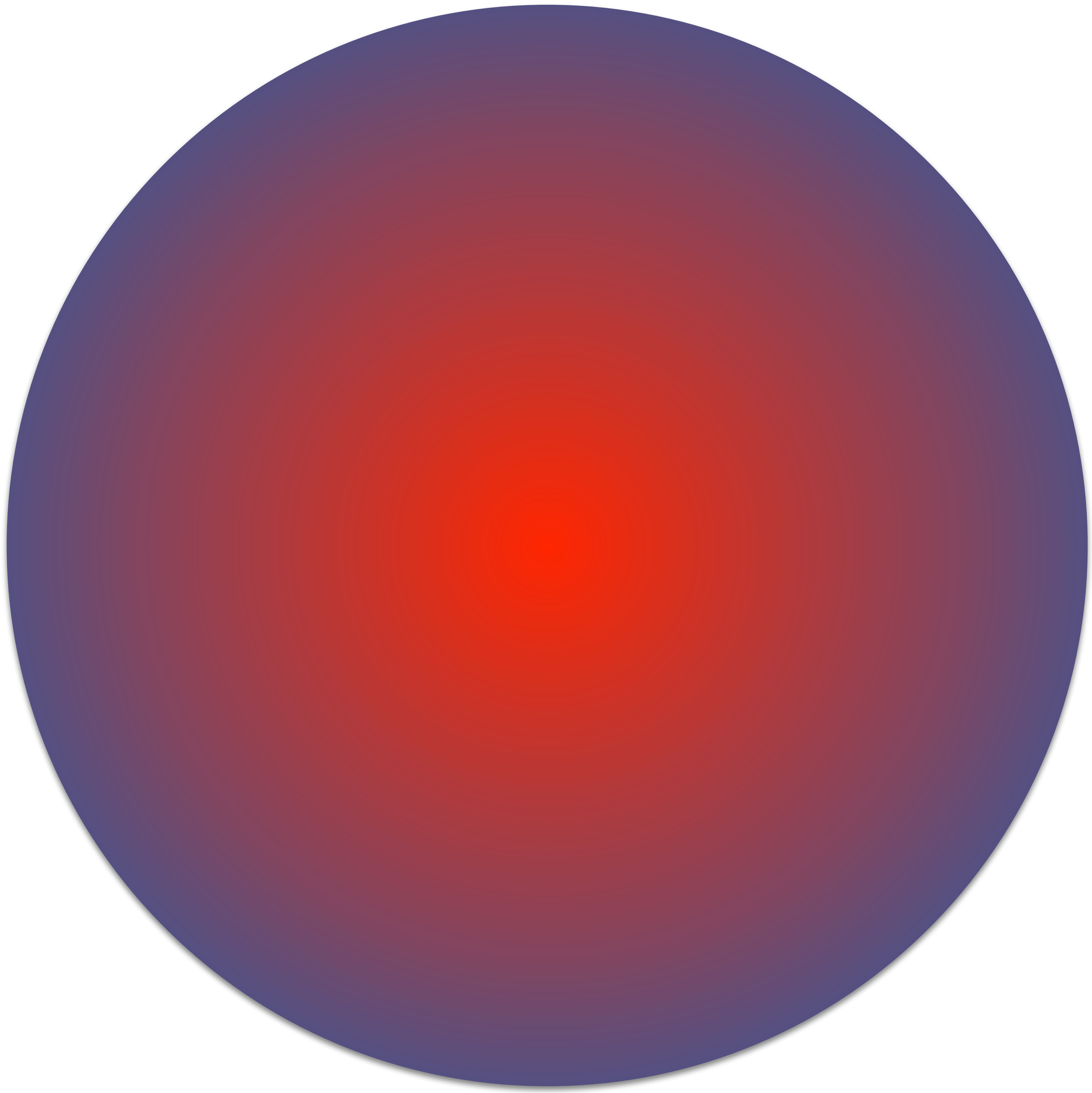
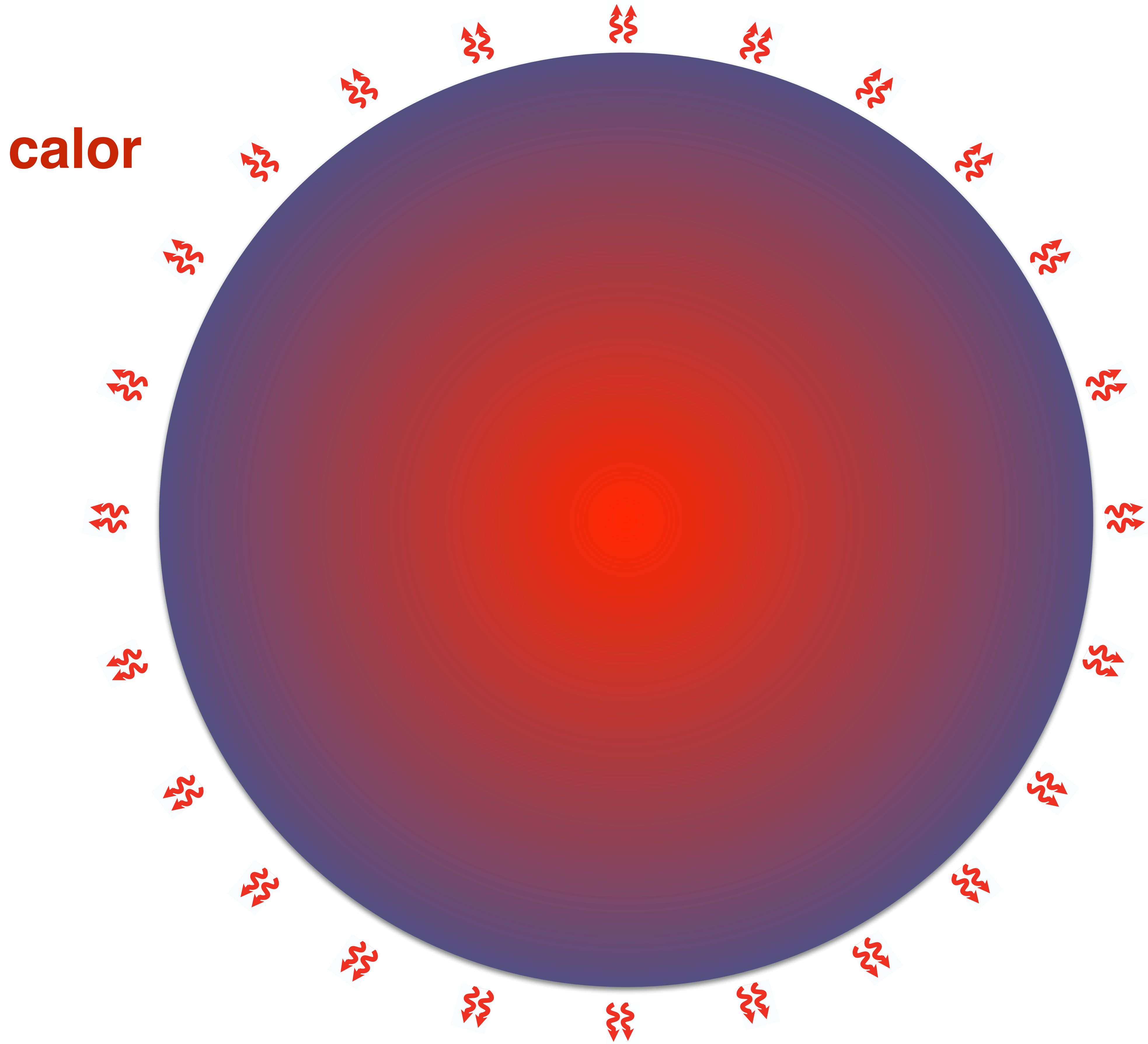
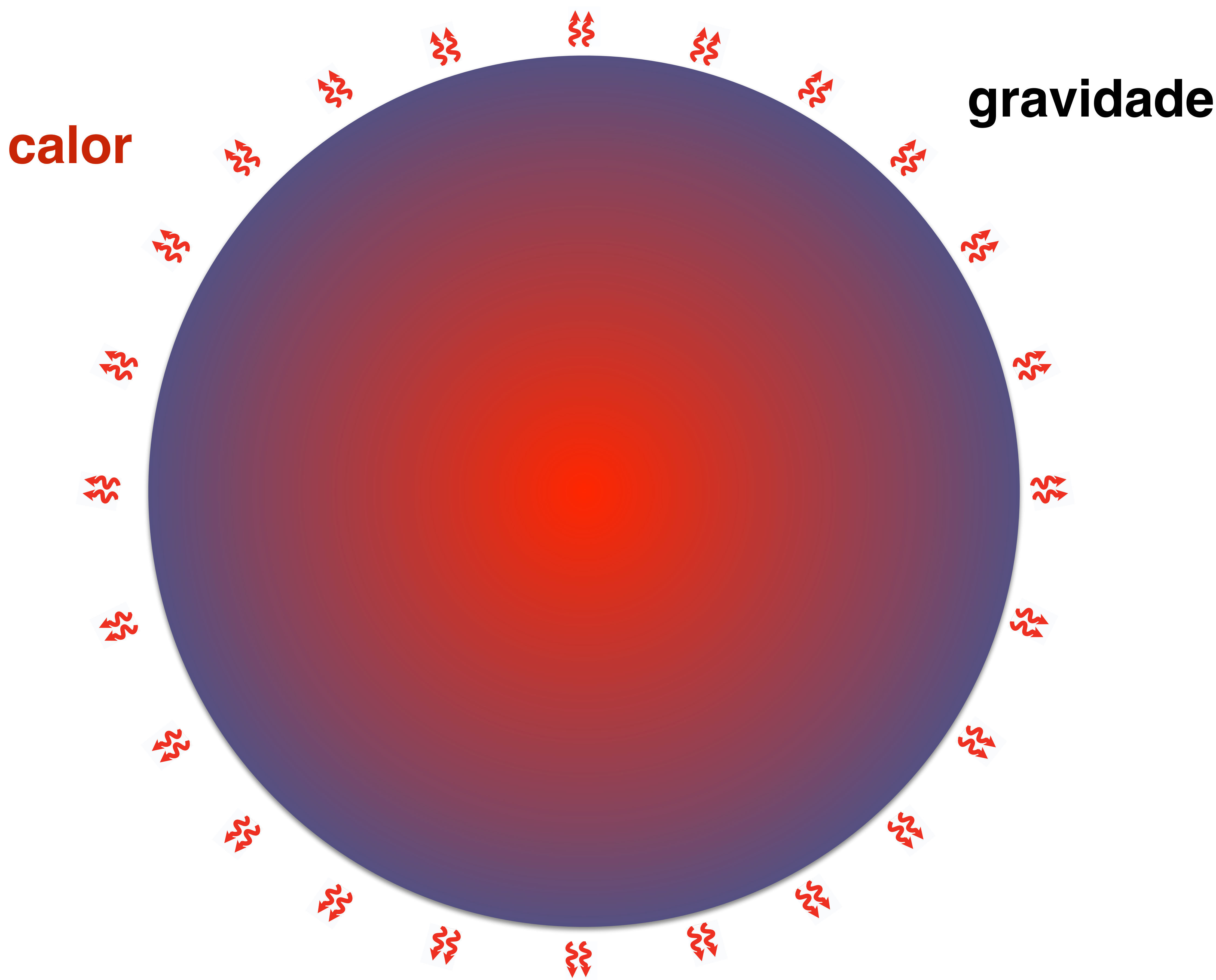
Modelos Quantitativos de Bacias Sedimentares

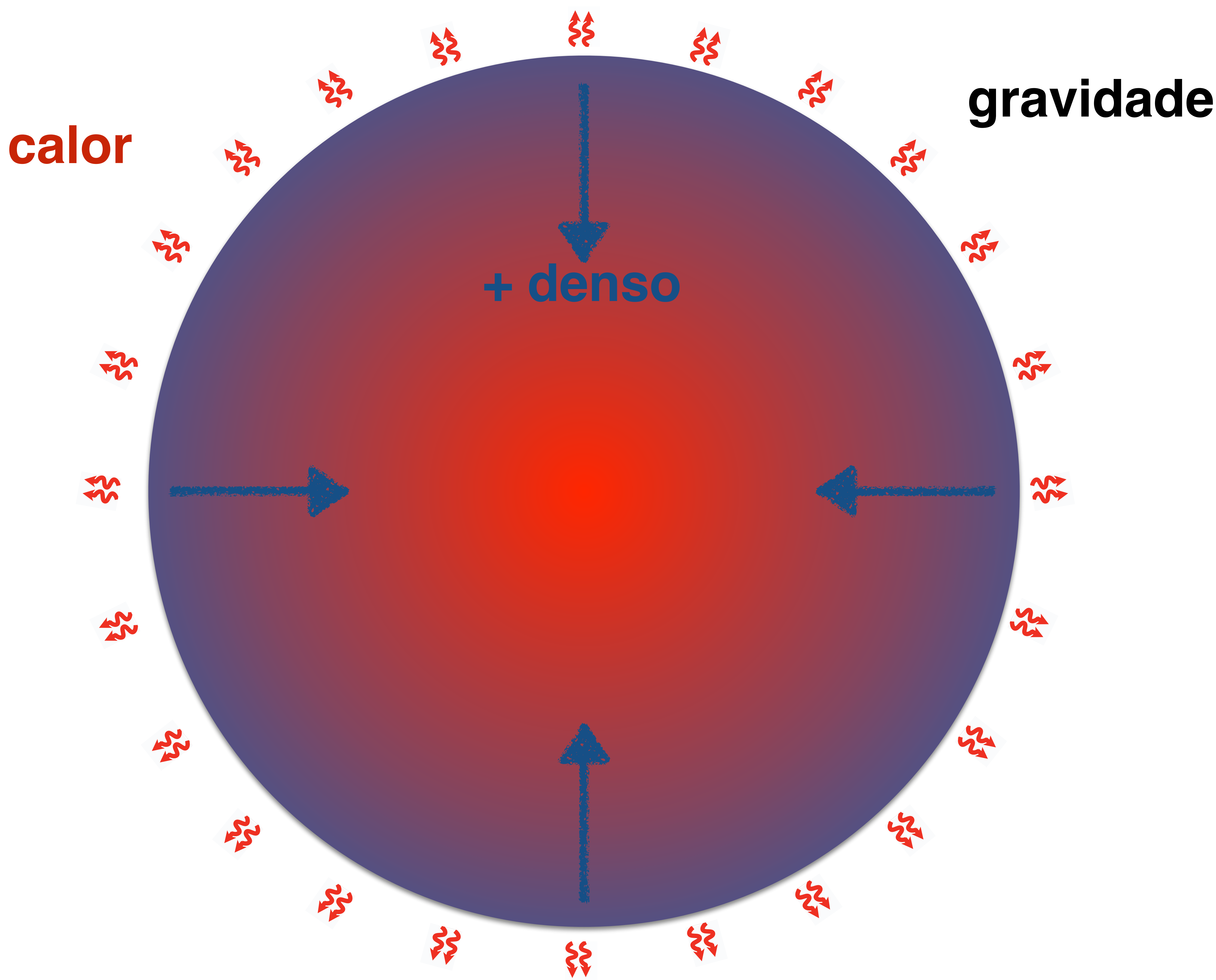
AGG0314

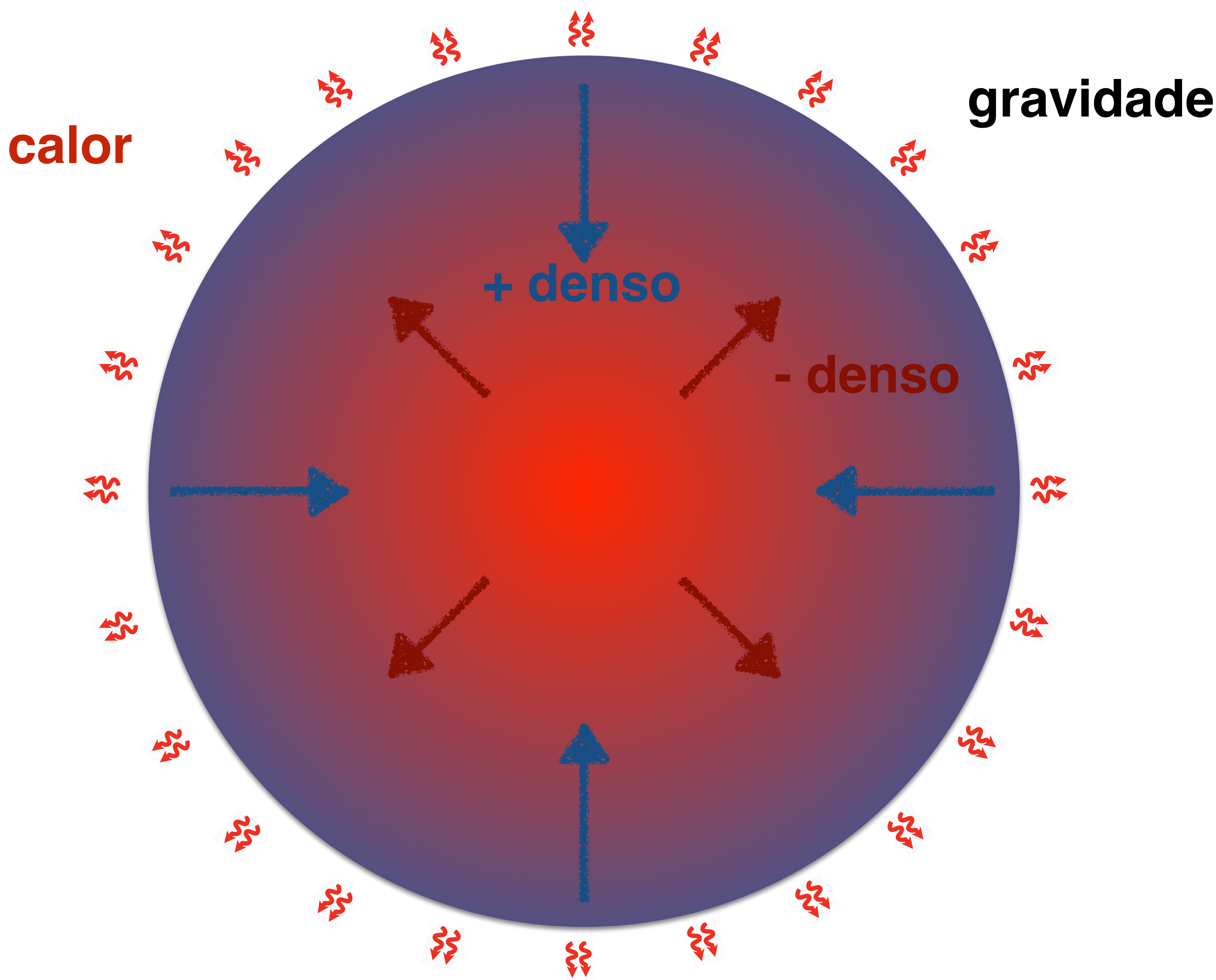
Aula 7 - Gravidade e Isostasia




calor

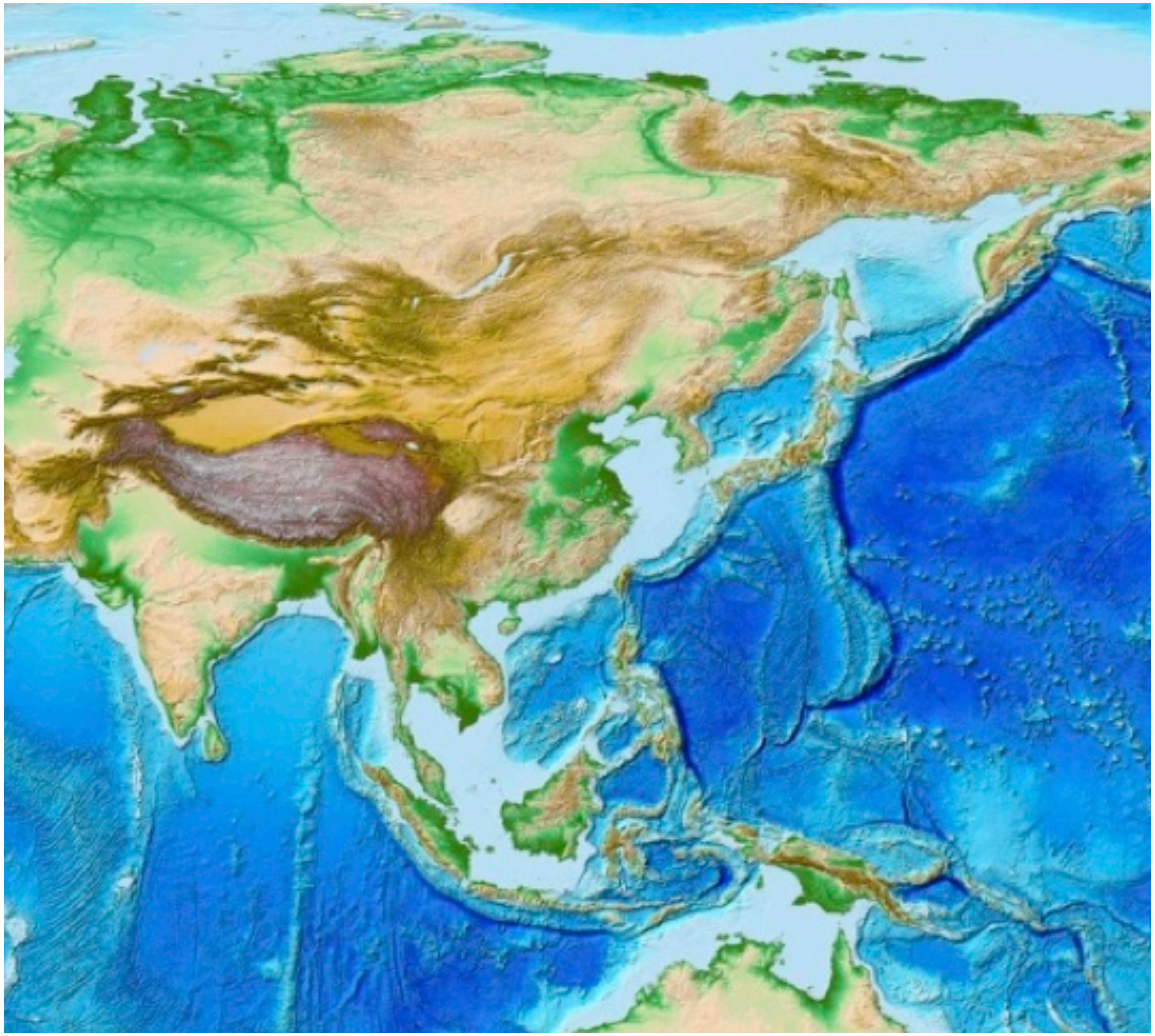

calor
gravidade


calor
gravidade
+ denso


calor
gravidade
+ denso
- denso

Quão “redonda” é a Terra?

Fossa das Marianas



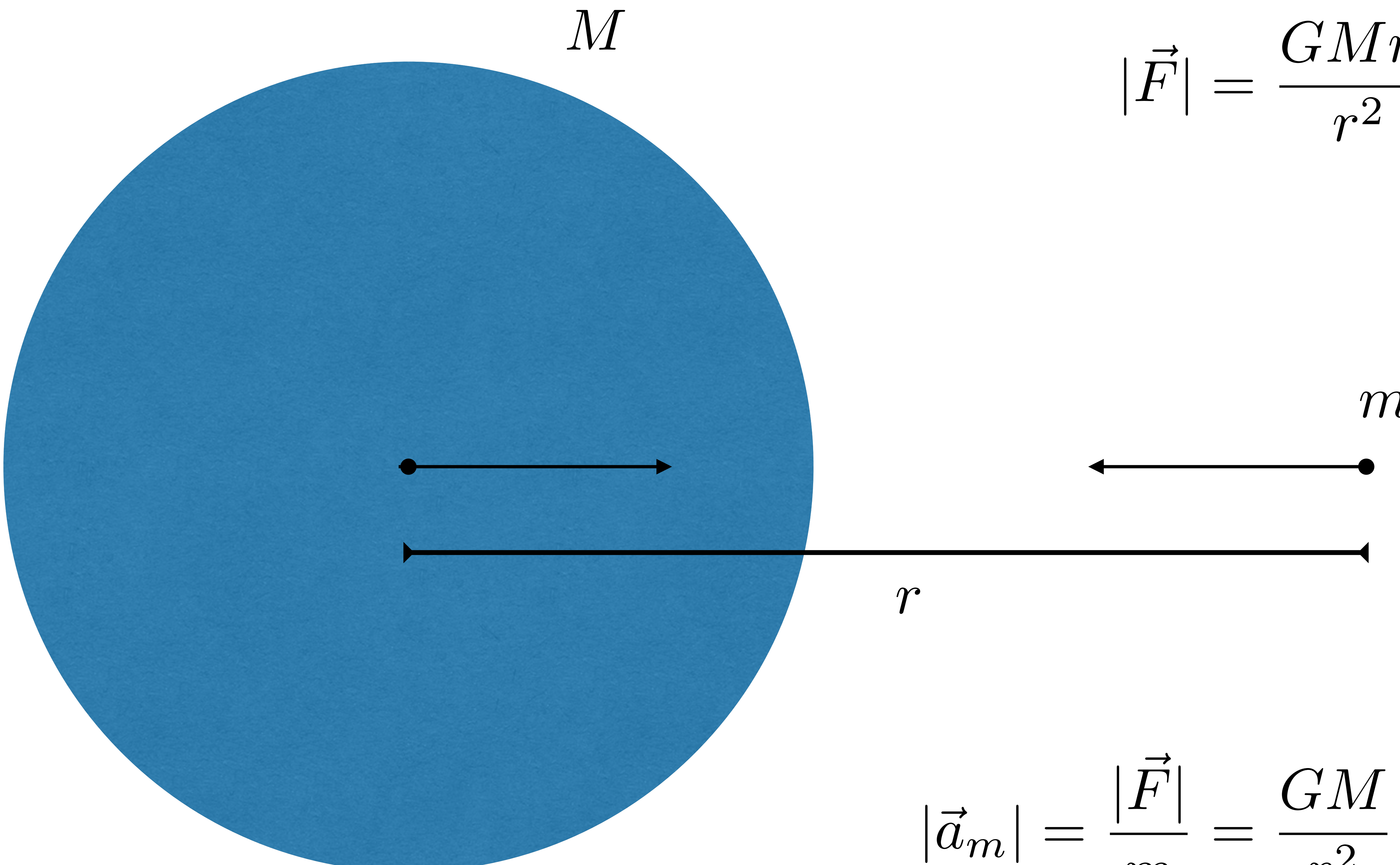
Terra x Pérola

Diâmetro: 1.27x10^4 km

Imperfeição: 11 km

Diâmetro: 1 cm

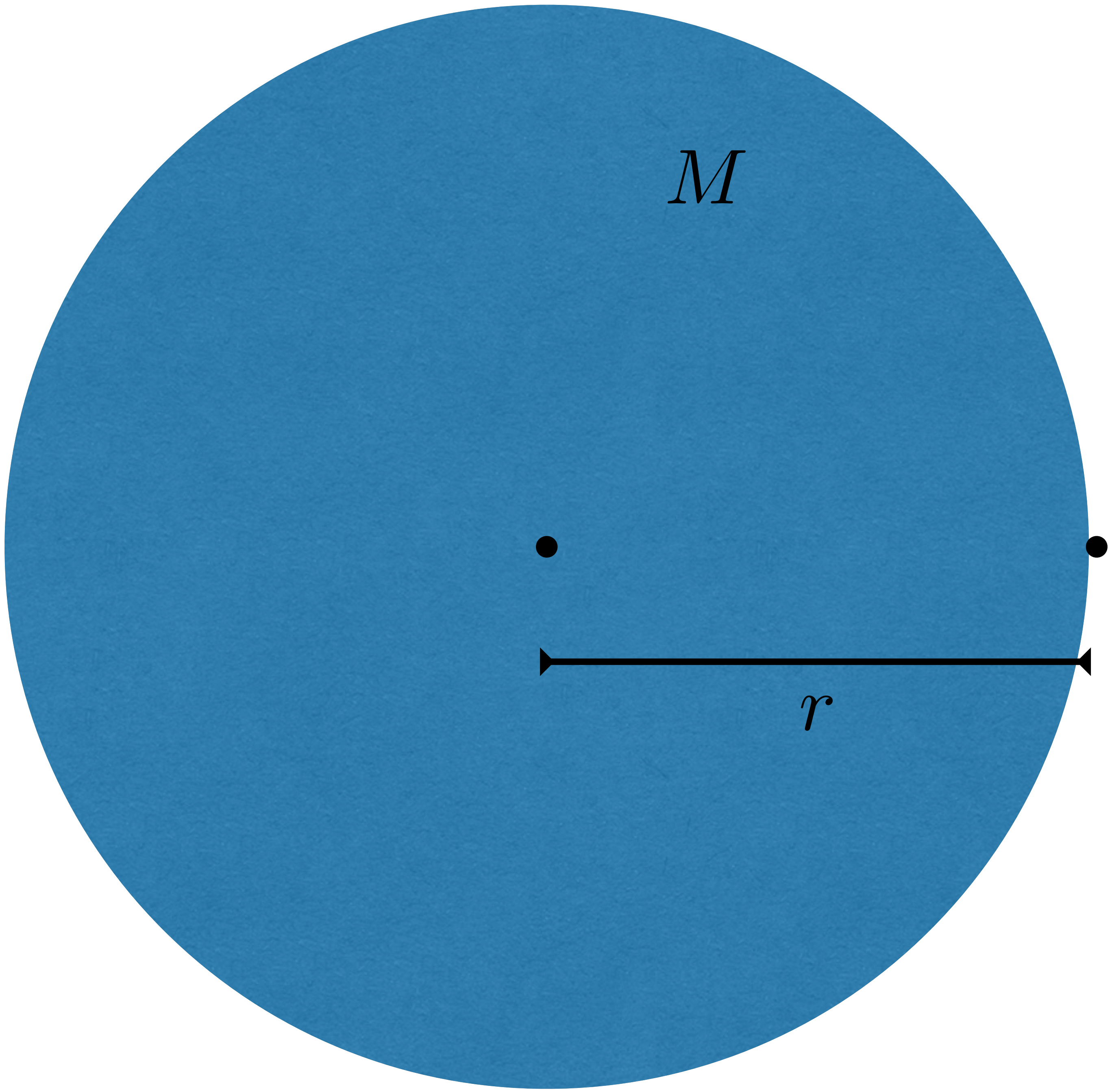
Imperfeição equivalente: ~8 μm



$$|\vec{F}| = \frac{GMm}{r^2}$$

$$|\vec{a}_m| = \frac{|\vec{F}|}{m} = \frac{GM}{r^2}$$

Qual é a aceleração da gravidade no interior da Terra?



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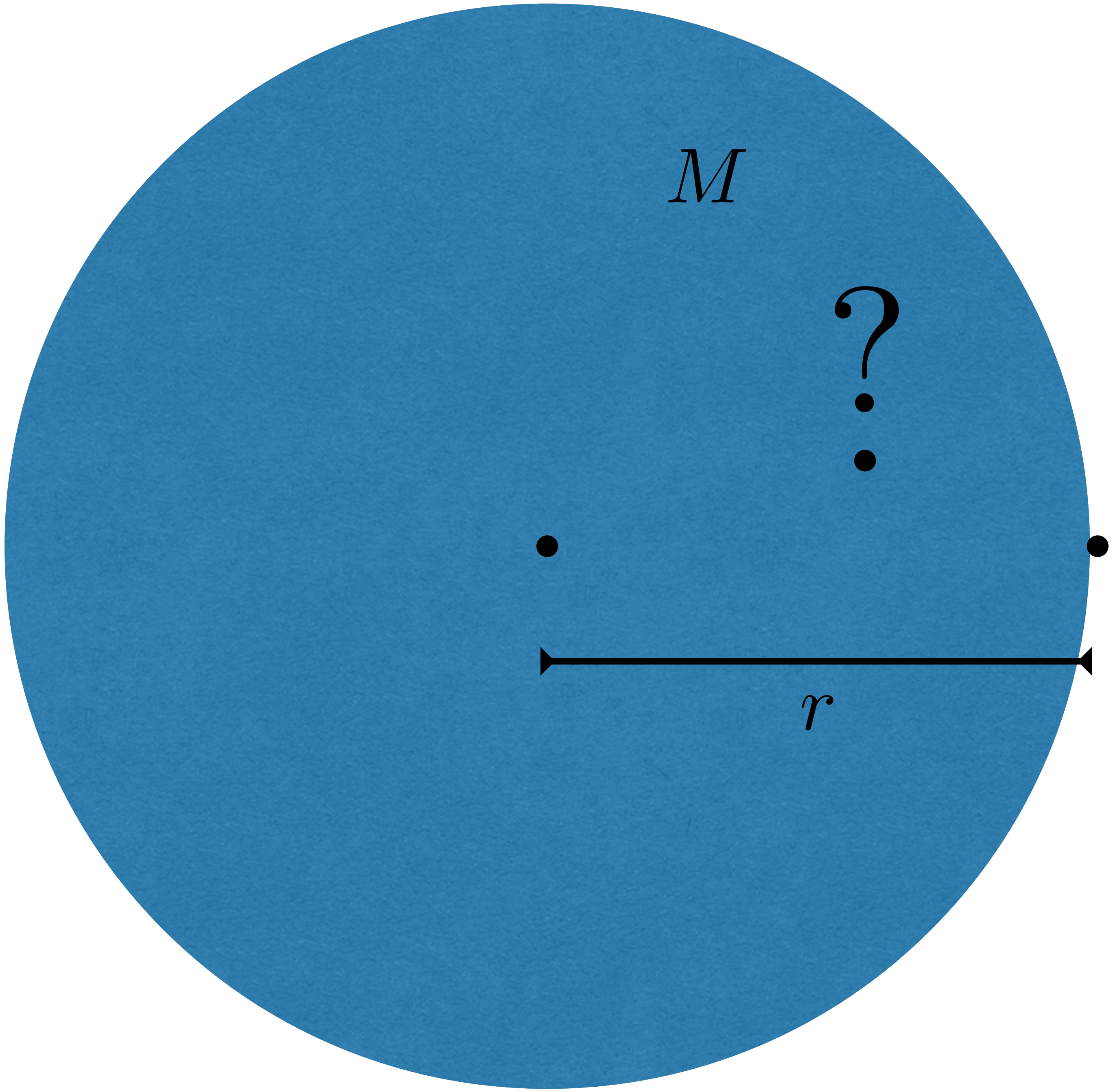

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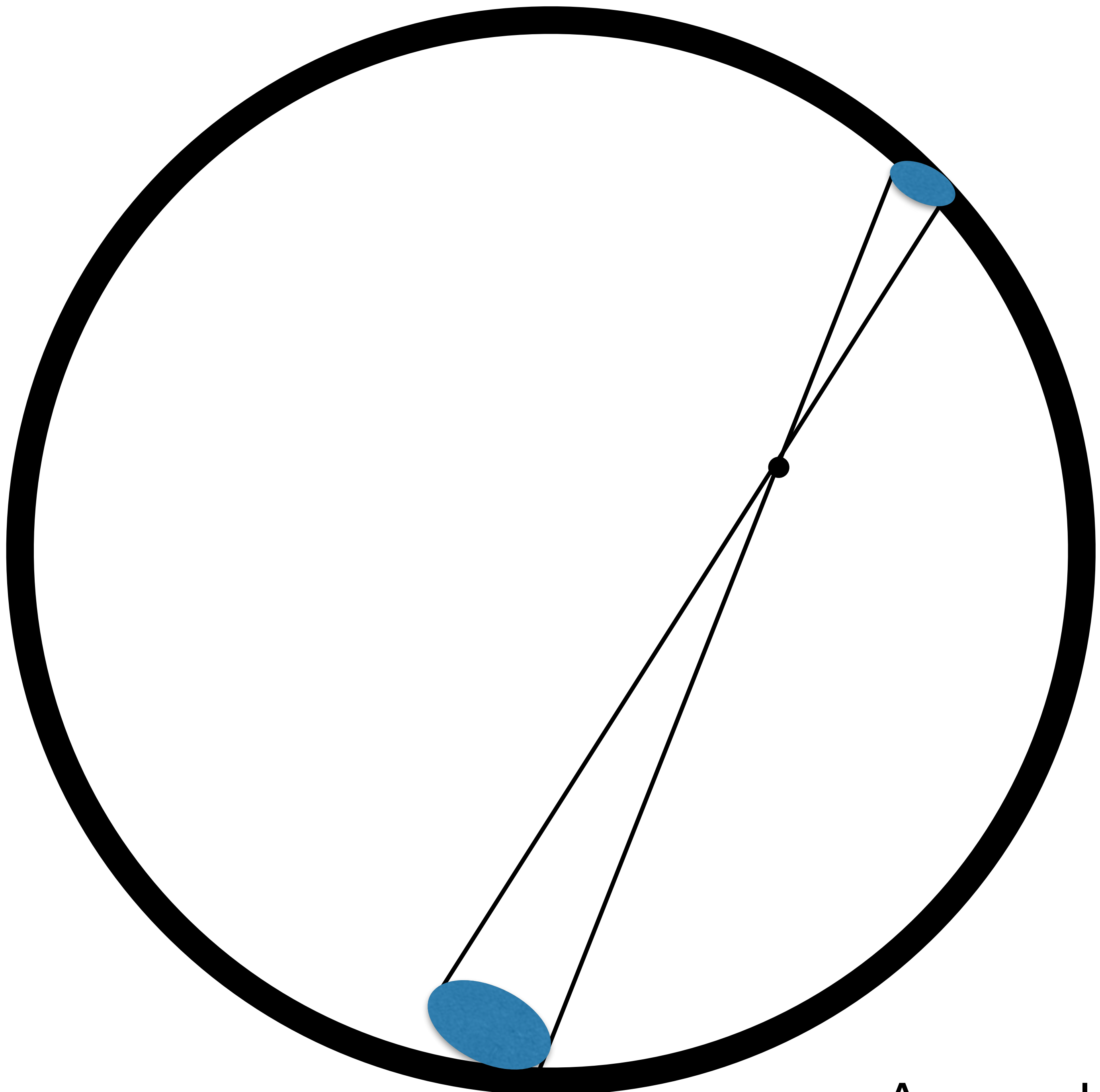
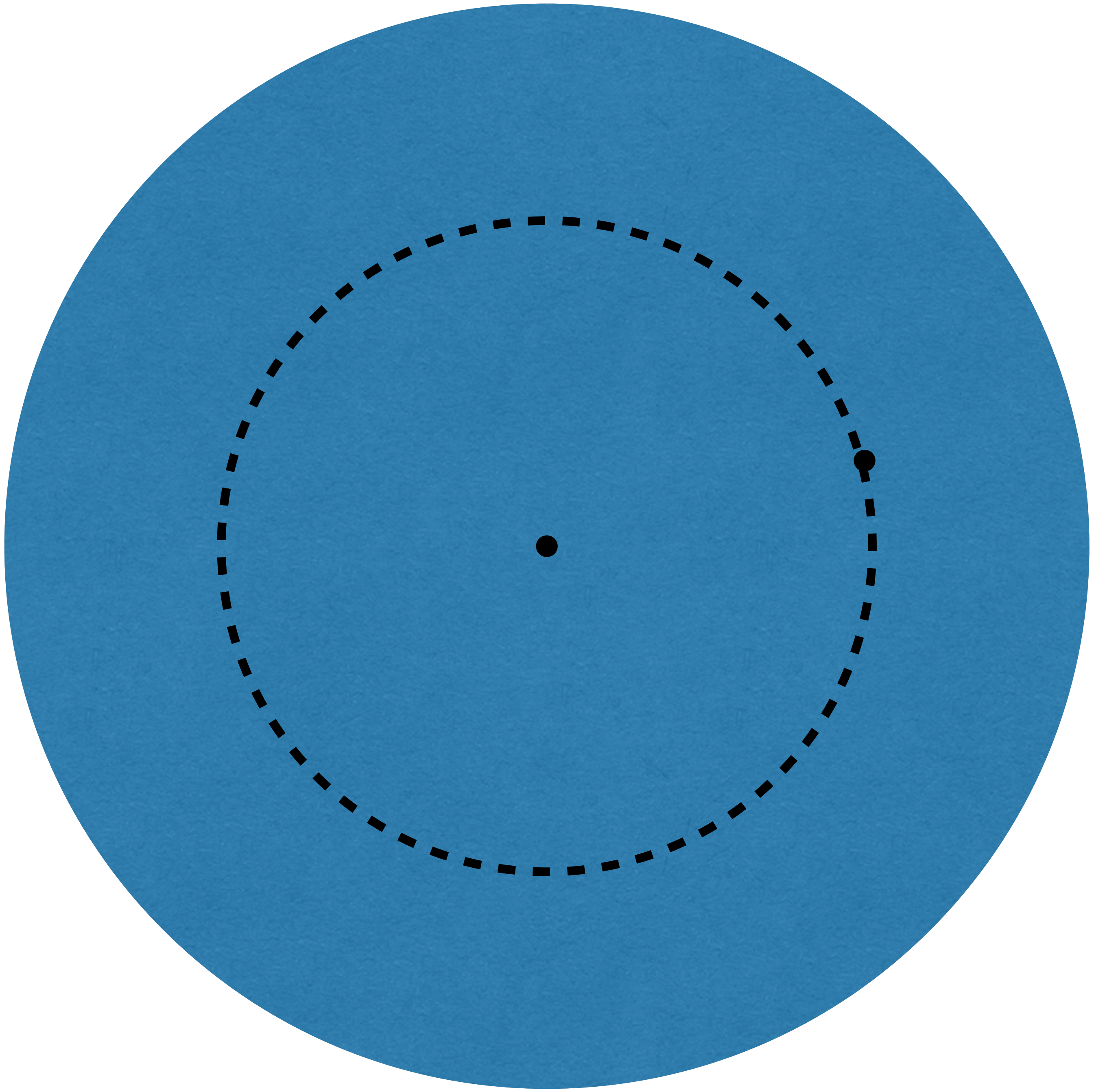
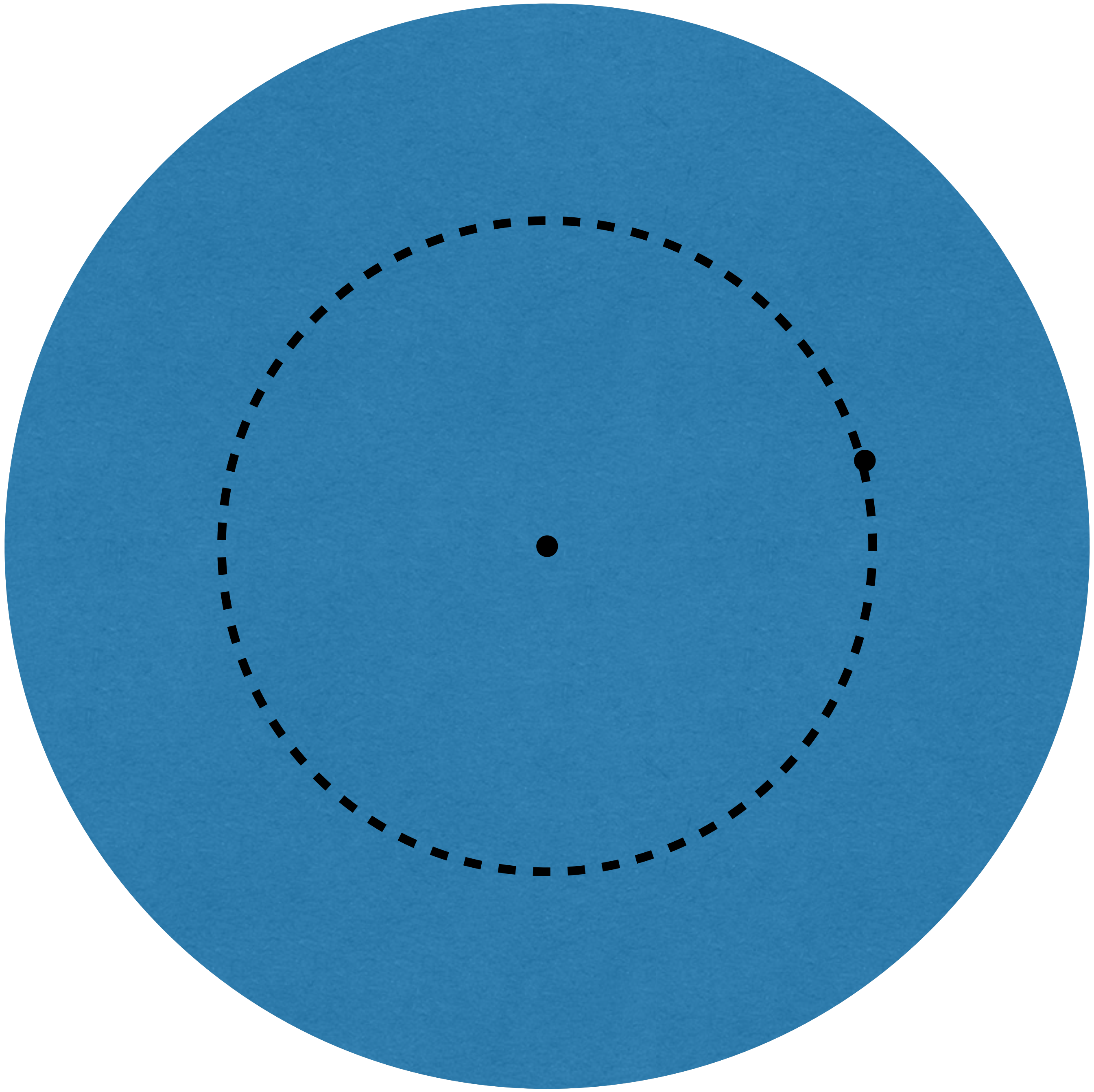


A aceleração da gravidade
exercida pela casca esférica
é nula na região interna a casca

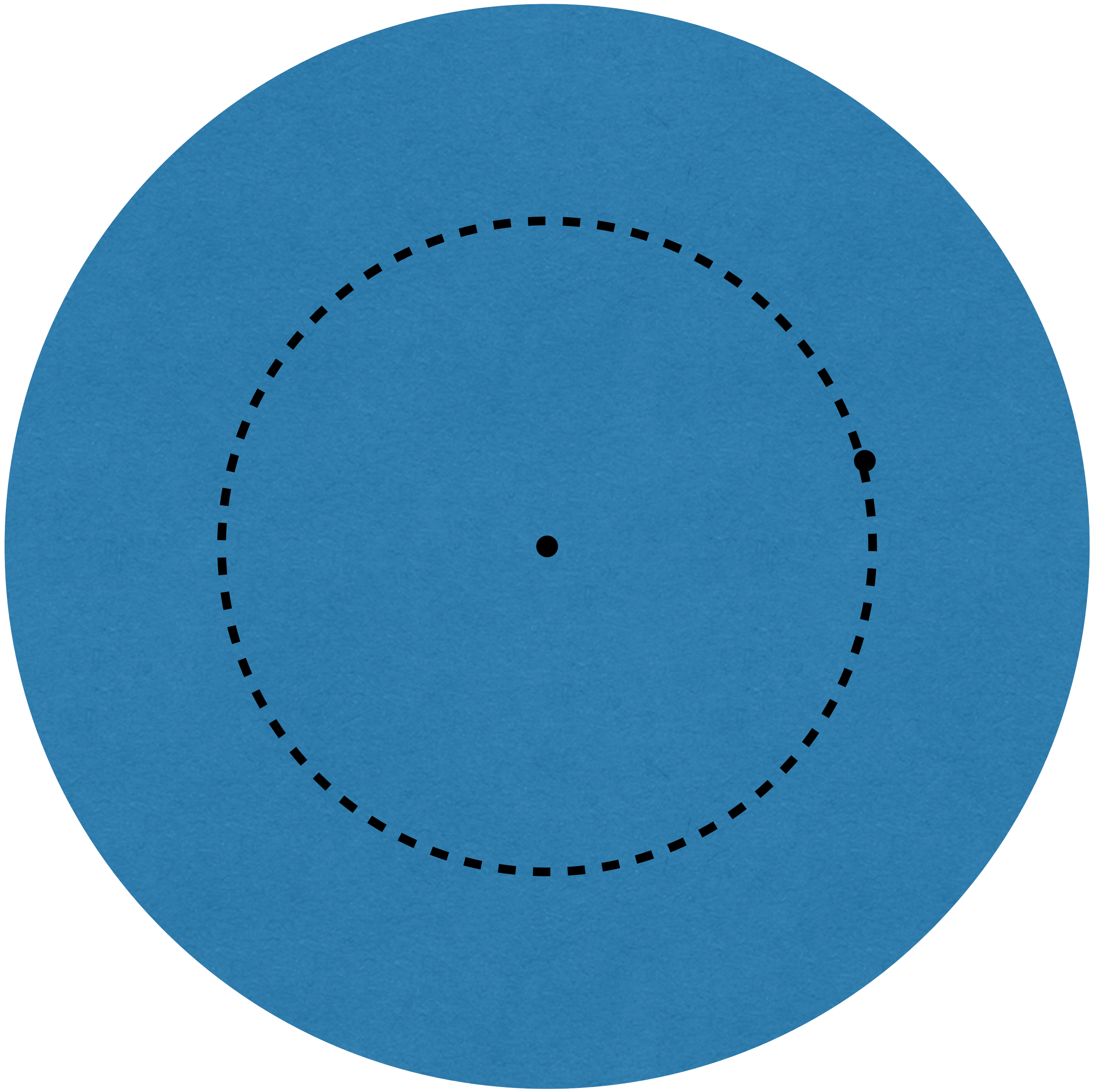


Assim a aceleração da gravidade em um ponto interno ao planeta depende apenas da massa contida na esfera de raio dado pela distância entre o centro do planeta e a posição do ponto de interesse.

Dada uma curva que representa a variação de densidade no interior do planeta, qual é o valor da aceleração da gravidade?



$$M = M_1 + M_2 + M_3 + M_4 + \ldots = \sum_i M_i$$



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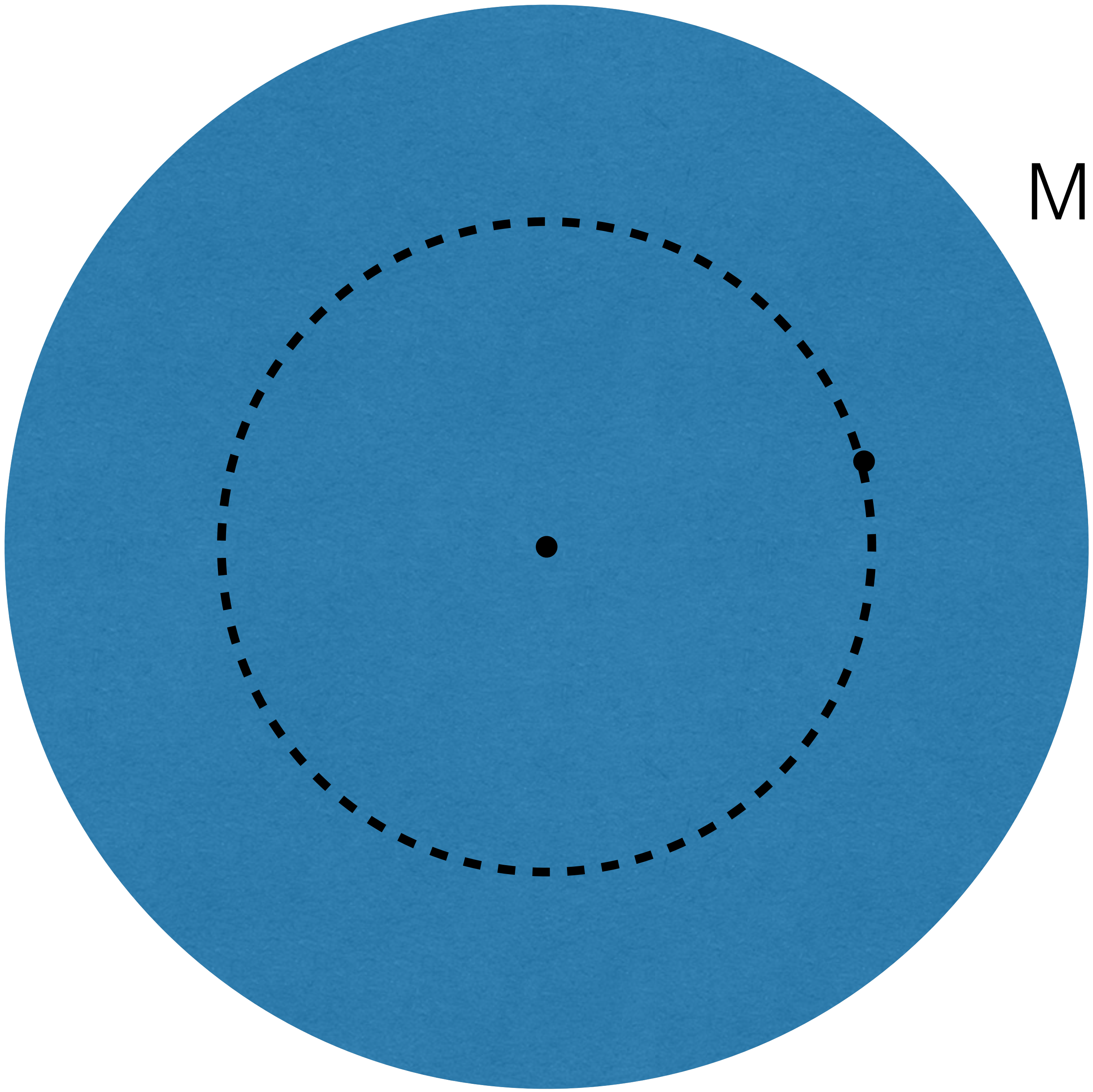
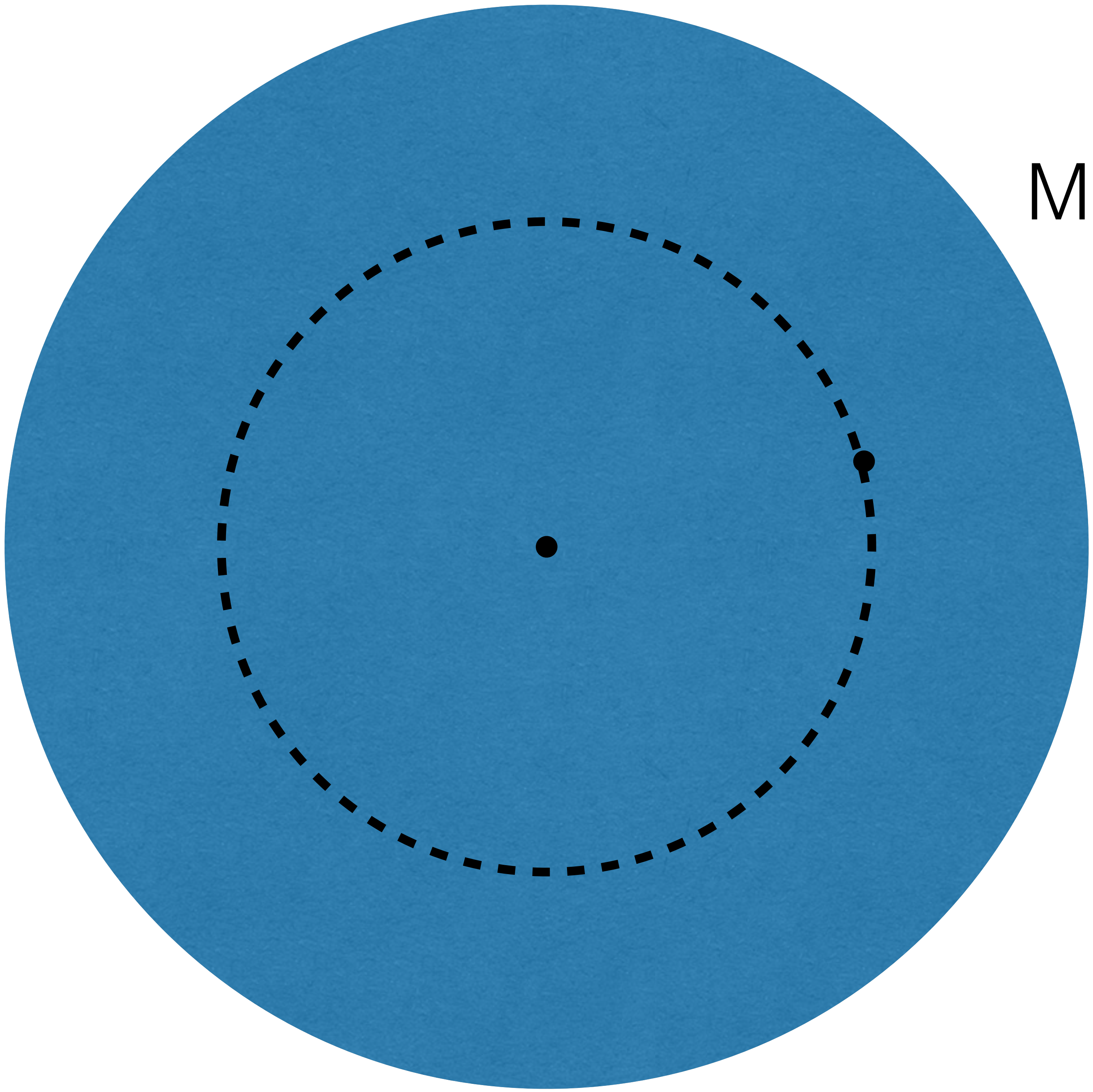


Massa de uma casca esférica
de densidade ρ

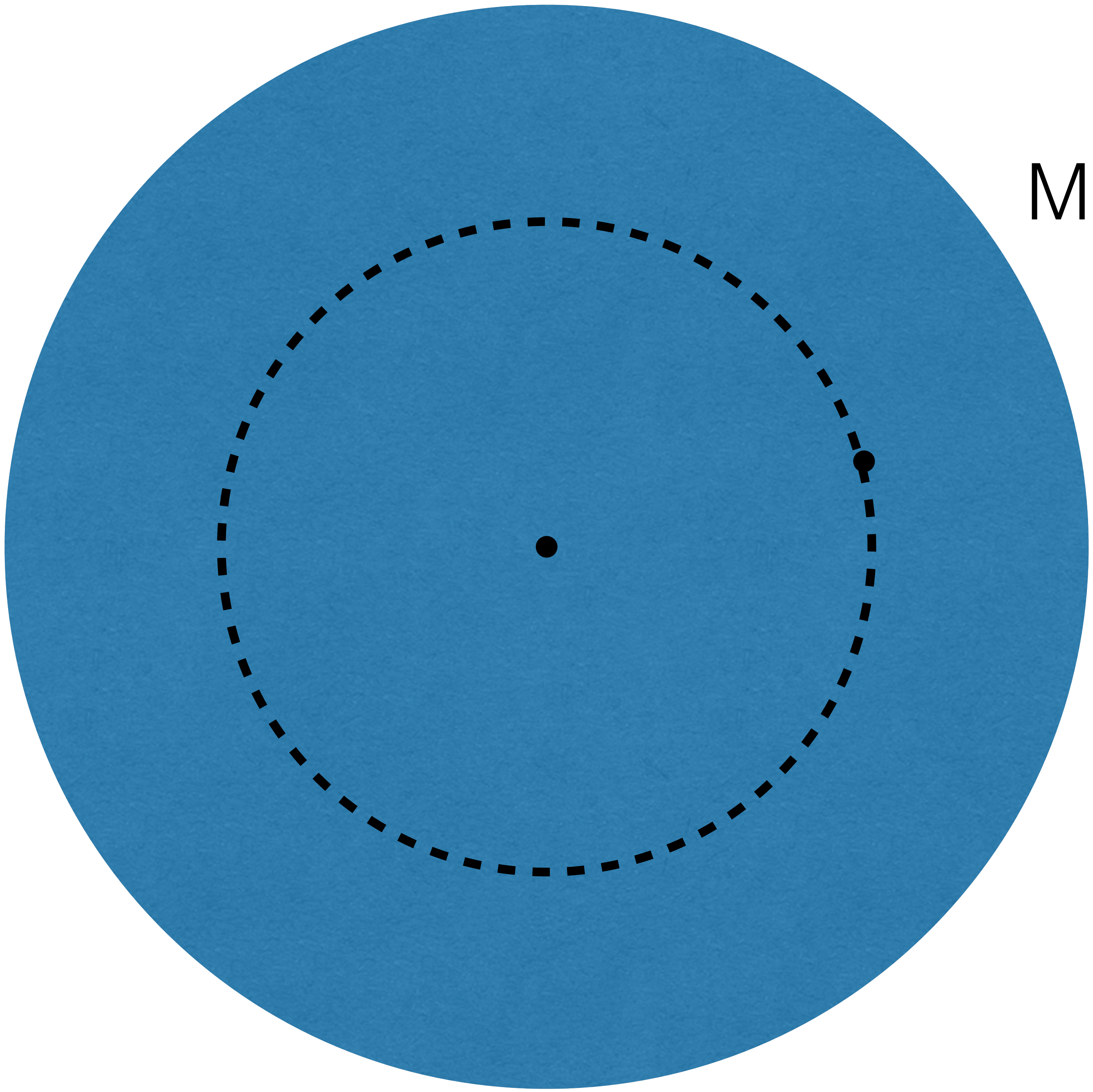
$$M = M_1 + M_2 + M_3 + M_4 + ... = \sum_i M_i$$



Massa de uma casca esférica de densidade ρ

$$dM = \rho \cdot dV$$

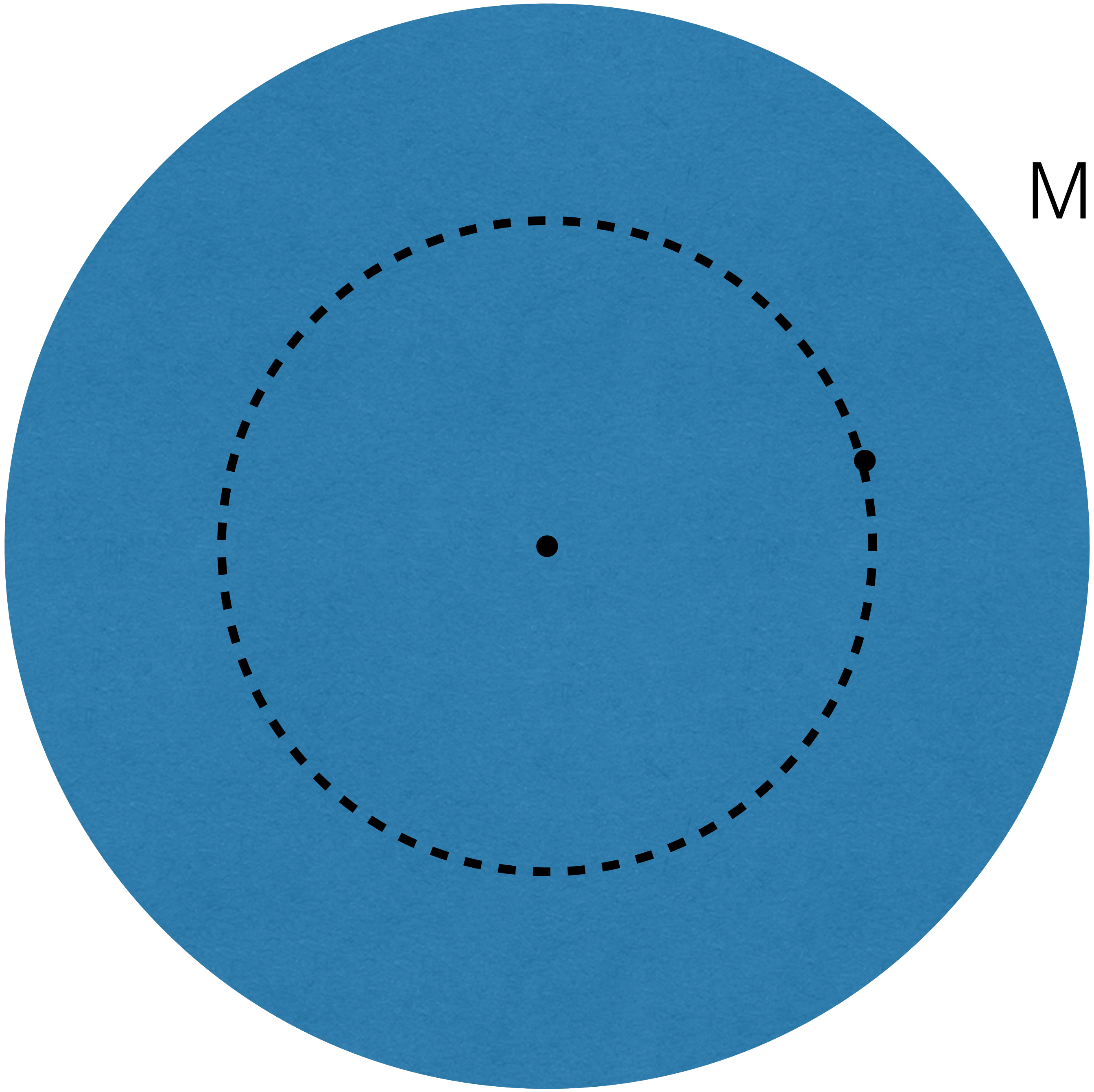
$$M = M_1 + M_2 + M_3 + M_4 + ... = \sum_i M_i$$



Massa de uma casca esférica
de densidade ρ

$$dM = \rho \cdot dV \; = \rho \cdot A \cdot dr$$

$$M = M_1 + M_2 + M_3 + M_4 + ... = \sum_i M_i$$



Massa de uma casca esférica de densidade ρ

$$dM = \rho \cdot dV \;\; = \rho \cdot A \cdot dr$$

$$= \rho \cdot 4\pi r^2 \cdot dr$$

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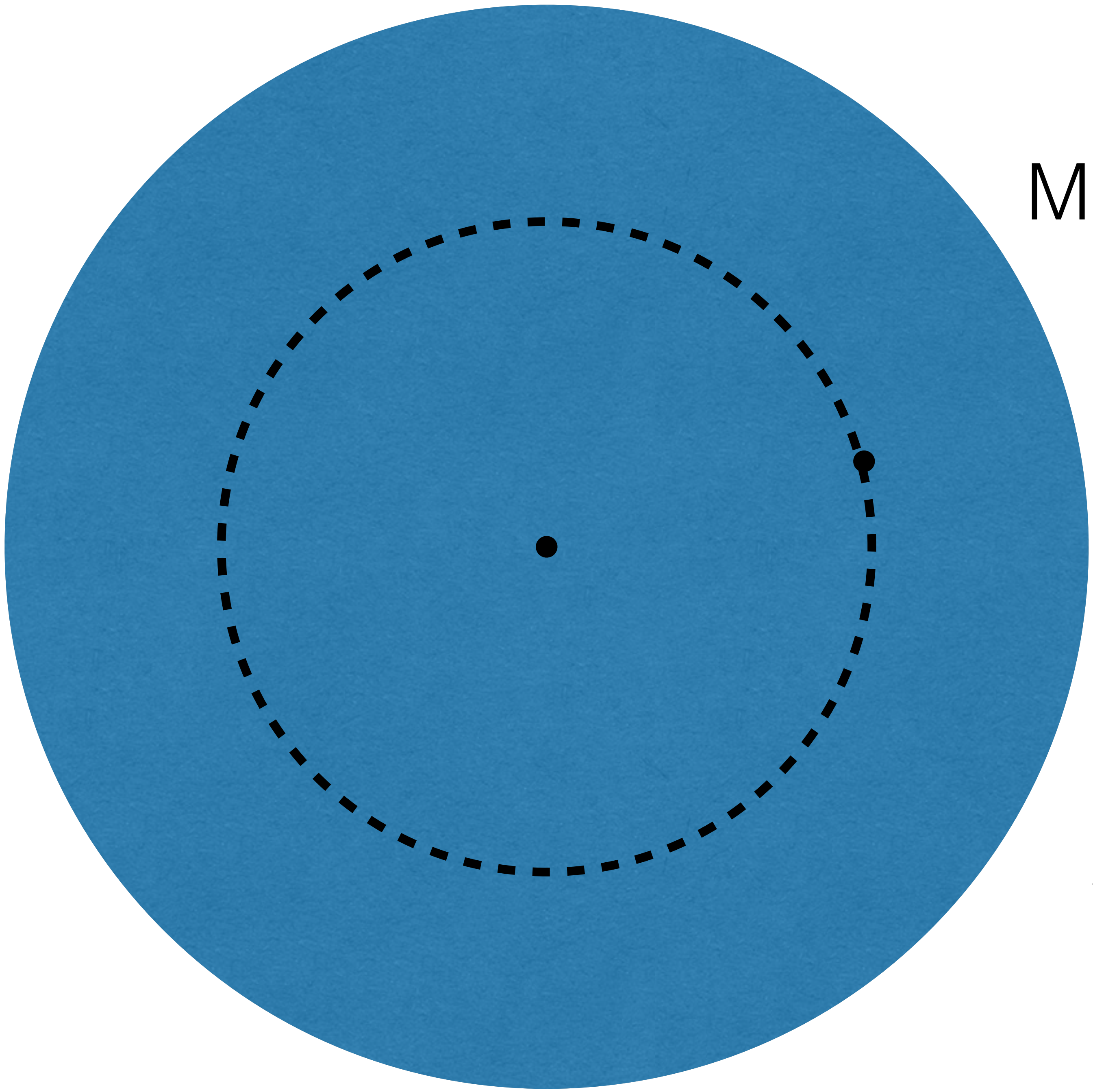


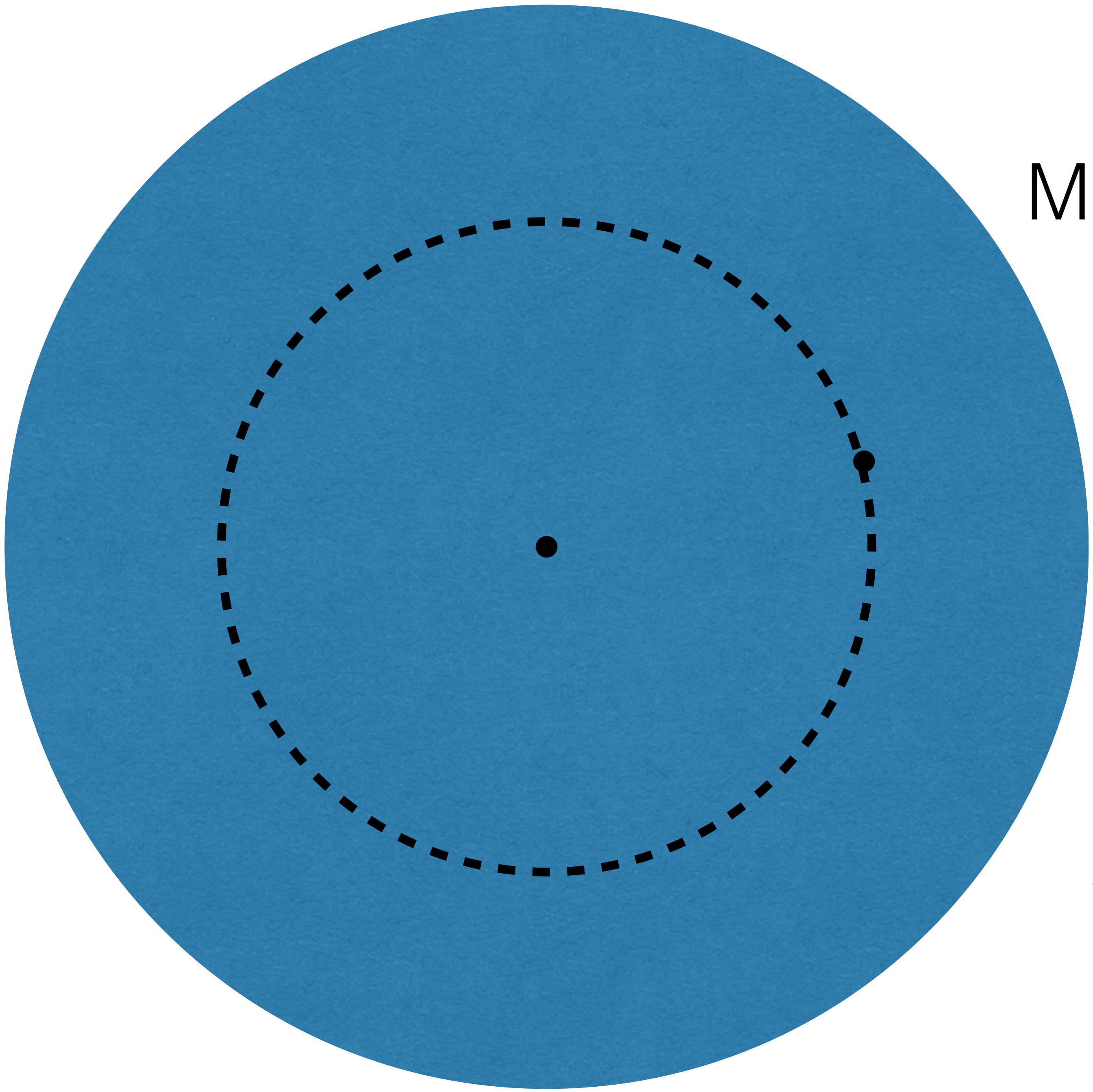
Massa de uma casca esférica de densidade ρ

$$dM = \rho \cdot dV \ = \rho \cdot A \cdot dr$$

$$= \rho \cdot 4\pi r^2 \cdot dr$$

$$M = \int dM$$

$$M = M_1 + M_2 + M_3 + M_4 + ... = \sum_i M_i$$



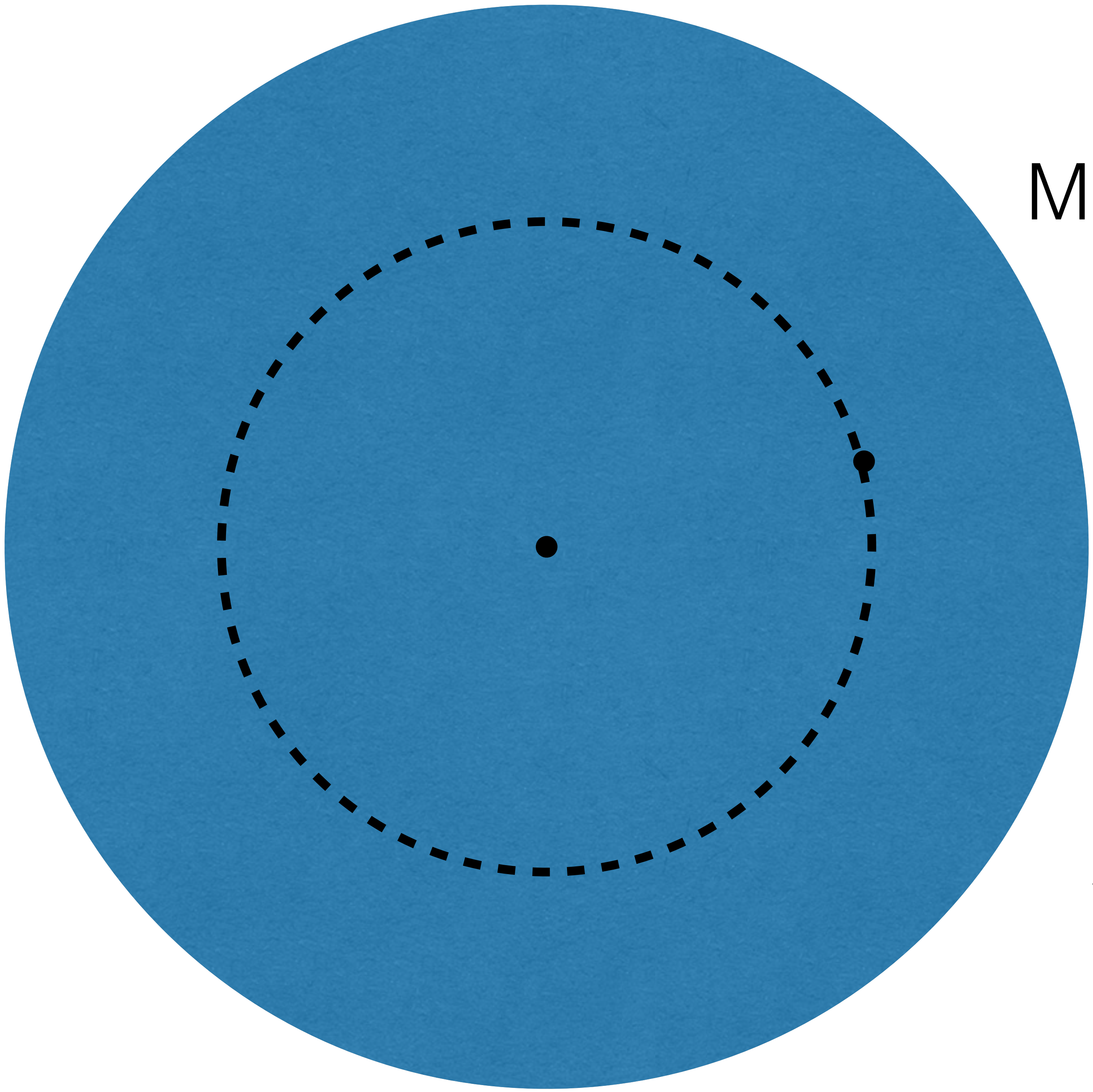
Massa de uma casca esférica de densidade ρ

$$dM = \rho \cdot dV \;= \rho \cdot A \cdot dr$$

$$= \rho \cdot 4\pi r^2 \cdot dr$$

$$M = \int dM \;= \int_0^R \rho(r) 4\pi r^2 dr$$

$$M = M_1 + M_2 + M_3 + M_4 + ... = \sum_i M_i$$



Massa de uma casca esférica de densidade ρ

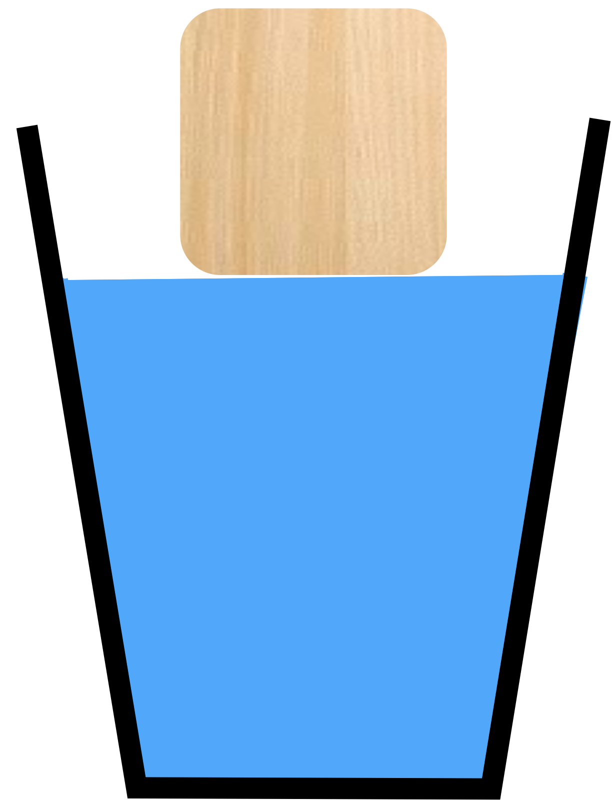
$$dM = \rho \cdot dV = \rho \cdot A \cdot dr$$

$$= \rho \cdot 4\pi r^2 \cdot dr$$

$$M = \int dM = \int_0^R \rho(r) 4\pi r^2 dr$$

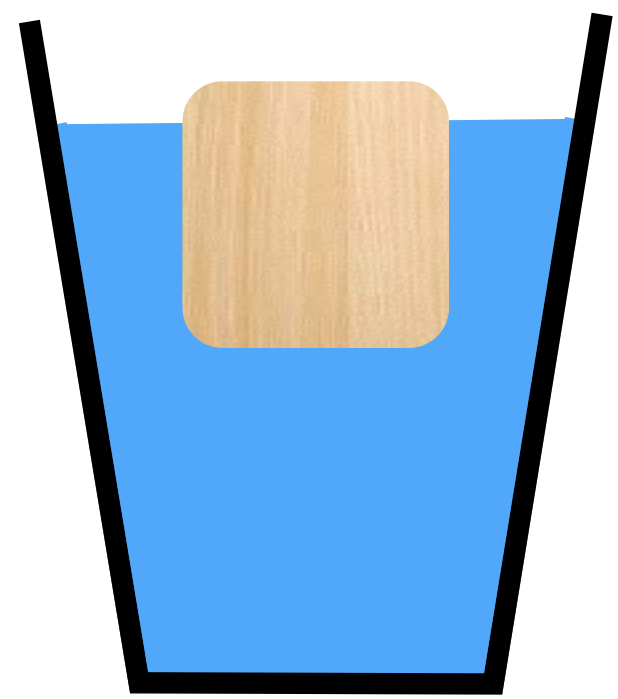
$$\approx \sum \rho(r) 4\pi r^2 \Delta r$$

Princípio de Arquimedes



Any floating object displaces its own weight of fluid.
— Archimedes of Syracuse

Princípio de Arquimedes



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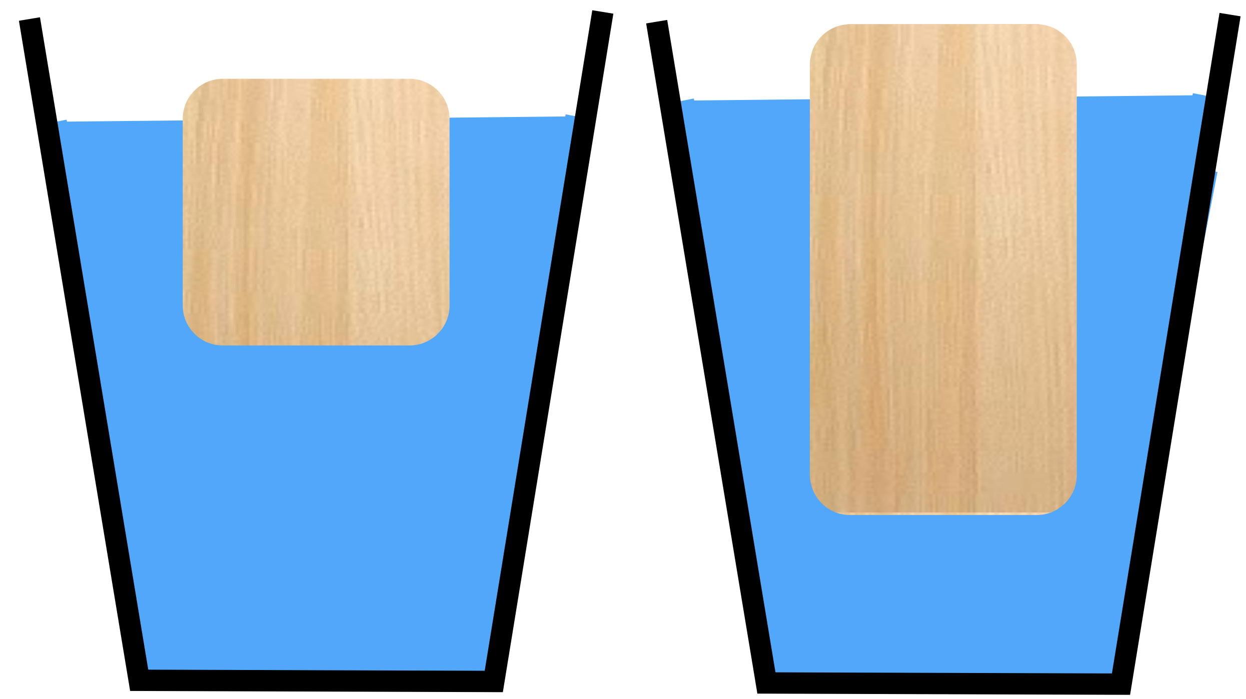
Princípio de Arquimedes



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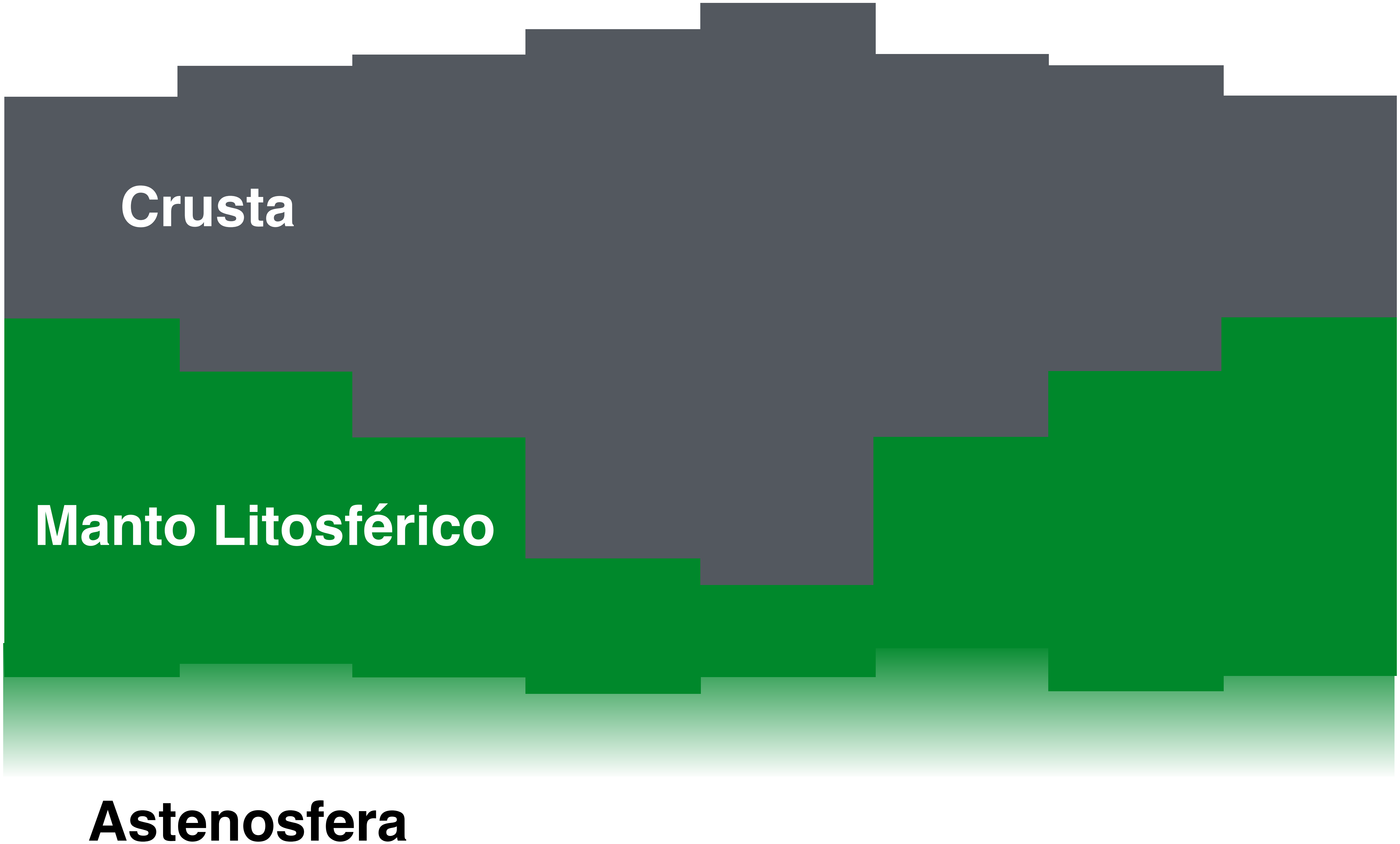
Isostasia da litosfera



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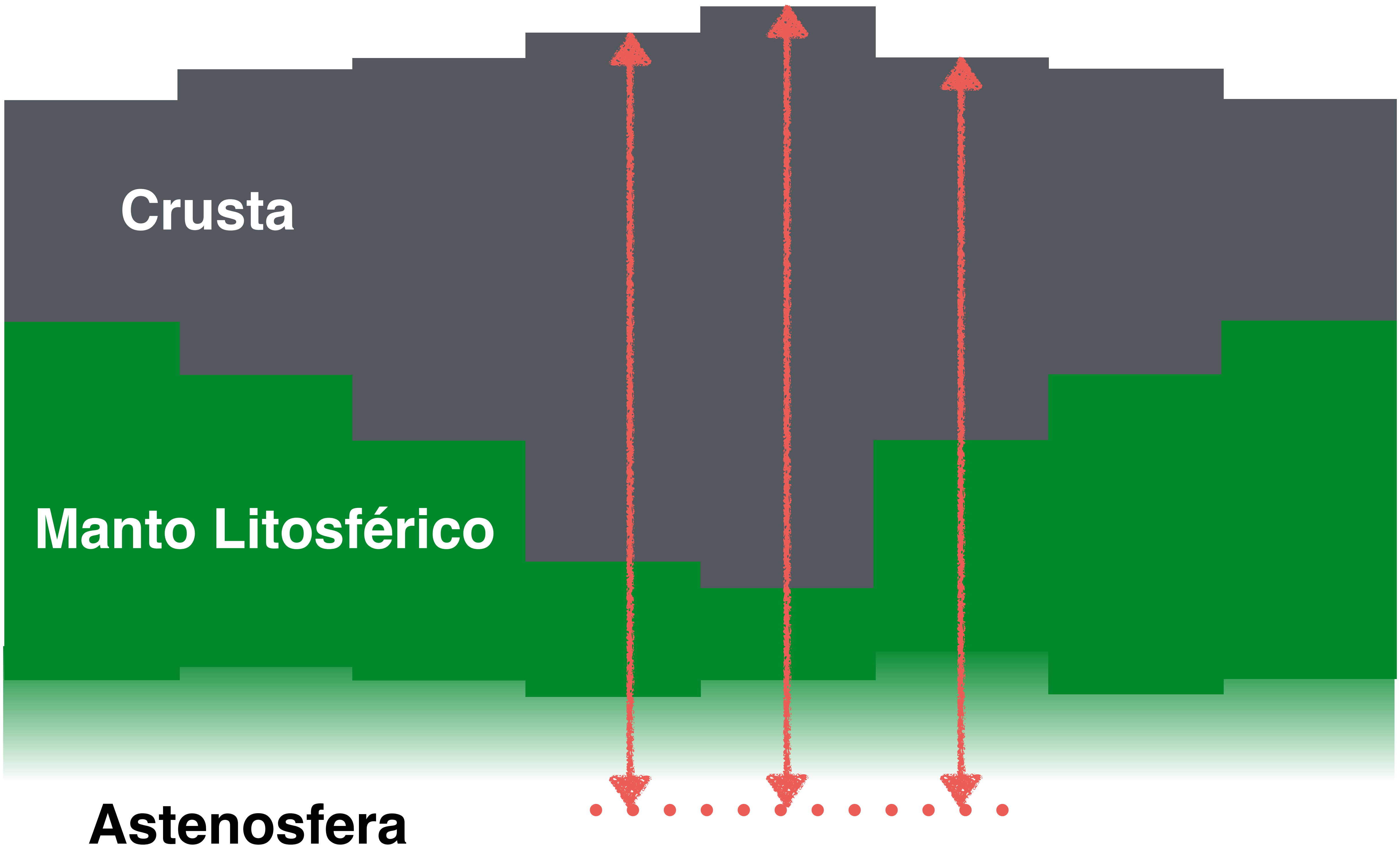

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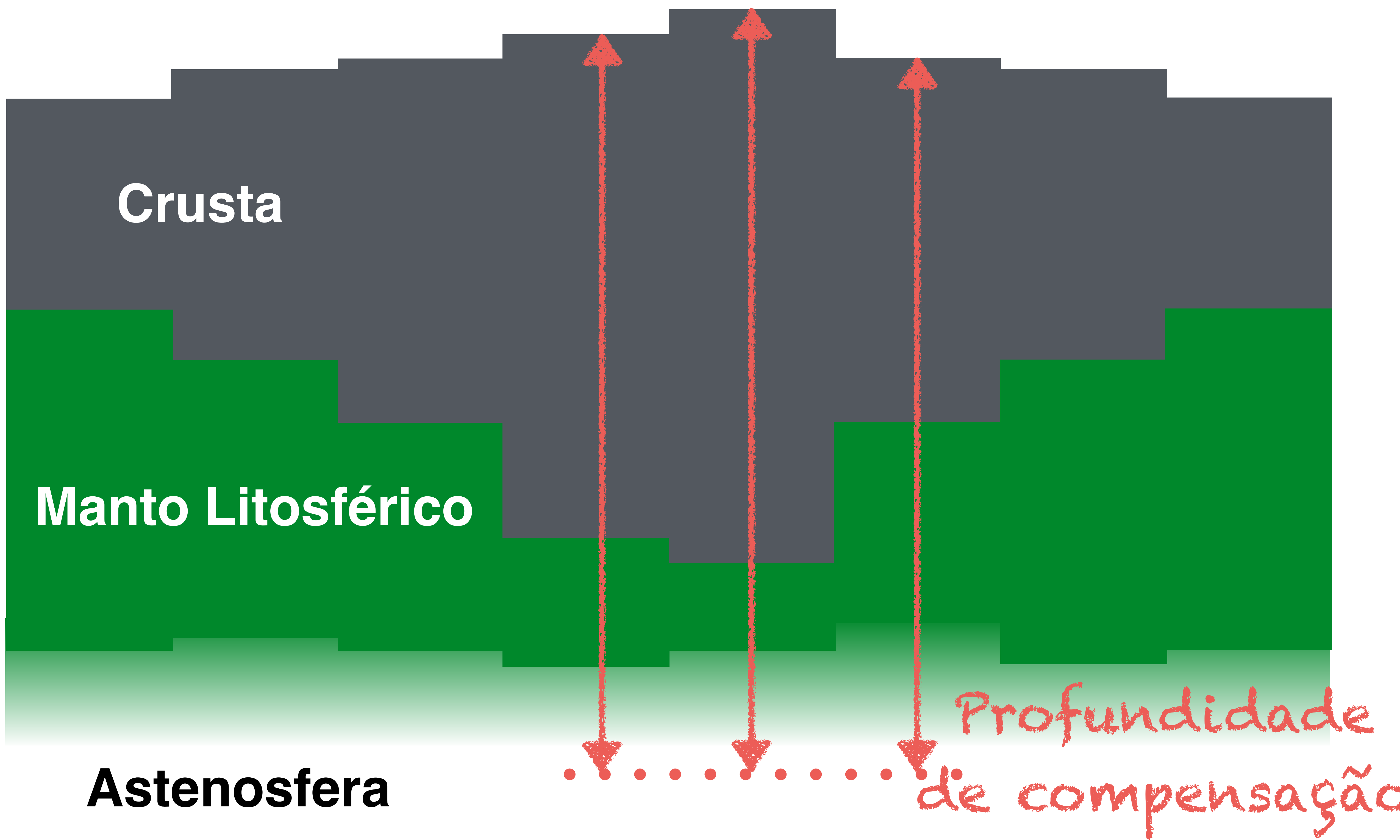
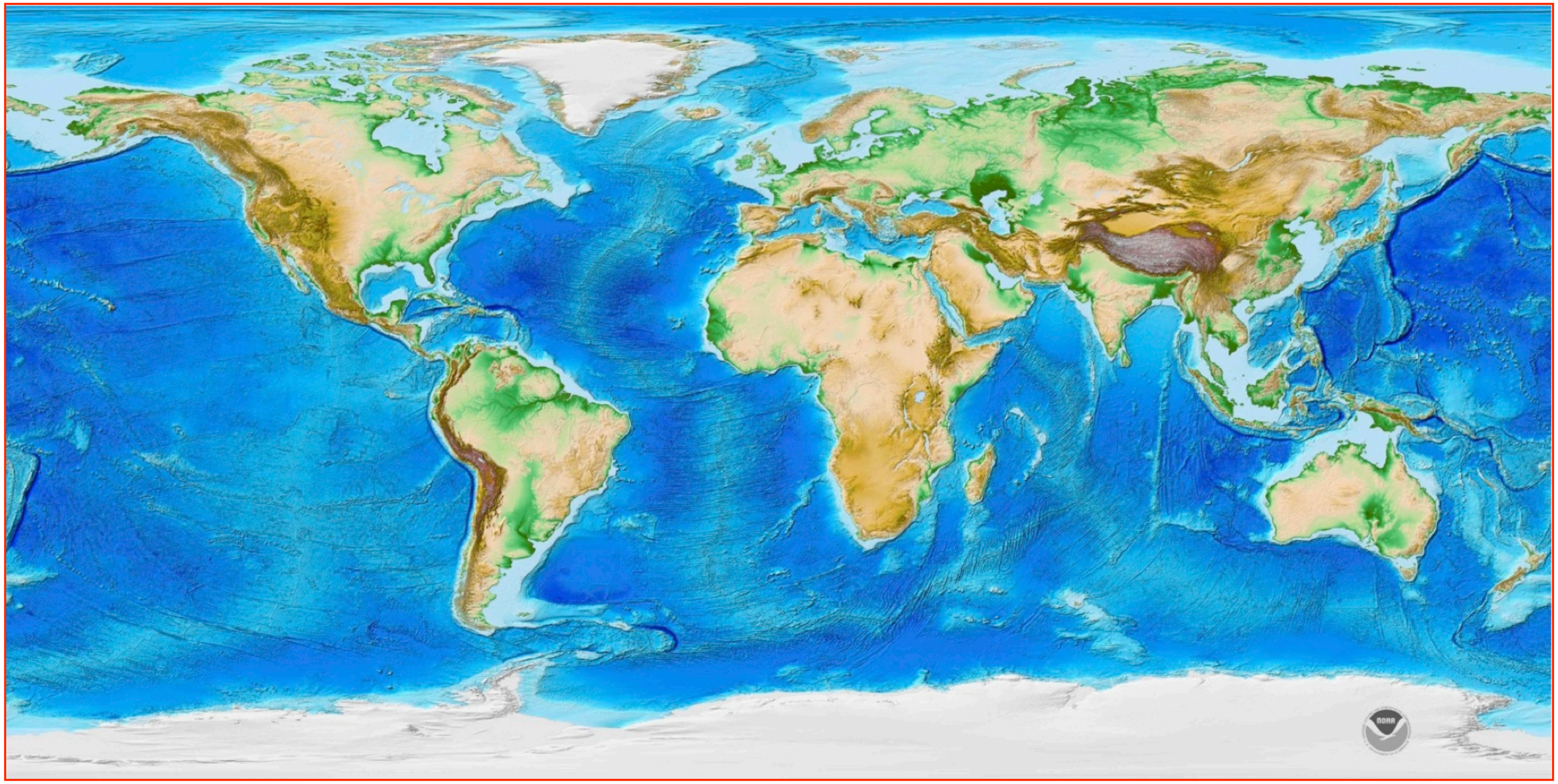
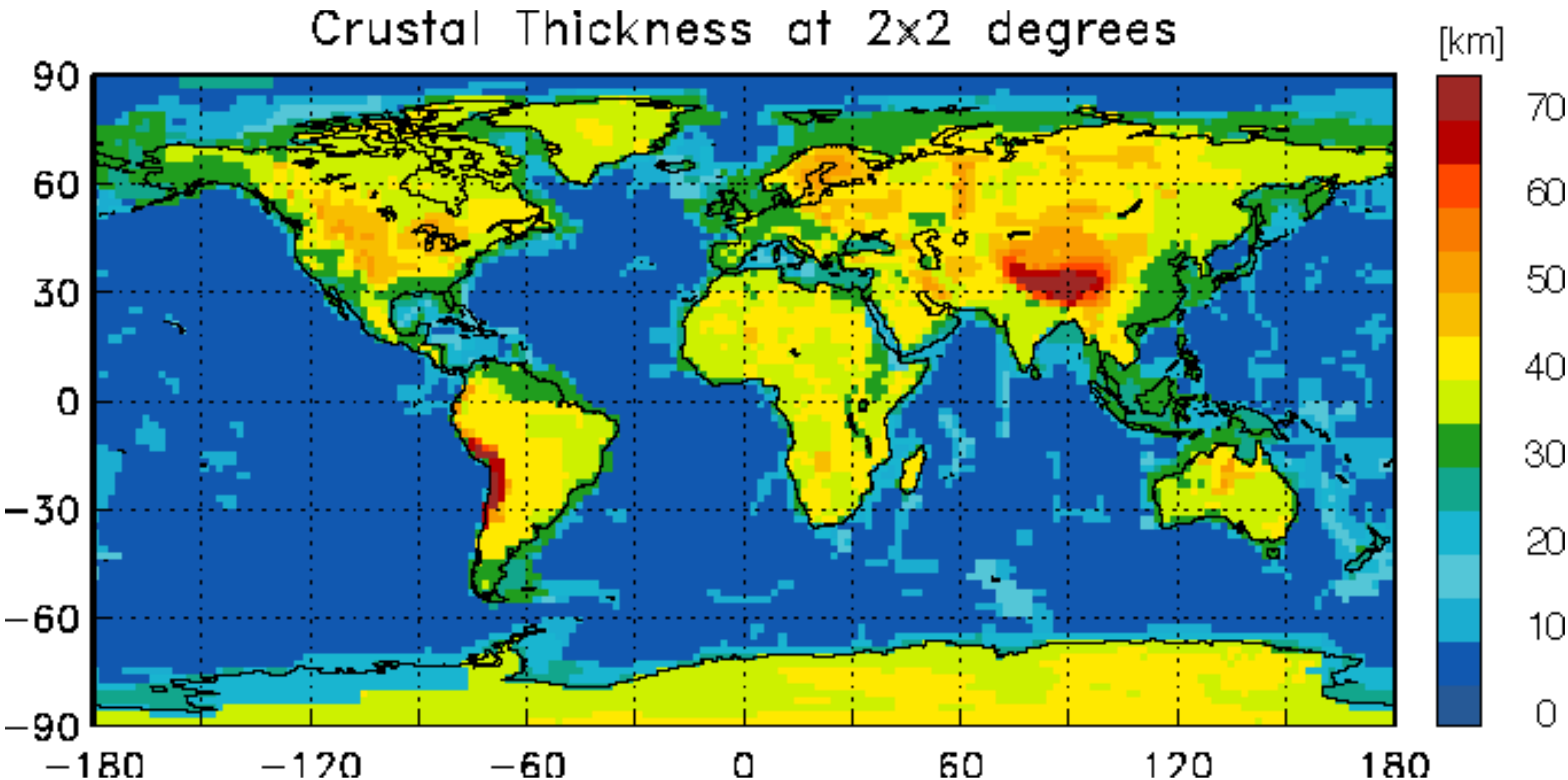


Topografia/Batimetria



Espessura da Crosta



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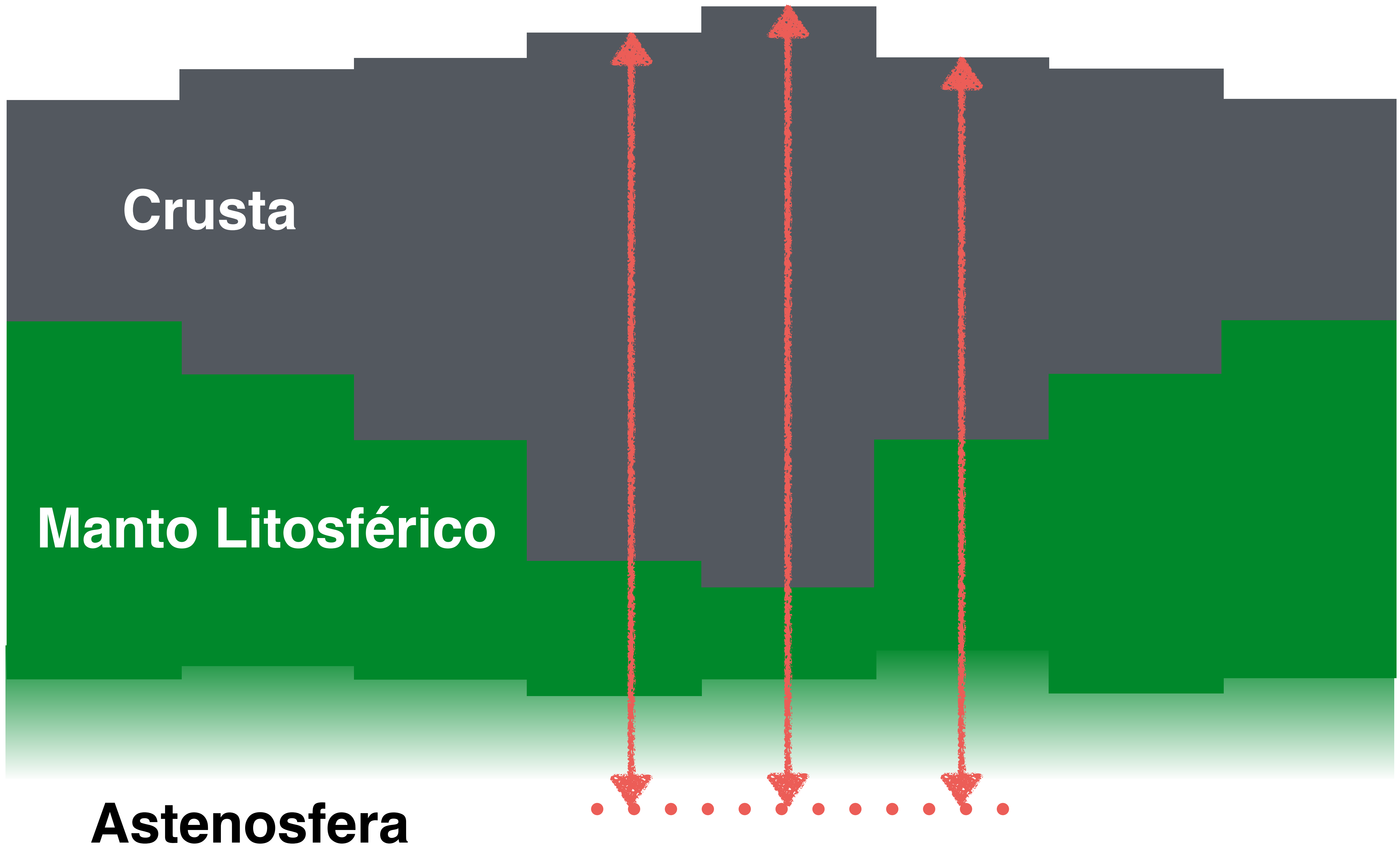

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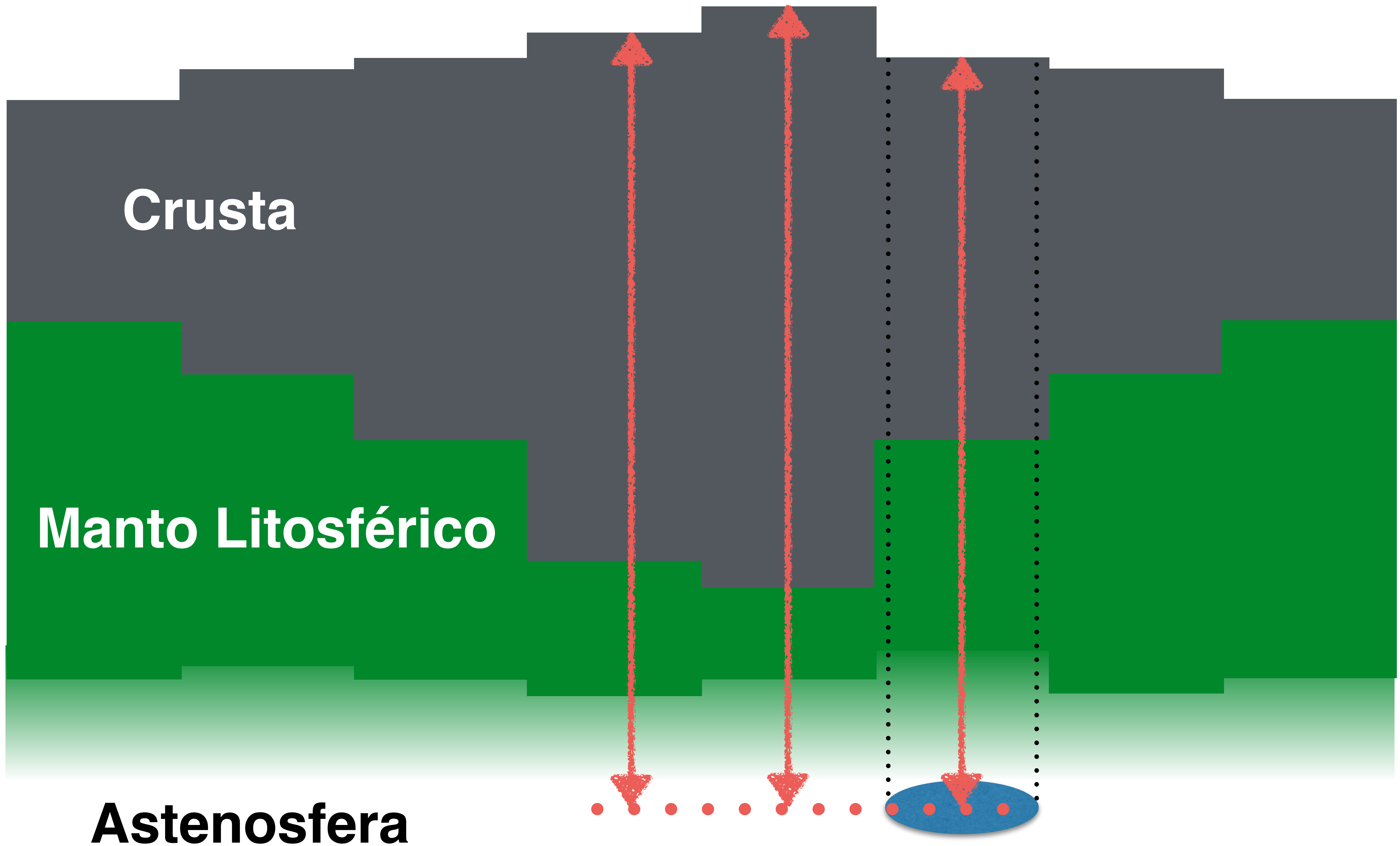

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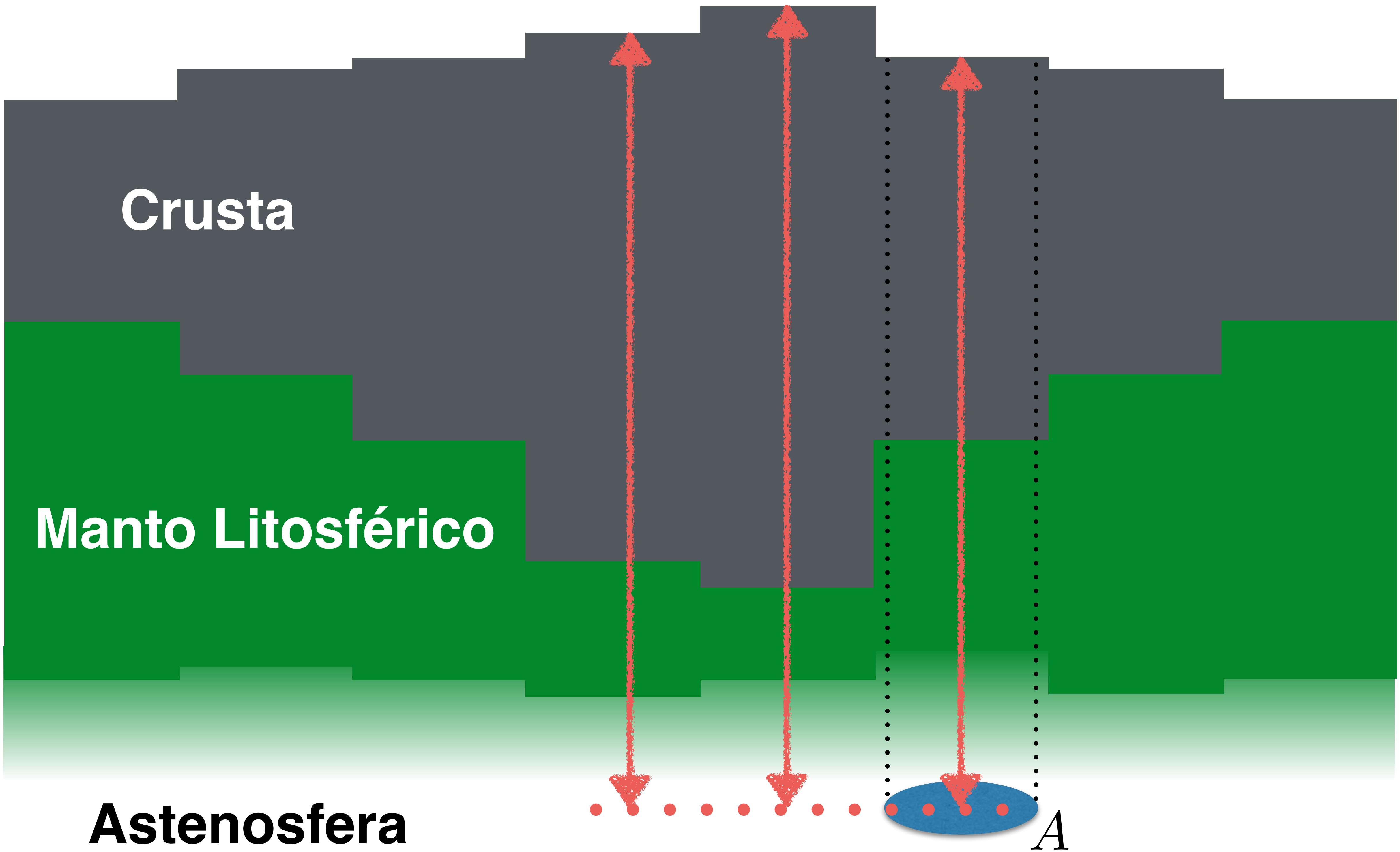

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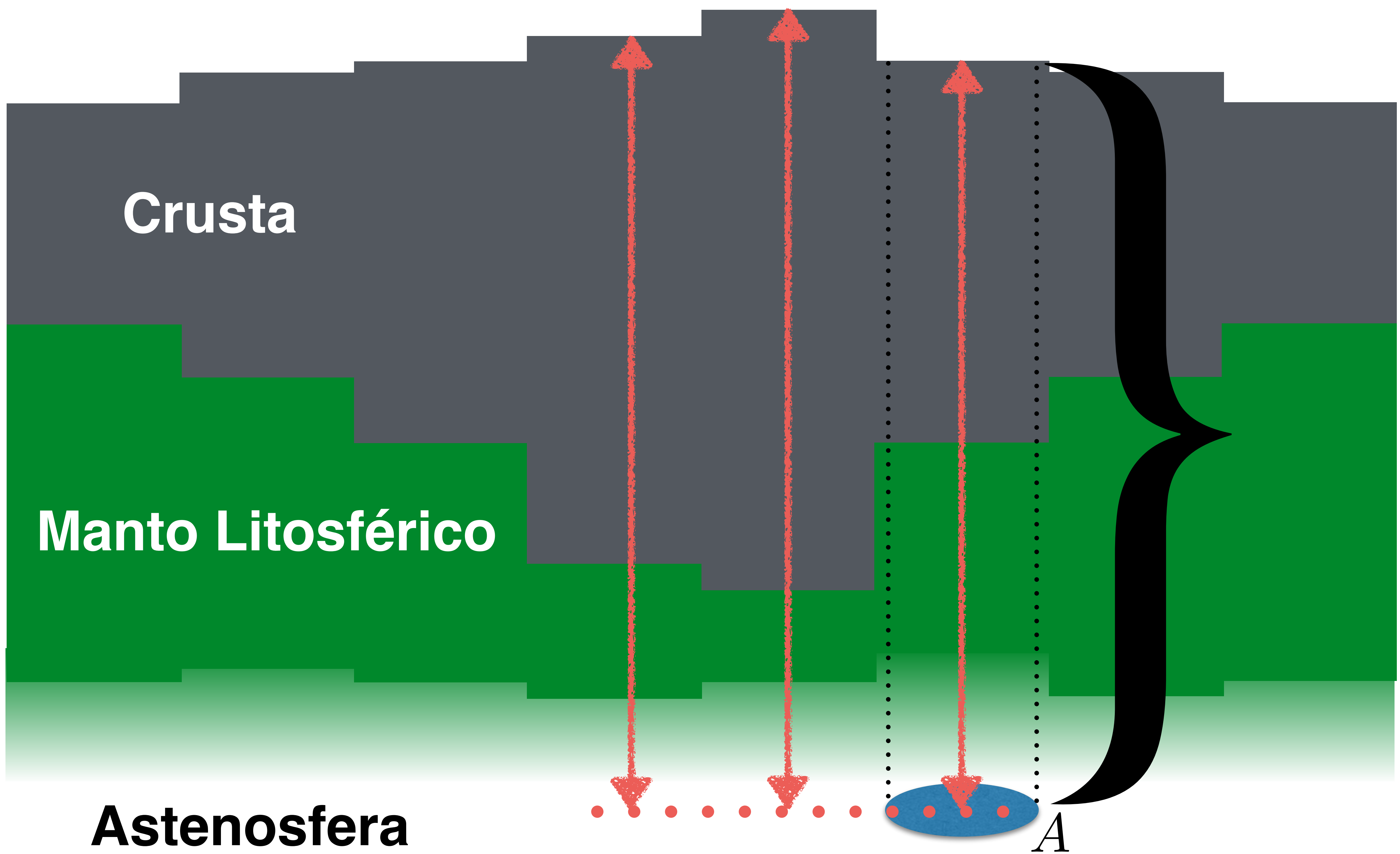

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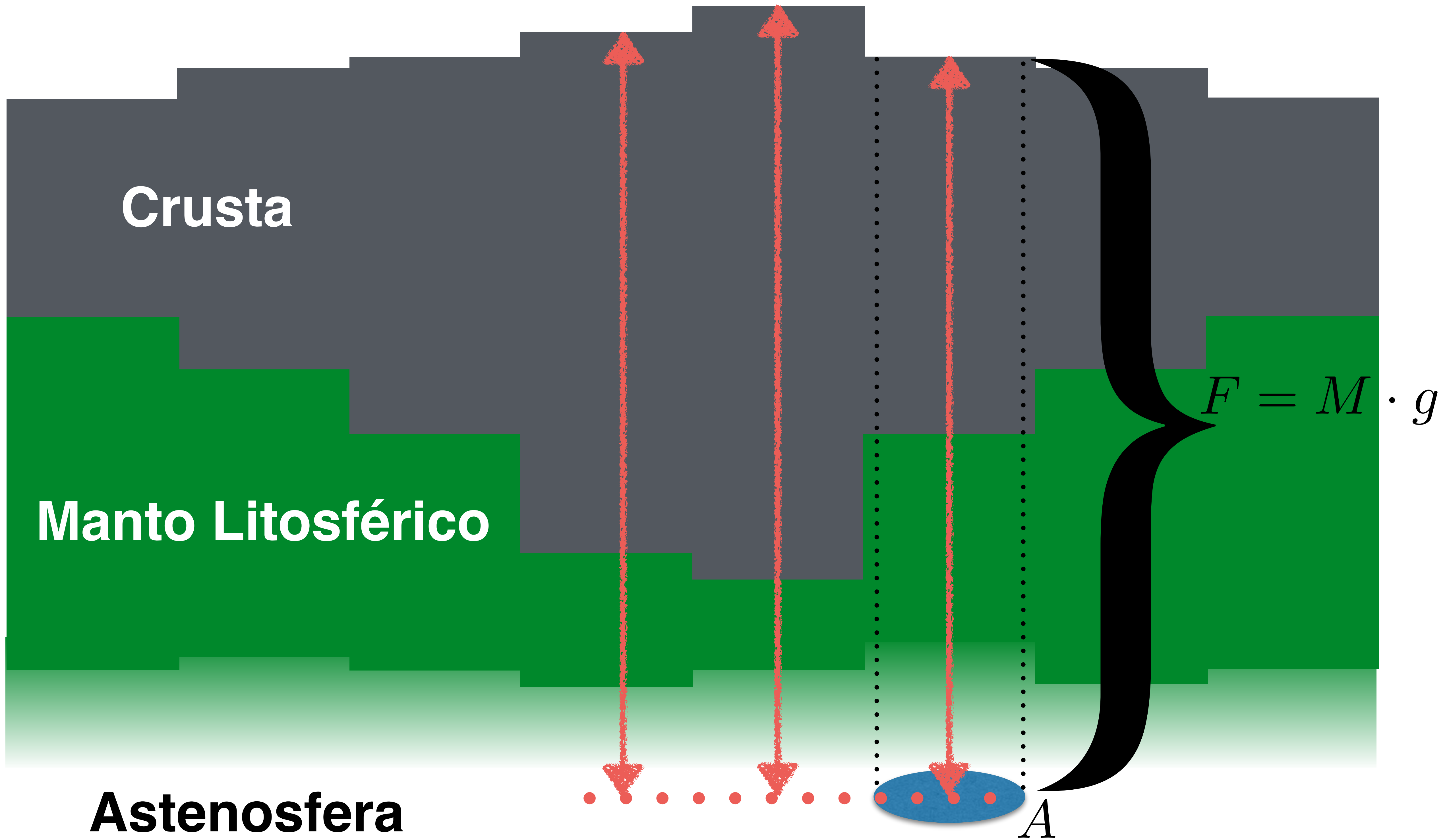

Pressão

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$$P = \frac{M \cdot g}{A}$$

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$$= \int_0^h \rho(z) dz \cdot g$$

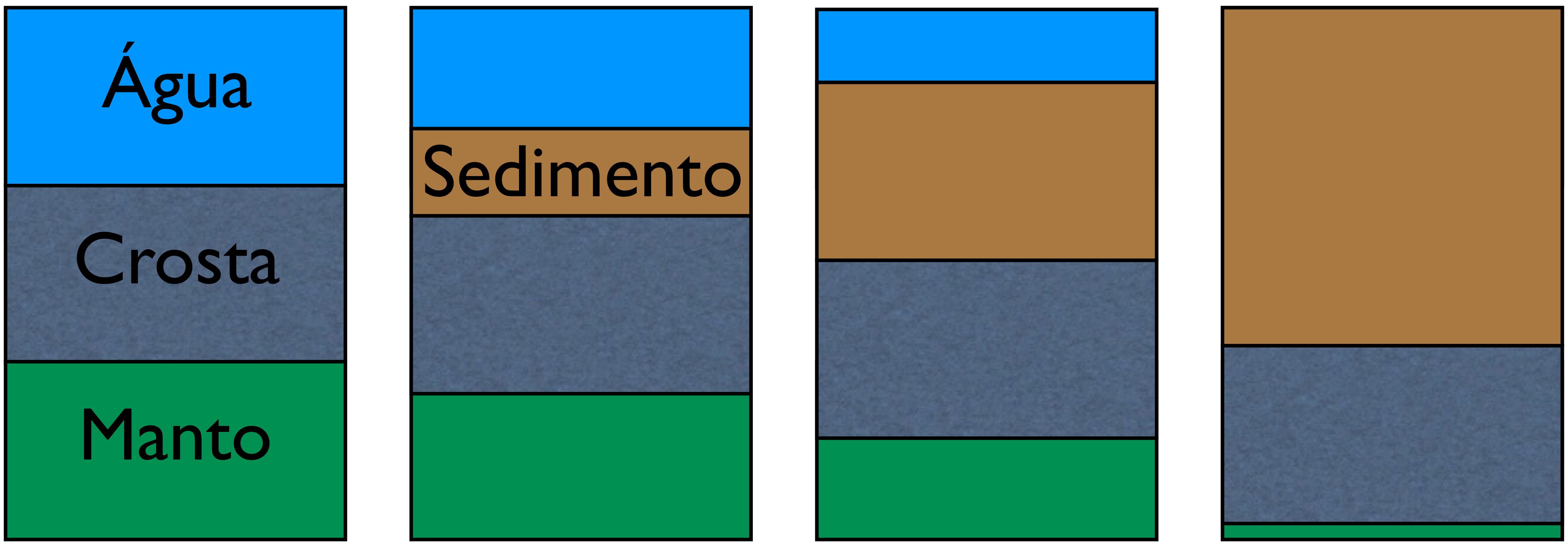
Pressão

$$P = \frac{M \cdot g}{A} = \frac{\int_V \rho(z) dV \cdot g}{A} = \frac{\int_0^h \rho(z) A dz \cdot g}{A}$$

$$= \int_0^h \rho(z) dz \cdot g$$

$$\approx \sum_i \rho_i g h_i$$

Subsidência das bacias sedimentares



Subsidência da litosfera oceânica

$$\int_0^h \rho dz \cdot g$$

Subsidência da litosfera oceânica

$$\int_0^h \rho dz \cdot g \; = \int_0^h \rho_0 \left(1 - T \cdot \alpha\right) dz \cdot g$$

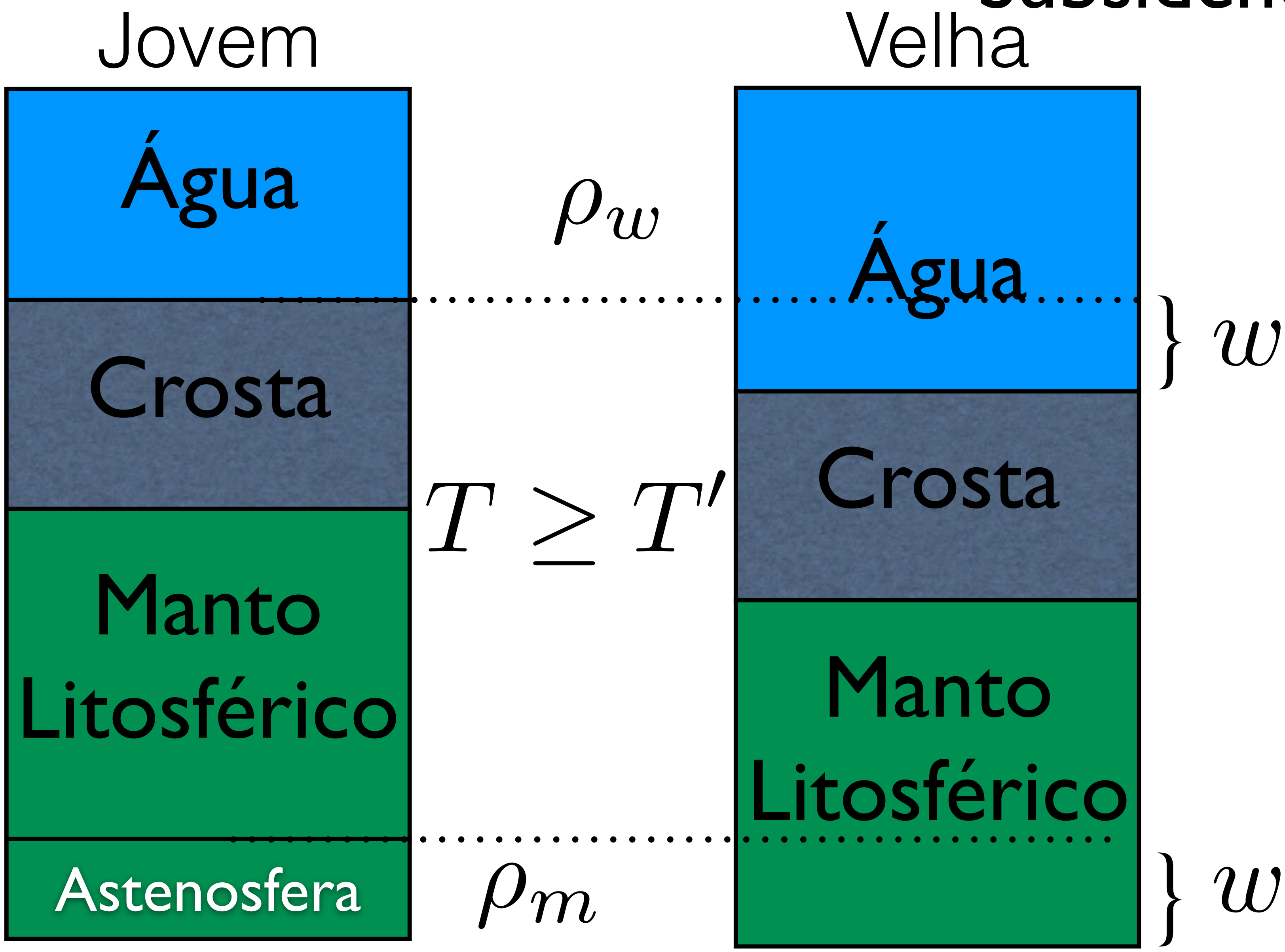
Subsidência da litosfera oceânica

Coeficiente de expansão volumétrica

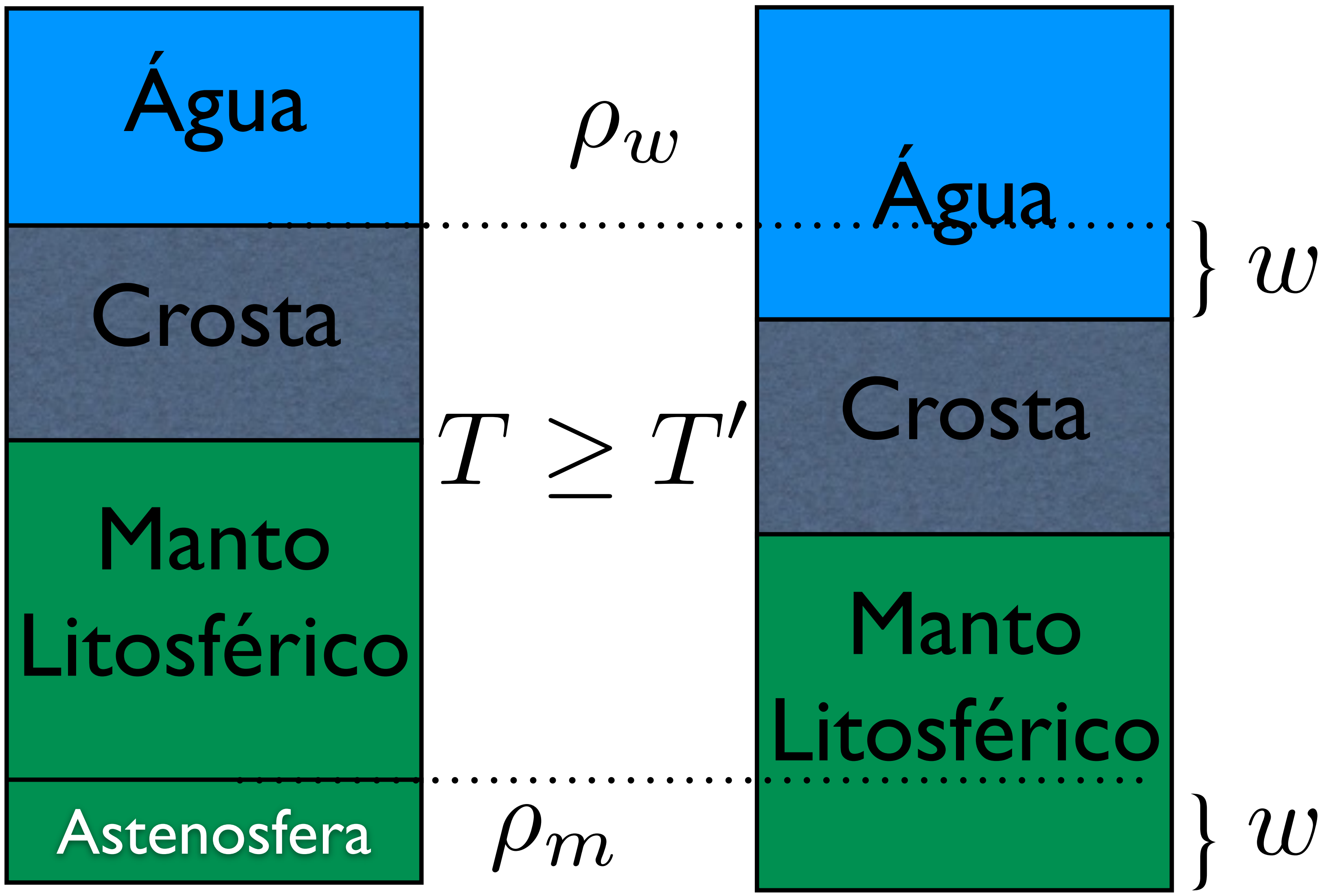
$$\int_0^h \rho dz \cdot g = \int_0^h \rho_0 \left(1 - T \cdot \alpha\right) dz \cdot g$$

Temperatura

Subsidência da litosfera oceânica

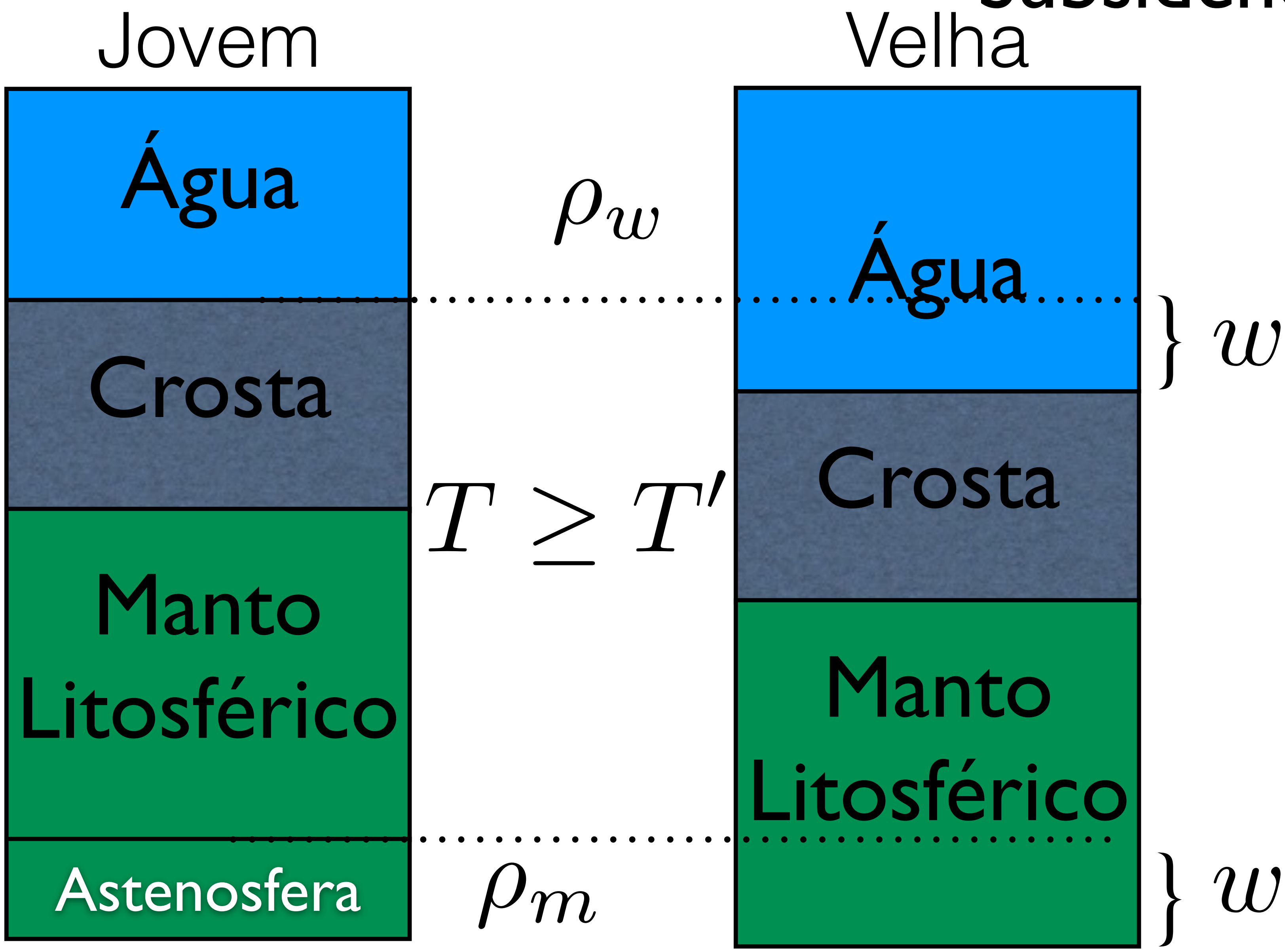


Subsidência da litosfera oceânica



$$\int_0^h \rho_0 \left(1 - T \cdot \alpha\right) dz \cdot g + w\rho_m g =$$

Subsidência da litosfera oceânica



$$\int_0^h \rho_0 \left(1 - T \cdot \alpha\right) dz \cdot g + w \rho_m g =$$

$$= \int_0^h \rho_0 \left(1 - T' \cdot \alpha\right) dz \cdot g + w \rho_w g$$

Subsidência da litosfera oceânica

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Subsidência da litosfera oceânica

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$$= \int_0^h \rho_0 \left(1 - T' \cdot \alpha\right) dz \cdot g + w \rho_w g$$

$$(\rho_m - \rho_w) w = \int_0^h \rho_0 \left(T - T'\right) \alpha dz \cdot$$