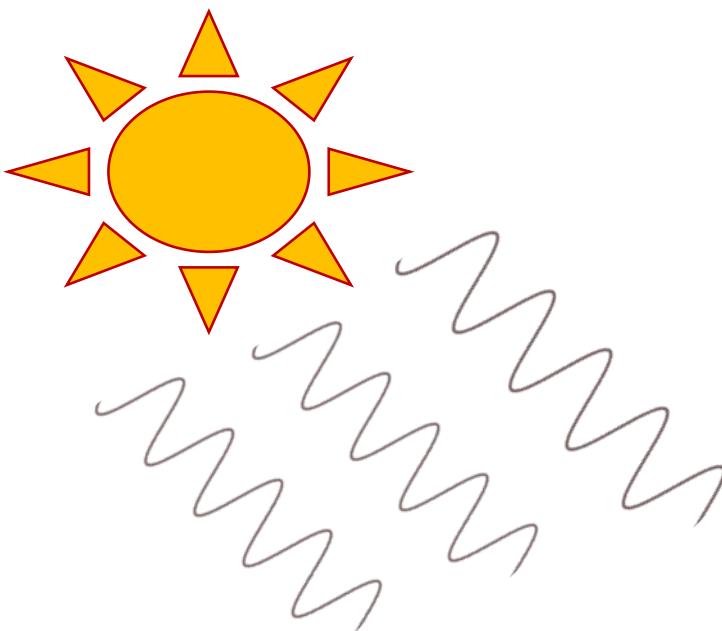
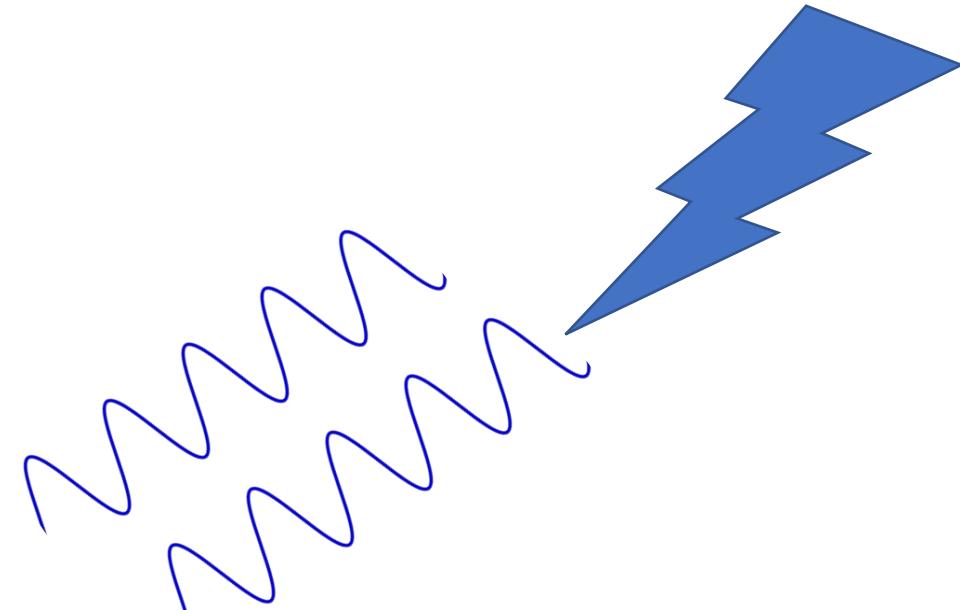
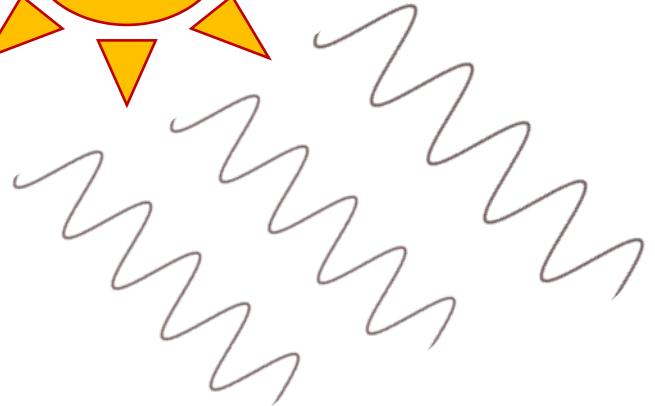
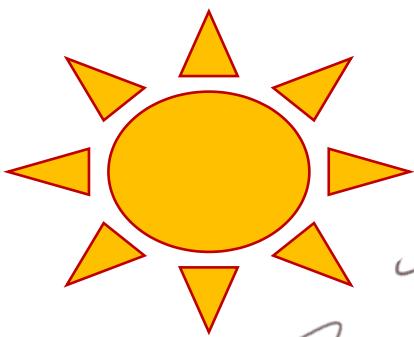


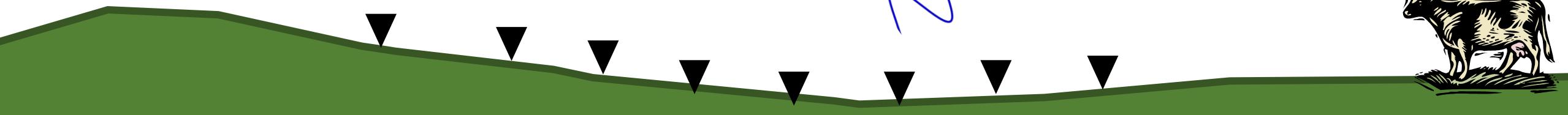
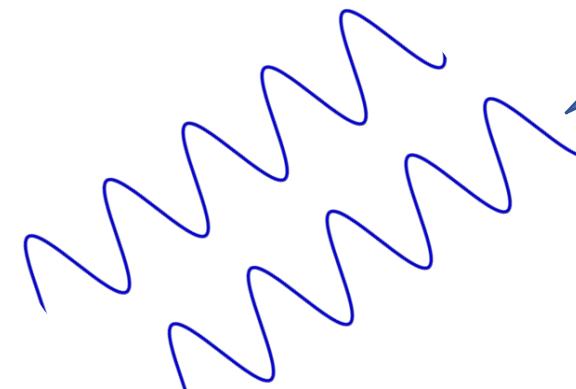
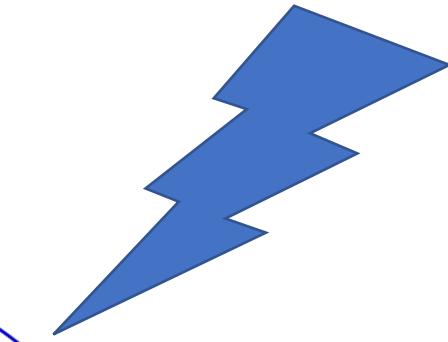
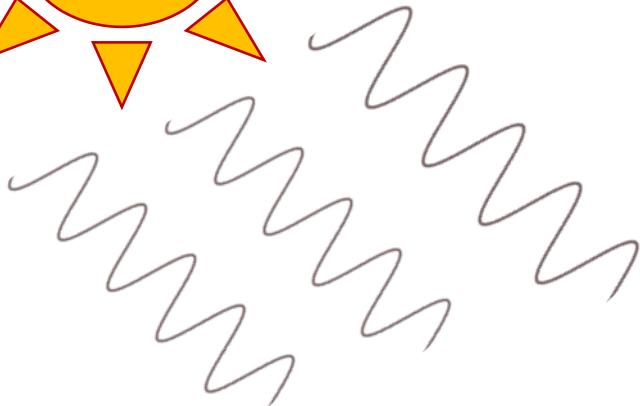
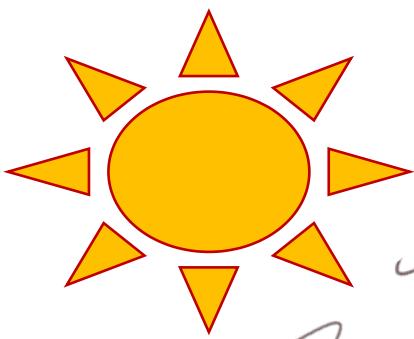
# Problema geofísico

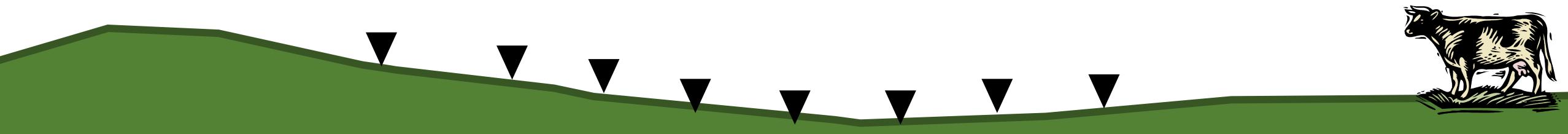
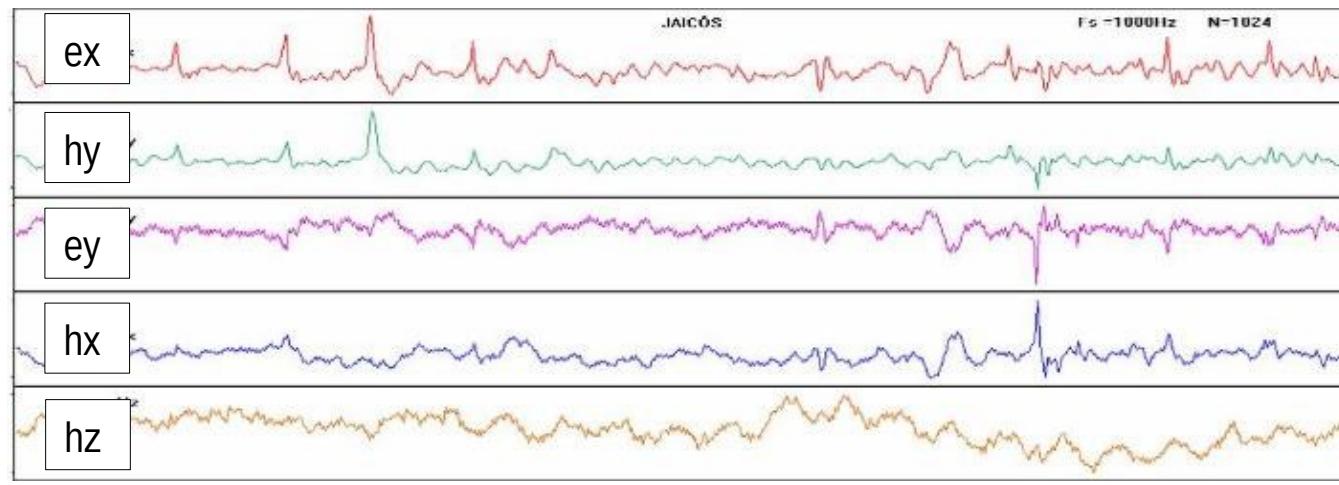
# Fontes naturais de campos EM

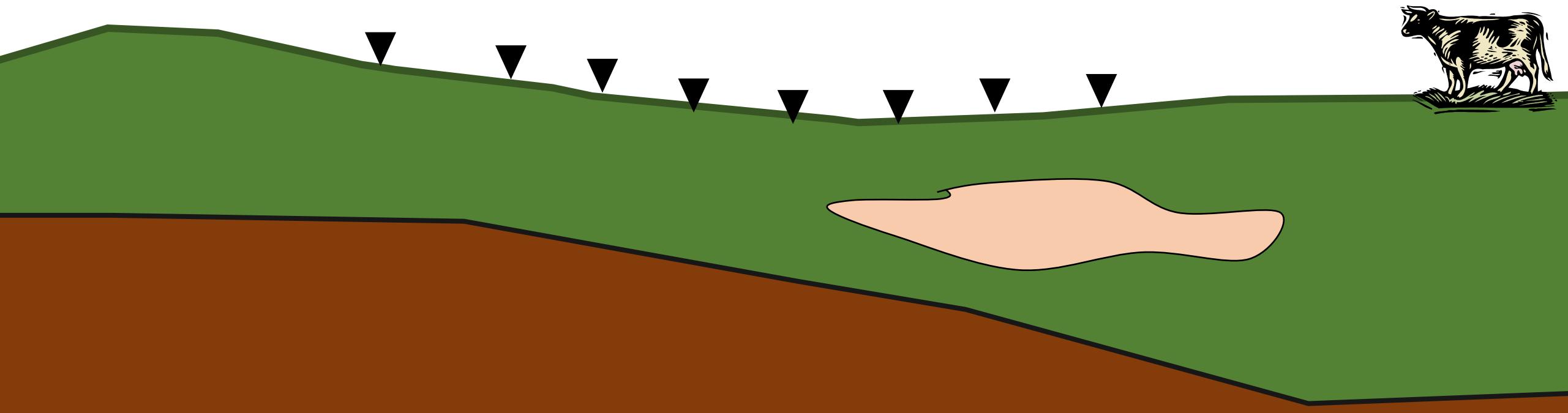
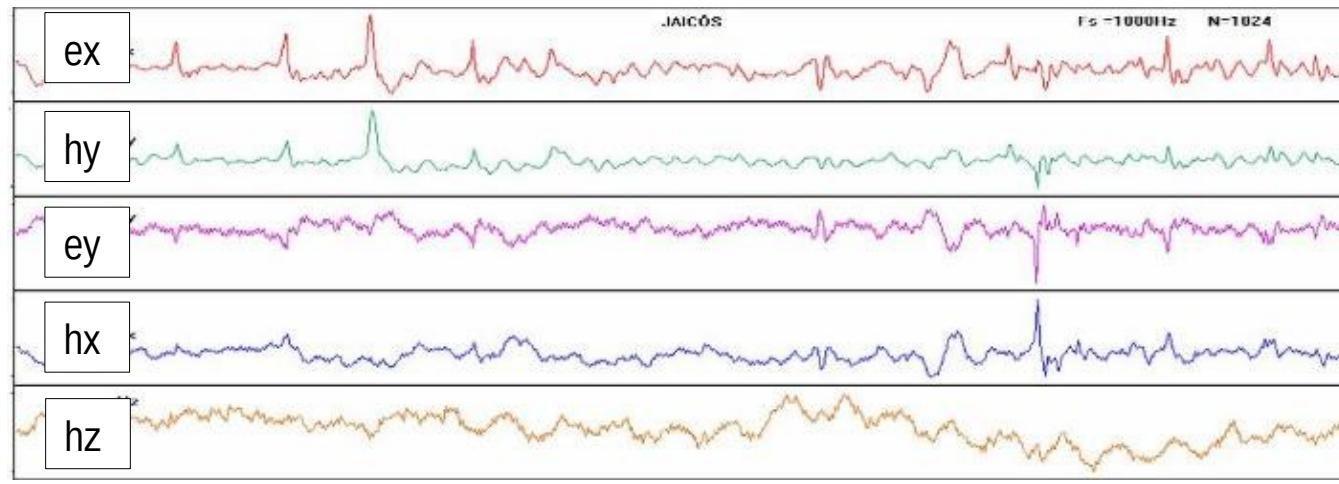


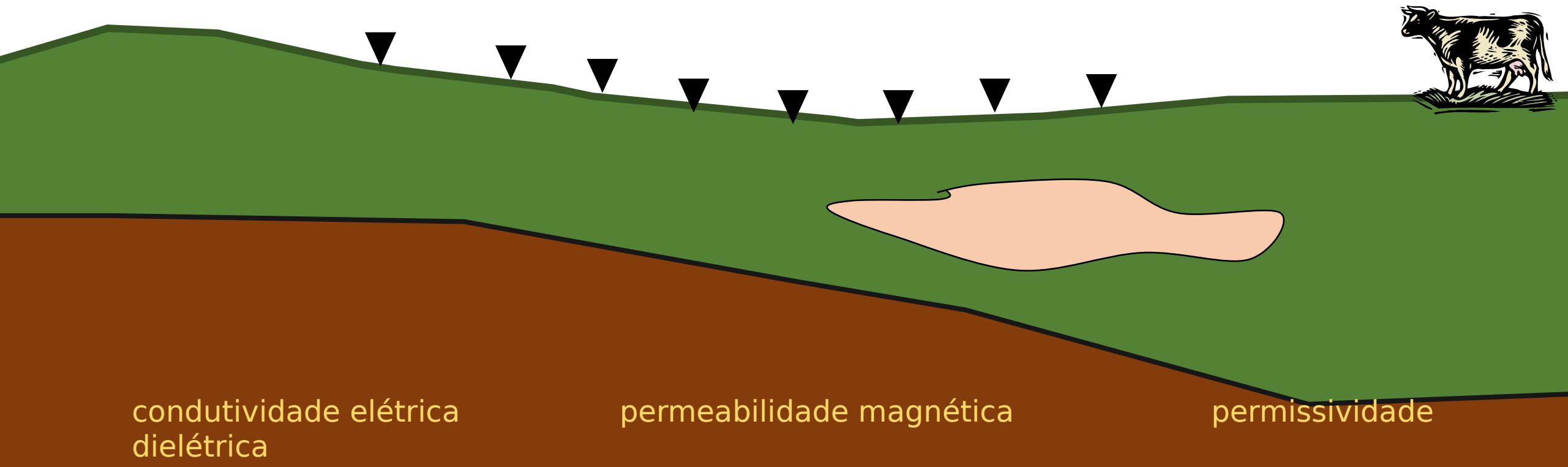
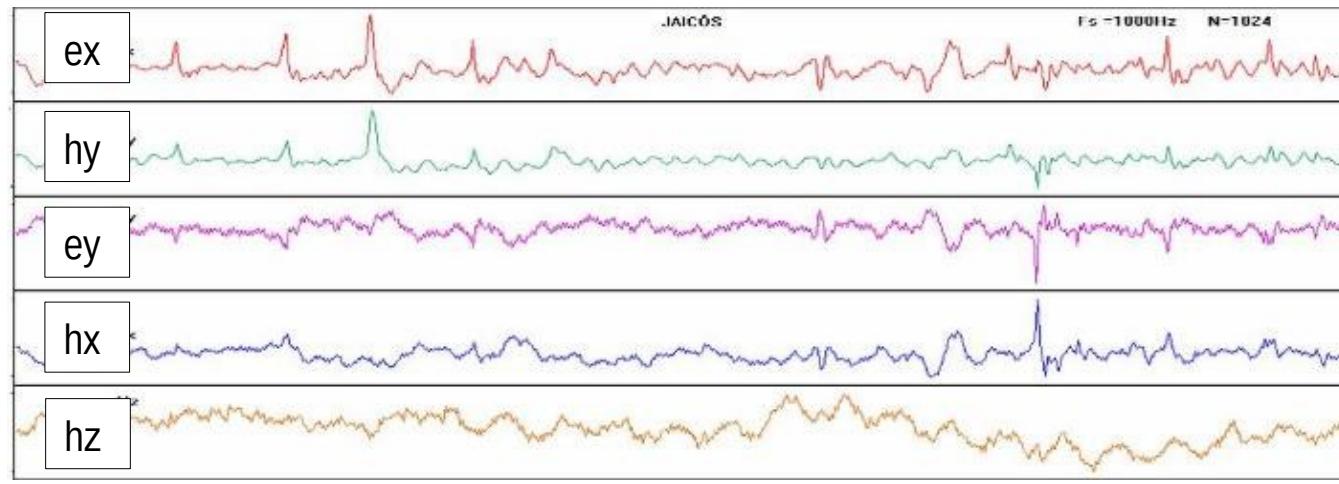












ex

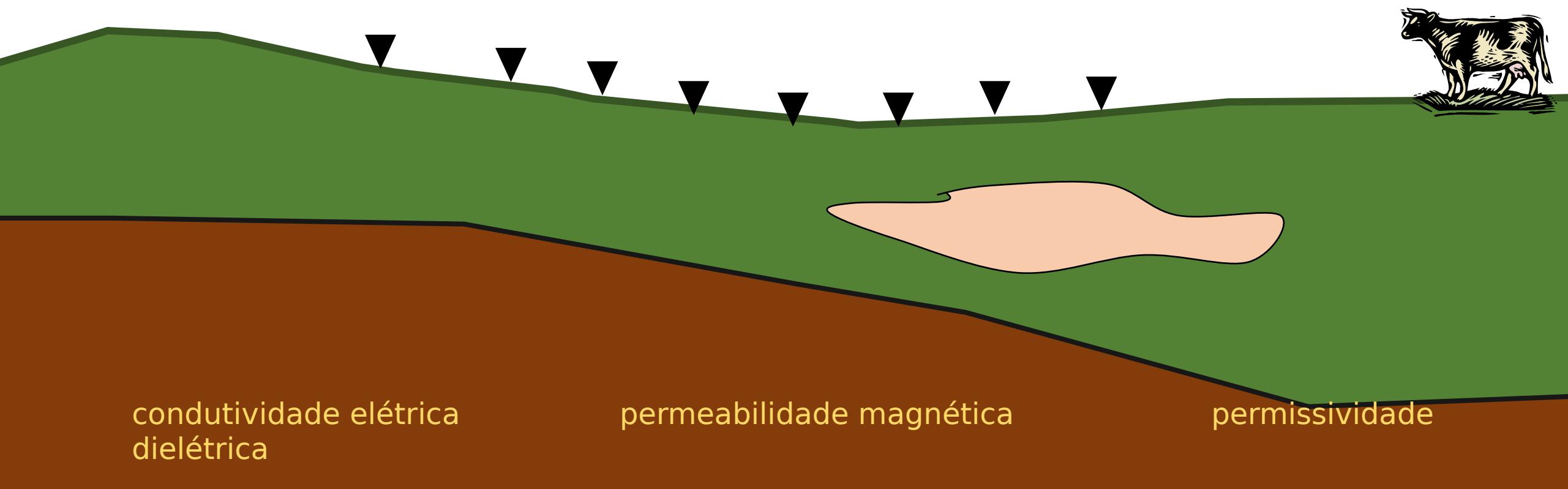
hy

ey

hx

hz

Tempo

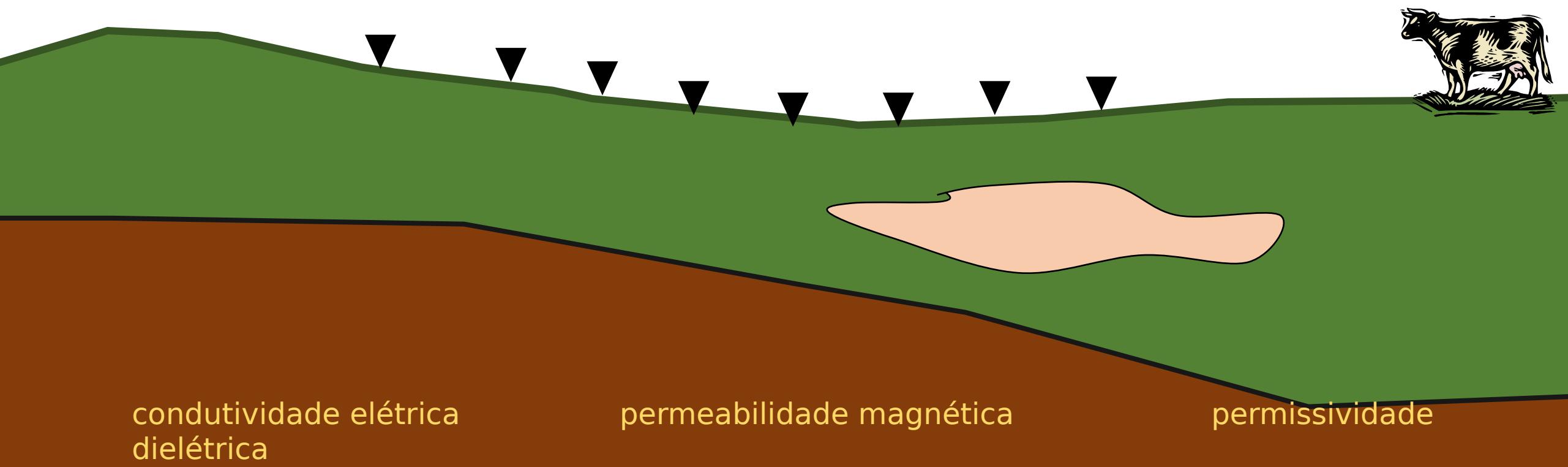


ex	Ex
hy	Hy
ey	Ey
hx	Hx
hz	Hz

Fourier

Tempo

Frequencia



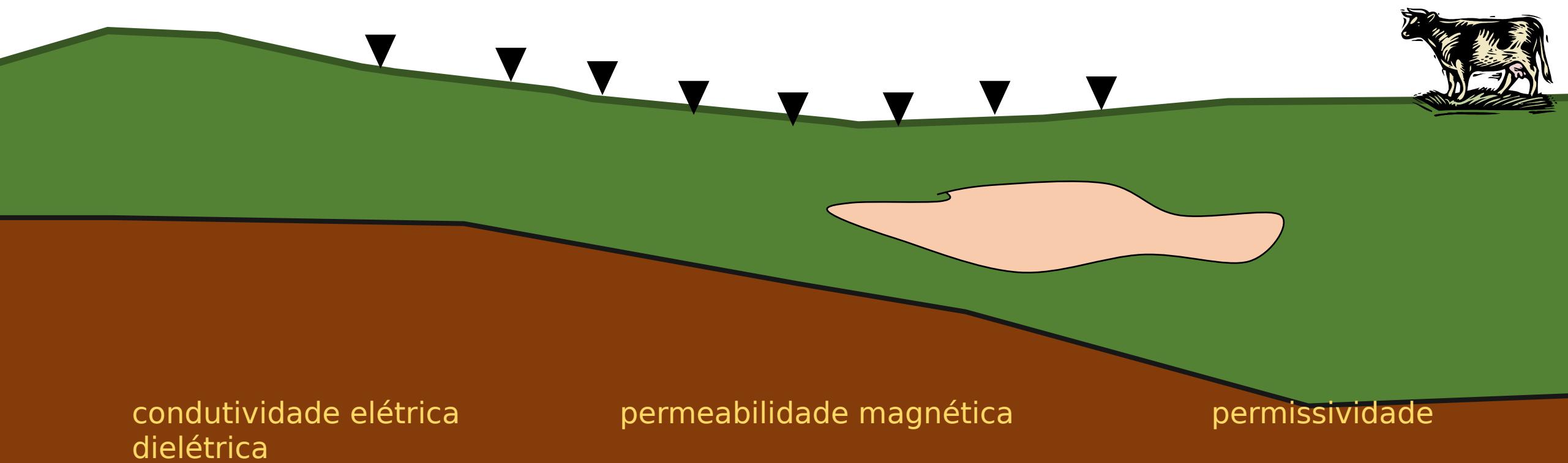
ex	Ex
hy	Hy
ey	Ey
hx	Hx
hz	Hz

Fourier

Tempo

Frequencia

Equações de Maxwell descrevem  
o comportamento dos campos  
EM em meios geológicos



ex

hy

ey

hx

hz

Ex

Hy

Ey

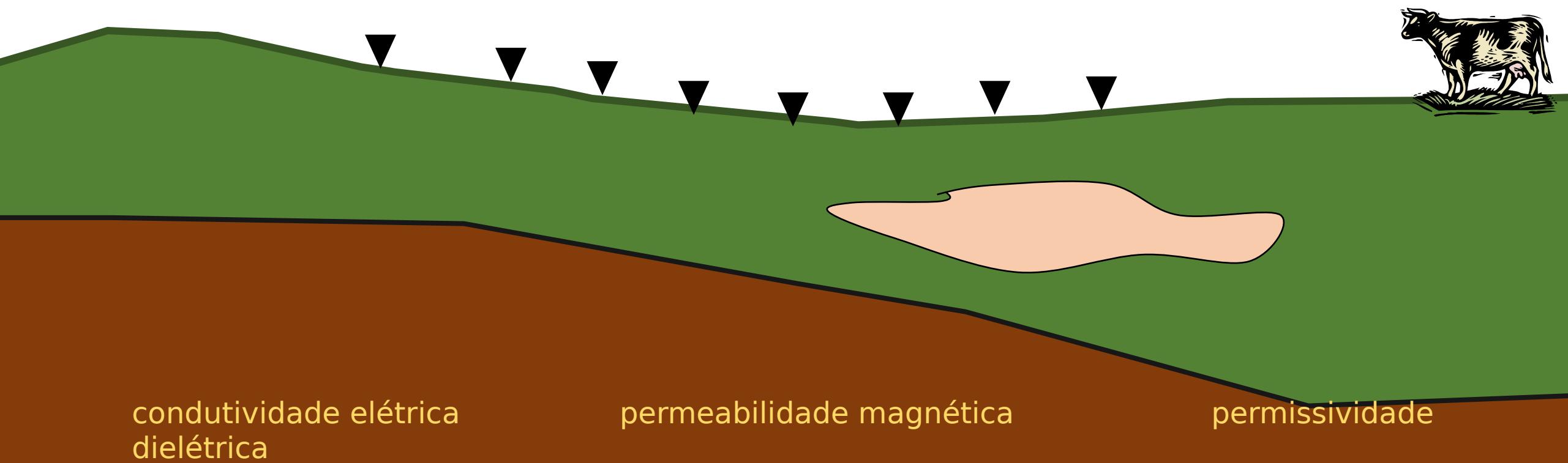
Hx

Hz

$$\nabla \times \mathbf{E} = -i\omega\mu\mathbf{H}$$

Lei de Faraday que determina  
que o campo elétrico  
rotacional induz campo  
magnético

Fourier



ex

hy

ey

hx

hz

Ex

Hy

Ey

Hx

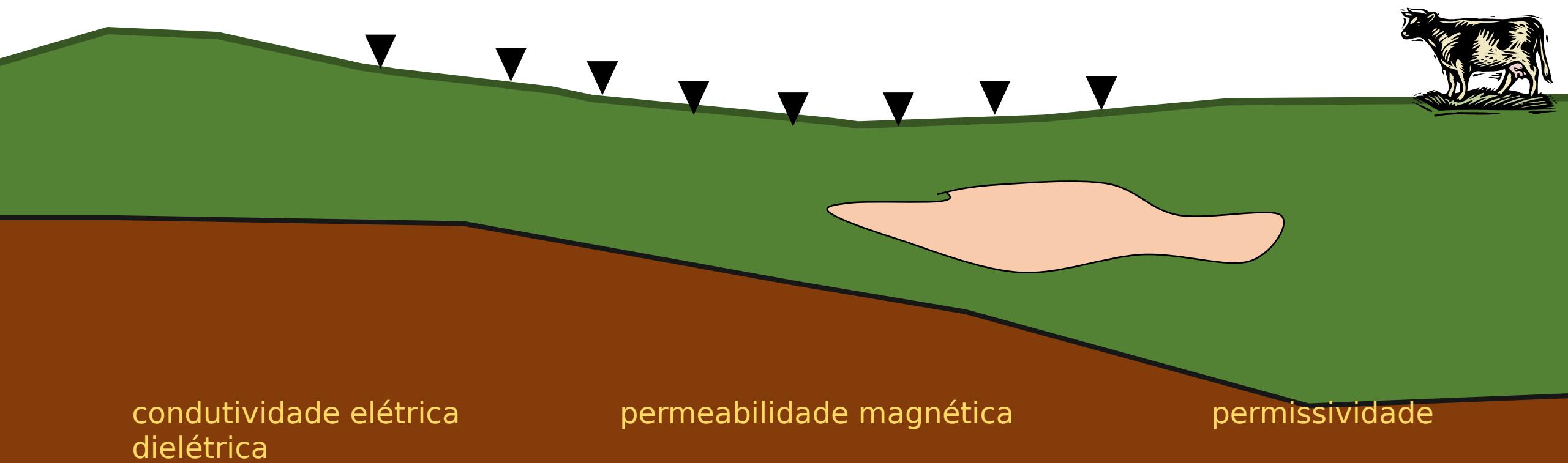
Hz

Fourier

$$\nabla \times \mathbf{E} = -i\omega\mu\mathbf{H}$$

$$\nabla \times \mathbf{H} = \mathbf{J} + i\omega\mathbf{D}$$

Relaciona o campo magnético  
com a densidade de corrente  
elétrica e a corrente de  
deslocamento  
eletrico.



ex

hy

ey

hx

hz

Ex

Hy

Ey

Hx

Hz

Fourier

$$\nabla \times \mathbf{E} = -i\omega\mu\mathbf{H}$$

$$\nabla \times \mathbf{H} = \mathbf{J} + i\omega\mathbf{D}$$

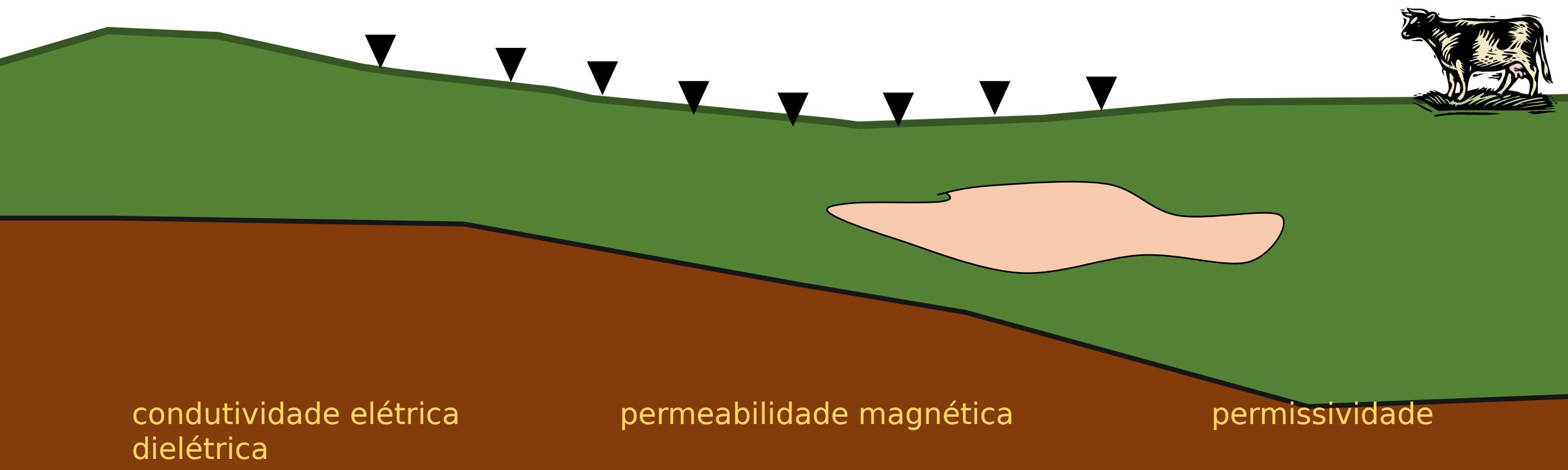
$$\nabla \cdot \mathbf{D} = q$$

$$\nabla \cdot \mathbf{B} = 0$$

Lei de Gauss para o campo elétrico  
descreve

como um campo elétrico estático é gerado  
por uma distribuição de cargas elétricas

Lei de Gauss para o campo magnético  
total de fluxo magnético através de uma  
superfície fechada e igual a zero.



condutividade elétrica  
dielétrica

permeabilidade magnética

permissividade

ex

hy

ey

hx

hz

Ex

Hy

Ey

Hx

Hz

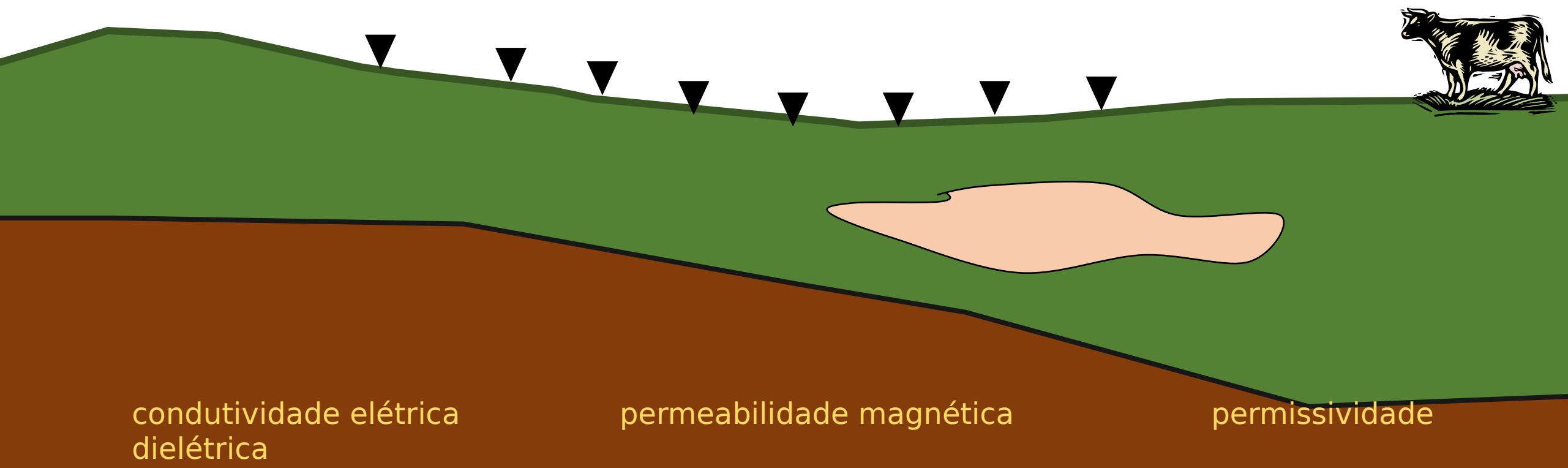
Fourier

$$\nabla \times \mathbf{E} = -i\omega\mu\mathbf{H}$$

$$\nabla \times \mathbf{H} = \mathbf{J} + i\omega\mathbf{D}$$

$$\nabla \cdot \mathbf{D} = q$$

$$\nabla \cdot \mathbf{B} = 0$$



ex

hy

ey

hx

hz

Ex

Hy

Ey

Hx

Hz

$$\nabla \times \mathbf{E} = -i\omega\mu\mathbf{H}$$

$$\nabla \times \mathbf{H} = \mathbf{J} + i\omega\mathbf{D}$$

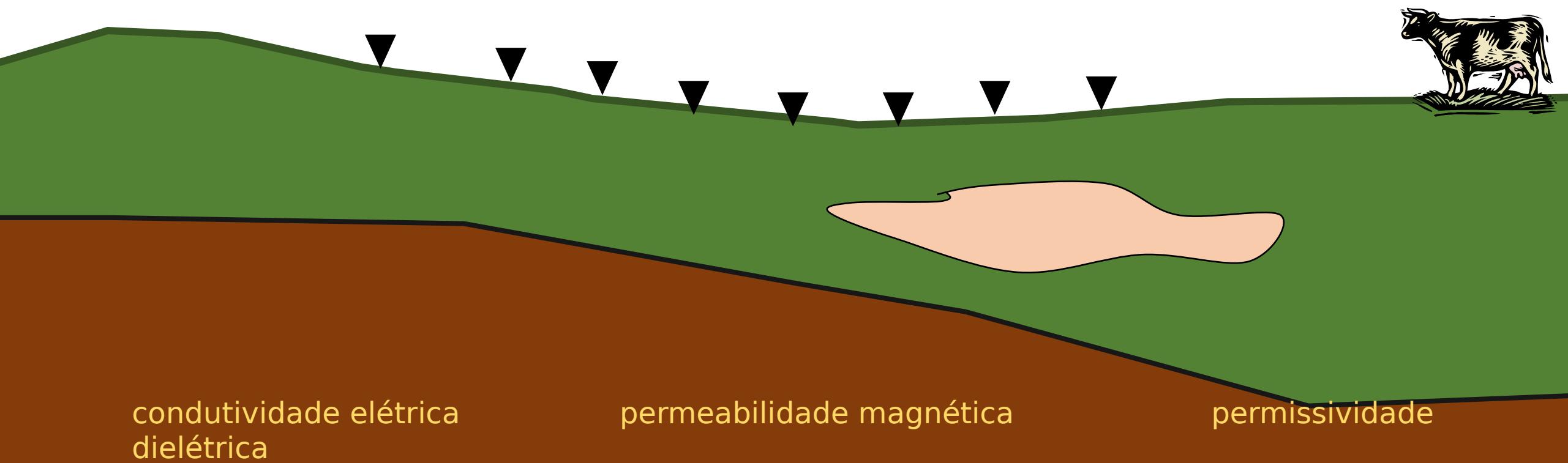
$$\nabla \cdot \mathbf{D} = q$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla^2 \mathbf{E} + k^2 \mathbf{E} = 0$$

$$\nabla^2 \mathbf{H} + k^2 \mathbf{H} = 0$$

Fourier



ex

hy

ey

hx

hz

Ex

Hy

Ey

Hx

Hz

$$\nabla \times \mathbf{E} = -i\omega\mu\mathbf{H}$$

$$\nabla^2 \mathbf{E} + k^2 \mathbf{E} = 0$$

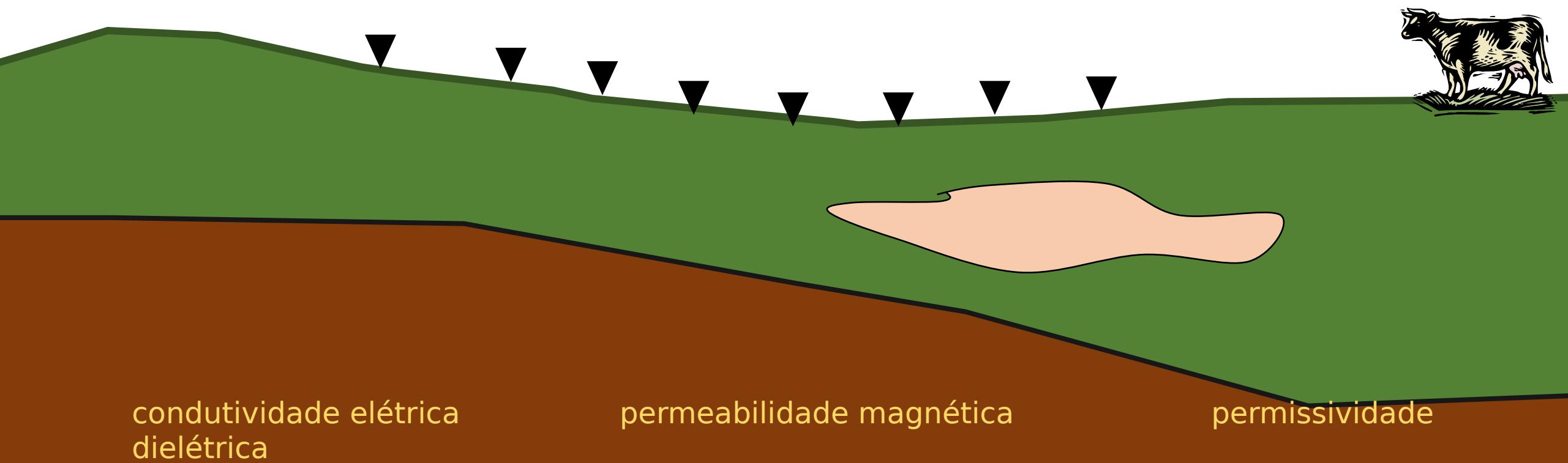
$$\nabla \times \mathbf{H} = \mathbf{J} + i\omega\mathbf{D}$$

$$\nabla^2 \mathbf{H} + k^2 \mathbf{H} = 0$$

$$\nabla \cdot \mathbf{D} = q$$

Equações de Helmholtz

$$\nabla \cdot \mathbf{B} = 0$$



ex

hy

ey

hx

hz

Ex

Hy

Ey

Hx

Hz

$$\nabla \times \mathbf{E} = -i\omega\mu\mathbf{H}$$

$$\nabla \times \mathbf{H} = \mathbf{J} + i\omega\mathbf{D}$$

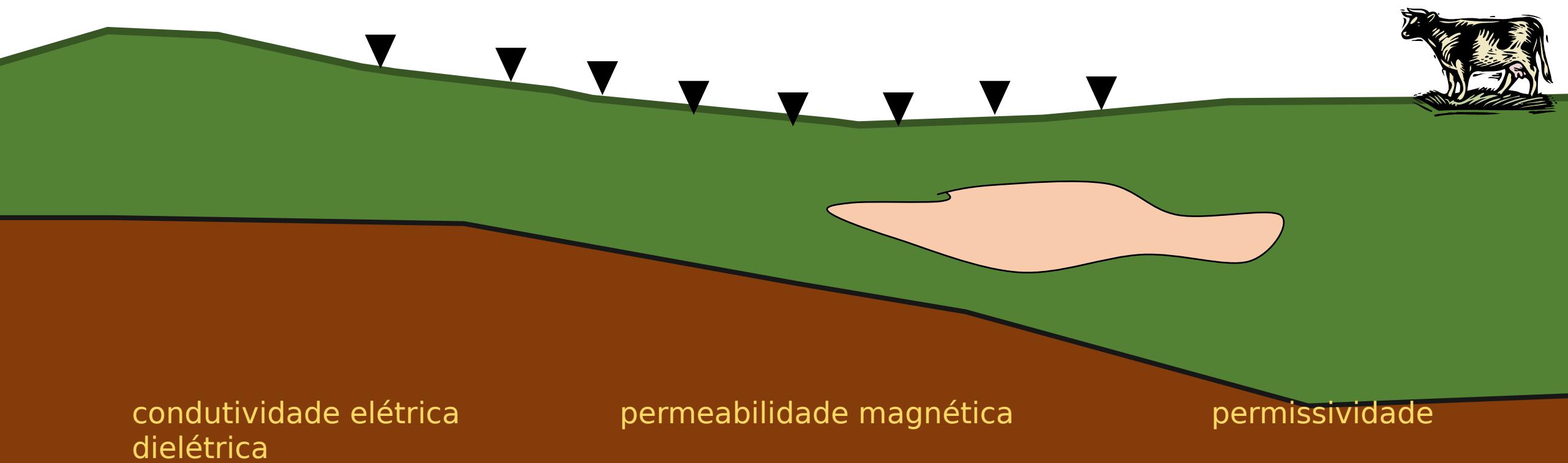
$$\nabla \cdot \mathbf{D} = q$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla^2 \mathbf{E} + k^2 \mathbf{E} = 0$$

$$\nabla^2 \mathbf{H} + k^2 \mathbf{H} = 0$$

$$k = (-i\mu\omega\sigma)^{1/2}$$



ex

hy

ey

hx

hz

Ex

Hy

Ey

Hx

Hz

Fourier

$$\nabla \times \mathbf{E} = -i\omega\mu\mathbf{H}$$

$$\nabla^2 \mathbf{E} + k^2 \mathbf{E} = 0$$

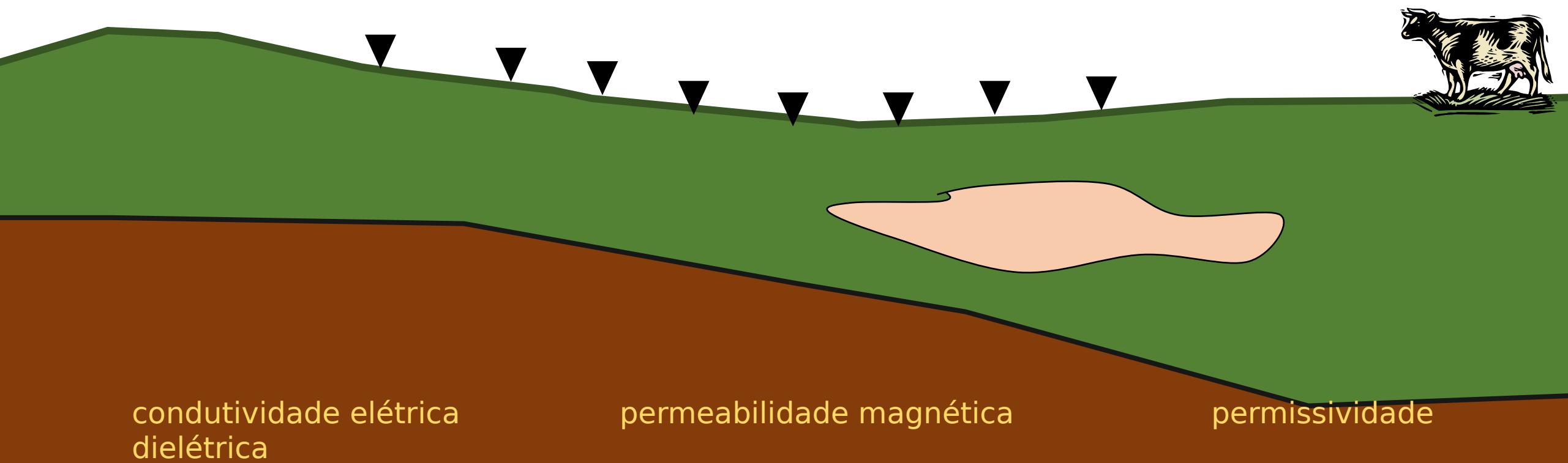
$$\nabla \times \mathbf{H} = \mathbf{J} + i\omega\mathbf{D}$$

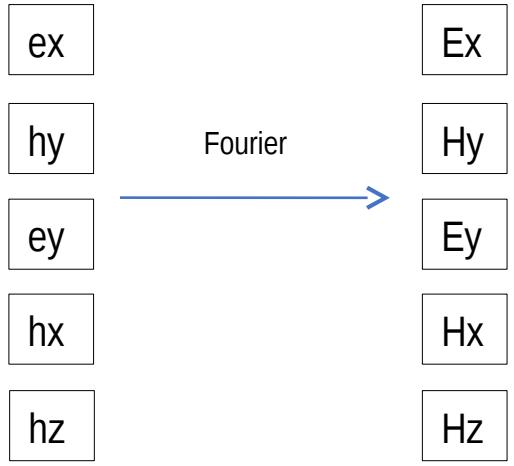
$$\nabla^2 \mathbf{H} + k^2 \mathbf{H} = 0$$

$$\nabla \cdot \mathbf{D} = q$$

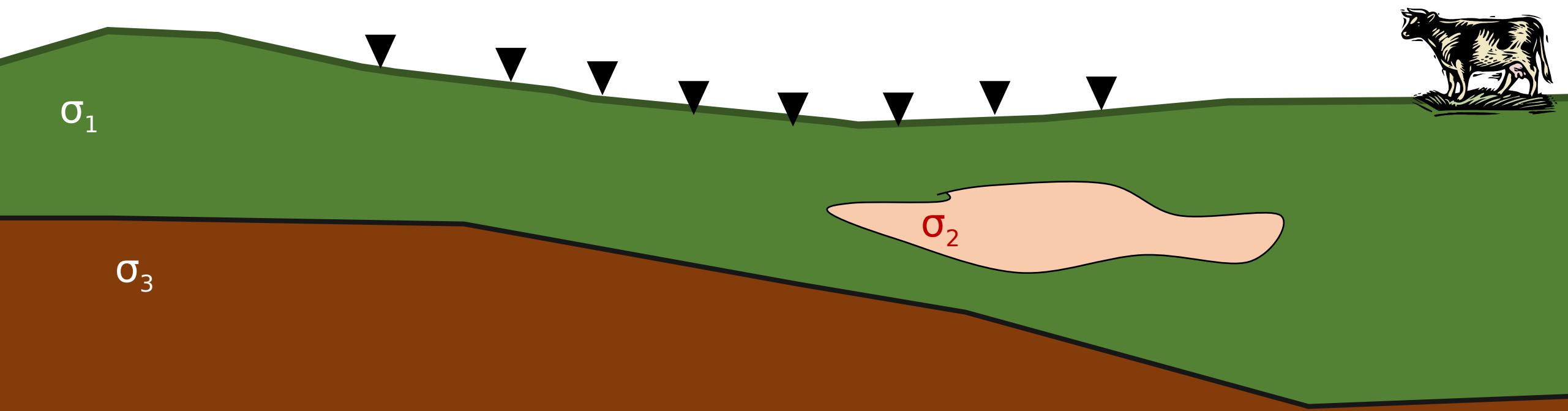
$$k = (-i\mu\omega\sigma)^{1/2}$$

$$\nabla \cdot \mathbf{B} = 0$$





No domínio da frequência podemos calcular algumas quantidades que dependem da distribuição de condutividade

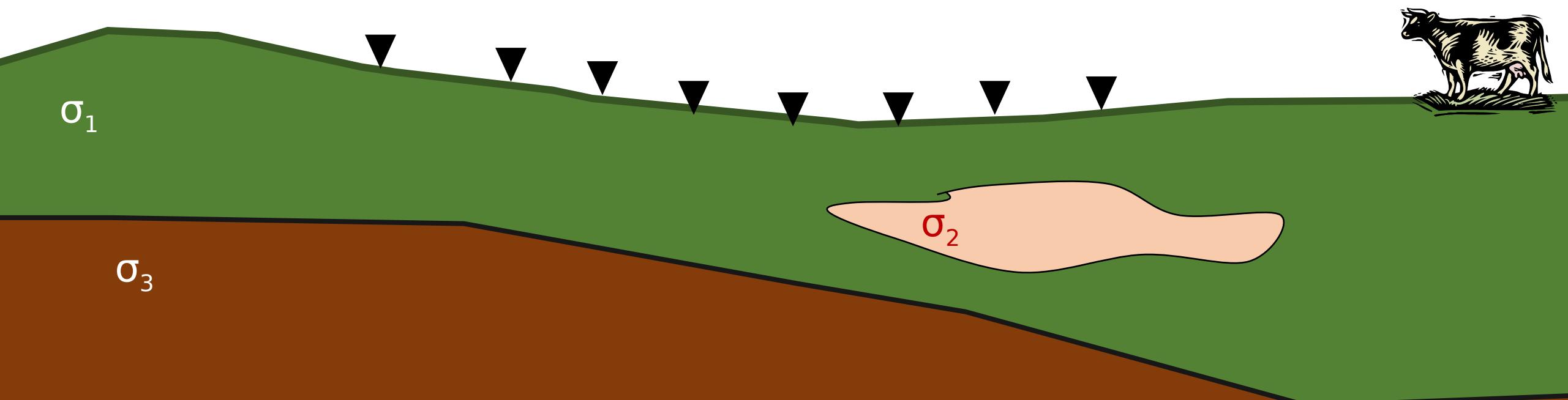


ex	Ex
hy	Hy
ey	Ey
hx	Hx
hz	Hz

Fourier

No domínio da frequência  
podemos calcular algumas  
quantidades que dependem  
da distribuição de  
condutividade

Tensor de impedância  
Resistividade aparente e  
fase  
Vetores de indução  
Tensor de fase

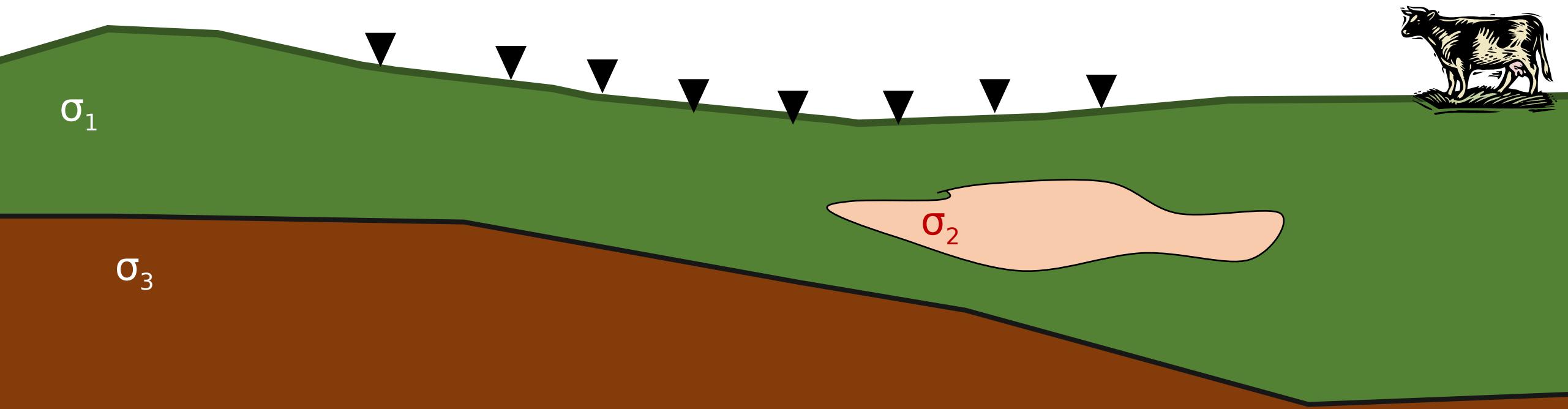


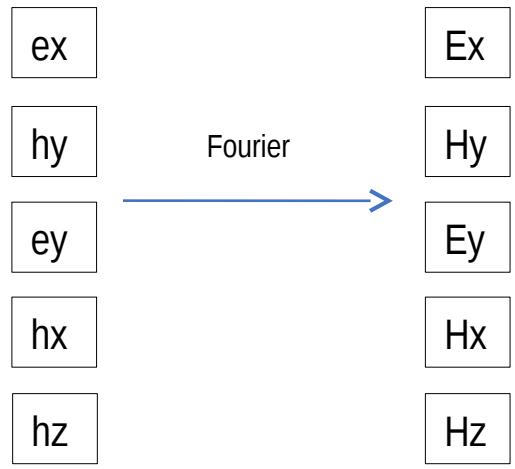
ex	Ex
hy	Hy
ey	Ey
hx	Hx
hz	Hz

Fourier

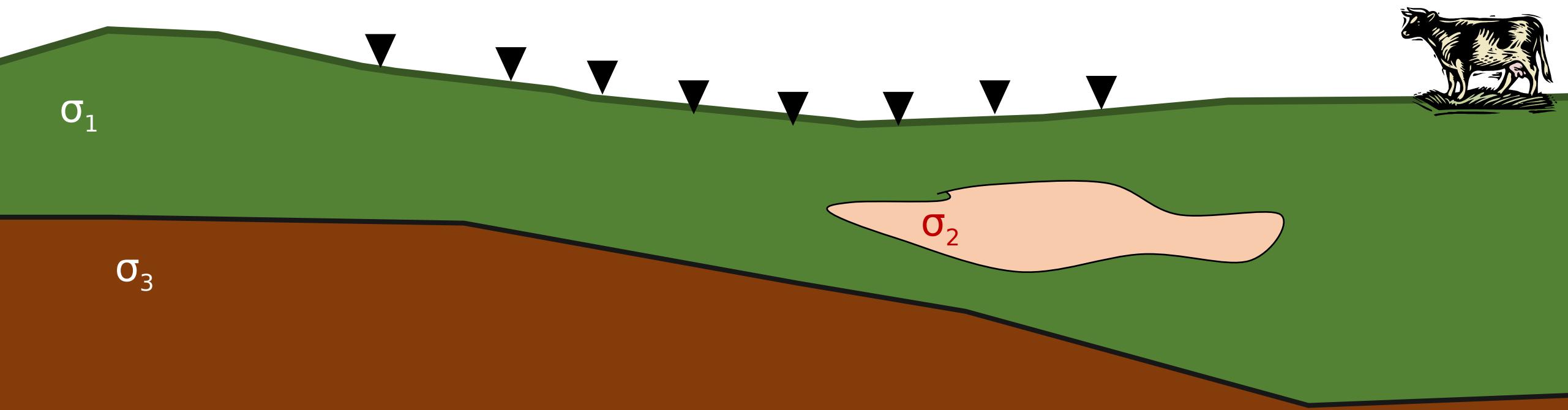
No domínio da frequência  
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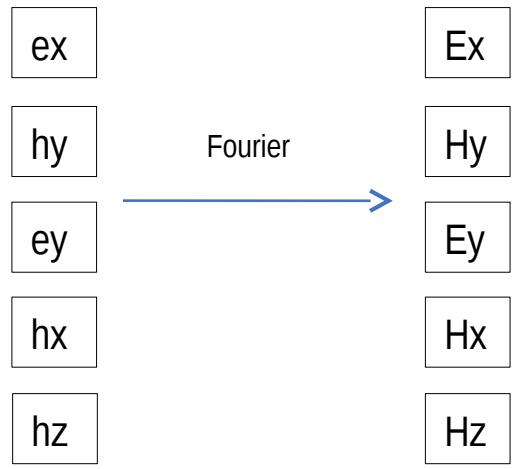
Tensor de impedância  
Resistividade aparente e  
fase  
Vetores de indução  
Tensor de fase



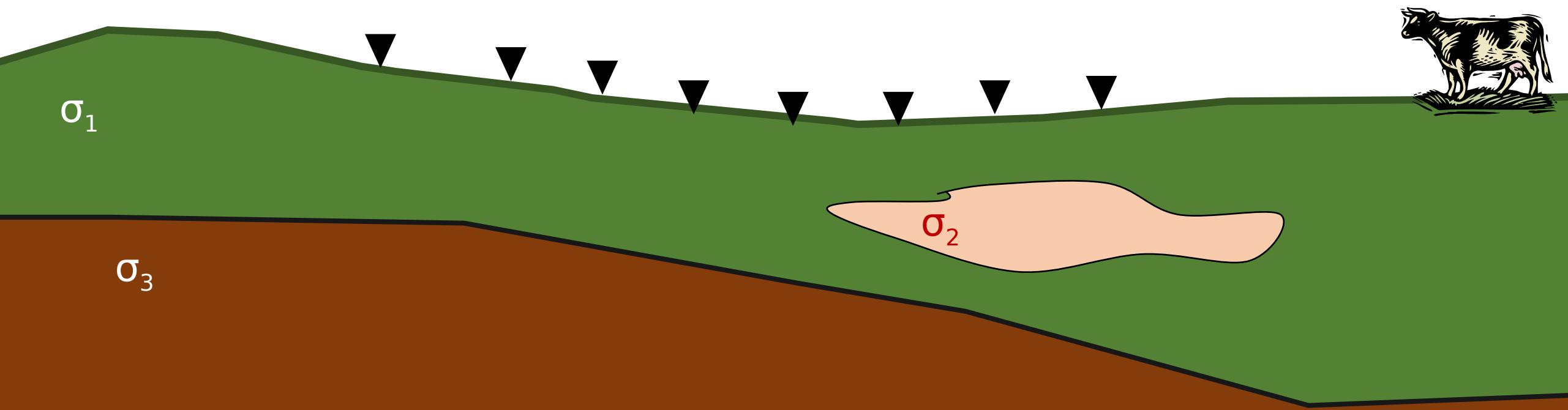


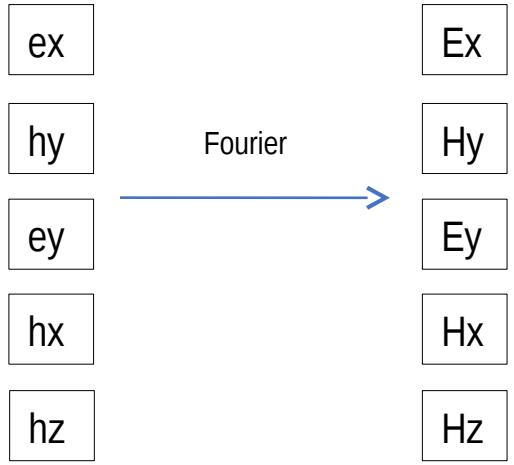
$$\begin{bmatrix} E_x \\ E_y \end{bmatrix} = \begin{bmatrix} Z_{xx} & Z_{xy} \\ Z_{yx} & Z_{yy} \end{bmatrix} \begin{bmatrix} H_x \\ H_y \end{bmatrix}$$





$$\begin{bmatrix} E_x \\ E_y \end{bmatrix} = \begin{bmatrix} Z_{xx} & Z_{xy} \\ Z_{yx} & Z_{yy} \end{bmatrix} \begin{bmatrix} H_x \\ H_y \end{bmatrix}$$



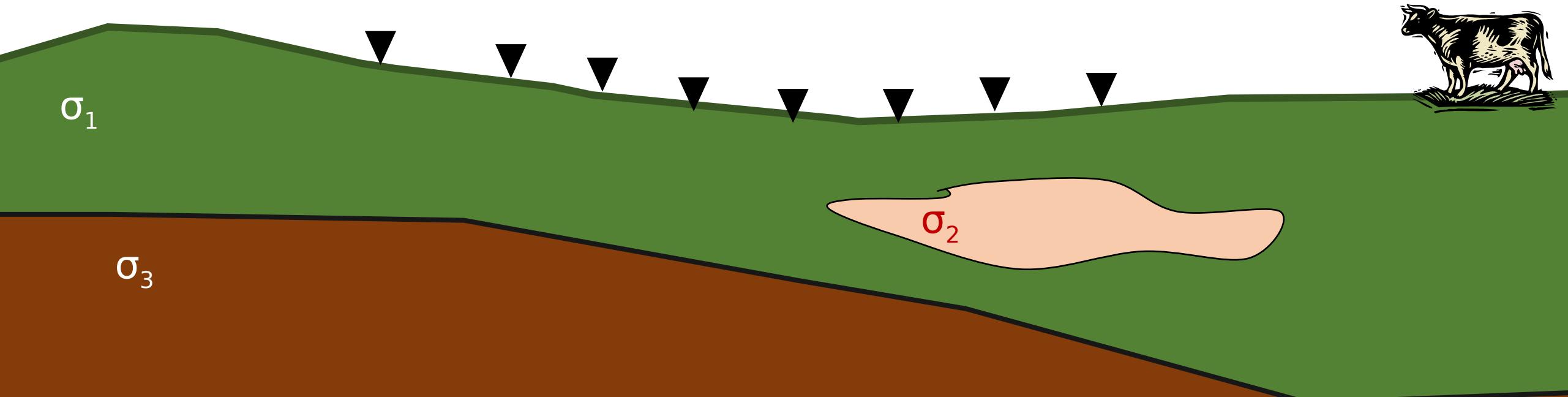
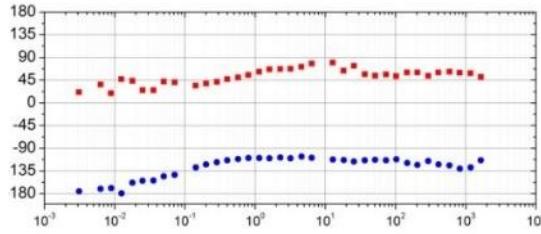
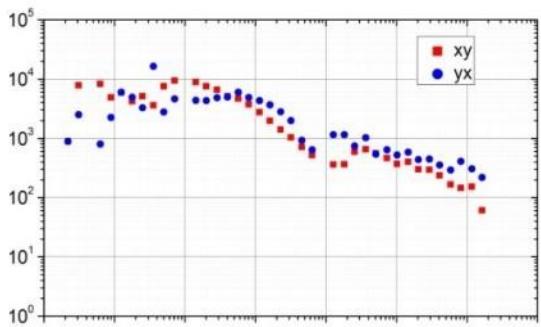


$$\begin{bmatrix} E_x \\ E_y \end{bmatrix} = \begin{bmatrix} Z_{xx} & Z_{xy} \\ Z_{yx} & Z_{yy} \end{bmatrix} \begin{bmatrix} H_x \\ H_y \end{bmatrix}$$

Resistividade aparente e  
fase

$$\rho_{xy} = \frac{1}{\omega\mu} |Z_{xy}|^2$$

$$\phi_{xy} = \tan^{-1} \left( \frac{\text{imag}(Z_{xy})}{\text{real}(Z_{xy})} \right)$$



ex  
hy  
ey  
hx  
hz

Fourier

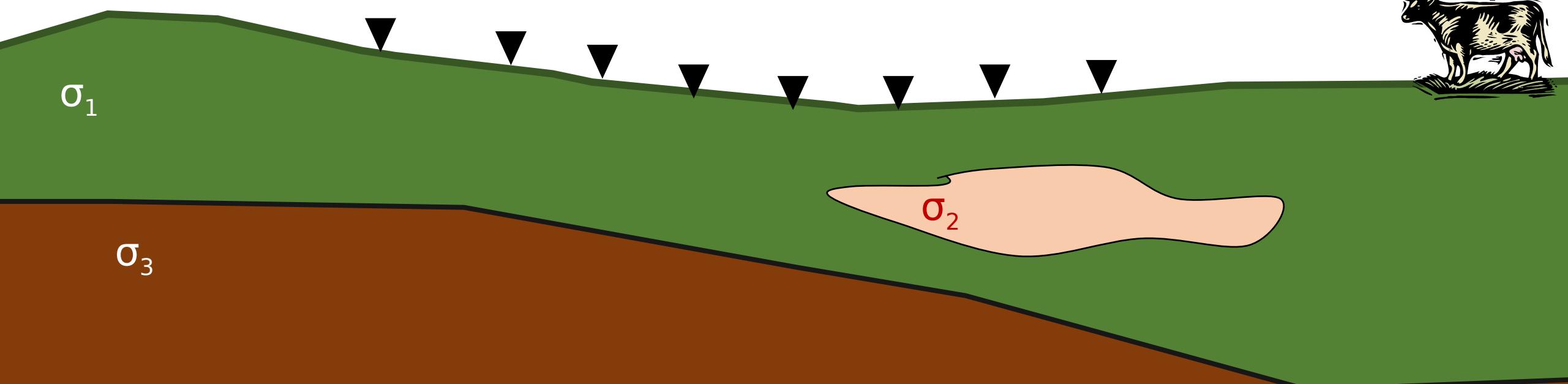
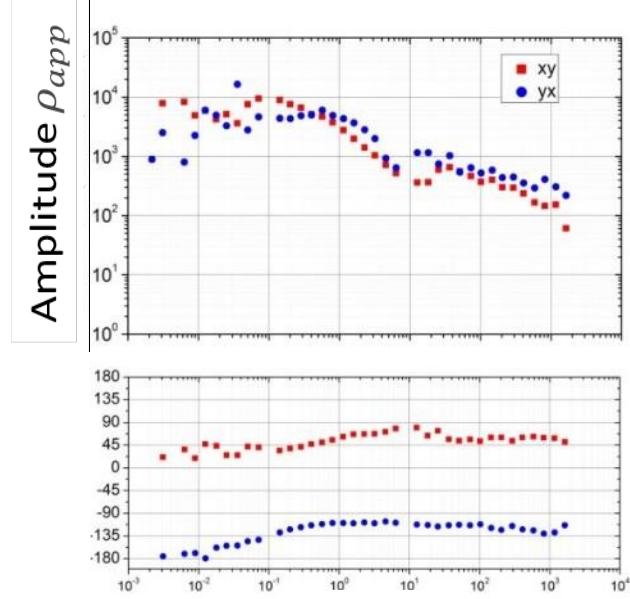
Ex  
Hy  
Ey  
Hx  
Hz

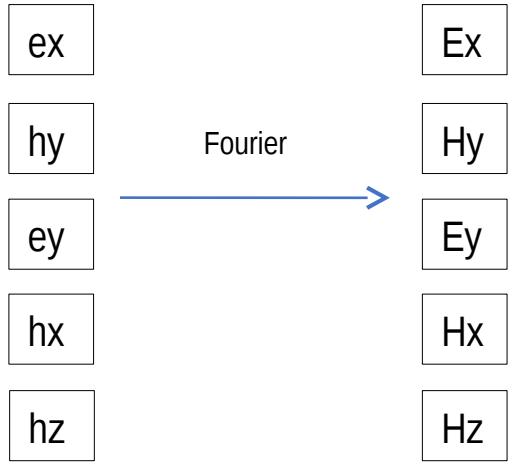
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Resistividade aparente e  
fase

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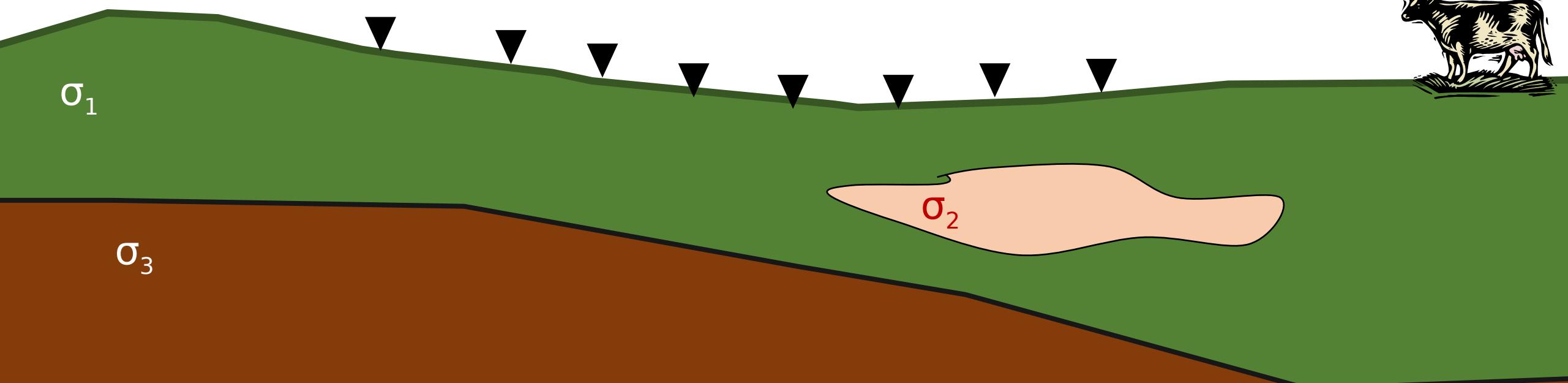
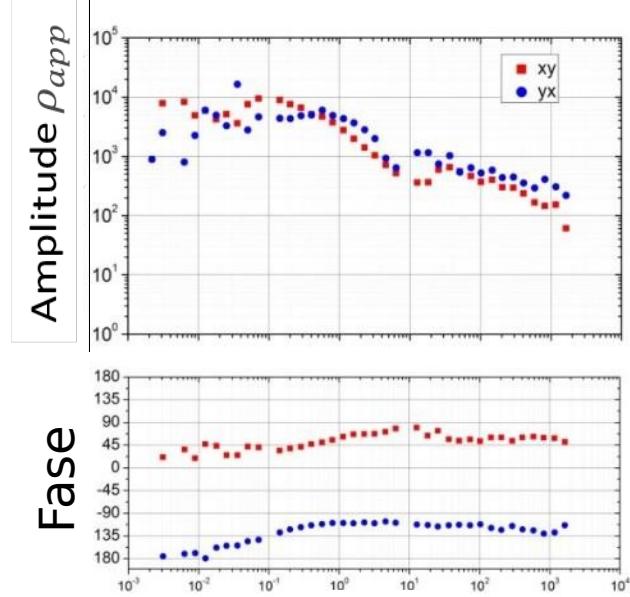


$$\begin{bmatrix} E_x \\ E_y \end{bmatrix} = \begin{bmatrix} Z_{xx} & Z_{xy} \\ Z_{yx} & Z_{yy} \end{bmatrix} \begin{bmatrix} H_x \\ H_y \end{bmatrix}$$

Resistividade aparente e fase

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ex  
hy  
ey  
hx  
hz

Fourier

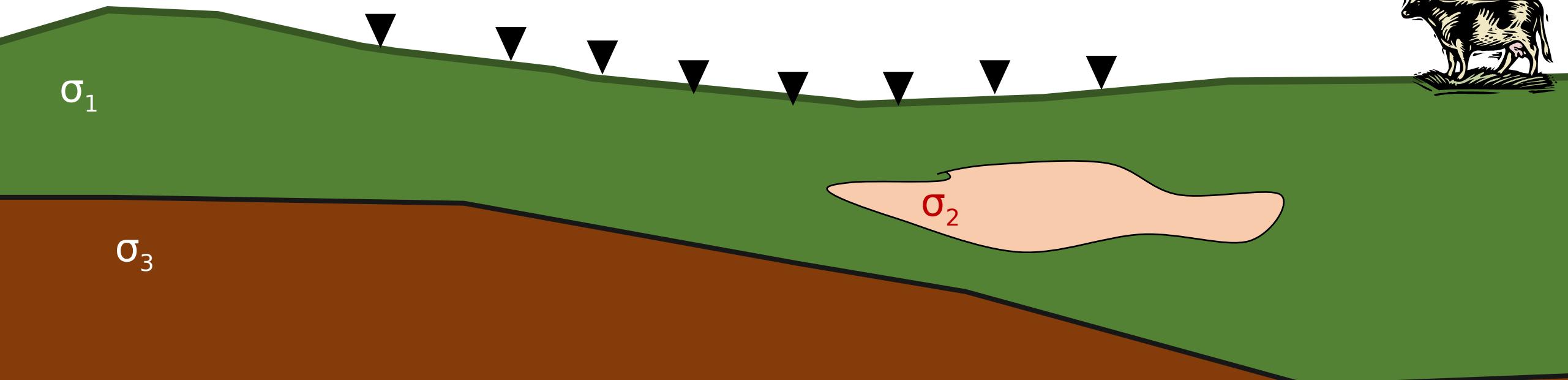
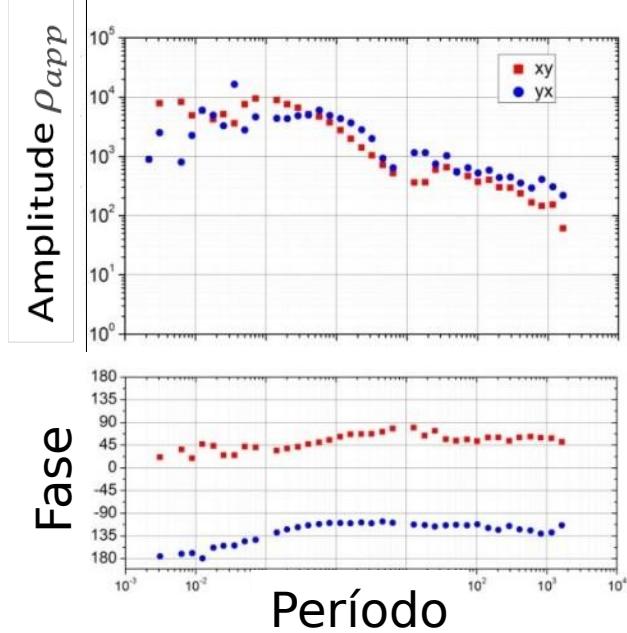
Ex  
Hy  
Ey  
Hx  
Hz

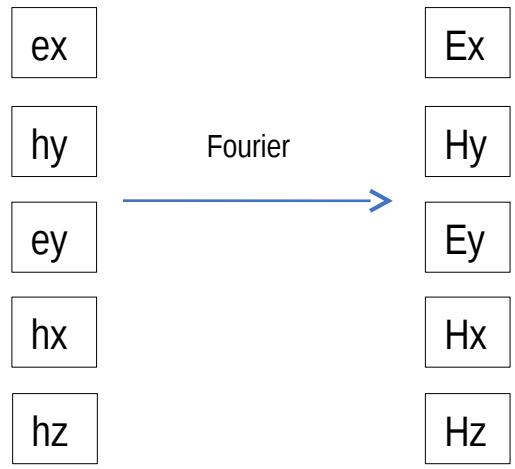
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Resistividade aparente e  
fase

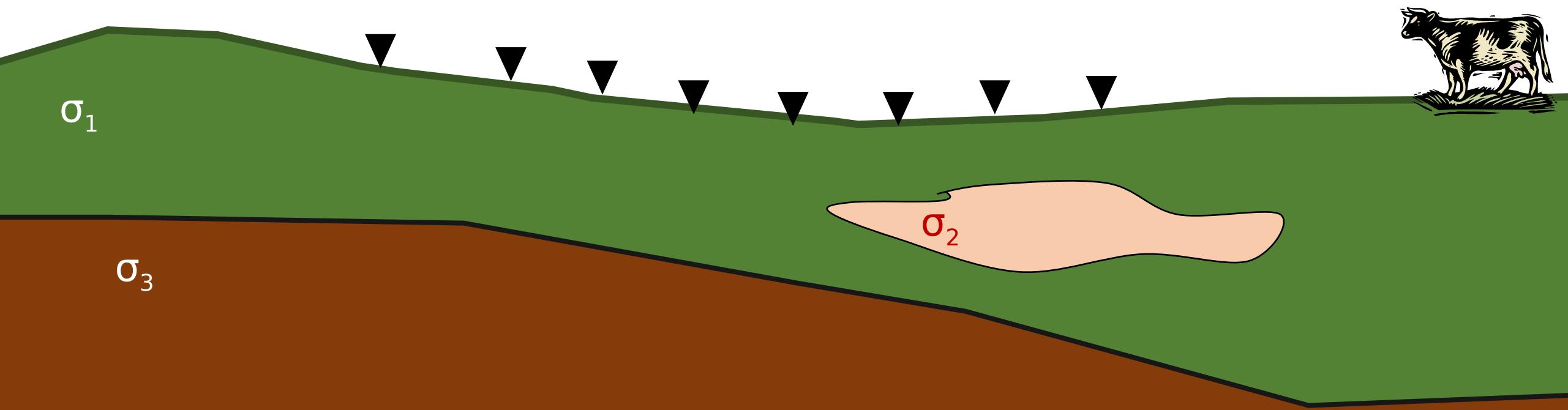
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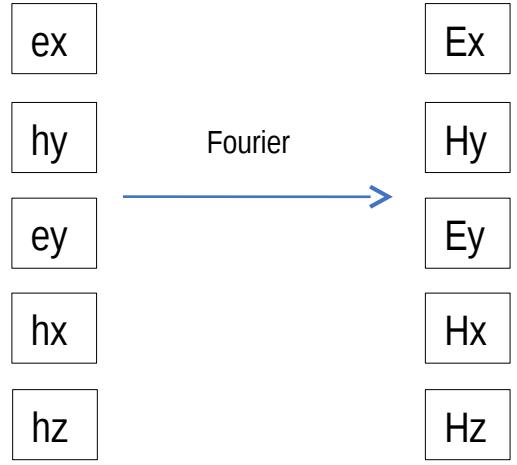
$$\phi_{xy} = \tan^{-1} \left( \frac{\text{imag}(Z_{xy})}{\text{real}(Z_{xy})} \right)$$



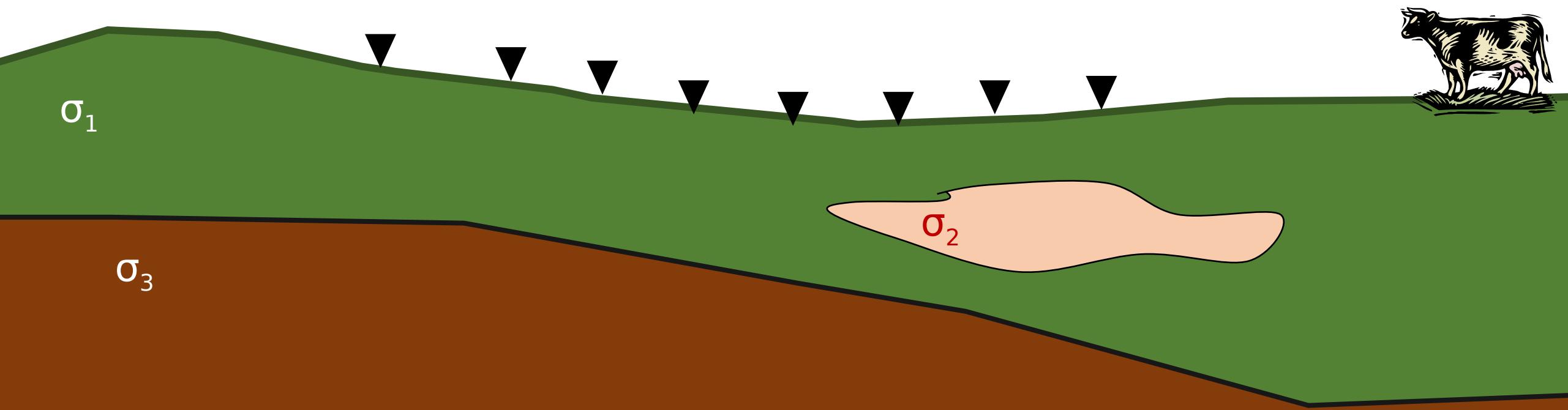


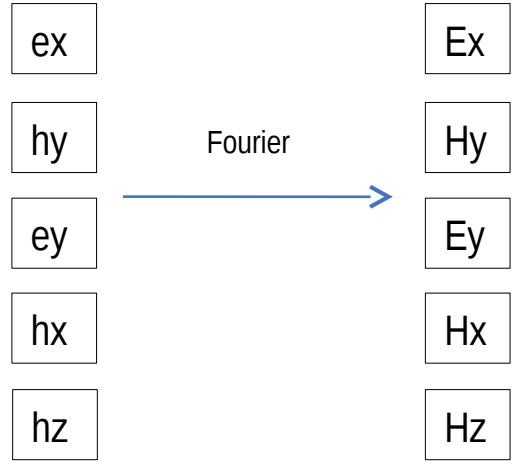
$$\begin{bmatrix} E_x \\ E_y \end{bmatrix} = \begin{bmatrix} Z_{xx} & Z_{xy} \\ Z_{yx} & Z_{yy} \end{bmatrix} \begin{bmatrix} H_x \\ H_y \end{bmatrix}$$





$$\begin{bmatrix} E_x \\ E_y \end{bmatrix} = \begin{bmatrix} Z_{xx} & Z_{xy} \\ Z_{yx} & Z_{yy} \end{bmatrix} \begin{bmatrix} H_x \\ H_y \end{bmatrix}$$

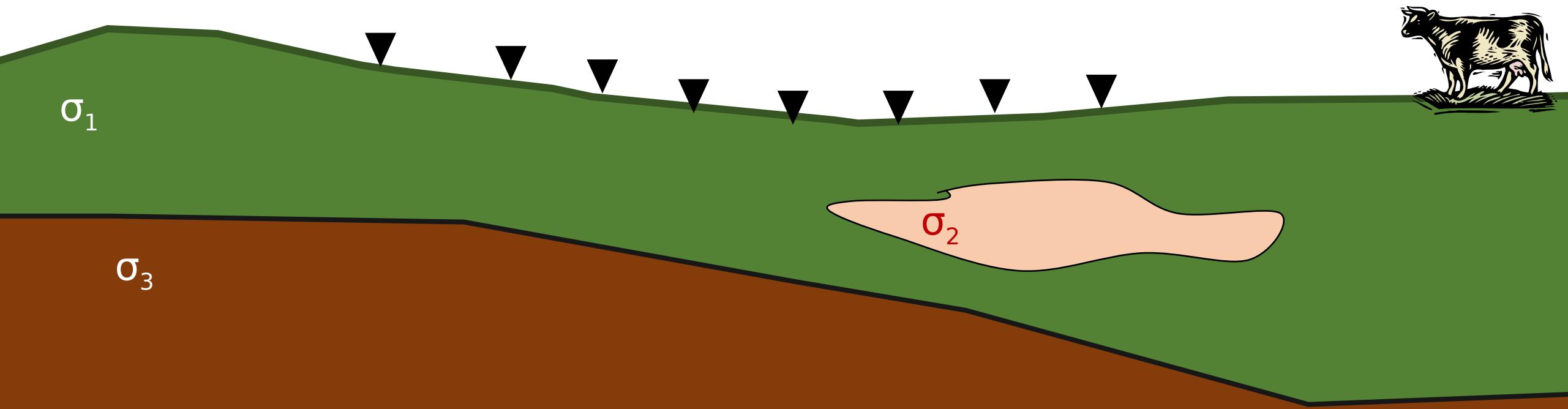


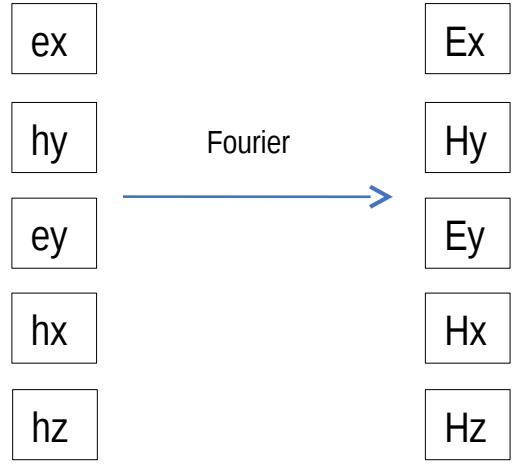


$$\begin{bmatrix} E_x \\ E_y \end{bmatrix} = \begin{bmatrix} Z_{xx} & Z_{xy} \\ Z_{yx} & Z_{yy} \end{bmatrix} \begin{bmatrix} H_x \\ H_y \end{bmatrix}$$

Vetores de indução

$$H_z(\omega) = \begin{bmatrix} T_x(\omega) & T_y(\omega) \end{bmatrix} \begin{bmatrix} H_x(\omega) \\ H_y(\omega) \end{bmatrix}$$



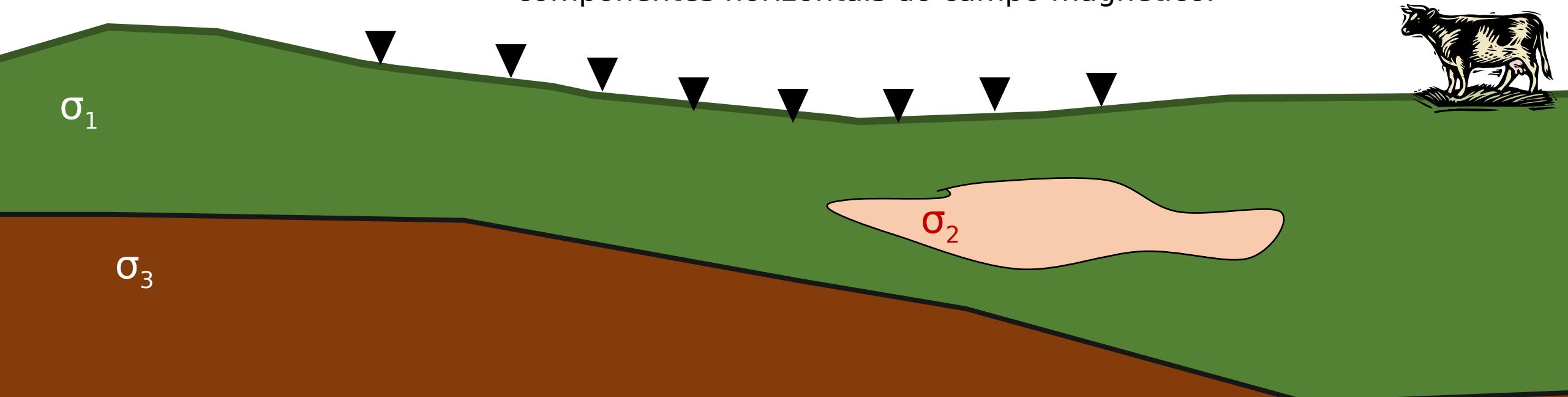


$$\begin{bmatrix} E_x \\ E_y \end{bmatrix} = \begin{bmatrix} Z_{xx} & Z_{xy} \\ Z_{yx} & Z_{yy} \end{bmatrix} \begin{bmatrix} H_x \\ H_y \end{bmatrix}$$

Vetores de indução

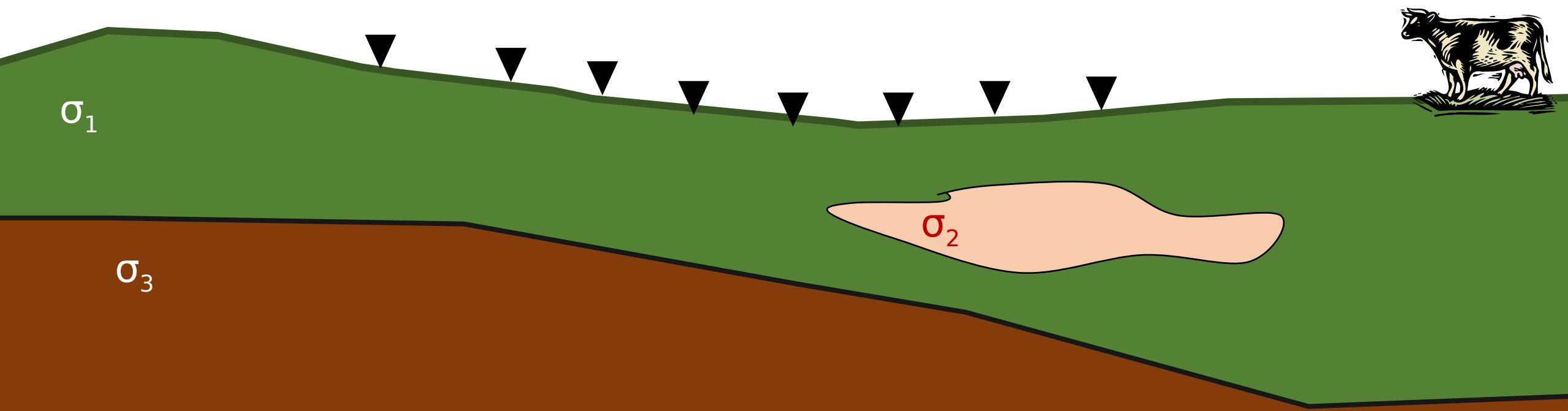
$$H_z(\omega) = \begin{bmatrix} T_x(\omega) & T_y(\omega) \end{bmatrix} \begin{bmatrix} H_x(\omega) \\ H_y(\omega) \end{bmatrix}$$

Razão complexa entre a componente vertical e componentes horizontais do campo magnético.



## Vetores de indução

Vetores de indução  
são sensíveis a  
variações laterais de  
condutividade



## Vetores de indução

Pouca variação

Vetores de indução  
são sensíveis a  
variações laterais de  
condutividade

$\sigma_1$

$\sigma_3$

$\sigma_2$



## Vetores de indução

Pouca variação

Vetores de indução  
são sensíveis a  
variações laterais de  
condutividade

$\sigma_1$

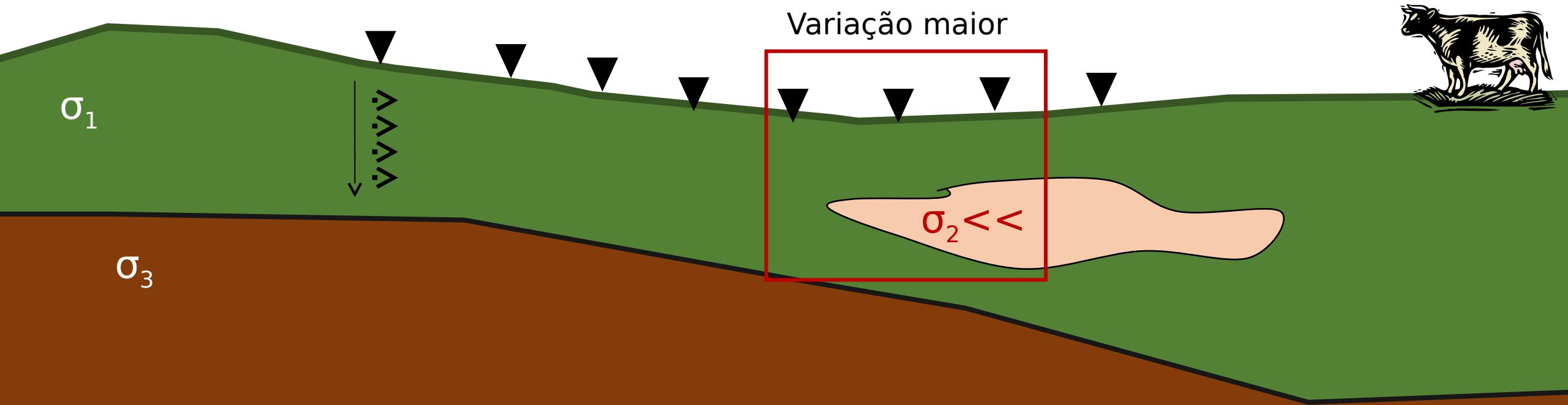
$\sigma_3$

$\sigma_2$



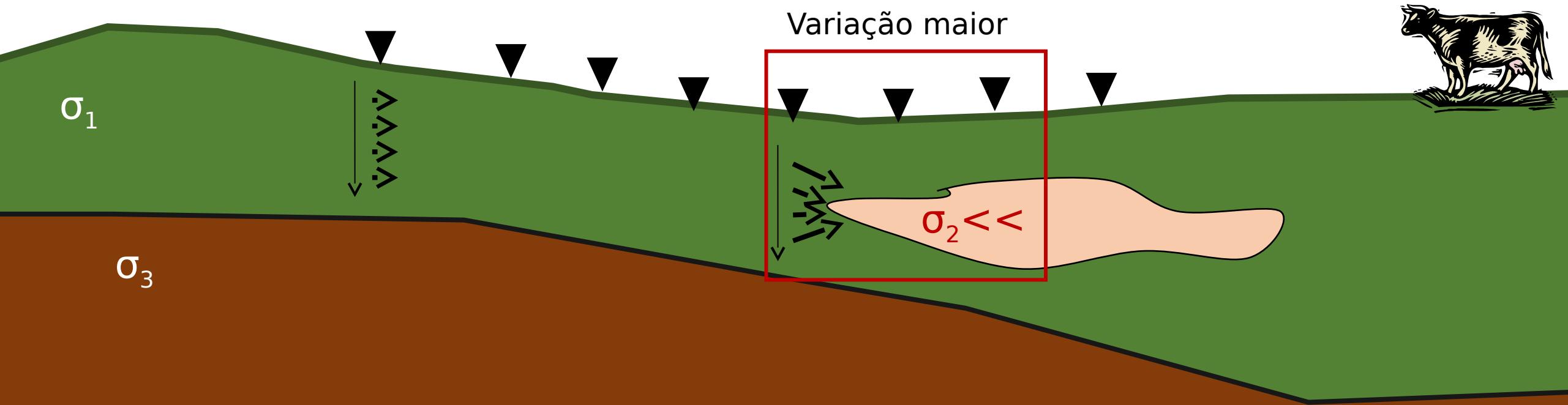
## Vetores de indução

Vetores de indução  
são sensíveis a  
variações laterais de  
condutividade

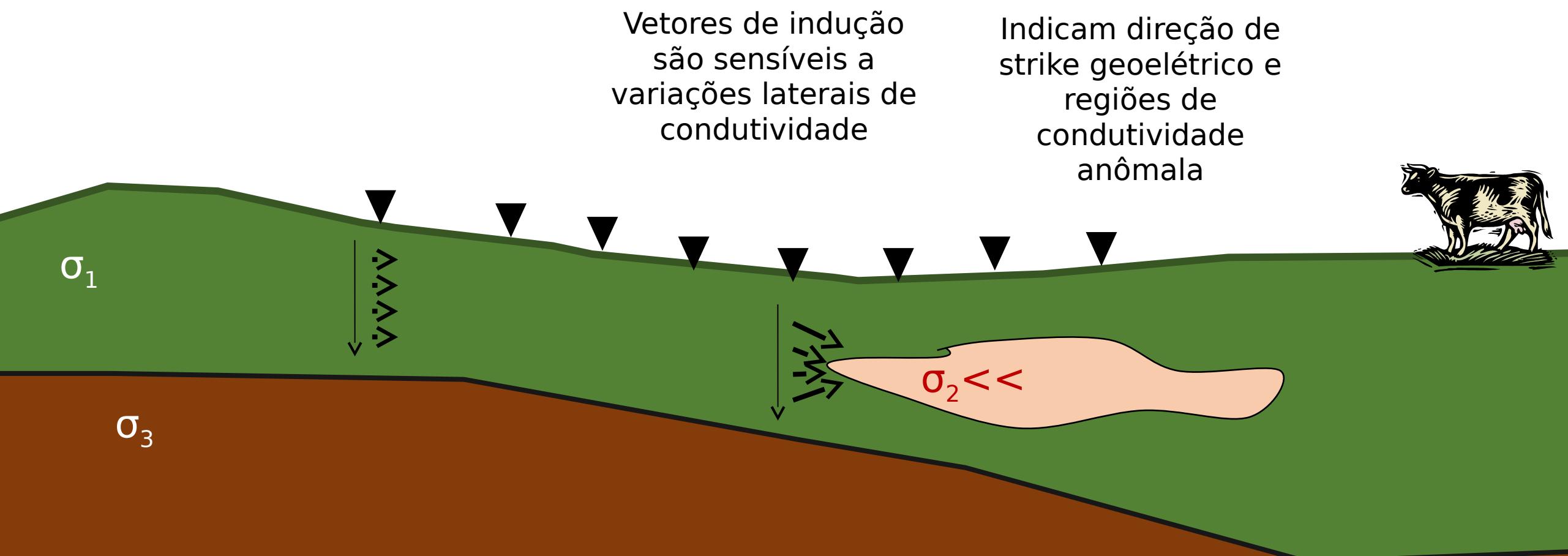


## Vetores de indução

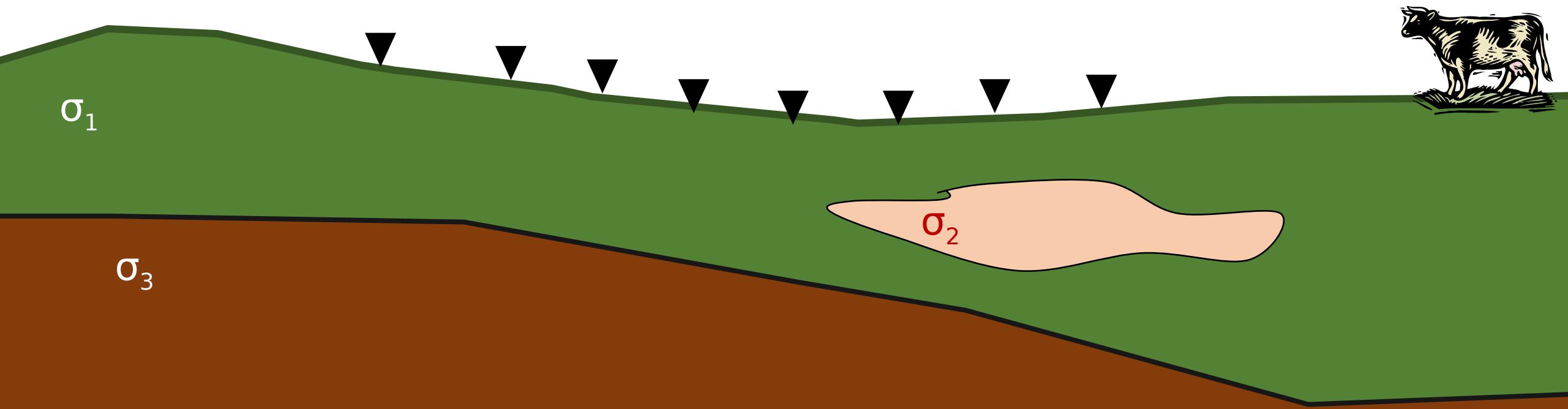
Vetores de indução  
são sensíveis a  
variações laterais de  
condutividade



## Vetores de indução



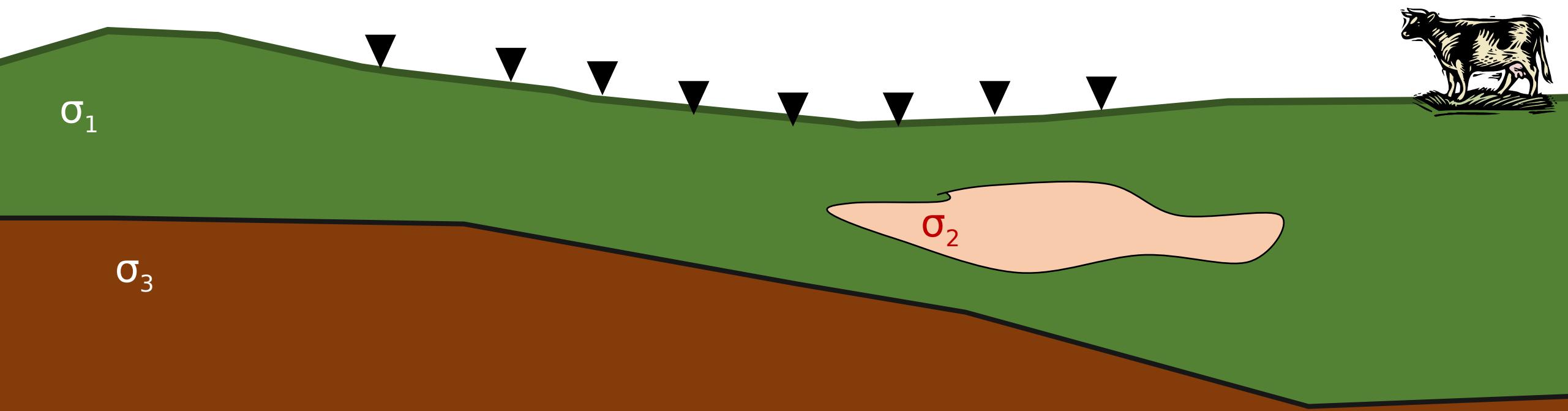
## Tensor de fase



## Tensor de fase

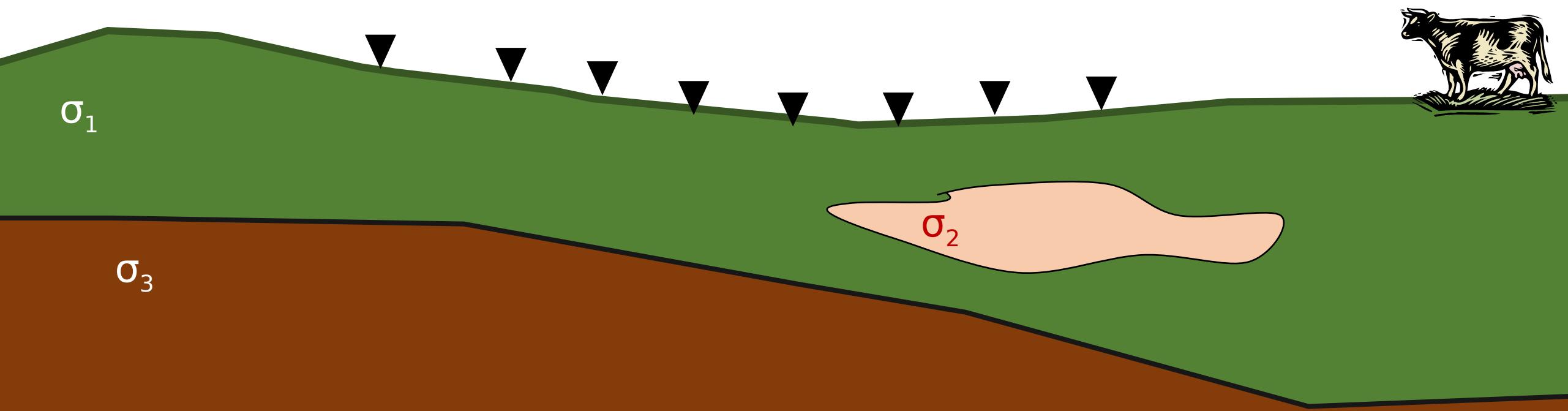
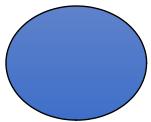
$$\mathbf{Z} = \mathbf{X} + i\mathbf{Y}$$

$$\Phi = \mathbf{X}^{-1}\mathbf{Y}$$



Tensor de fase

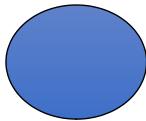
Representado por elipses



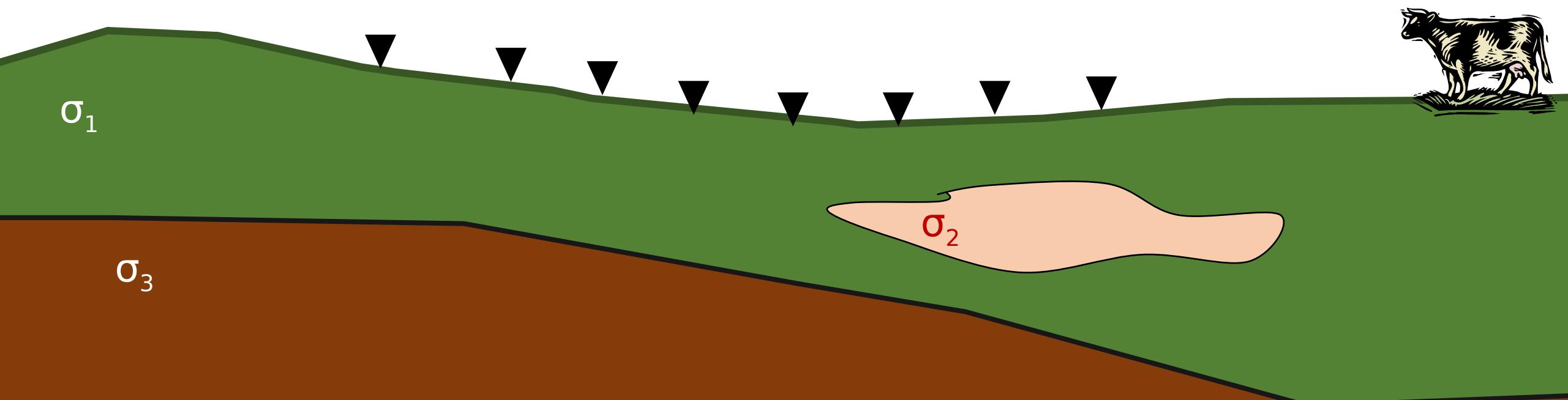
Tensor de fase

Representado por elipses

Elipticidade



Razão entre os eixos



Tensor de fase

Representado por elipses

Elipticidade

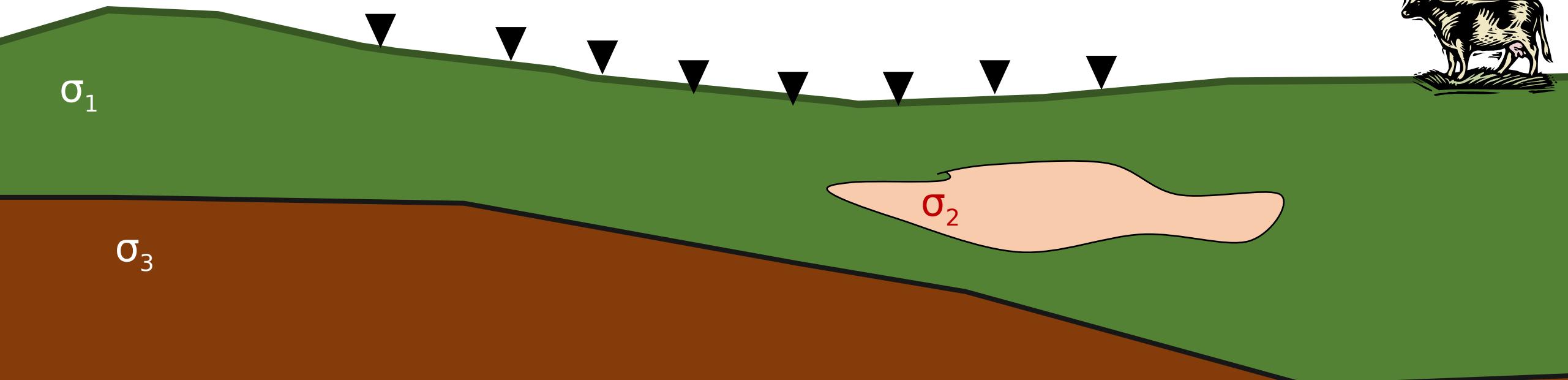
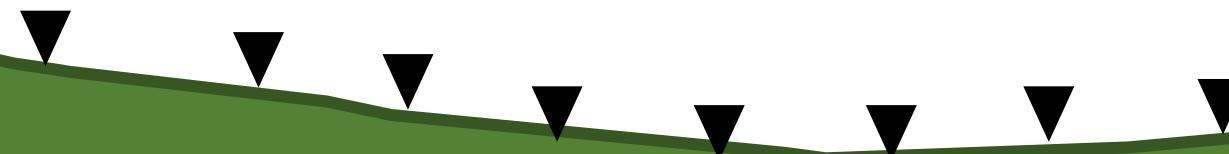
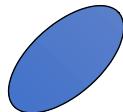
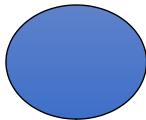
Skew

Ângulo de rotação

$\sigma_1$

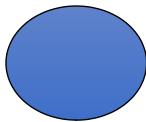
$\sigma_3$

$\sigma_2$

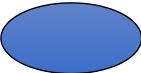


Tensor de fase

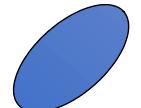
Representado por elipses



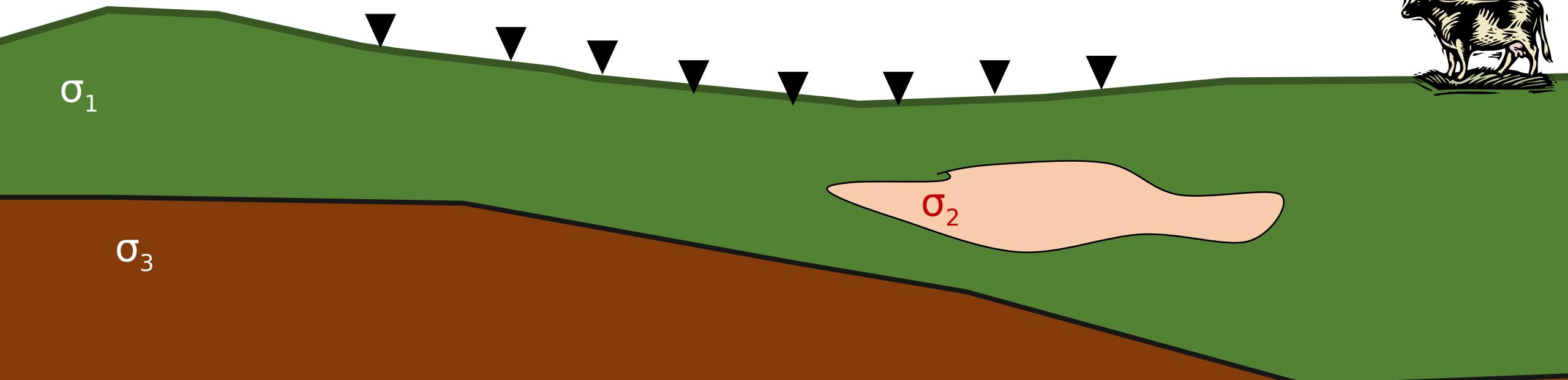
Elipticidade

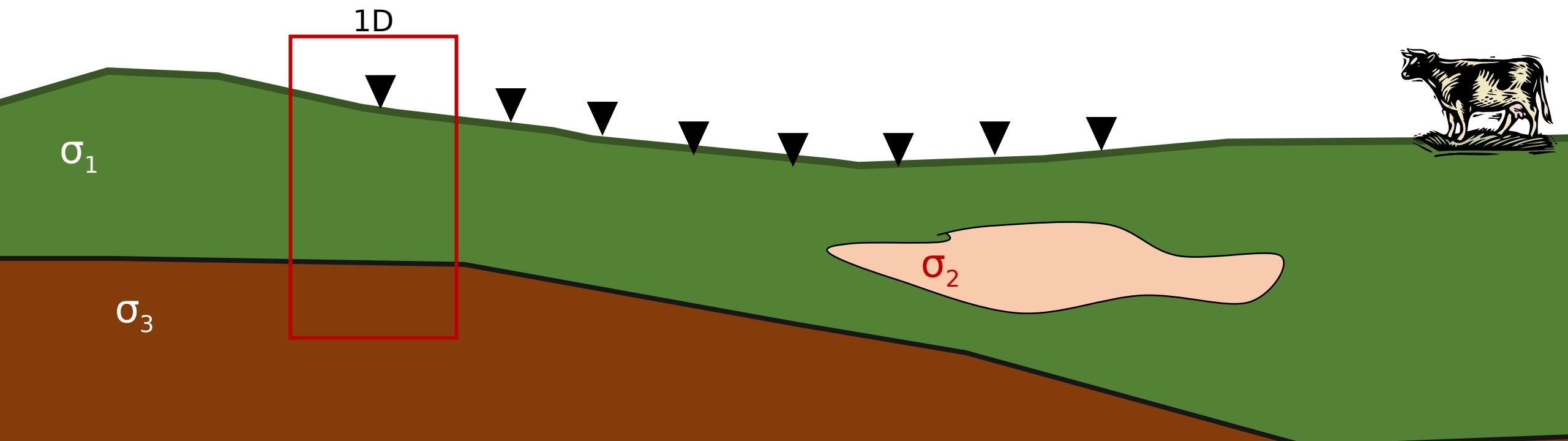


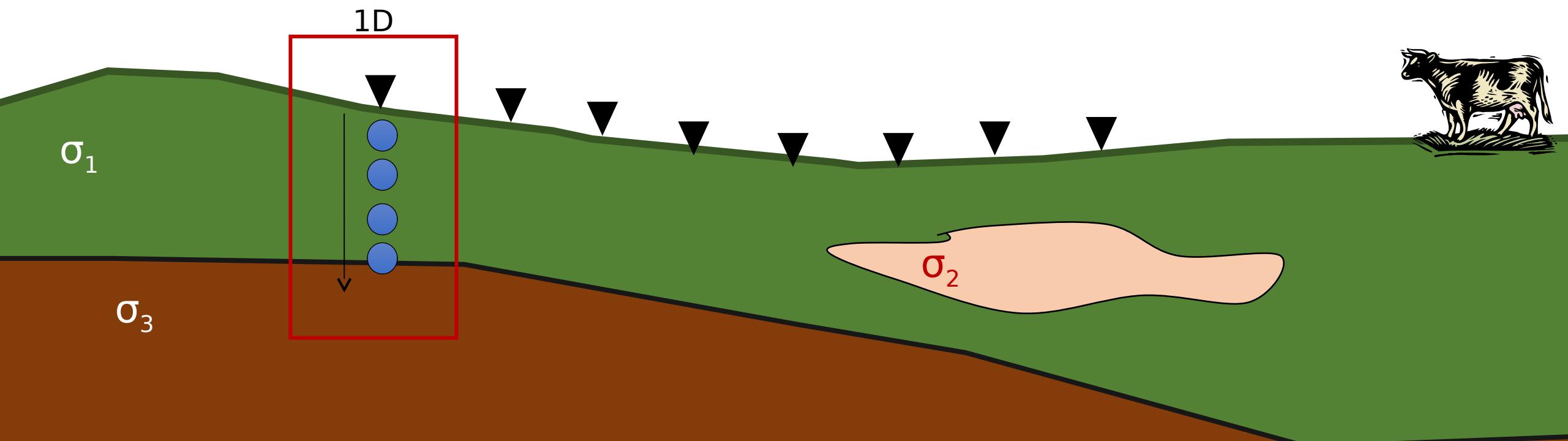
Skew

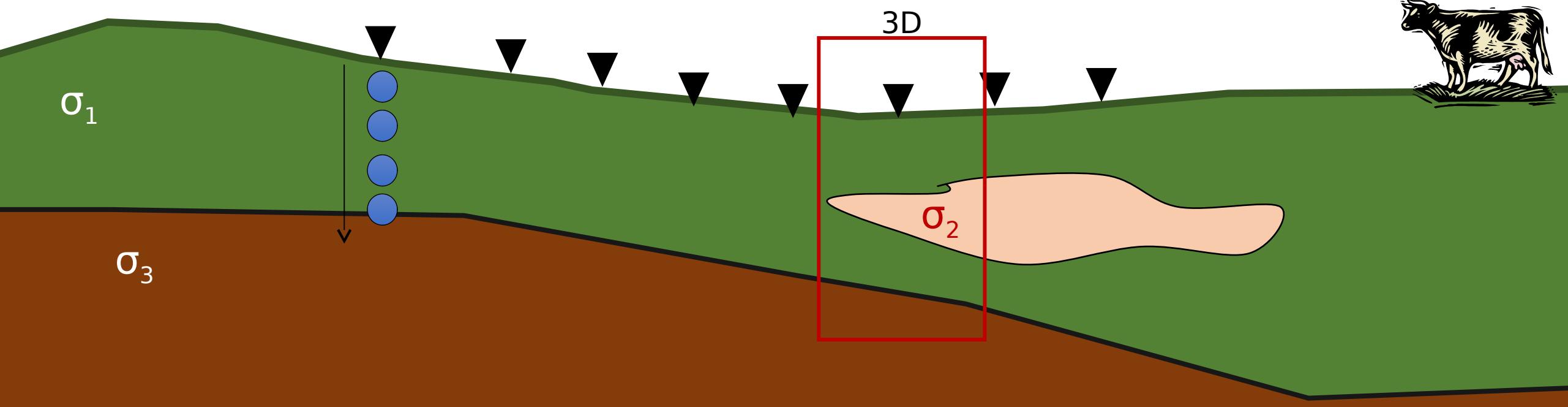


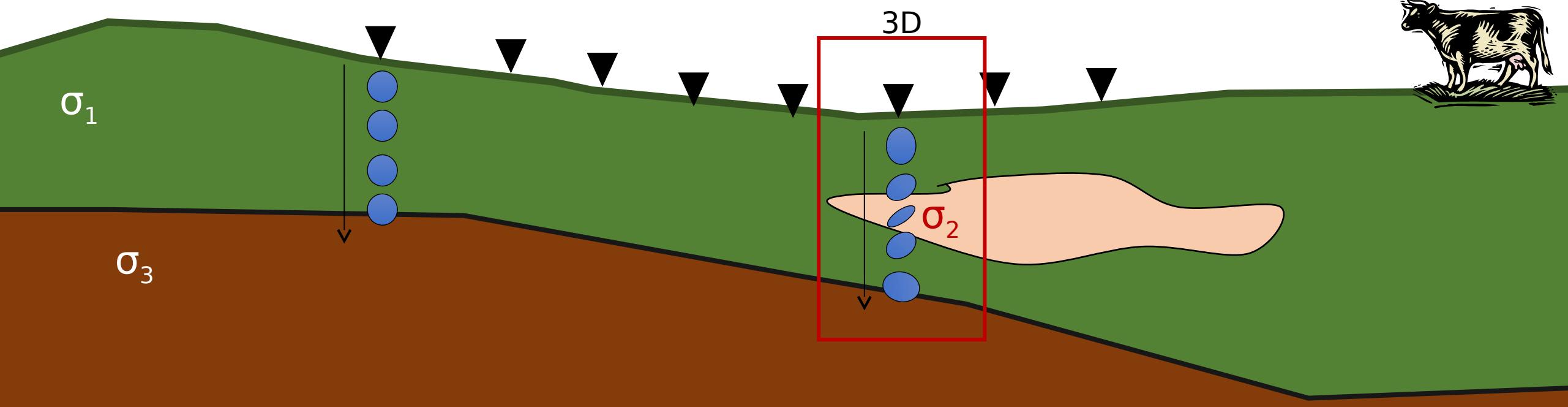
Indicar a assimetria causada  
pela presença de estruturas 3D.  
Mede em graus quanto o tensor  
de fase se distancia de uma  
resposta 1D ou 2D.

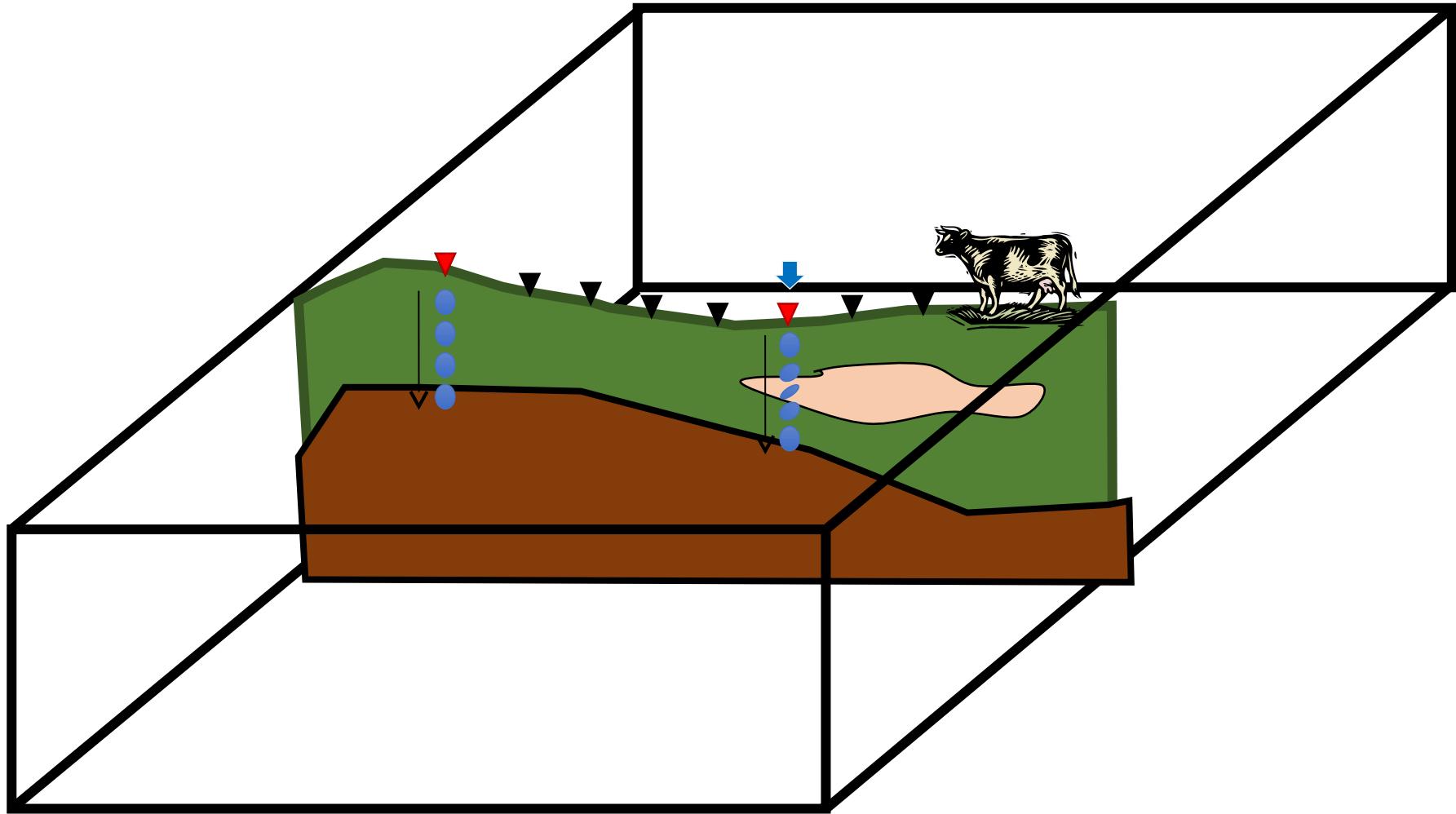


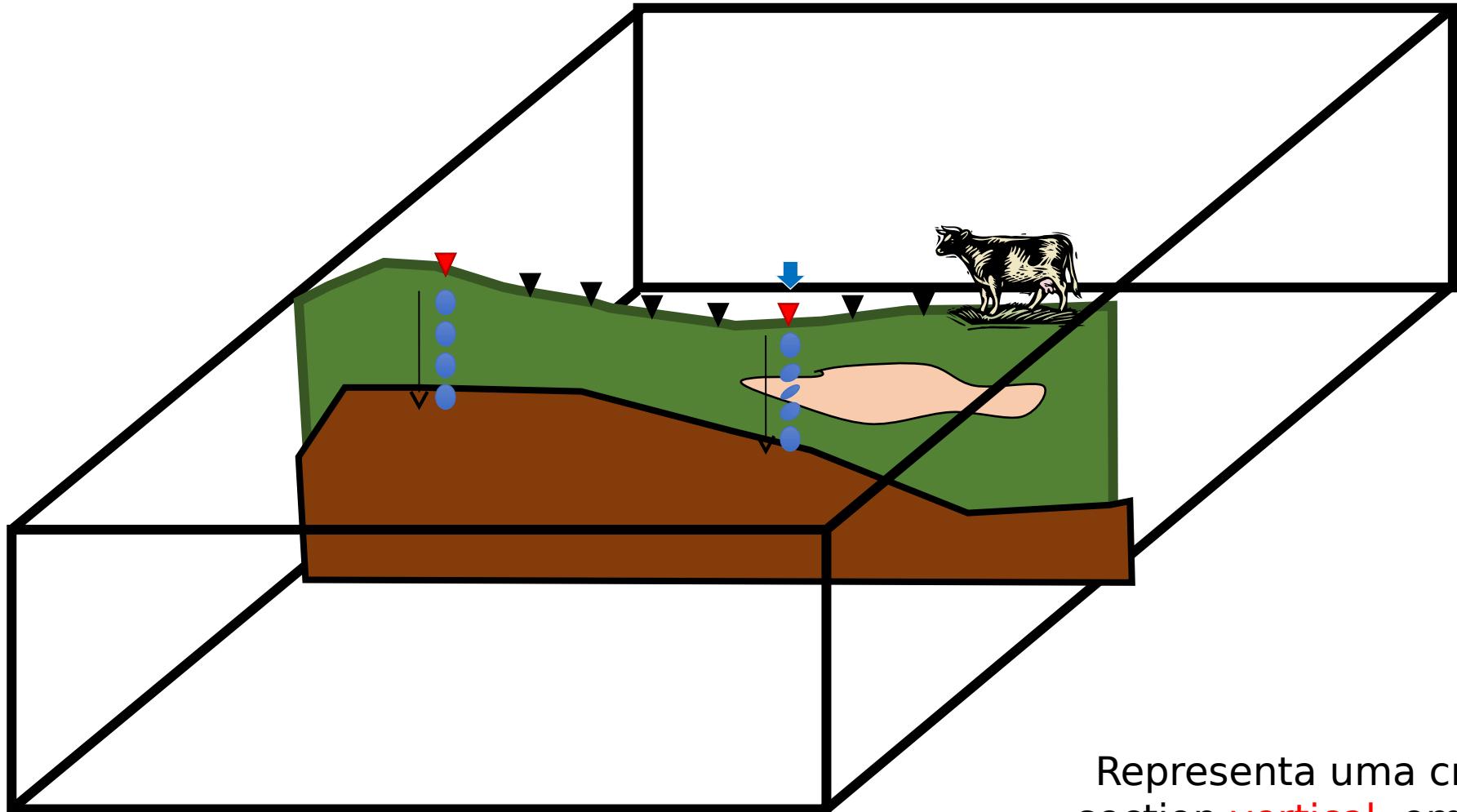






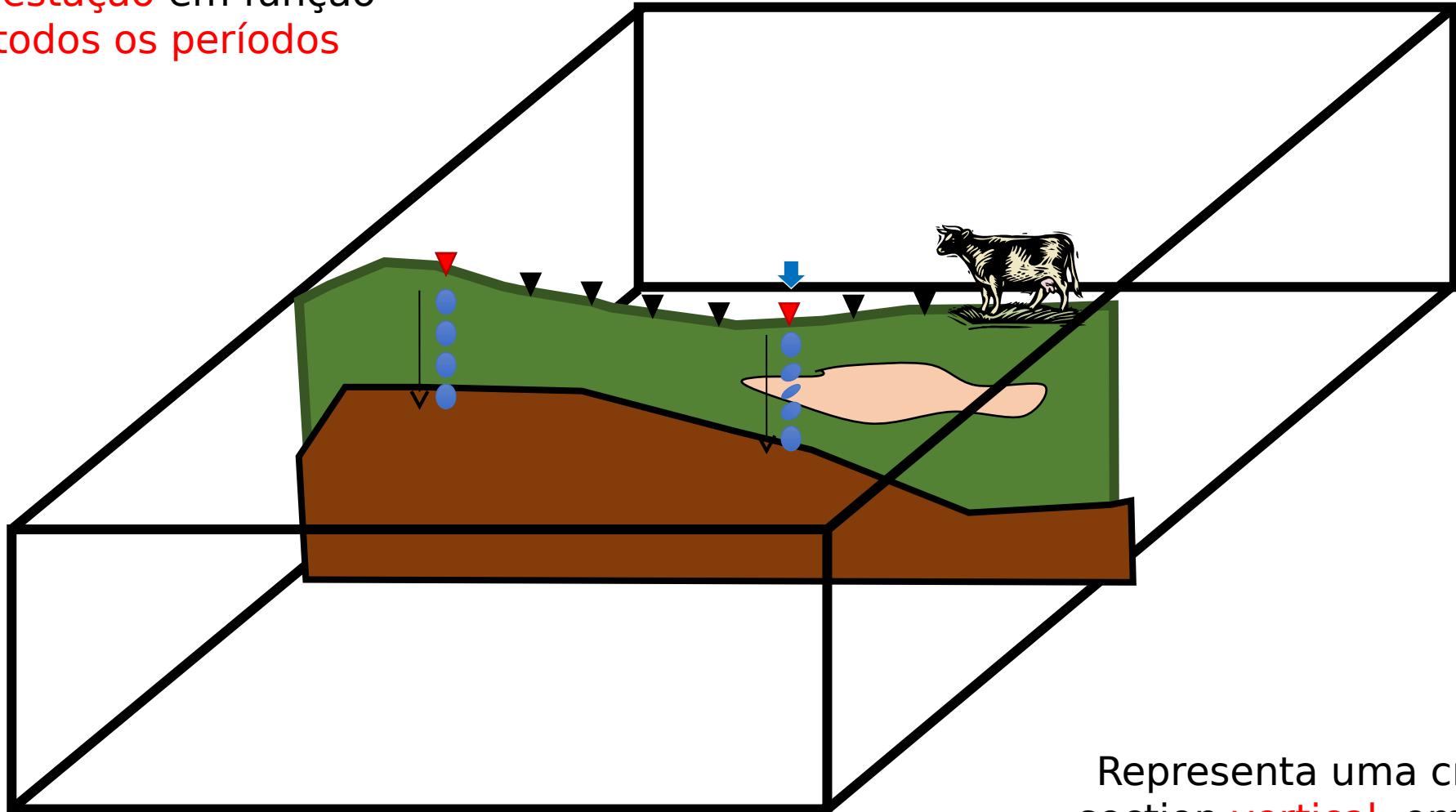




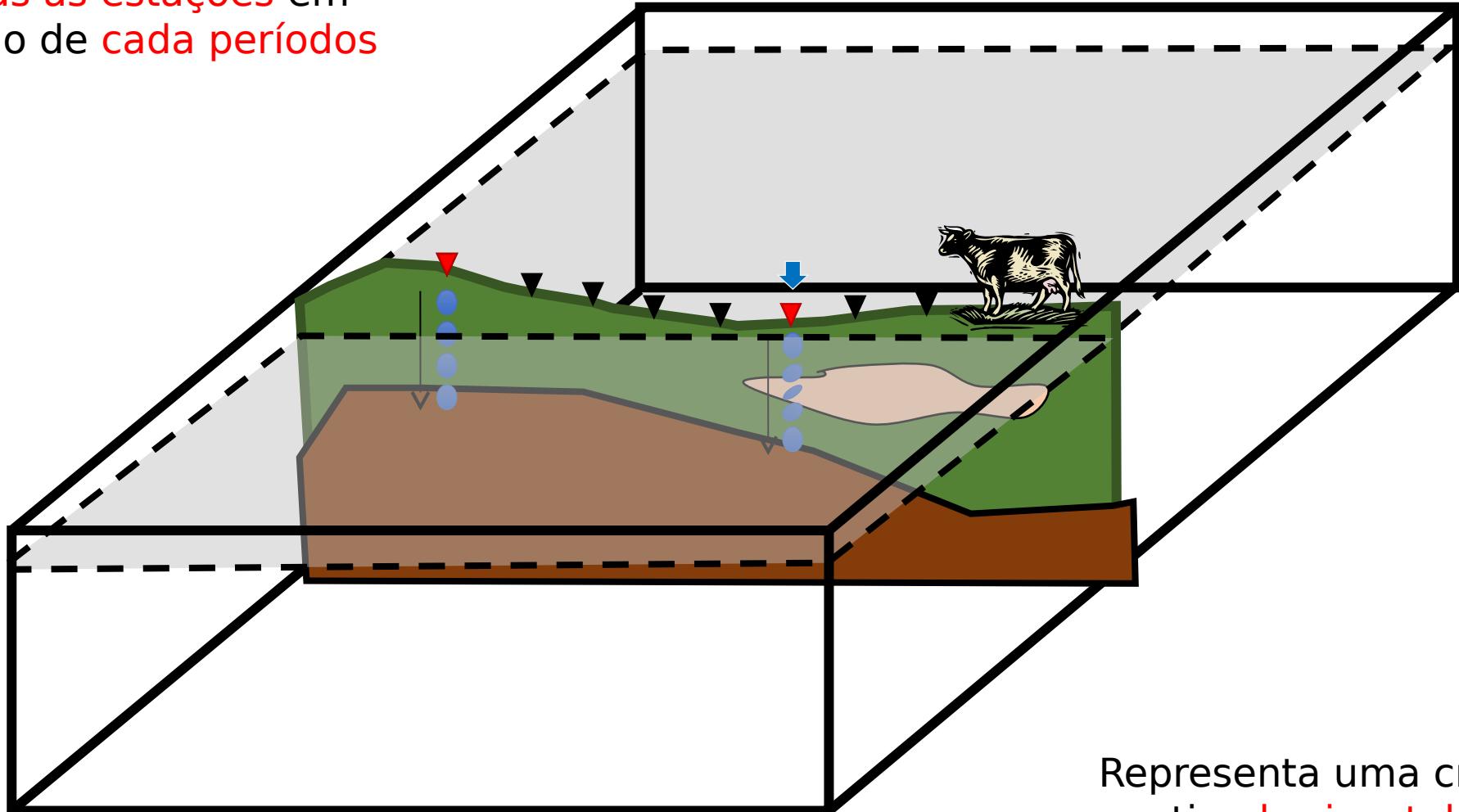


Representa uma cross-section **vertical** em uma região 3D

Vetores de indução ou  
tensores de fase para  
**cada estação** em função  
de todos os períodos

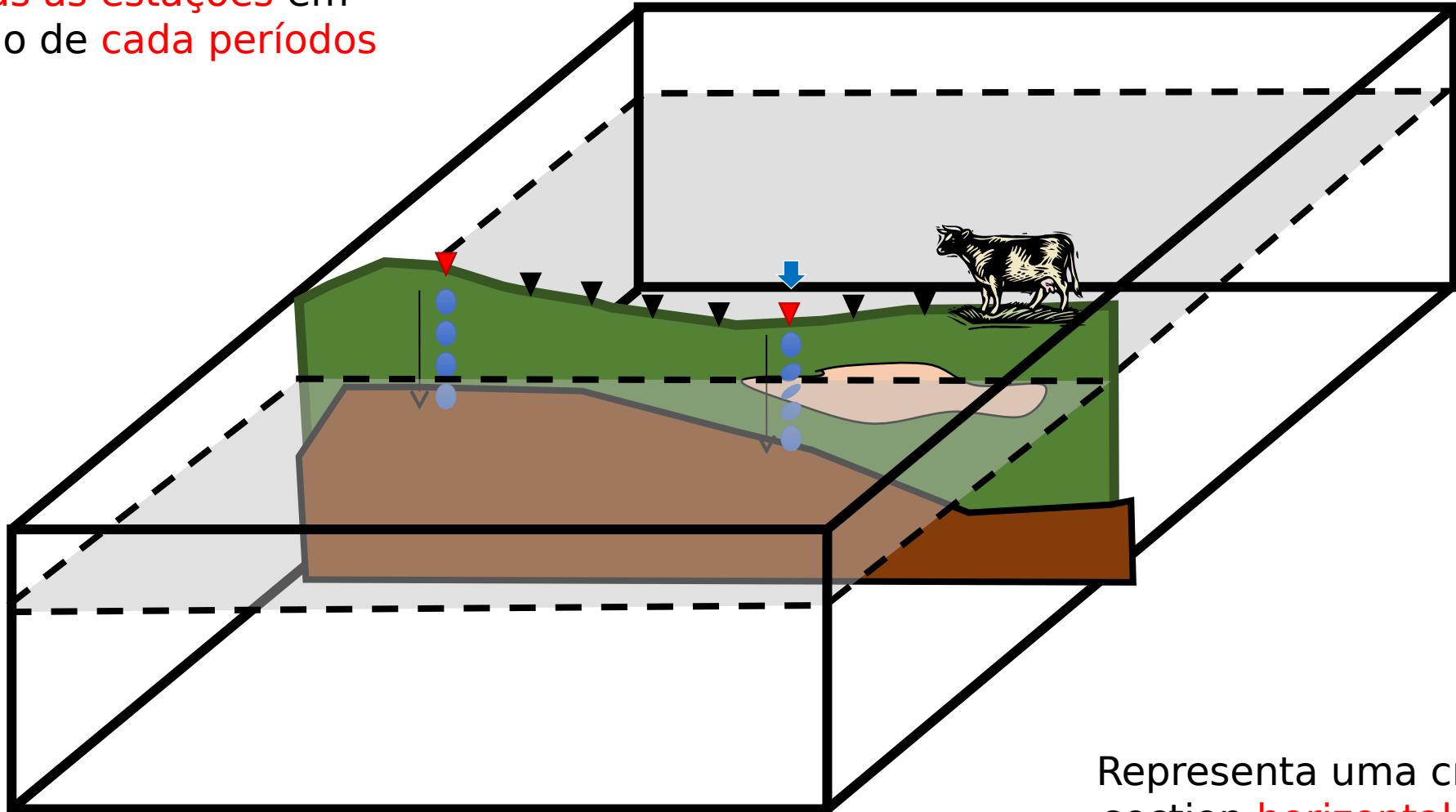


Vetores de indução ou  
tensores de fase para  
**todas as estações** em  
função de **cada períodos**



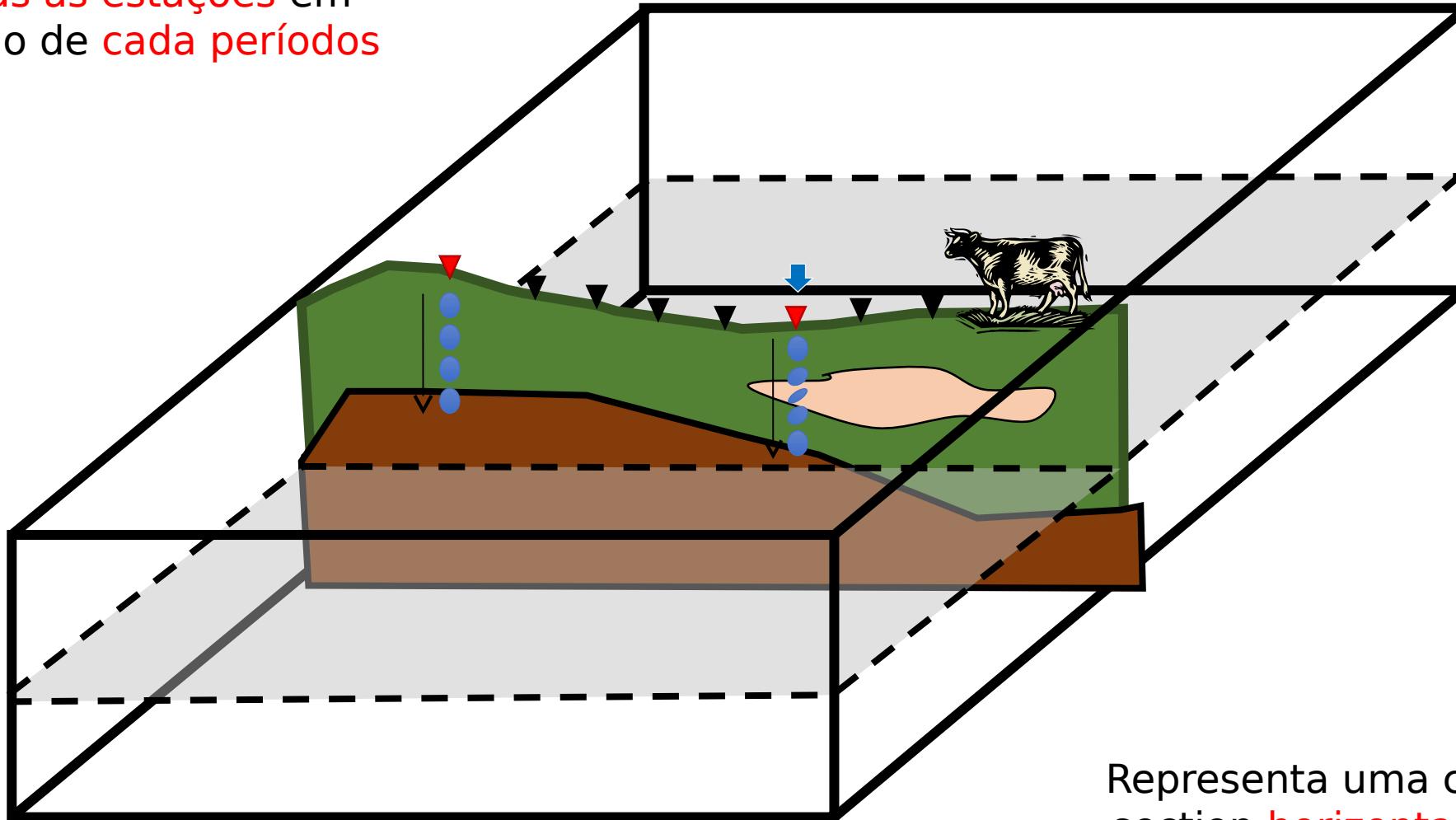
Representa uma cross-  
section **horizontal** em  
uma região 3D

Vetores de indução ou  
tensores de fase para  
**todas as estações** em  
função de **cada períodos**



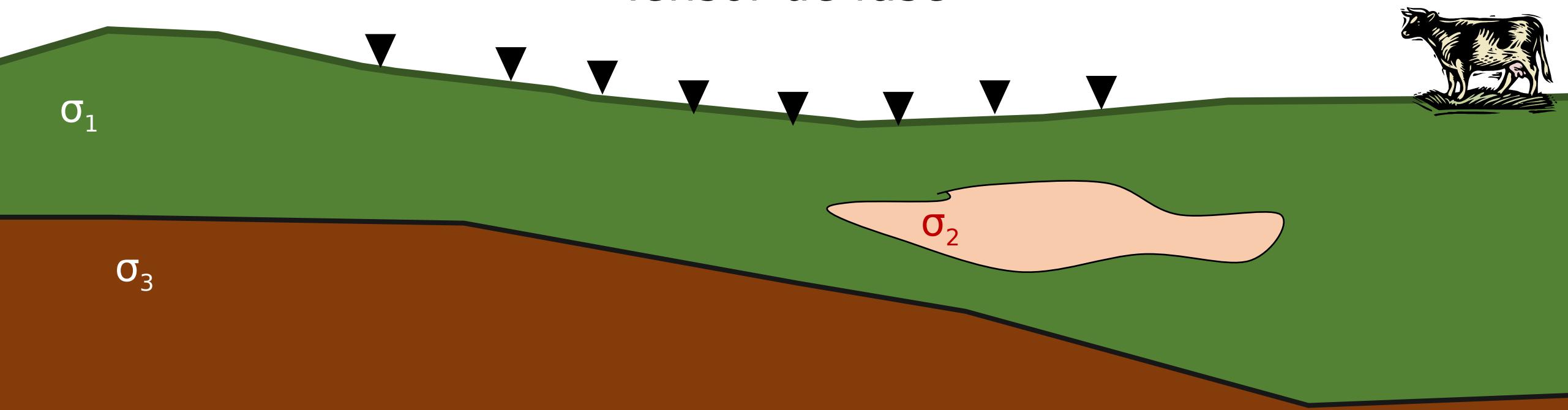
Representa uma cross-  
section **horizontal** em  
uma região 3D

Vetores de indução ou  
tensores de fase para  
**todas as estações** em  
função de **cada períodos**

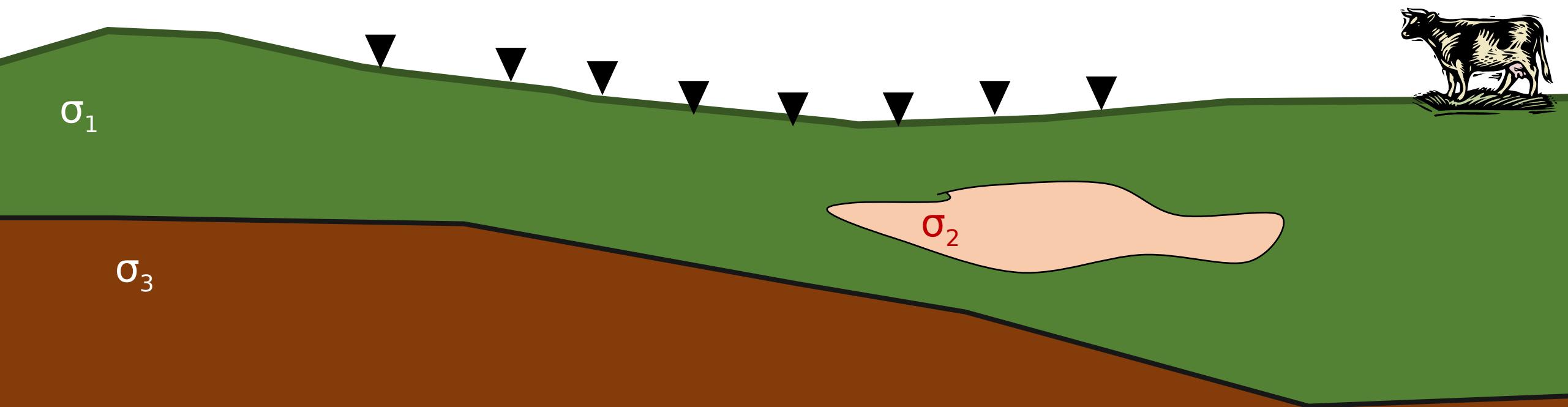


Representa uma cross-  
section **horizontal** em  
uma região 3D

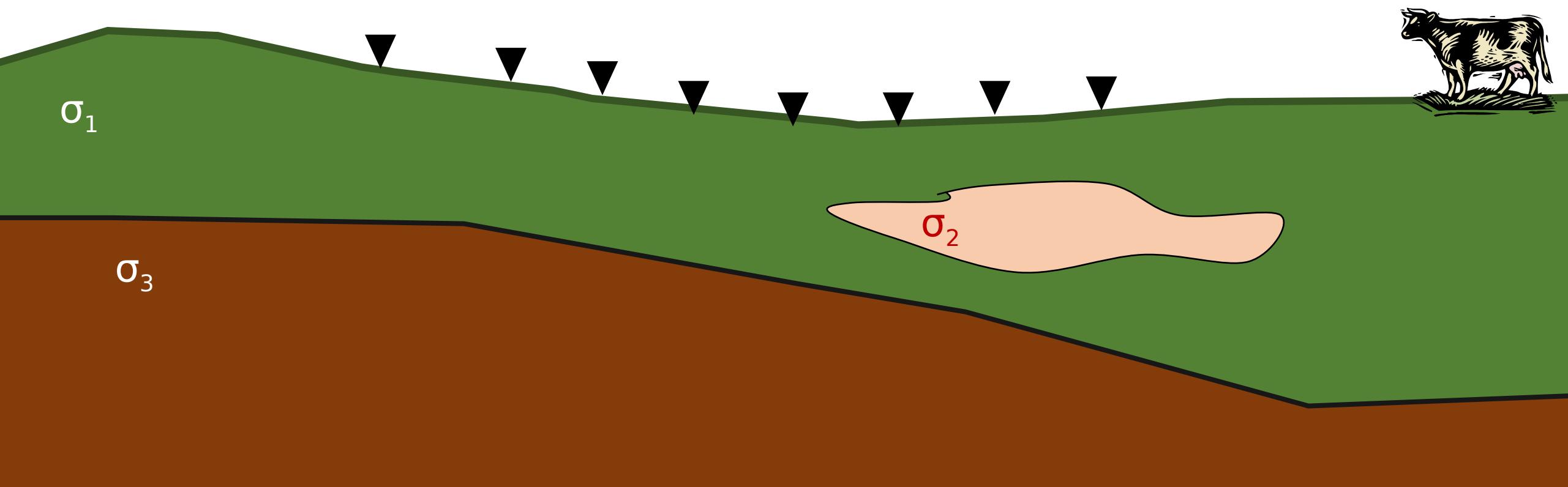
Tensor de Impedância  
Resistividade aparente e  
fase  
Vetores de indução  
Tensor de fase



Assume-se que estes dados são causadas por uma distribuição de condutividade elétrica no subsolo.



Qual é a distribuição de condutividade elétrica que gera os dados observados em todas as estações MT?



# Metodologia

Modelagem 3D MT

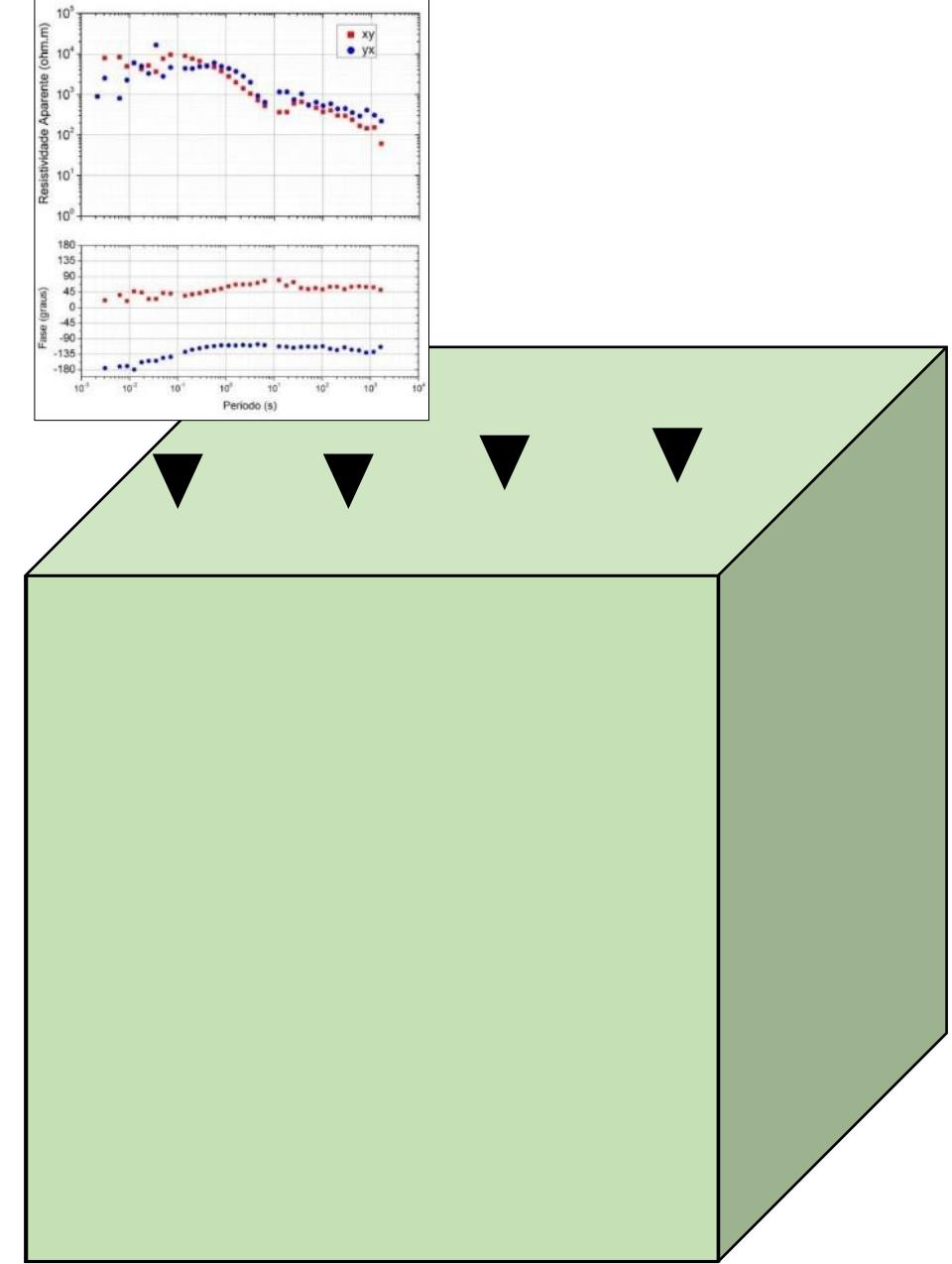
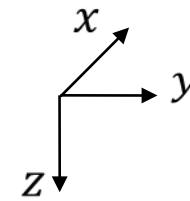
Inversão 3D MT

# Metodologia

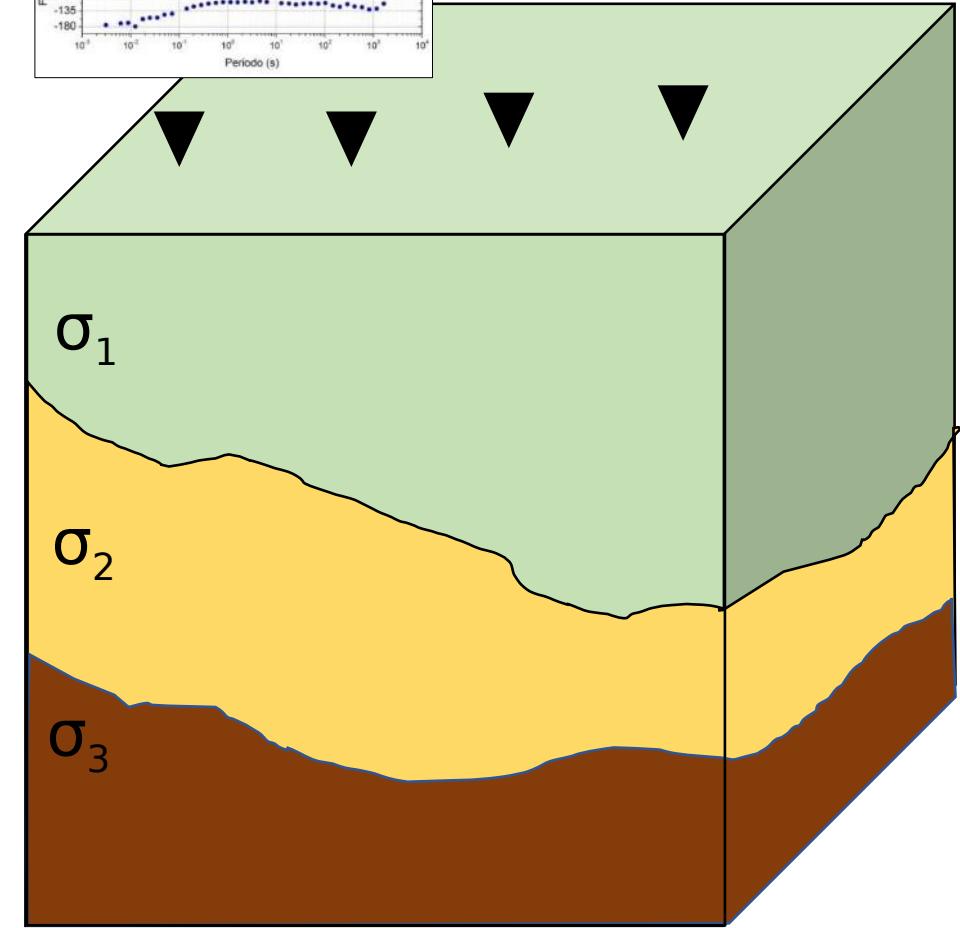
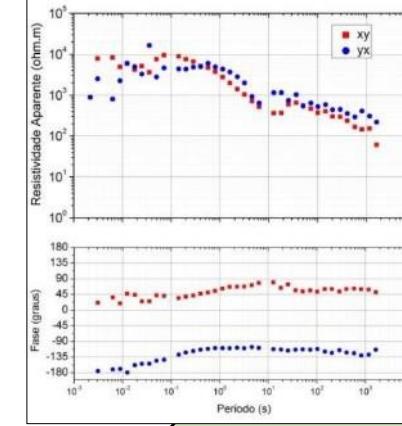
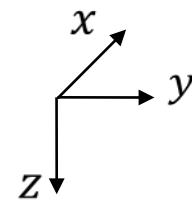
Modelagem 3D MT

Inversão 3D MT

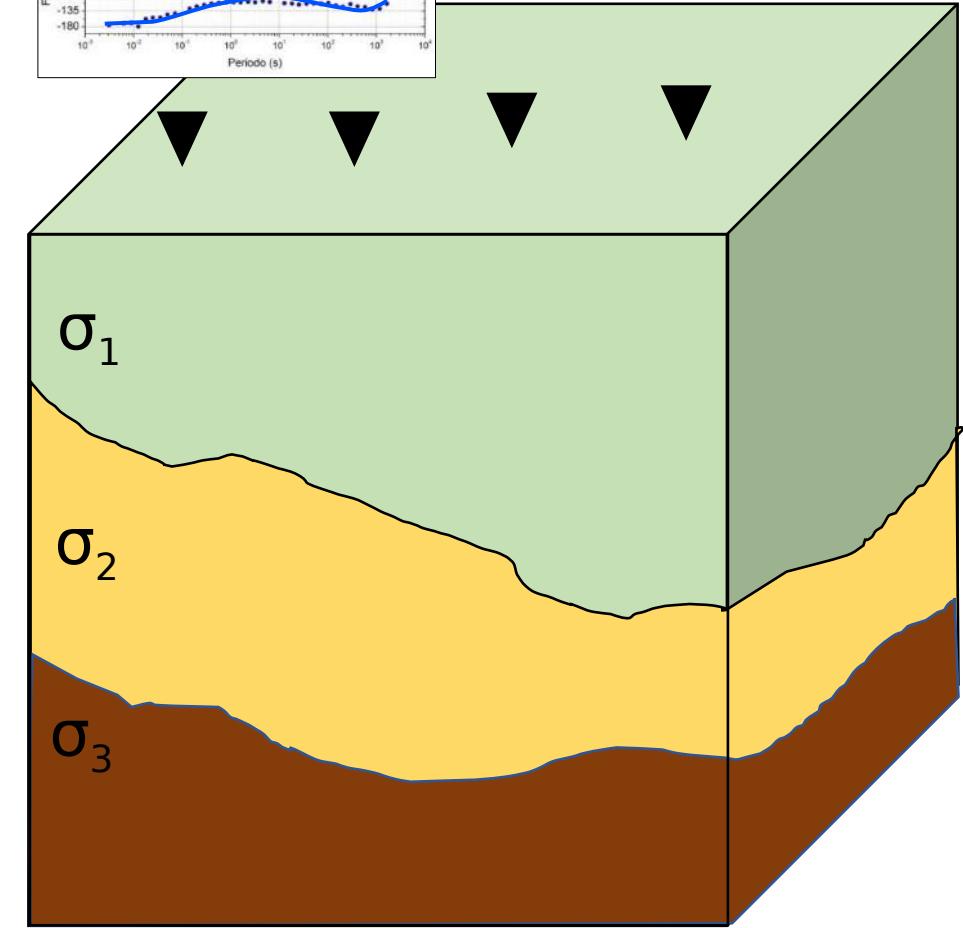
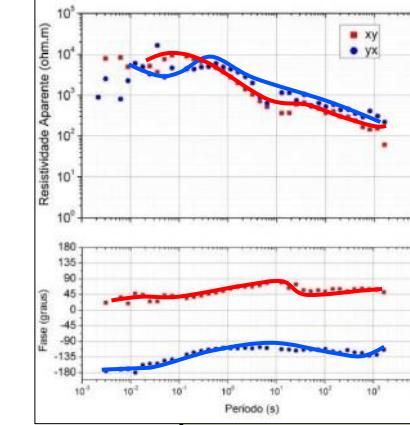
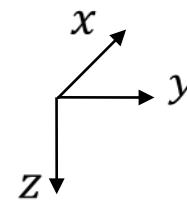
# Modelagem 3D



# Modelagem 3D



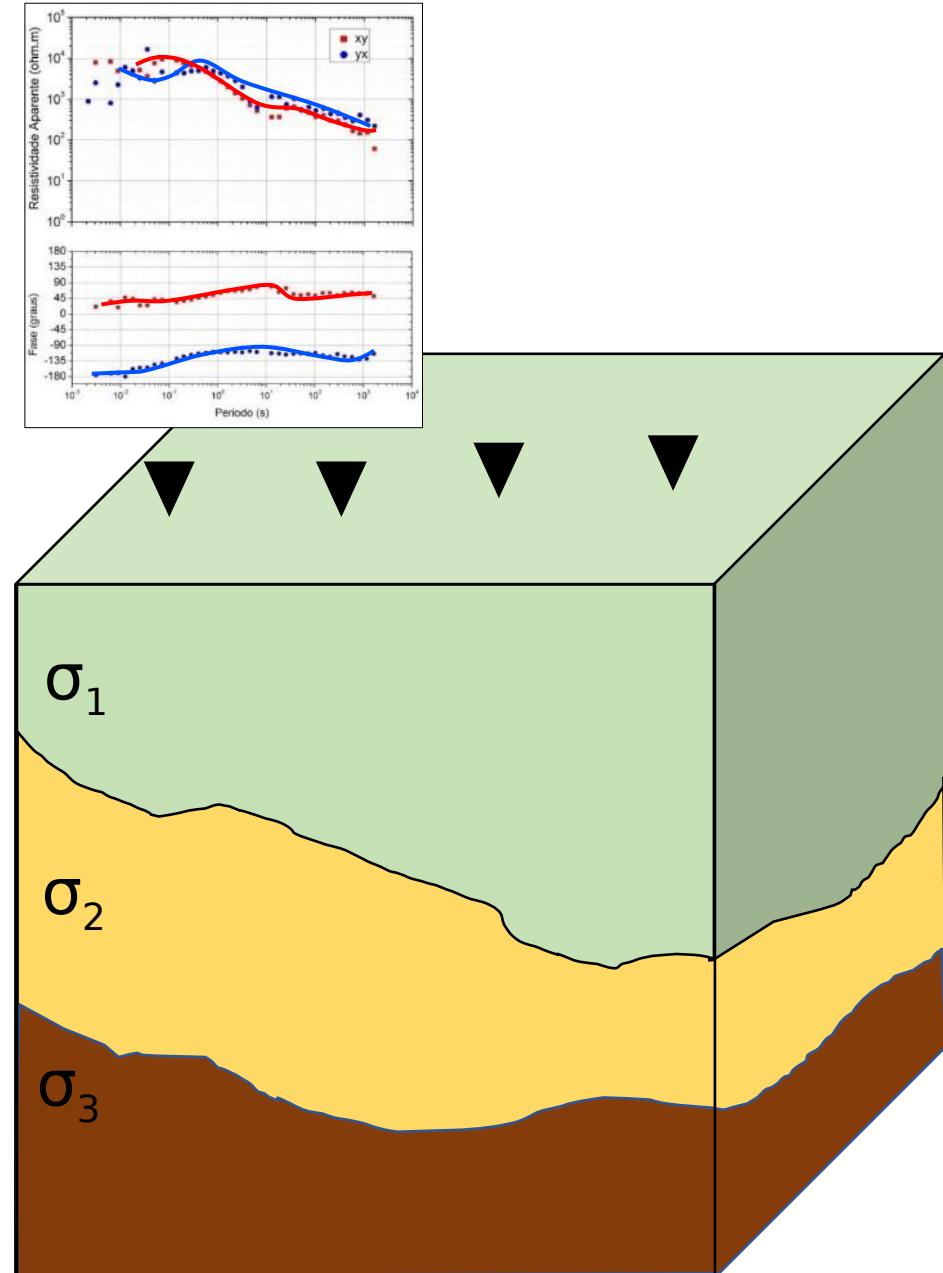
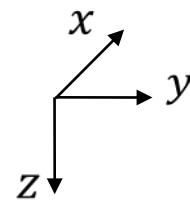
# Modelagem 3D



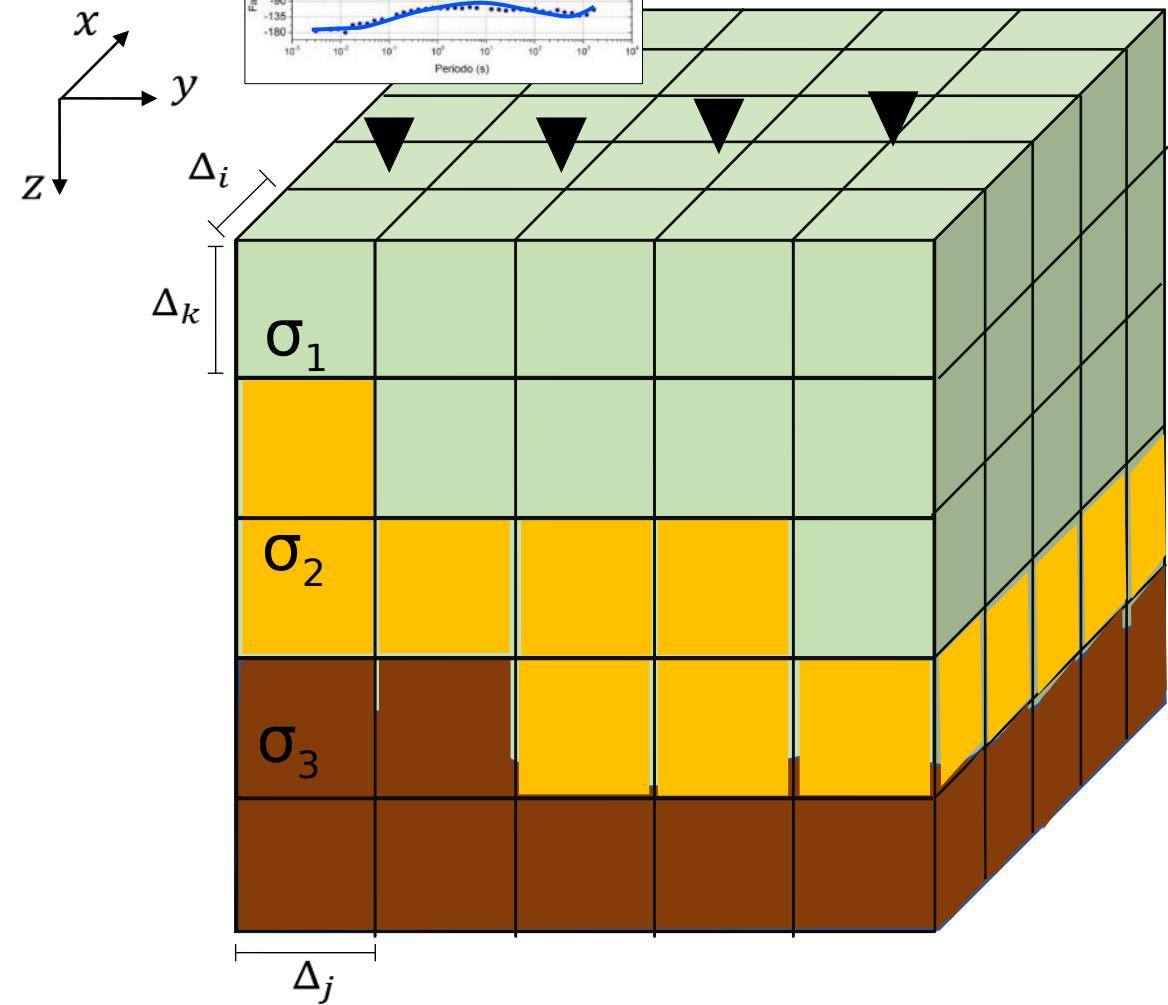
# Modelagem 3D

$$\nabla \times \nabla \times \mathbf{E} + i\mu\omega\sigma\mathbf{E} = 0$$

Diferenças Finitas

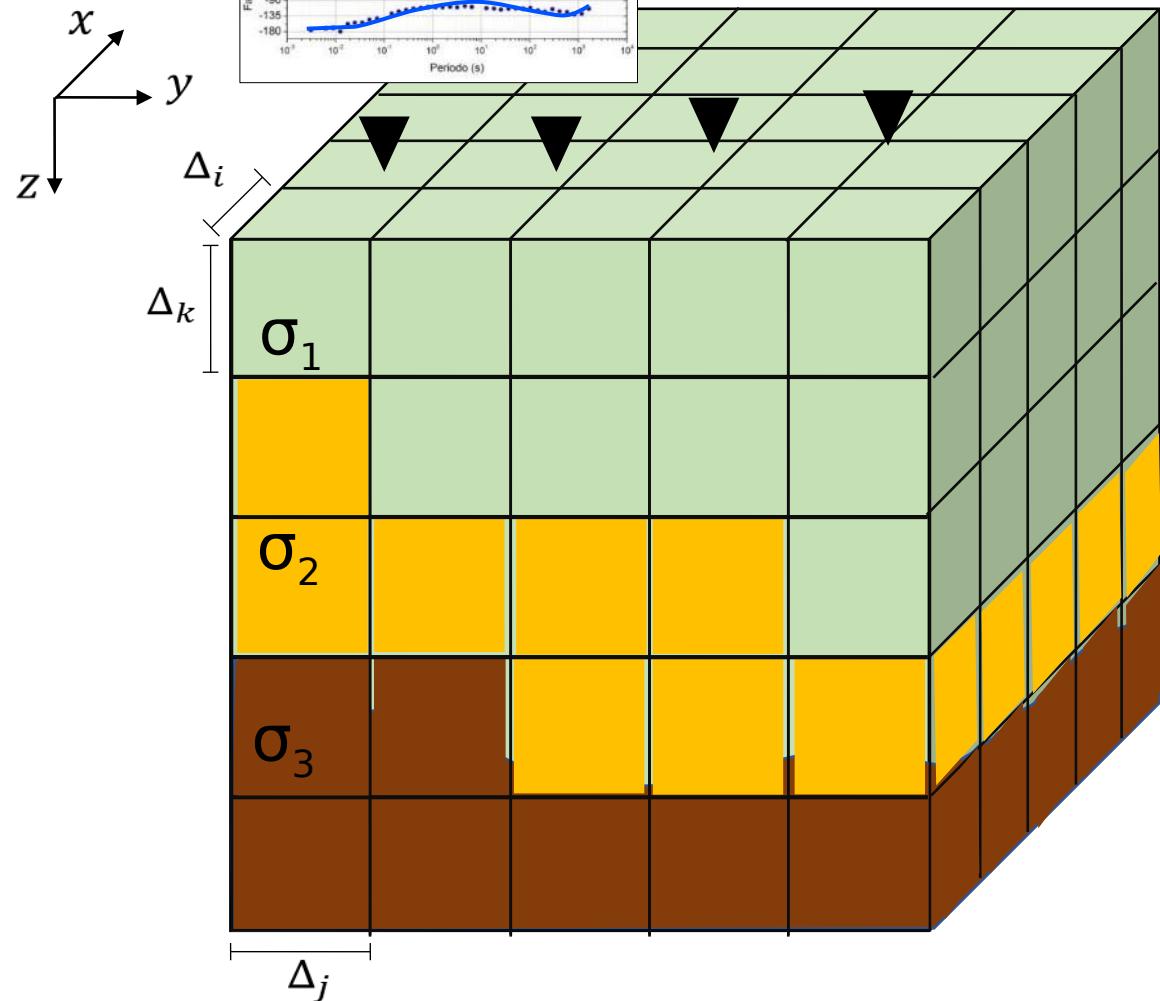


# Modelagem 3D



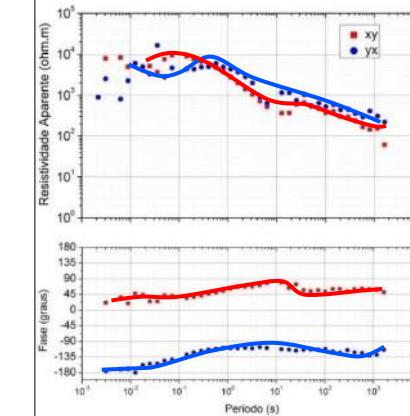
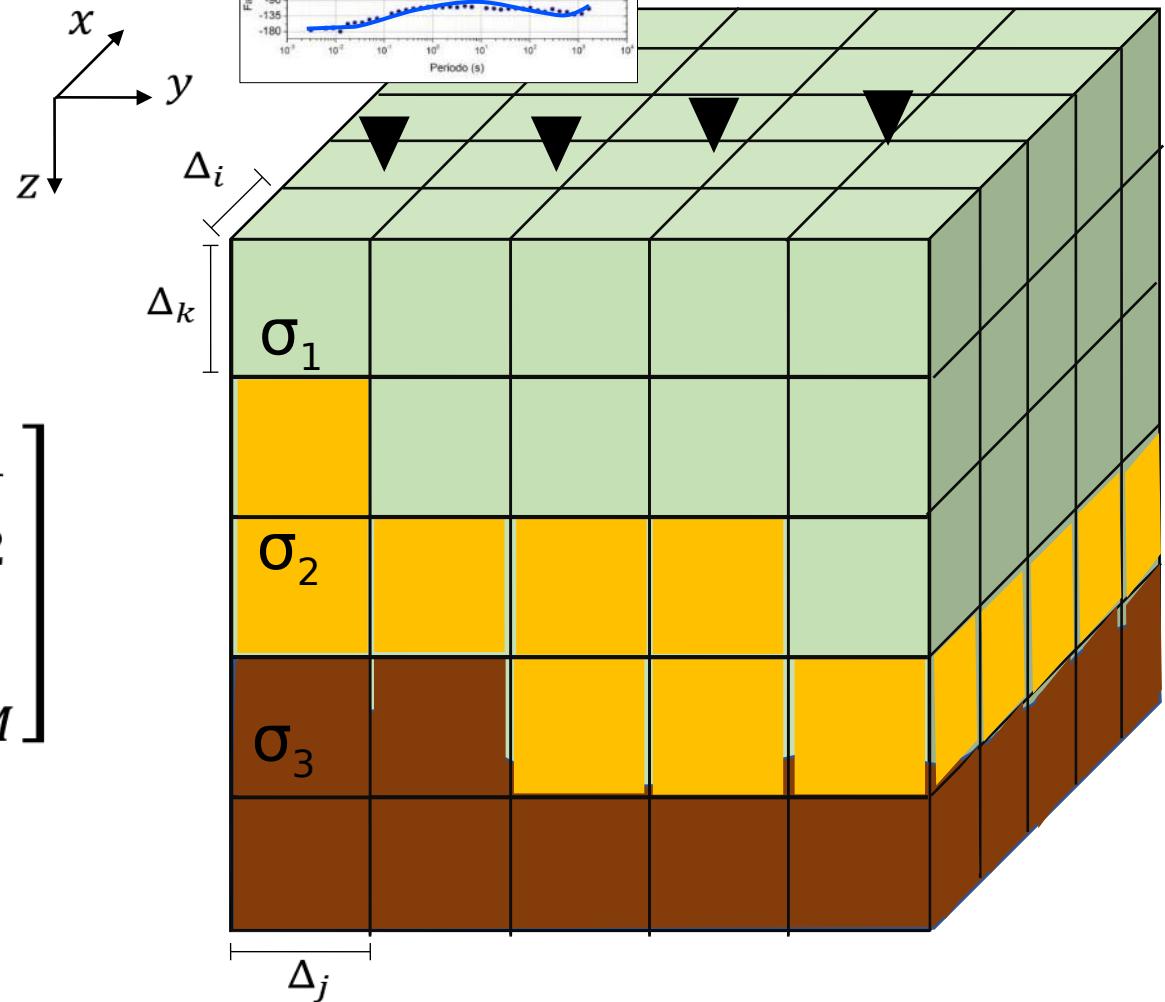
# Modelagem 3D

Dimensões e  
condutividade  
conhecidas



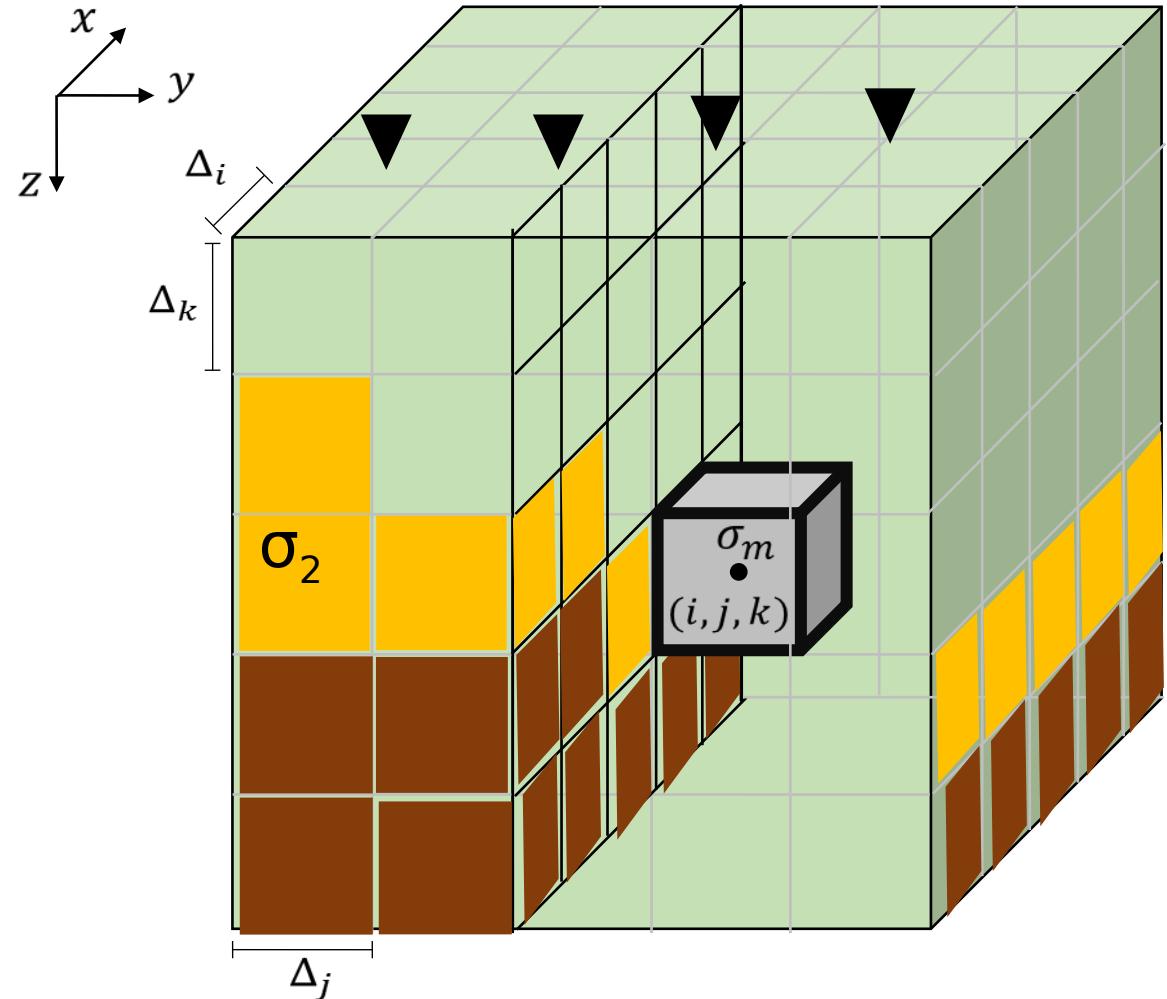
# Modelagem 3D

Vetor de parâmetros  $\boldsymbol{\sigma} = \begin{bmatrix} \sigma_1 \\ \sigma_2 \\ \vdots \\ \sigma_M \end{bmatrix}$

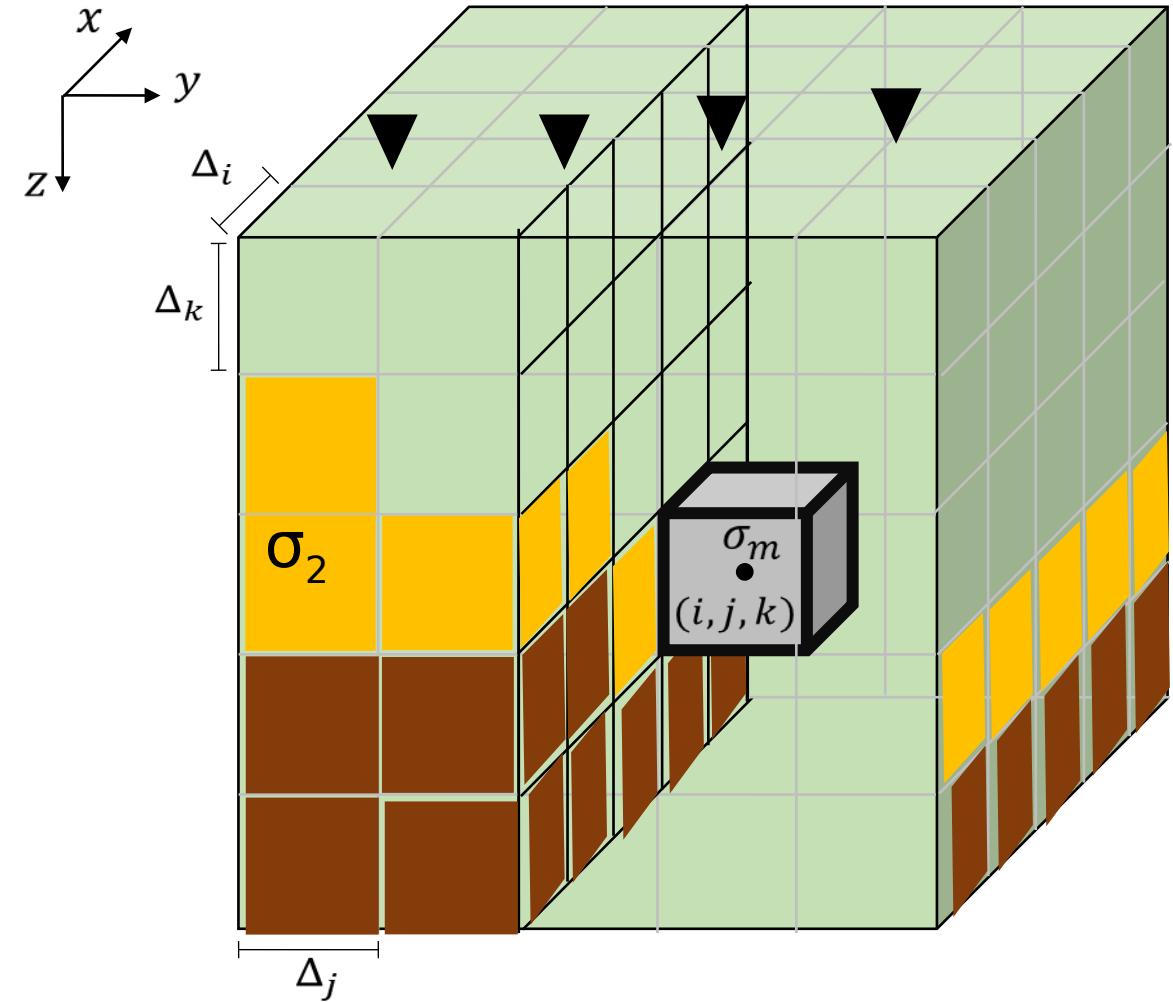
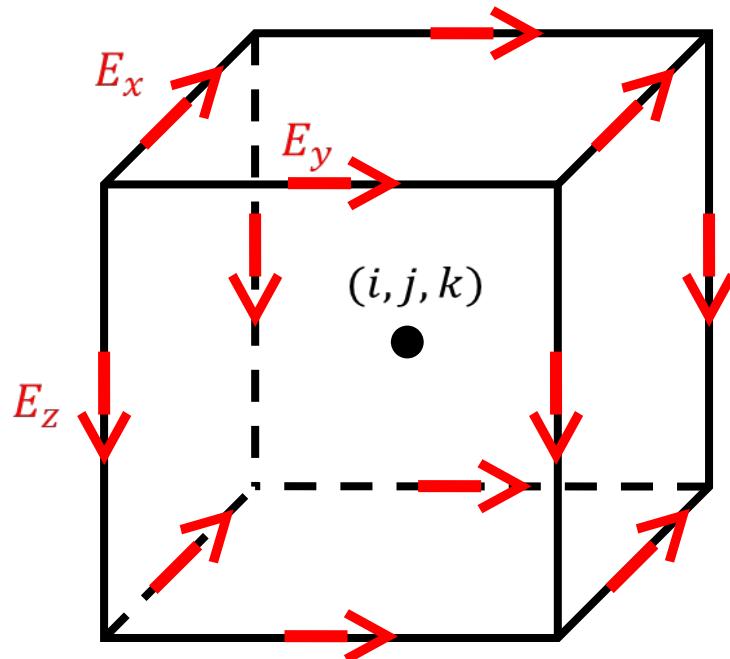


# Modelagem 3D

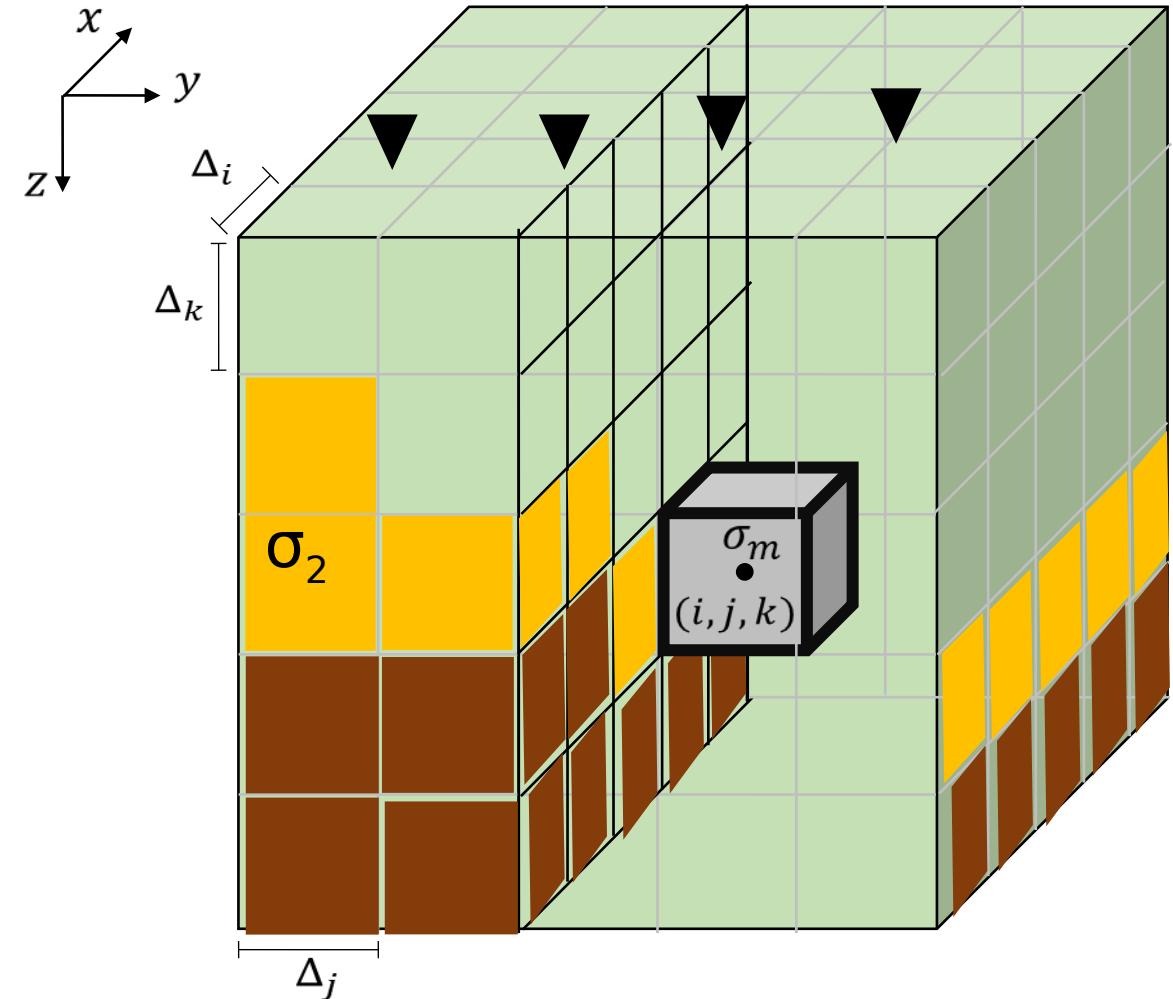
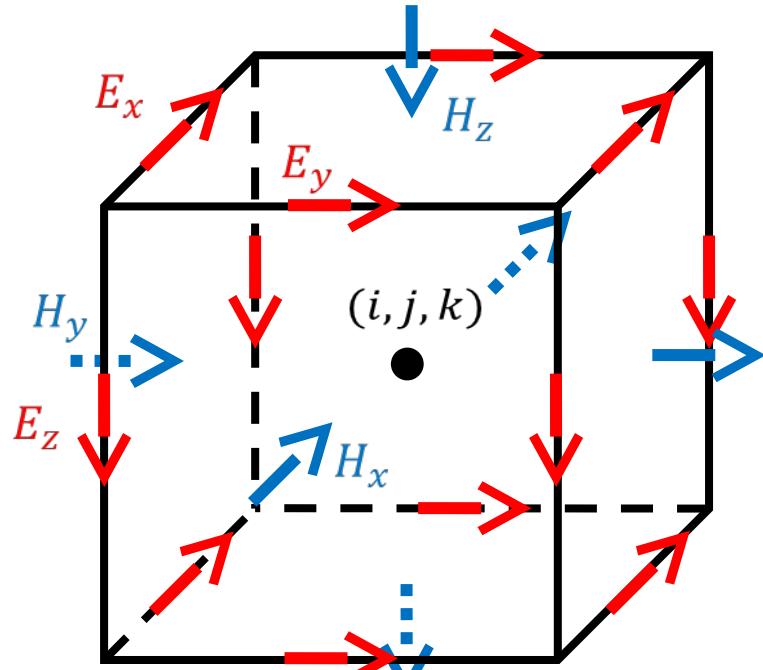
Calcula-se o campo  
elétrico para cada  
prisma



# Modelagem 3D

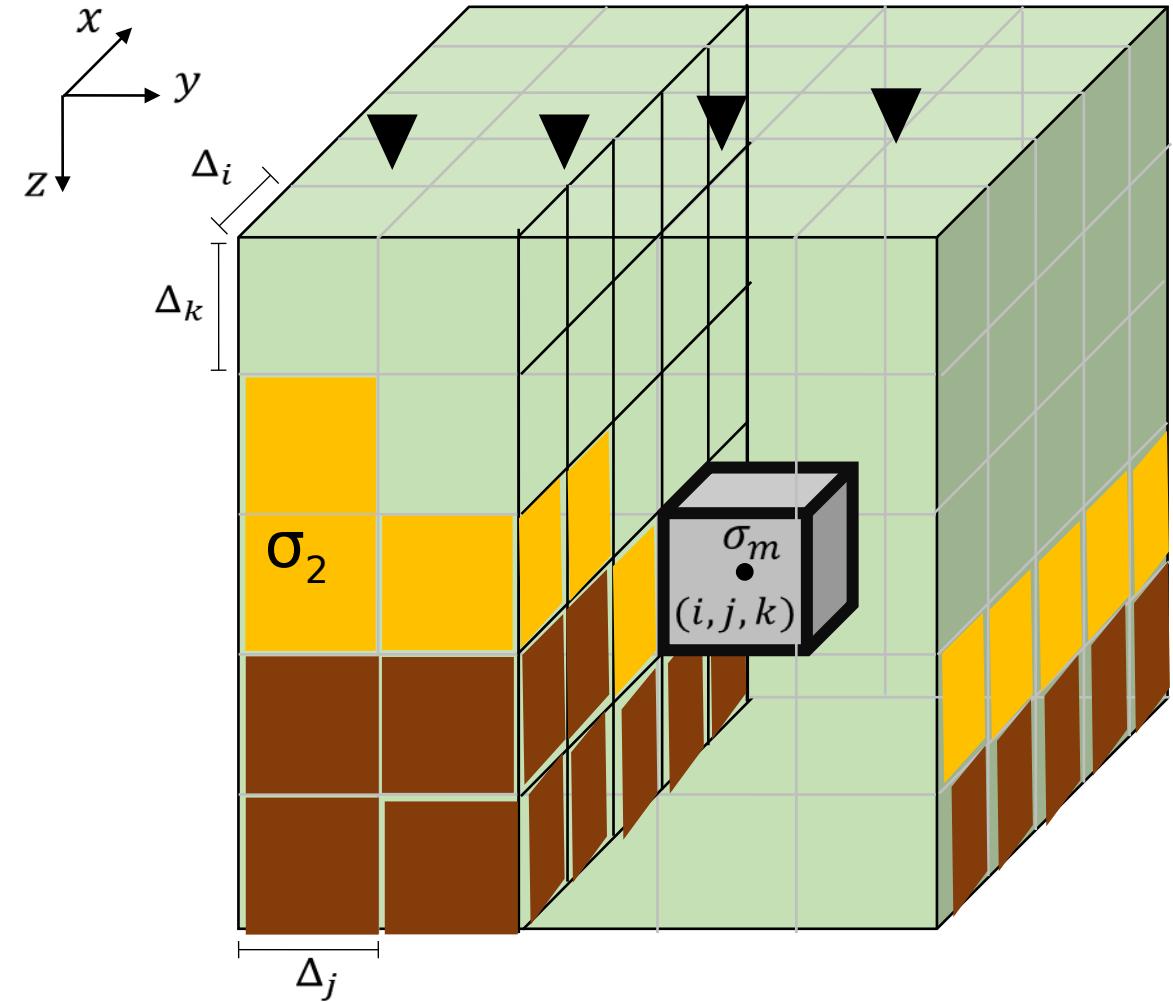
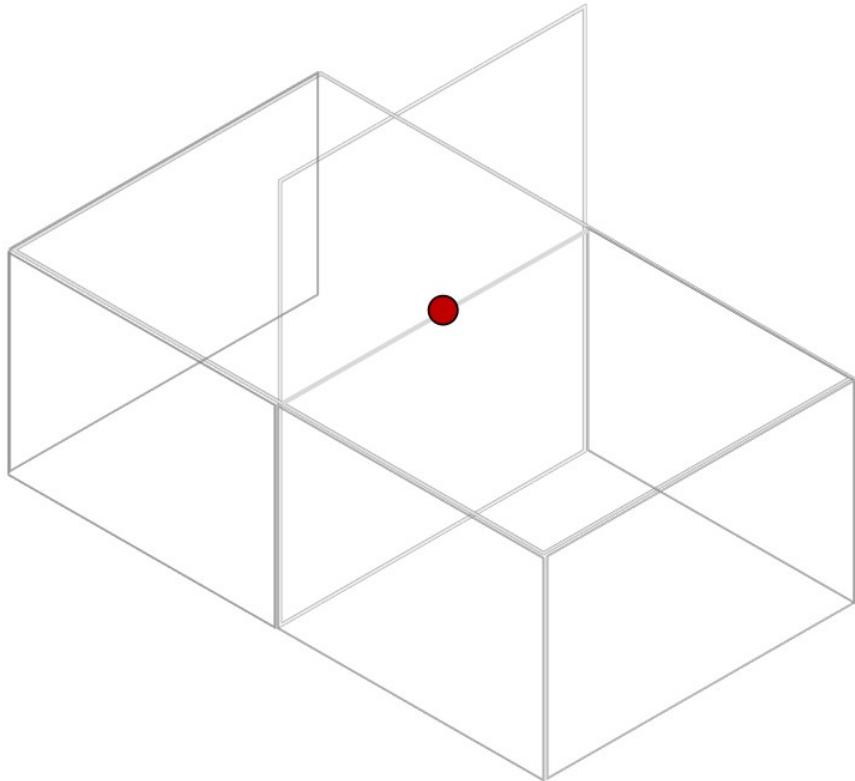


# Modelagem 3D

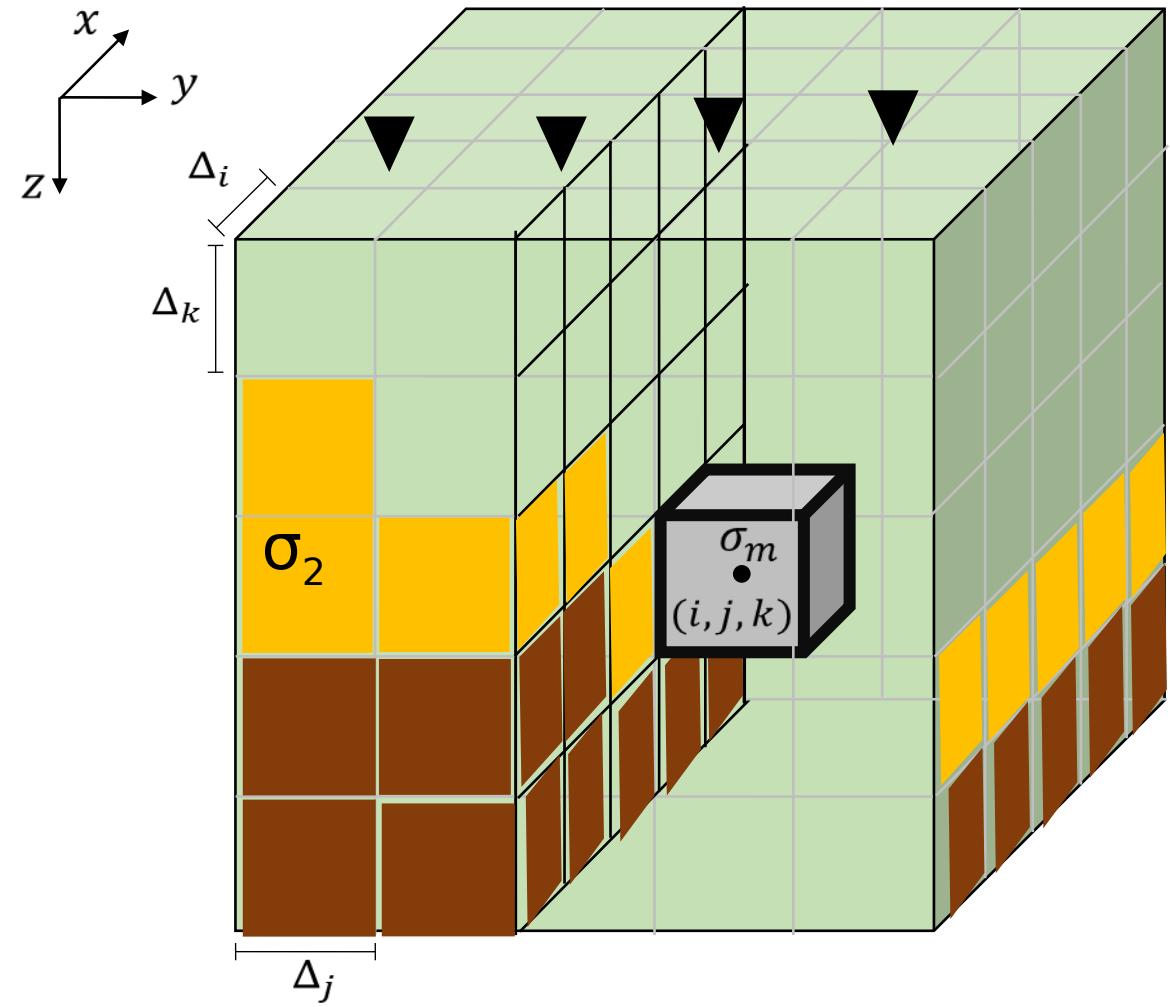
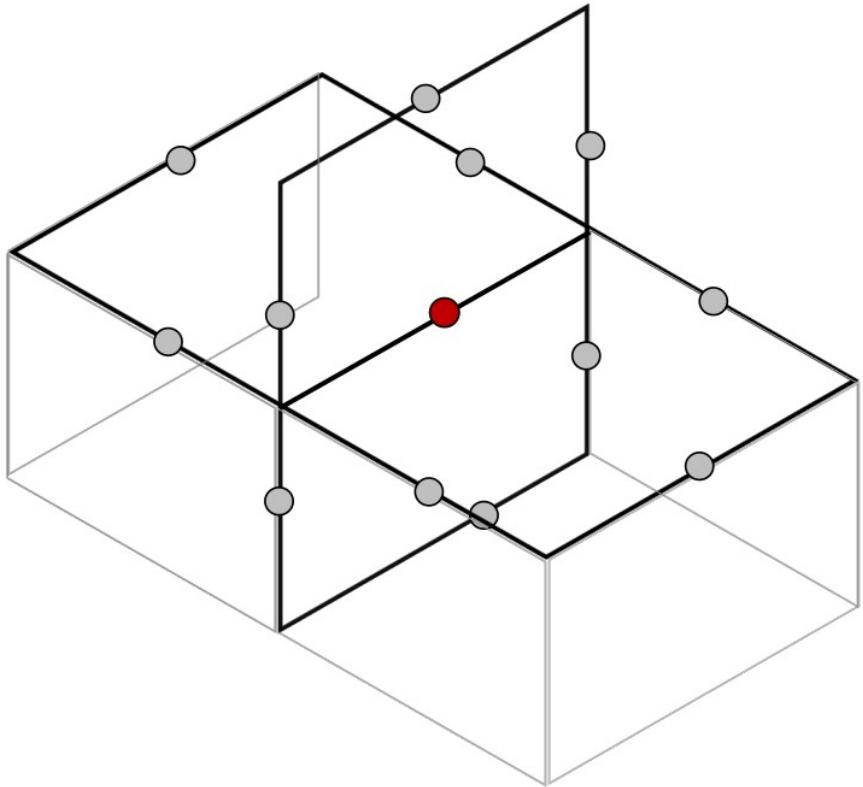


$$\mathbf{H} = (-i\mu\omega)^{-1} \nabla \times \mathbf{E} = 0$$

# Modelagem 3D

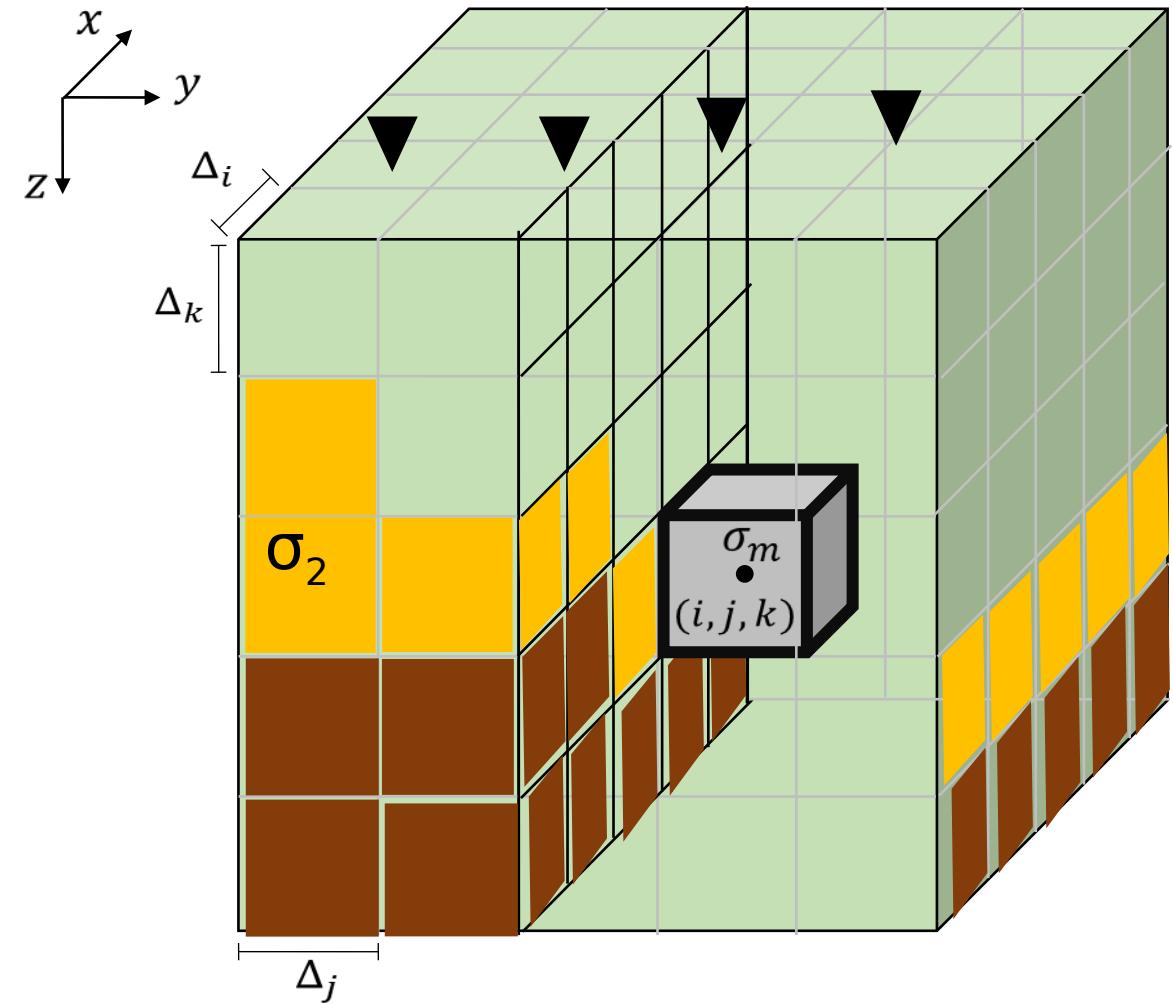
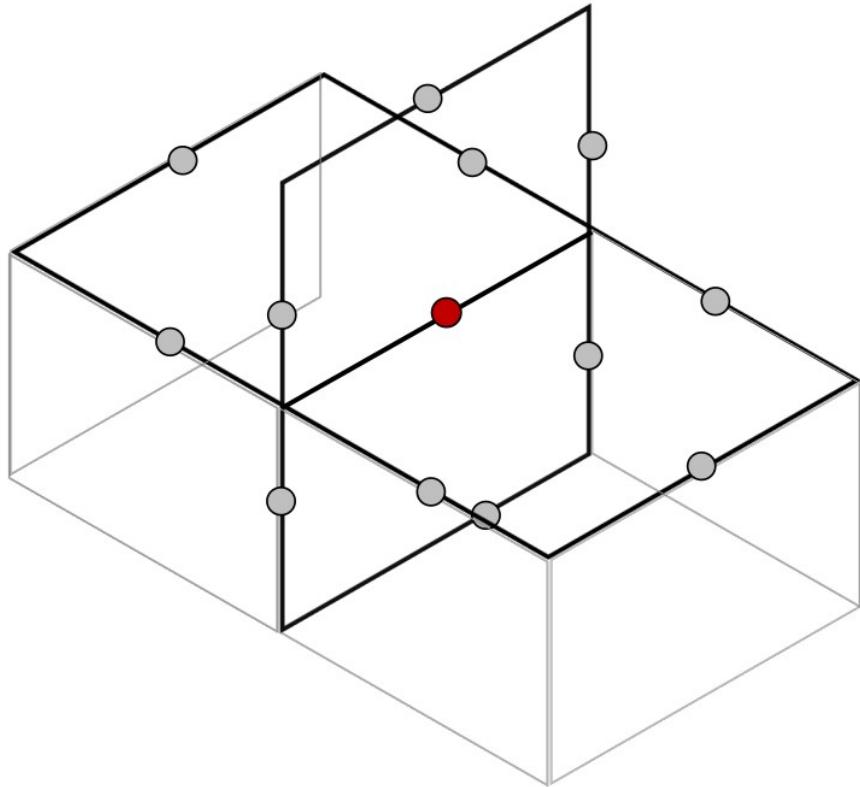


# Modelagem 3D



# Modelagem 3D

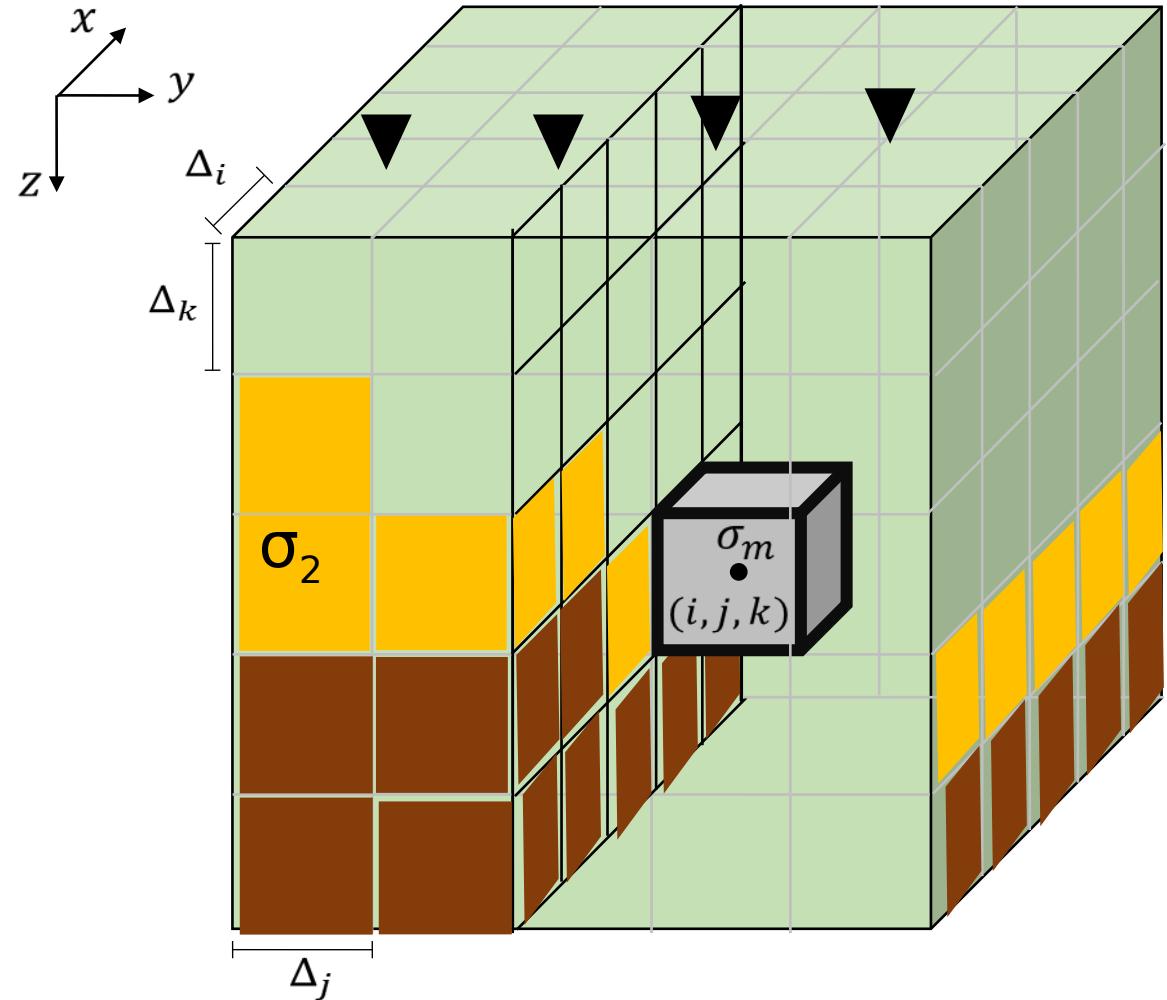
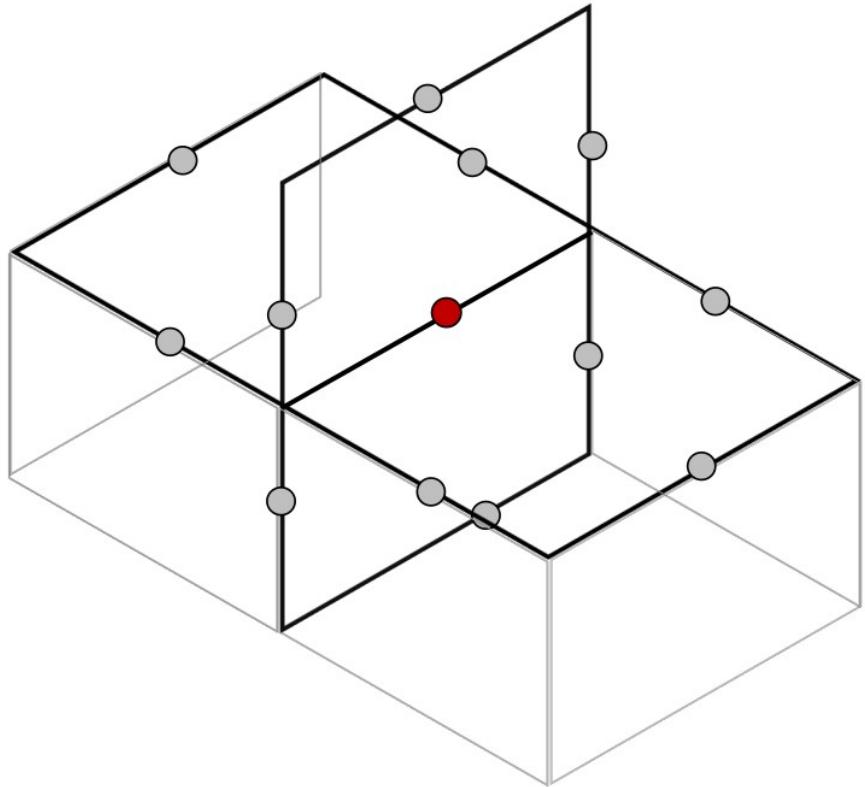
$$\mathbf{A}\mathbf{e} = \mathbf{b}$$



# Modelagem 3D

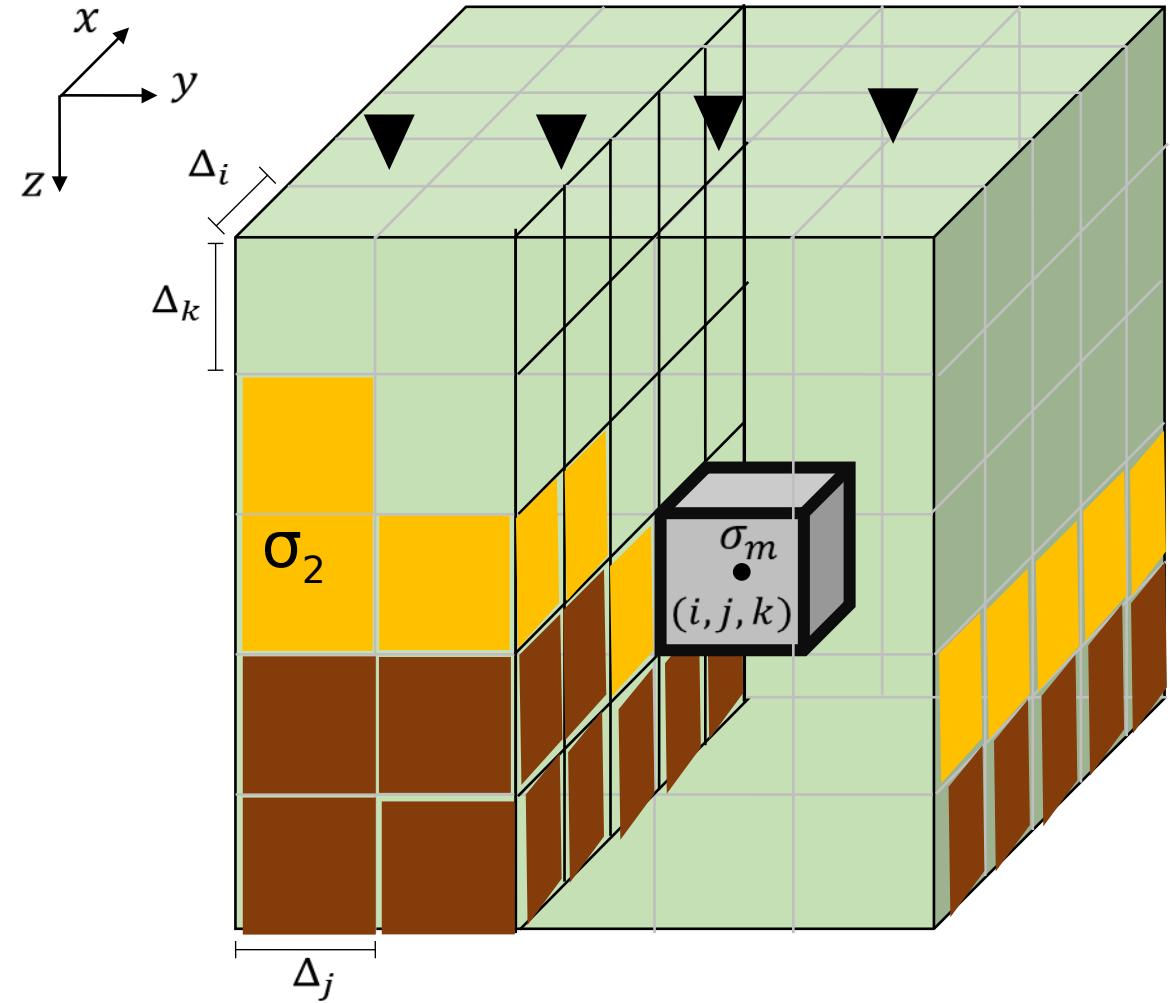
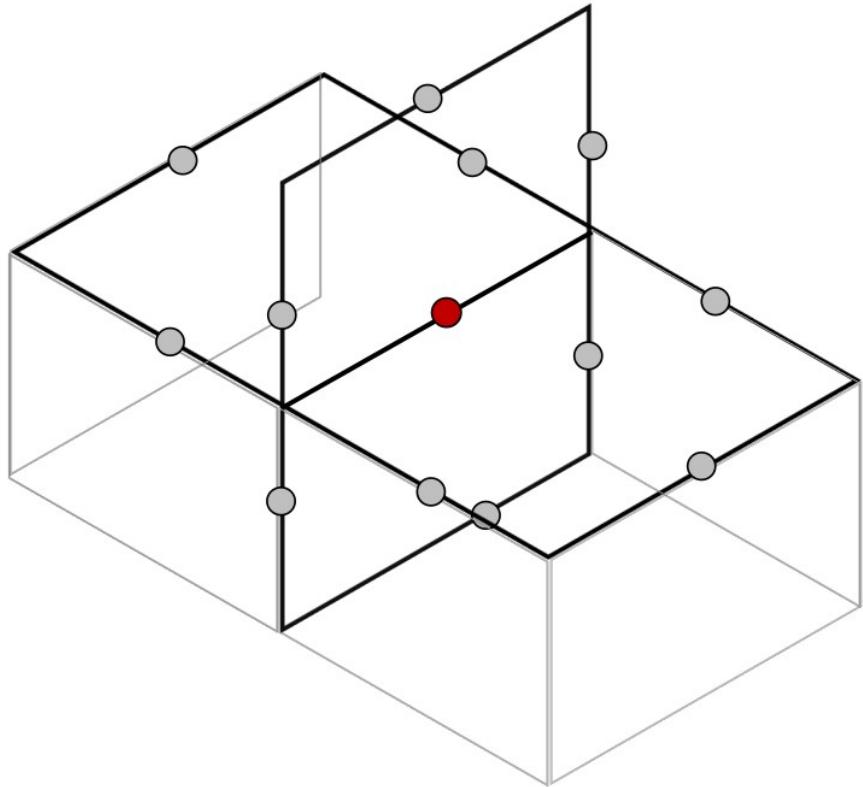
$$\mathbf{A}\mathbf{e} = \mathbf{b}$$

$$\mathbf{A}(\Delta_i, \Delta_j, \Delta_k, \sigma, \mu, \omega)$$



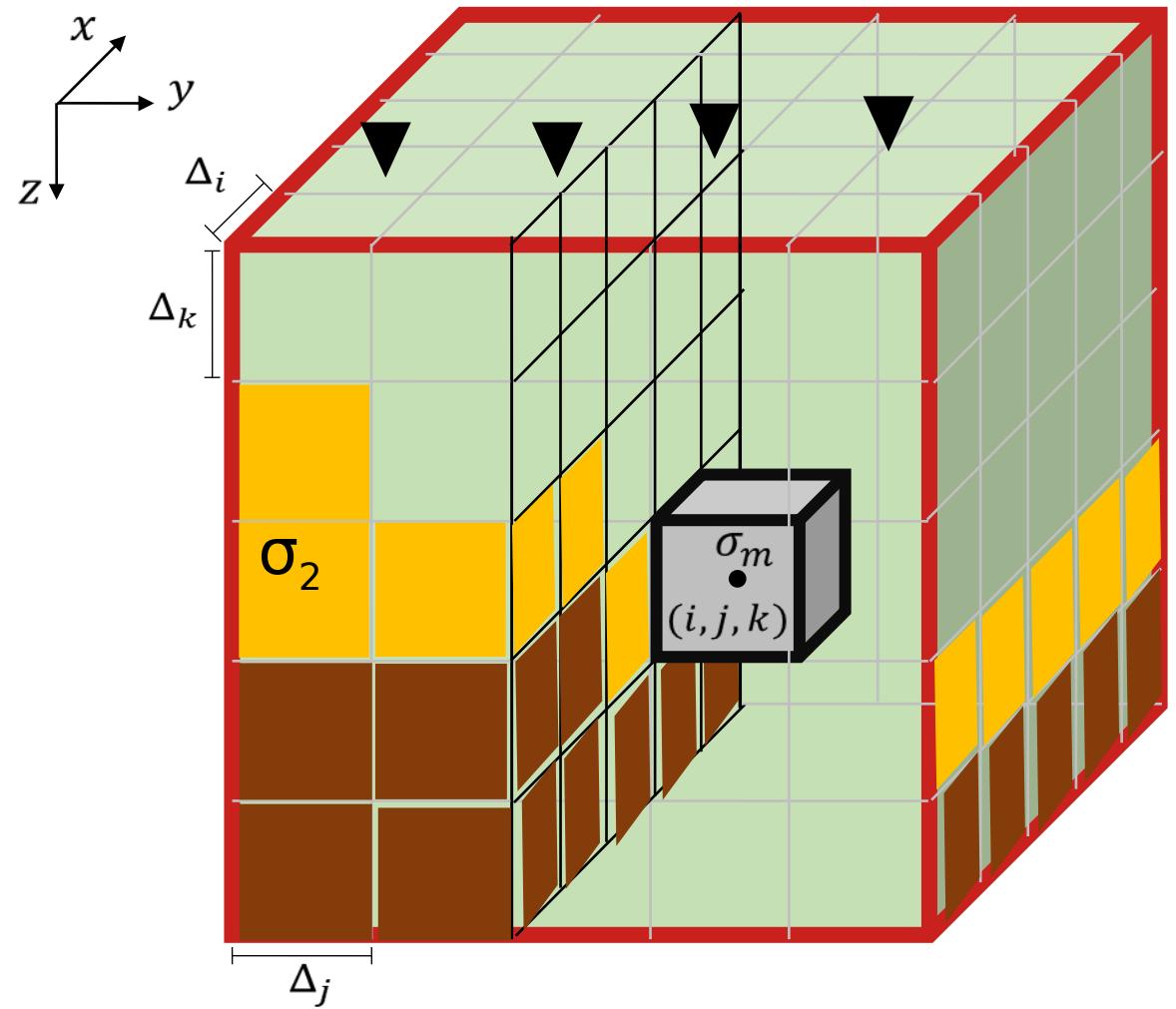
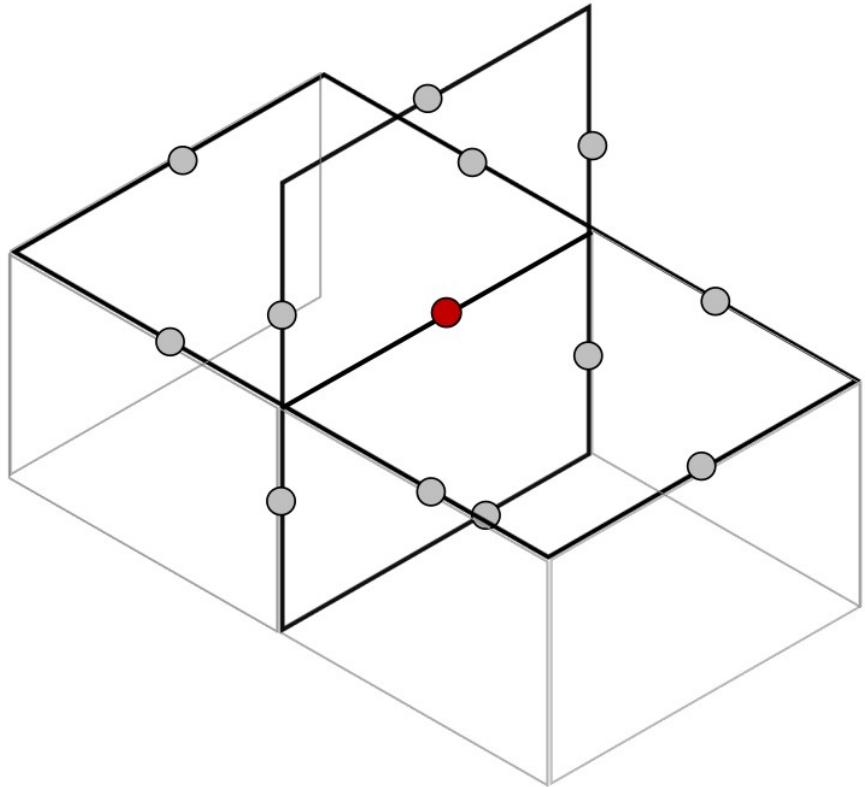
# Modelagem 3D

$$\mathbf{A}\mathbf{e} = \mathbf{b}$$



# Modelagem 3D

$$\mathbf{Ae} = \mathbf{b}$$

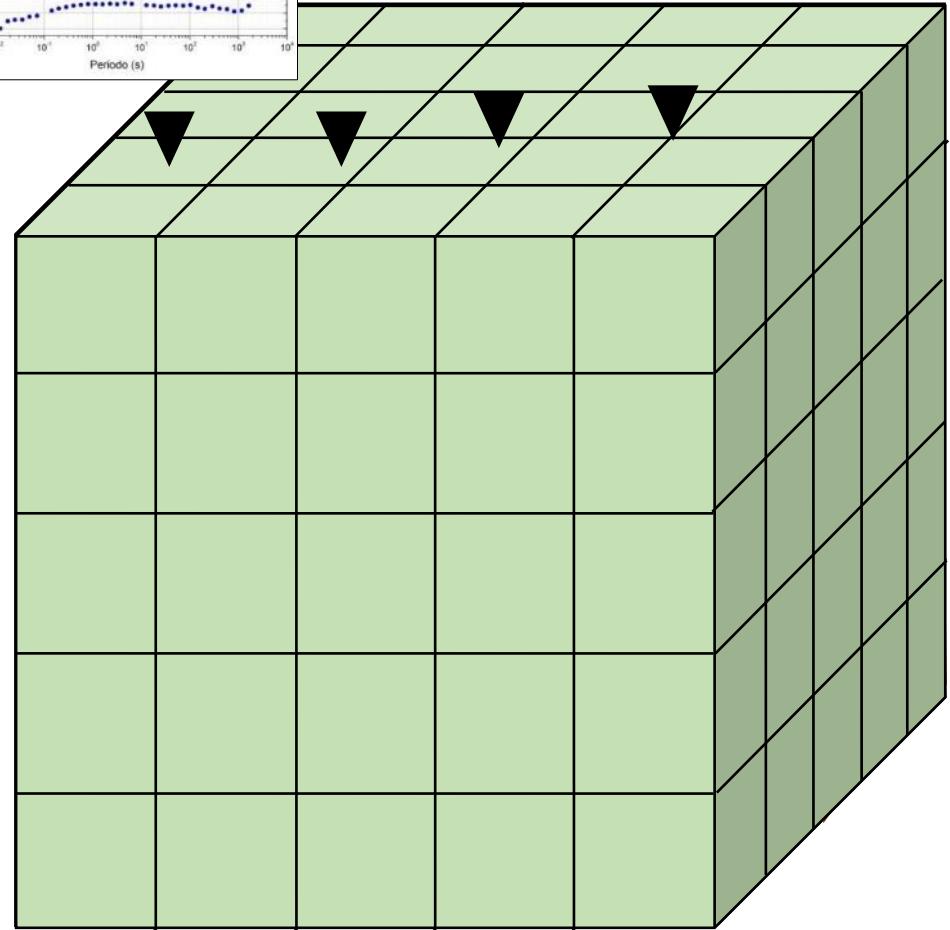
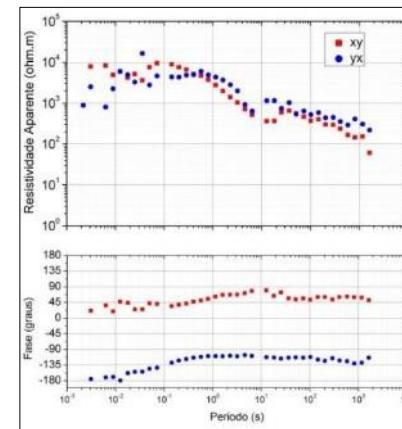


# Metodologia

Modelagem 3D MT

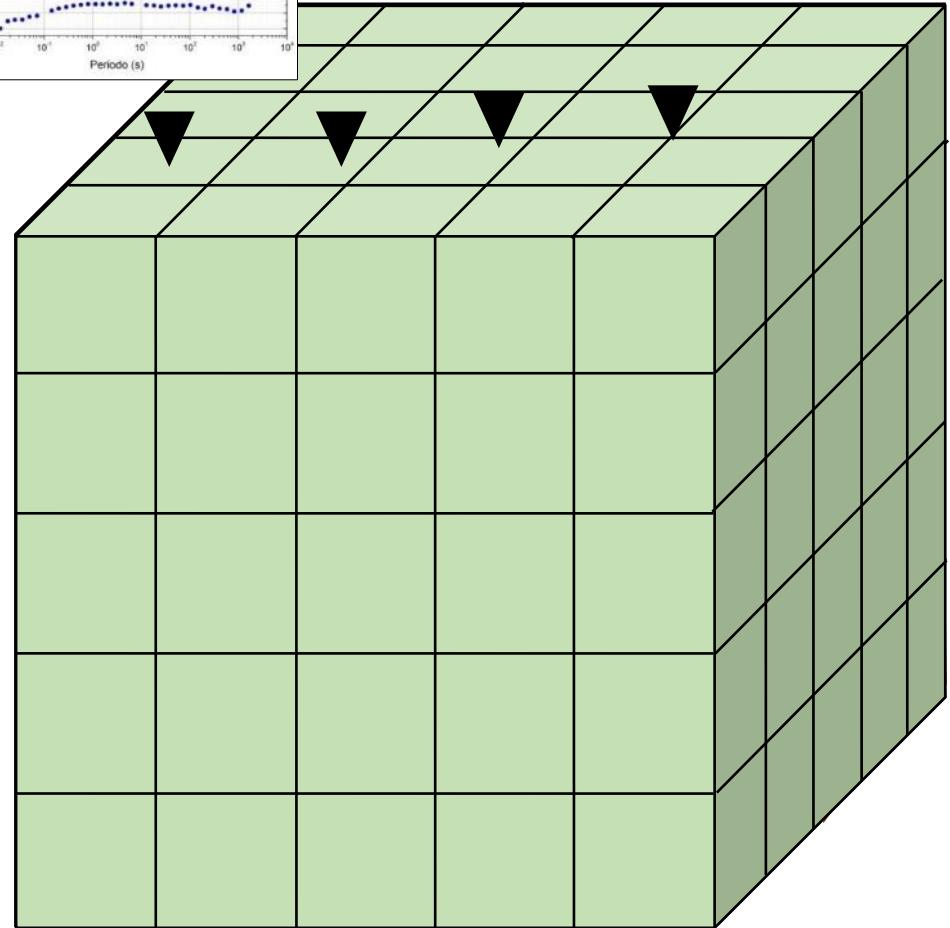
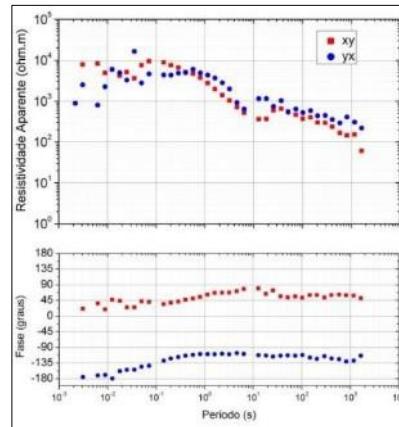
Inversão 3D MT

# Inversão 3D



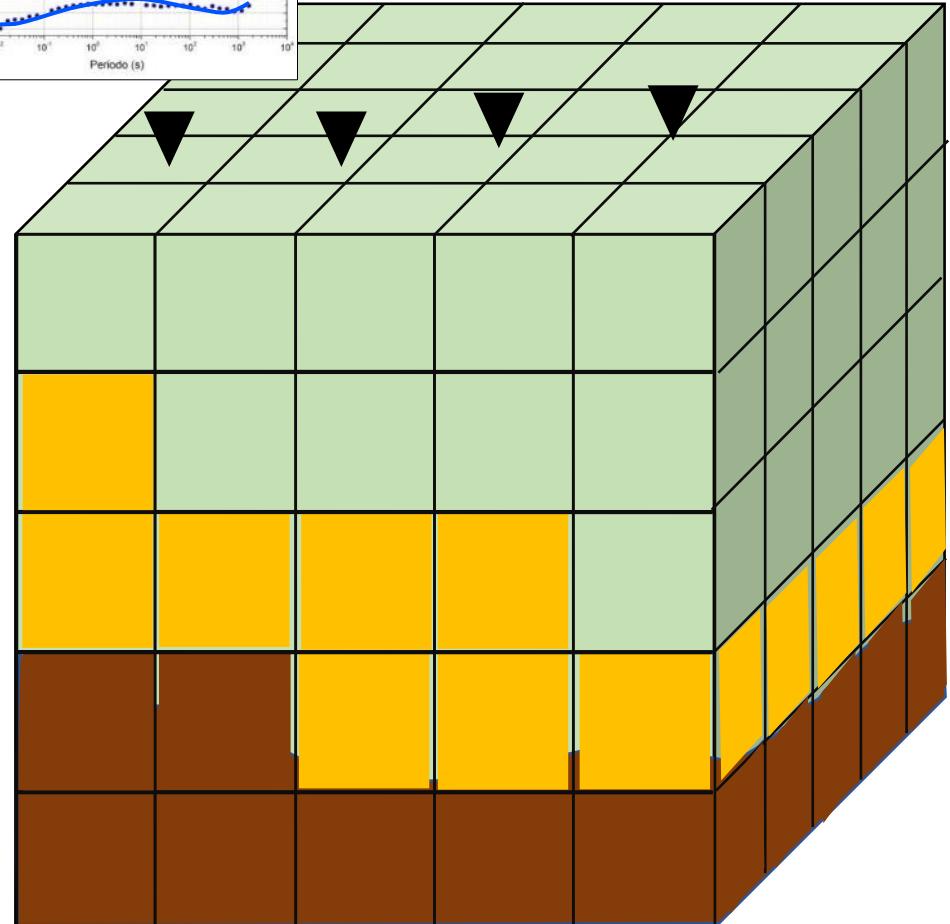
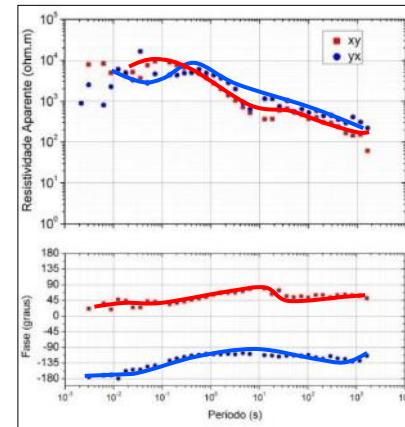
# Inversão 3D

$$\mathbf{d} = \begin{bmatrix} d_1 \\ d_2 \\ \vdots \\ d_N \end{bmatrix}$$

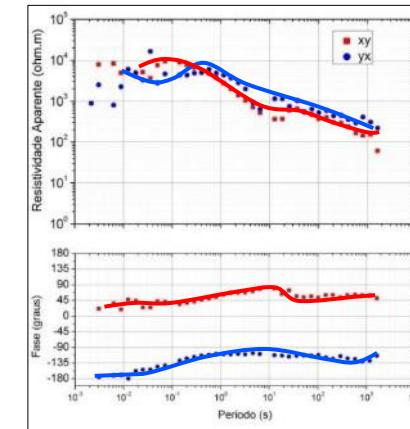


# Inversão 3D

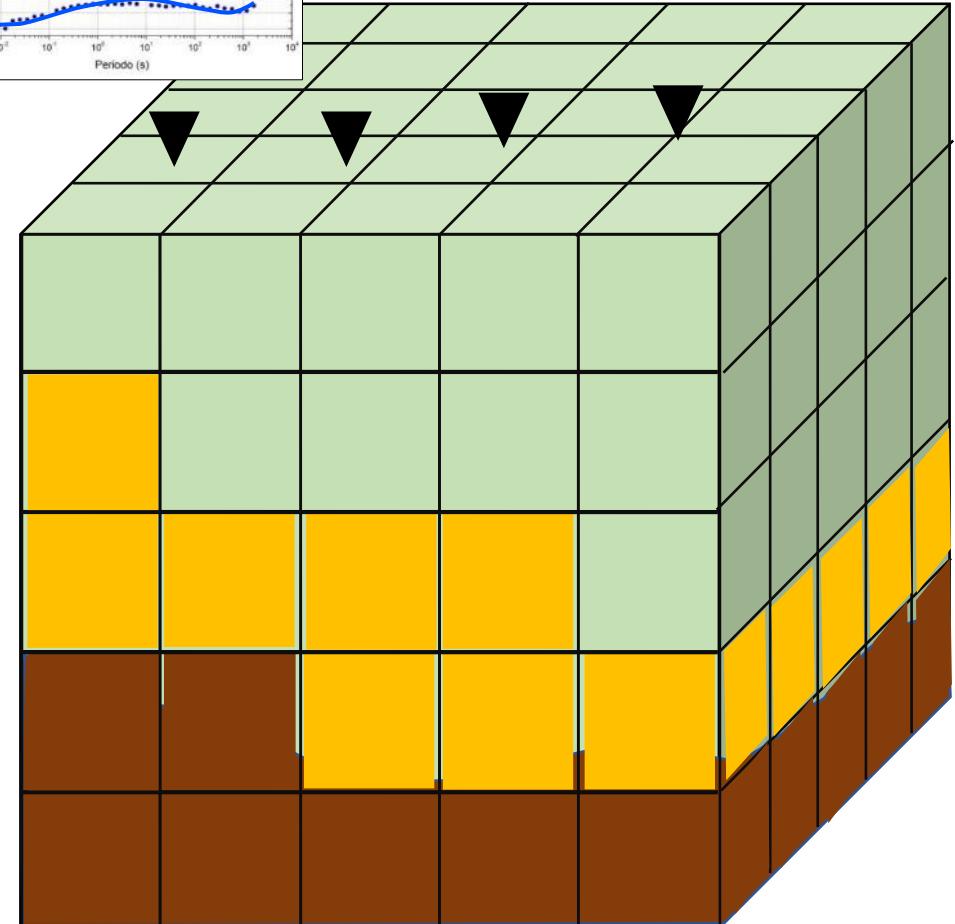
$$\mathbf{d} = \begin{bmatrix} d_1 \\ d_2 \\ \vdots \\ d_N \end{bmatrix} \approx \mathbf{d}(\sigma) = \begin{bmatrix} d_1 \\ d_2 \\ \vdots \\ d_N \end{bmatrix}$$



# Inversão 3D



$$\Phi(\boldsymbol{\sigma}) = [\mathbf{d} - \mathbf{d}(\boldsymbol{\sigma})]^T \mathbf{C}_d^{-1} [\mathbf{d} - \mathbf{d}(\boldsymbol{\sigma})] - \nu [\boldsymbol{\sigma} - \boldsymbol{\sigma}_0]^T \mathbf{C}_{\boldsymbol{\sigma}}^{-1} [\boldsymbol{\sigma} - \boldsymbol{\sigma}_0]$$

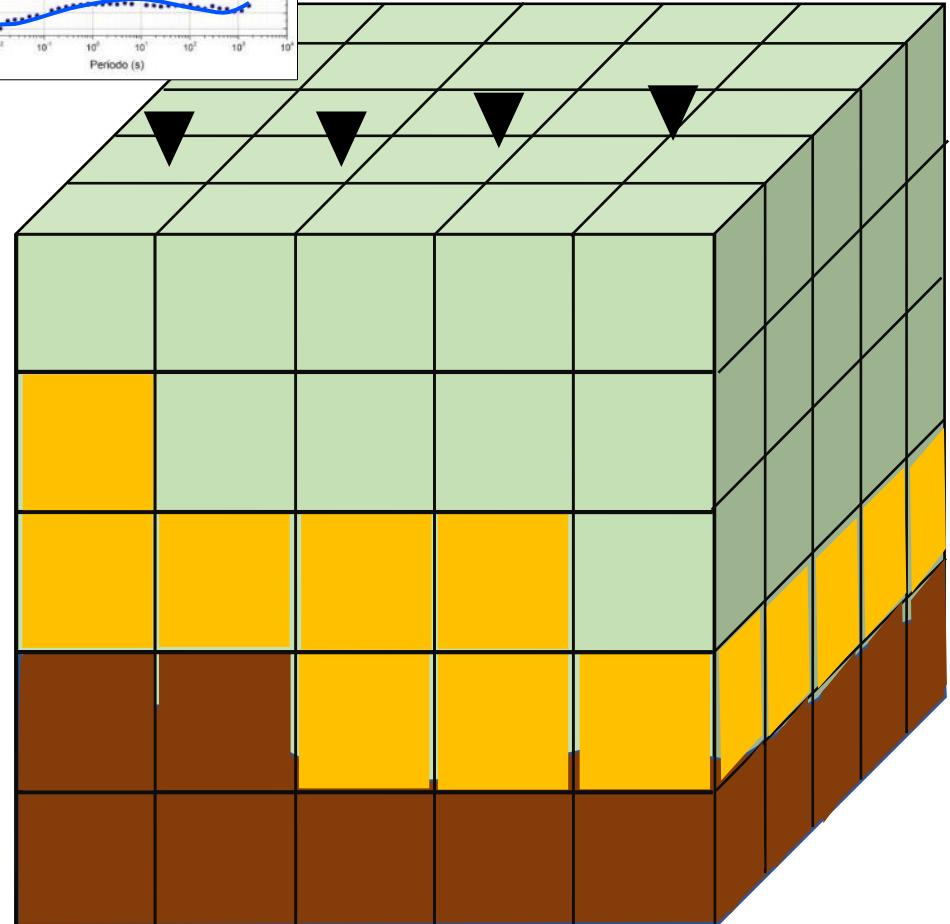
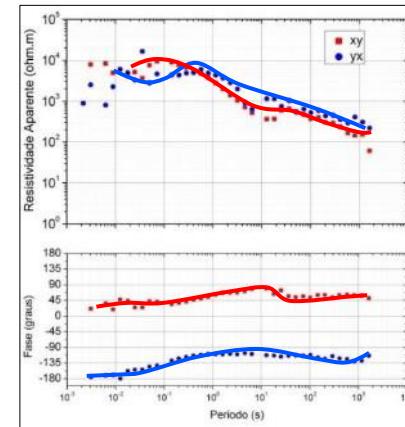


# Inversão 3D

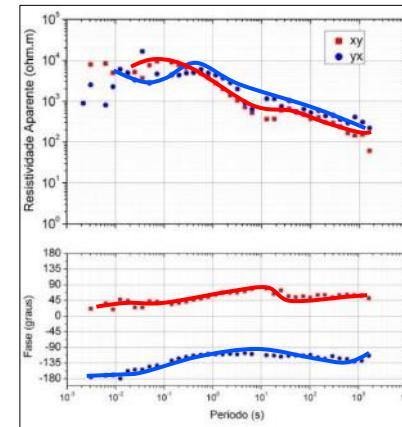
$$\Phi(\sigma) = [\mathbf{d} - \mathbf{d}(\sigma)]^T \mathbf{C}_d^{-1} [\mathbf{d} - \mathbf{d}(\sigma)] - \nu [\sigma - \sigma_0]^T \mathbf{C}_{\sigma}^{-1} [\sigma - \sigma_0]$$



Vetor de  
dados  
observados

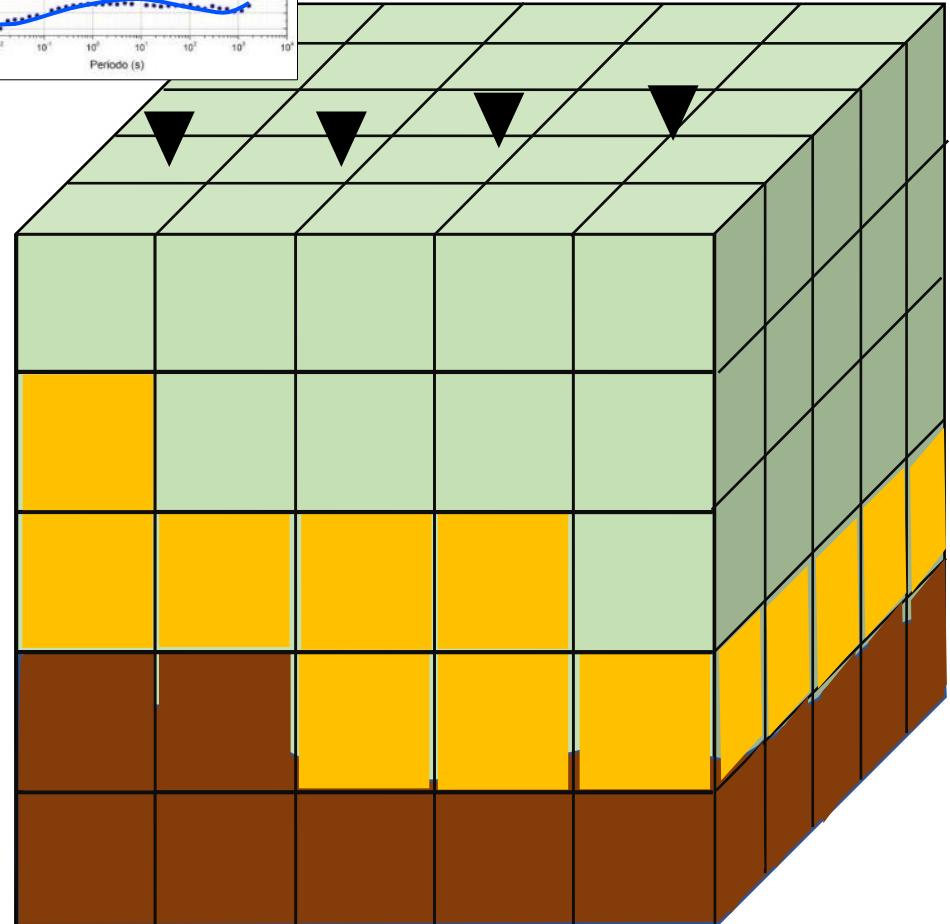


# Inversão 3D

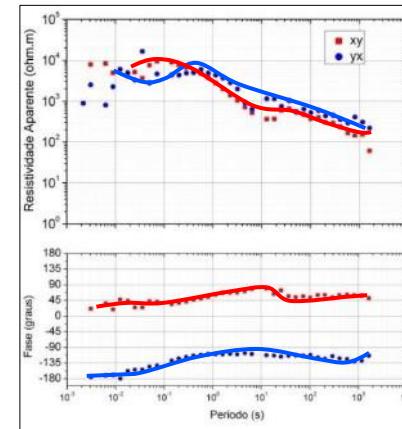


$$\Phi(\sigma) = [\mathbf{d} - \mathbf{d}(\sigma)]^T \mathbf{C}_d^{-1} [\mathbf{d} - \mathbf{d}(\sigma)] - \nu [\sigma - \sigma_0]^T \mathbf{C}_{\sigma}^{-1} [\sigma - \sigma_0]$$

↑  
Vetor de  
dados  
preditos

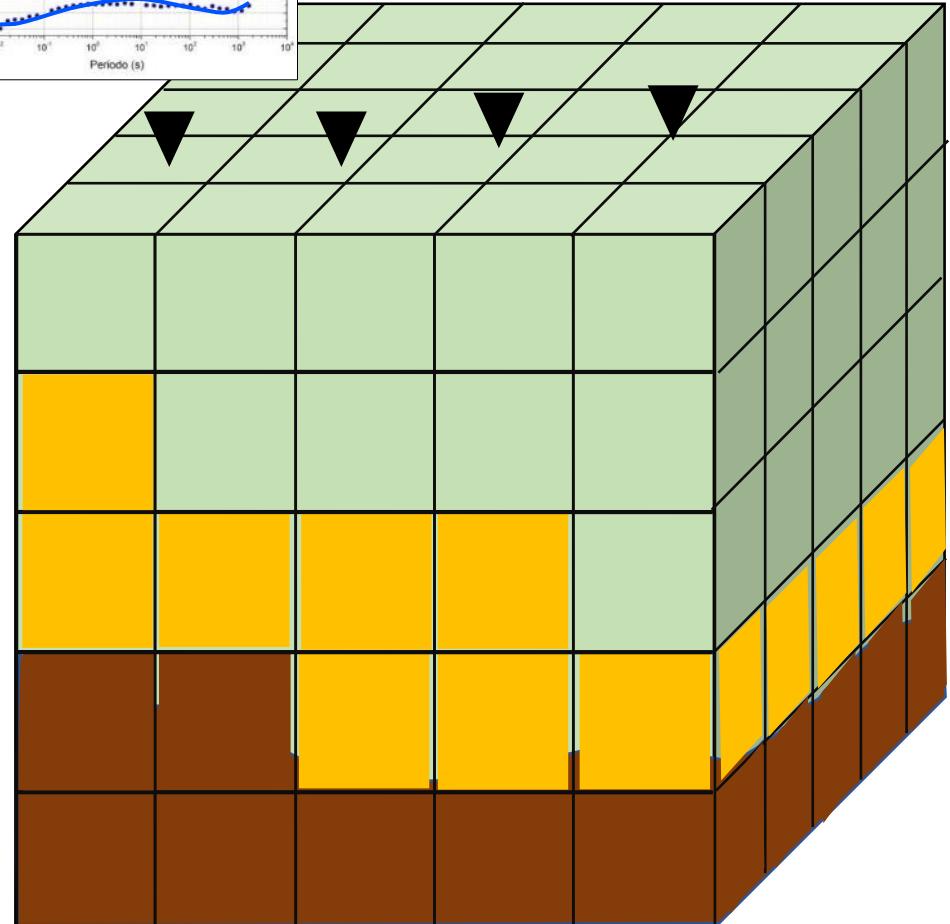


# Inversão 3D



$$\Phi(\sigma) = [\mathbf{d} - \mathbf{d}(\sigma)]^T \mathbf{C}_d^{-1} [\mathbf{d} - \mathbf{d}(\sigma)] - \nu [\sigma - \sigma_0]^T \mathbf{C}_{\sigma}^{-1} [\sigma - \sigma_0]$$

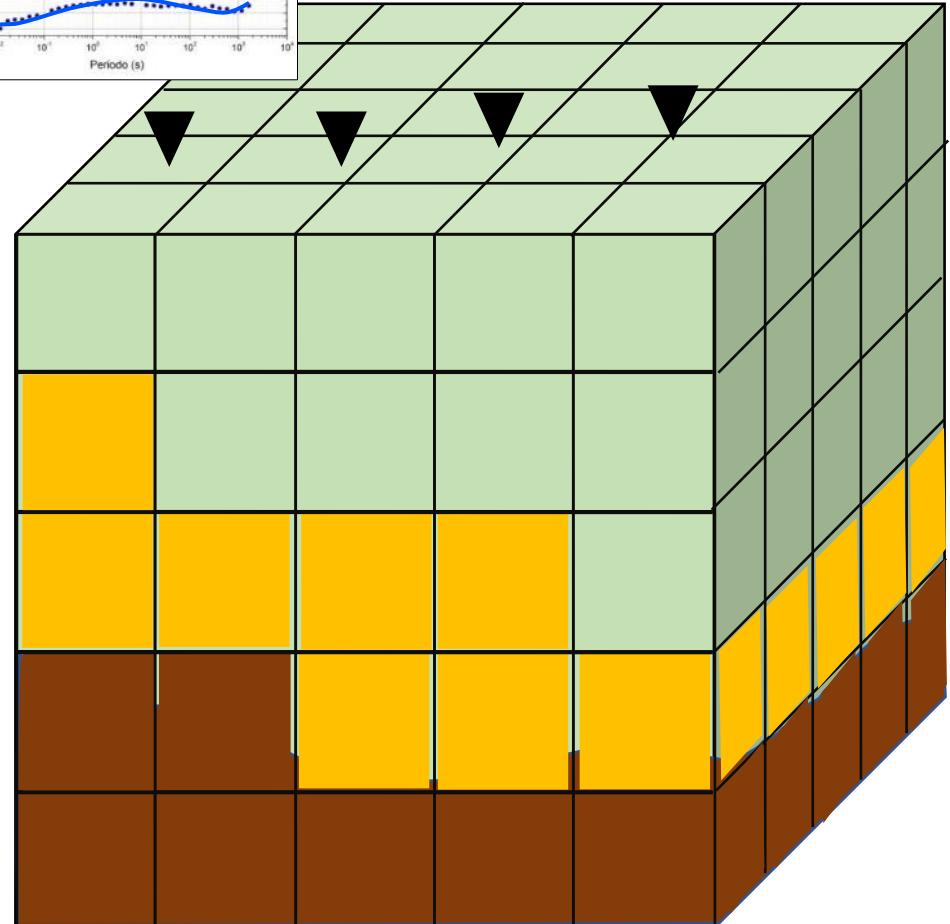
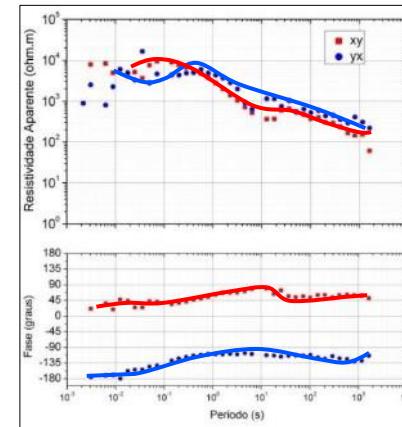
↑  
Matriz de covariância



# Inversão 3D

$$\Phi(\sigma) = [\mathbf{d} - \mathbf{d}(\sigma)]^T \mathbf{C}_d^{-1} [\mathbf{d} - \mathbf{d}(\sigma)] - \nu [\sigma - \sigma_0]^T \mathbf{C}_{\sigma}^{-1} [\sigma - \sigma_0]$$

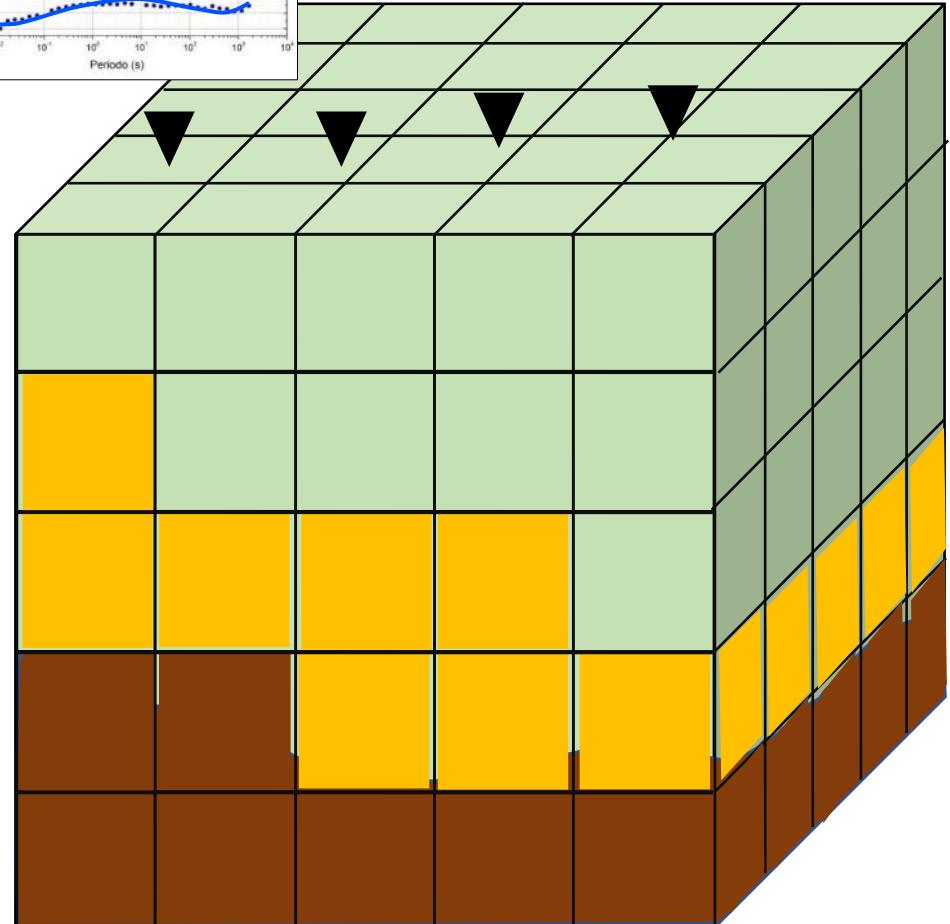
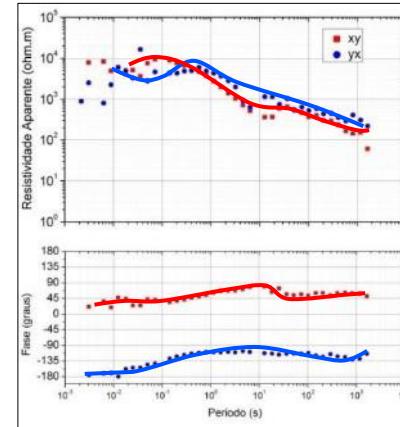
↑  
Vetor de  
parâmetros



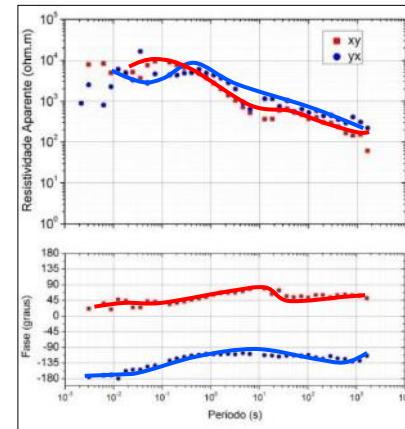
# Inversão 3D

$$\Phi(\sigma) = [\mathbf{d} - \mathbf{d}(\sigma)]^T \mathbf{C}_d^{-1} [\mathbf{d} - \mathbf{d}(\sigma)] - \nu [\sigma - \sigma_0]^T \mathbf{C}_{\sigma}^{-1} [\sigma - \sigma_0]$$

↑  
Modelo a  
priori ou  
chute inicial



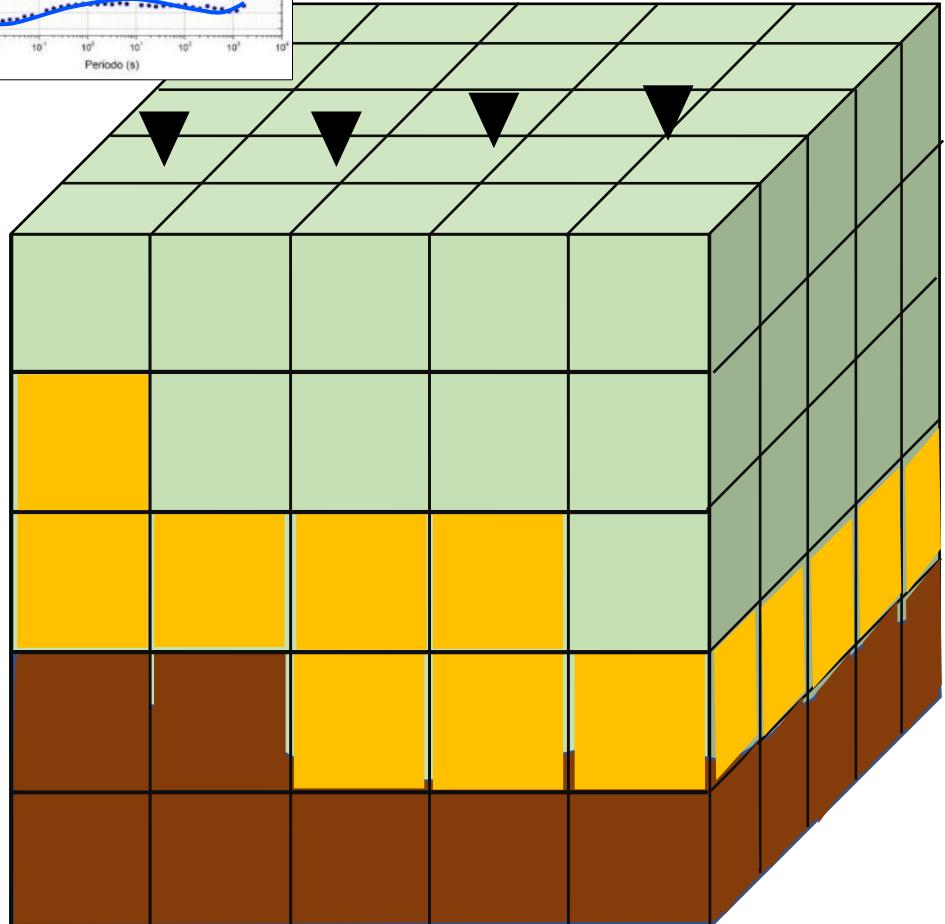
# Inversão 3D



$$\Phi(\sigma) = [\mathbf{d} - \mathbf{d}(\sigma)]^T \mathbf{C}_d^{-1} [\mathbf{d} - \mathbf{d}(\sigma)] - \nu [\sigma - \sigma_0]^T \mathbf{C}_{\sigma}^{-1} [\sigma - \sigma_0]$$



Matriz de covariância  
dos parâmetros

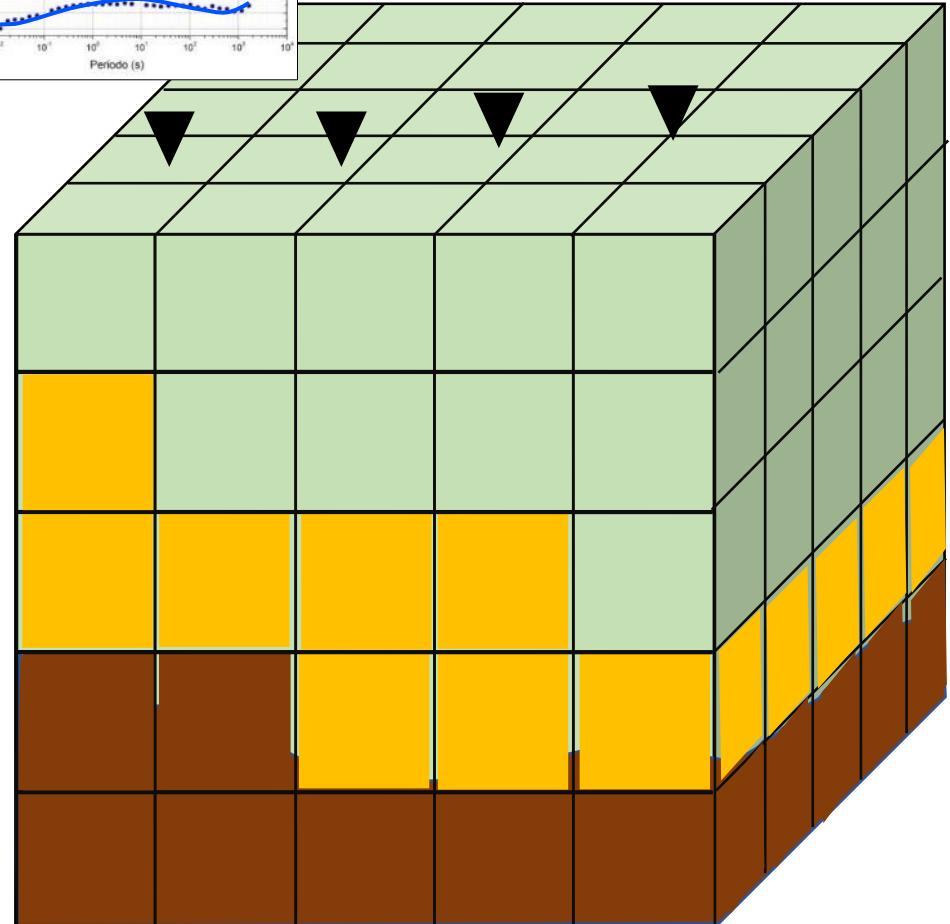
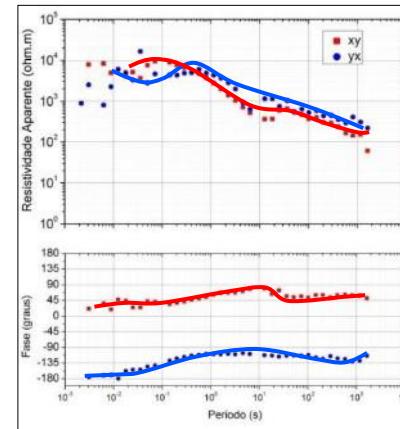


# Inversão 3D

$$\Phi(\sigma) = [\mathbf{d} - \mathbf{d}(\sigma)]^T \mathbf{C}_d^{-1} [\mathbf{d} - \mathbf{d}(\sigma)] - \nu [\sigma - \sigma_0]^T \mathbf{C}_\sigma^{-1} [\sigma - \sigma_0]$$



Parâmetro  
de  
regularizaçã  
o



# Exemplos de Modelagem 3D

# Ambientes Geológicos

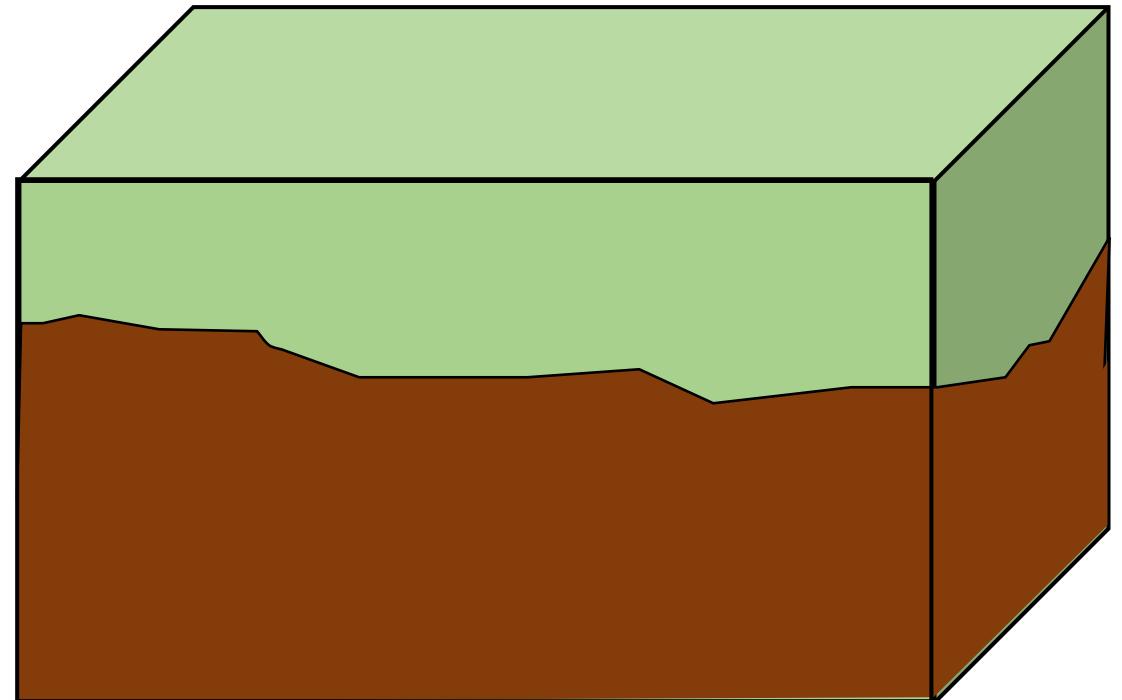
- Foram criados alguns modelos de resistividade 3D para simular algumas situações numa bacia sedimentar;

# Ambientes Geológicos

- Foram criados alguns modelos de resistividade 3D para simular algumas situações numa bacia sedimentar;
  - Bacias sedimentares
  - Crosta resistiva (intrusões máficas)
  - Crosta condutiva (presença de minerais na crosta)
  - Diápiros de sal
  - Intrusões de diabásio
  - Quimberlitos

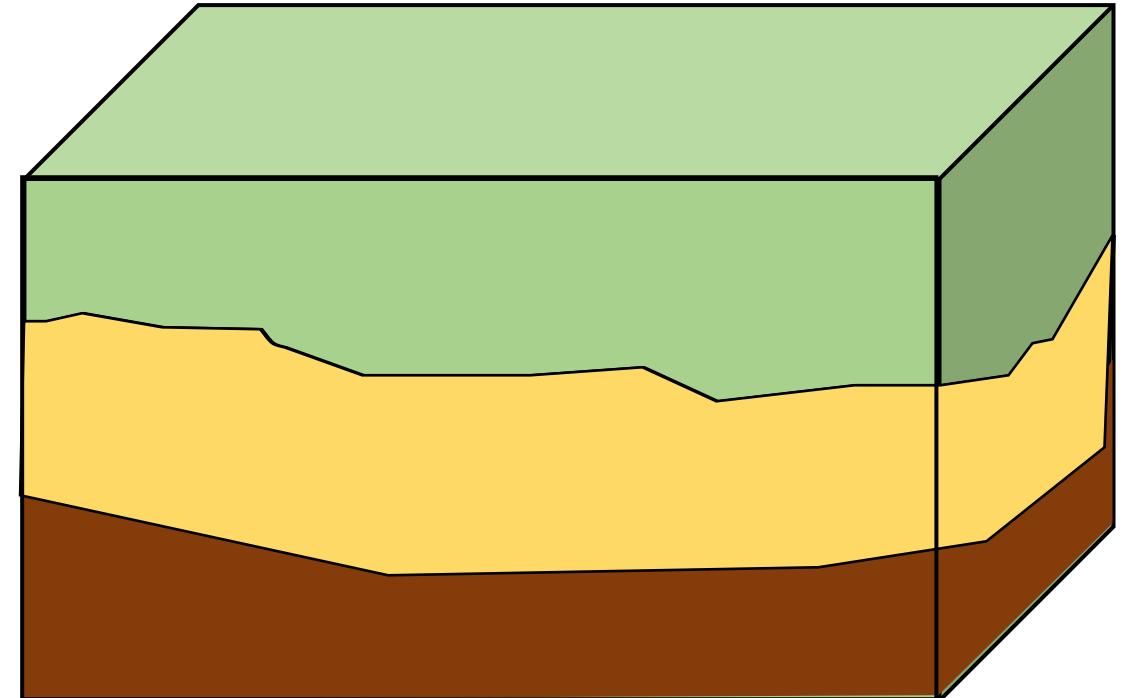
# Para testar a presença de condutores

- Foram criados alguns modelos de resistividade 3D para simular algumas situações numa bacia sedimentar;
  - Bacia 2D fixa



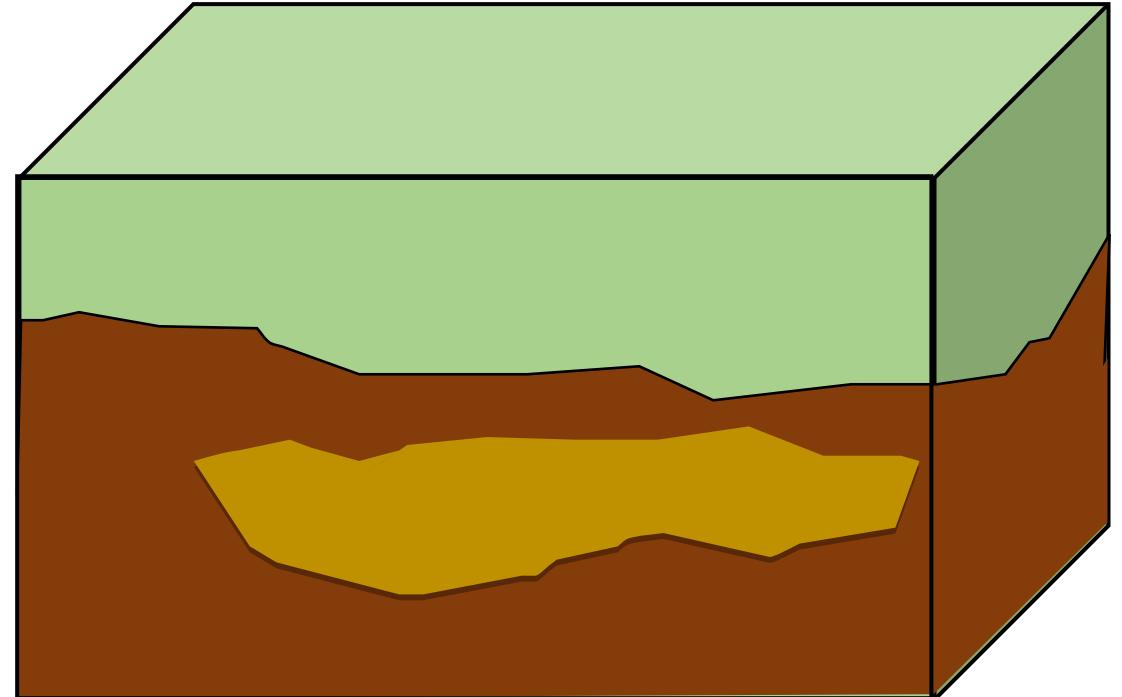
# Para testar a presença de condutores

- Foram criados alguns modelos de resistividade 3D para simular algumas situações numa bacia sedimentar;
  - Bacia 2D fixa
  - Diferentes situações na crosta



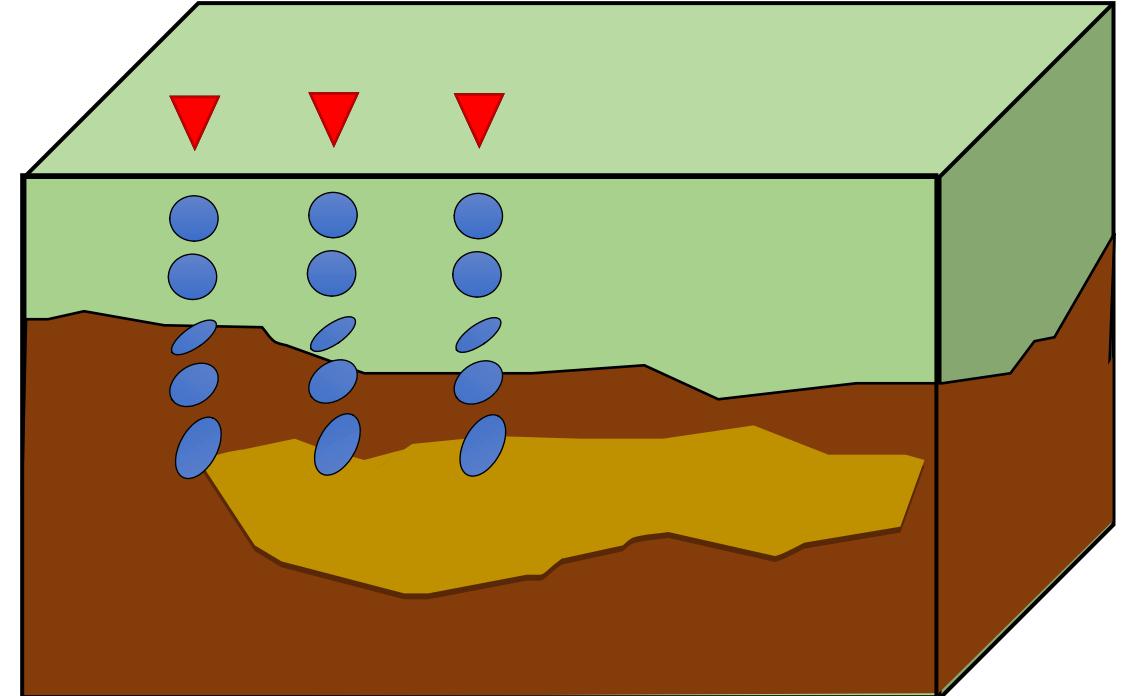
# Para testar a presença de condutores

- Foram criados alguns modelos de resistividade 3D para simular algumas situações numa bacia sedimentar;
  - Bacia 2D fixa
  - Diferentes situações na crosta

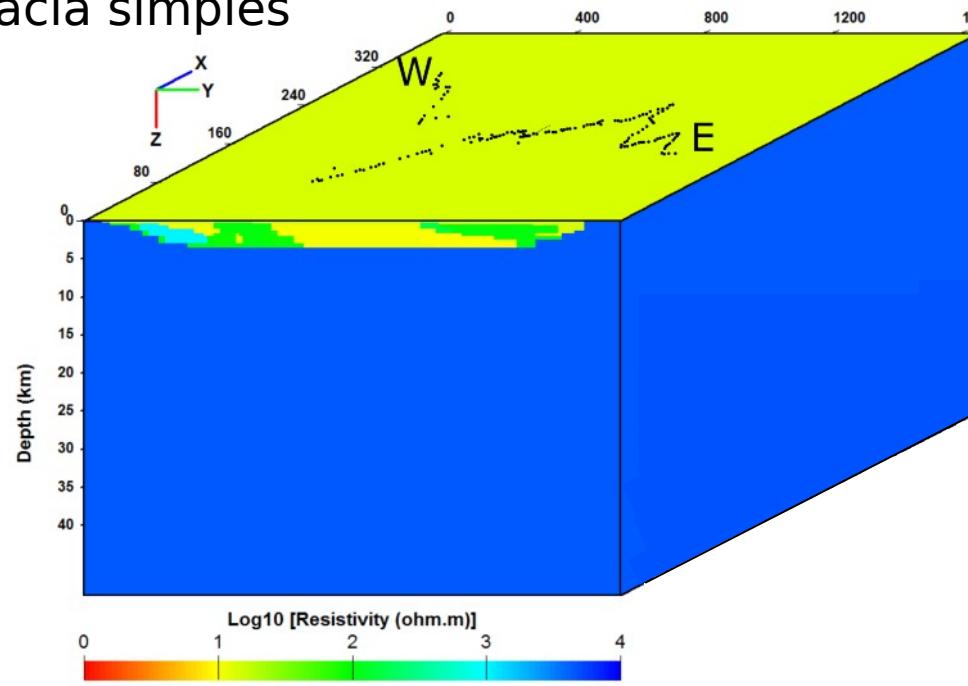


# Para testar a presença de condutores

- Através da modelagem 3D, foram calculadas as respostas MT (tensor de fase e vetores de indução) para esses modelos;

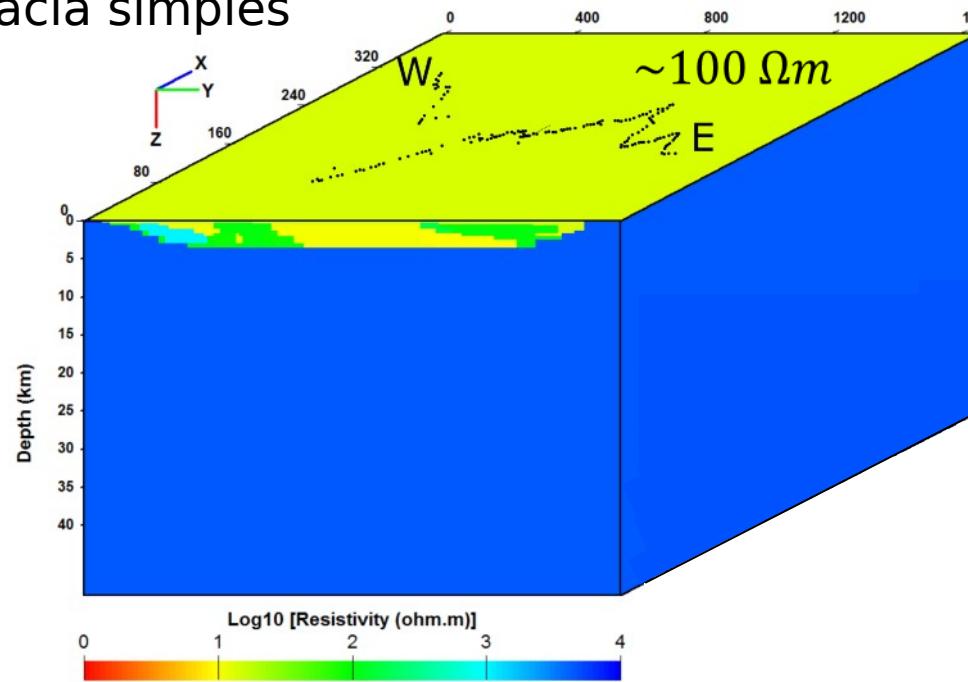


## Teste 1: distribuição 2D – bacia simples



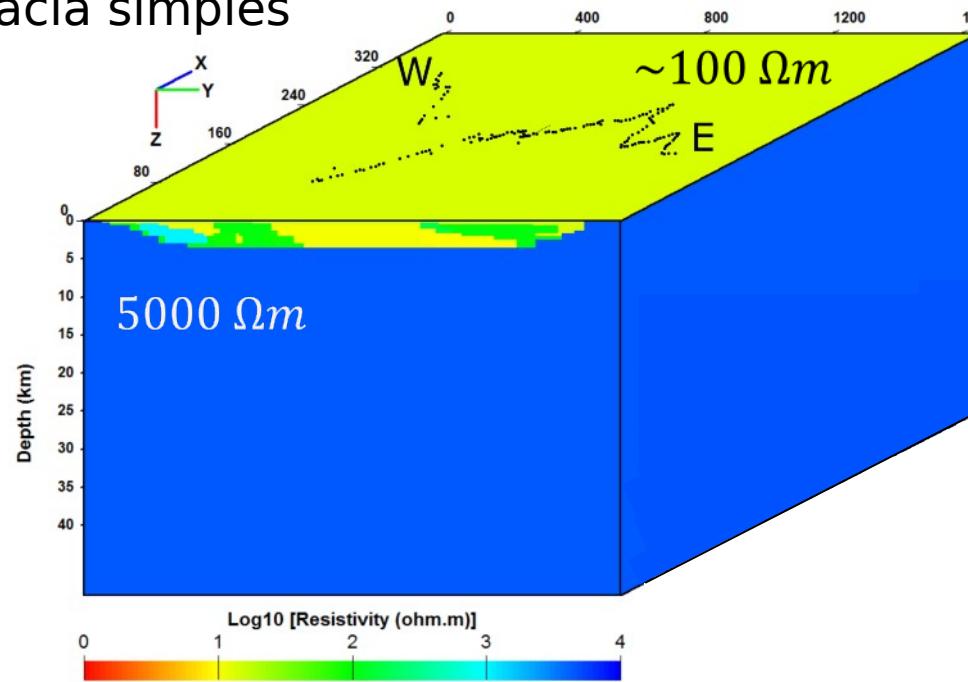
(a)

## Teste 1: distribuição 2D – bacia simples



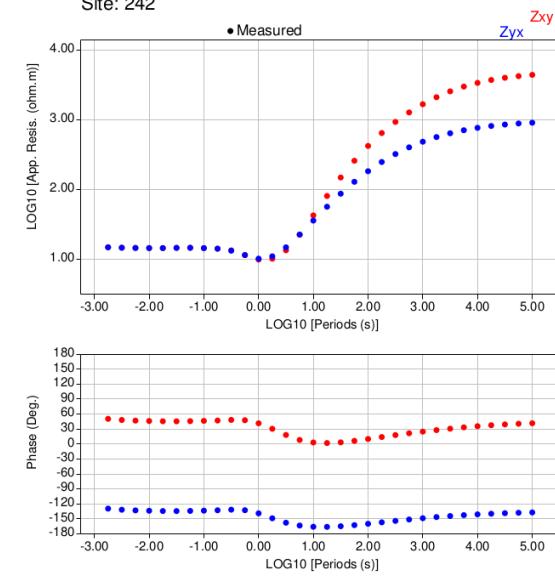
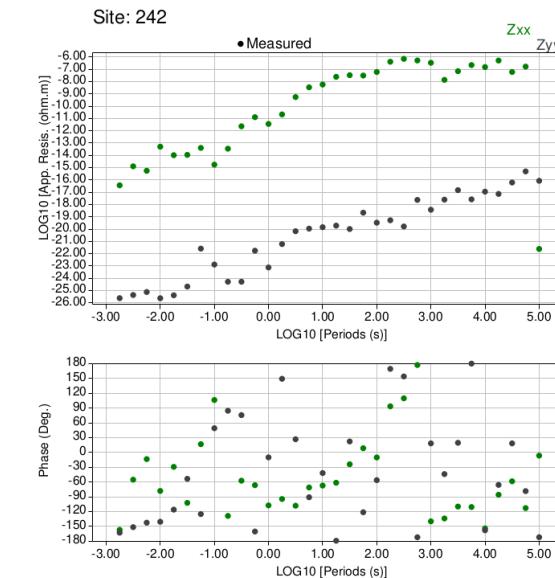
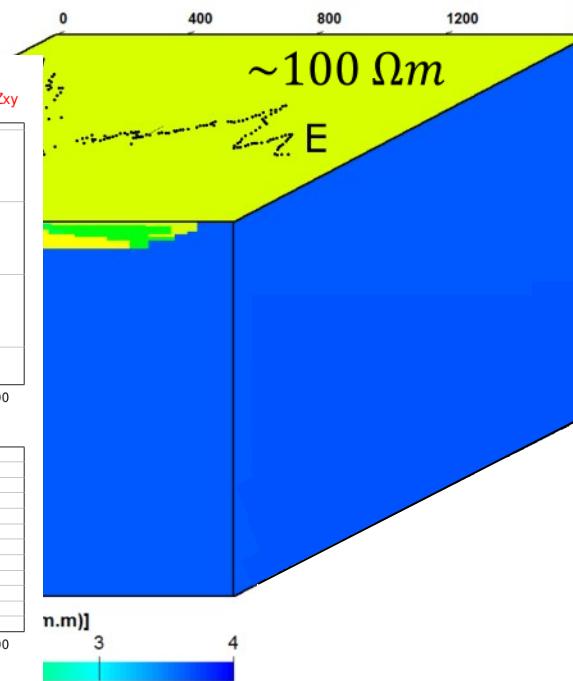
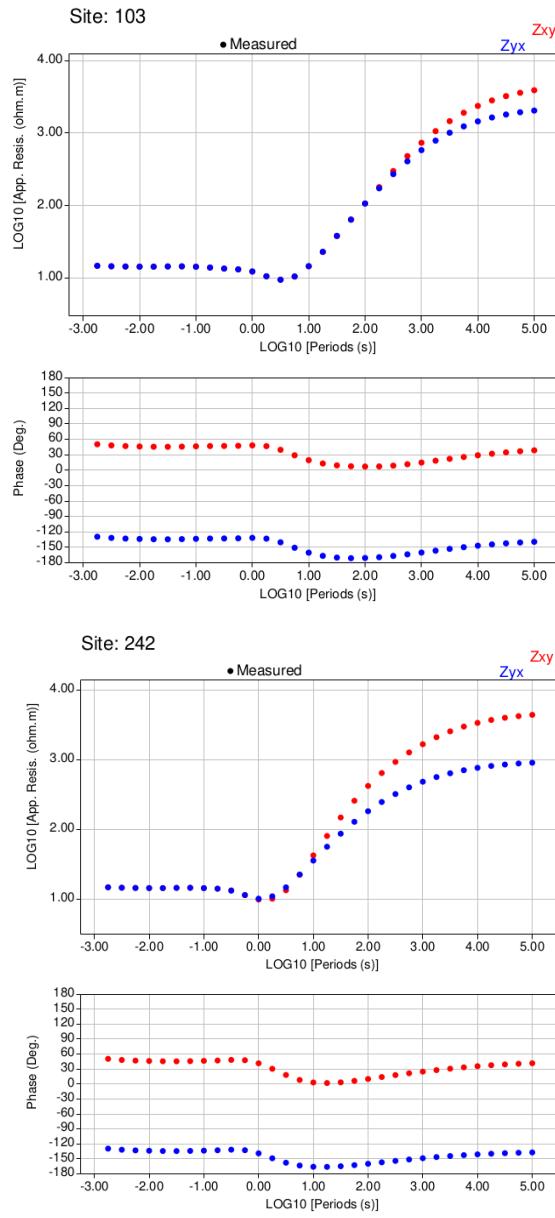
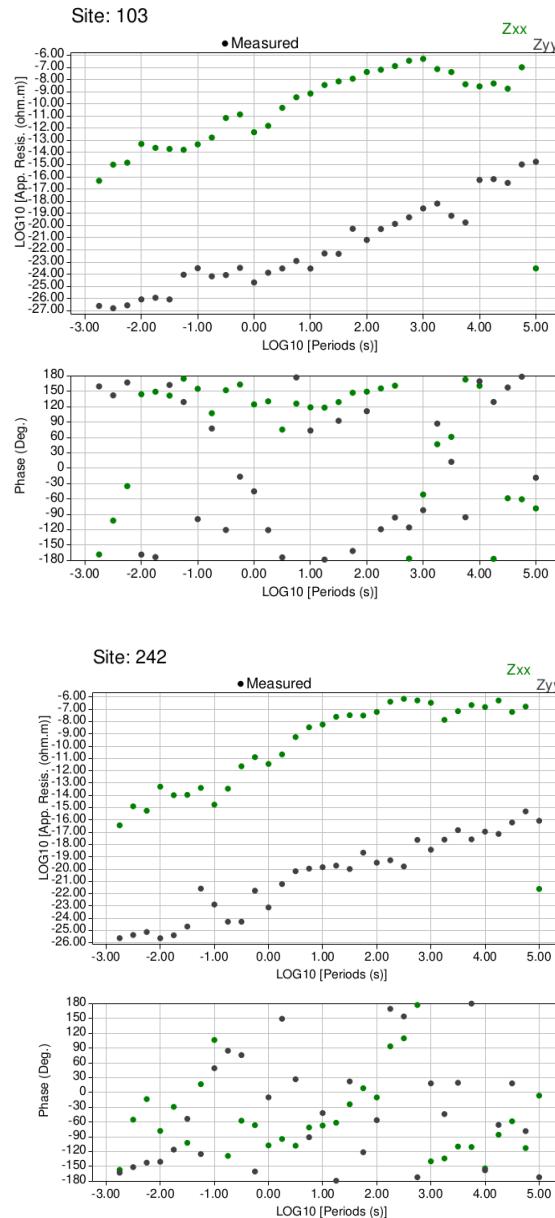
(a)

## Teste 1: distribuição 2D – bacia simples

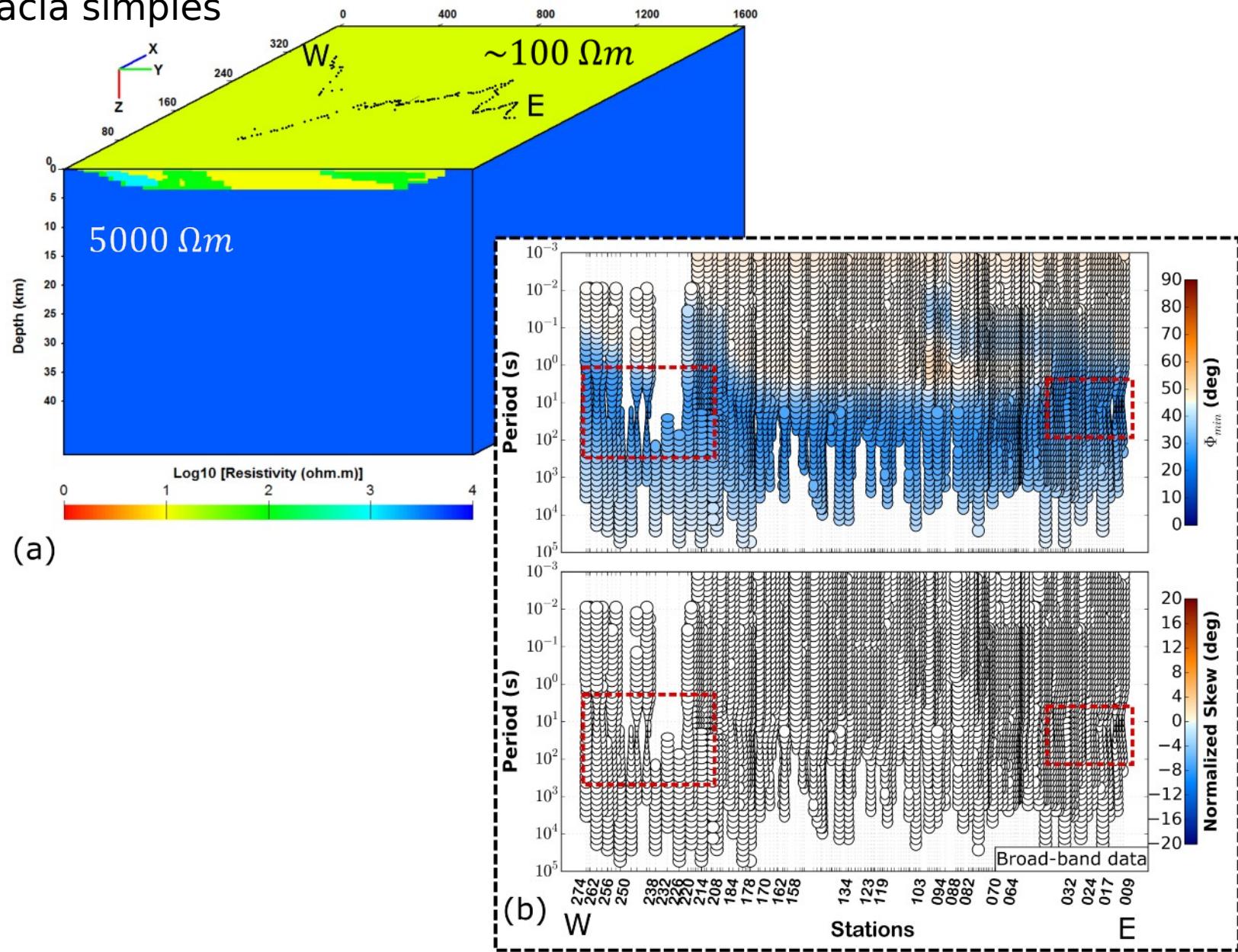


(a)

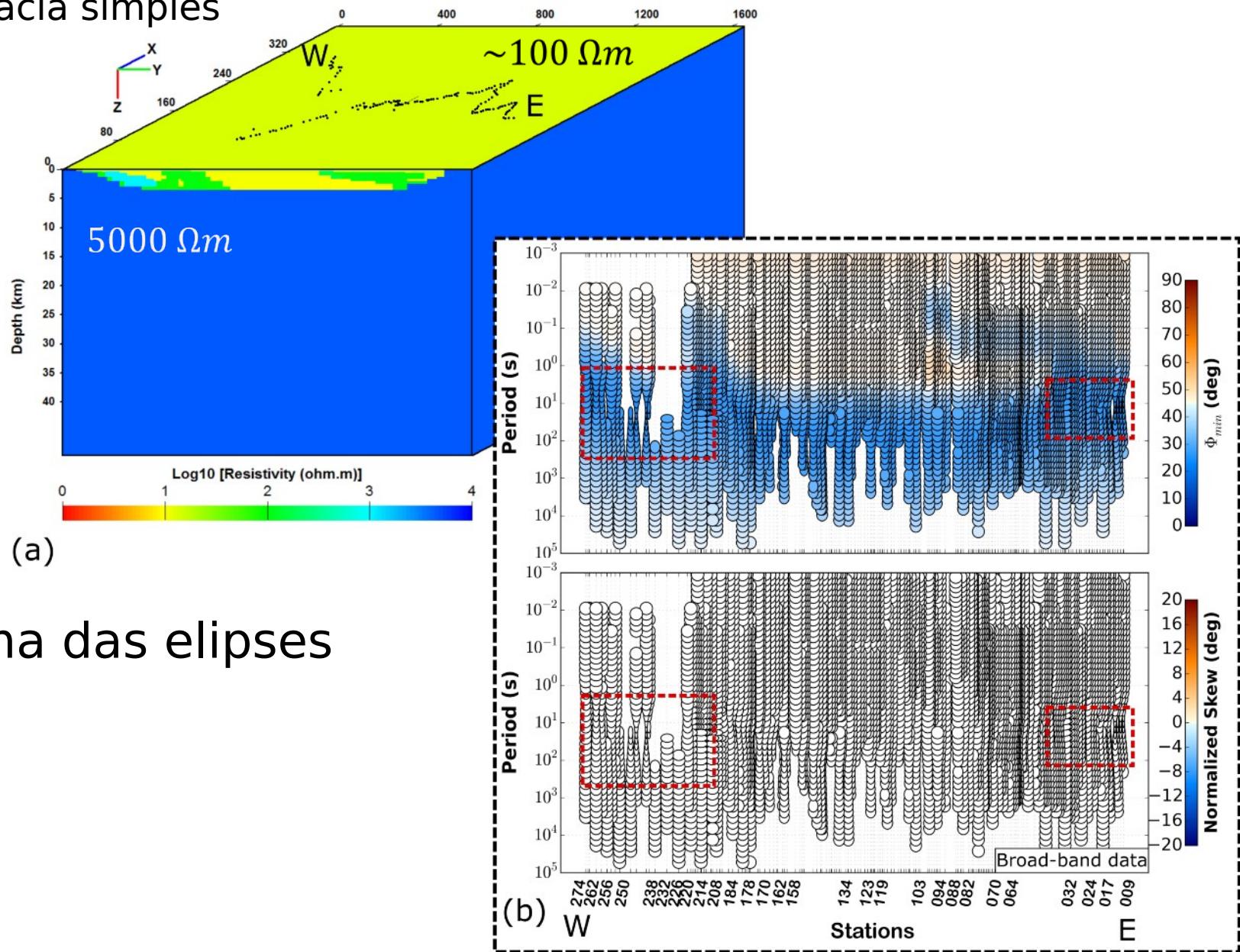
# Teste 1: distribuição 2D - bacia simples



## Teste 1: distribuição 2D – bacia simples

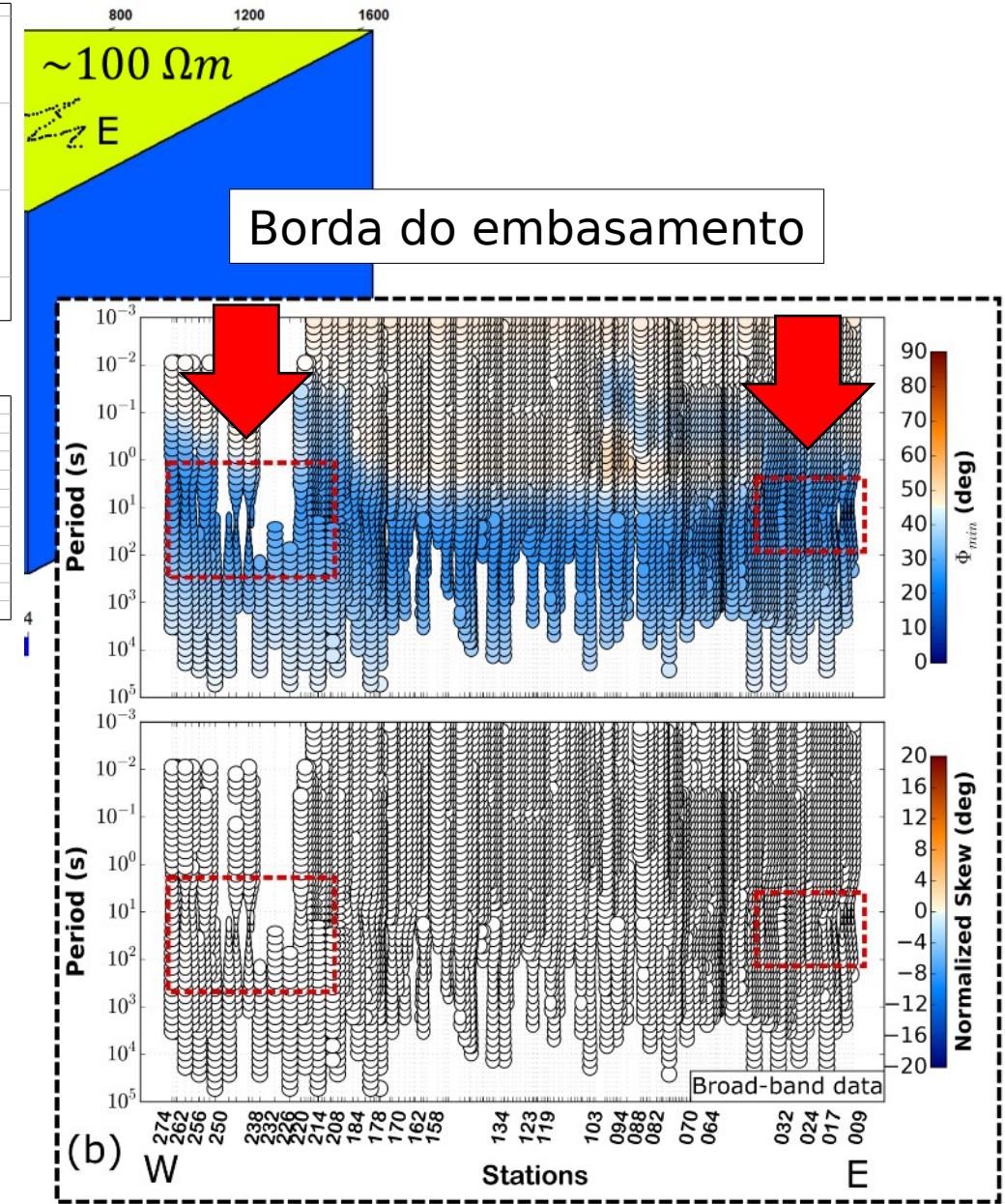
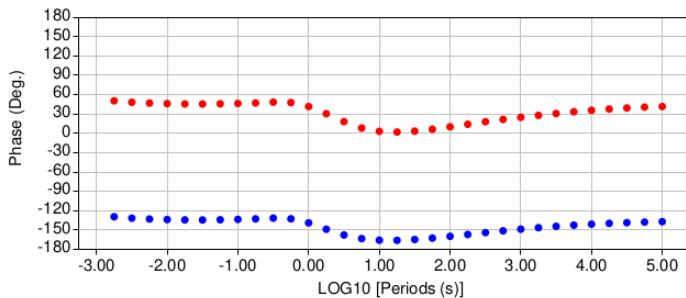
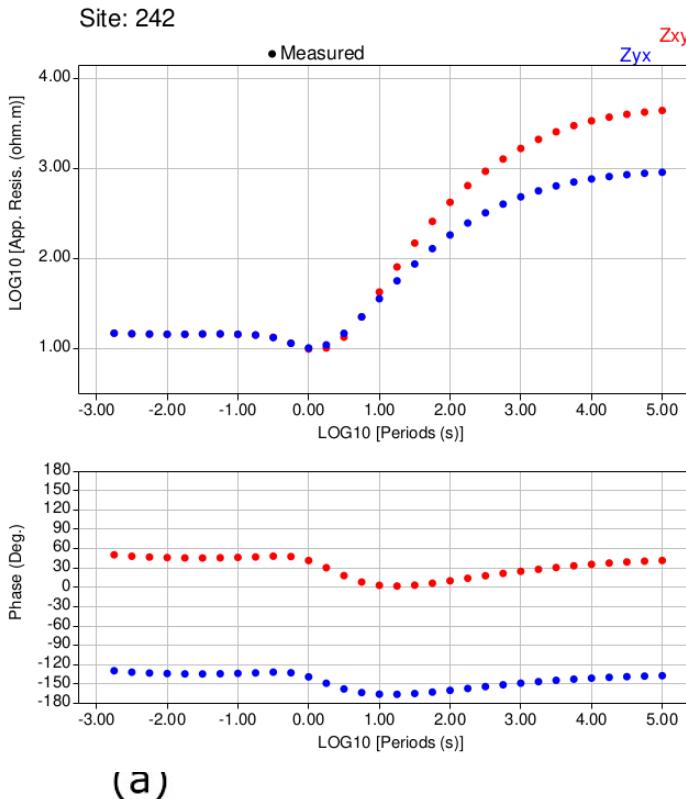


## Teste 1: distribuição 2D - bacia simples



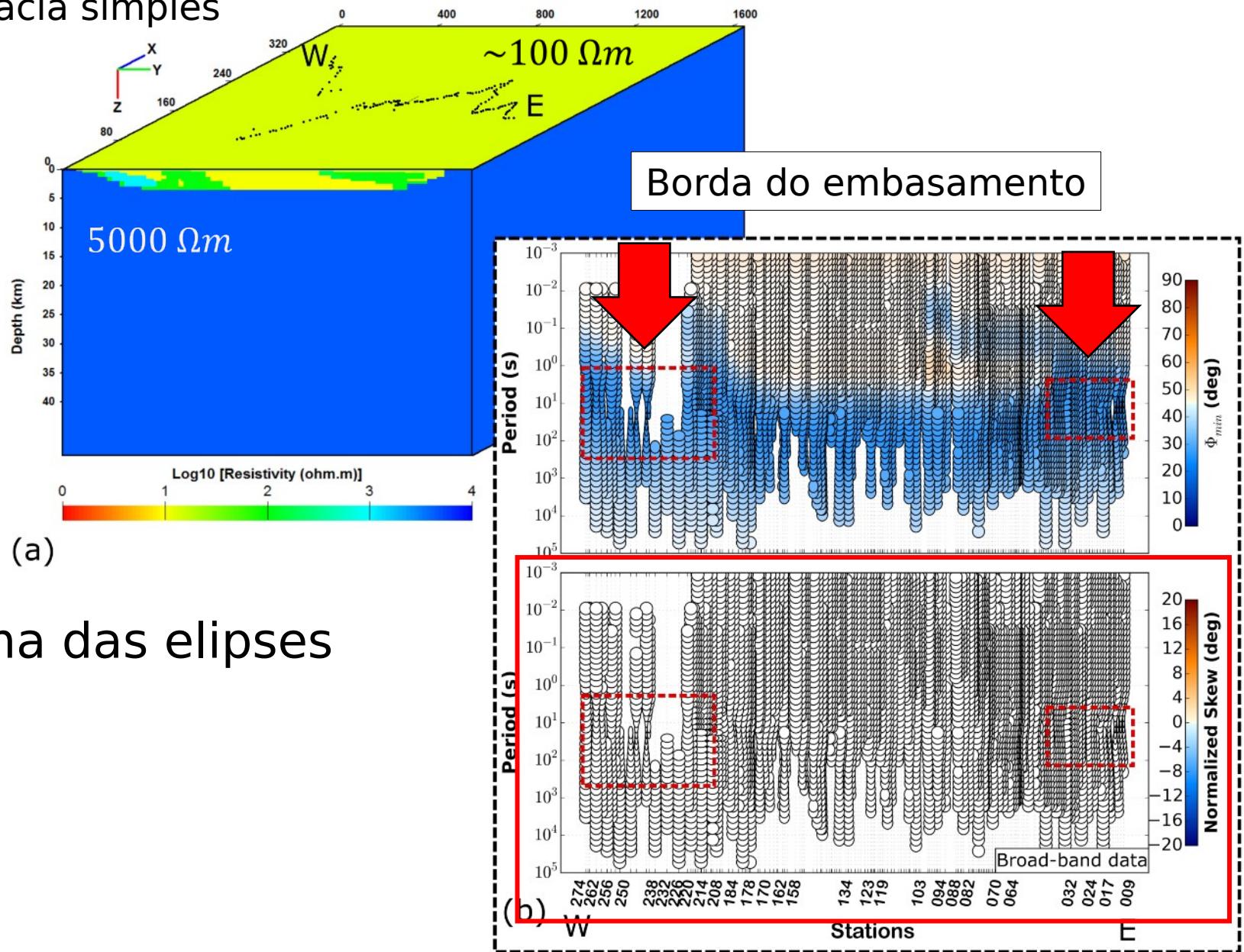
Pouca variação na forma das elipses

## Teste 1: distribuição 2D



Pouca variação na forma das elipses

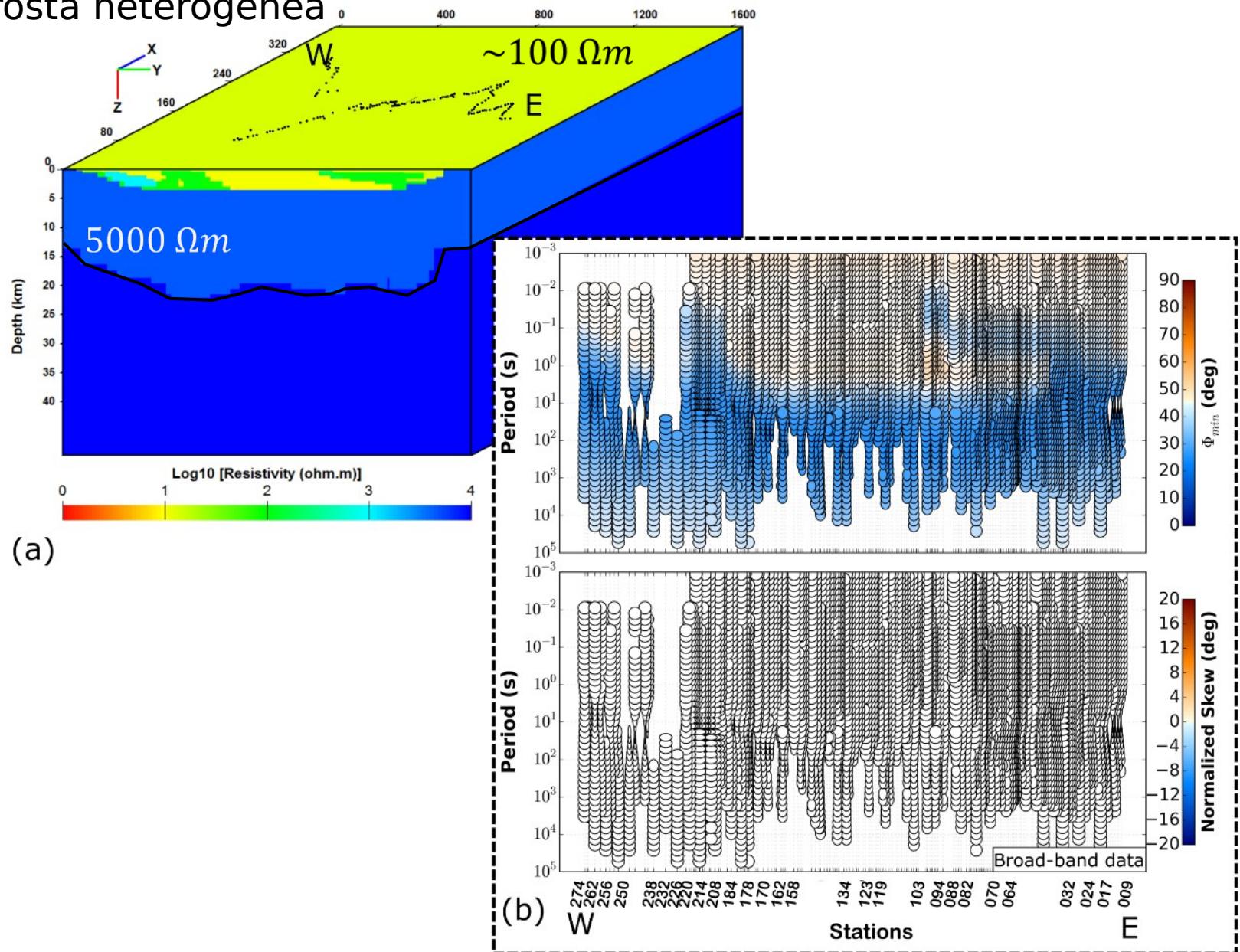
## Teste 1: distribuição 2D – bacia simples



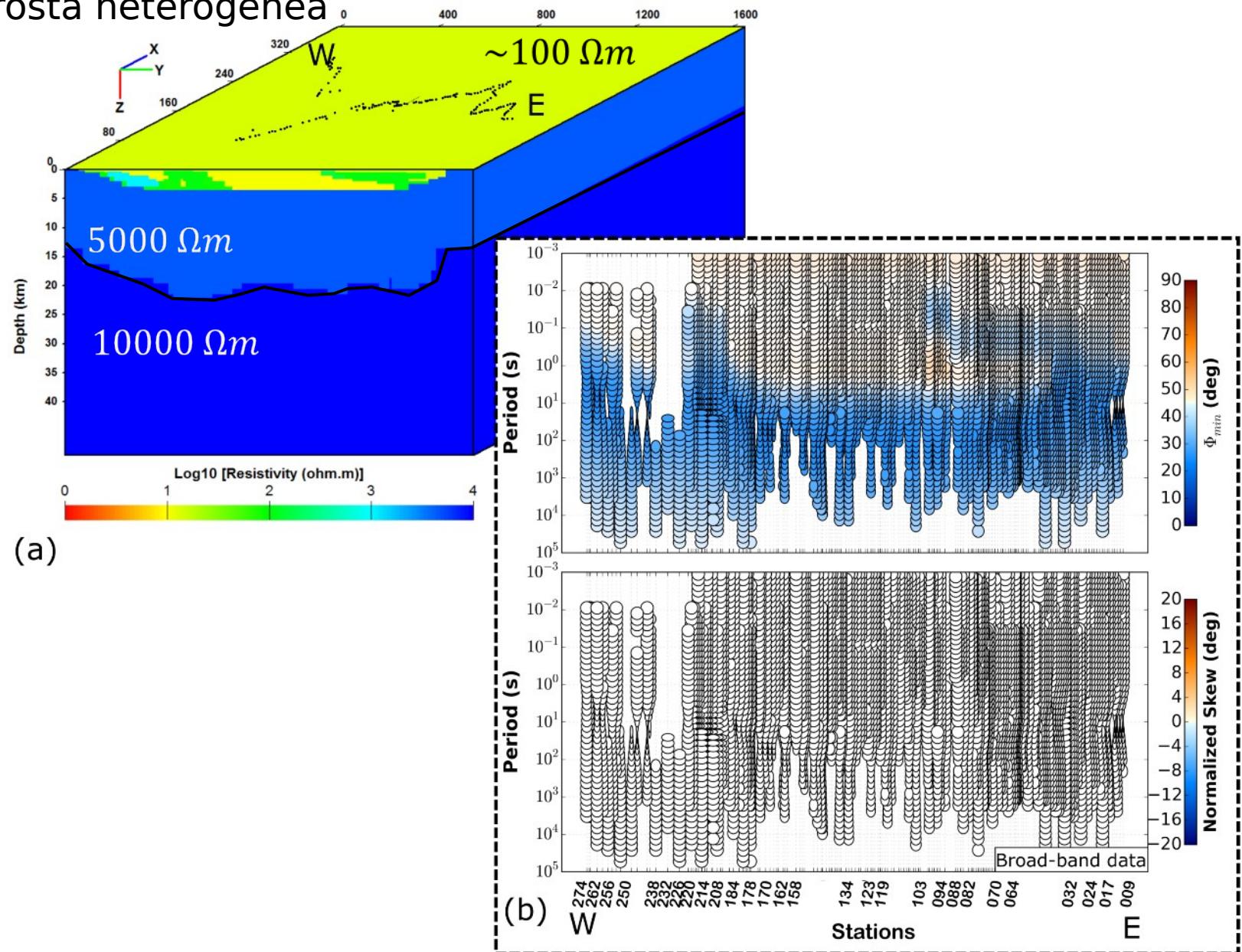
Pouca variação na forma das elipses

Skew = 0

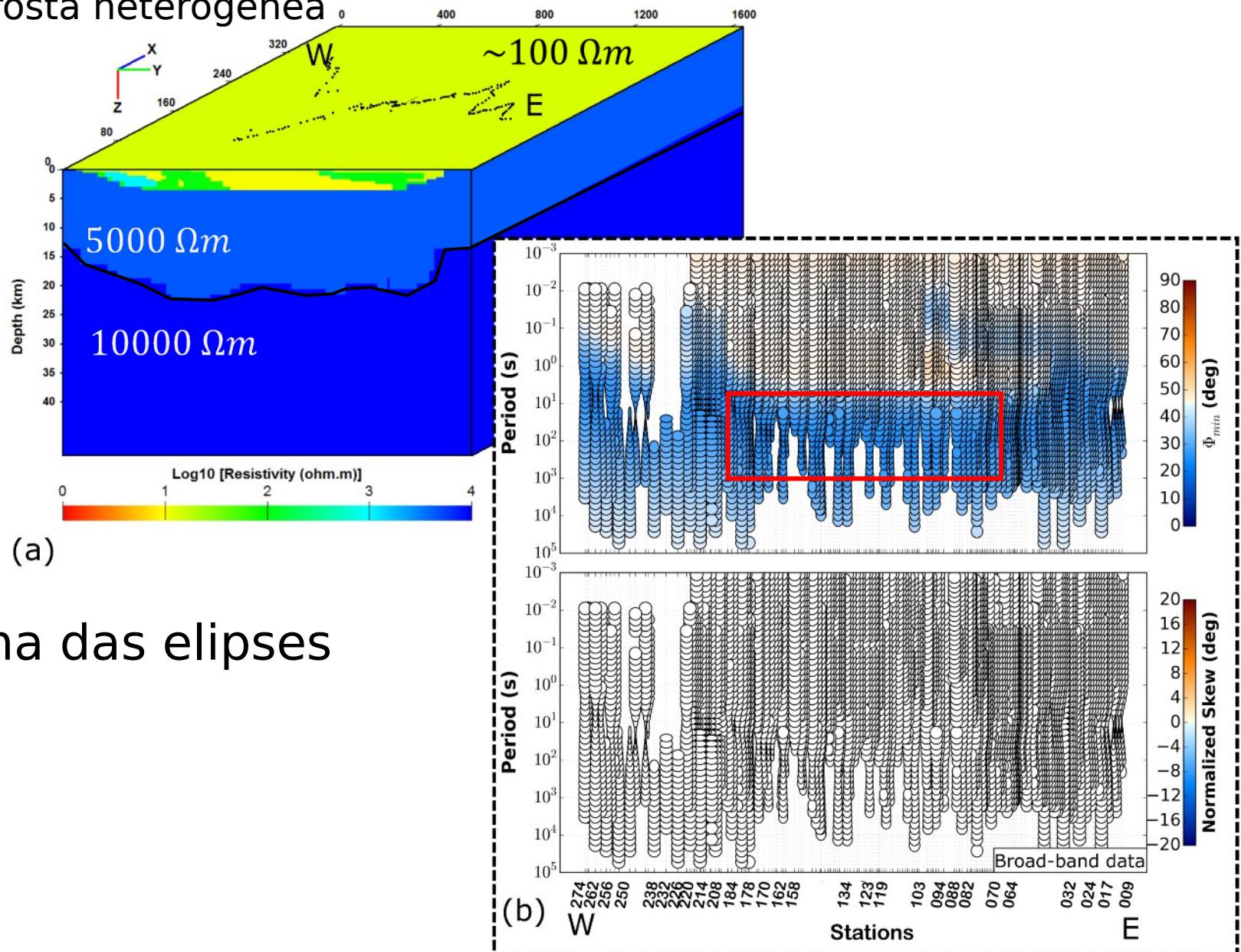
## Teste 2: distribuição 2D - crosta heterogênea



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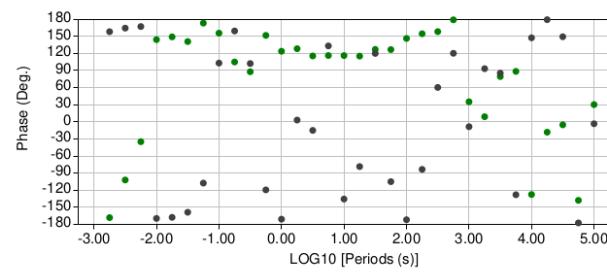
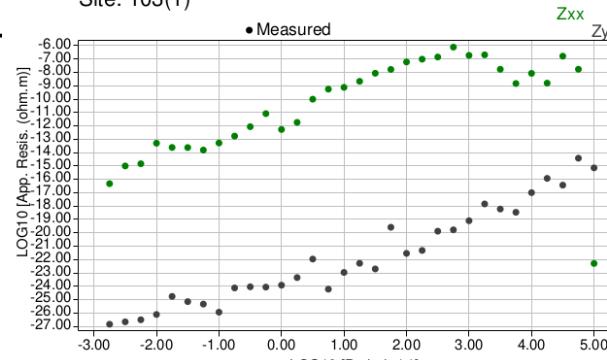
## Teste 2: distribuição 2D - crosta heterogênea



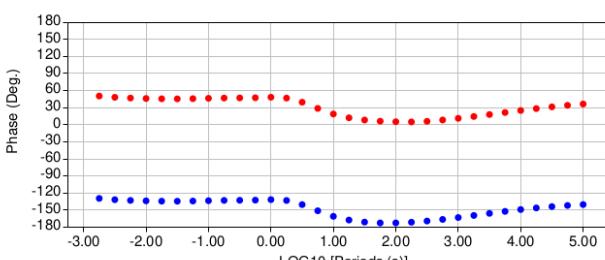
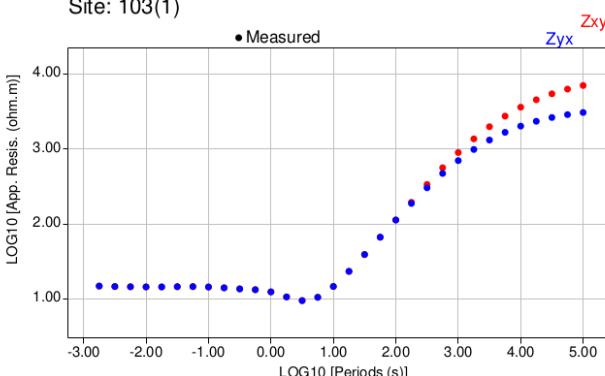
Pouca variação na forma das elipses

Skew = 0

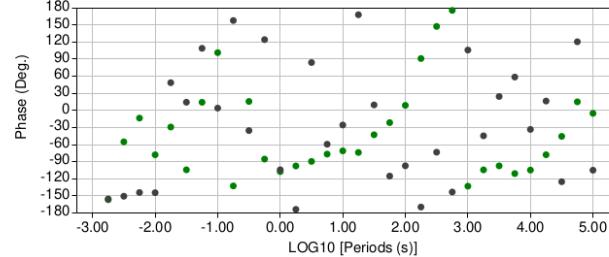
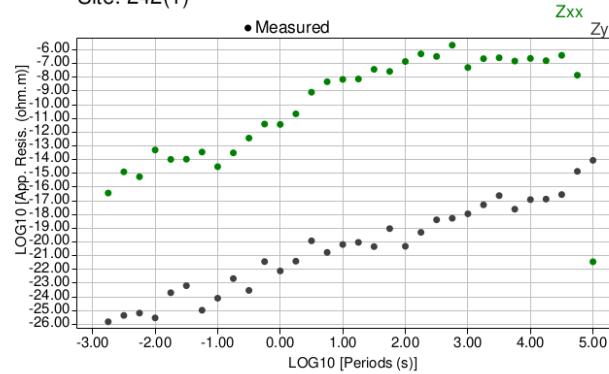
Site: 103(1)



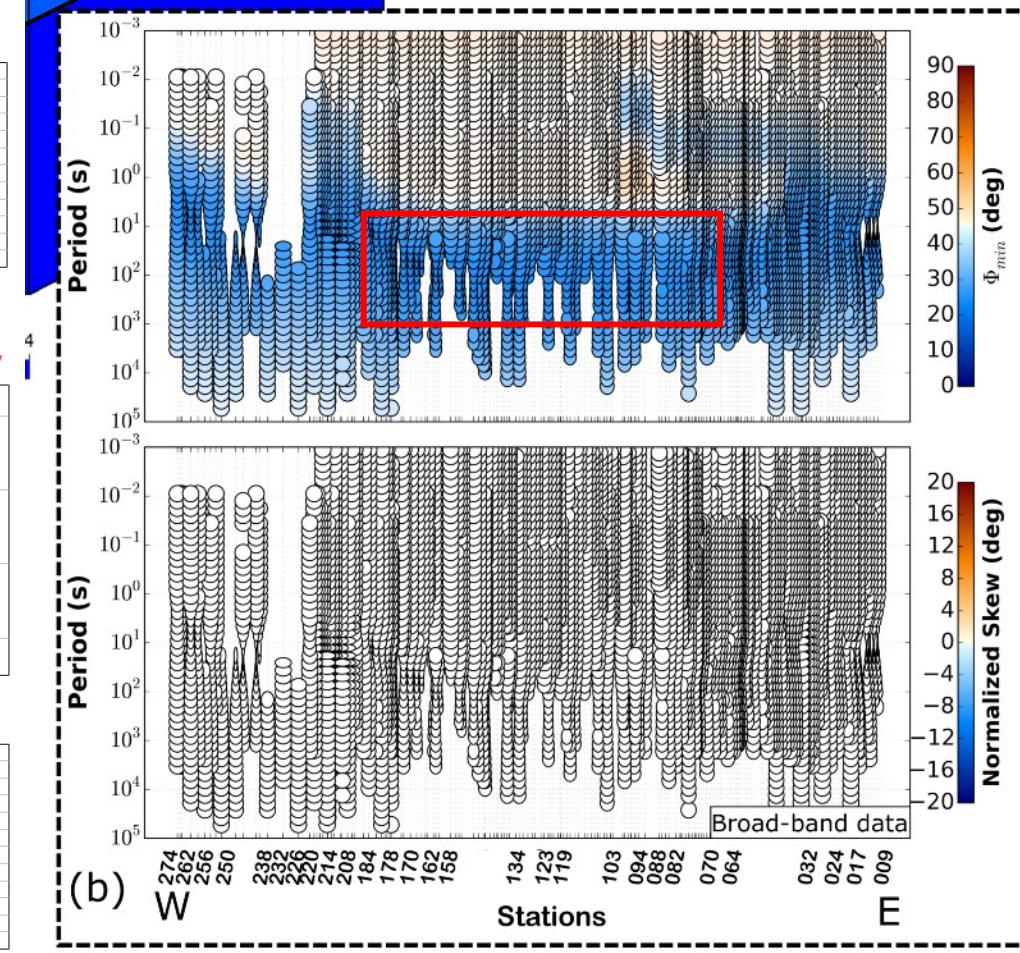
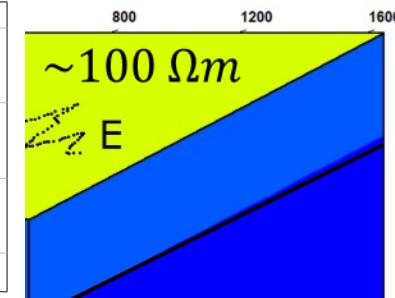
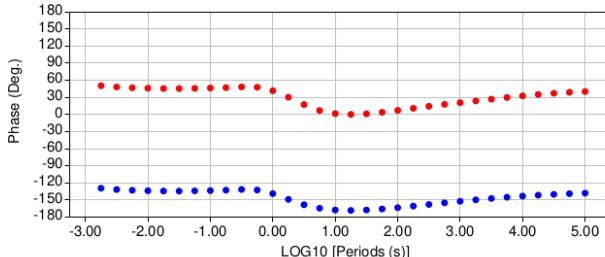
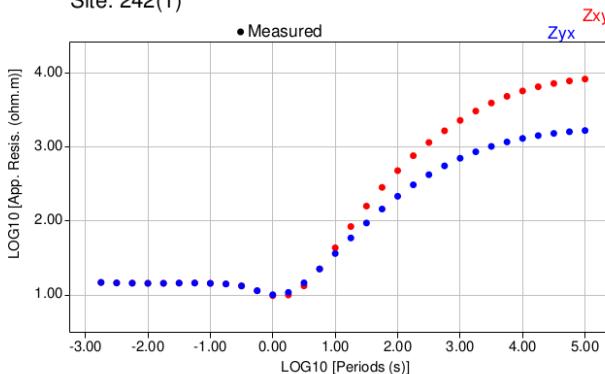
Site: 103(1)



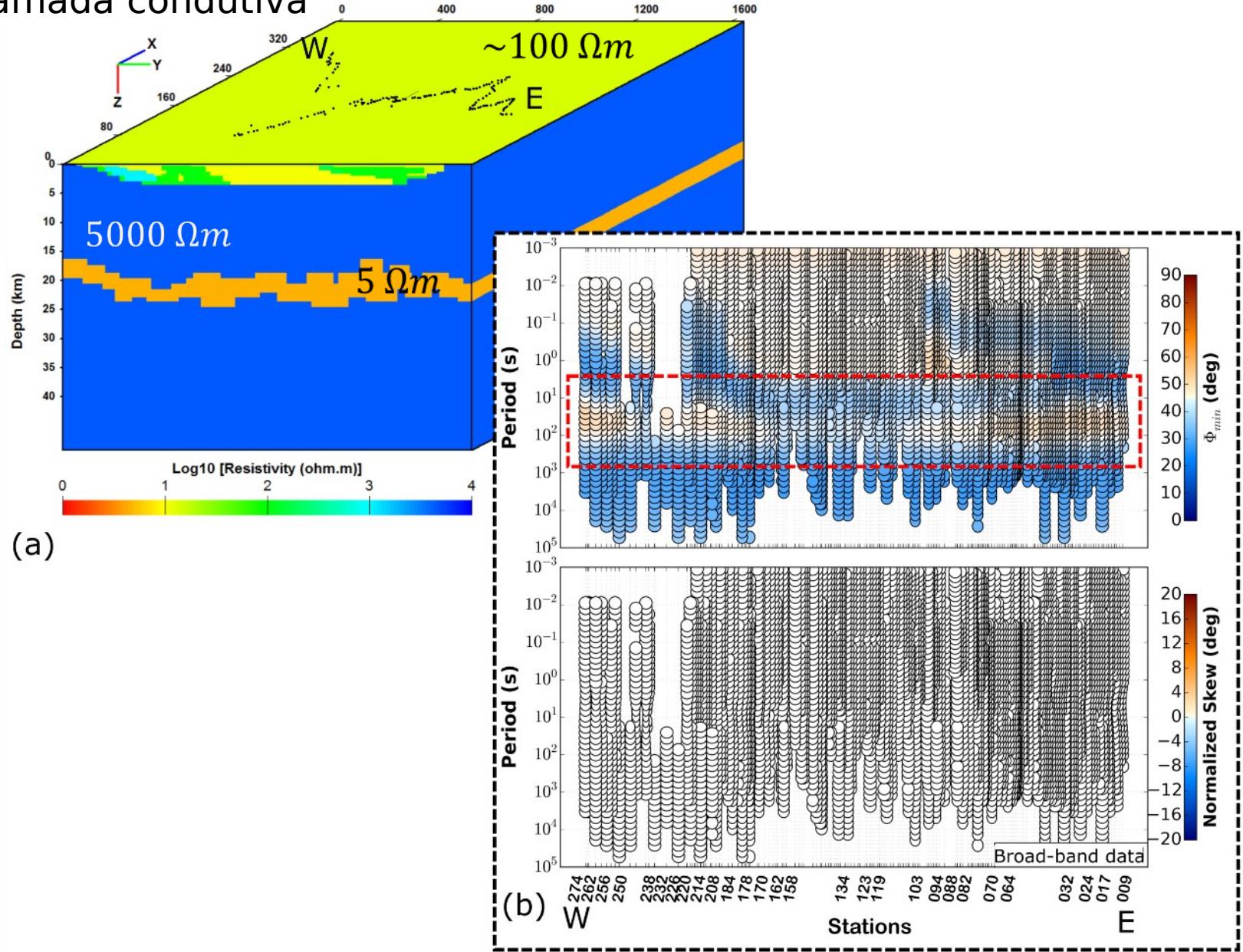
Site: 242(1)



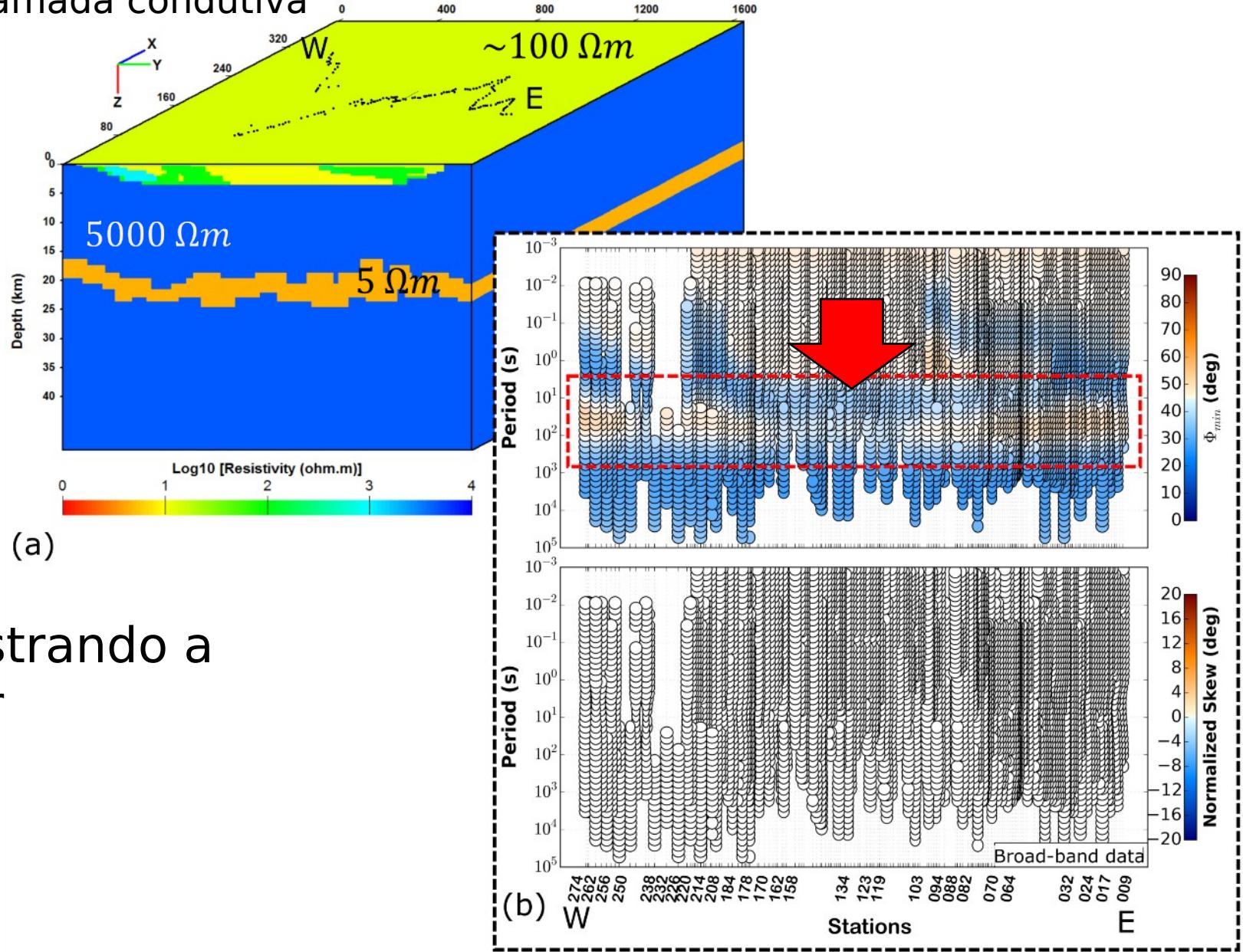
Site: 242(1)



## Teste 3: distribuição 2D – camada condutiva 2D

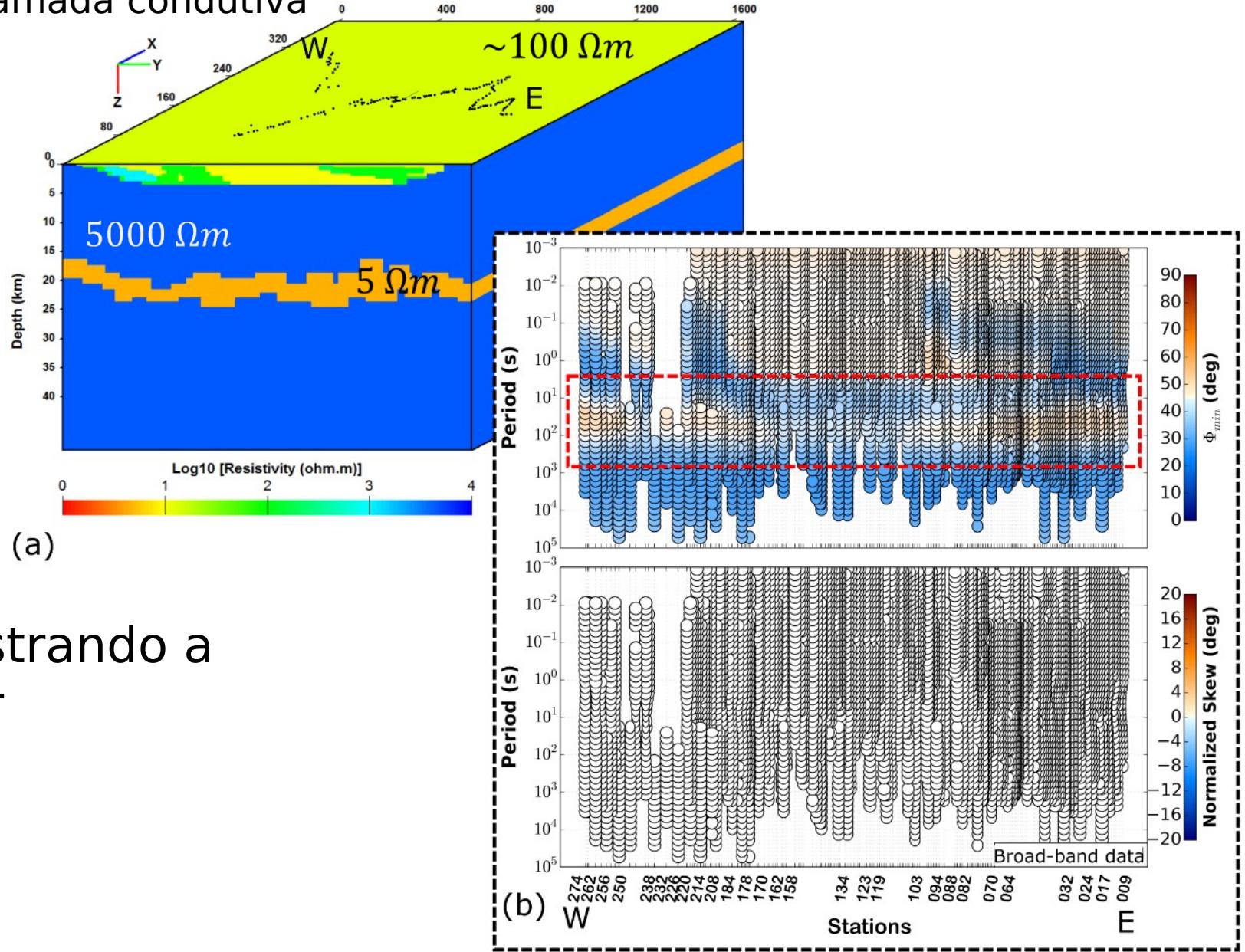


## Teste 3: distribuição 2D – camada condutiva 2D



Aumento na fase, mostrando a influência do condutor

## Teste 3: distribuição 2D – camada condutiva 2D

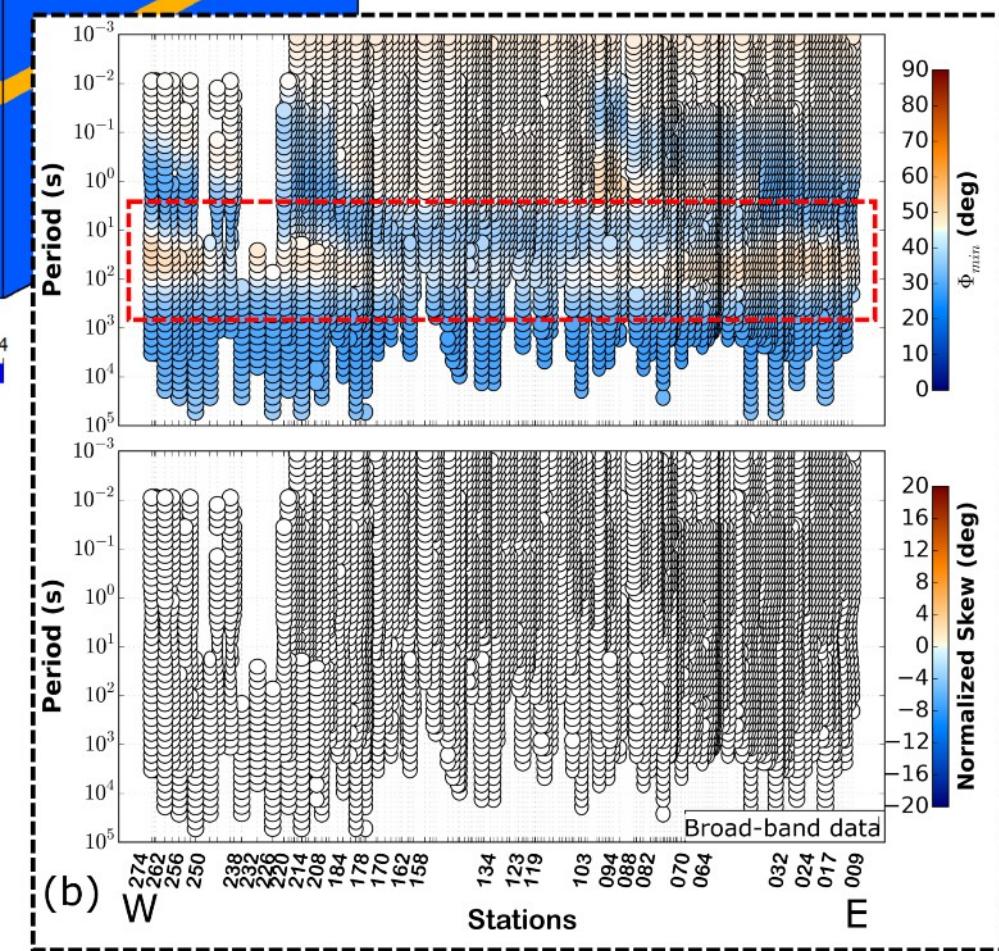
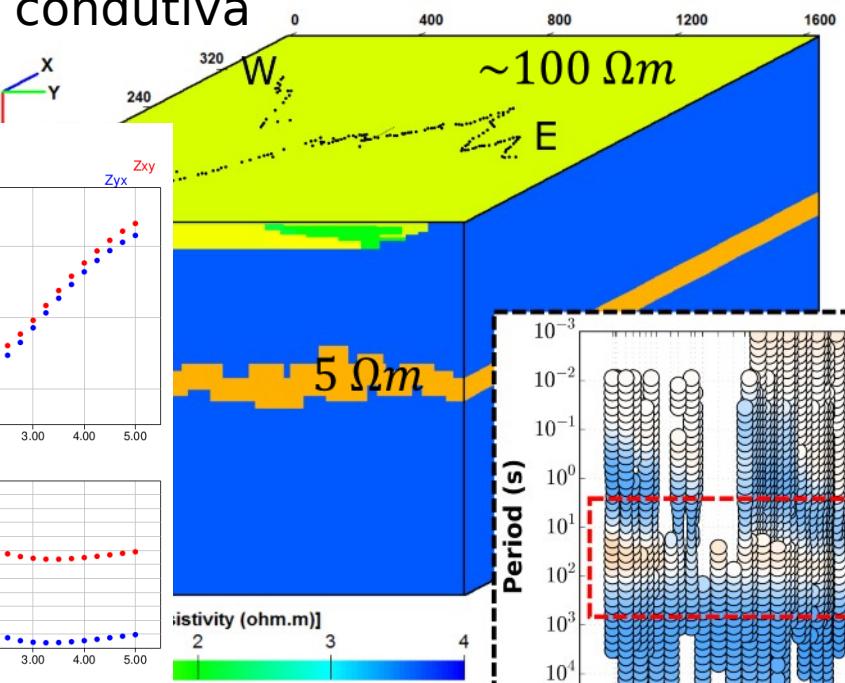
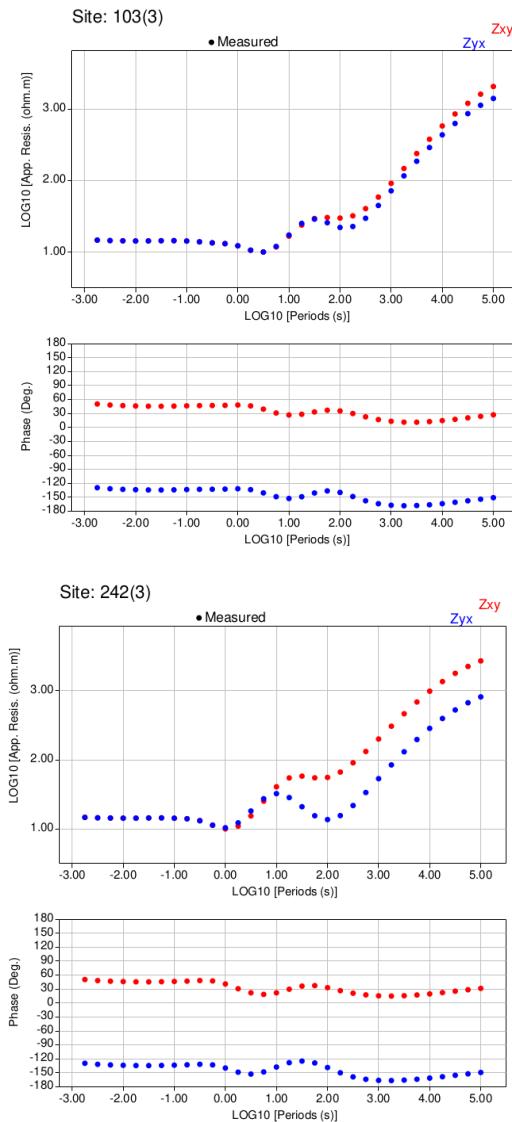
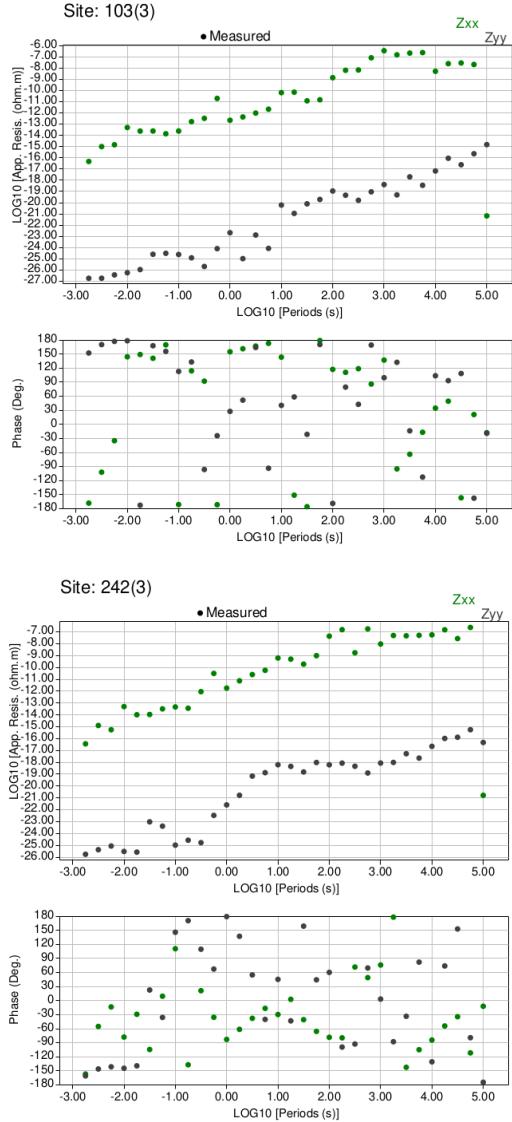


Aumento na fase, mostrando a influência do condutor

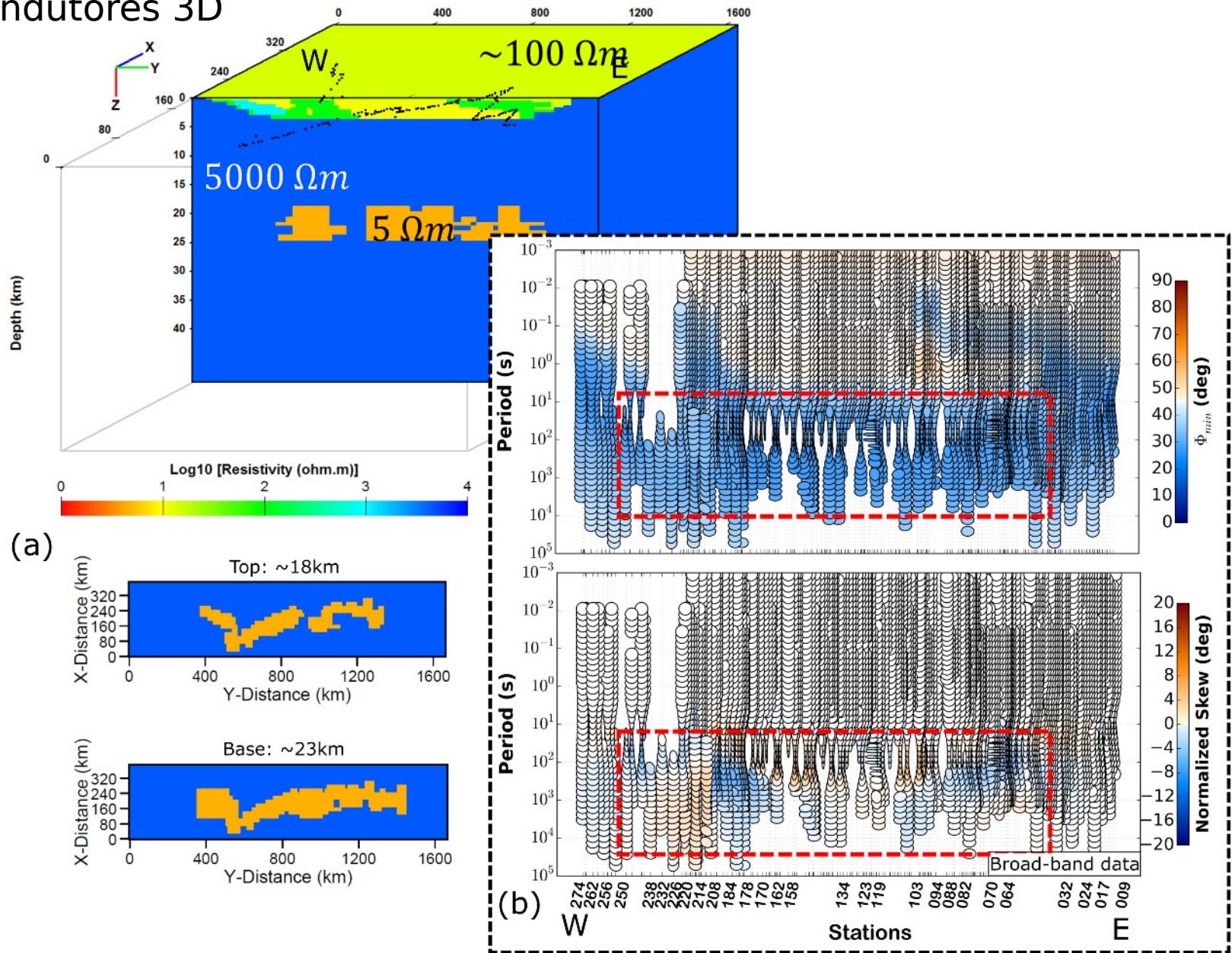
Skew = 0

# Teste 3: distribuição 2D - camada condutiva

## 2D

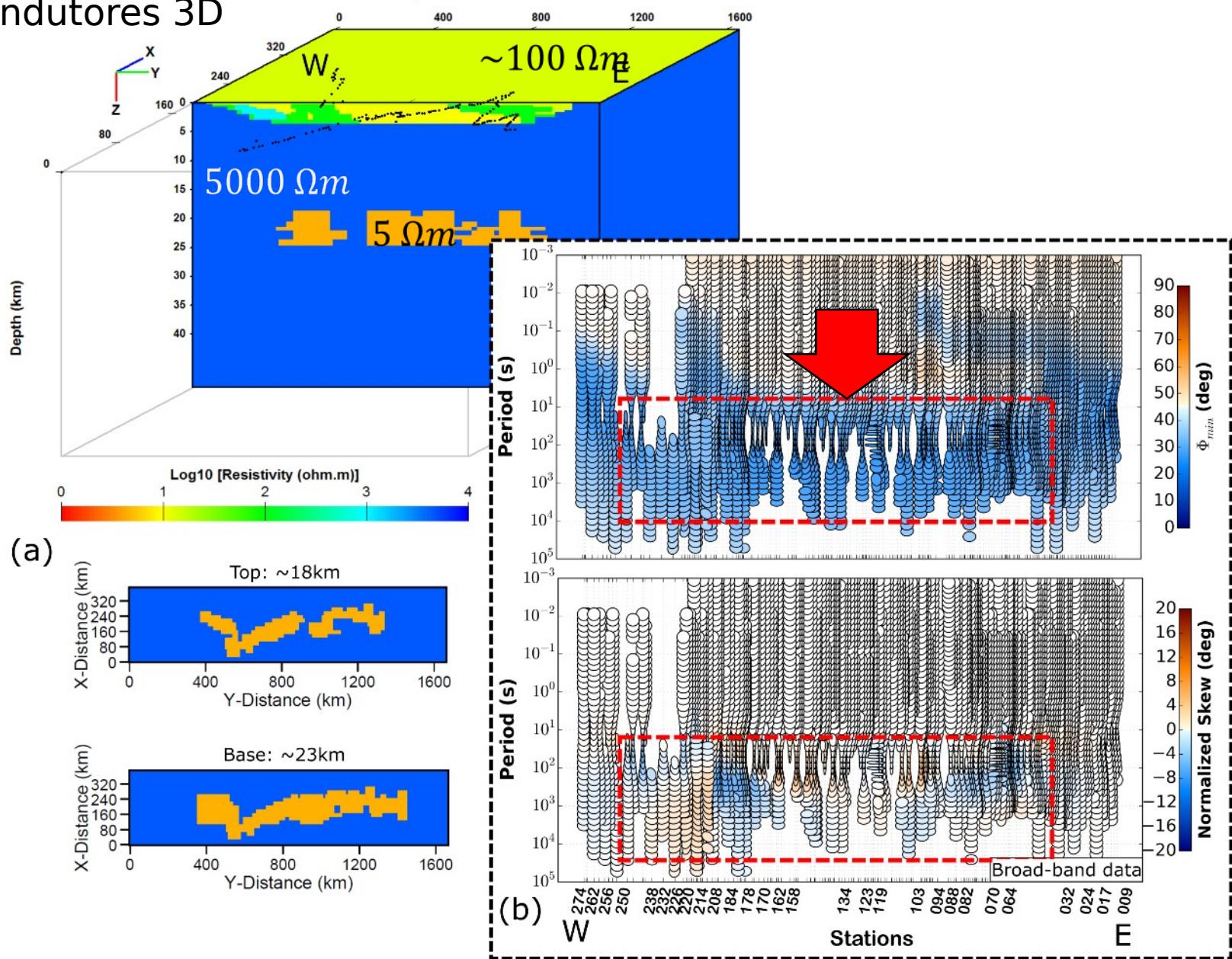


## Teste 4: distribuição 2D -condutores 3D



## Teste 4: distribuição 2D -condutores 3D

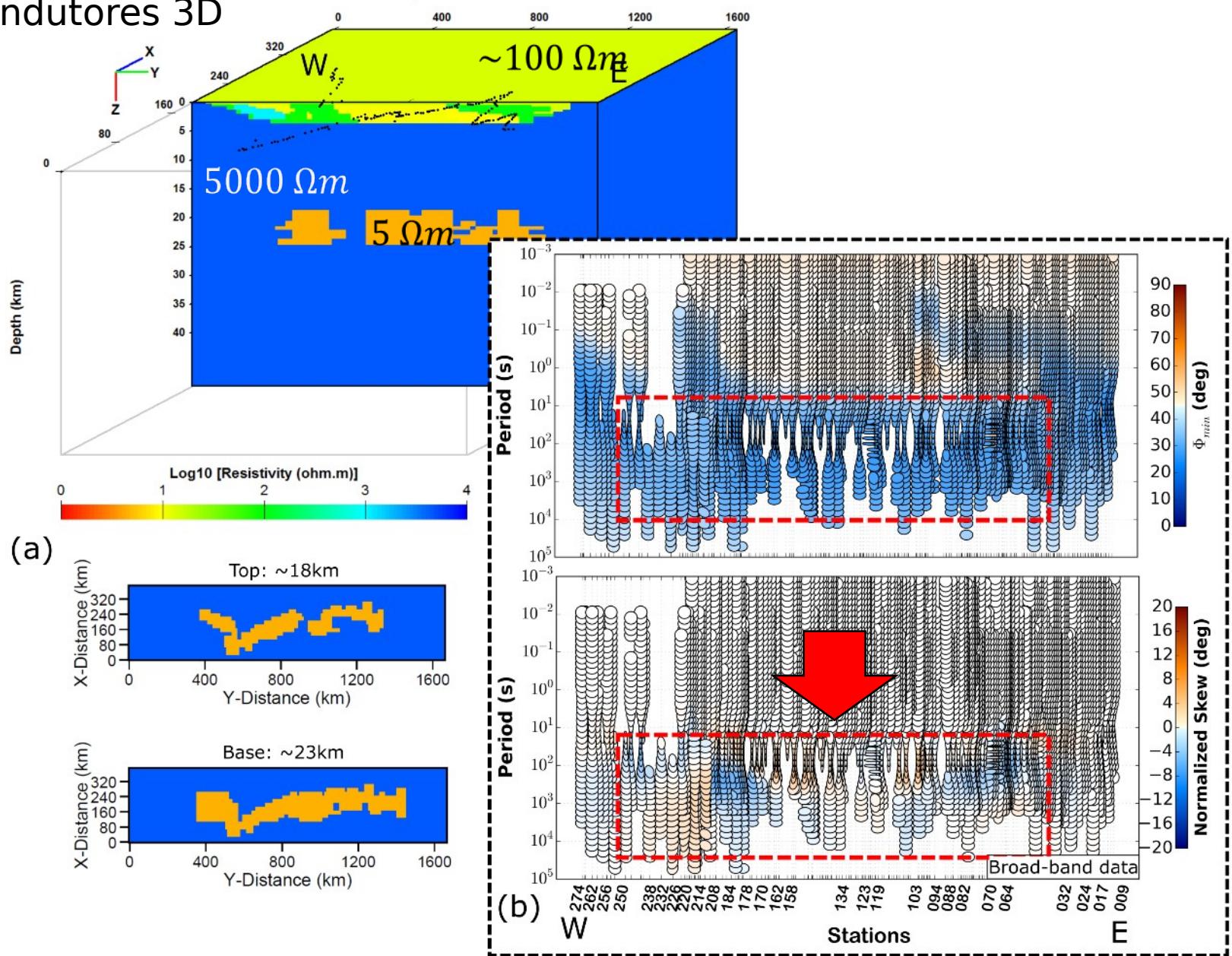
Variação na forma das elipses



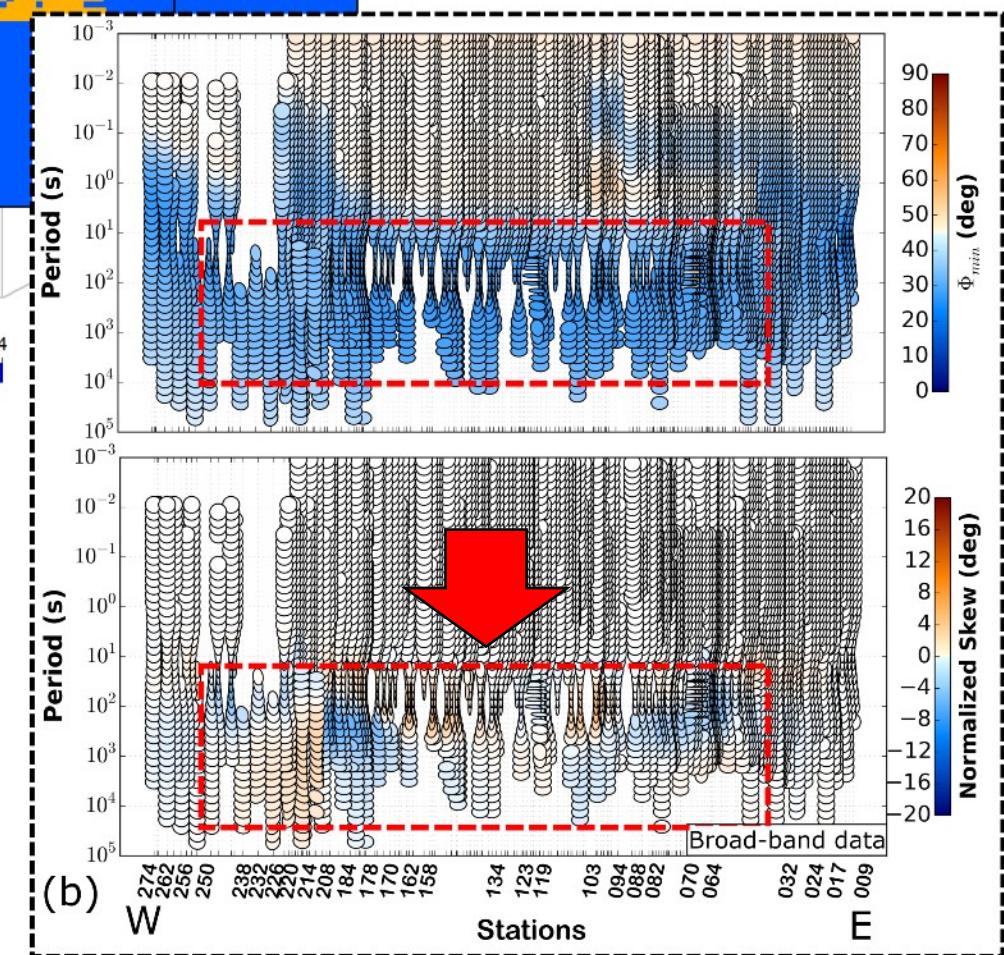
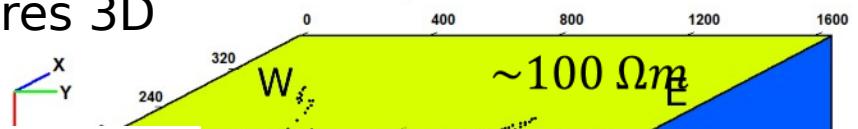
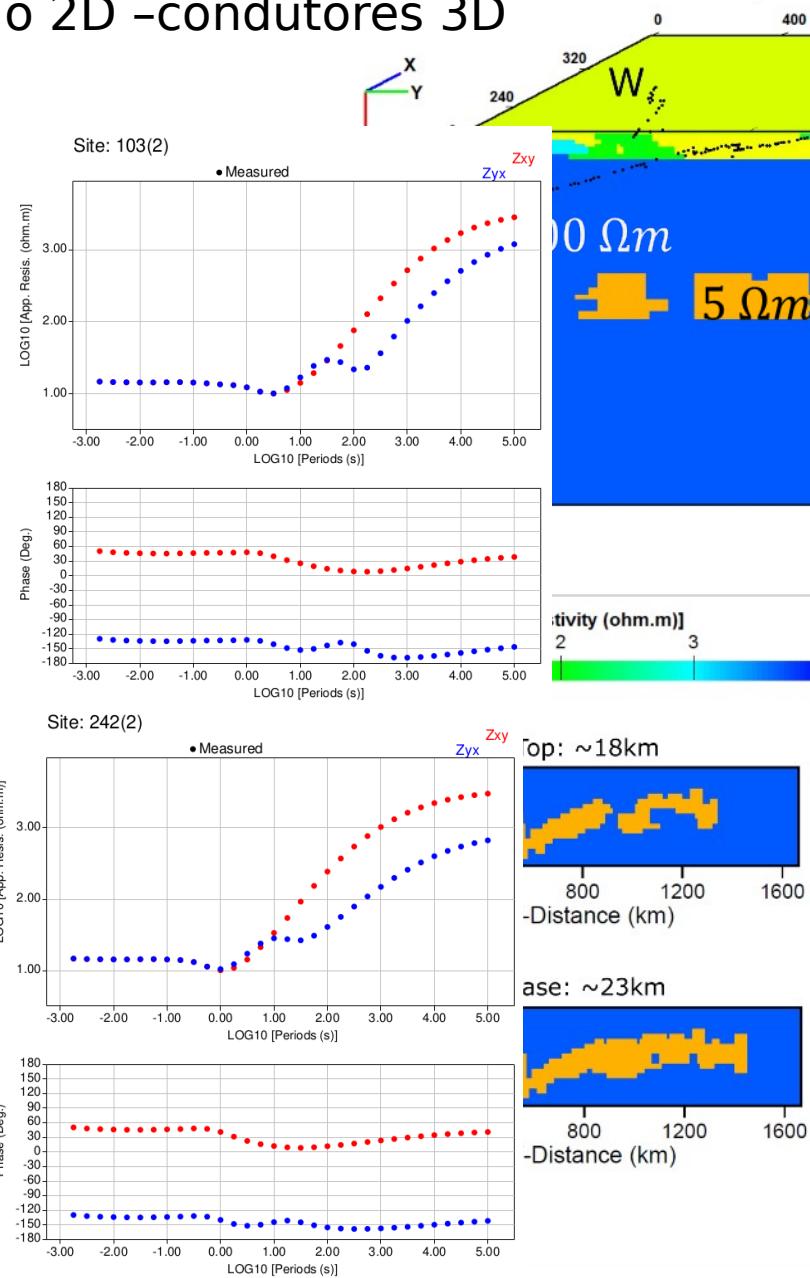
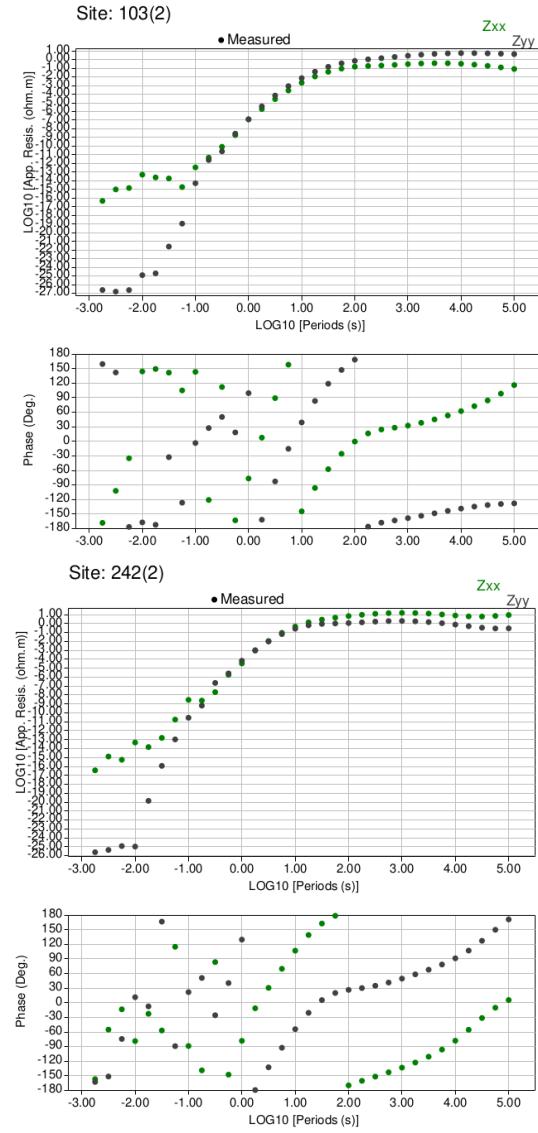
## Teste 4: distribuição 2D -condutores 3D

Variação na forma  
das elipses

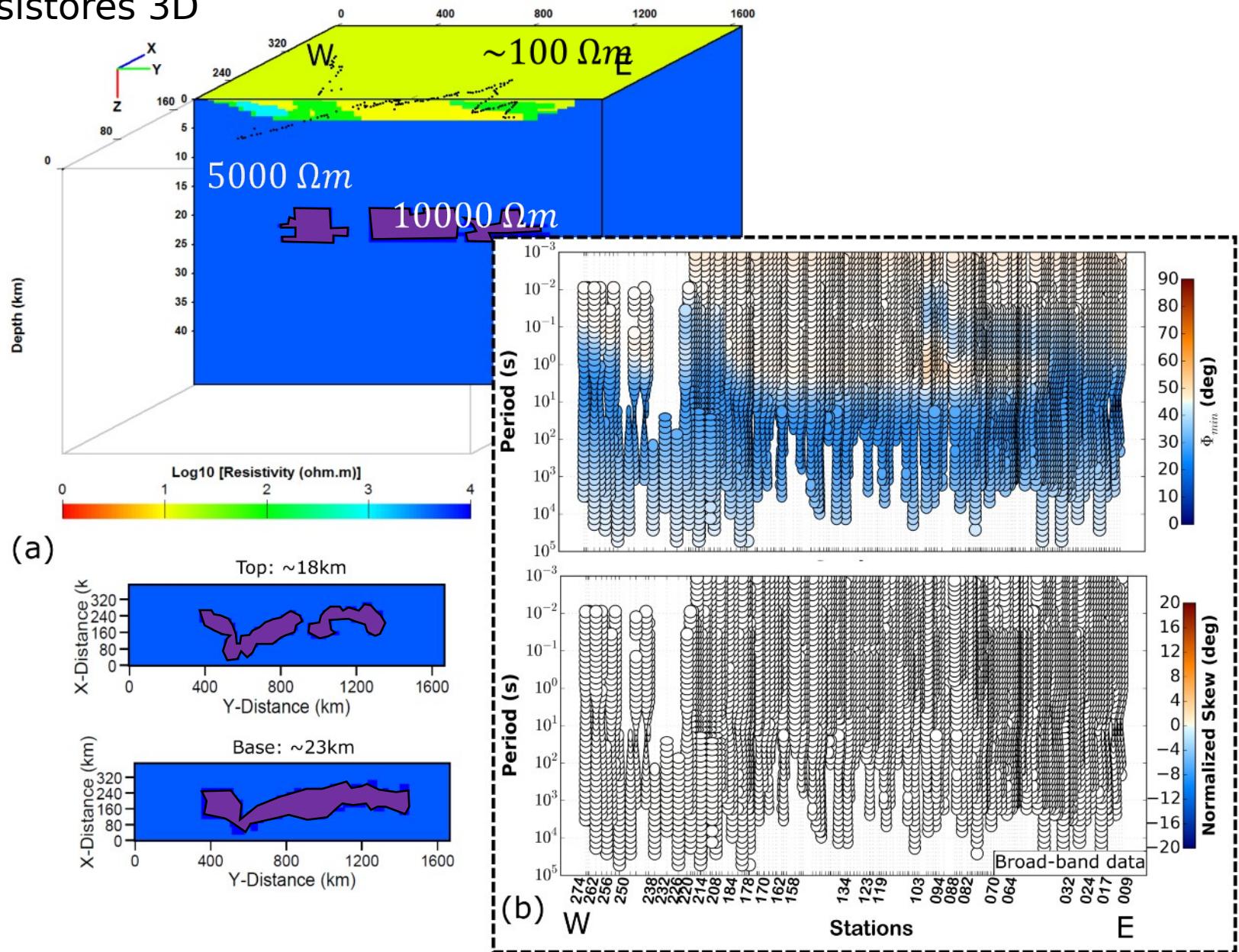
$\text{Skew} \neq 0$



## Teste 4: distribuição 2D -condutores 3D



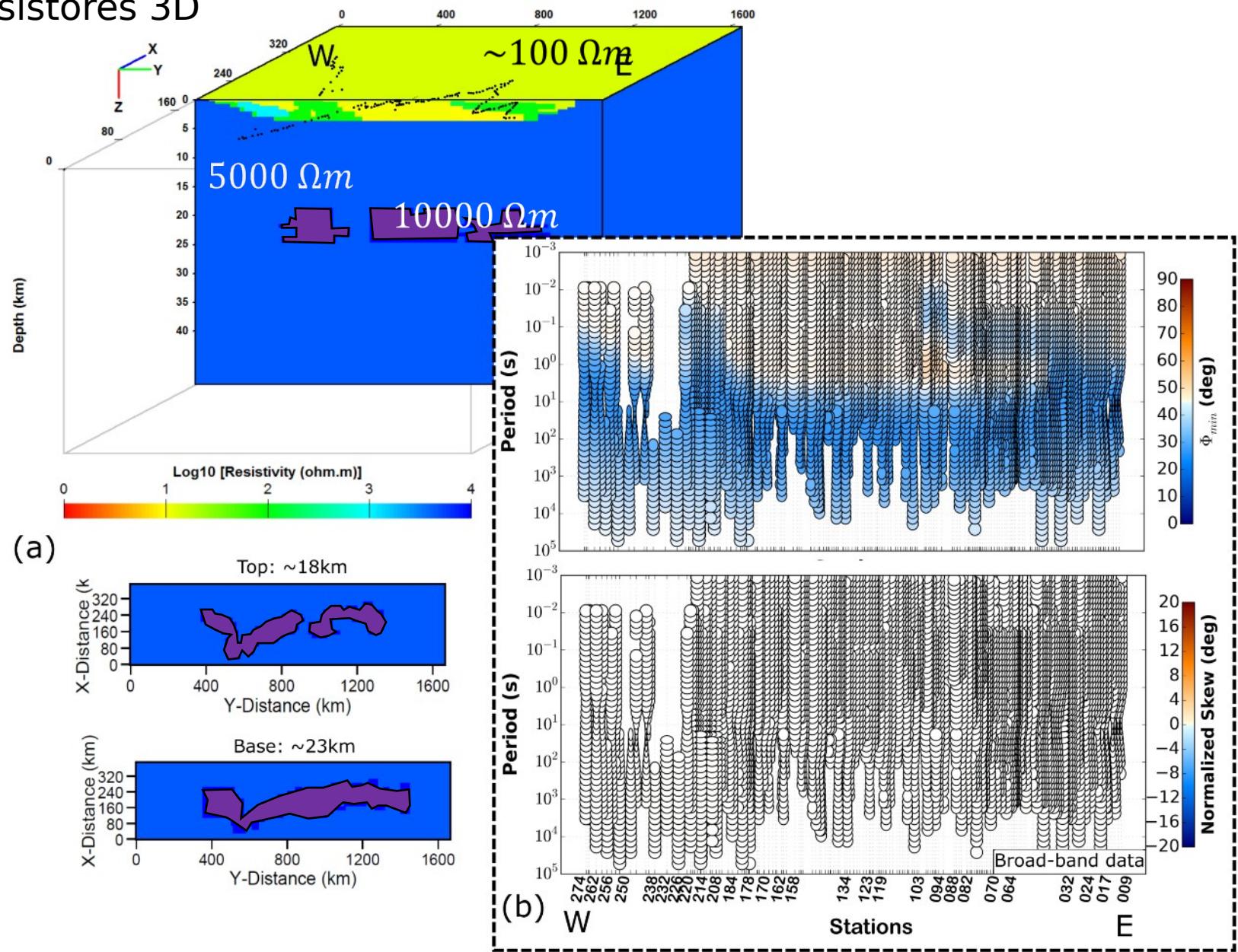
## Teste 5: distribuição 2D -resistores 3D



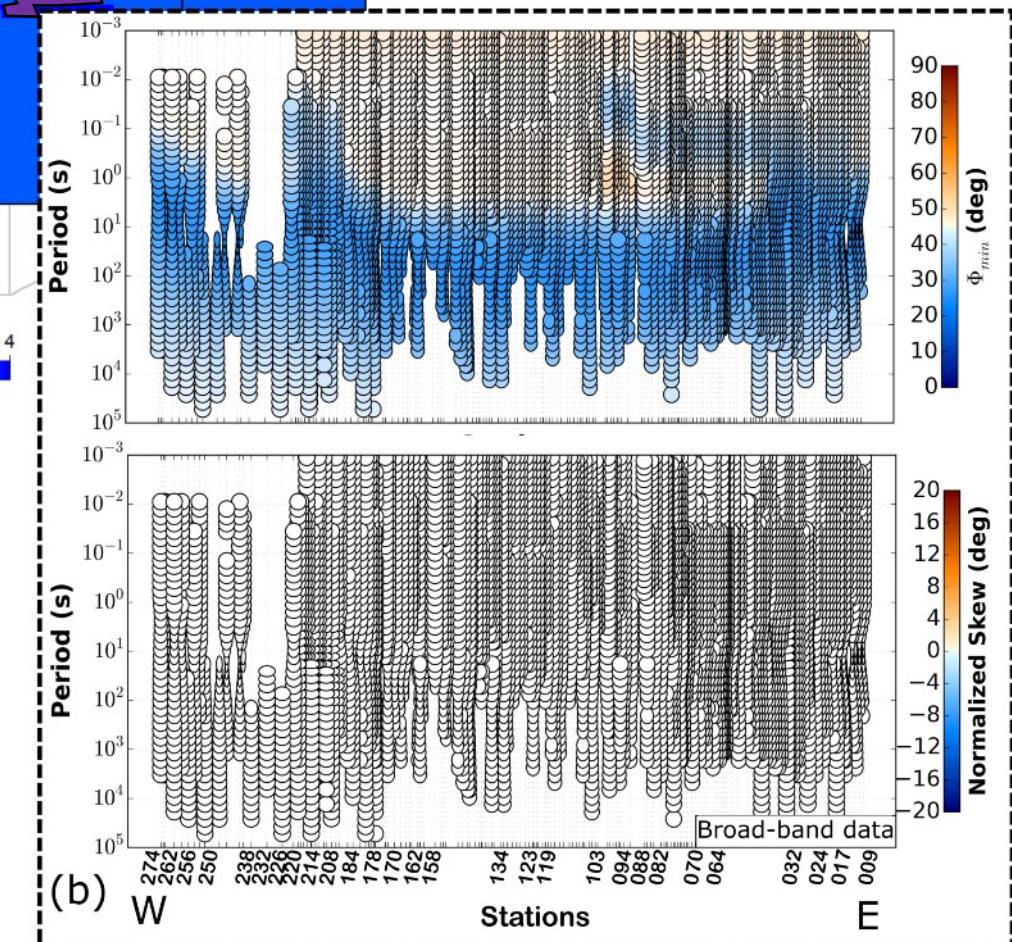
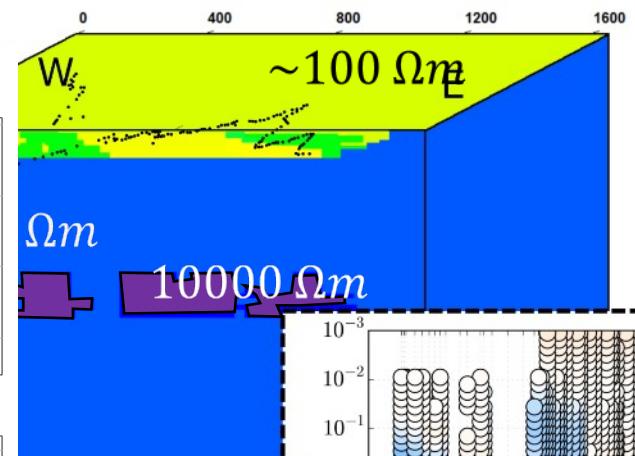
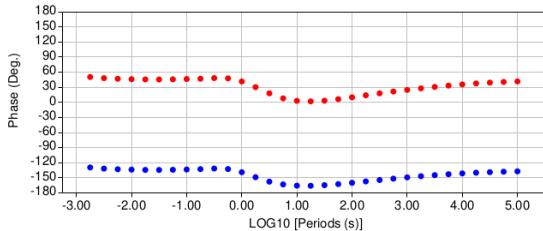
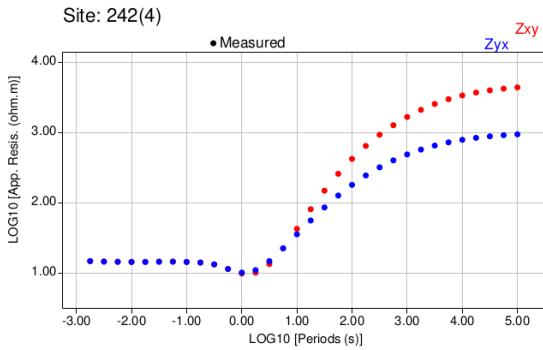
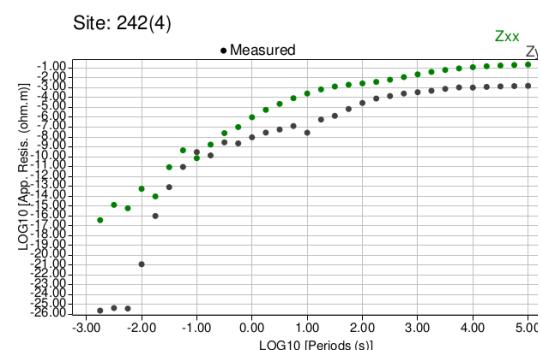
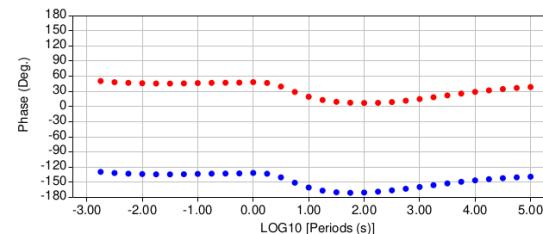
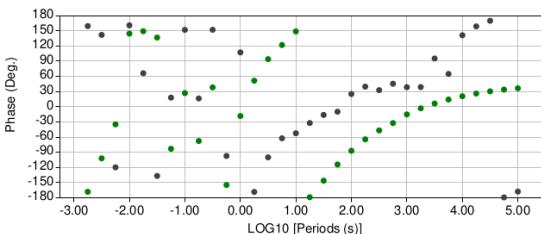
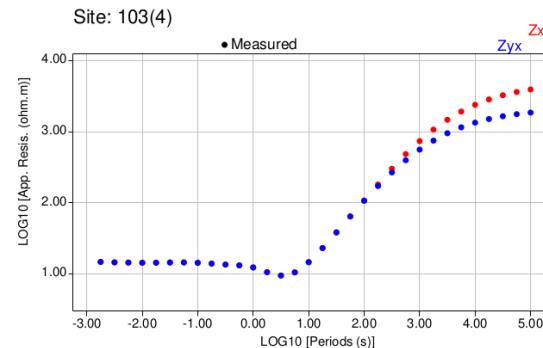
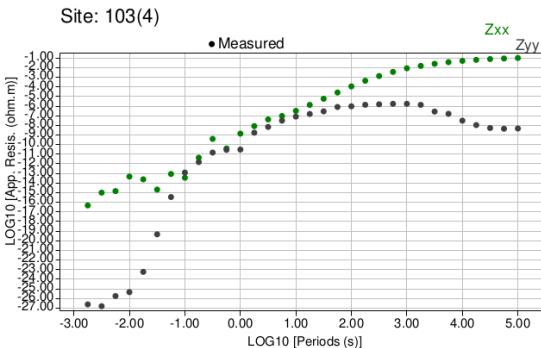
## Teste 5: distribuição 2D -resistores 3D

Pouca variação na forma das elipses

Skew = 0



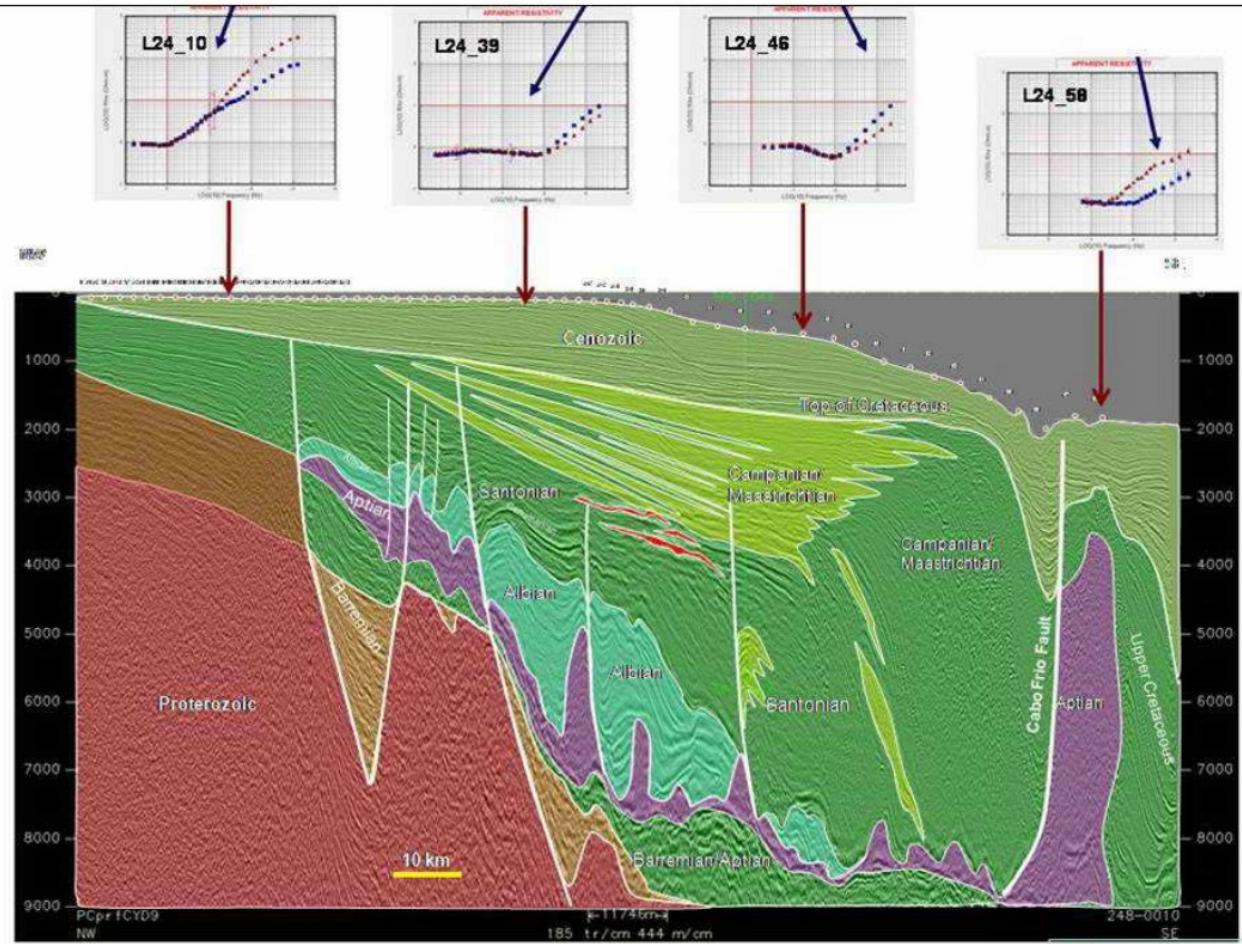
# Teste 5: distribuição 2D -resistores 3D



Para testar a presença de corpos salinos em uma bacia

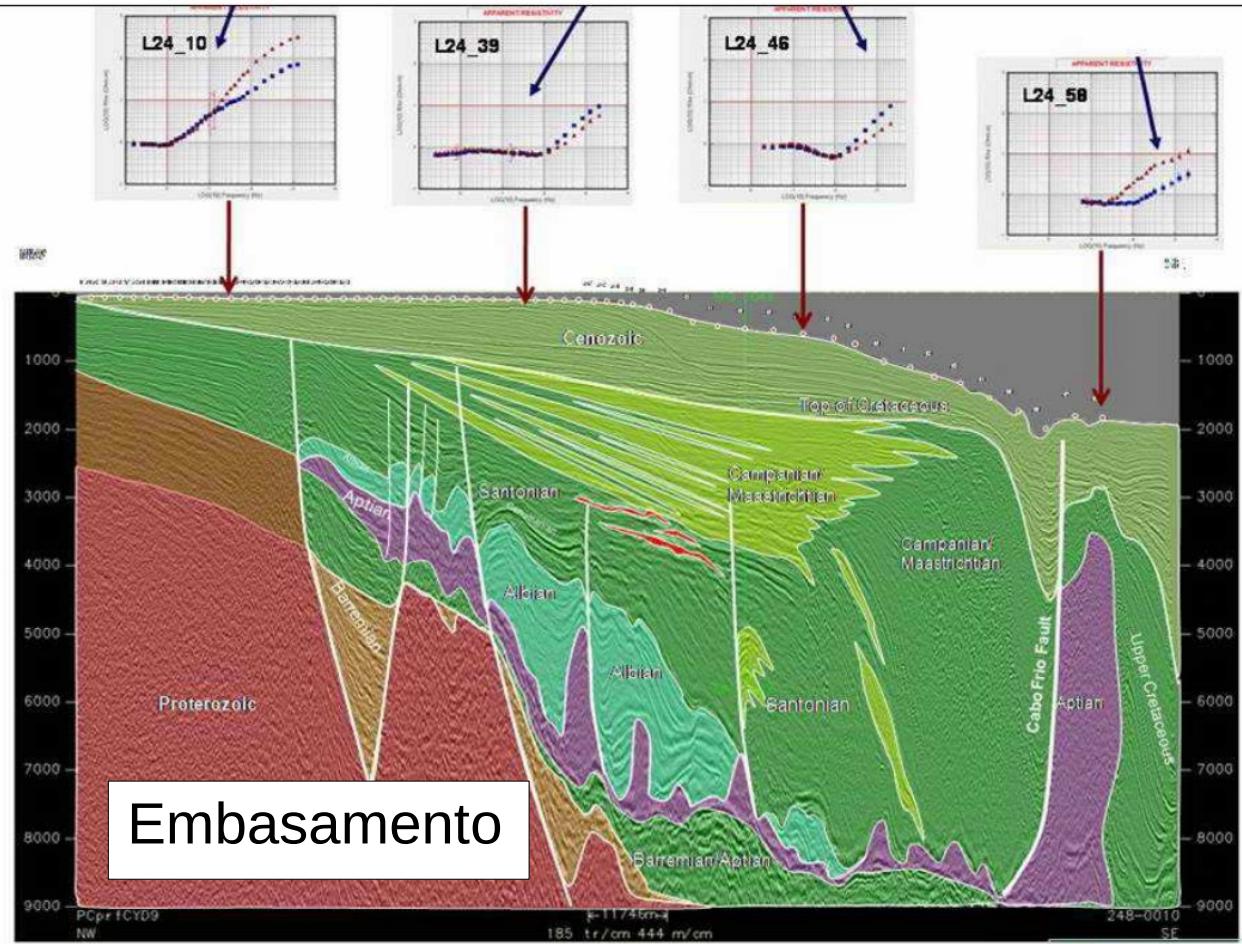
- Foram criados alguns modelos de resistividade 3D para simular algumas situações numa bacia sedimentar;

# MMT na Bacia de Santos



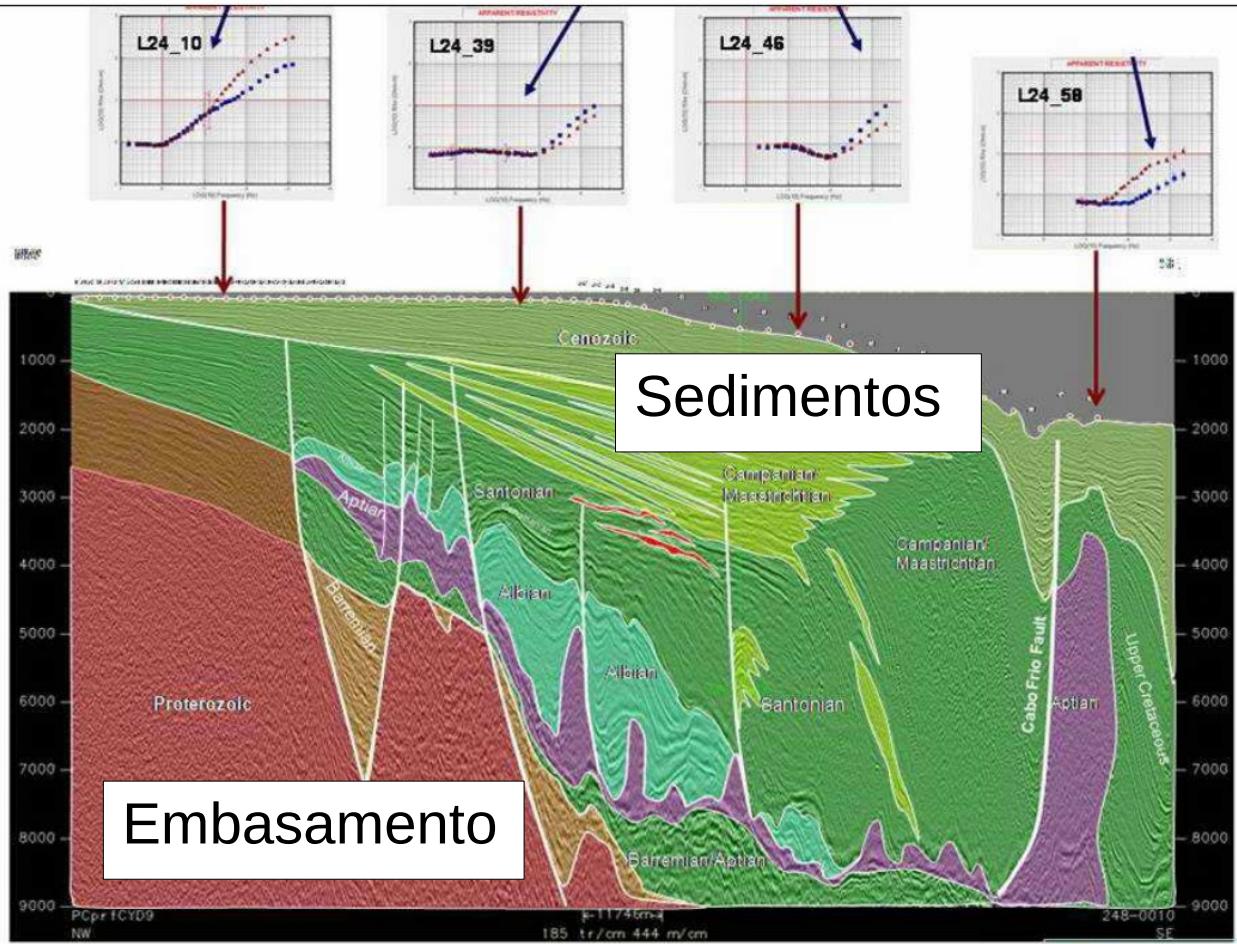
Fontes et al 2009

# MMT na Bacia de Santos



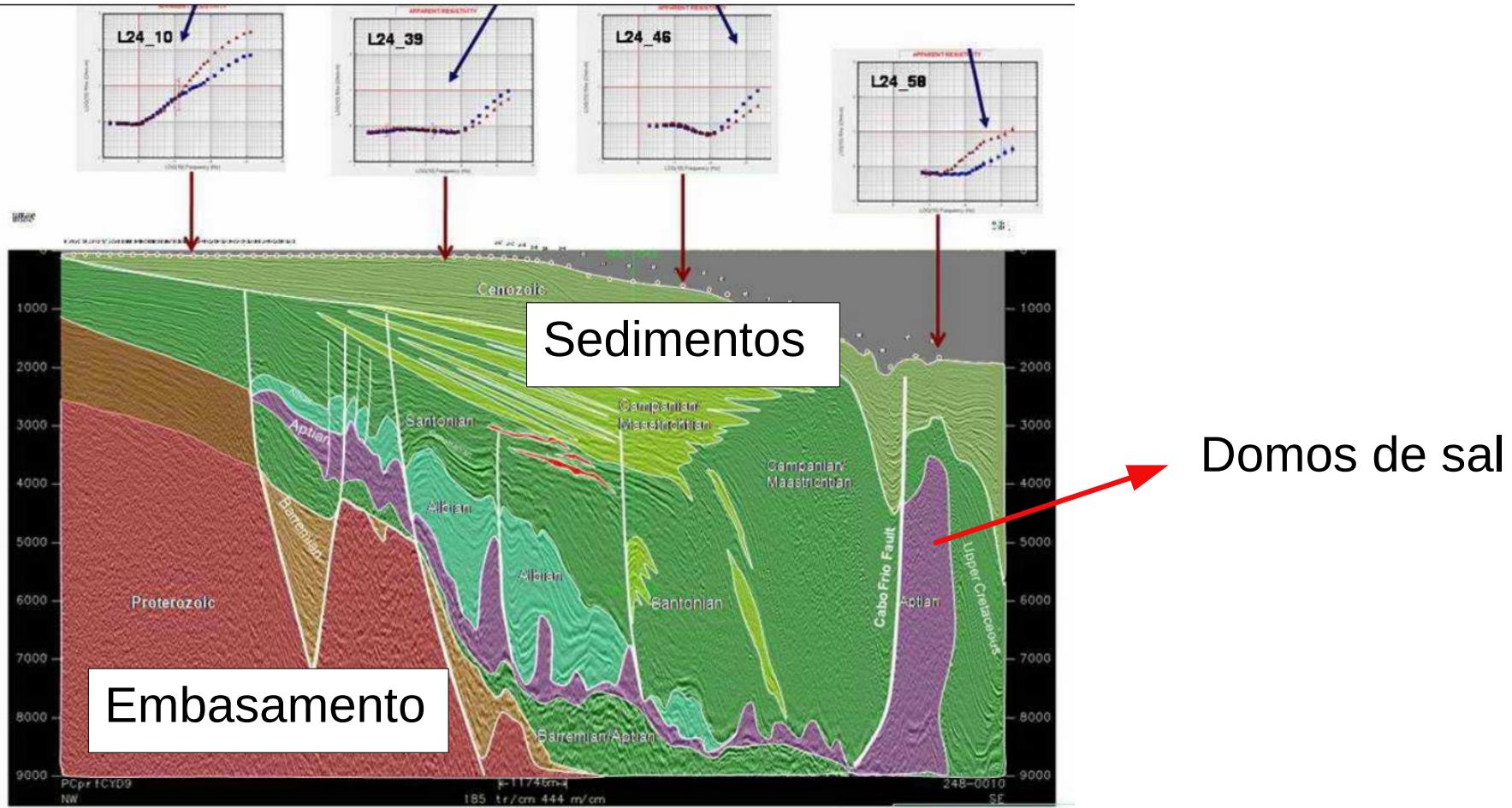
Fontes et al 2009

# MMT na Bacia de Santos



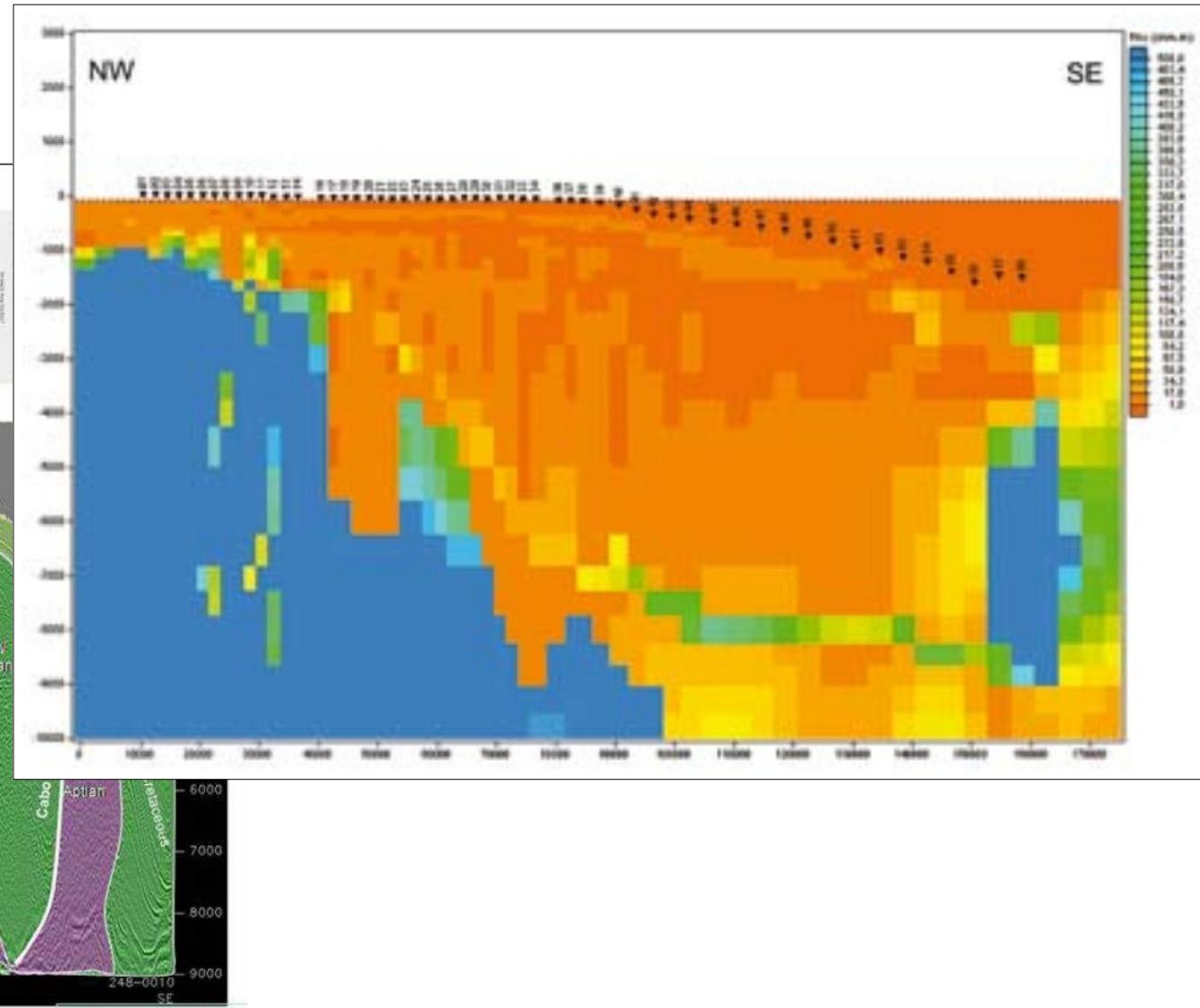
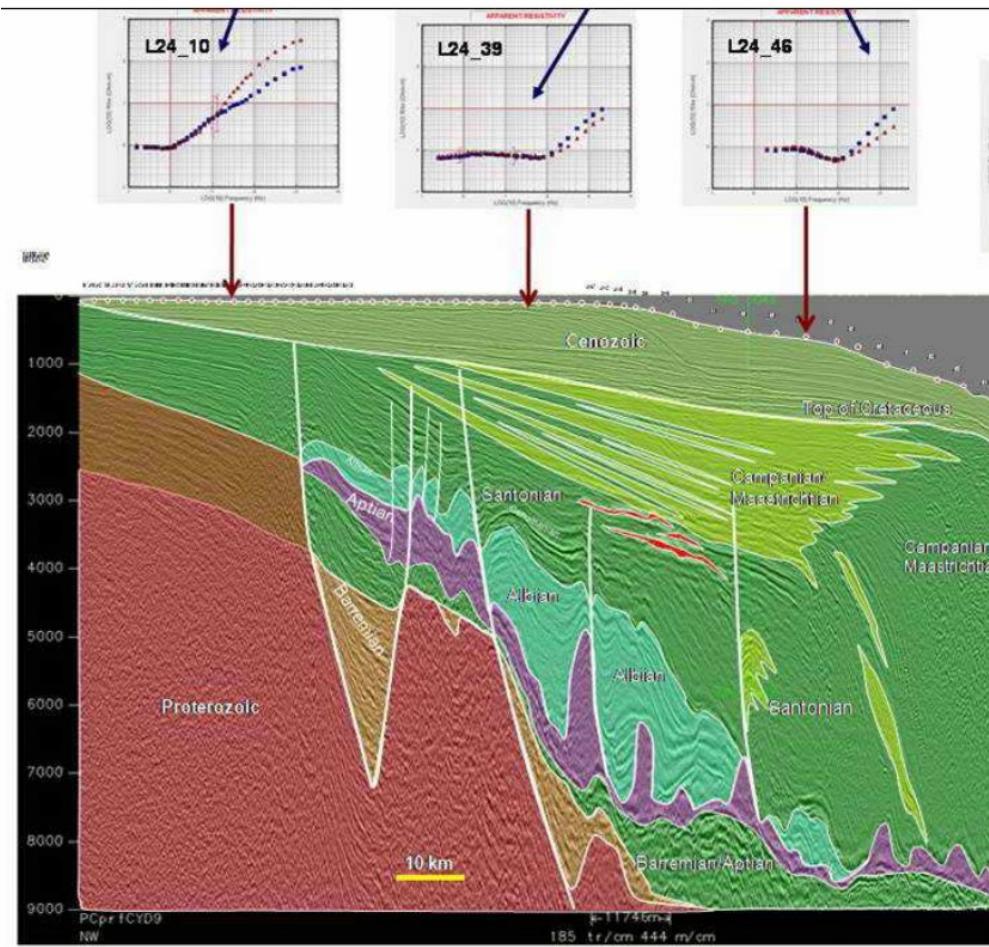
Fontes et al 2009

# MMT na Bacia de Santos



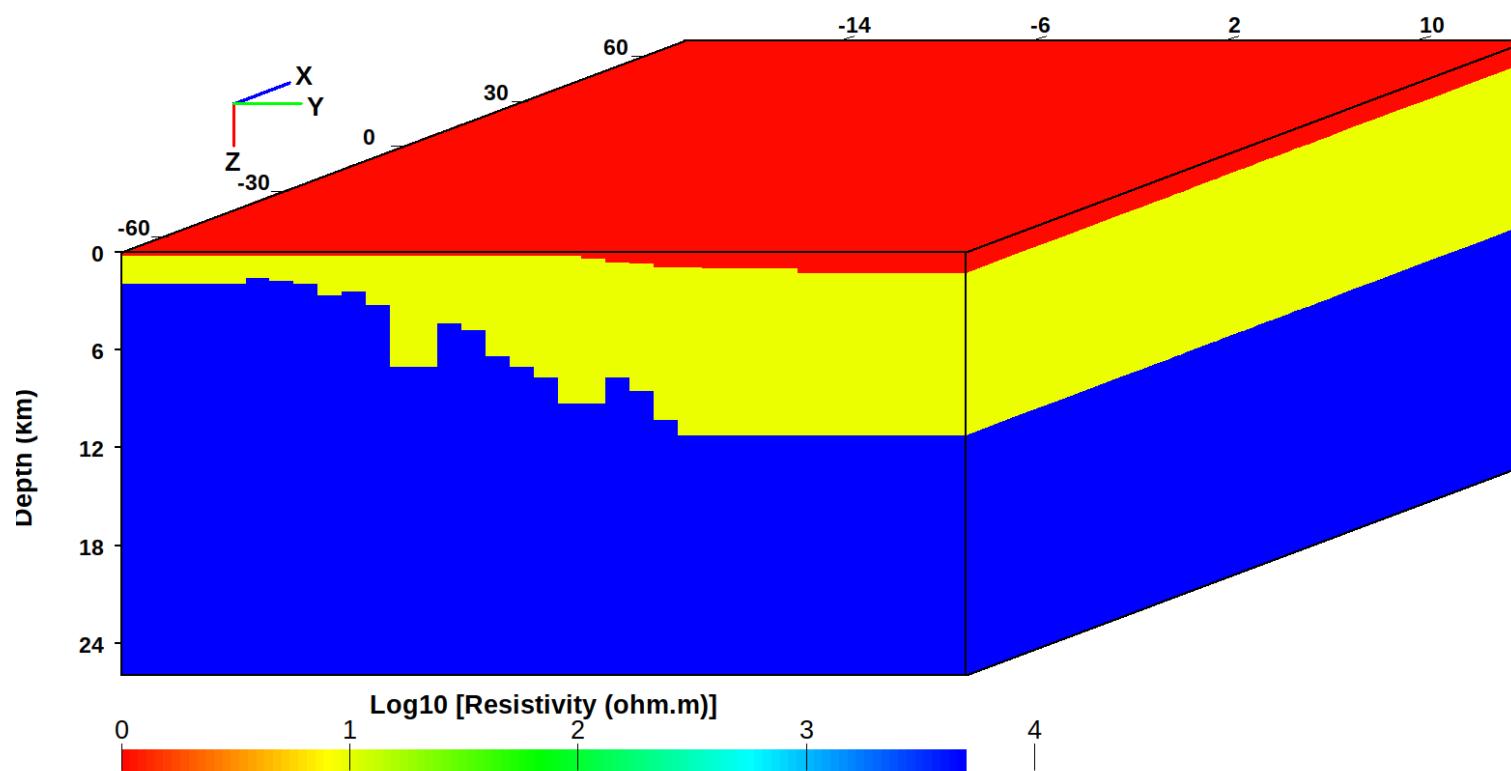
Fontes et al 2009

# MMT na Bacia de Santos

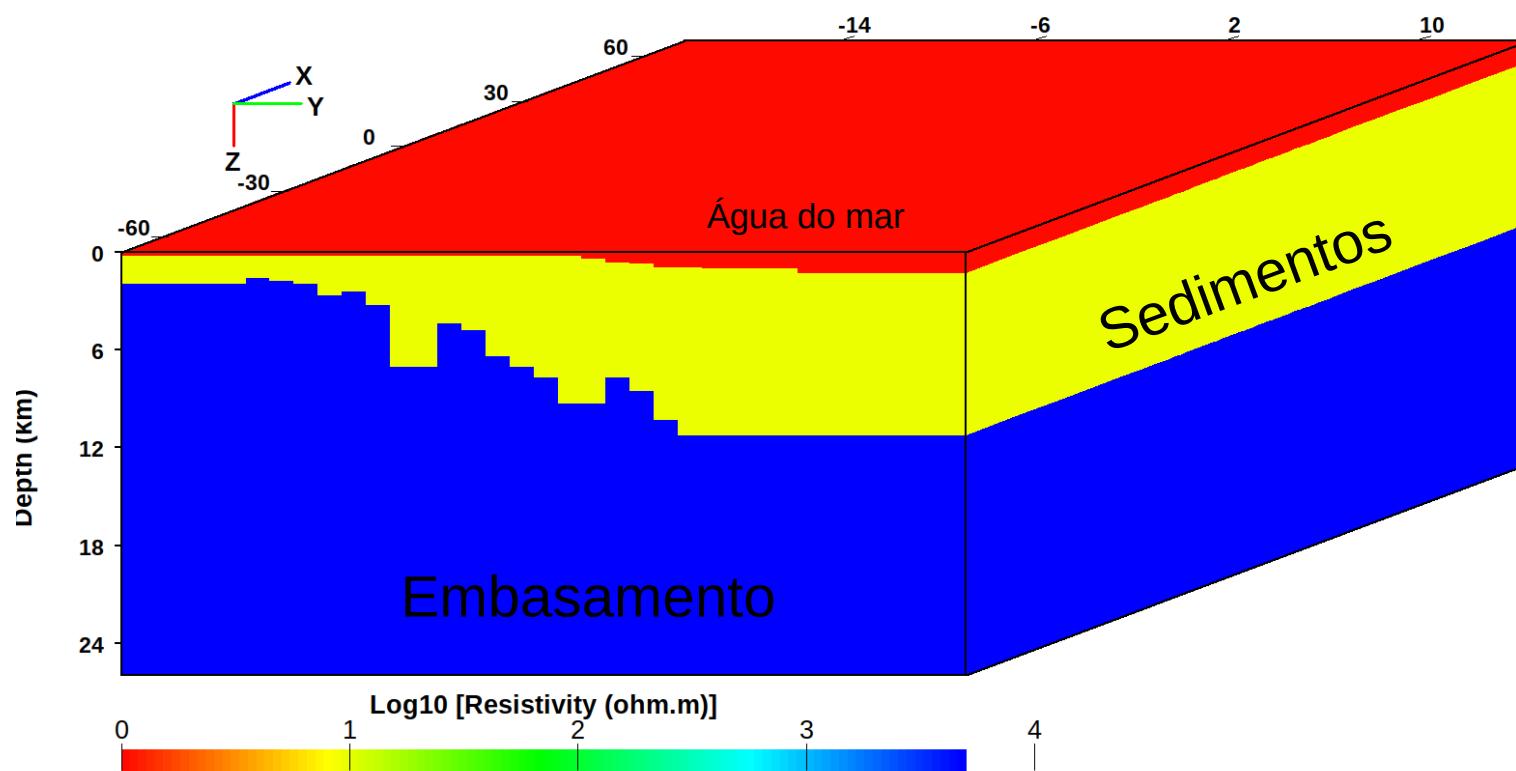


Fontes et al 2009

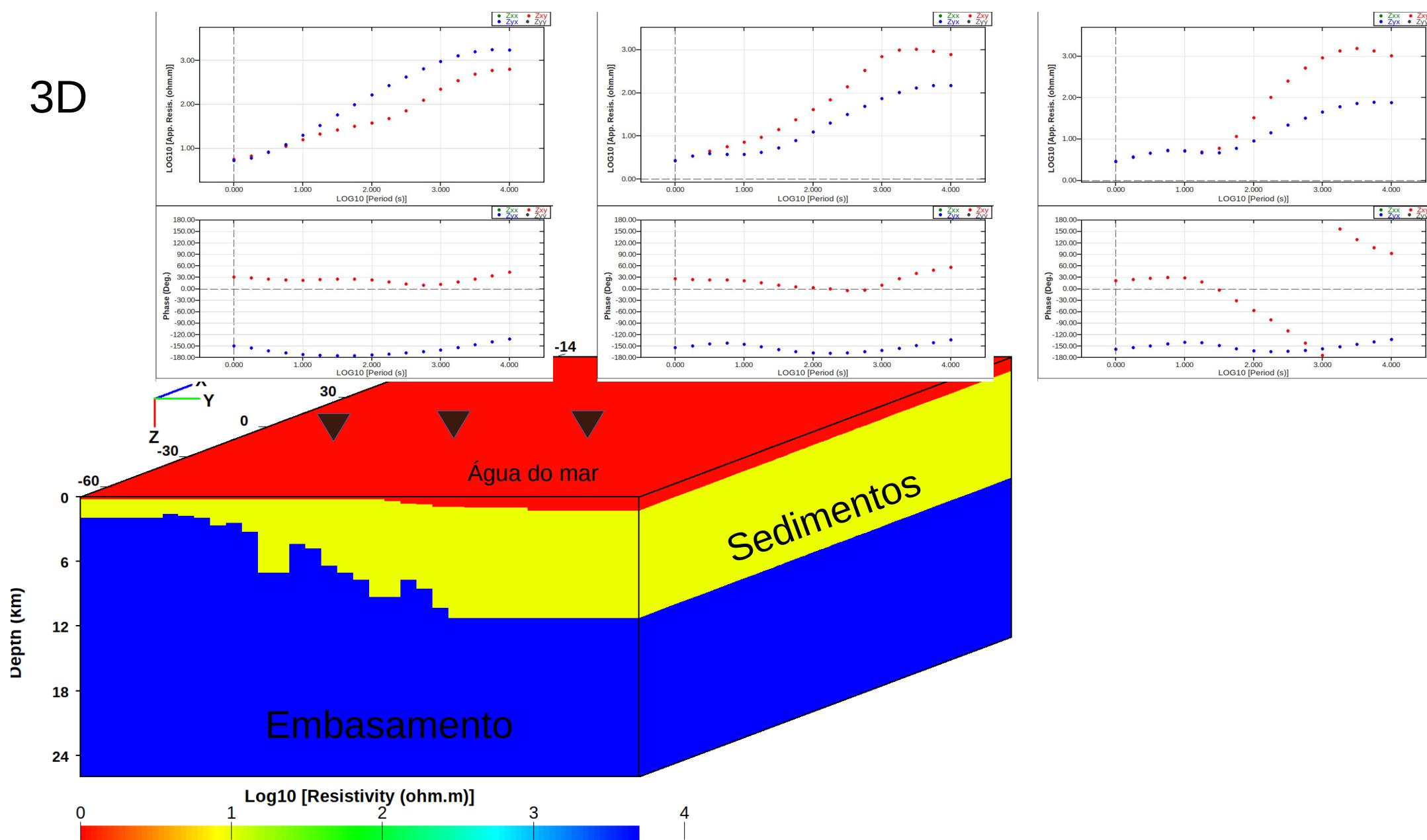
3D



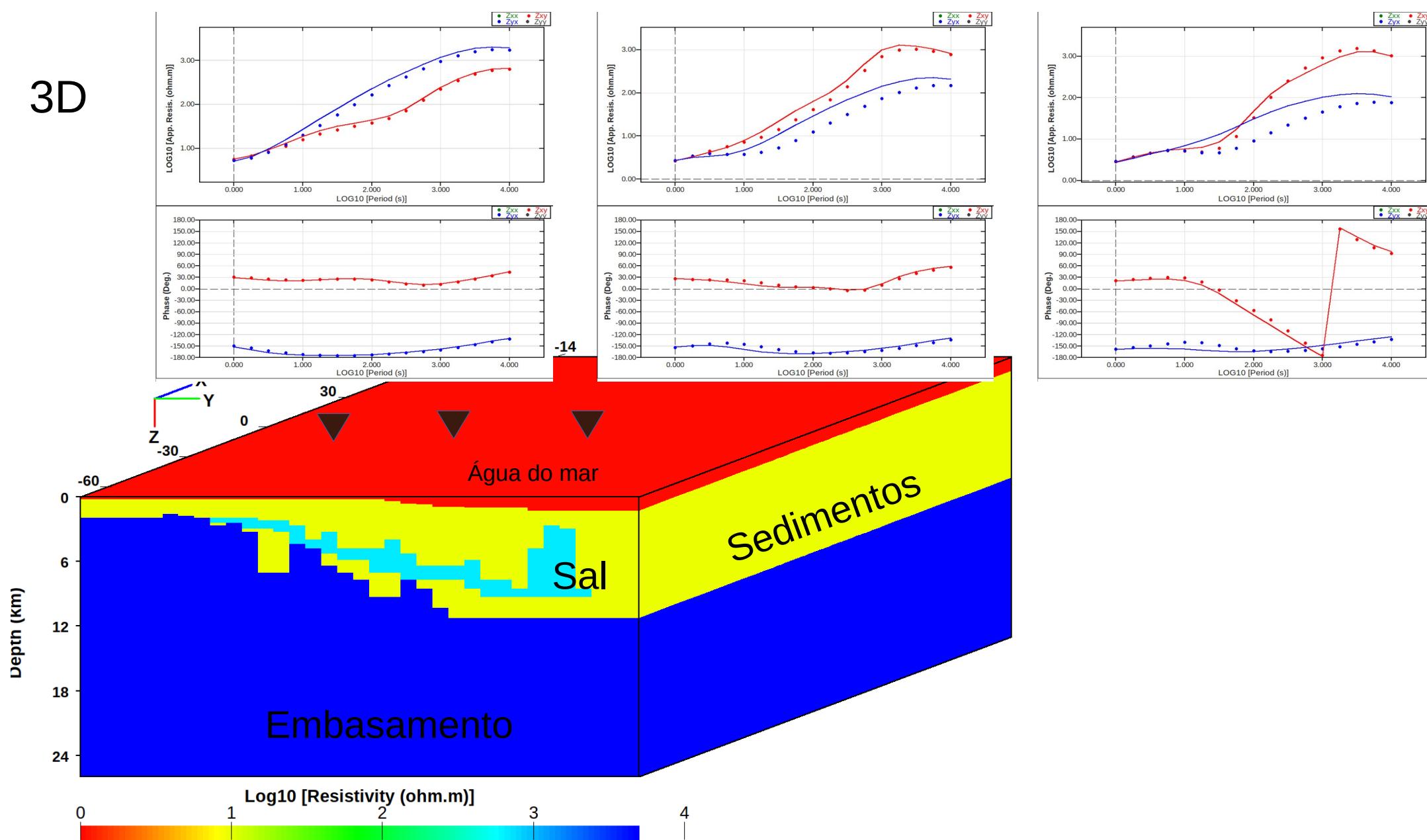
3D



3D



3D



# Intrusões de diabásio – Bacia do Paraná

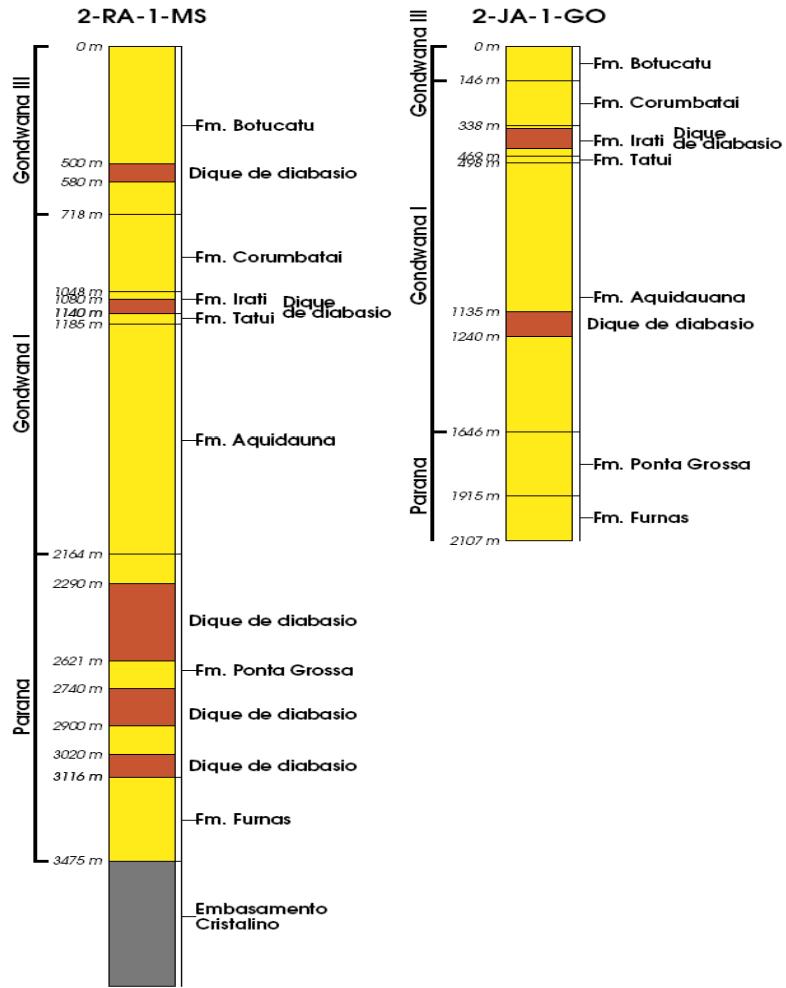


Figura 1.4: Wells profile of the study region

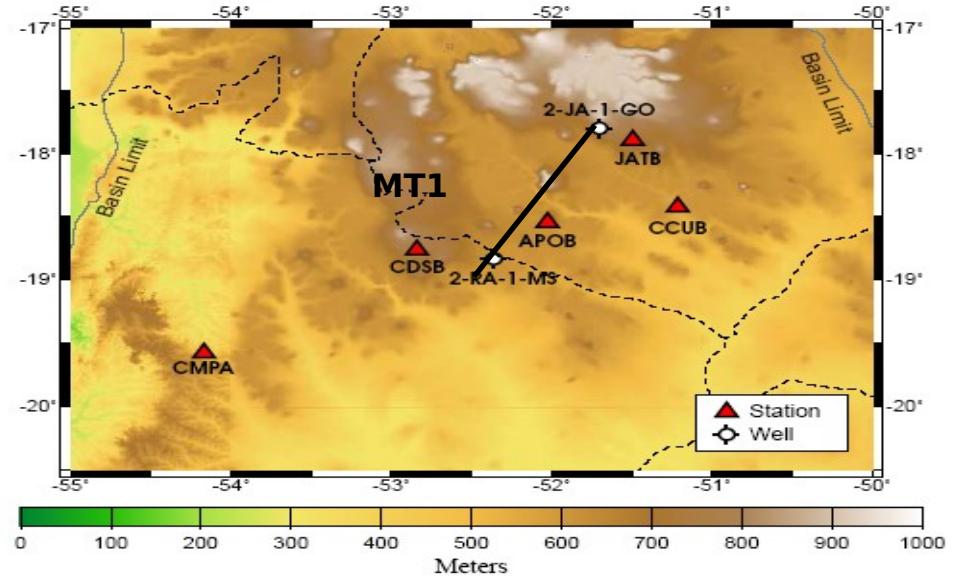
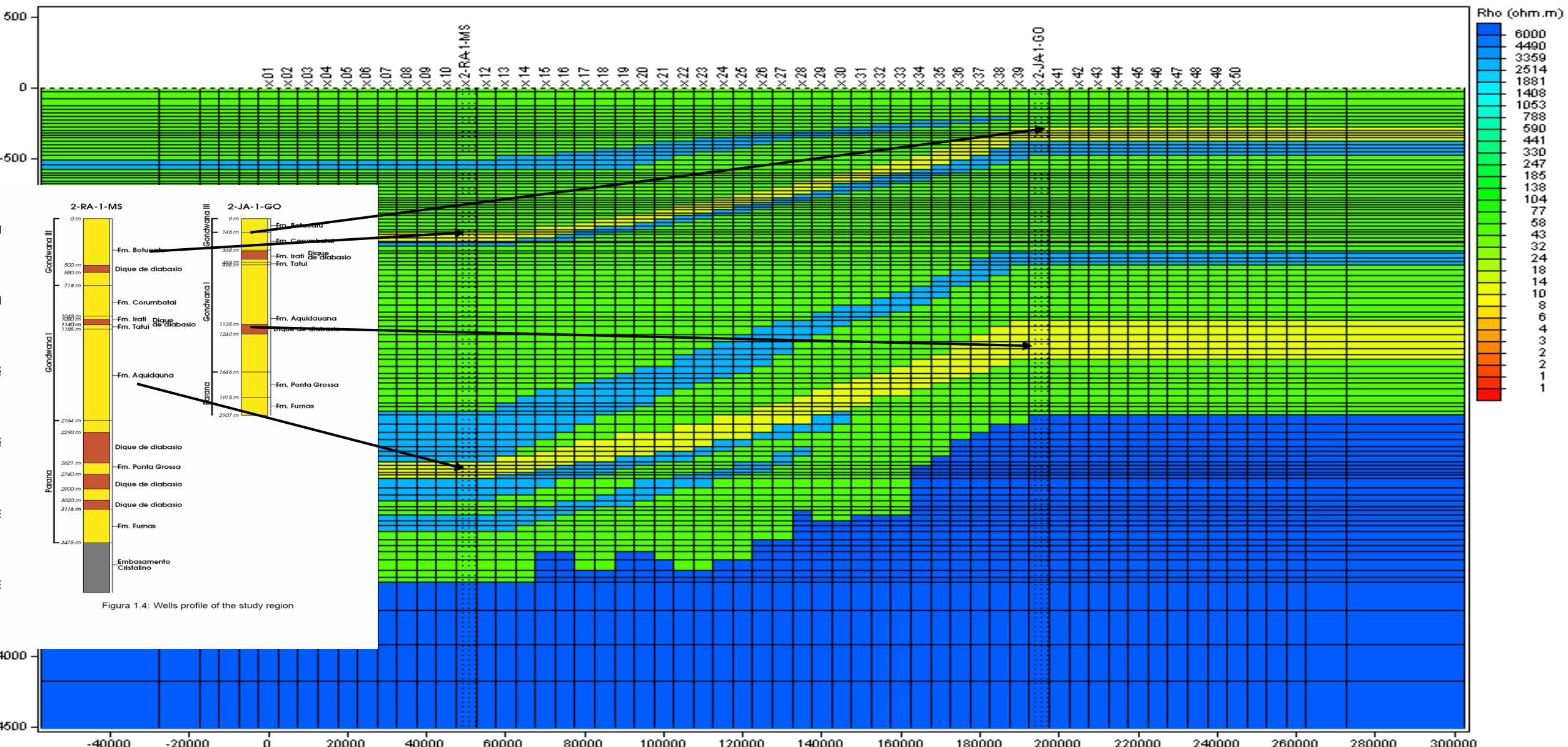
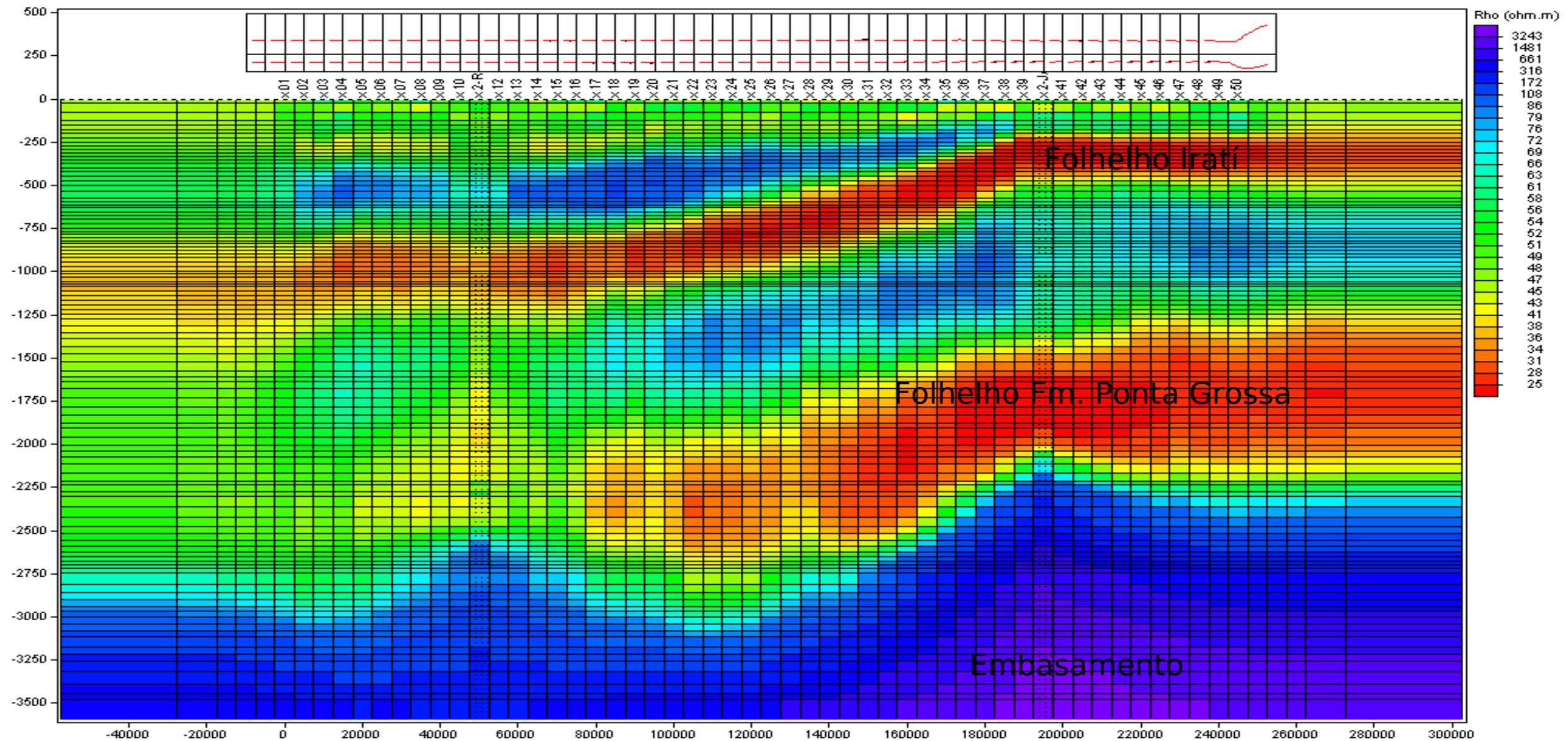


Figura 3.3: Stations (triangles) and wells (circles) used in this study. Colors are topography

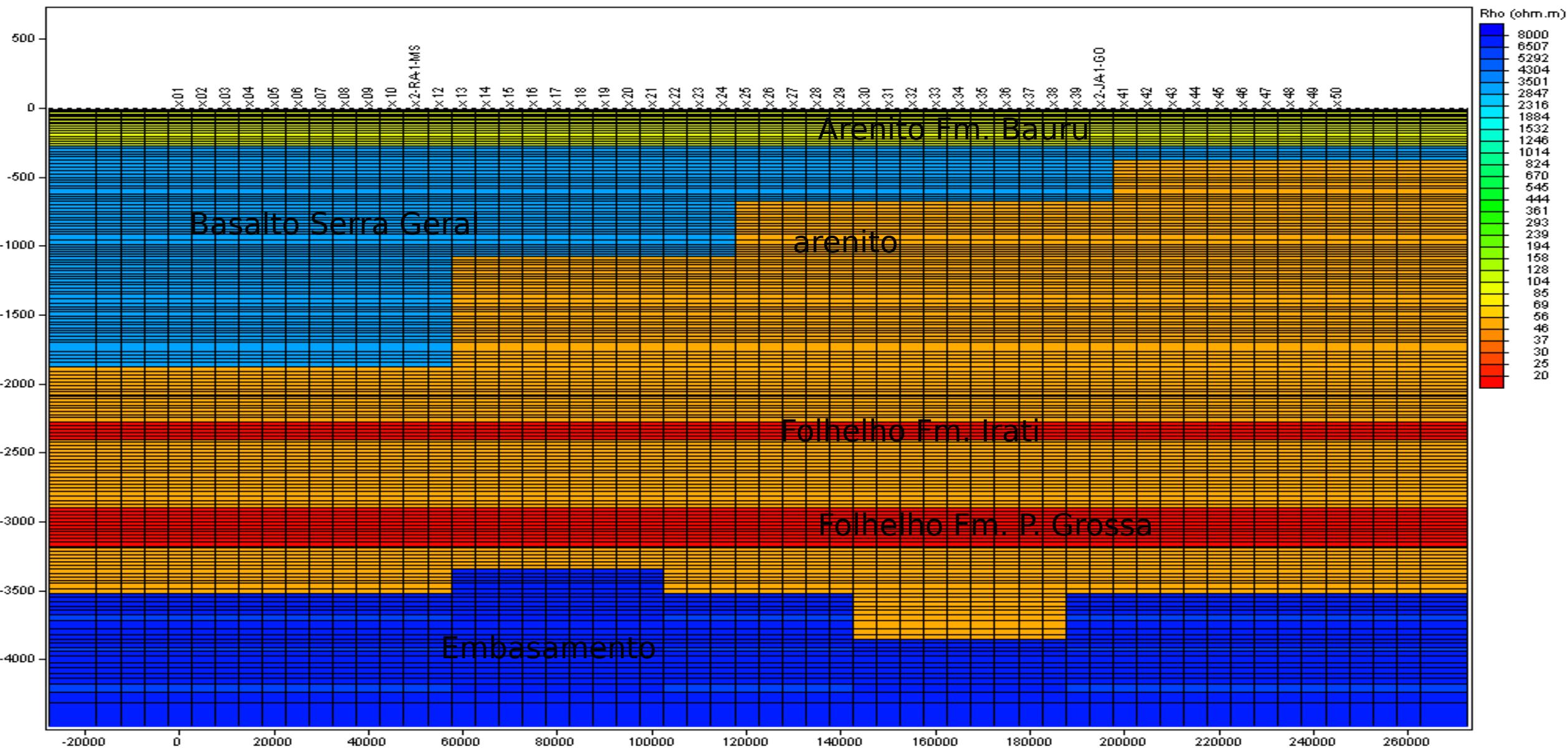
# Intrusões de diabásio – Bacia do Paraná



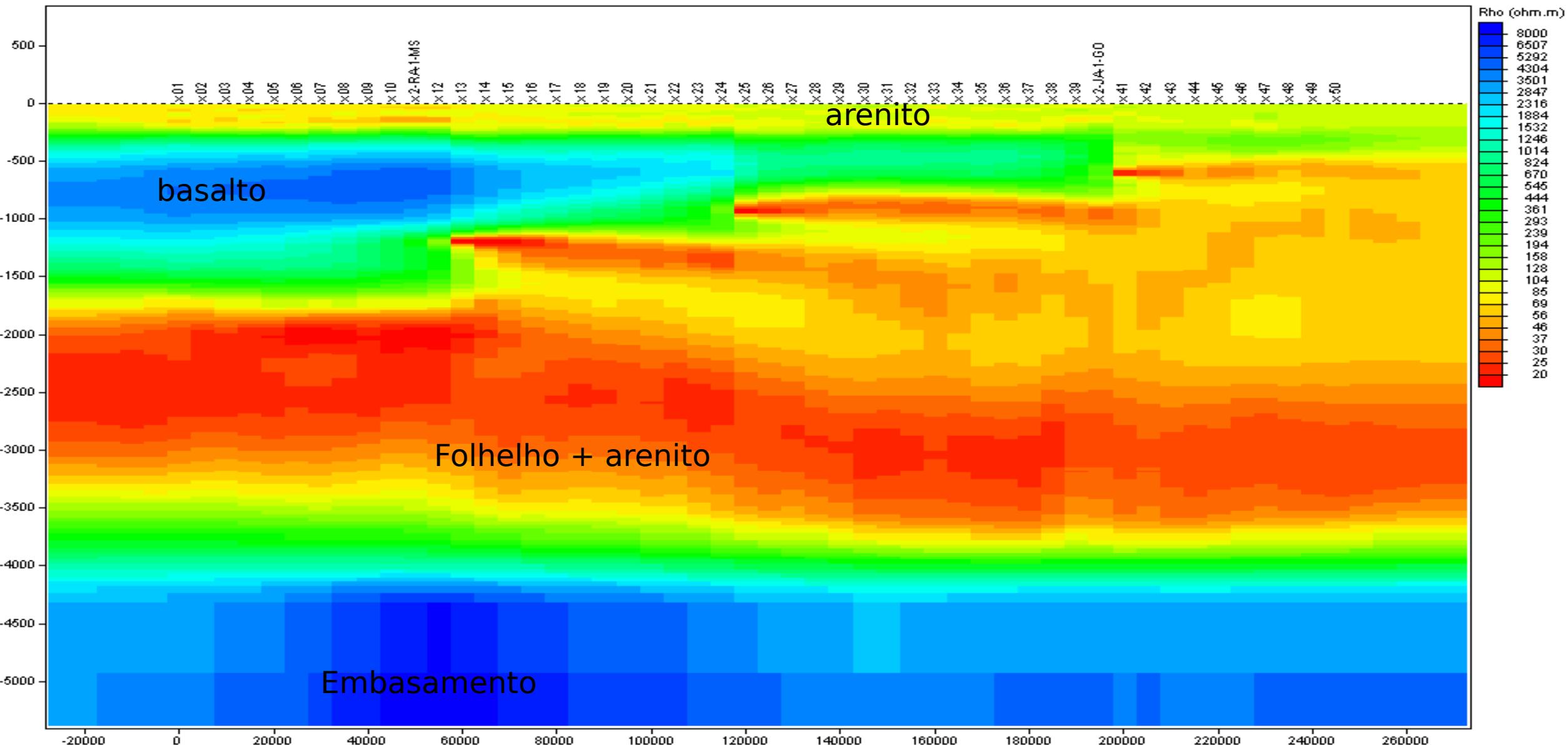
# Intrusões de diabásio – Bacia do Paraná



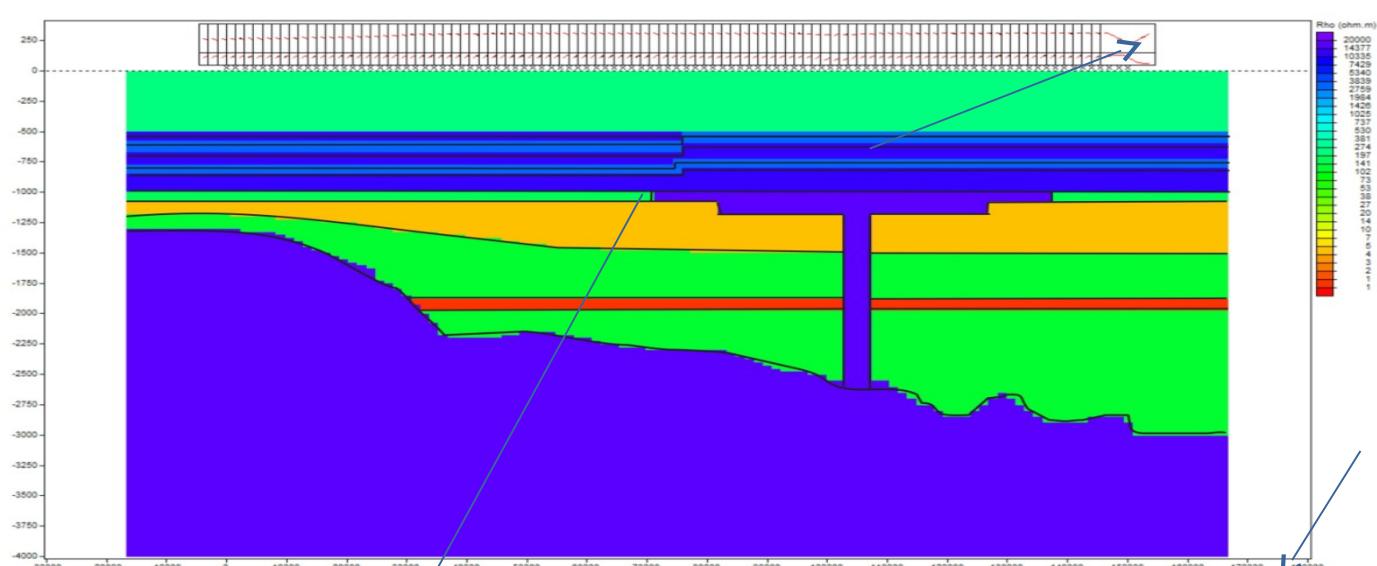
# Intrusões de diabásio – Bacia do Paraná



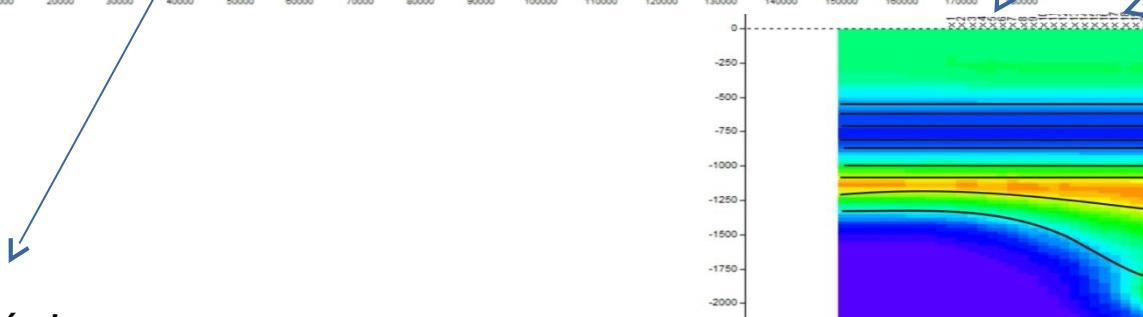
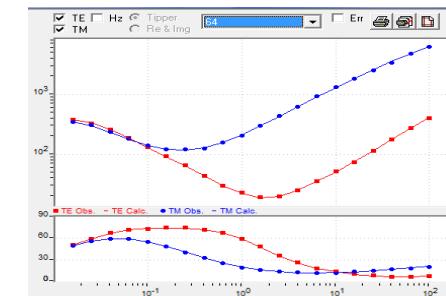
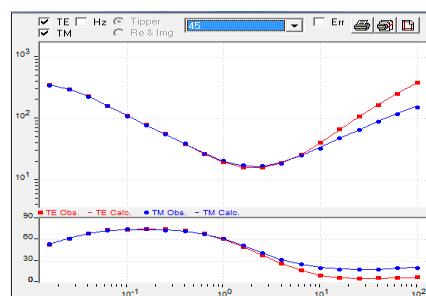
# Intrusões de diabásio – Bacia do Paraná



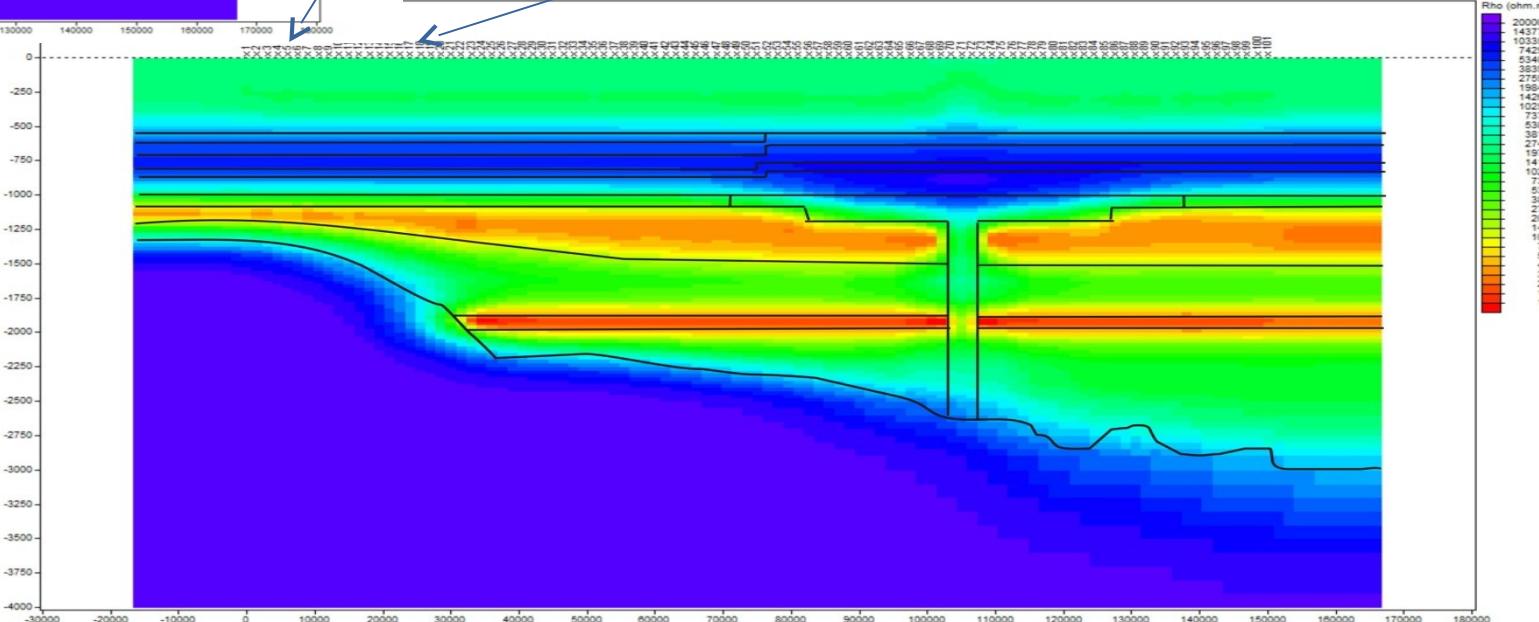
# Intrusões de diabásio – Bacia do Paraná



Sal

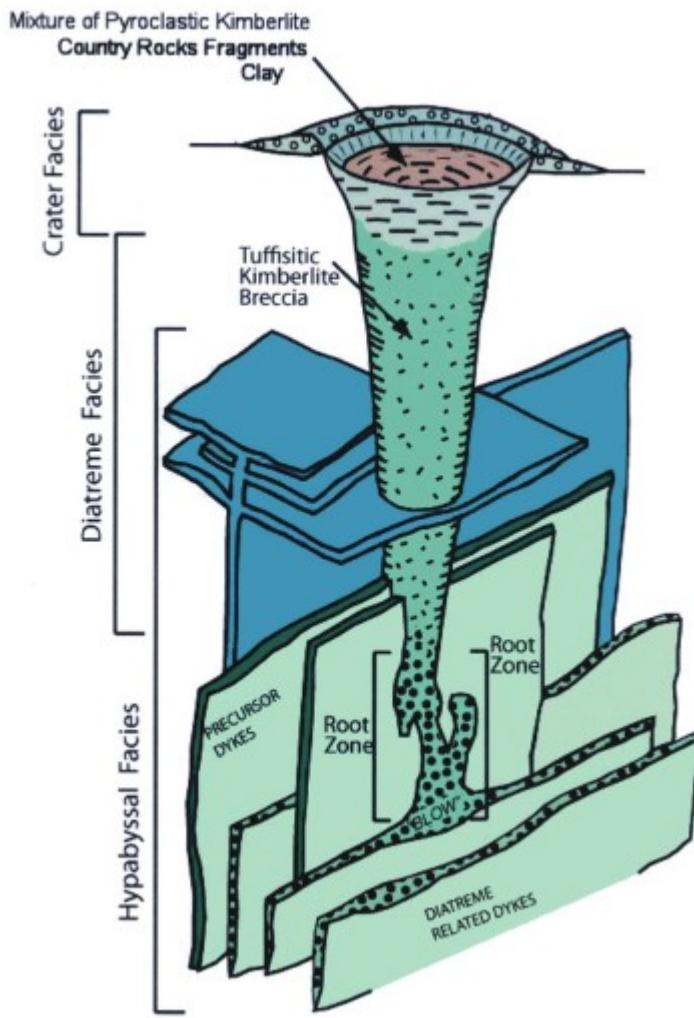


Diabásio

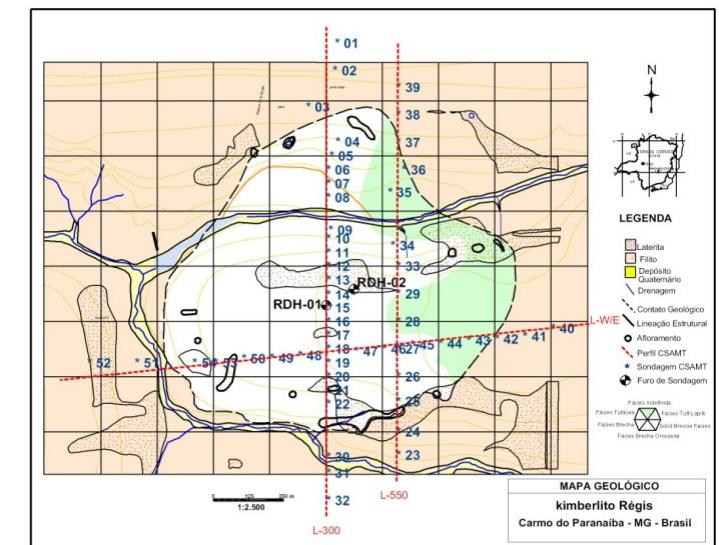
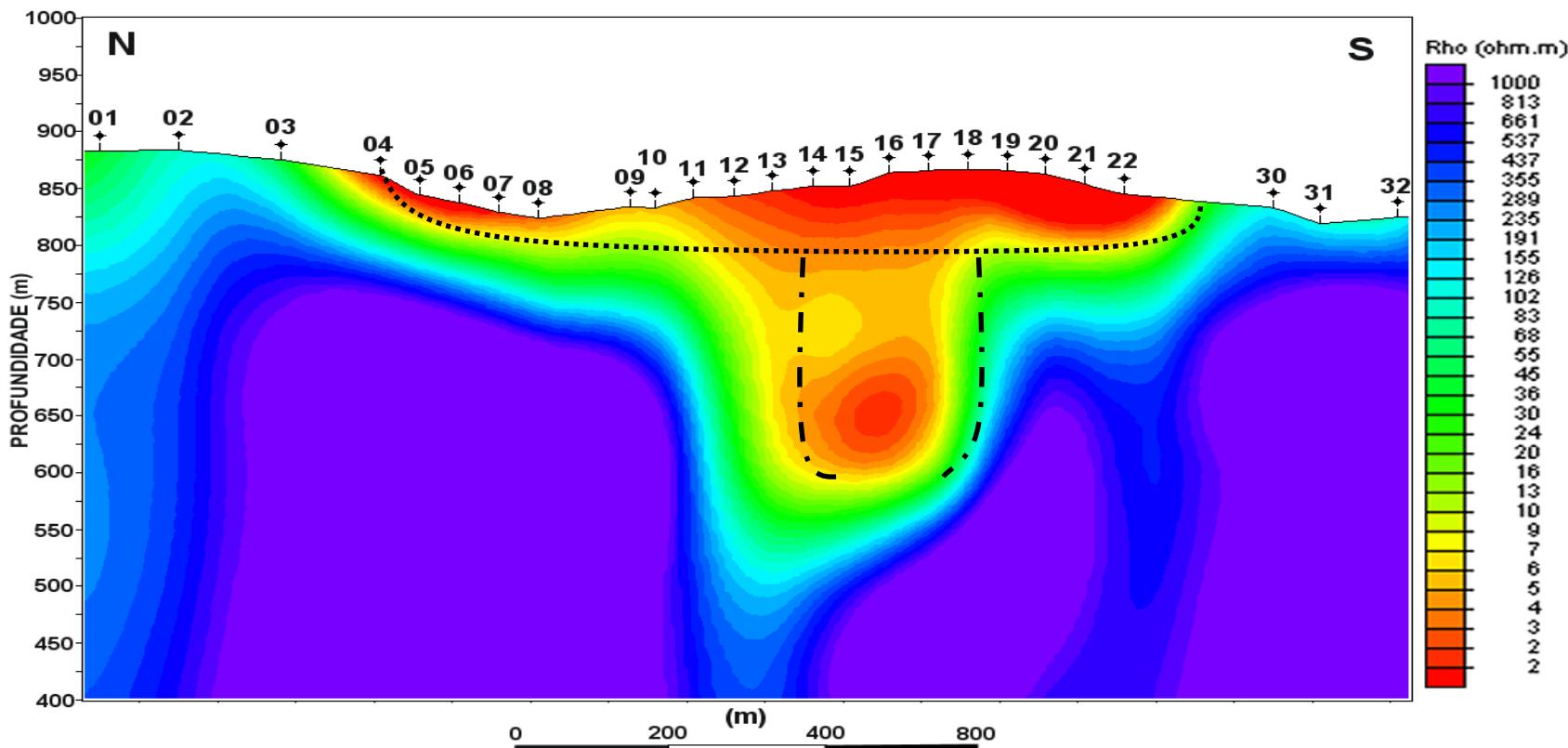


# Exemplos de Inversão 2D e 3D

# Exploração de quimberlitos - CSAMT

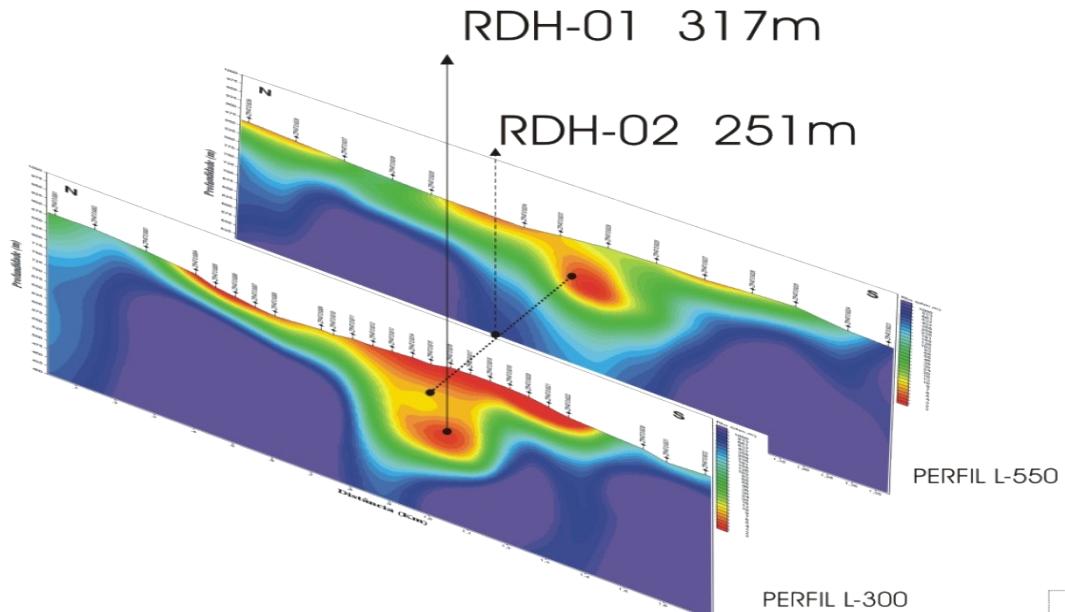


# Exploração de quimberlitos - CSAMT



Emanuele F. La Terra; Paulo T.L. Menezes (2012). Audiomagnetotelluric 3D imaging of the Regis kimberlite pipe, Minas Gerais, Brazil. , 77(none), 0–38. doi:10.1016/j.jappgeo.2011.11.010

# Exploração de quimberlitos - CSAMT



Localização dos furos de sondagens, RDH-01 e RDH-02 referenciados aos perfis geofísicos.

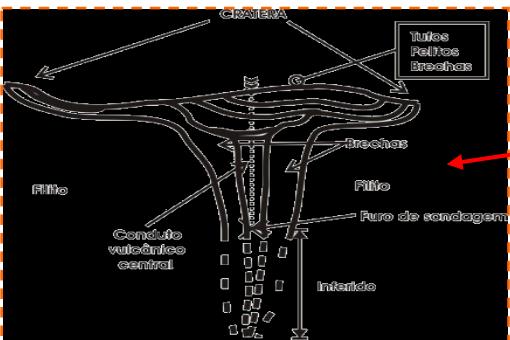
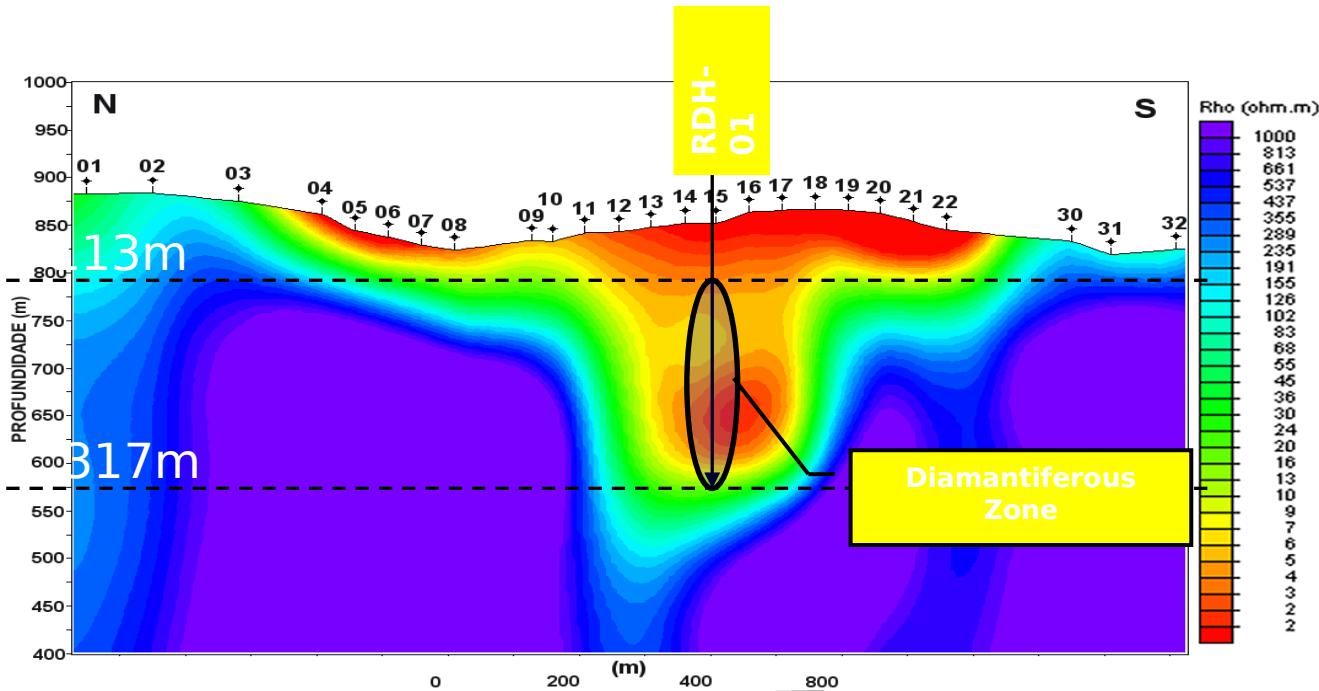


# Exploração de quimberlitos - CSAMT

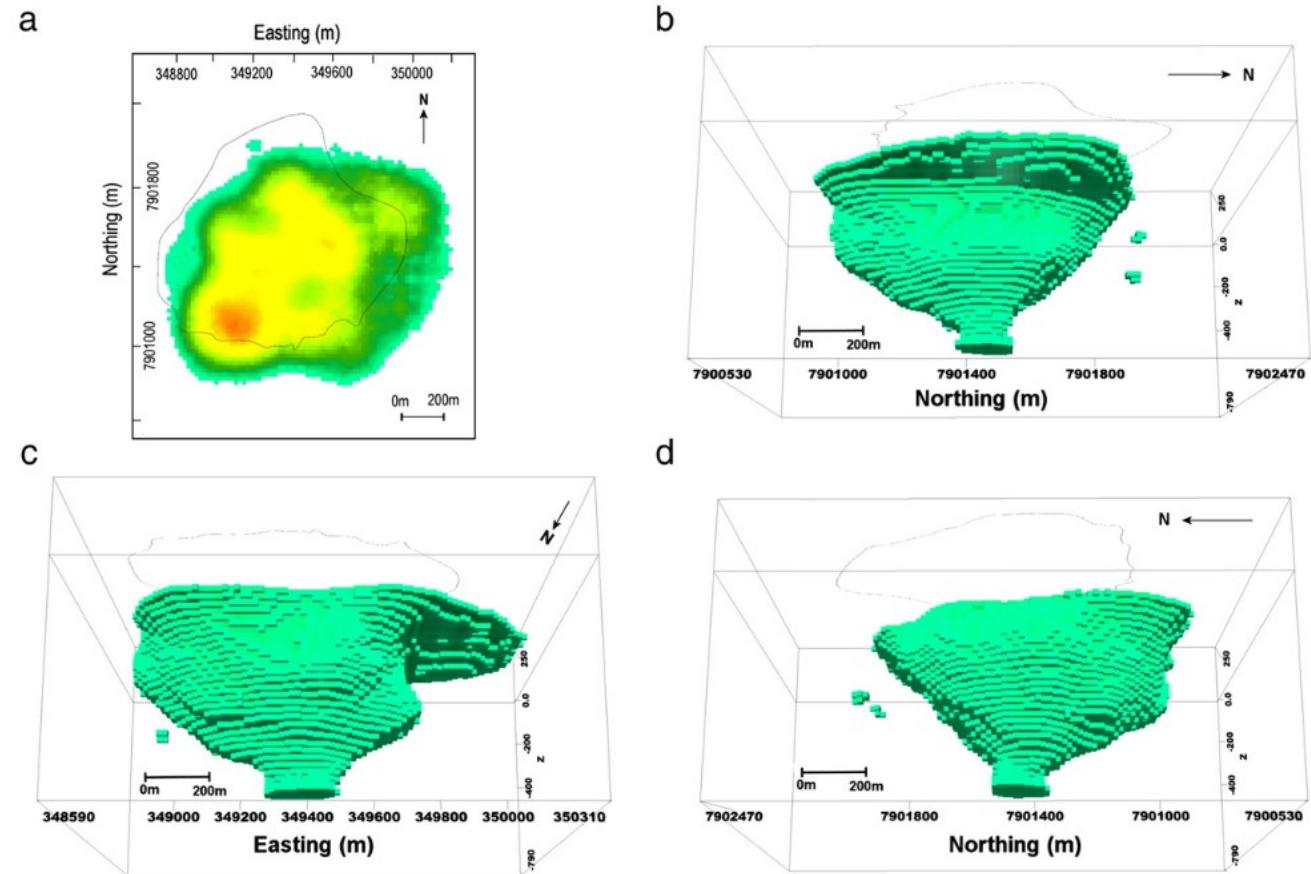
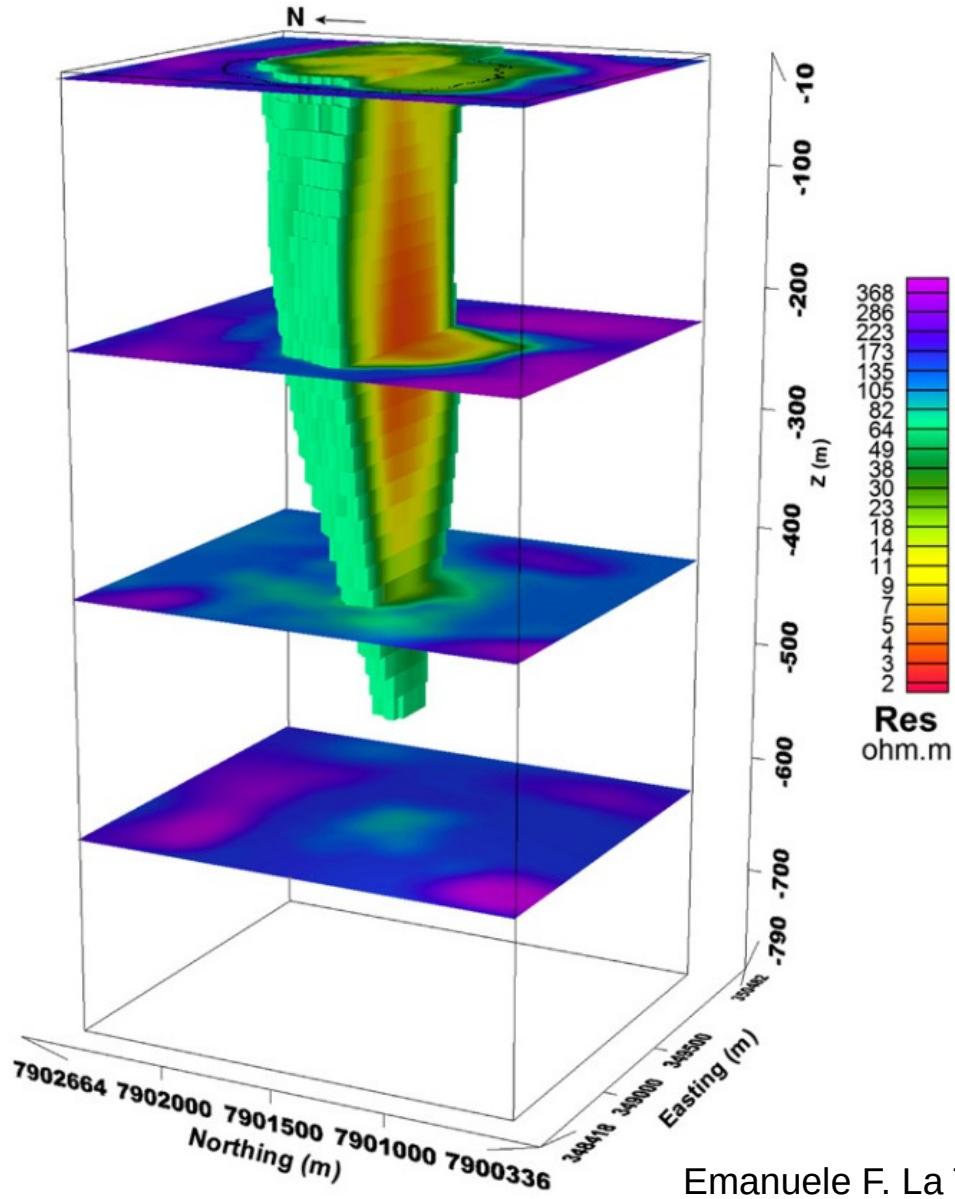
## Drill hole features RDH-01

- Depth - 317m
- Overlying crater facies - 113m thick
- Pipe facies - Micro-diamonds: 113m - 317m
- Diamonds sizes - 0.075 a 0.600 mm

QUANTITY	SIZE	WEIGHT
0	0.600mm	
1	0.425mm	
1	0.300mm	
9	0.212mm	
19	0.150mm	
37	0.106mm	
62	0.075mm	
<b>129</b>	<b>TOTAL</b>	<b>348.75Kg</b>

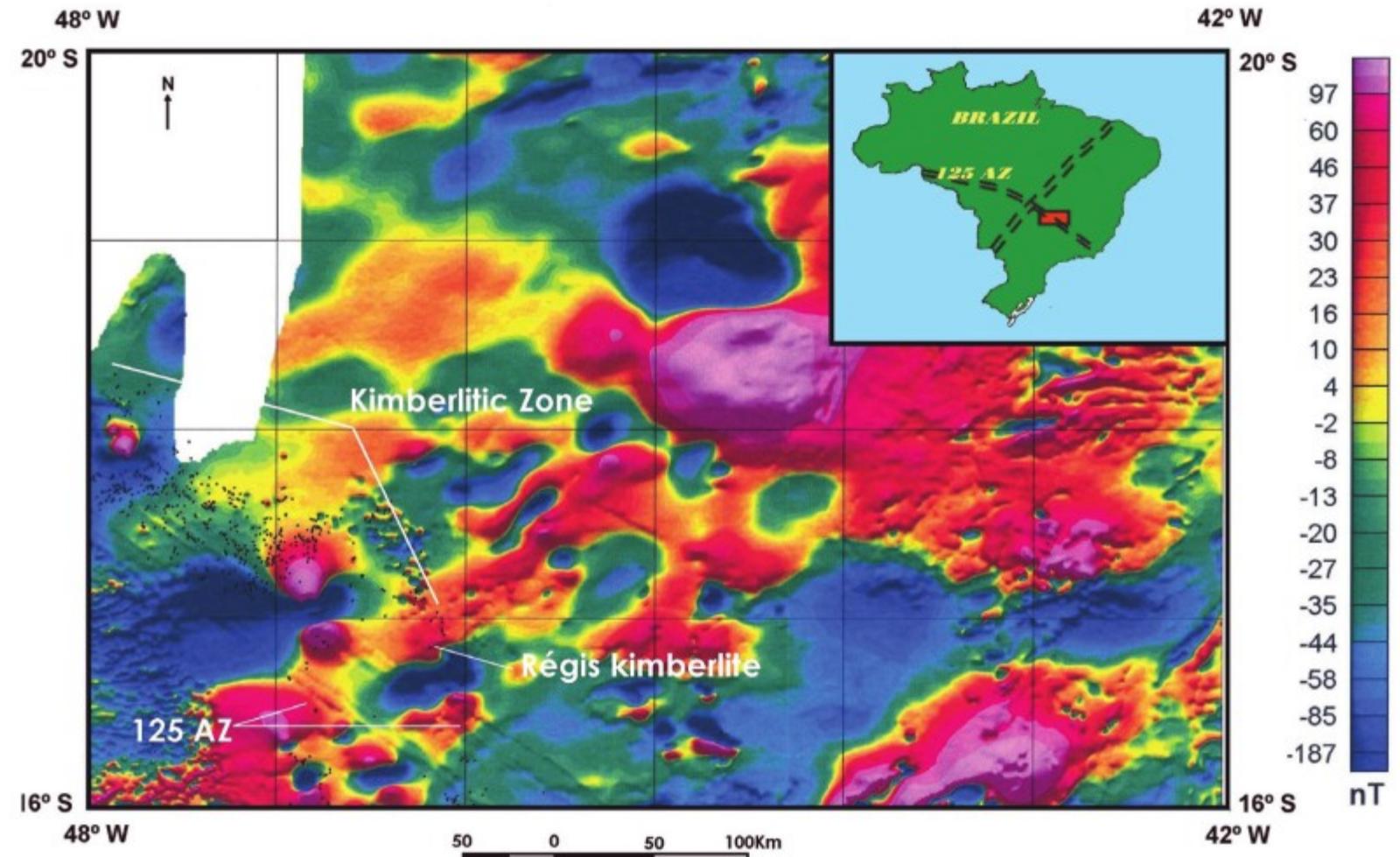
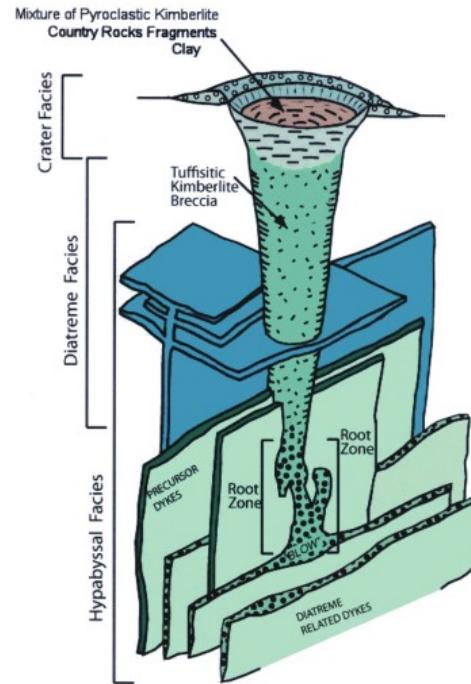


**GEOLOGICAL PROPOSED MODEL**



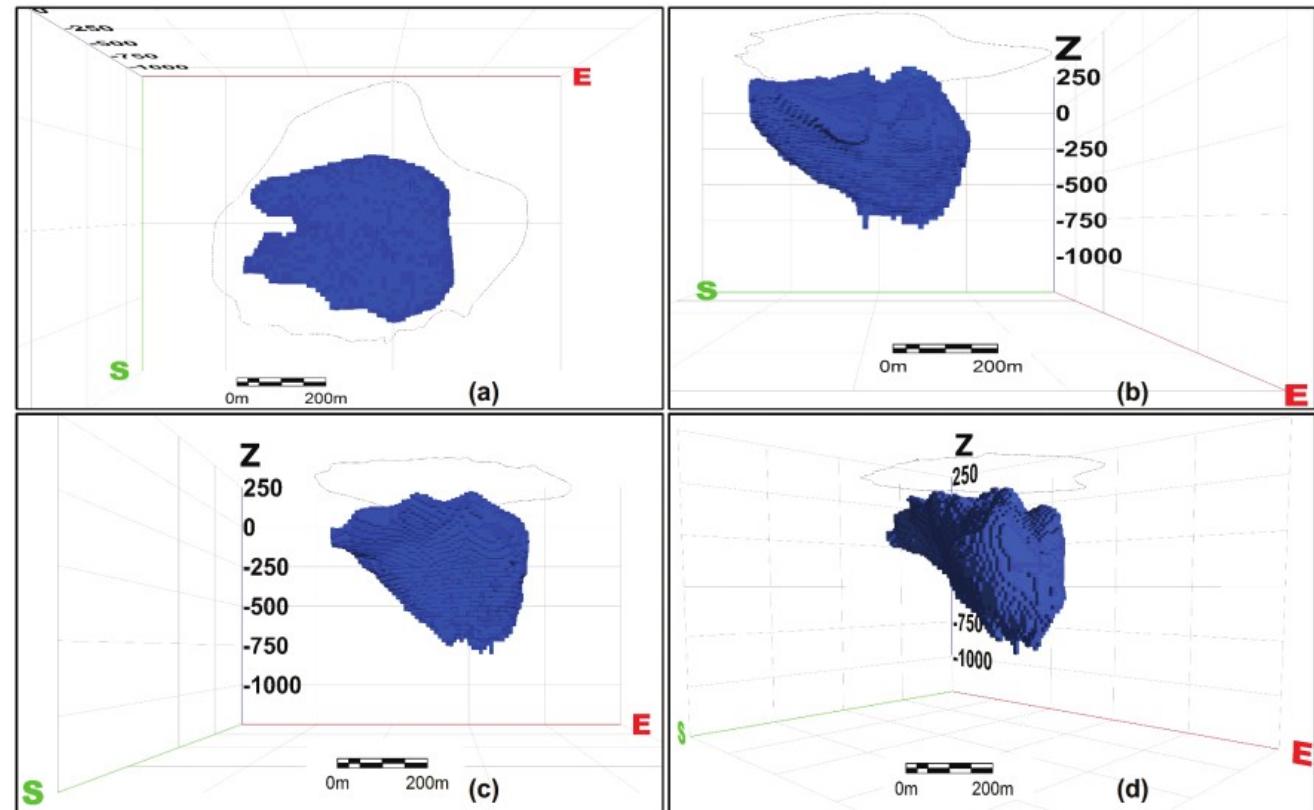
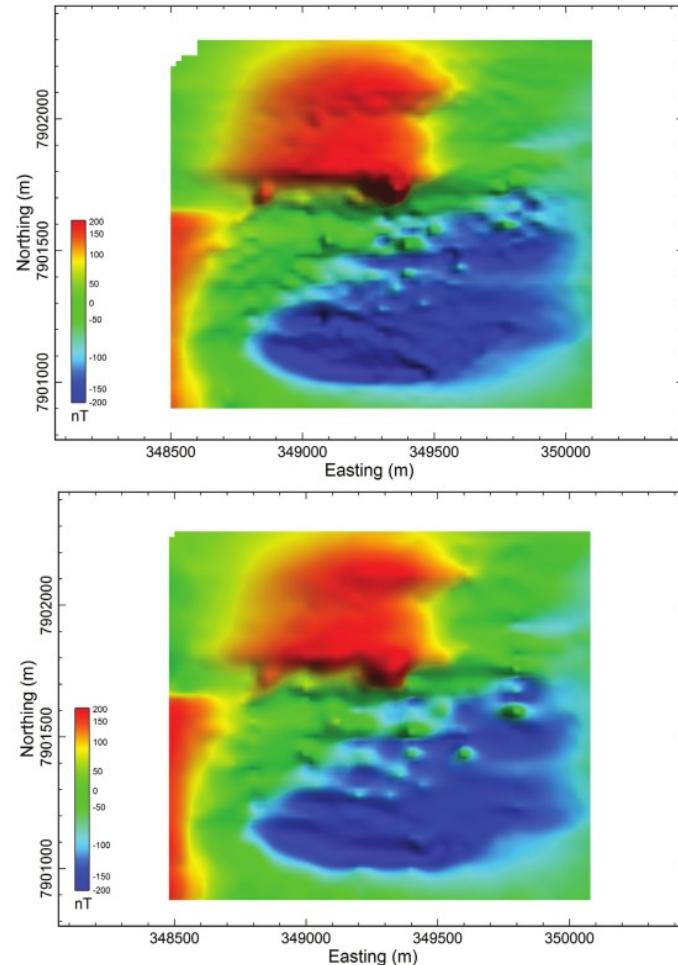
Emanuele F. La Terra; Paulo T.L. Menezes (2012). Audiomagnetotelluric 3D imaging of the Regis kimberlite pipe, Minas Gerais, Brazil. , 77(none), 0–38. doi:10.1016/j.jappgeo.2011.11.010

# Exploração de quimberlitos - Magnetometria



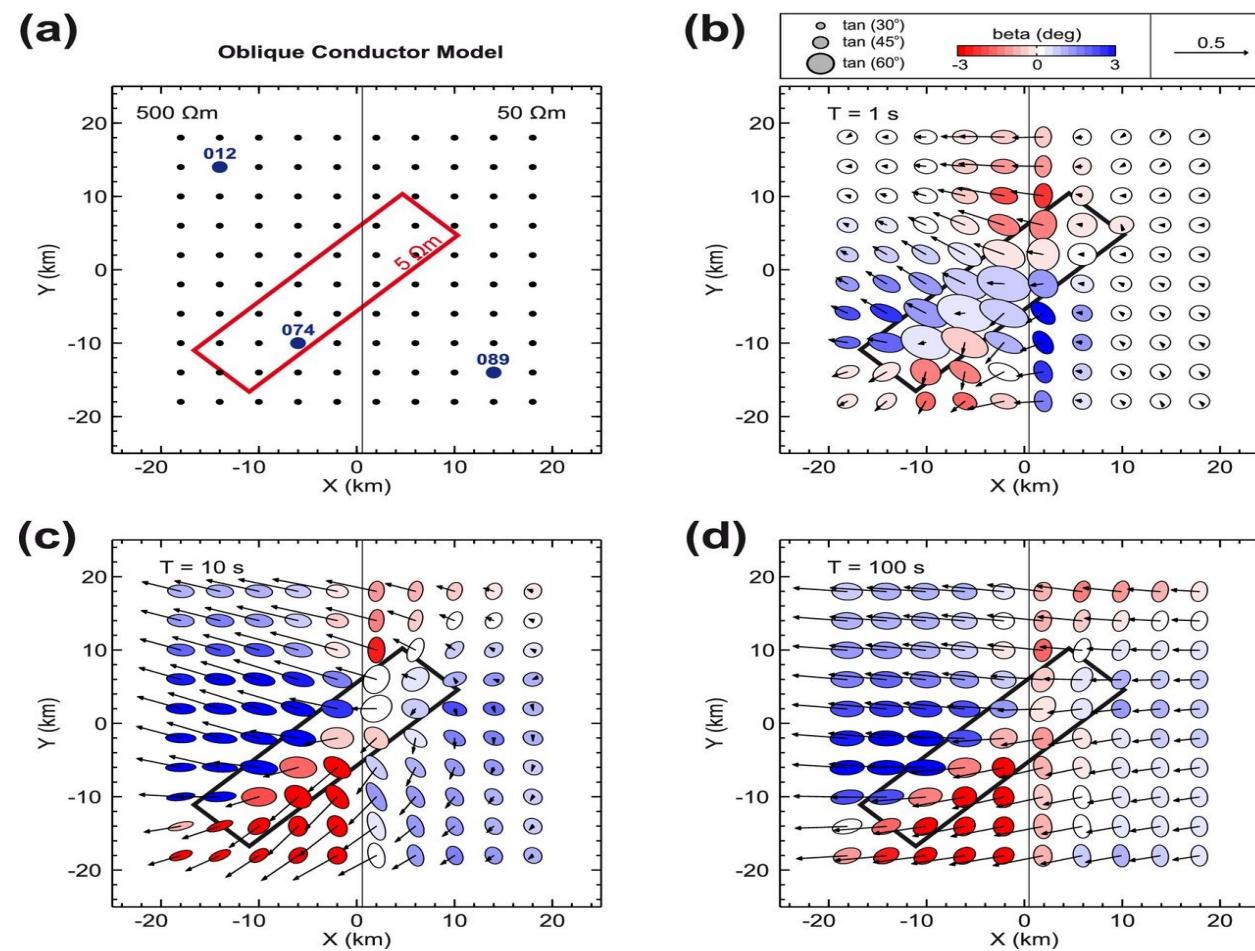
Menezes, Paulo T.L.; La Terra, Emanuele F. (2011). 3D magnetic interpretation of the Regis kimberlite pipe, Minas Gerais, Brazil. *Near Surface Geophysics*, 9(4), 331–338. doi:10.3997/1873-0604.2011005

# Exploração de quimberlitos - Magnetometria

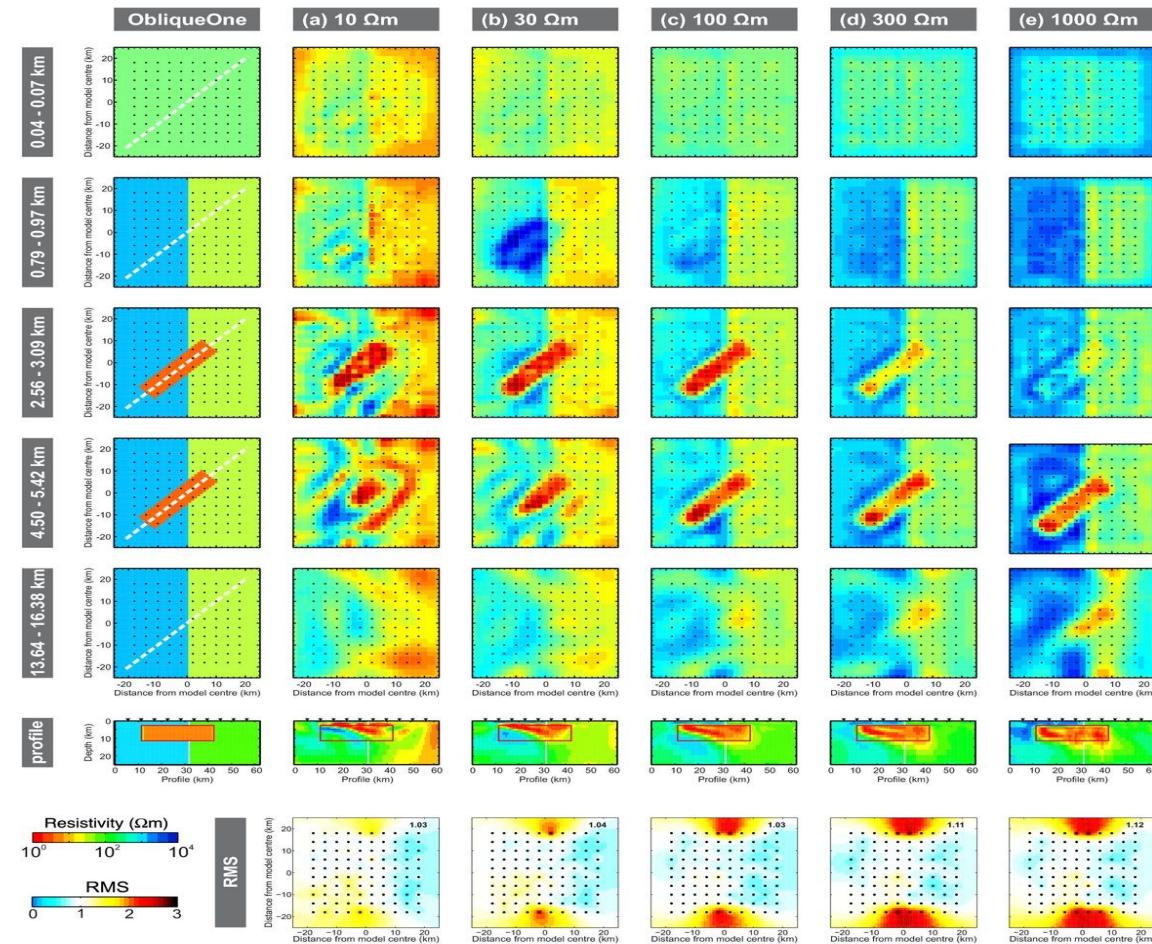


# Inversão conjunta 3D de Phase Tensor e Vetor de induçao

**Figure 1.** (a) The main structural feature of the synthetic model is a conductive  $5 \Omega\text{m}$  block of  $30 \text{ km} \times 9 \text{ km} \times 9 \text{ km}$  ...



**Figure 2.** Resistivity models obtained from inversion of phase tensors (OC data set, cf. Fig. 1), displayed as ...



**Figure 4.** Resistivity models obtained from joint inversion of phase tensors and VTFs (OC data, cf. Fig. 1), displayed ...

