

# Seismic Attenuation for Reservoir Characterization

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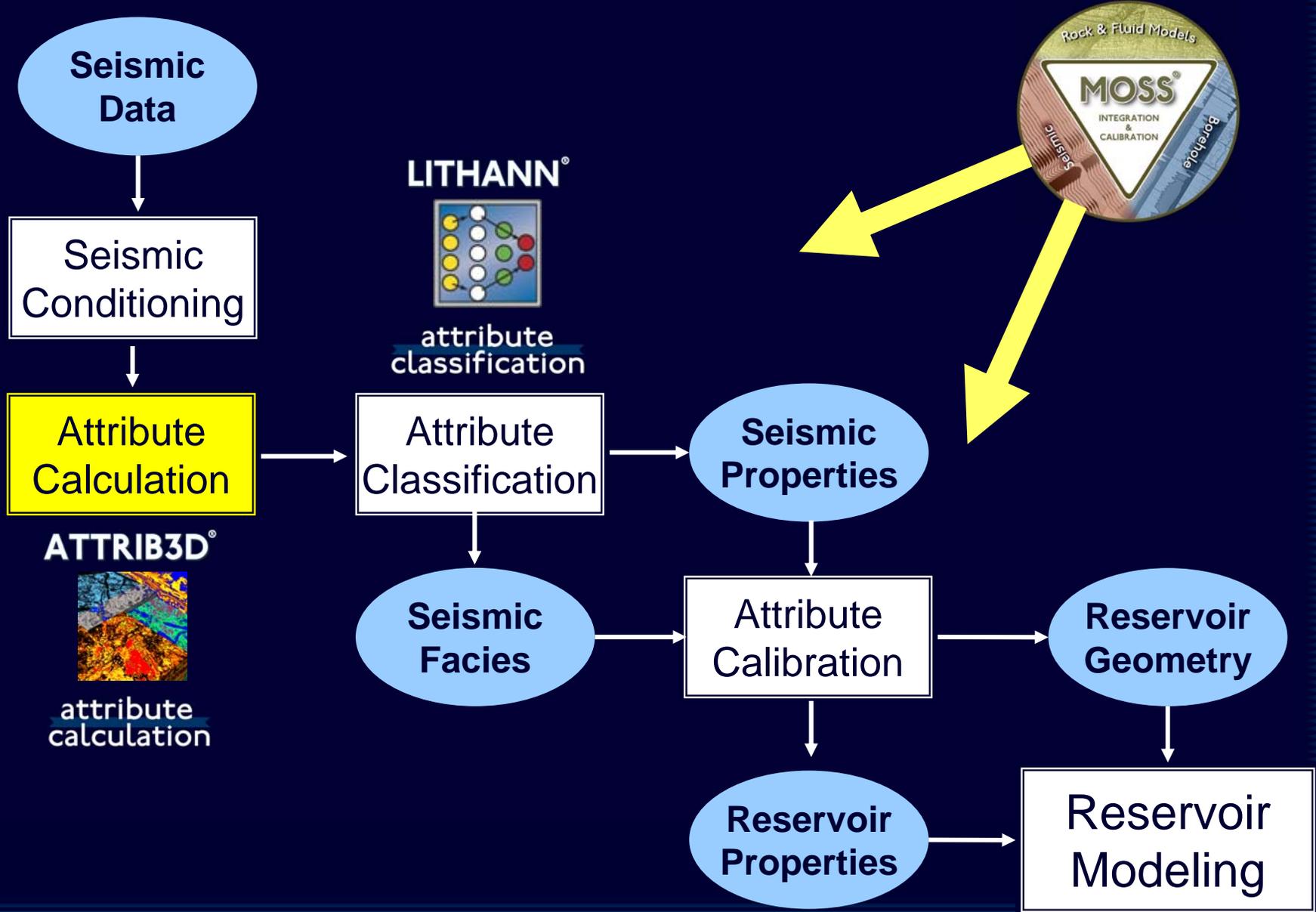
**Presented To:**



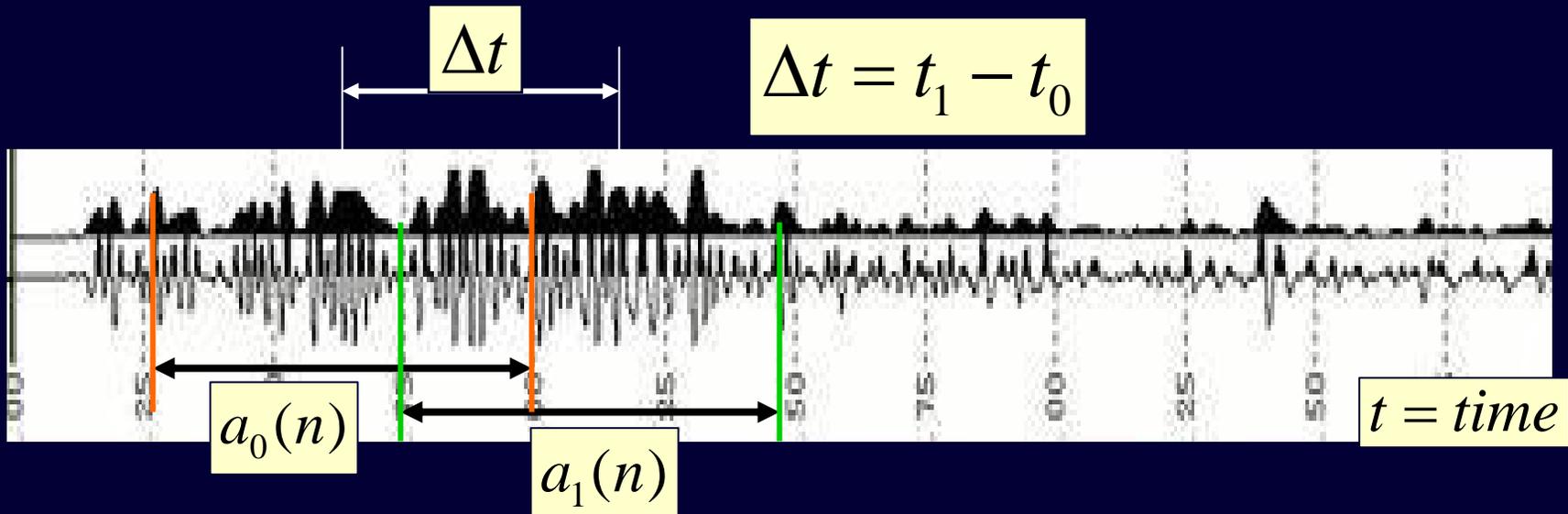
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**Tulsa, Oklahoma**

# Generic Workflow (MARC)



# Computation of minimum phase inverse operator over 2 windows



$$a_1(n) = b_1^{-1}(n)$$

$$a_0(n) = b_0^{-1}(n)$$

# Fundamentals

$$B(f) = |B(f)|e^{-i\phi(f)}$$

## Kramers-Kronig Conditions

$$\text{Ln}|B(f)| \quad \text{and} \quad \phi(f)$$

Are Hilbert Transform Pairs for a wavelet  
which is causal and minimum-phase

# Absorption Equations

$$|B_1(f)| = |B_0(f)| \exp(-\pi f (t_1 - t_0) / Q)$$

$$\ln \left| \frac{B_1(f)}{B_0(f)} \right| = -\pi f (t_1 - t_0) / Q$$

# Data Based Q-decon

$$a_0(n) * q(n) = a_1(n)$$

$$q(n) = a_1(n) * b_0(n) \quad Q\text{-filter}$$

$$q^{-1}(n) = b_1(n) * a_0(n) \quad Q\text{-decon filter}$$

$\Rightarrow a_0, a_1, b_0, b_1, q, q^{-1}$  are ALL minimum phase!

$\Rightarrow a_1$  and  $a_0$  are separated by  $\Delta t = t_1 - t_0$

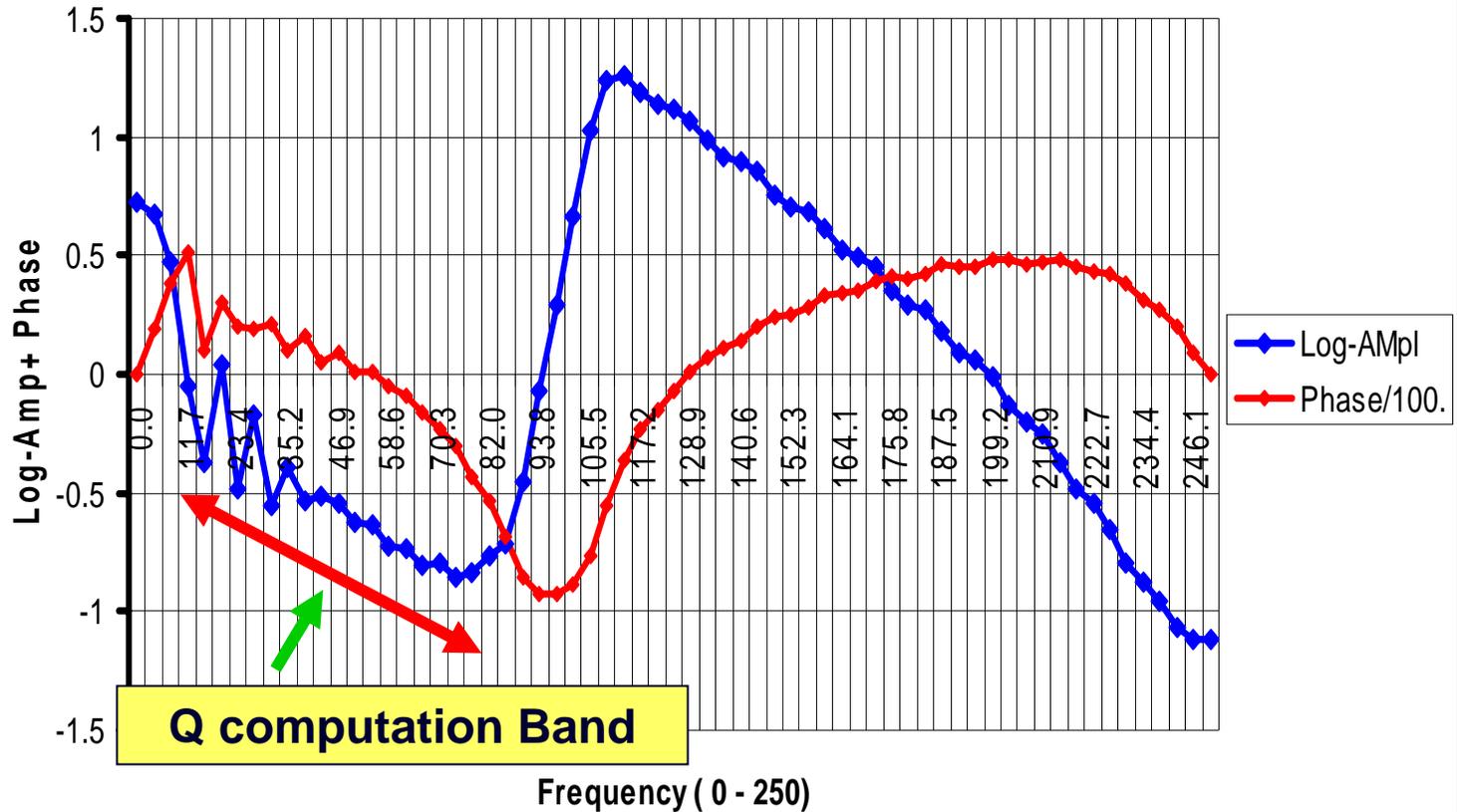
# Data based Q-decon

$$q^{-1}(f) = \left| \frac{A_0(f)}{A_1(f)} \right| \exp[i\phi(f)]$$

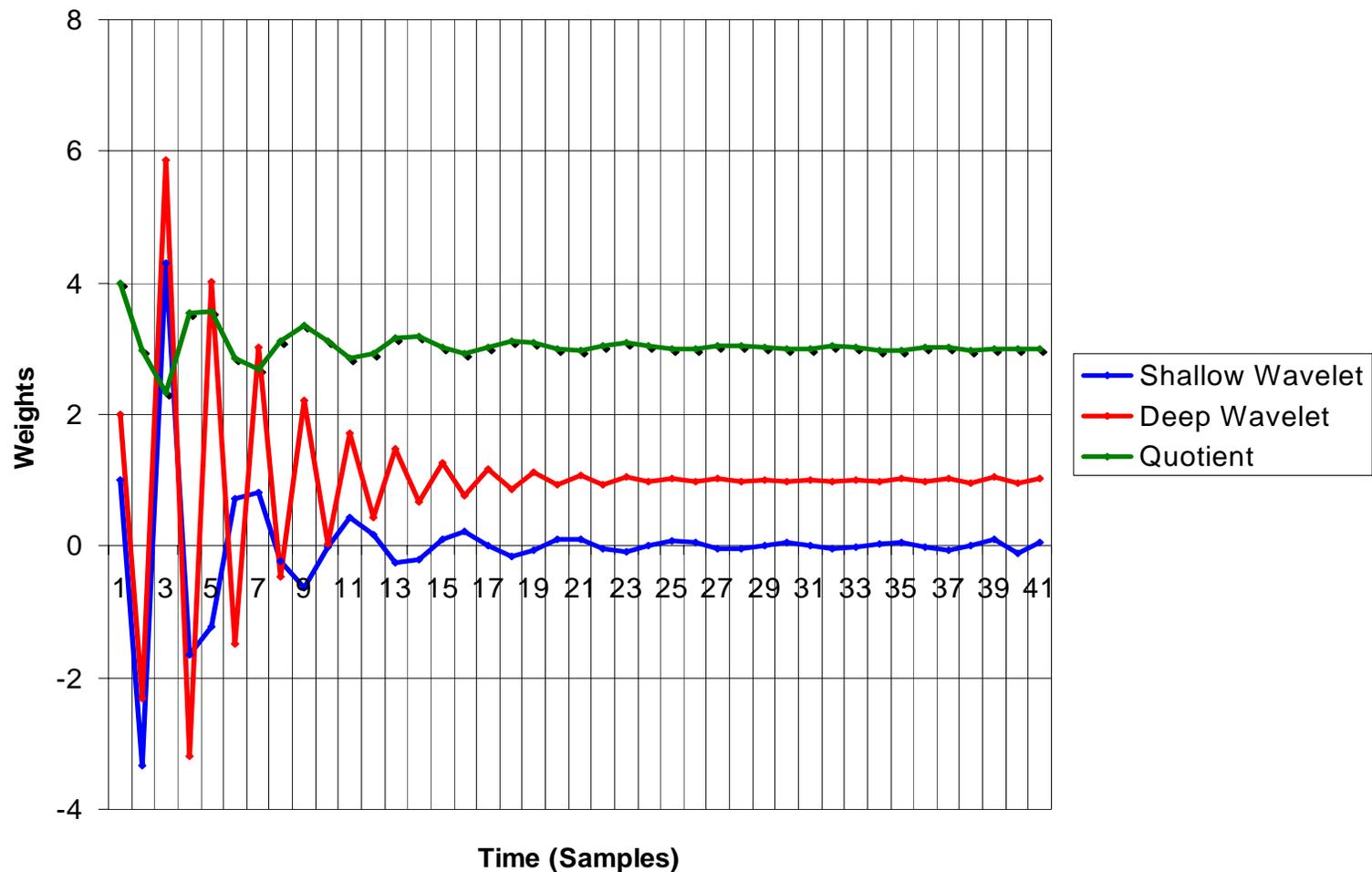
$\therefore \ln \left| \frac{A_0(f)}{A_1(f)} \right|$  and  $\phi(f)$  are Hilbert transform pairs

$\Rightarrow \Delta t$  can be as small as the sampling increment

### Model 1 Layer 1 Quotient Wavelet Spectrum

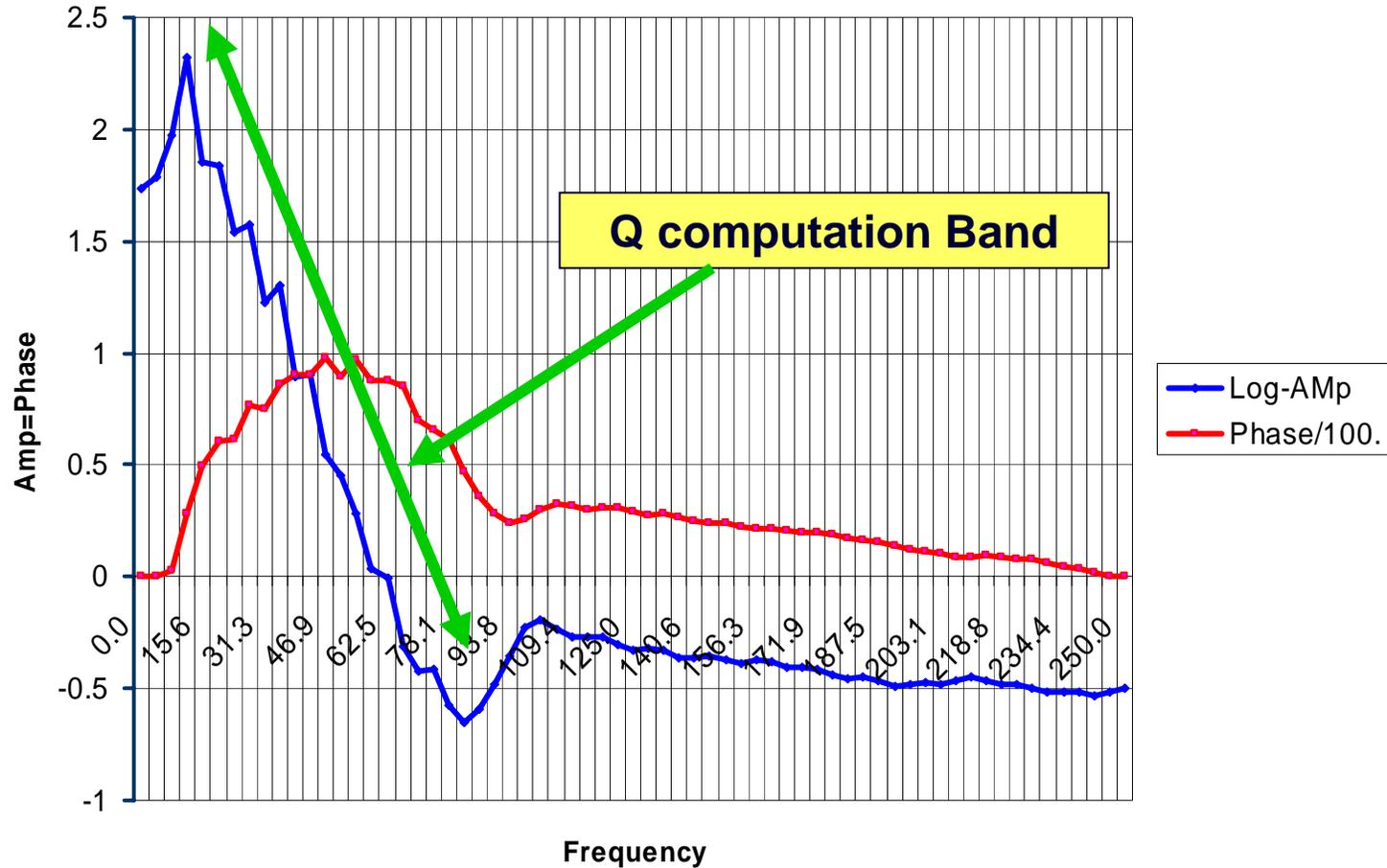


### Amplitude and Phase Spectrum of the Quotient Wavelet

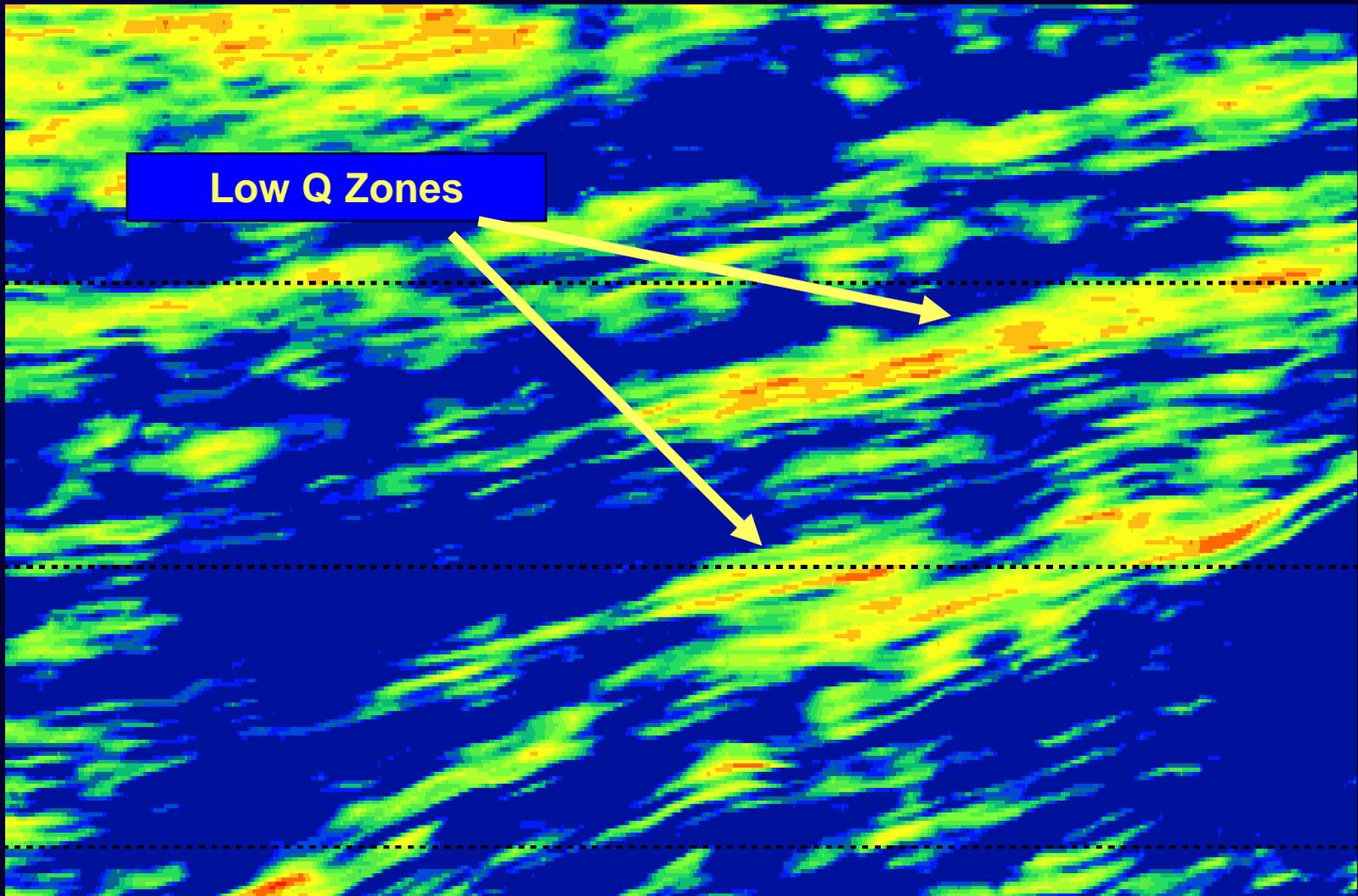


**Minimum Phase Inverse Wavelets at top and base of a bed with Low Q and Quotient Wavelet**

## Spectra of Model 2 Layer 2 Quotient



**Amplitude and Phase Spectrum of the Quotient Wavelet  
for a LOW Q zone**



**Q Computation ( Warm colors LOW Q) Computed @ 2 samples**