Webcast Errata
CSEG Lunchbox Geophysics
Sep 30, 2008

“Exploring” AVO
Chuck Ursenbach

The following are corrected versions of slides 10, 16, 17 and 21 of the presentation. Corrections are underlined in green

Aki-Richards Approximation

Taylor expansion about $R_\alpha = R_\beta = R_\rho = 0$

Truncate at linear order

$$R_{\mathrm{PP}}^{\mathrm{A\text{-}R}}(\theta) = c_\alpha R_\alpha + c_\beta R_\beta + c_\rho R_\rho, \qquad c_i = c_i(\gamma, \theta), \qquad \theta = \frac{\theta_1 + \theta_2}{2}$$

$$R_{\mathrm{PP}}^{\mathrm{A\text{-}R}}(\theta) = \frac{R_\alpha}{\cos^2\theta} - \underline{\underline{8}}\gamma^2 \sin^2\theta \, R_\beta + \underline{\underline{(1 - 4\gamma^2 \sin^2\theta)}} R_\rho$$

$$R_{\mathrm{PP}}^{\mathrm{Fatti}}(\theta) = c_I R_I + c_J R_J + c_\rho R_\rho$$

$$R_{\mathrm{PP}}^{\mathrm{Gray}}(\theta) = c_\lambda R_\lambda + c_\mu R_\mu + c_\rho R_\rho$$

$$R_{\mathrm{PP}}^{\mathrm{Goodway}}(\theta) = c_\alpha R_\alpha + c_\mu R_\mu + c_\rho R_\rho$$

$$R_{\mathrm{PP}}^{\mathrm{Shuey}}(\theta) = A + B \sin^2\theta + C \sin^2\theta \tan^2\theta$$

Modeling versus Inversion

- Modeling formula

$$R_{PP}^{\text{Fatti}}(\theta) = \frac{R_I}{\cos^2\theta} - 8\gamma^2 \sin^2\theta \; R_J$$

- Inversion formula

$$R_{PP}(\theta) = \frac{R_I^{\text{Fatti}}}{\cos^2\theta} - 8\gamma^2 \sin^2\theta \; R_J^{\text{Fatti}}$$

Two-point inversion

- Two points: $\theta = 0$ and $\theta = \theta_{\max}$
- Assume Aki-Richards is exact

e.g. $$R_{PP}^{A-R}(0) = \frac{R_I^{Fatti}}{\cos^2 0} - 8\gamma^2 \sin^2 0 \, R_J^{Fatti}$$

- 2 equations in 2 variables

$$R_\alpha + R_\rho = R_I^{Fatti}$$

$$\frac{R_\alpha}{\cos^2\theta_{\max}} - 4\gamma^2 \sin^2\theta_{\max} \, (2R_\beta + R_\rho) + R_\rho = \frac{R_I^{Fatti}}{\cos^2\theta_{\max}} - 8\gamma^2 \sin^2\theta_{\max} \, R_J^{Fatti}$$

Conversion formulas

- Error expressions → transformations
- E.g.

$$R_I^{\text{Fatti}} = \frac{5}{4} R_\alpha^{\text{S-G}}$$

$$R_J^{\text{Fatti}} = R_\beta^{\text{S-G}} + \frac{1}{8}\left(1 \underset{=}{+} \frac{1}{4\gamma^2 \cos^2 \theta_{\max}}\right) R_\alpha^{\text{S-G}}$$

- Reason: All two-point inversions are linear combinations of $R_{PP}(0)$ and $R_{PP}(\theta_{max})$