



UNIVERSIDADE FEDERAL DO PARÁ
INSTITUTO DE GEOCIÊNCIAS
PROGRAMA DE PÓS-GRADUAÇÃO EM GEOFÍSICA
QUALIFICAÇÃO DE DOUTORADO

Inversão do modelo de velocidades no domínio ERC utilizando as aproximações de tempo de trânsito SRC não hiperbólico

Autor: Rodolfo André Cardoso Neves

Orientador: Prof.Dr. João Carlos Cruz

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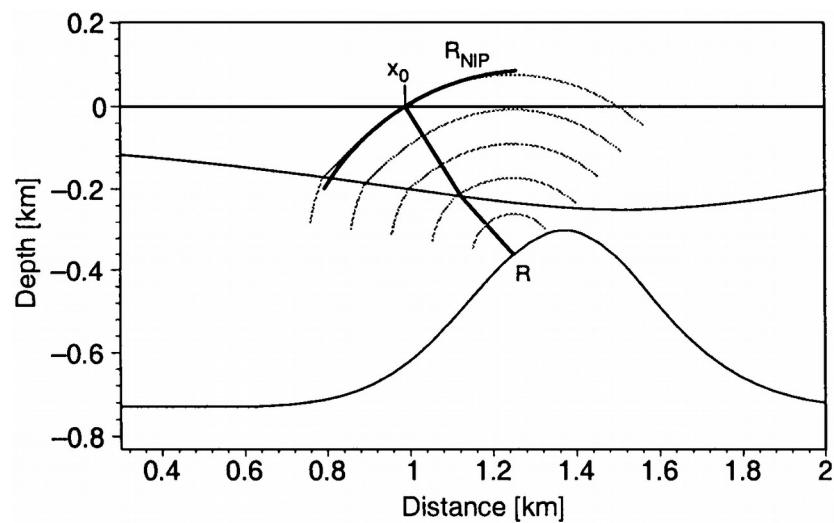
RELATÓRIO DE QUALIFICAÇÃO DE DOUTORADO

Relatório apresentado ao Programa de Pós-Graduação
em Geofísica do Instituto de Geociências da Universidade
Federal do Pará, em cumprimento às exigências para
obtenção do grau de Doutor em Geofísica.

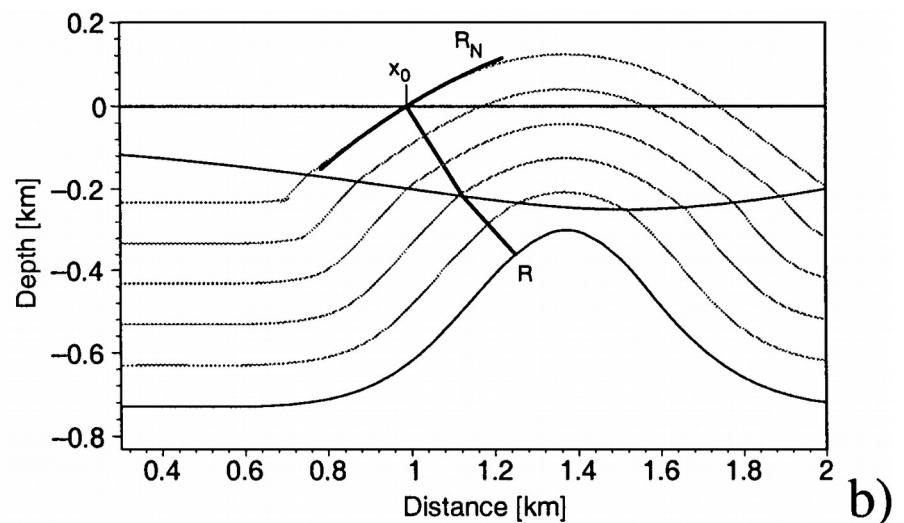
Orientador: Prof. Dr. João Carlos Ribeiro Cruz

Belém-Pará
2020

Método Superfície de reflexão comum (SRC)



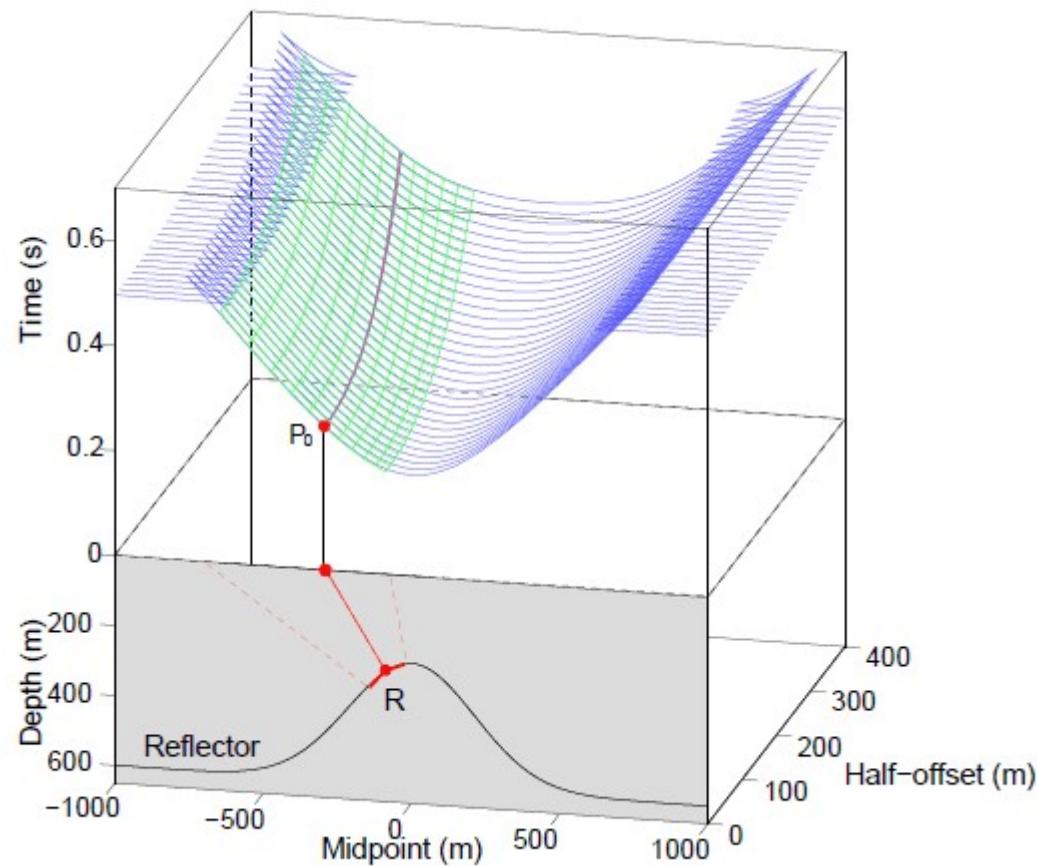
a)



b)

Fonte: (JAGER et al, 2001).

Método Superfície de reflexão comum (SRC)



Aproximação de tempo SRC não hiperbólica

$$\Phi_{CRS}(h, d; t_0) = \sqrt{\frac{F(d) + ch^2 + \sqrt{F(d-h)F(d+h)}}{2}}$$

$$c = 2b_2 + a_1^2 - a_2$$

$$F(d-h) = (t_0 + a_1(d-h))^2 + a_2(d-h)^2$$

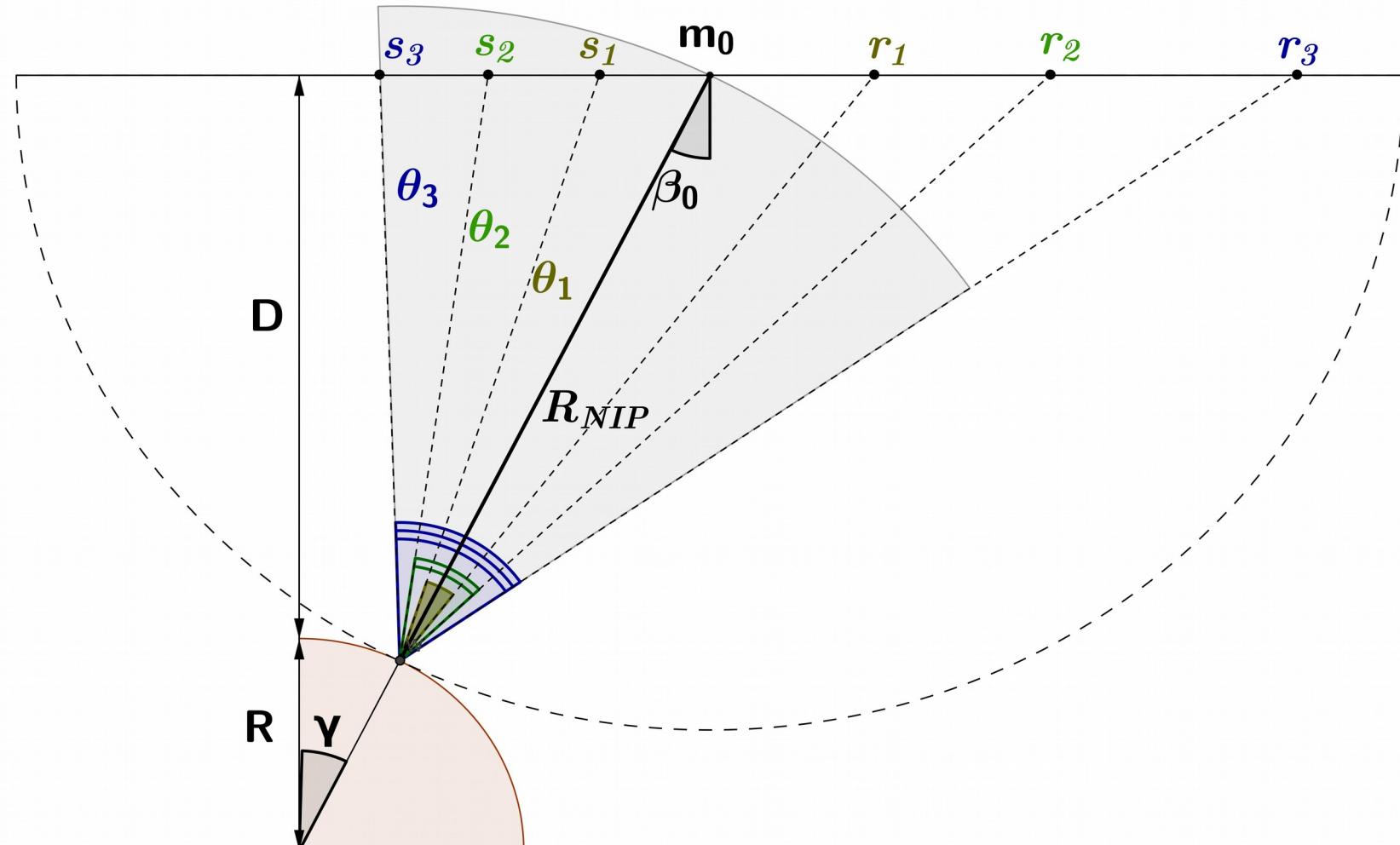
$$F(d+h) = (t_0 + a_1(d+h))^2 + a_2(d+h)^2$$

$$a_1 = \frac{2 \sin(\beta_0)}{v_0}$$

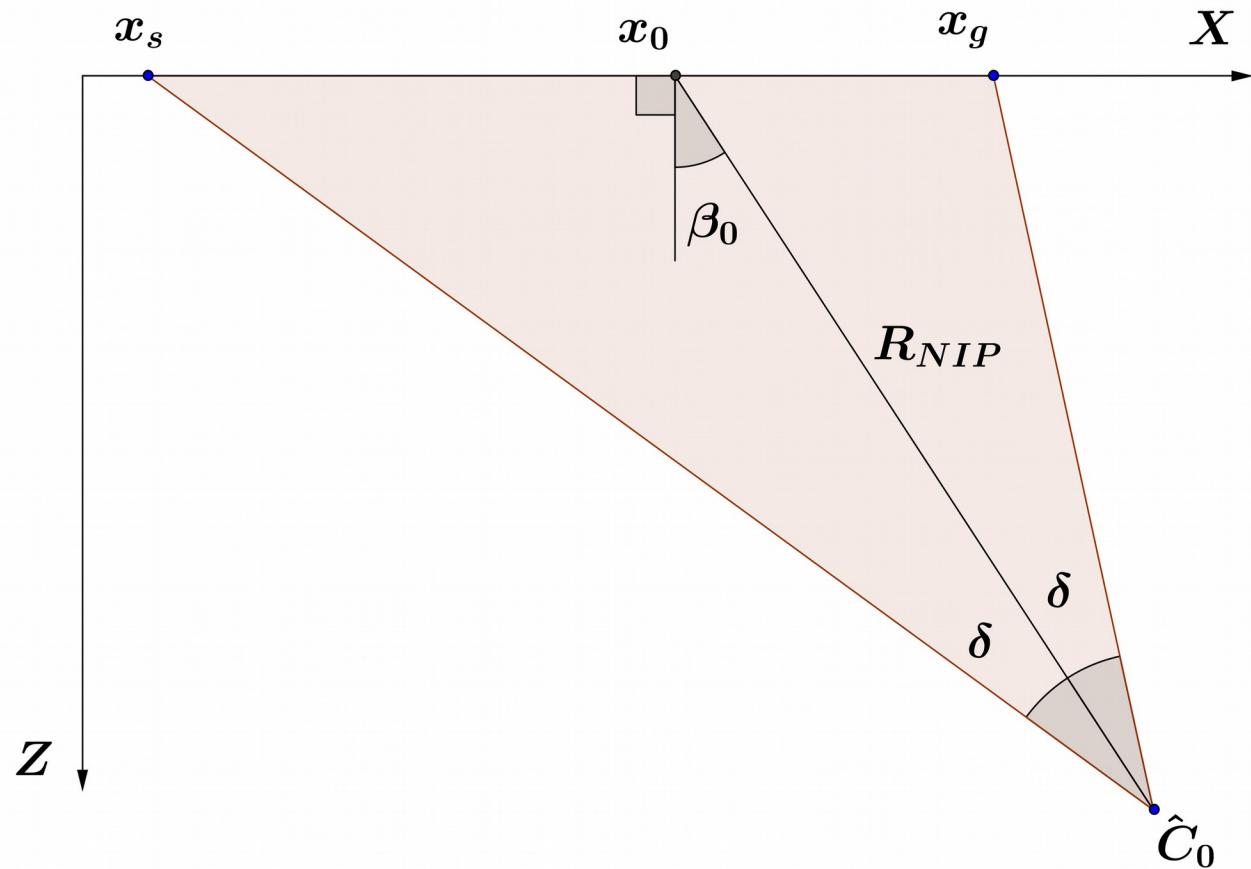
$$a_2 = \frac{2 \cos^2(\beta_0)t_0}{R_N v_0}$$

$$b_2 = \frac{2 \cos^2(\beta_0)t_0}{R_{NIP} v_0}$$

Método Elemento de reflexão comum (ERC)



Método Elemento de reflexão comum (ERC)

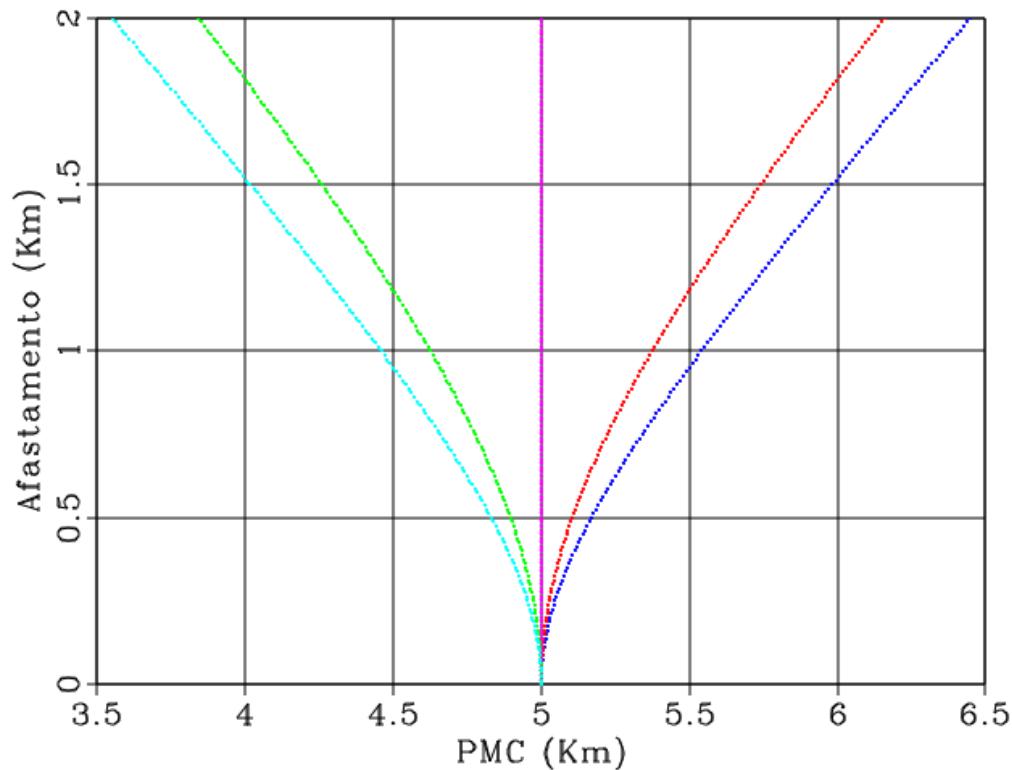


Equações de tempo ERC

$$m = m_0 + \frac{1}{2\alpha} (1 - \sqrt{1 + 4\alpha^2 h^2})$$

$$\begin{aligned} t(m, h) &= \left(\tau_0 - \frac{2R_{NIP}}{v_0} \right) \\ &+ \frac{R_{NIP}}{v_0} \sqrt{1 - 2\alpha(m - m_0 + h) + \frac{(m - m_0 + h)^2}{R_{NIP}^2}} \\ &+ \frac{R_{NIP}}{v_0} \sqrt{1 - 2\alpha(m - m_0 - h) + \frac{(m - m_0 - h)^2}{R_{NIP}^2}} \end{aligned}$$

Parâmetro de assimetria (alfa)



$$\alpha = \frac{\sin \beta_0}{R_{NIP}}$$

O problema da bola de tênis e da folha de papel

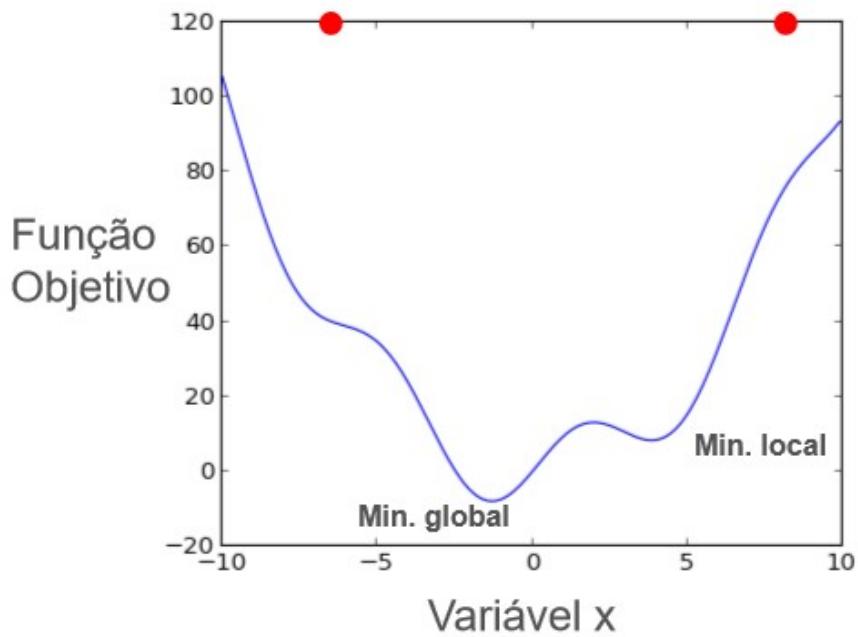


$$\Theta(\alpha, \beta, \gamma)$$



Fonte: <https://pixabay.com/>

Otimização dos parâmetros do SRC com o Very Fast Simulated Annealing (VFSA)



Para atualizar utilize o critério probabilístico de aceitação (critério de Metropolis):

$$P = \exp\left(\frac{-\Delta E}{T}\right);$$

se $\Delta E \leq 0$ então

 Atualize:

$$m_0 = m_{new};$$

$$E(m_0) = E(m_{new});$$

fim

se $\Delta E > 0$ então

 Escreva um numero aleatório $r = U[0, 1]$;

 se $P > 0$ então

 Atualize:

$$m_0 = m_{new};$$

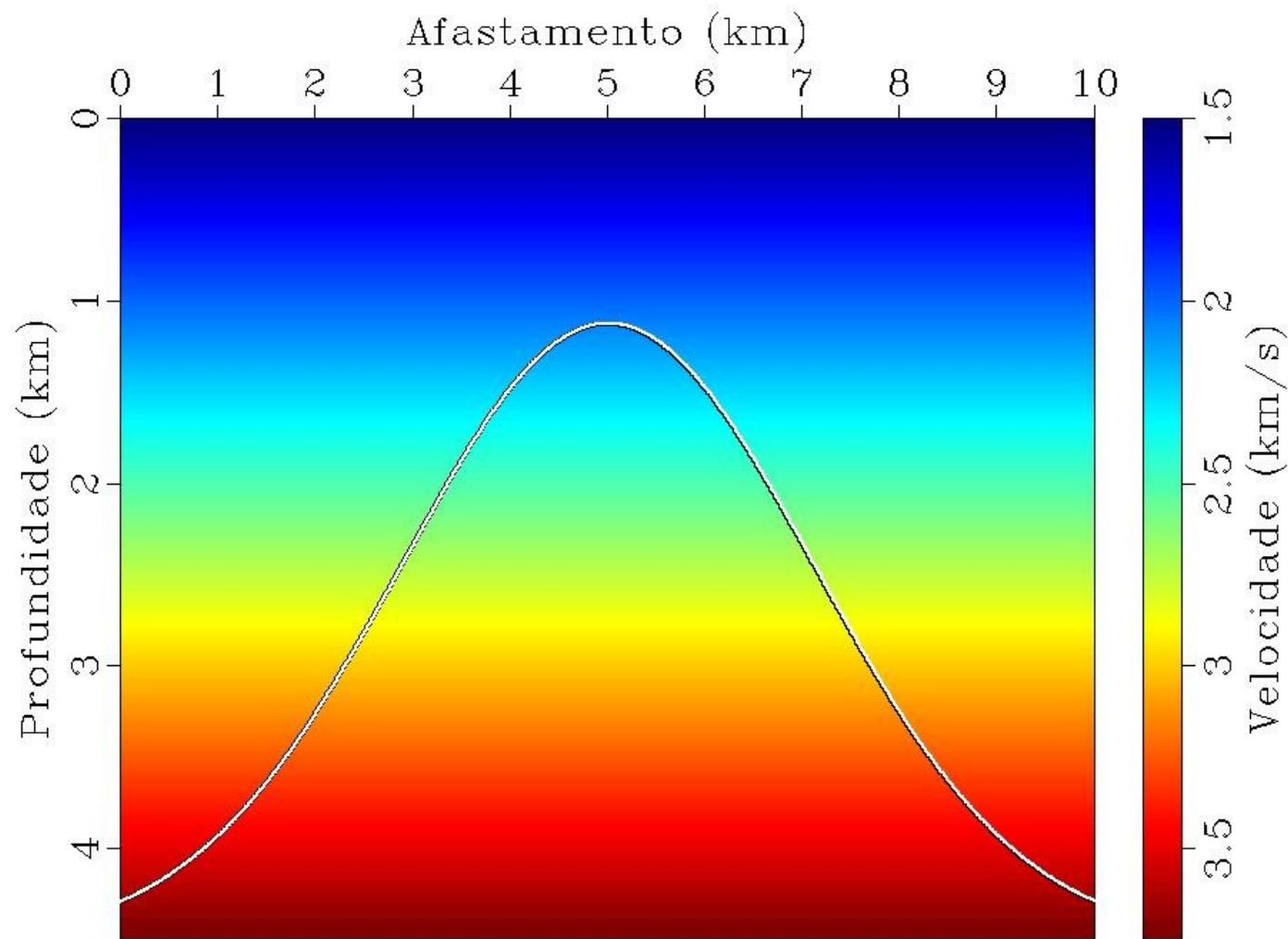
$$E(m_0) = E(m_{new});$$

fim

fim

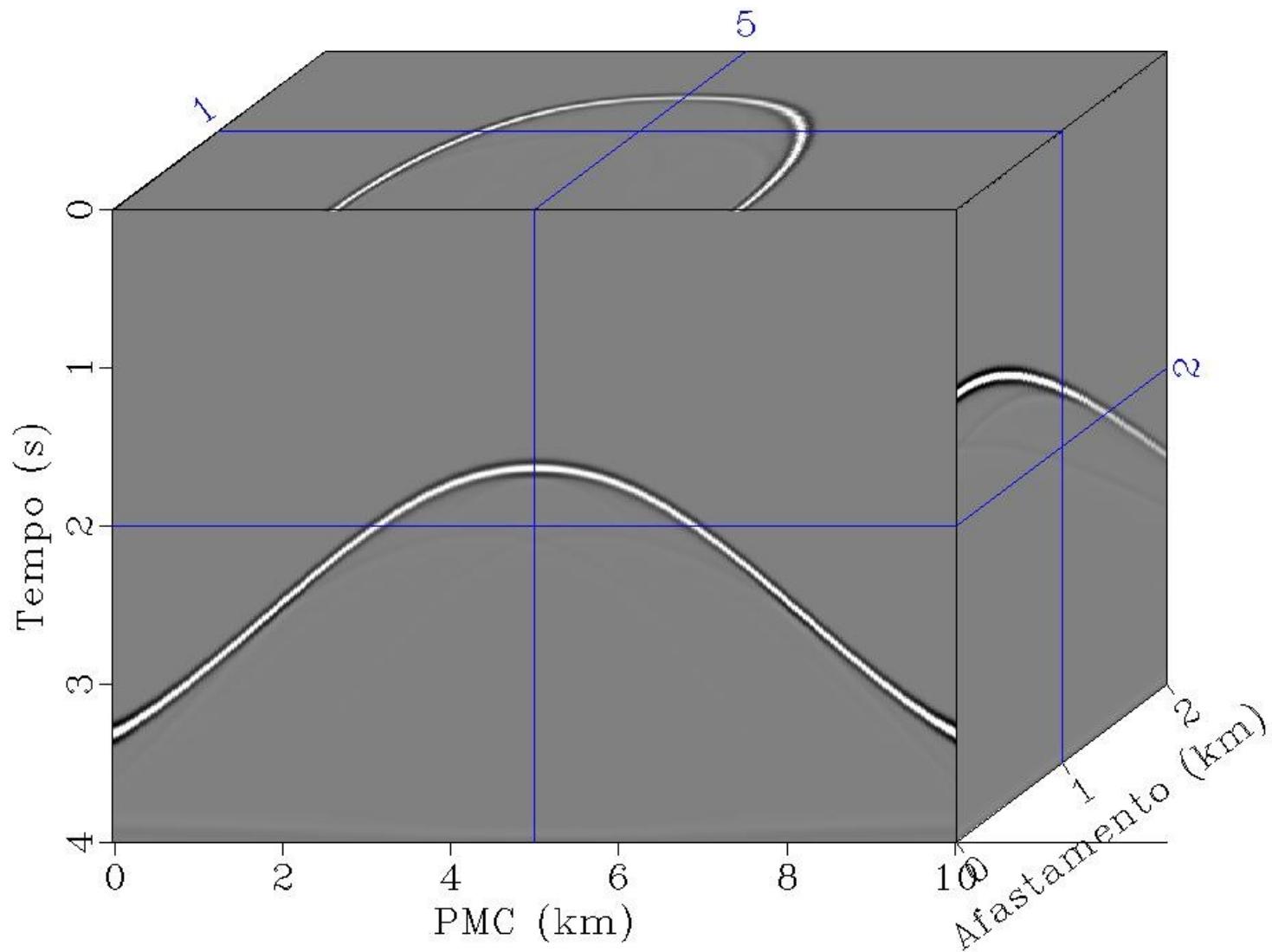
Fonte: <https://altairuniversity.com/>

Modelo do refletor gaussiano

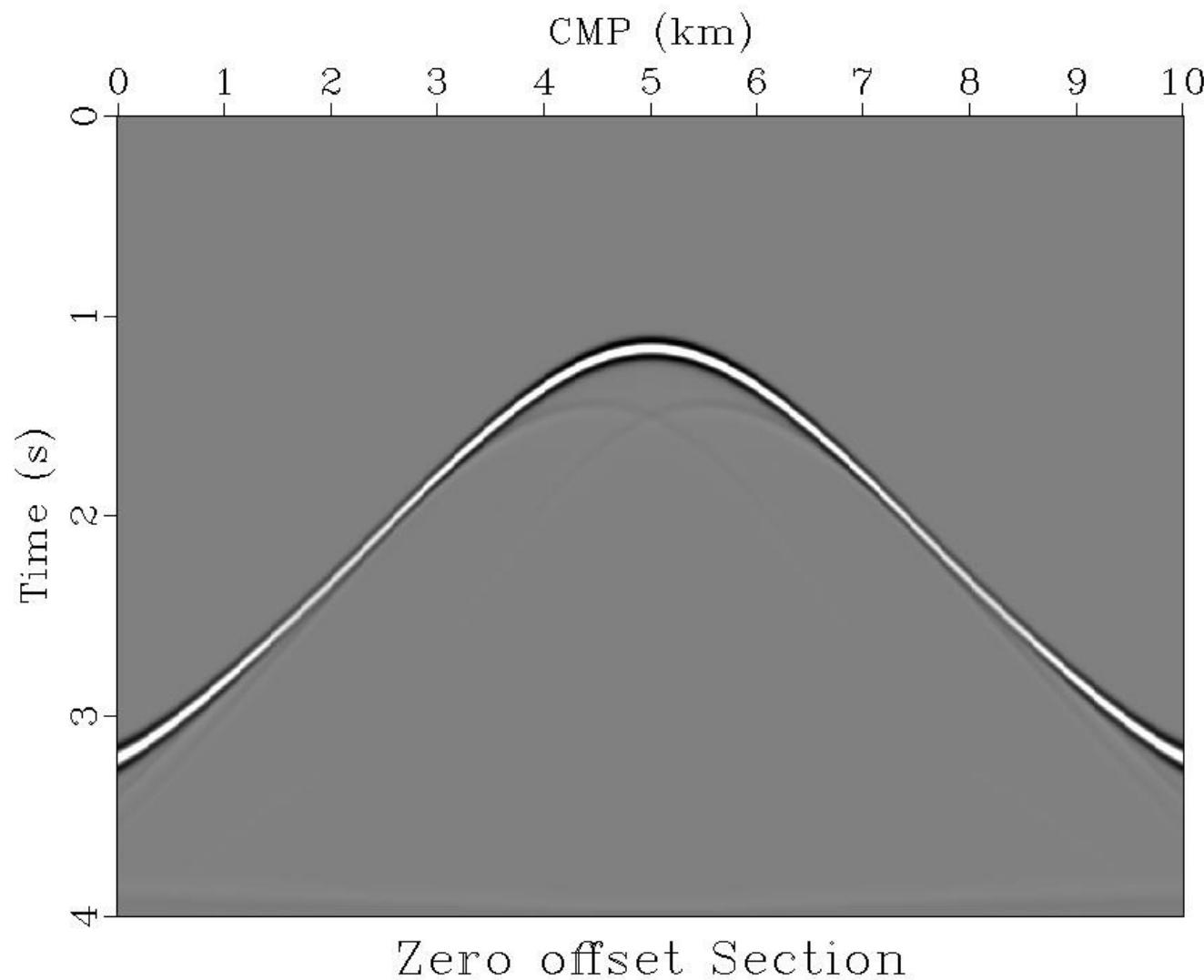


O “cubo de dados”

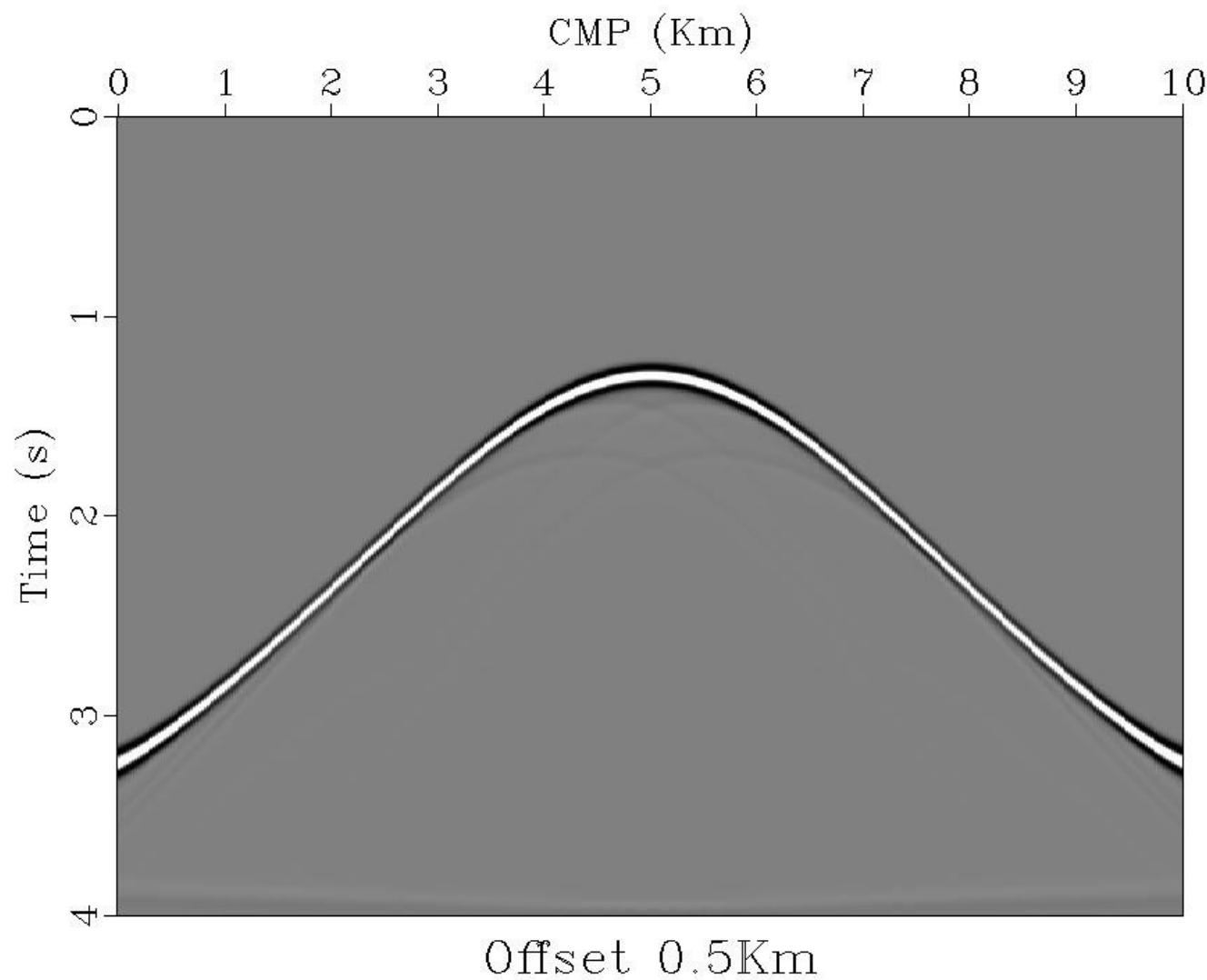
Cubo de dados modelado



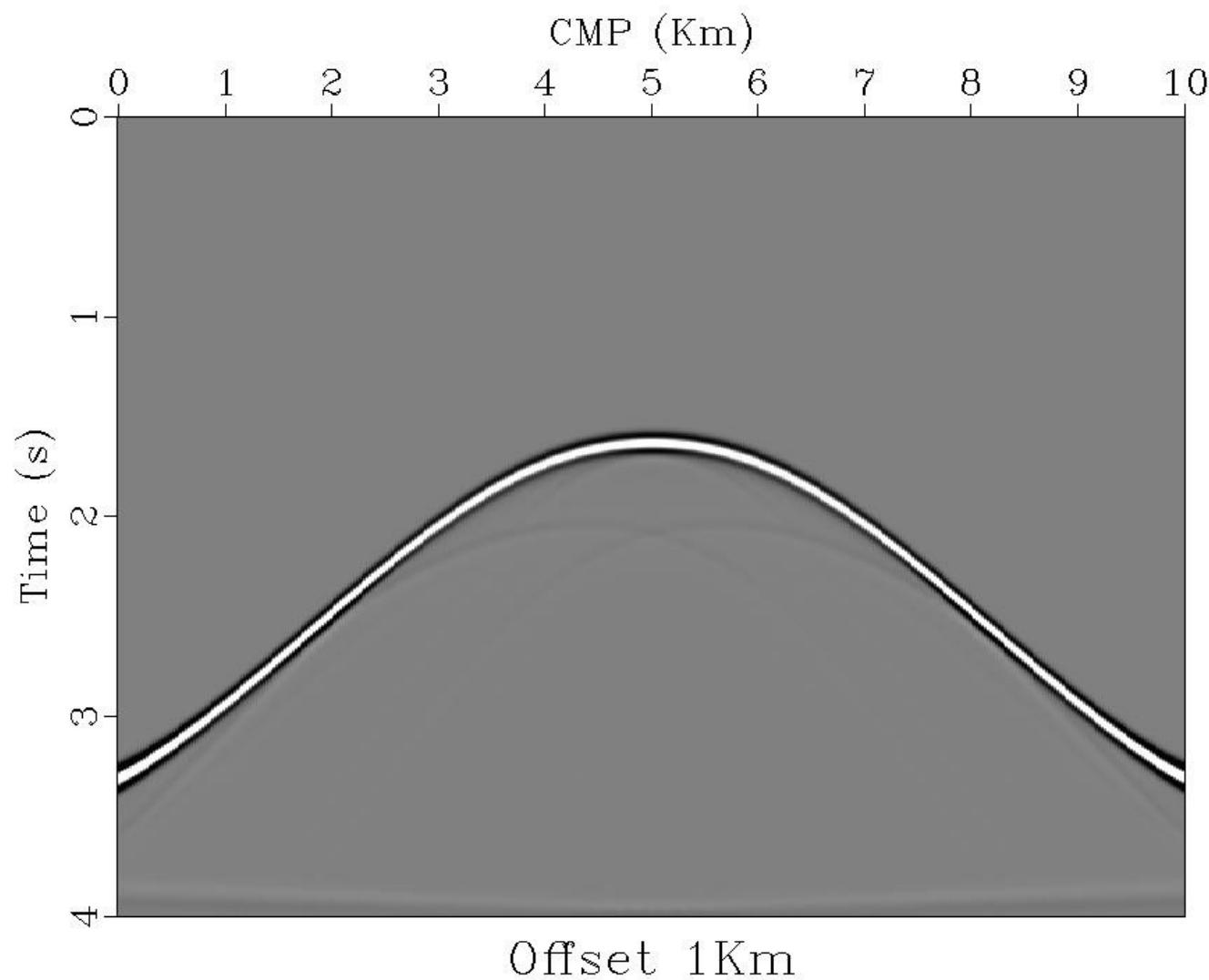
Seção de afastamento nulo



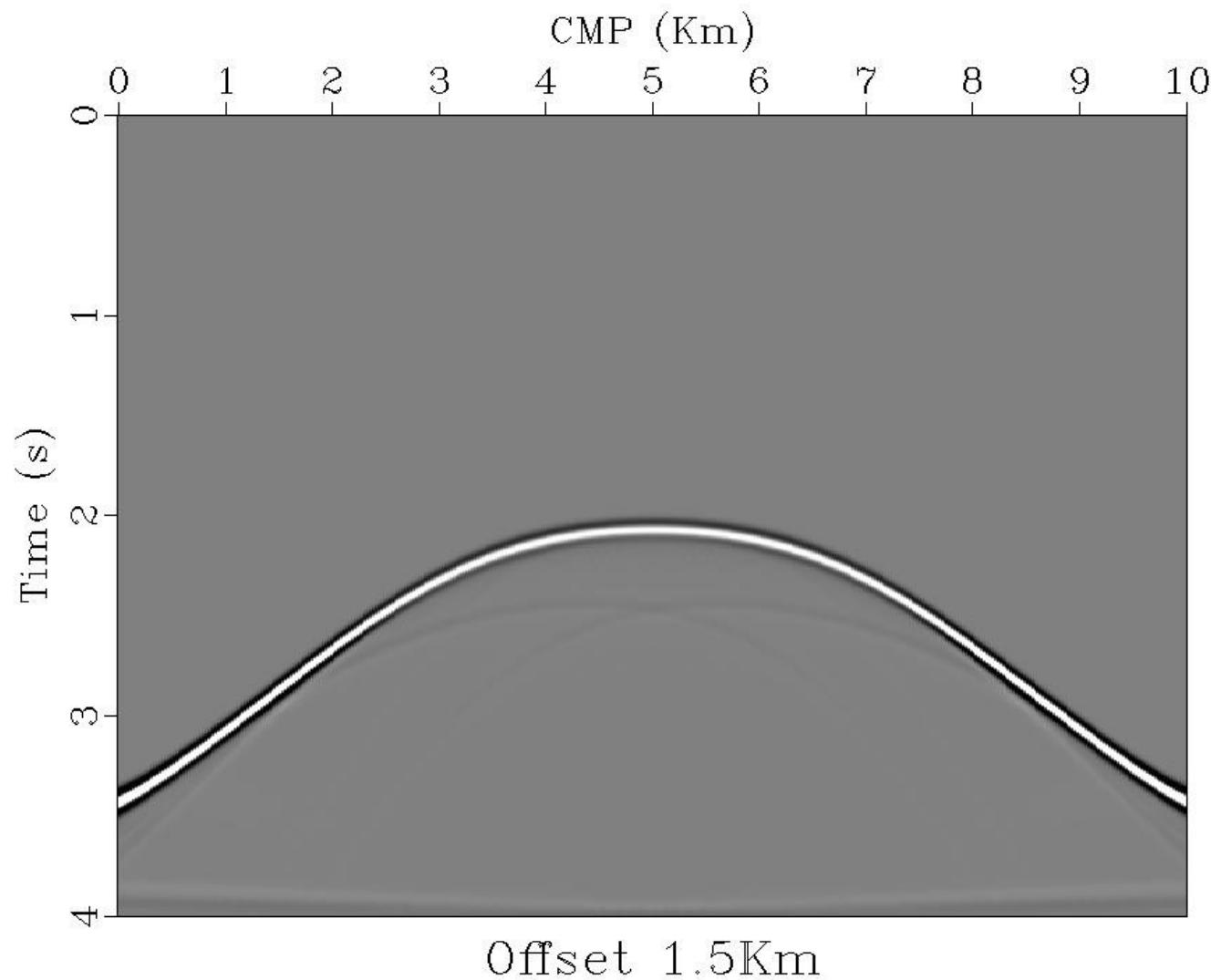
Seção de afastamento constante ($h=0.5\text{Km}$)



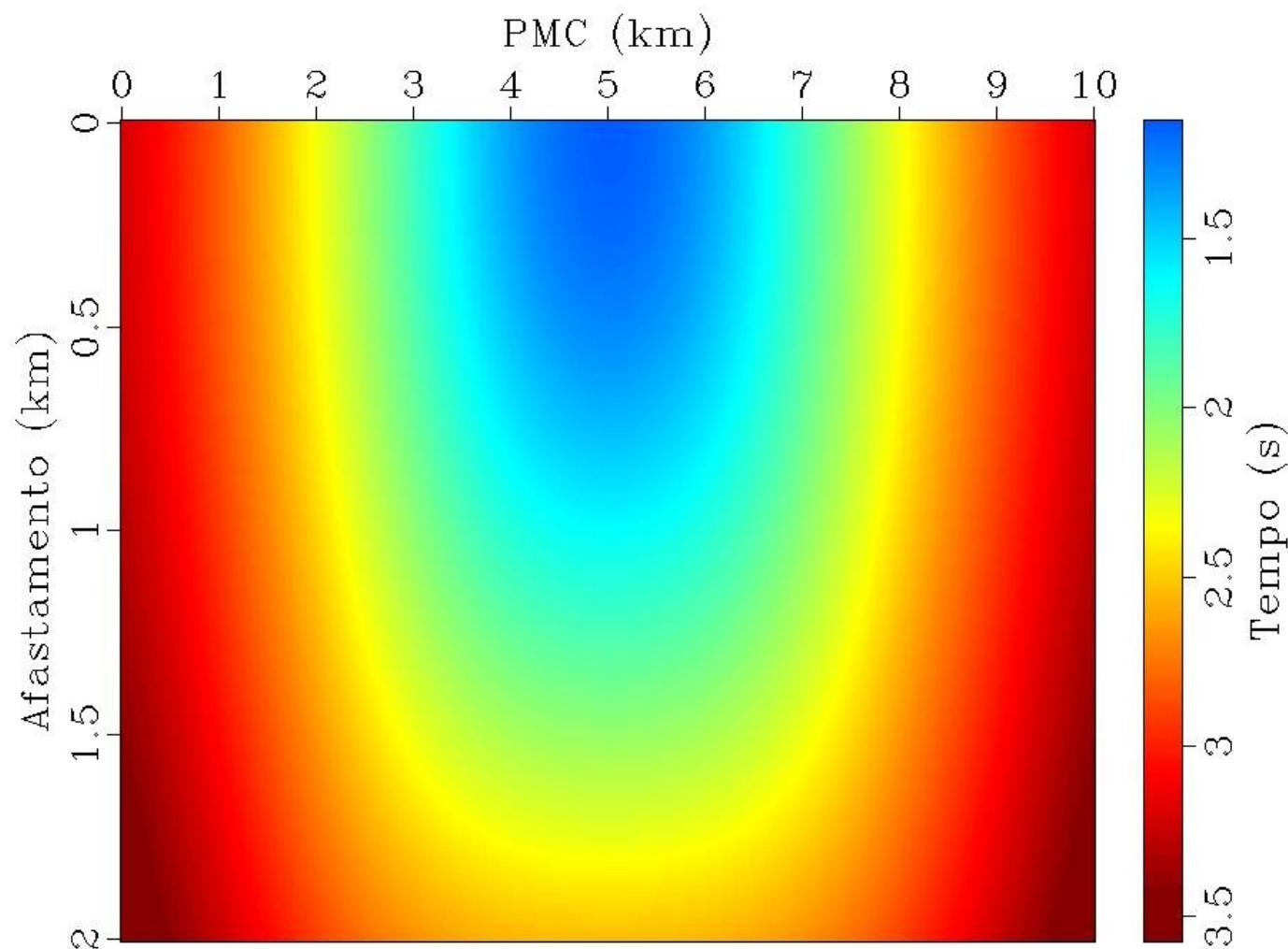
Seção de afastamento constante ($h=1.0\text{Km}$)



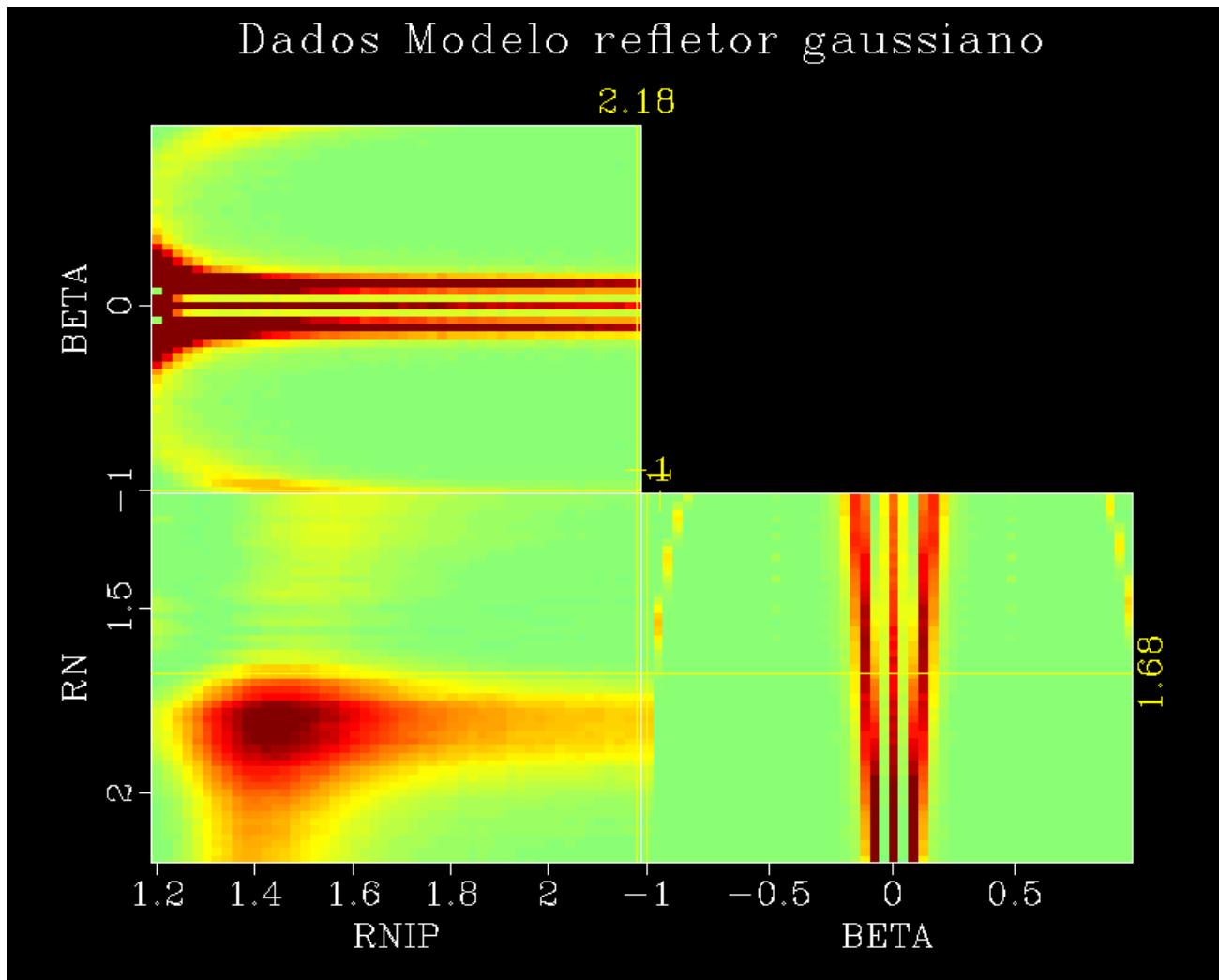
Seção de afastamento constante ($h=1.5\text{Km}$)



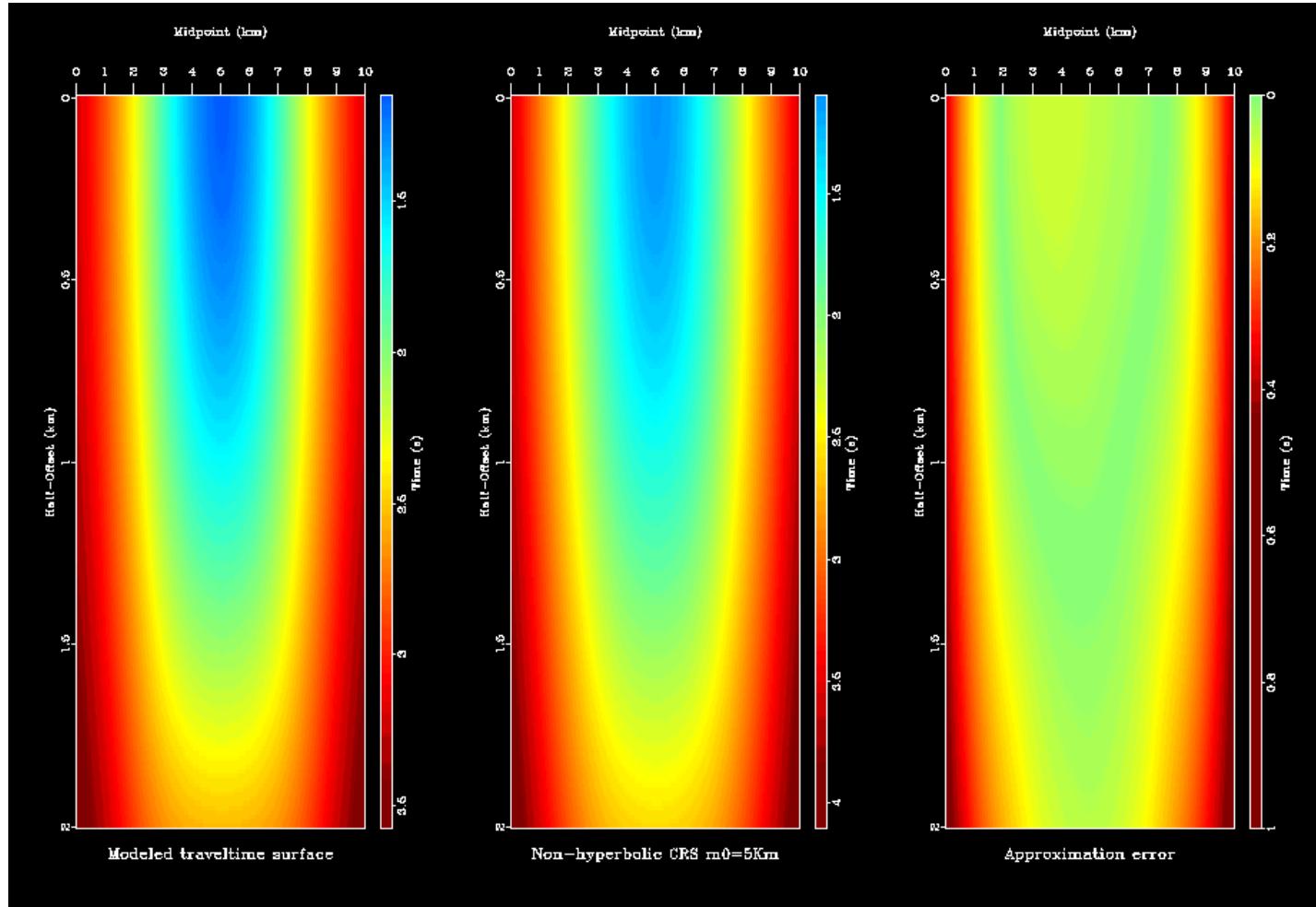
Superfície de tempo de trânsito de reflexão



Análise de coerência dos parâmetros do SRC



Erro de aproximação



Contribuição ao pacote Madagascar

github.com/ahay/src/pull/178

| [ABOUT](#)

Merged New contributor Rodolfo A C Neves (Dirack) #178
zhichenggeng merged 6 commits into [ahay:master](#) from [Dirack:master](#) 19 hours ago

Update NEWS.txt ... Verified a5d62c0 No milestone

Dirack requested review from **sfomel** and **zhichenggeng** 3 days ago

zhichenggeng merged commit [41097e5](#) into [ahay:master](#) 19 hours ago 1 check passed

Pull request closed If you wish, you can delete this fork of [ahay/src](#).

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Contribuição ao pacote Madagascar

github.com/ahay/src/tree/master/user/dirack

 sfomei python3 compatibility ✓ Latest commit 8b62f62 10 hours ago

..

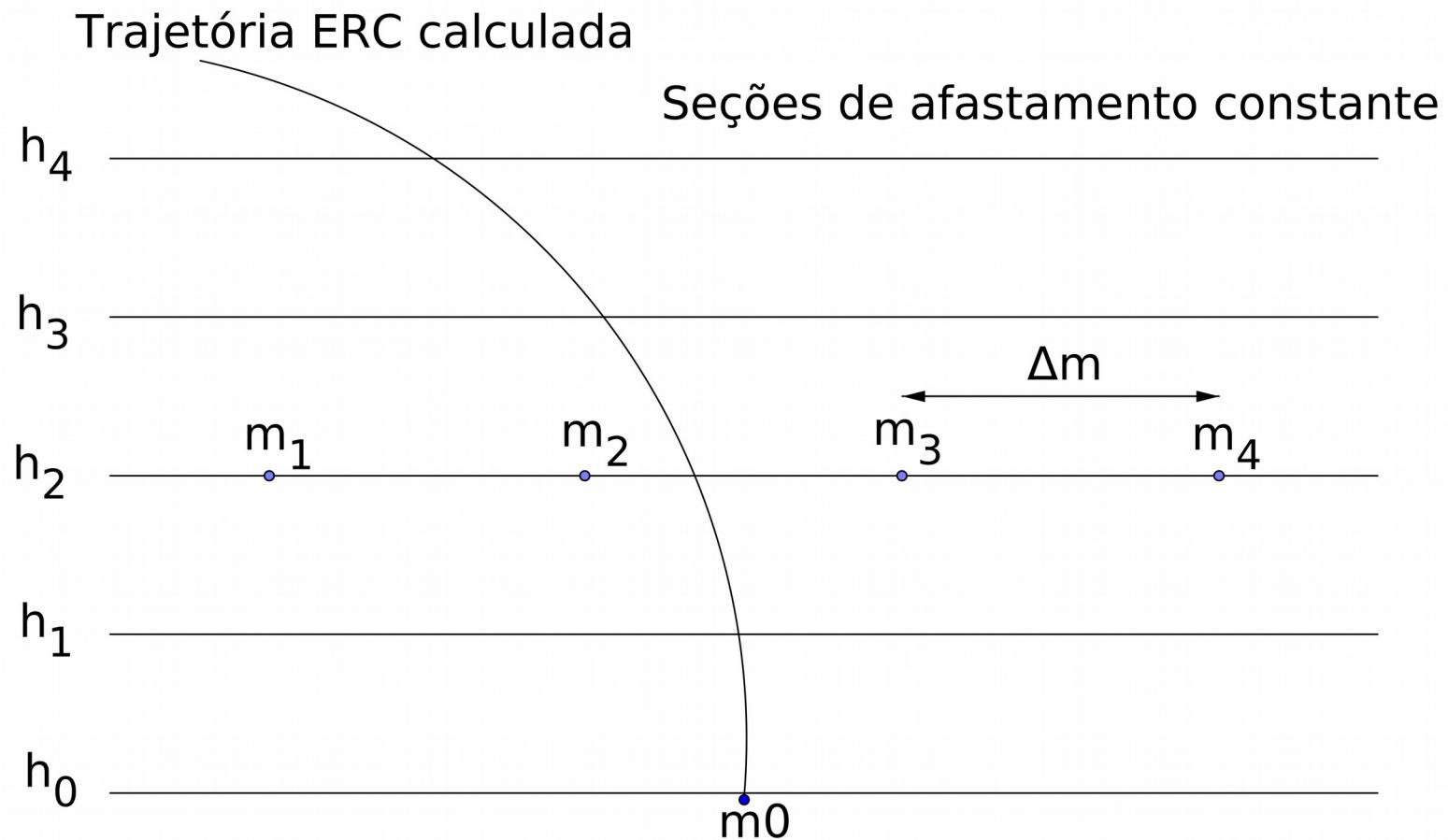
usage_examples	Usage example of sfvfsacrsnh and sfnhcrrsurf	3 days ago
Mnhcrrsurf.c	Add program sfvfsacrsnh and sfnhcrrsurf	3 days ago
Mvfsacrsnh.c	Add program sfvfsacrsnh and sfnhcrrsurf	3 days ago
README.md	Create README.md	3 days ago
SConstruct	python3 compatibility	10 hours ago
vfsacrsnh_lib.c	Add program sfvfsacrsnh and sfnhcrrsurf	3 days ago
vfsacrsnh_lib.h	Add program sfvfsacrsnh and sfnhcrrsurf	3 days ago

[README.md](#)

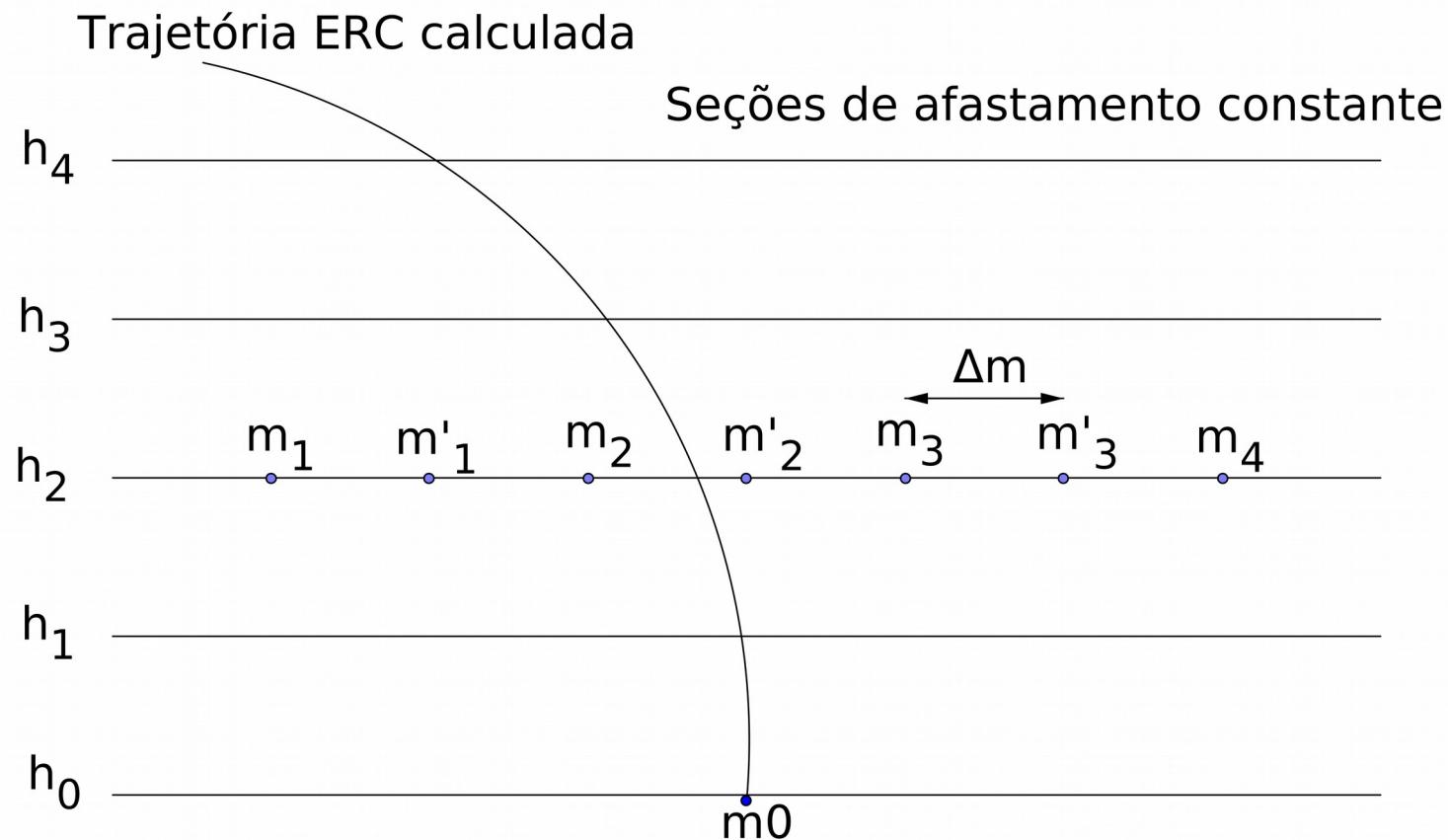
Rodolfo A C Neves (Dirack)

This is a open source repository with programs developed for Madagascar package version 3.0. Any doubt? please contact me by email rodolfo_profissional@hotmail.com (email) or [github](#)

Estratégia de interpolação



Estratégia de interpolação



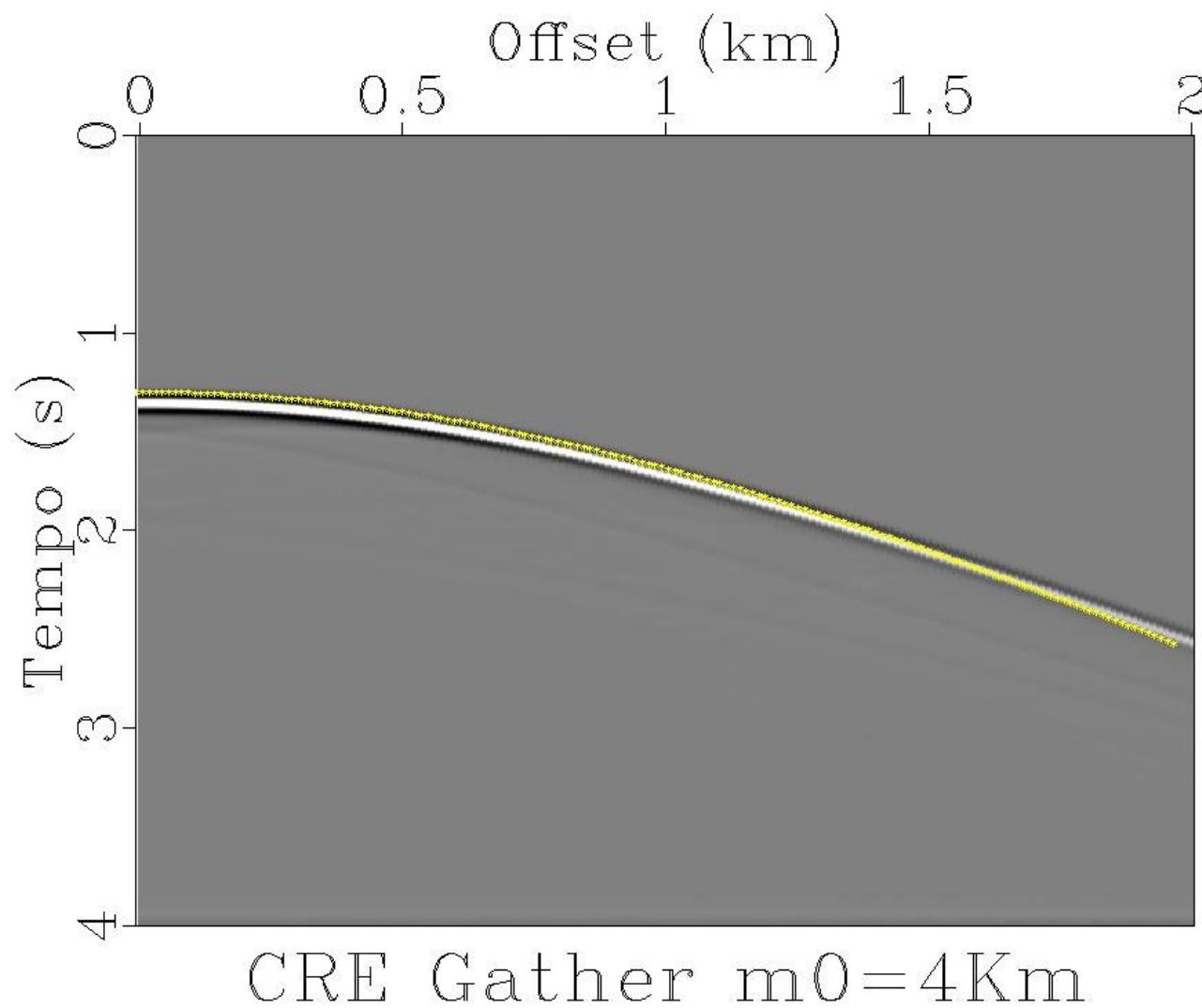
Filtros adaptativos de predição de erro (FPE)

$$\hat{B}_n(t, x) = \arg \min_{B_n} \left\| K(t, x) \left[S(t, x) - \sum_{n=1}^N B_n(t, x) S_n(t, x) \right] \right\|_2^2 + \epsilon^2 \sum_{n=1}^N \|D[B_n(t, x)]\|_2^2$$

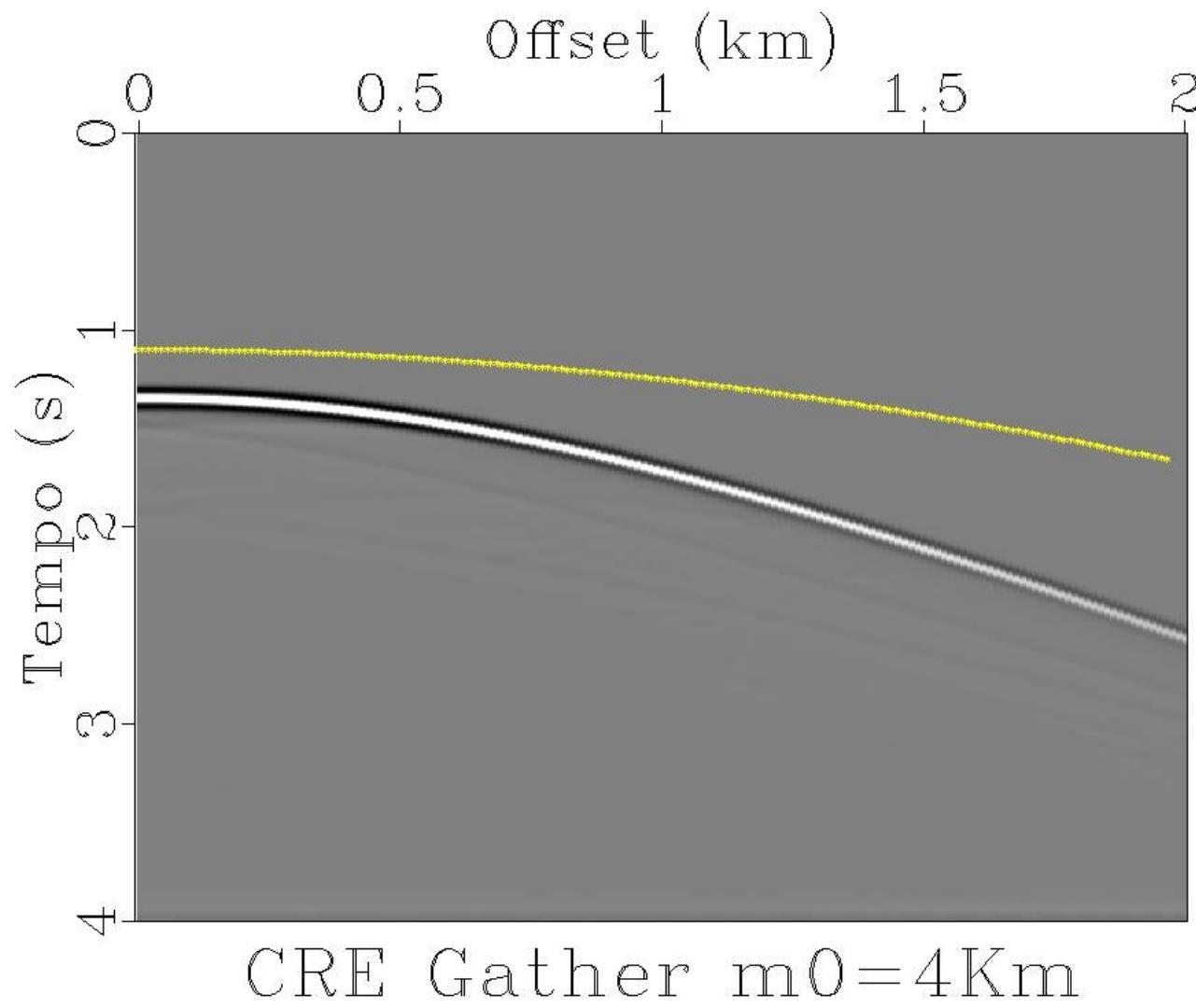
$$\hat{S}(t, x) = \arg \min_S \left\| S(t, x) - \sum_{n=1}^N \hat{B}_n(t, x) S_n(t, x) \right\|_2^2$$

$$\hat{S}(t, x) = S_{known}(t, x_k)$$

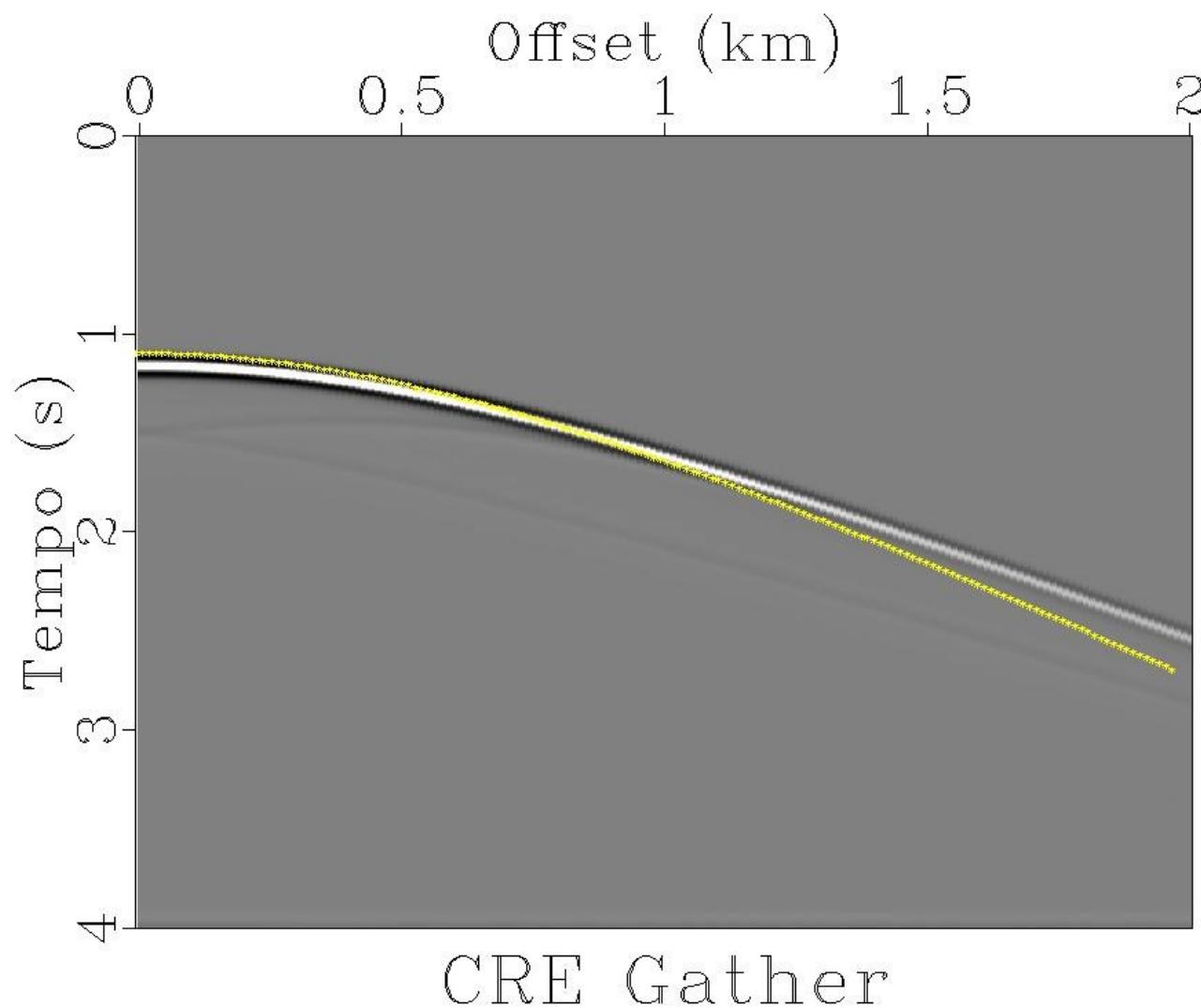
Ajuste das famílias ERC



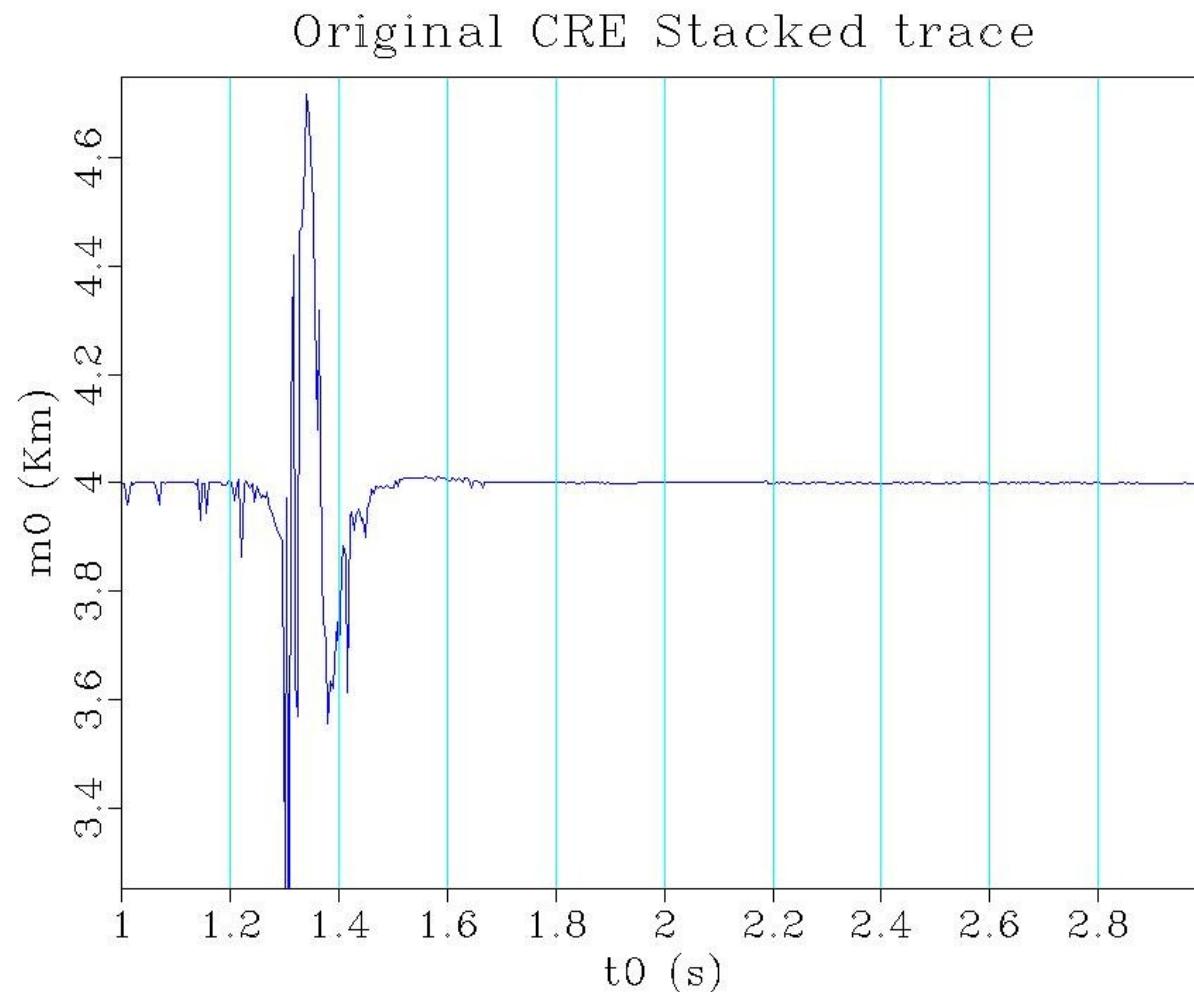
Ajuste das famílias ERC



Ajuste das famílias ERC

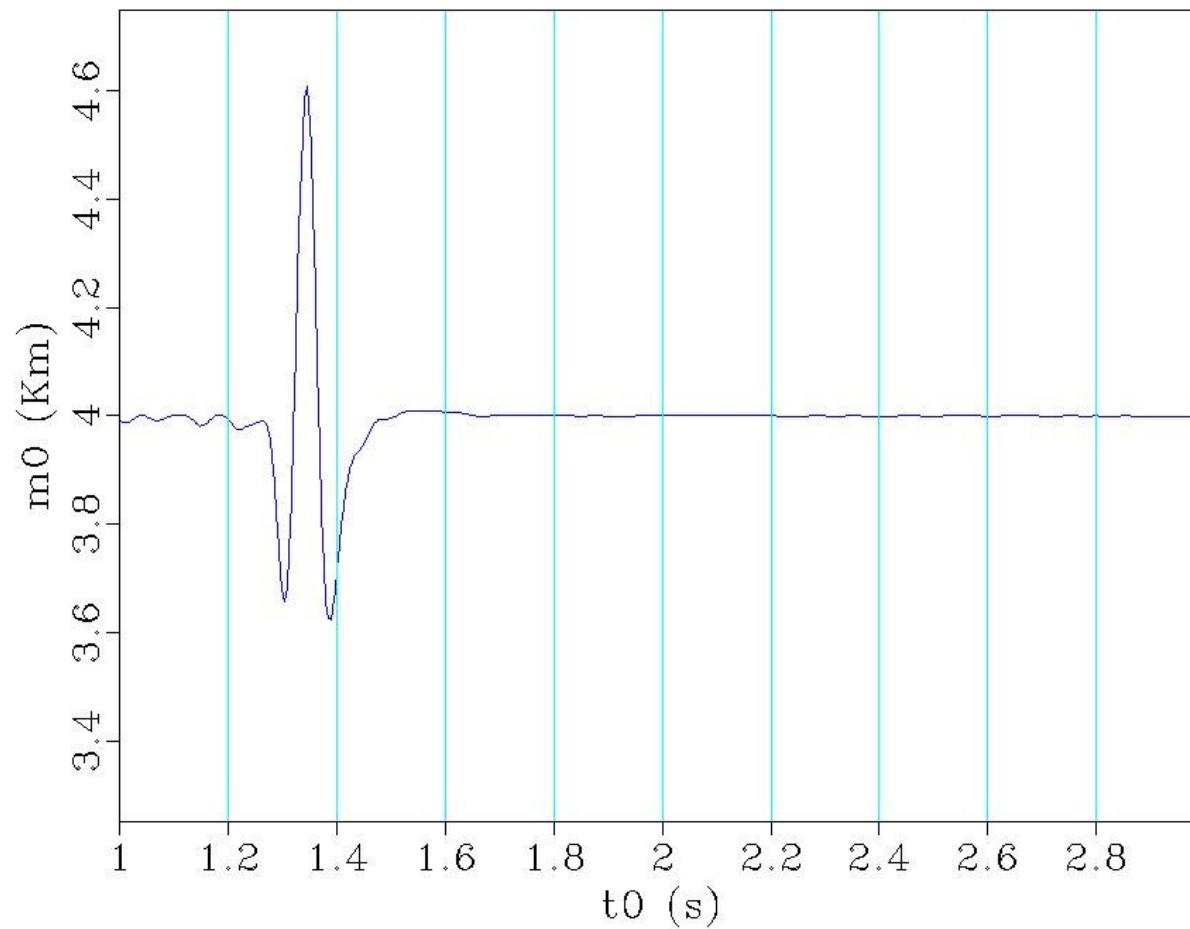


Supertraços ERC

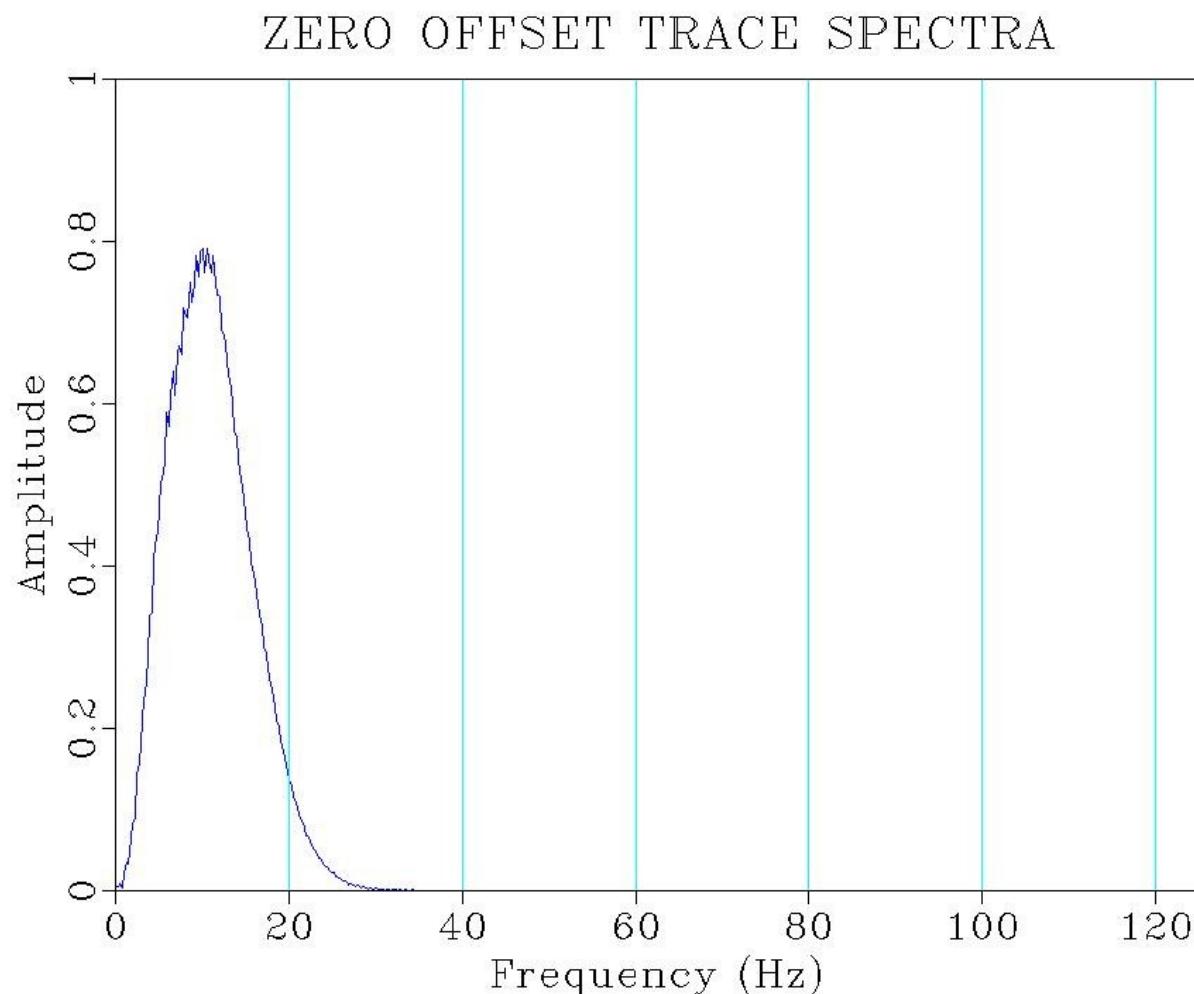


Supertraços ERC

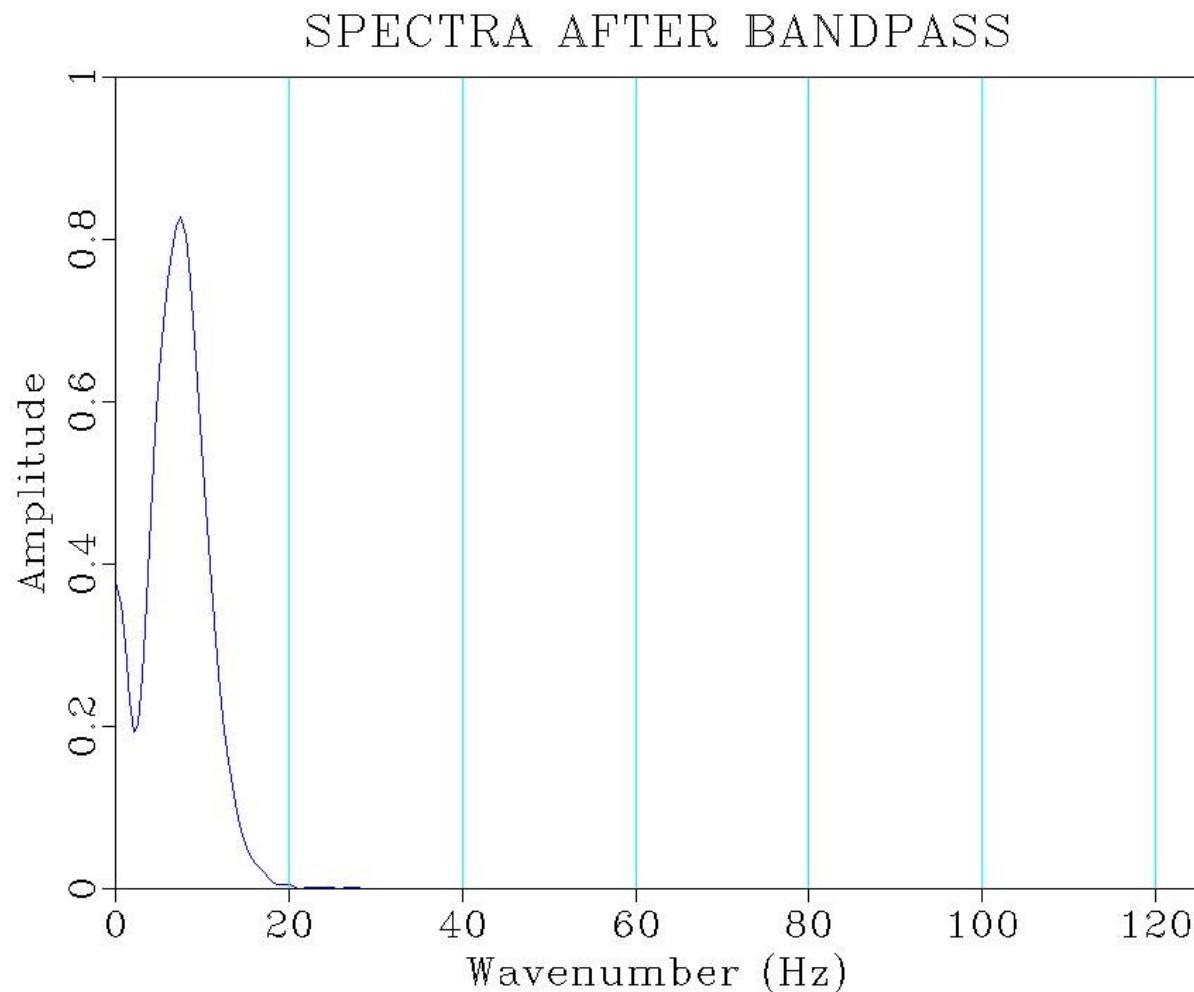
Filtered CRE Stacked trace



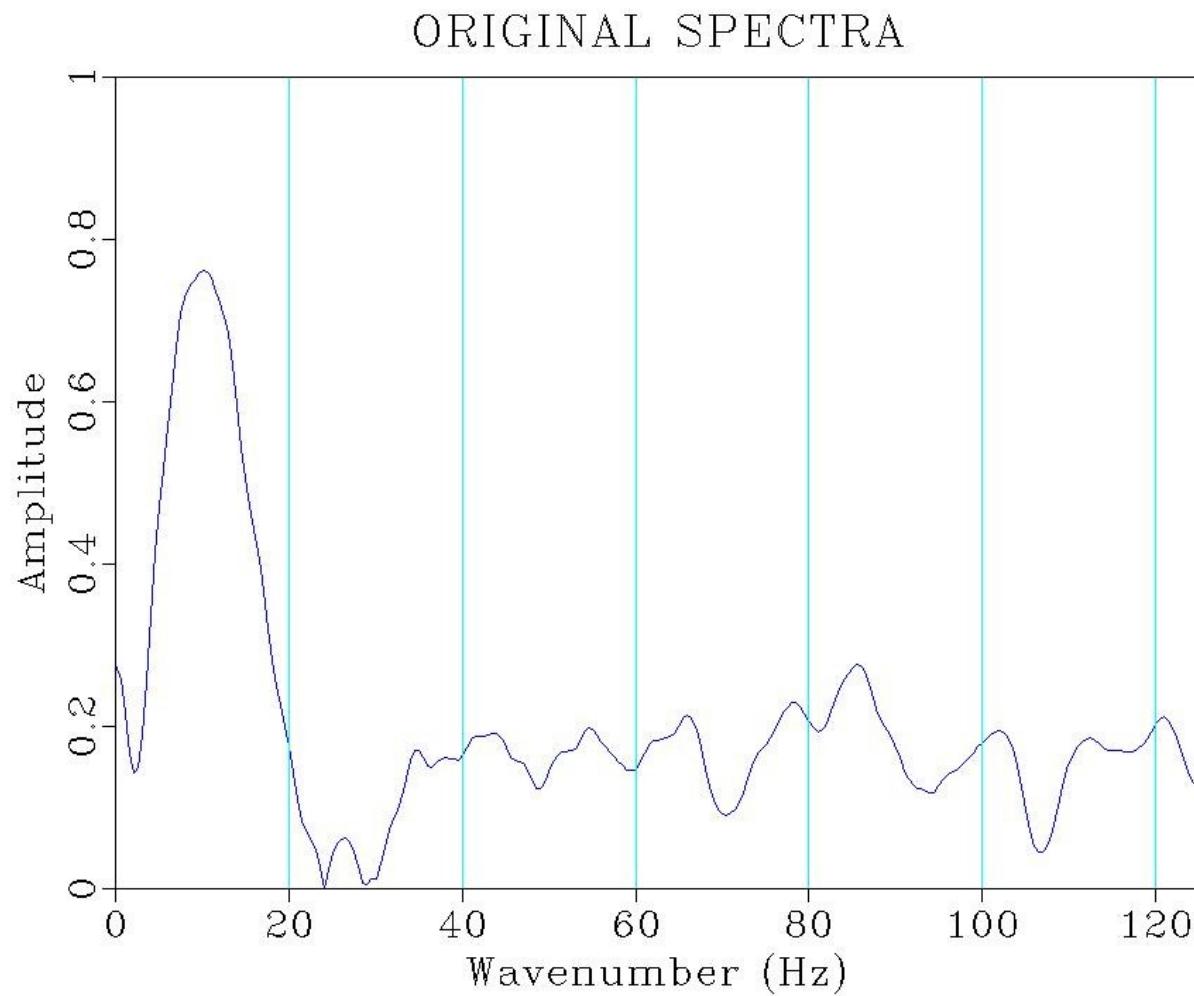
Supertraços ERC



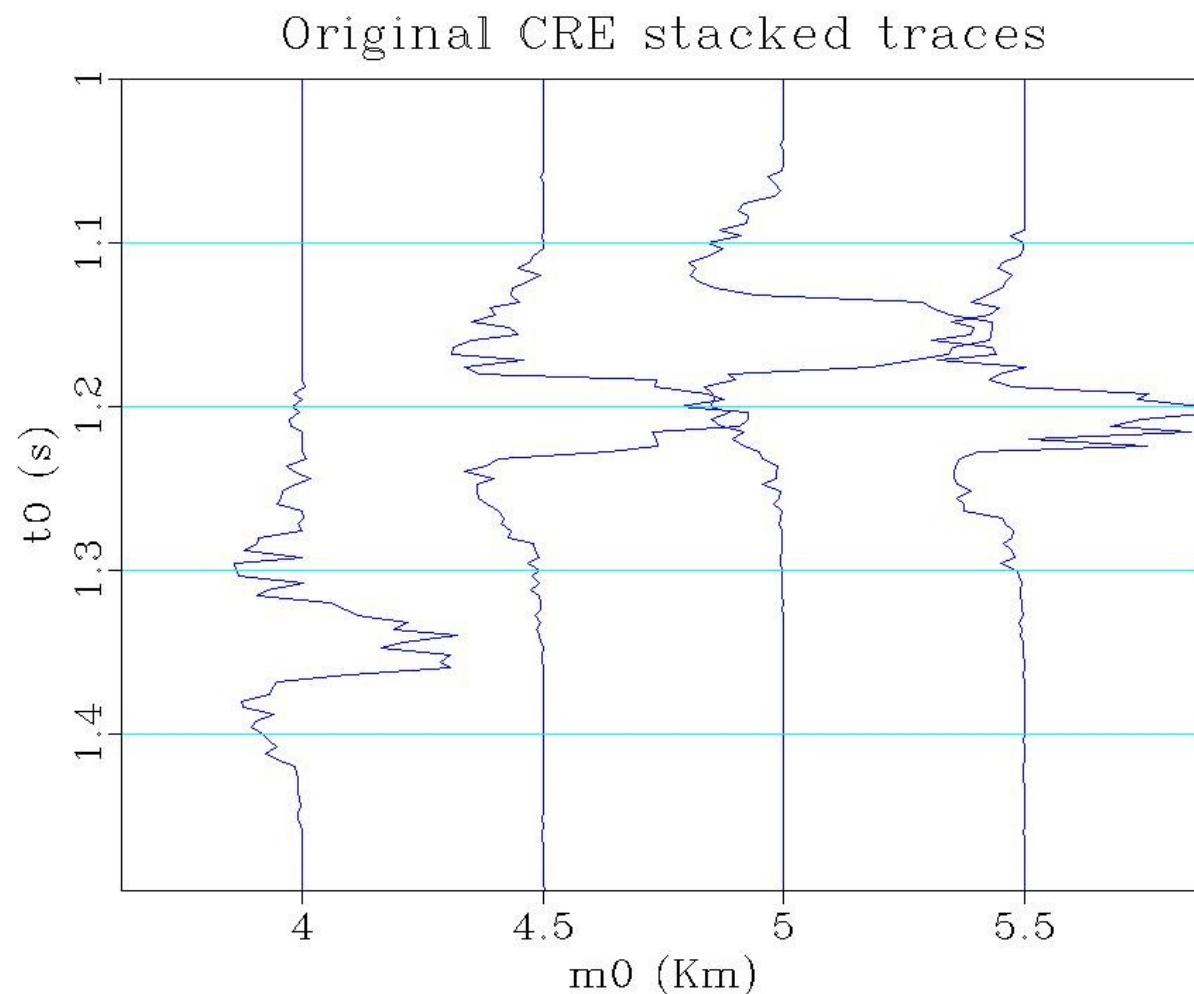
Supertraços ERC



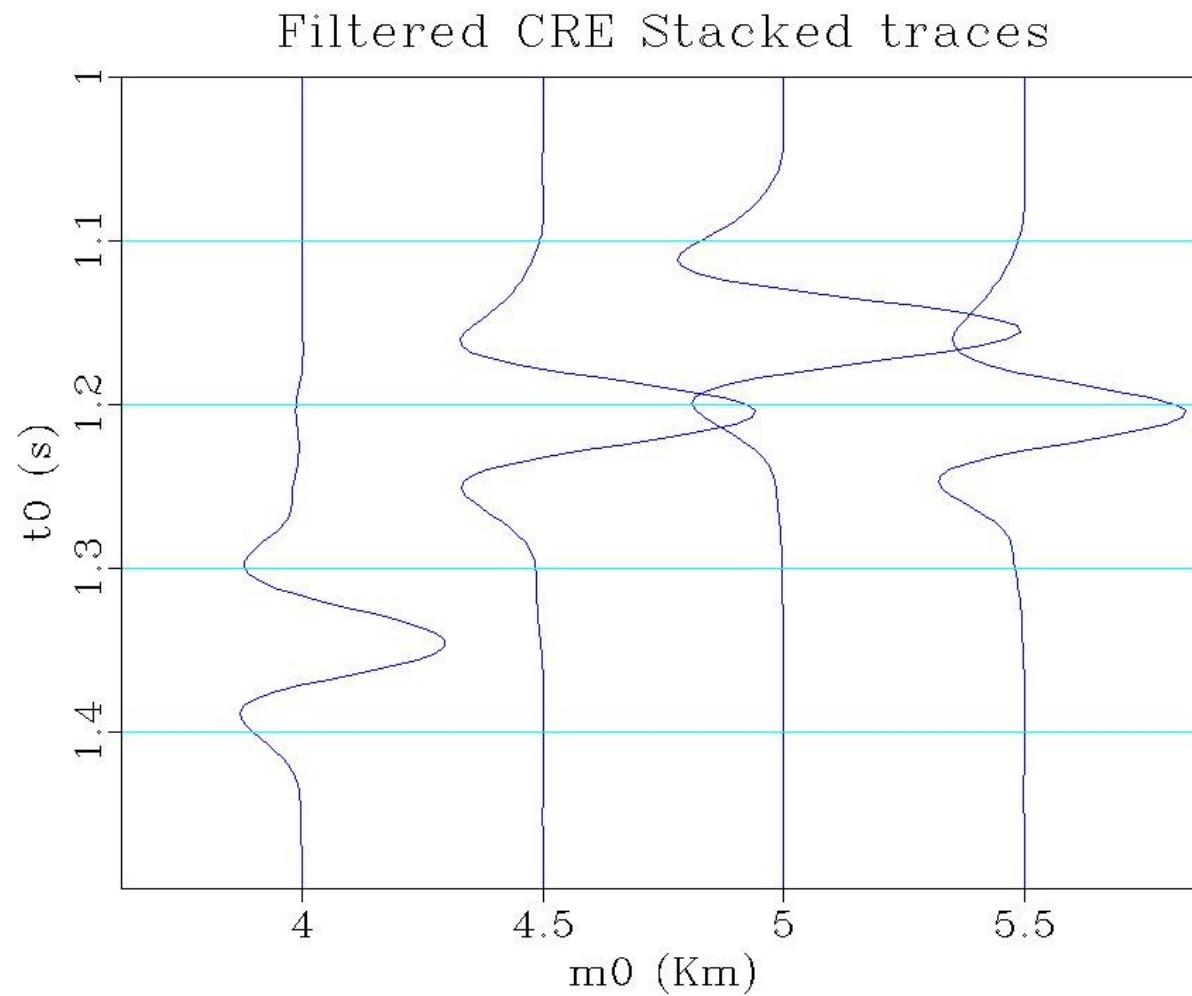
Supertraços ERC



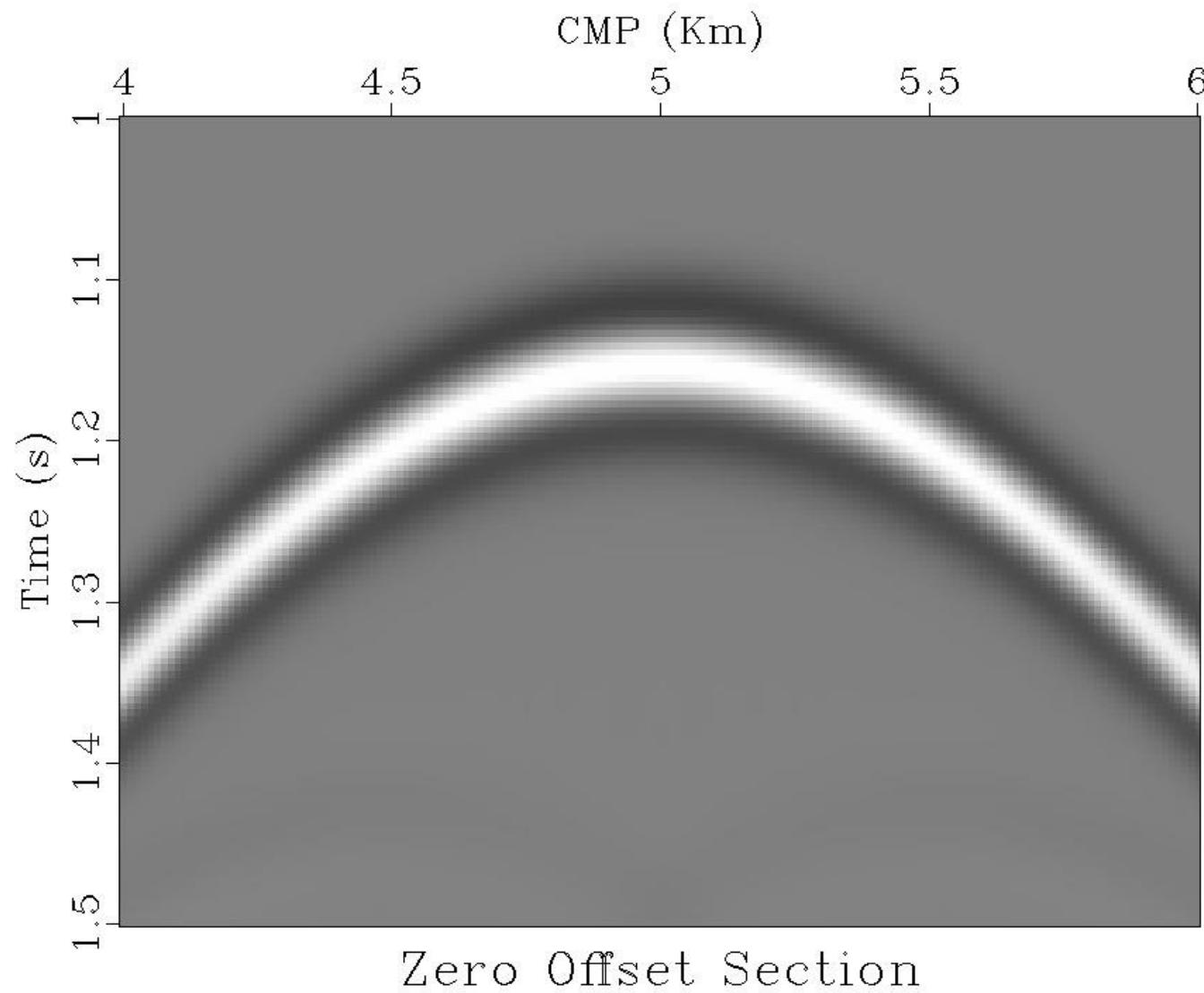
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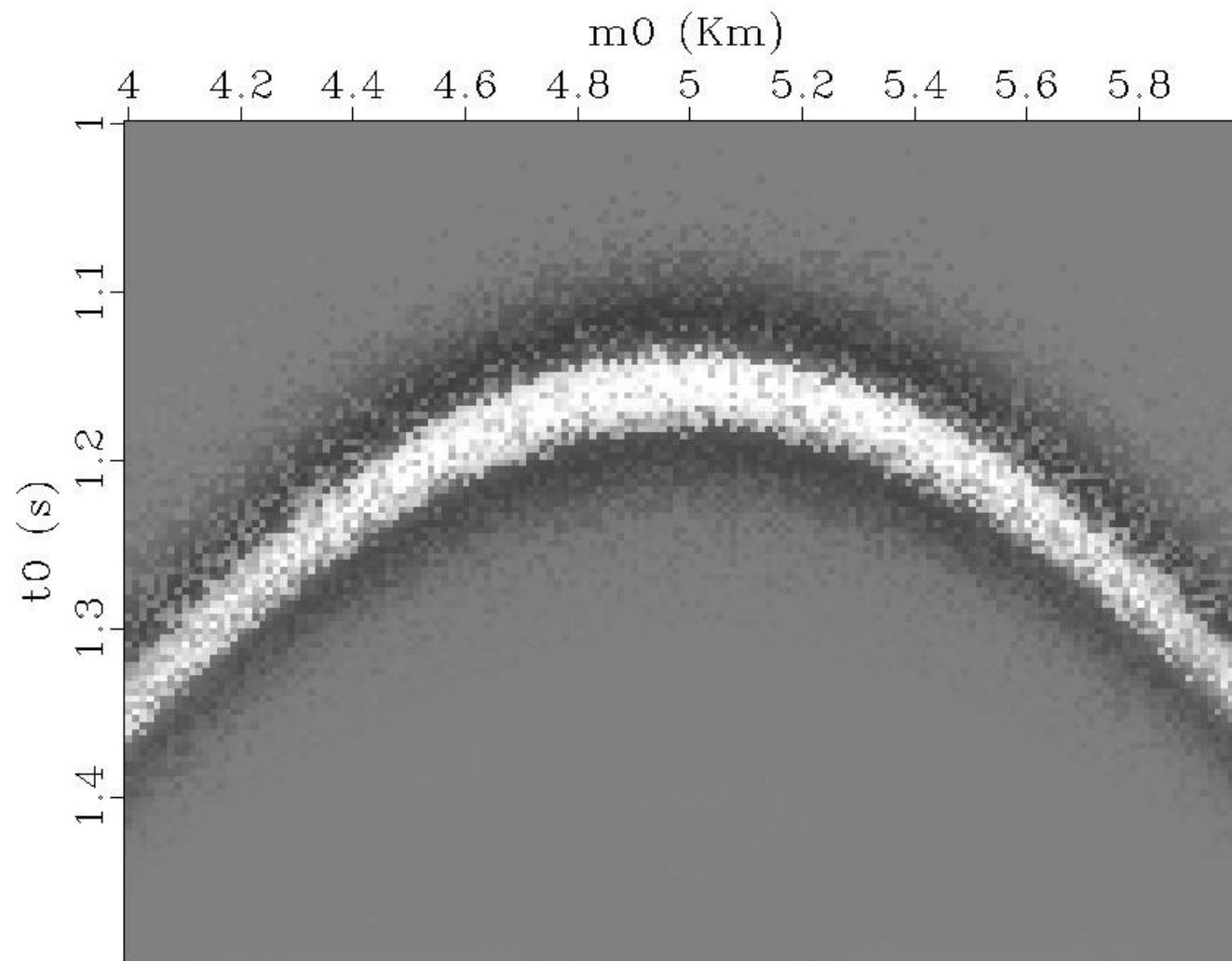
Supertraços ERC



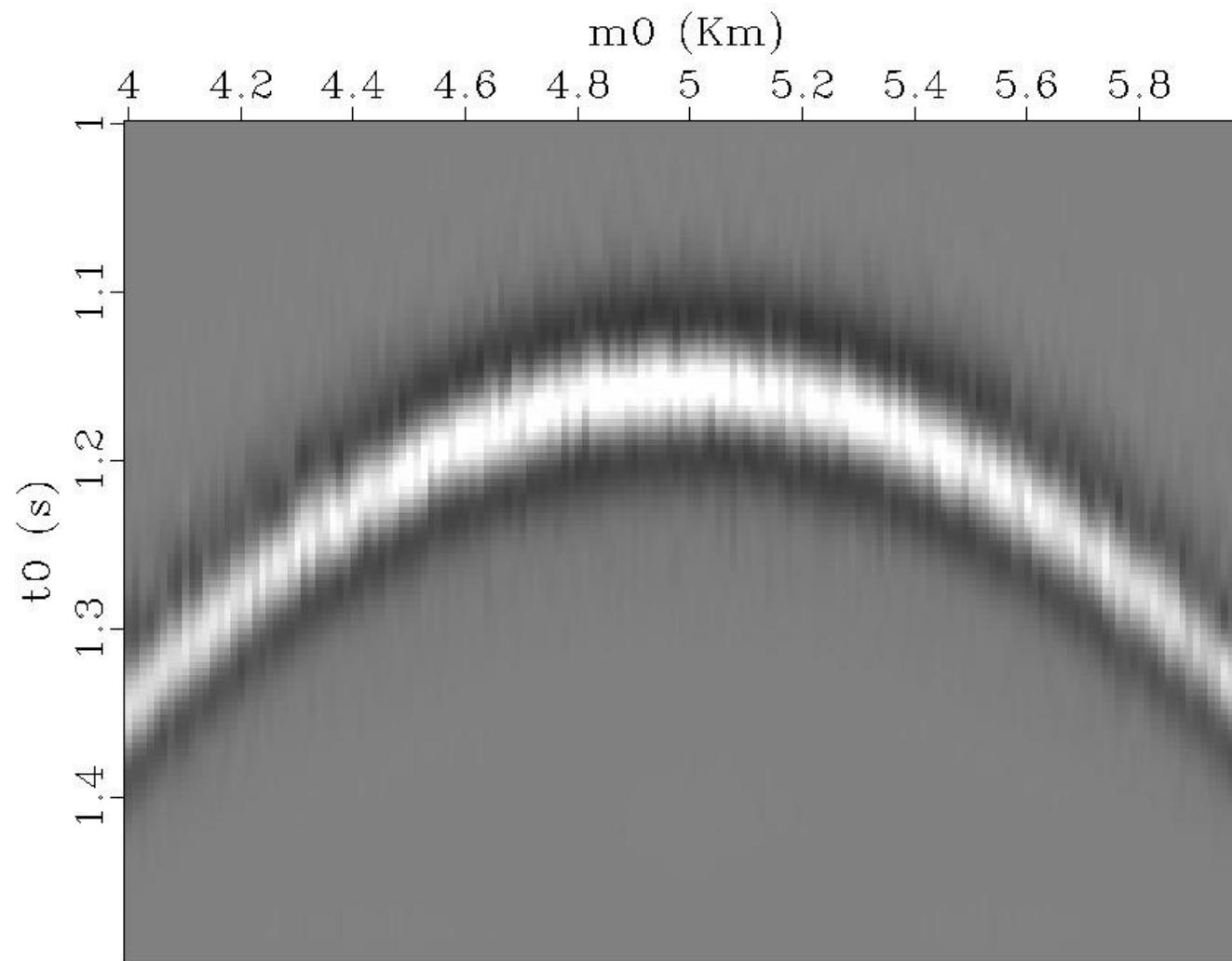
Seção empilhada ERC



Seção empilhada ERC

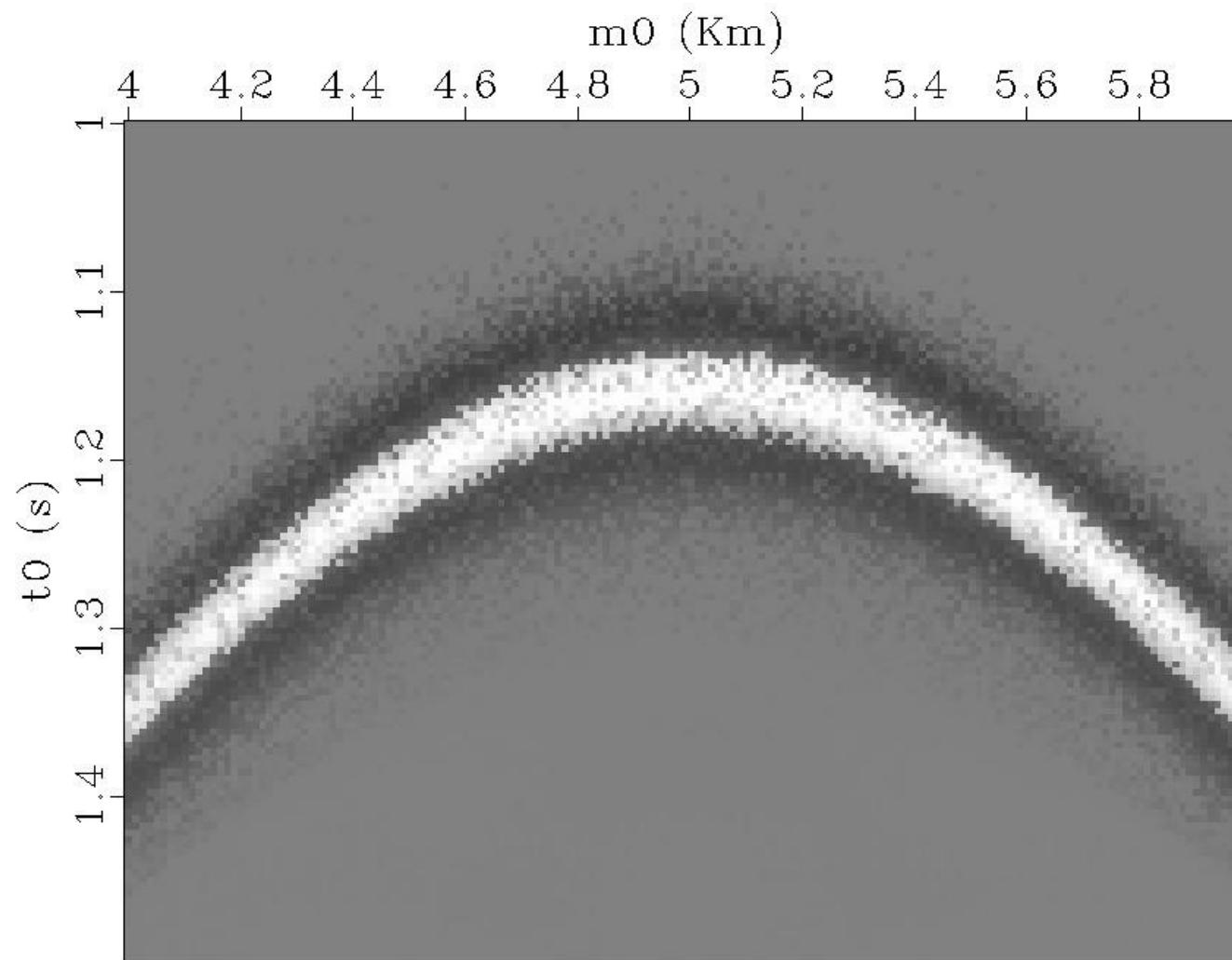


Seção empilhada ERC



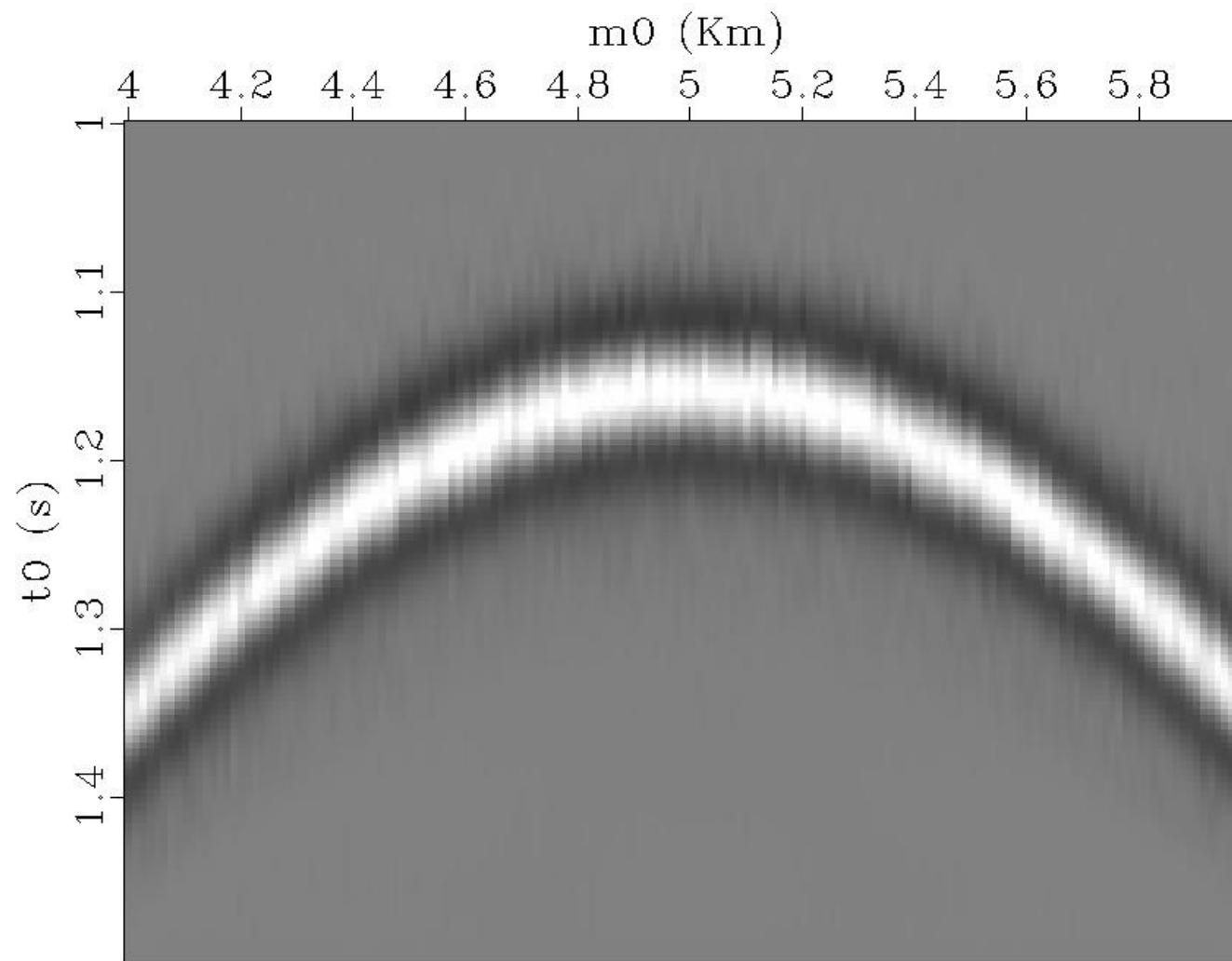
Filtered Stacked Section

Seção empilhada ERC



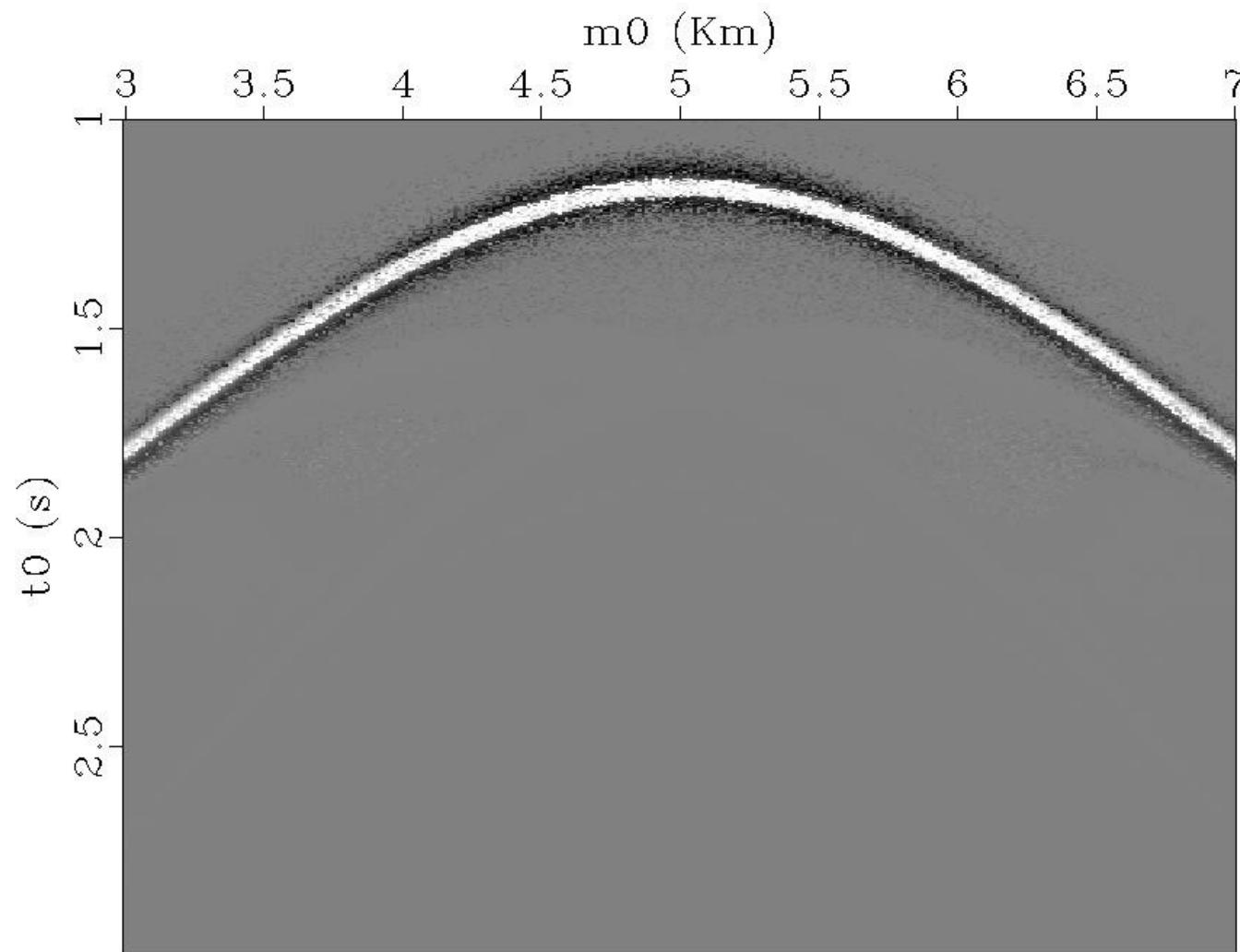
Stacked Section Non Hyperbolic CRS

Seção empilhada ERC



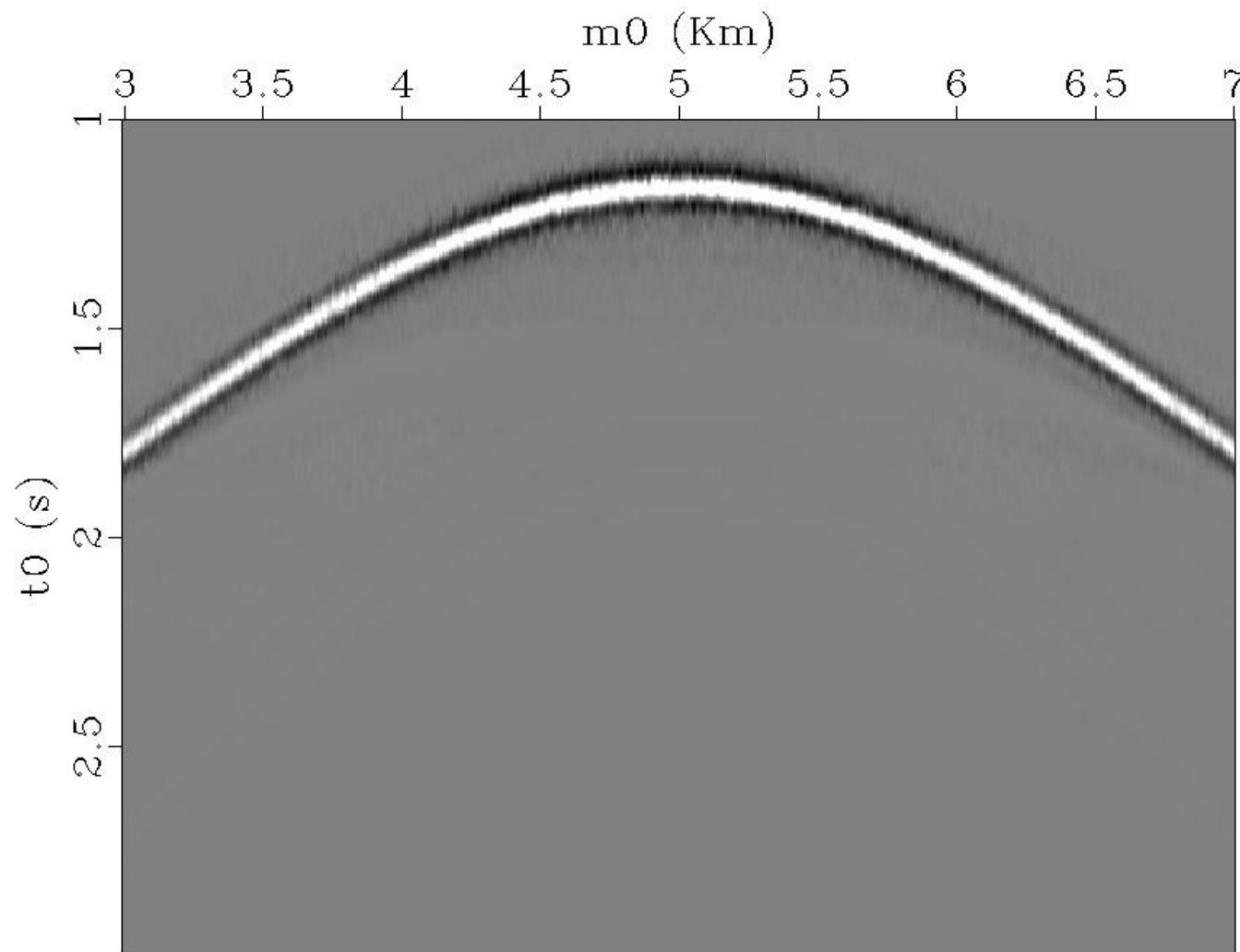
Filtered Stacked Section Non hyperbolic CRS

Seção empilhada ERC



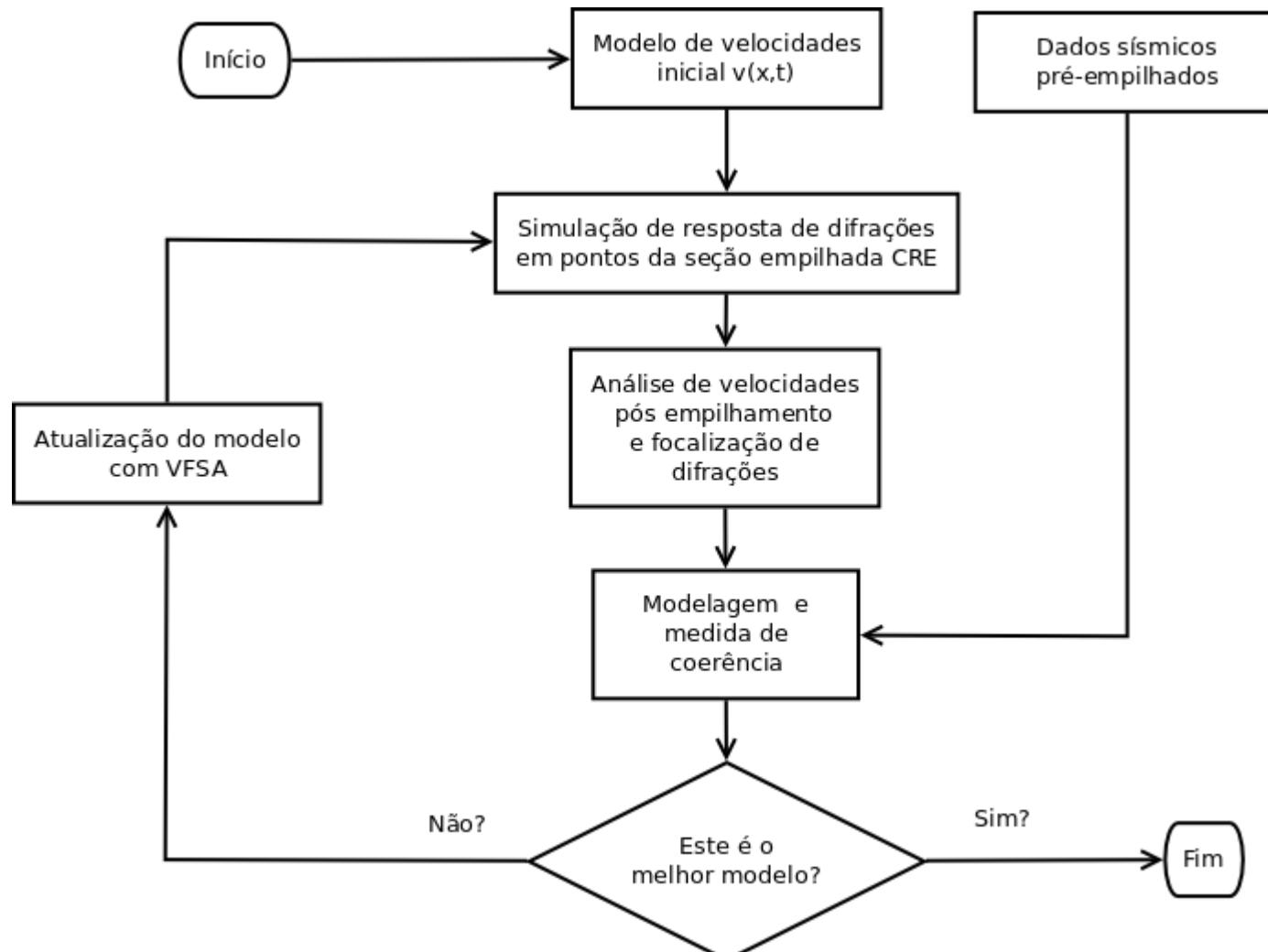
Brute Stacked Section

Seção empilhada ERC

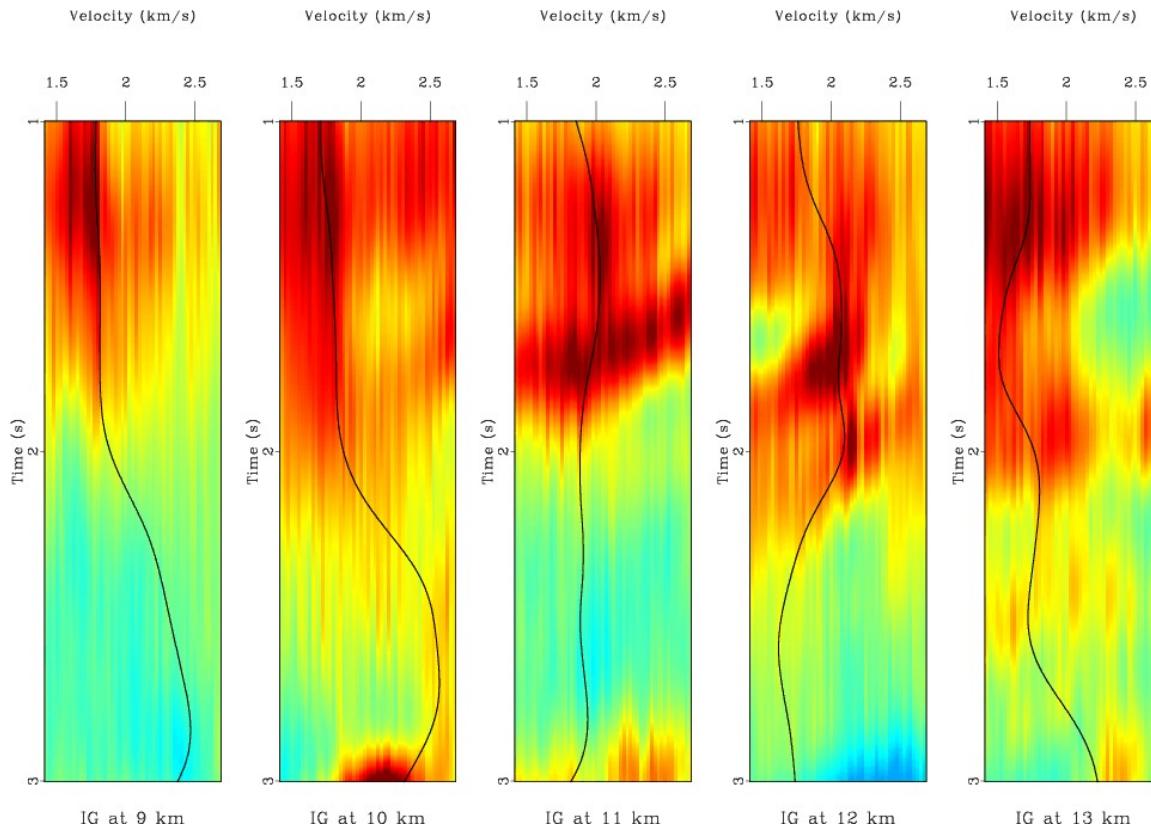


Filtered Stacked Section

Estratégia de inversão do modelo de velocidades



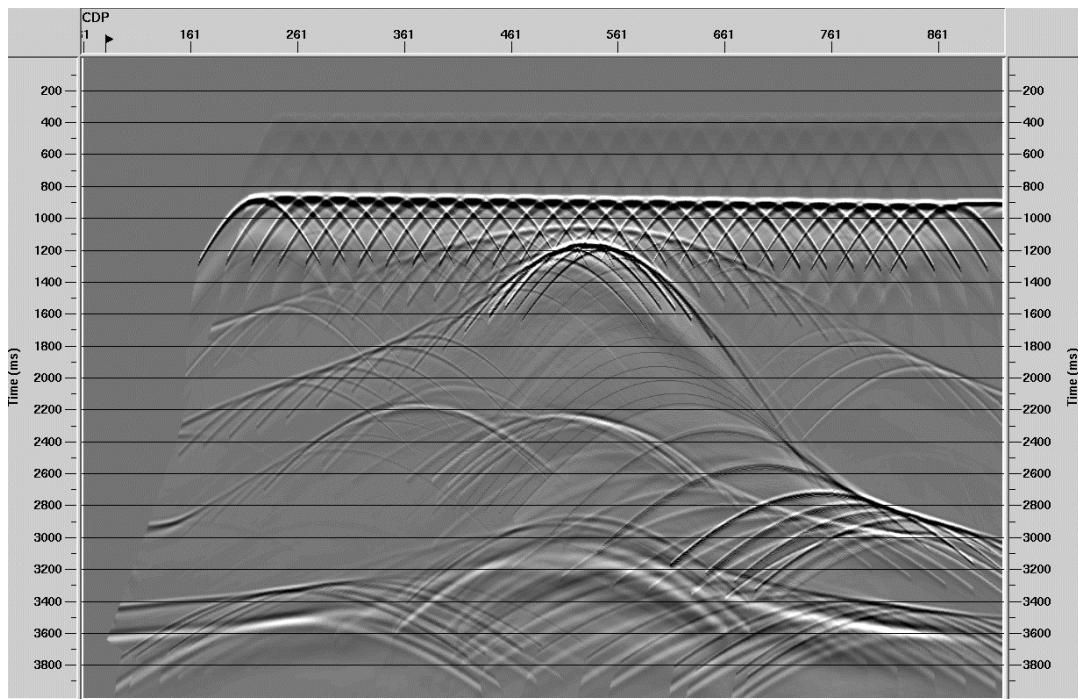
Variação máxima local



$$\phi_i = \frac{N \sum_{i=1}^N s_i^4}{\left(\sum_{i=1}^N s_i^2 \right)}$$

Fonte: (FOMEL; LANDA; TANER, 2007).

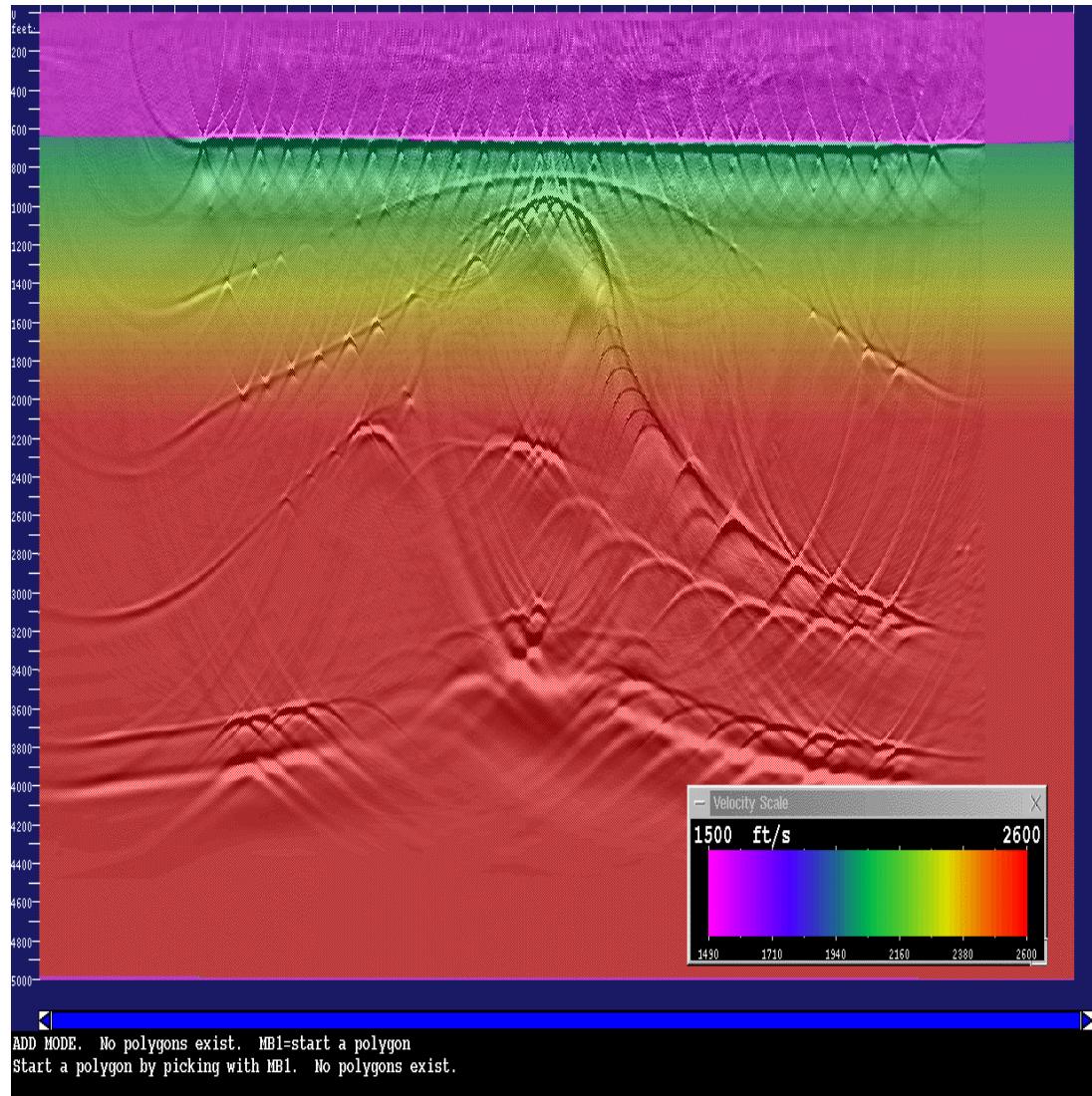
Resposta de difração simulada



$$T_D^2 = t_0^2 + \frac{x^2}{v_{RMS}^2}$$

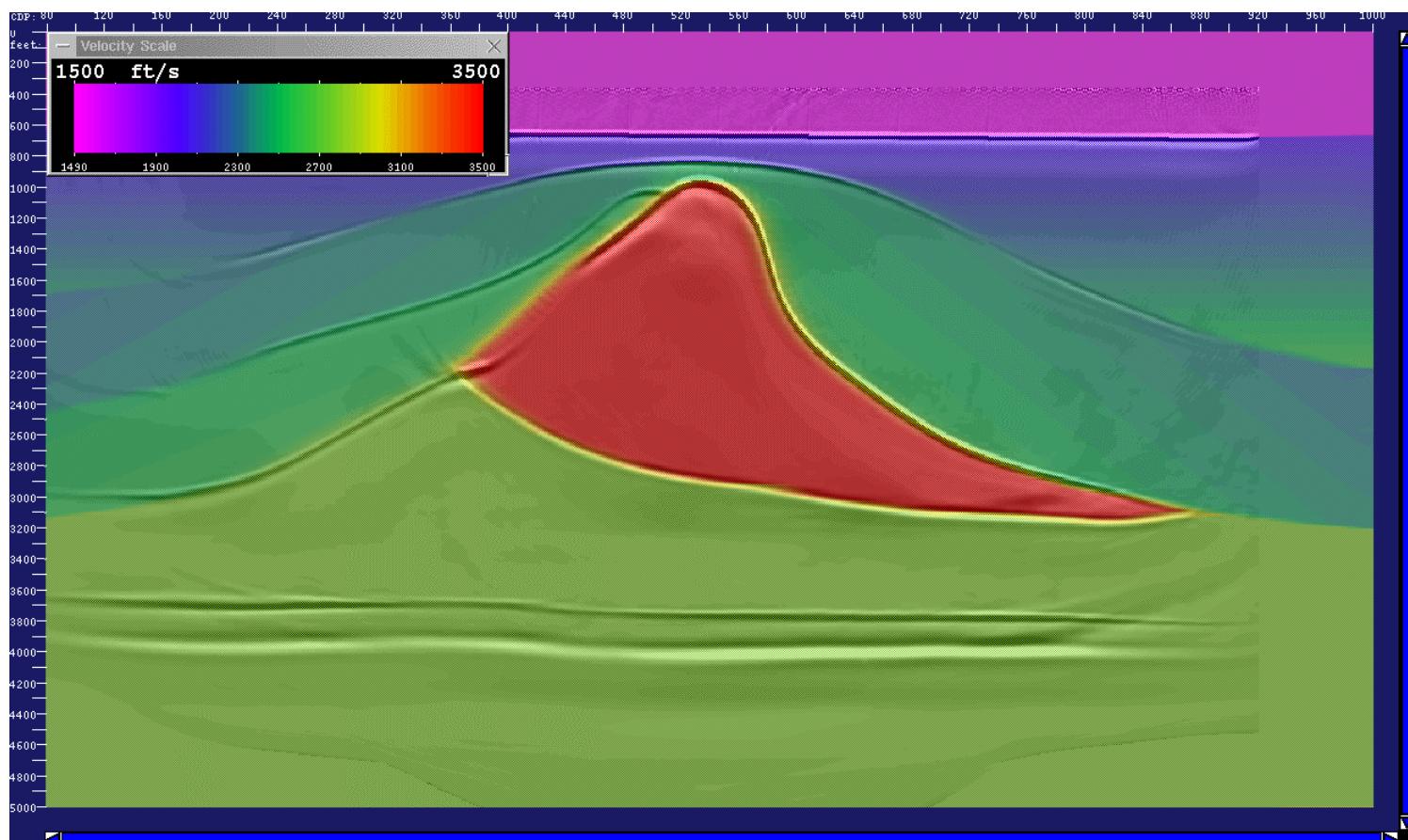
Fonte: (SOLLNER; YANG, 2002).

Resposta de difração simulada



Fonte: (SOLLNER; YANG, 2002).

Resposta de difração simulada



Fonte: (SOLLNER; YANG, 2002).

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