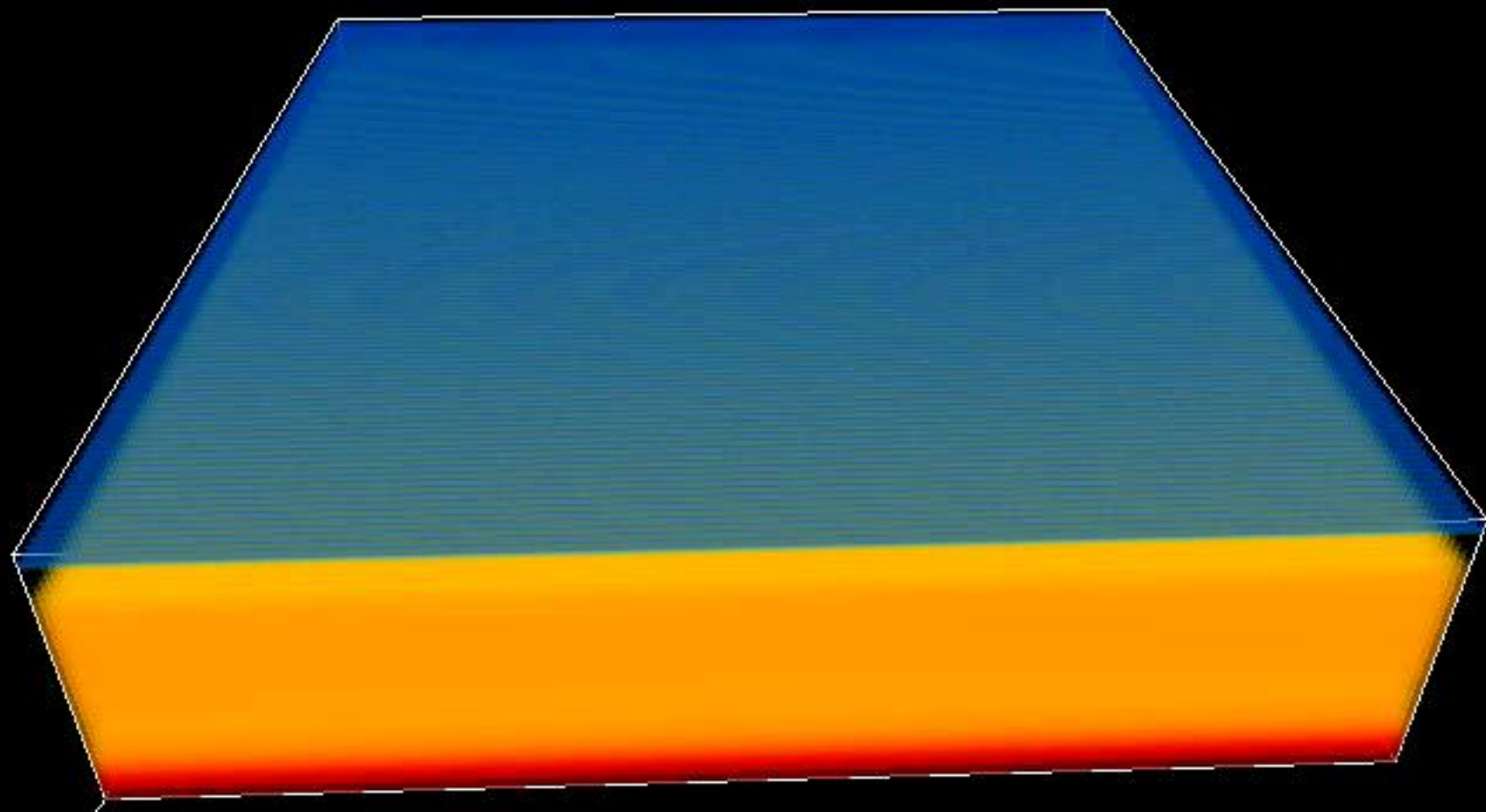






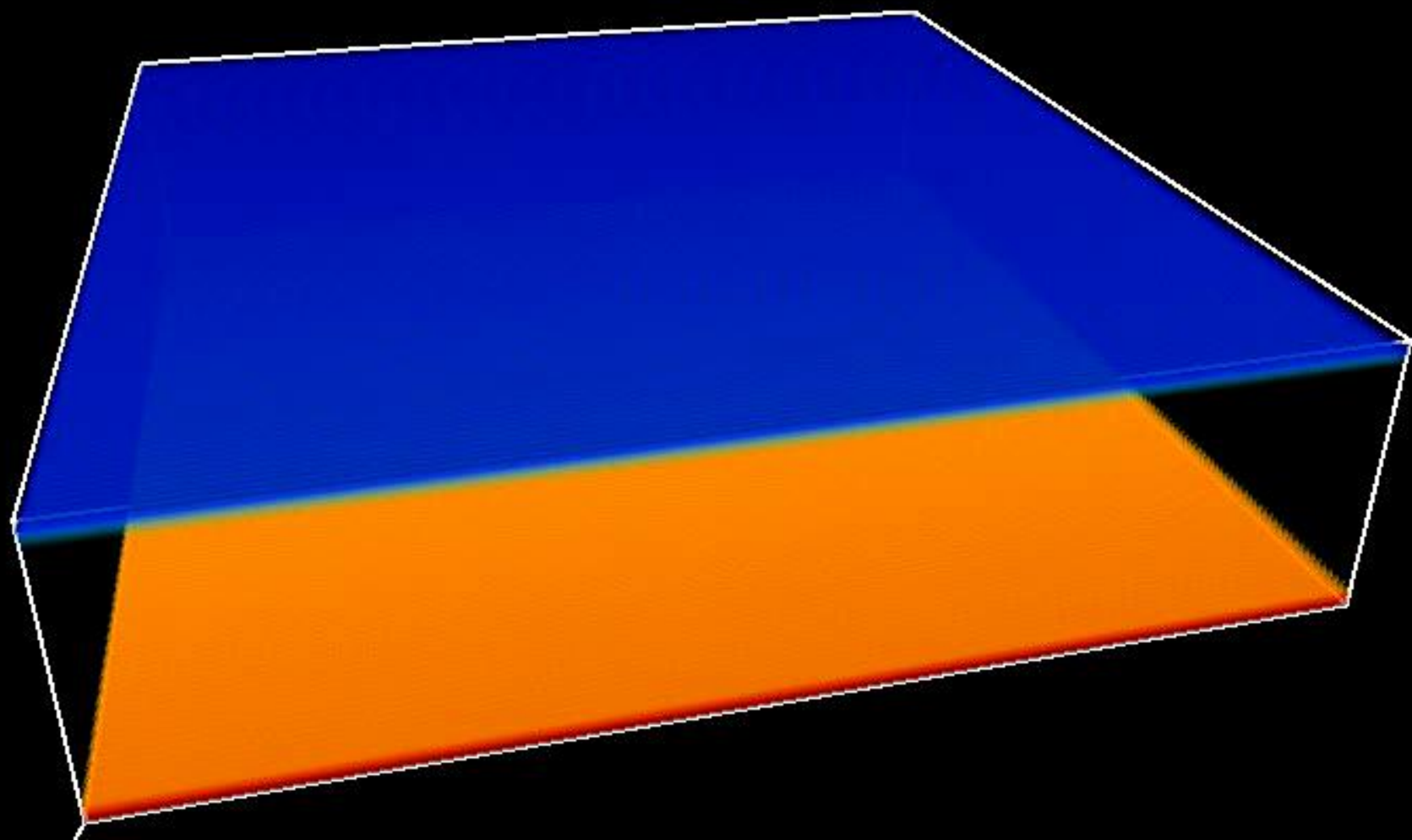
Nstep = 40

Time = 0.002441



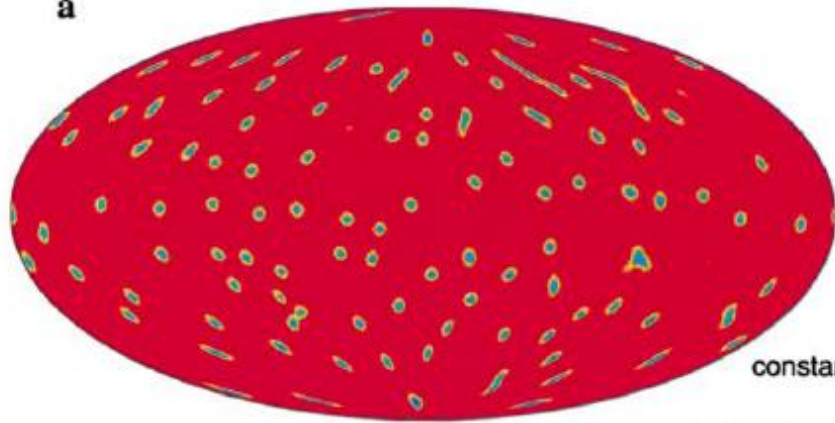
Nstep = 40

Time = 0.002441



free slip

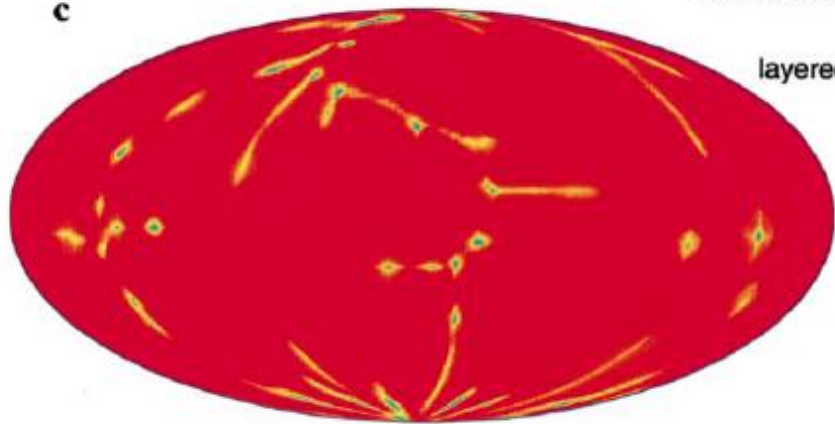
a



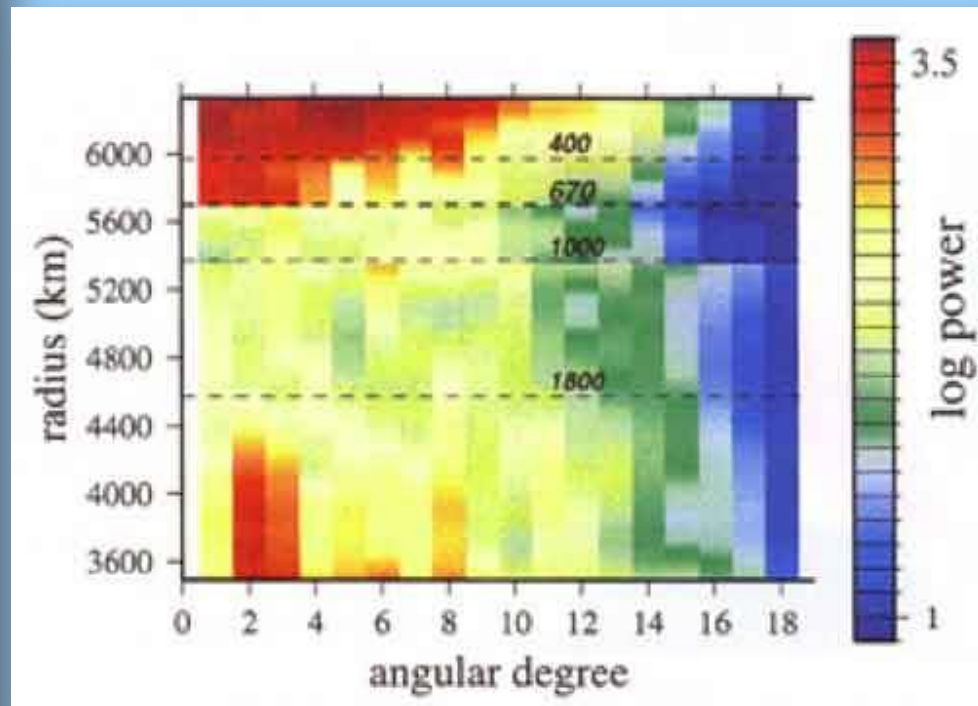
constant

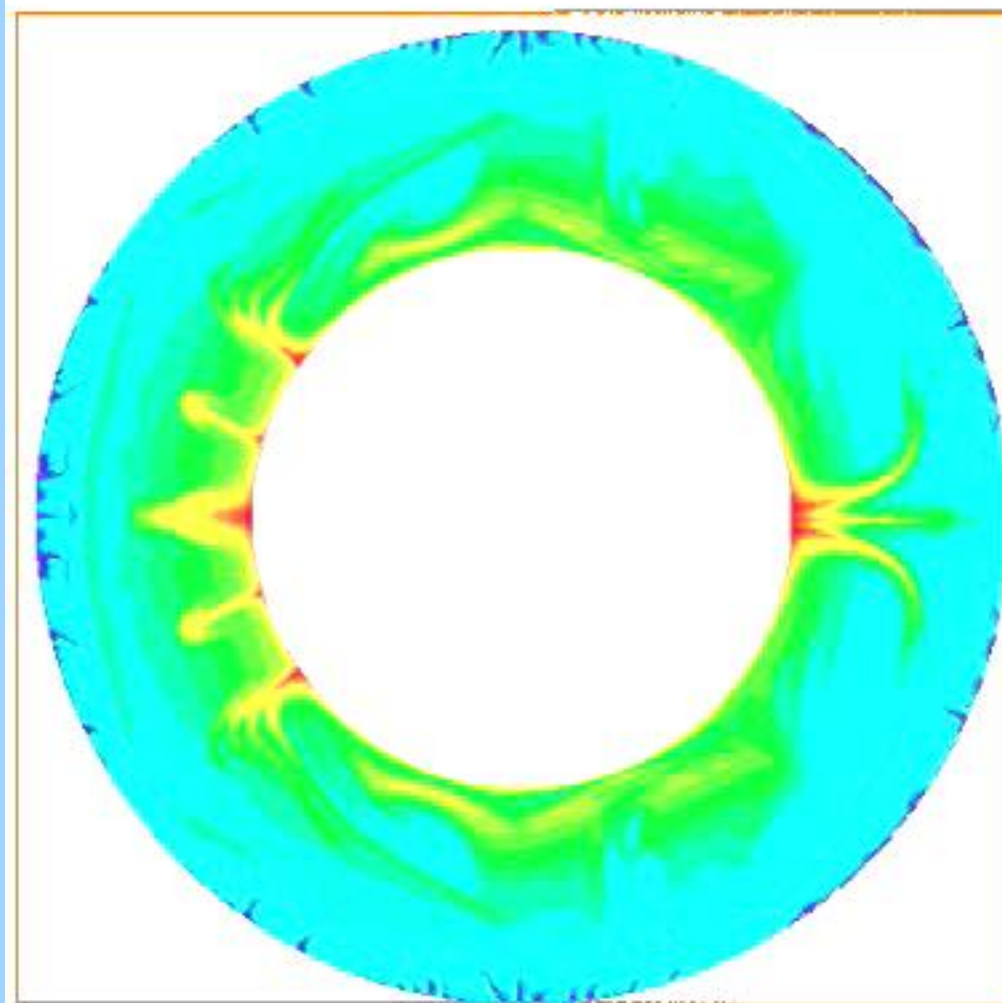
100% inter

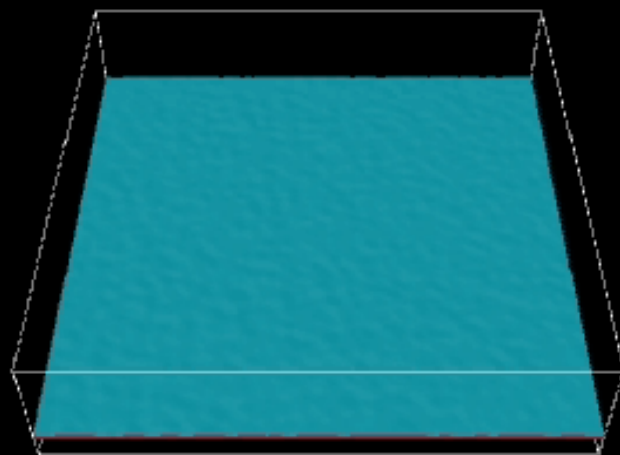
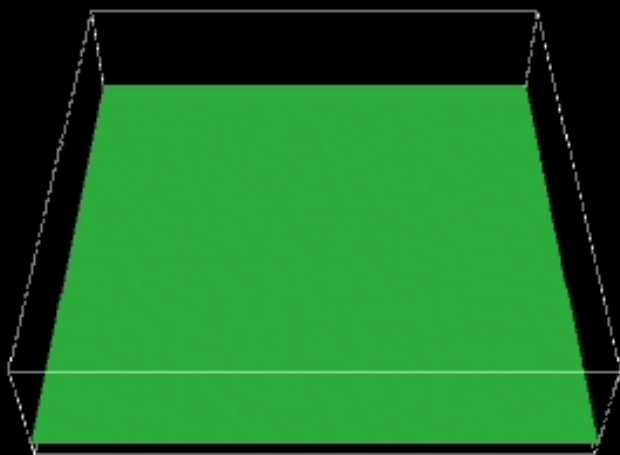
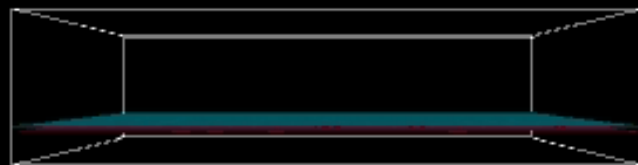
c

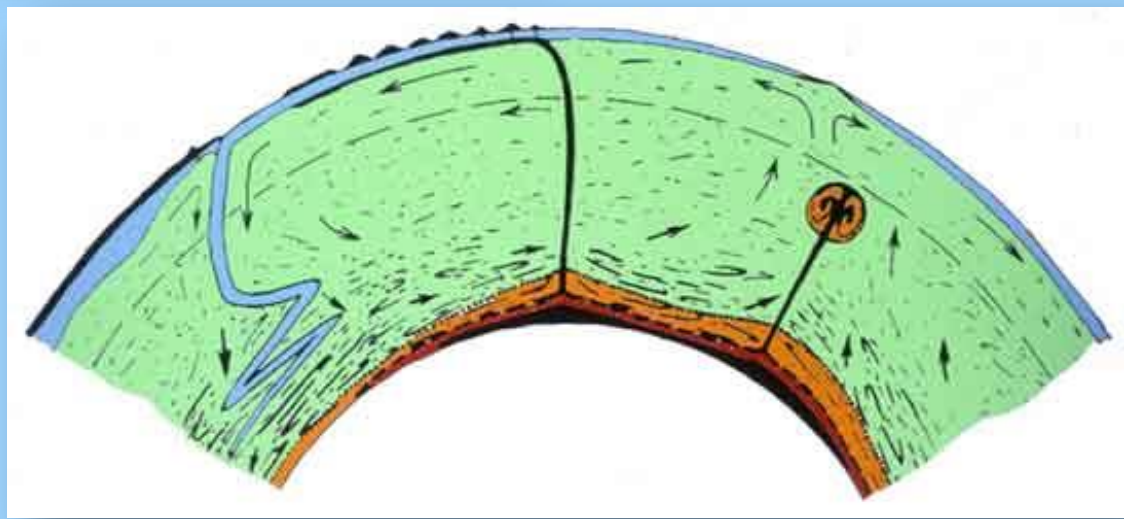
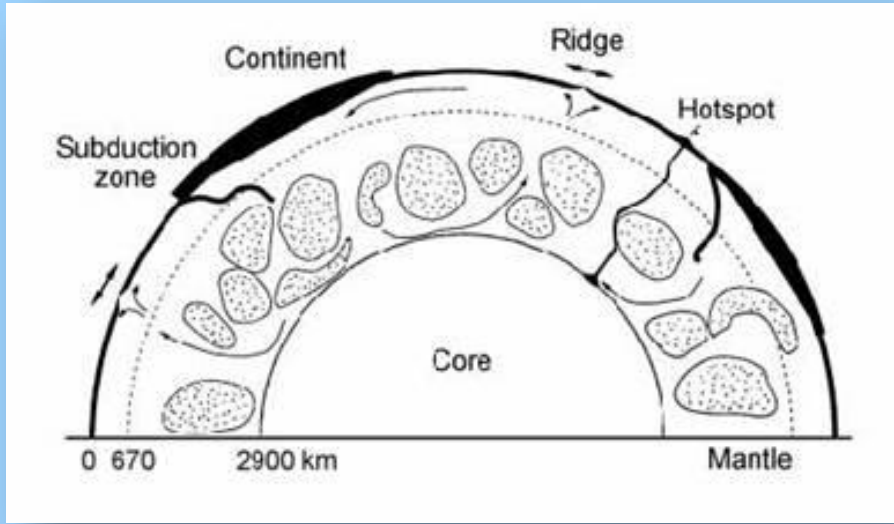
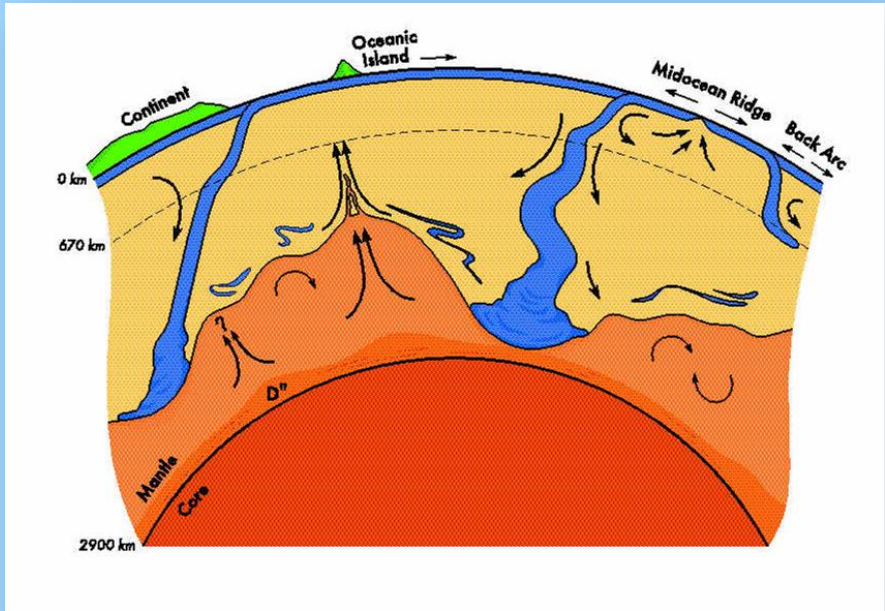


























layered



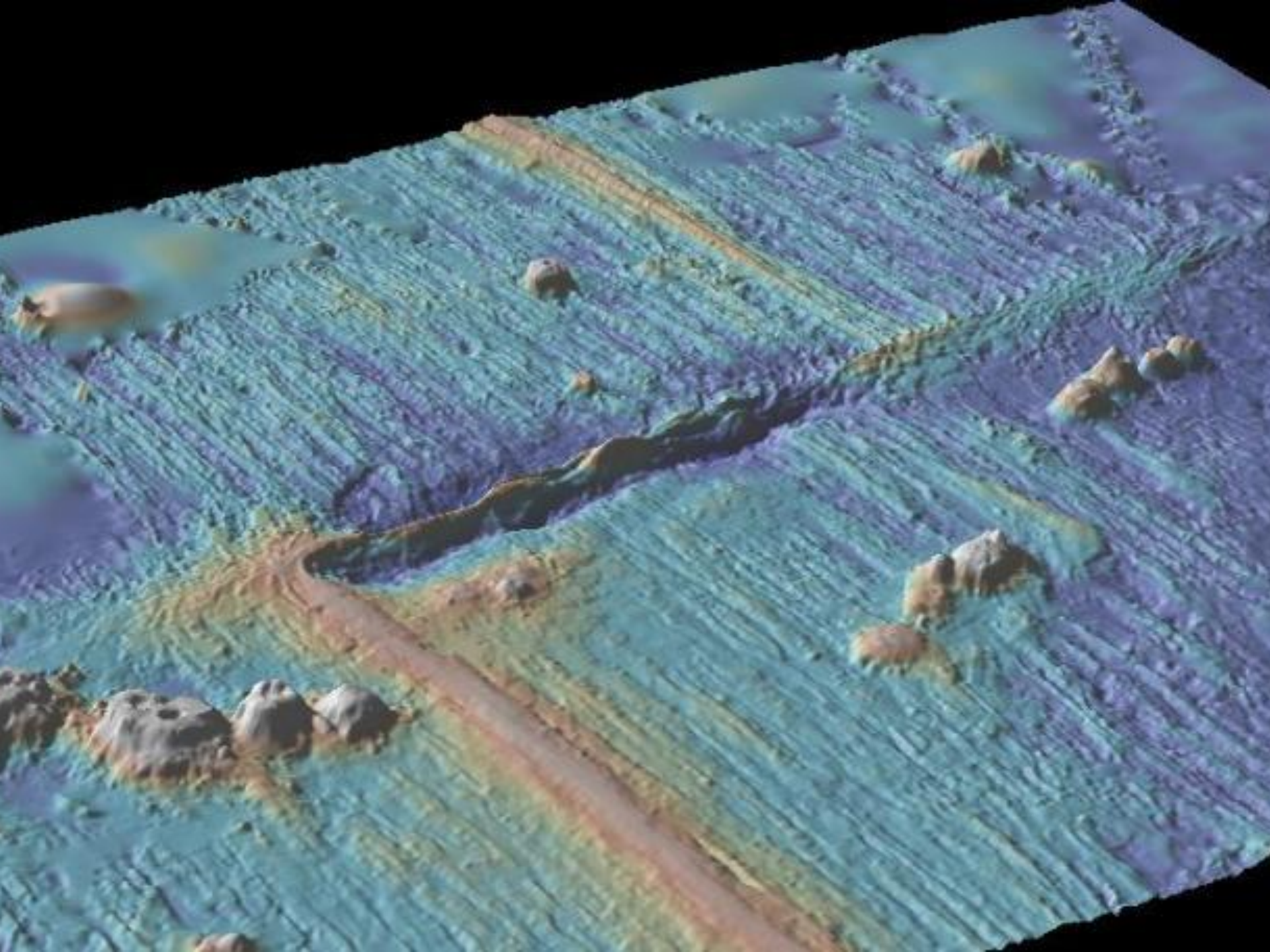


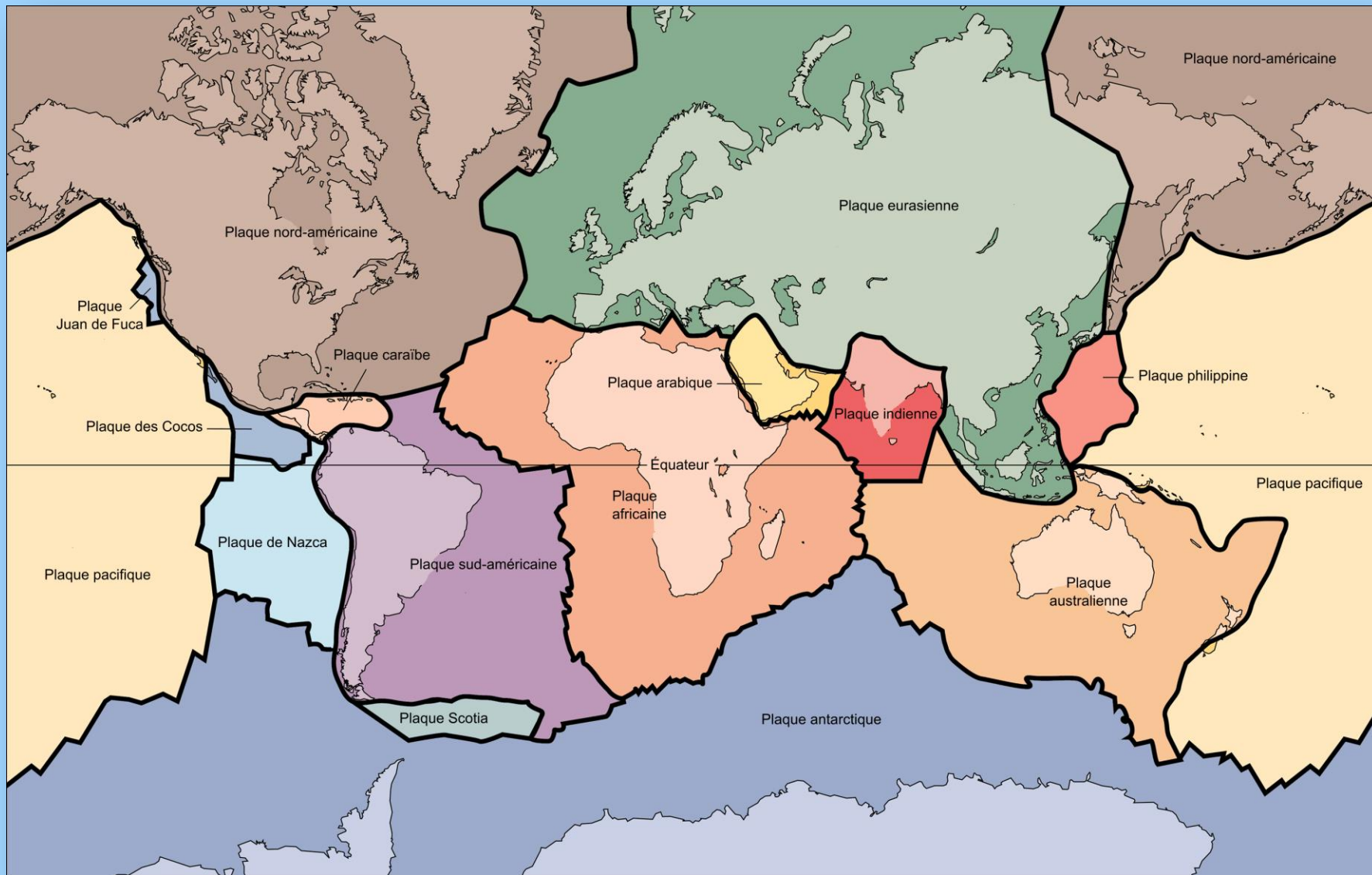




Date	0/12 h	12/24 h	Vent	Matin	Apm	Temps/Ecarts saisonniers des températures*		
Mar 12			 Nord 5 à 15 km/h	2/4°	7/9°	Le ciel s'ennuage progressivement ce soir - peut-être quelques gouttes cette nuit  0%		
Mer 13			 Nord 15 à 30 km/h	3/5°	9/10°	Temps gris et frais / quelques bruines possibles en matinée  10%		
Jeu 14			 Nord-Ouest 5 à 15 km/h	3/5°	8/10°	Généralement couvert et frais avec quelques pluies dans l'après-midi et la soirée  30%		
Ven 15			 Nord 15 à 30 km/h	3/5°	5/7°	Encore quelques pluies résiduelles et une fraîcheur plus accentuée  70%		
Sam 16			 Nord 5 à 15 km/h	2/4°	4/5°	Gris et froid / éventuellement quelques gouttes  30%		
Dim 17			 Nord-Ouest 5 à 15 km/h	1/3°	6/8°	Persistance d'un temps gris et froid  10%		

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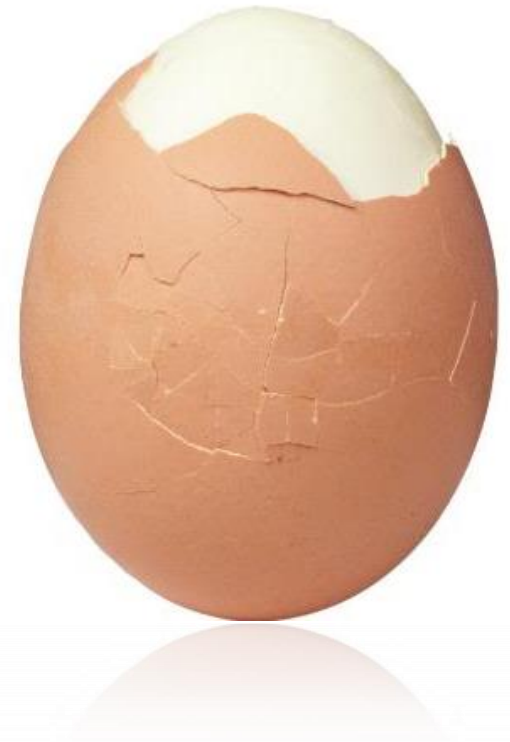
Tectonique des plaques



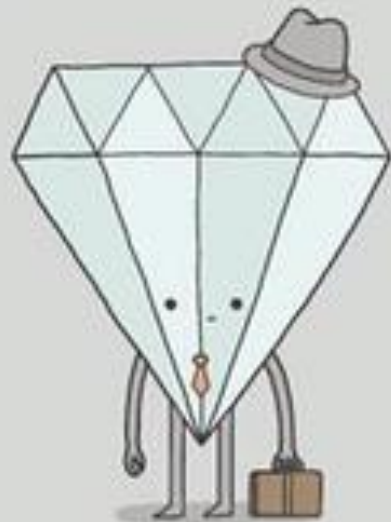
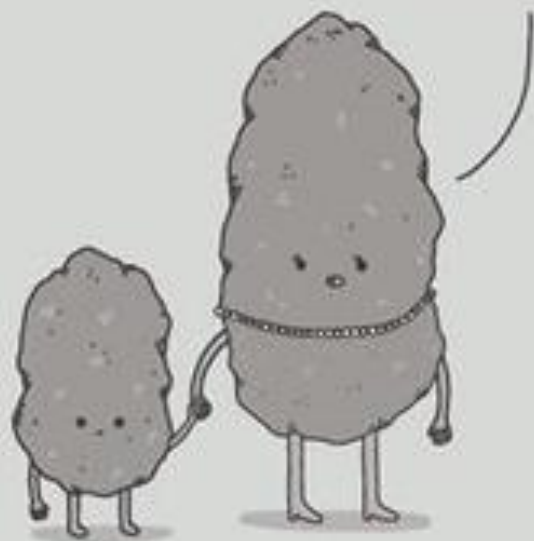
**Convection du manteau
En pratique**



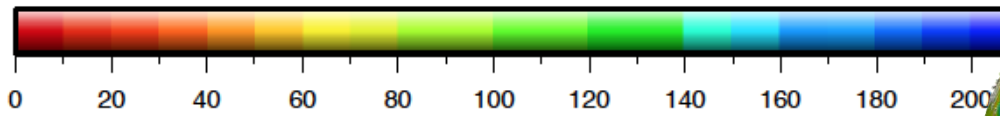
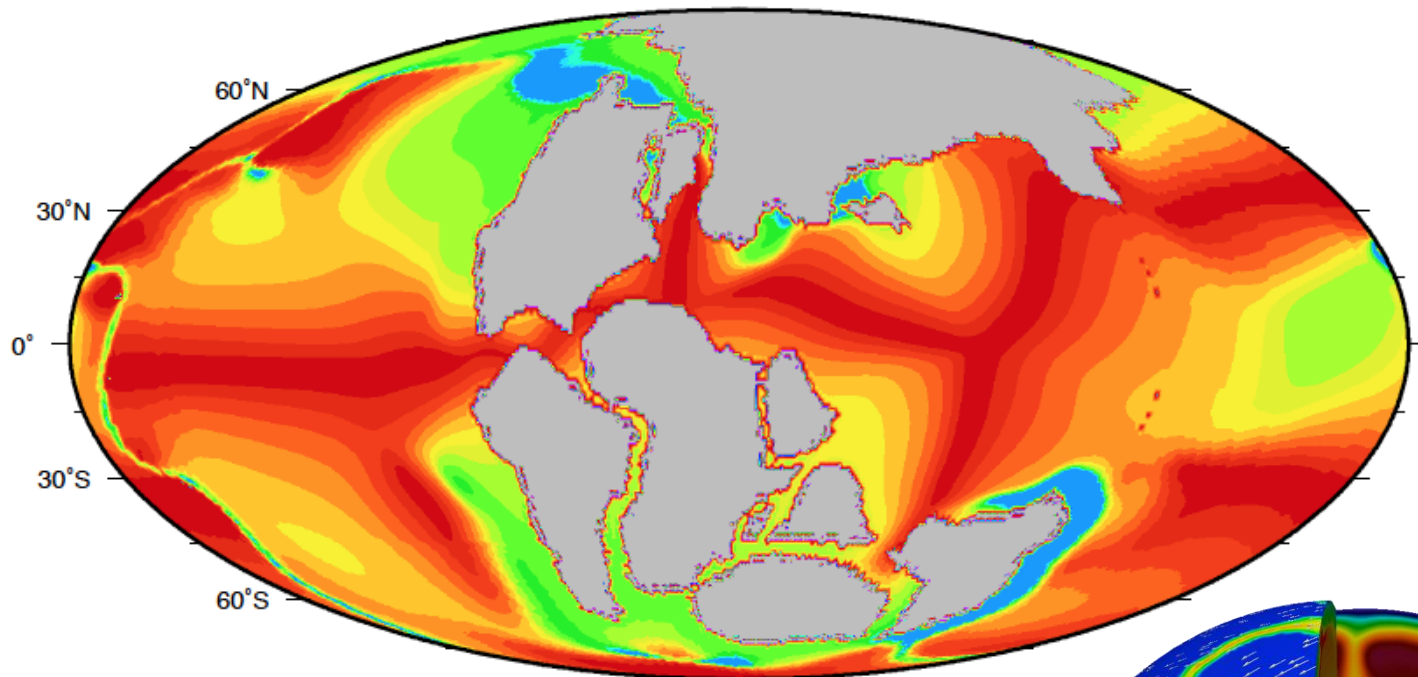
**Le futur de la
dynamique du
manteau**



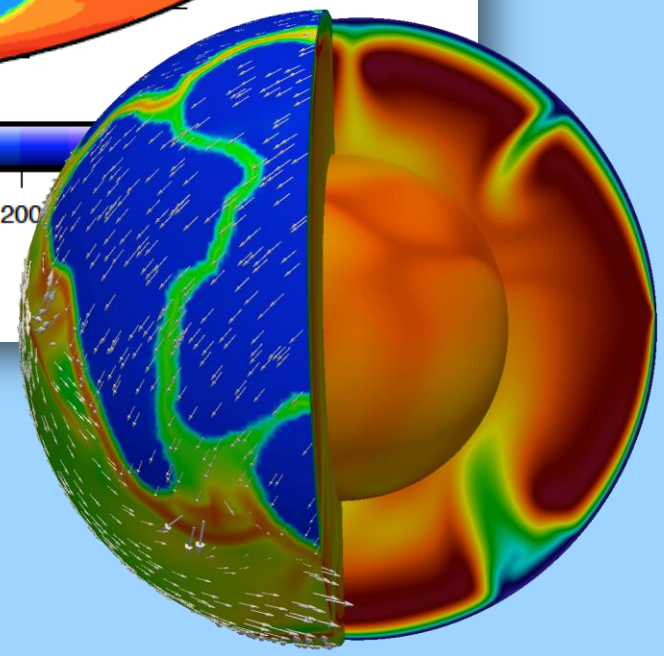
YOUR DAD'S BEEN
UNDER A LOT OF
PRESSURE LATELY.







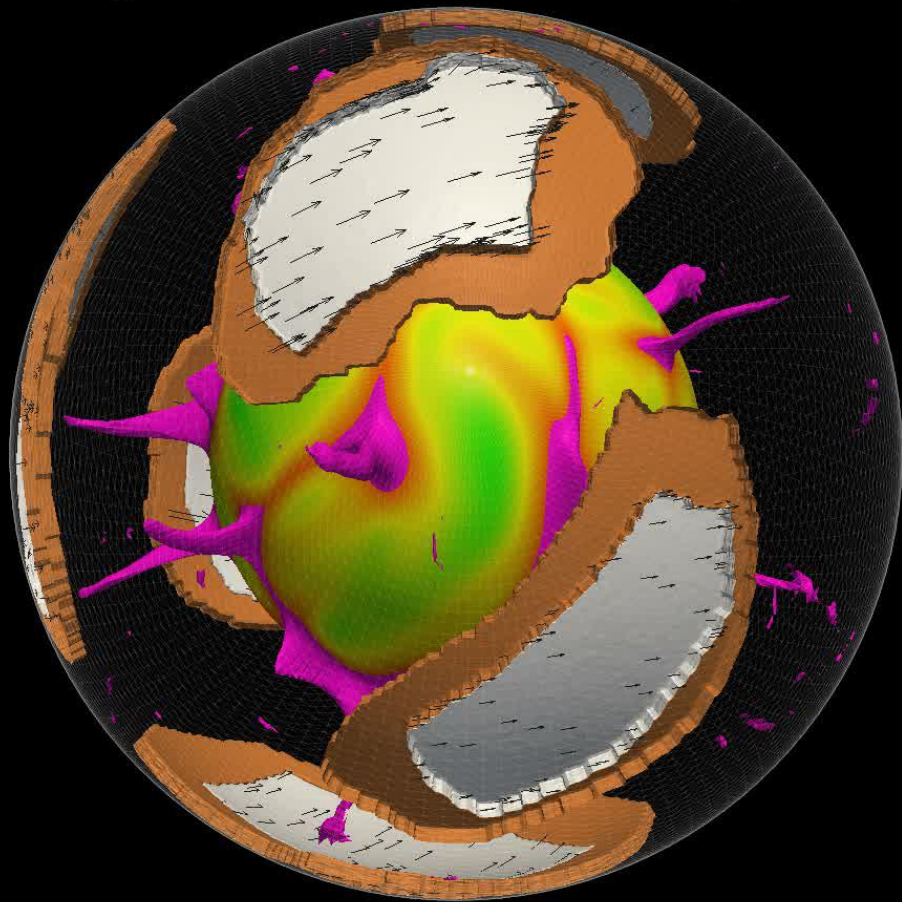
Age of Oceanic Lithosphere [m.y.]



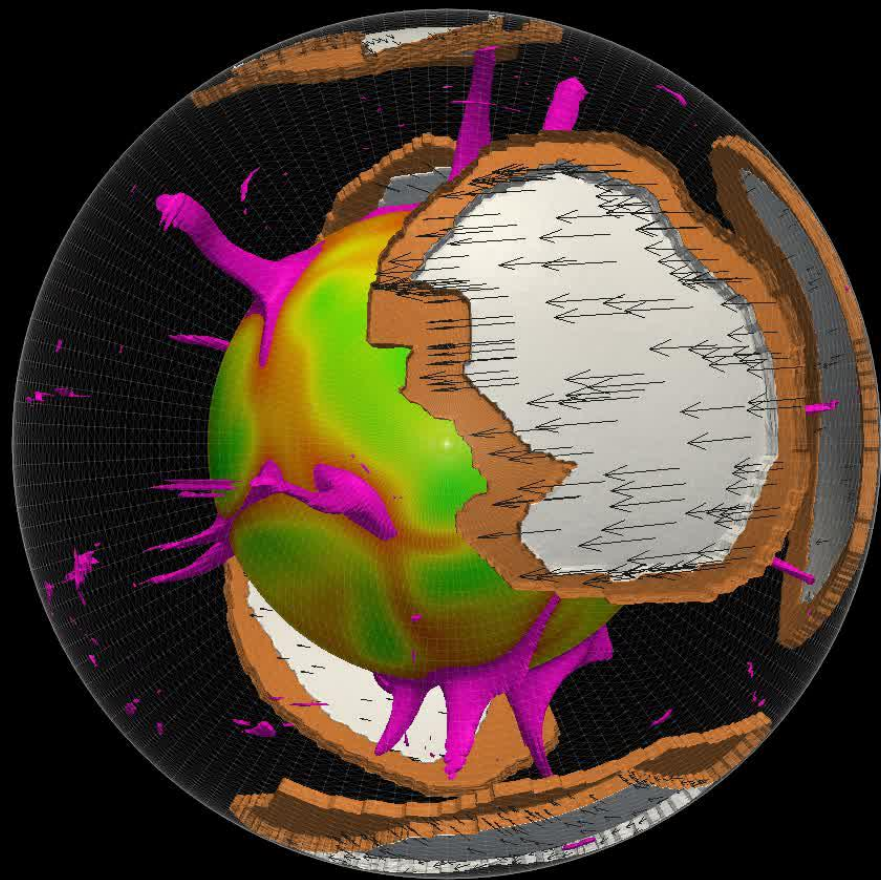
T



$t = -4 \text{ Ma}$



$t^* = 0.008717$



$t = -0.05 T$

Late Proterozoic 650 Ma

