Why is there a phase difference of -90° between the seismic data and impedance data obtained after inversion?

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sections from the seismic amplitude and inverted impedance data volumes. Notice how the seismic horizon (trough) is -90° off on the impedance section compared with the seismic section.

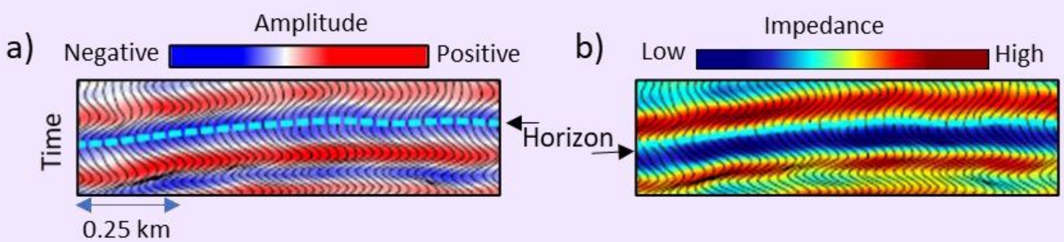

Figure 2: Comparison of segments of sections from (a) seismic, and (b) impedance data. Notice the phase difference of 90° between the two sections.

Mathematically, the reflection coefficients are defined as the rate of change of impedance contrast. For normal incidence, the reflection coefficient R at the j^{th} interface is given as

$$R_j = \frac{Z_{j+1} - Z_j}{Z_{j+1} + Z_j}$$

where Z_{j+1}, and Z_j are the acoustic impedance in the $(j+1)^{th}$ layer and j^{th} layer respectively. If the vertical changes in impedance are reasonably smooth, we can approximate

$$R_j \approx \frac{\Delta Z_j}{2Z_j} = \frac{1}{2} \frac{\partial}{\partial t}[lnZ].$$

The differential operator is associated with a phase change of -90°.

Thus, the observed phase difference (-90°) can be explained both graphically and mathematically.

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