PP spherical-wave reflection coefficients for viscoelastic media

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Reflection coefficients

Use of the coefficients in:

forward modelling (reflectivity, ray theory, etc.)

inverse modelling (AVO, AVA, etc.)

Type of the coefficients:

plane-wave reflection coefficients

spherical-wave reflection coefficients

Reflection coefficients

PP plane-wave reflection coefficients:

frequency independent

singularity at the critical point (infinite derivative)

maximum at the critical point (CP)

non-oscillating in sub- and over-critical region

problems with application in viscoelastic media

Reflection coefficients

PP spherical-wave reflection coefficients:

frequency dependent

no singularity, smooth at the critical point

shift of the maximum behind the critical point

oscillations behind the maximum

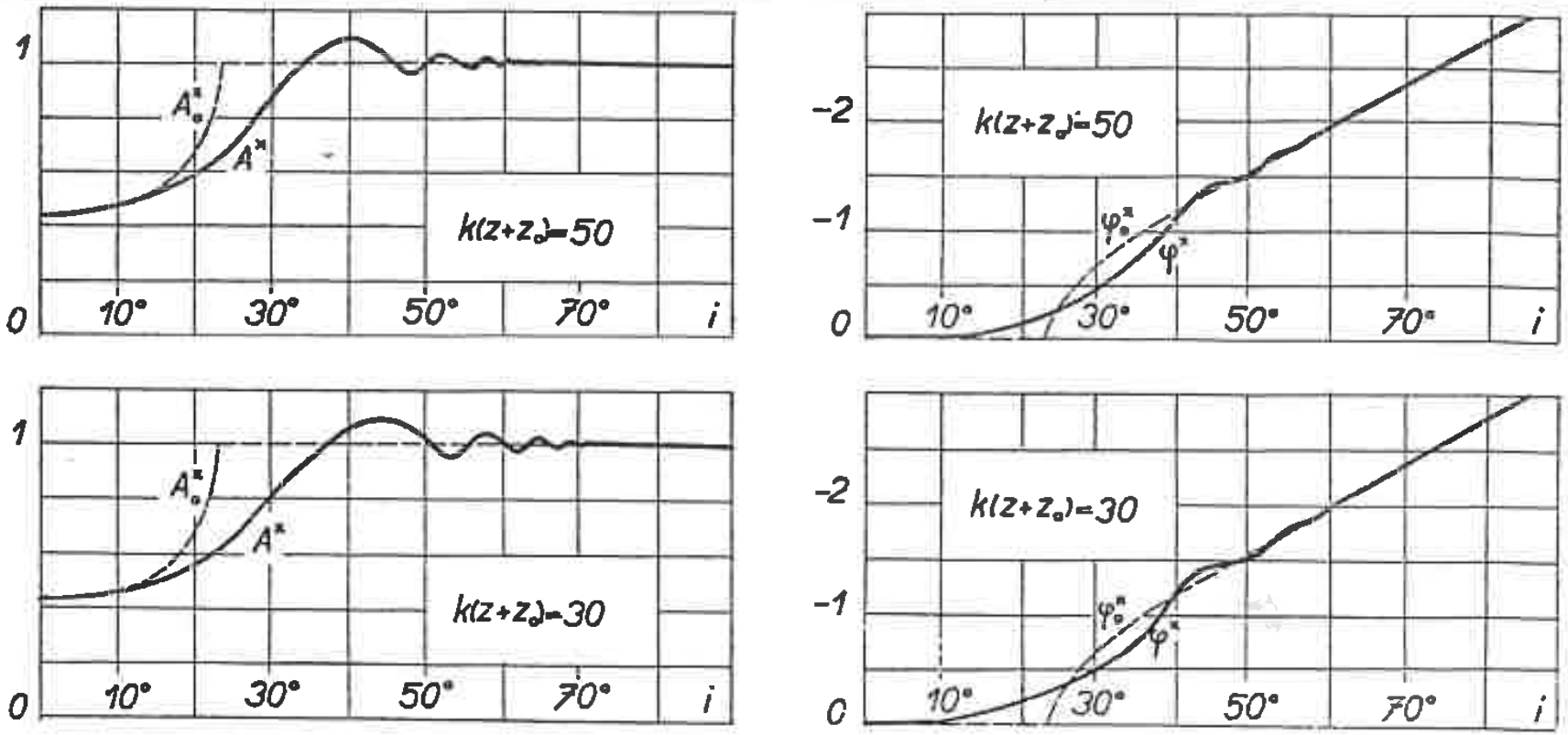
rare application in viscoelastic media

$\Rightarrow$ **motivation to study the problem**

Numerical examples

PP reflection due to a point source - HF asymptotic method

(Červený and Hron, 1961. SGEG, 5, 122-132)

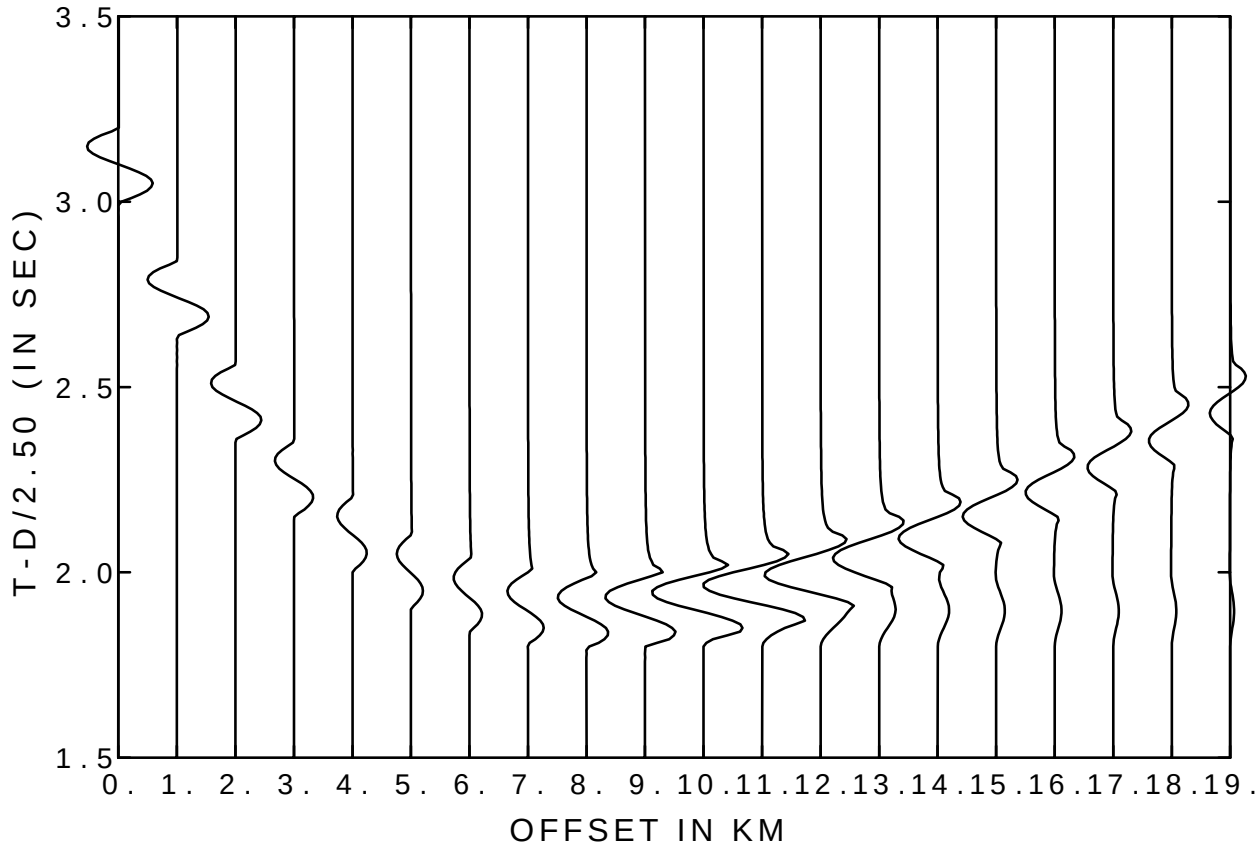


Numerical examples

point-source PP reflection (CP - 8 km) - reflectivity (Wang, 1999)

α_1 =2.0 km/s, β_1 =1.156 km/s, ρ_1 =1.0 km/m^3, Q_1 =10000

α_2 =2.5 km/s, β_2 =1.445 km/s, ρ_2 =1.1 km/m^3, Q_2 =10000



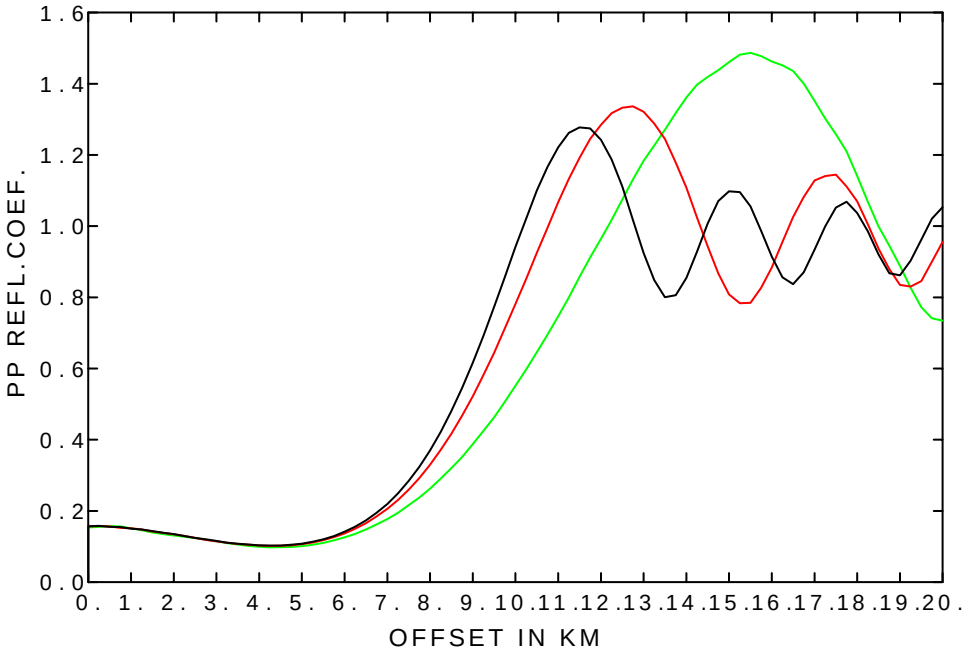
Numerical examples

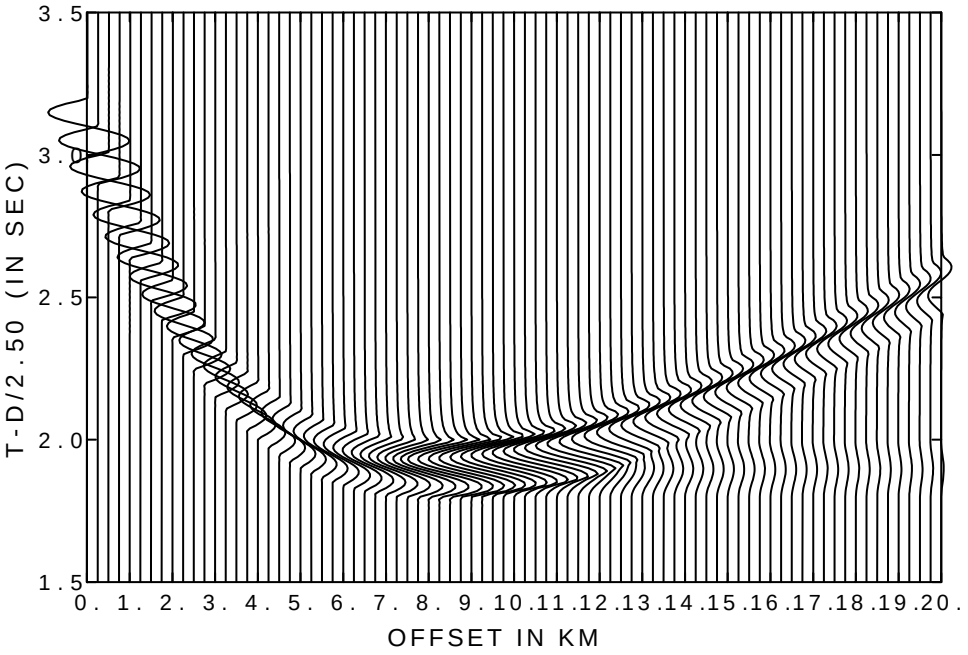
point-source PP seismograms and amplitudes (CP - 8 km) - reflectivity

α_1 =2.0 km/s, β_1 =1.156 km/s, ρ_1 =1.0 km/m^3, Q_1 =10000

α_2 =2.5 km/s, β_2 =1.445 km/s, ρ_2 =1.1 km/m^3, Q_2 =10000

f =**10 Hz**, f =**20 Hz**, f =30 Hz





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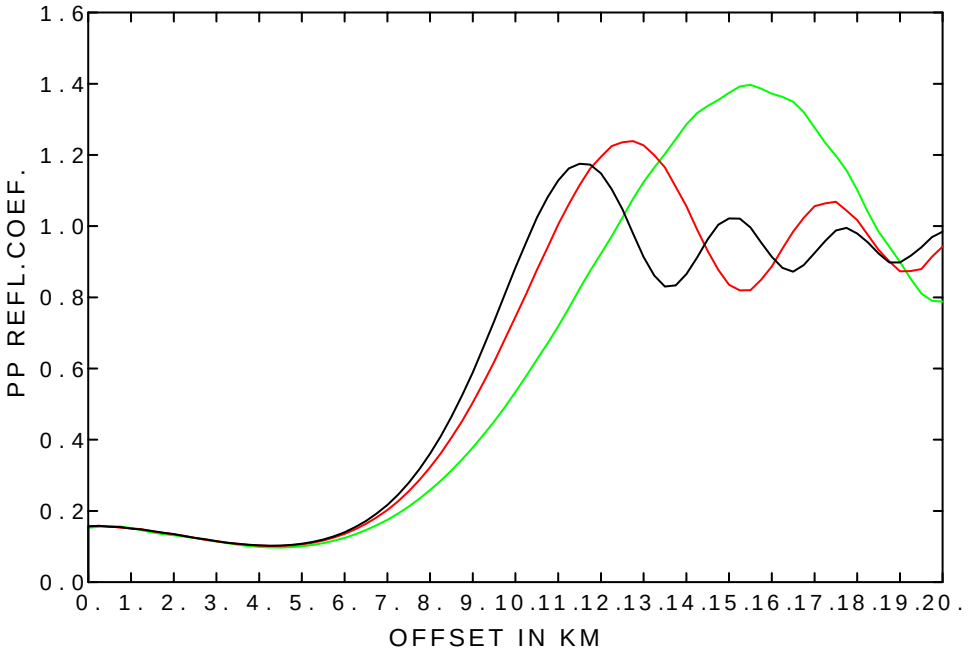
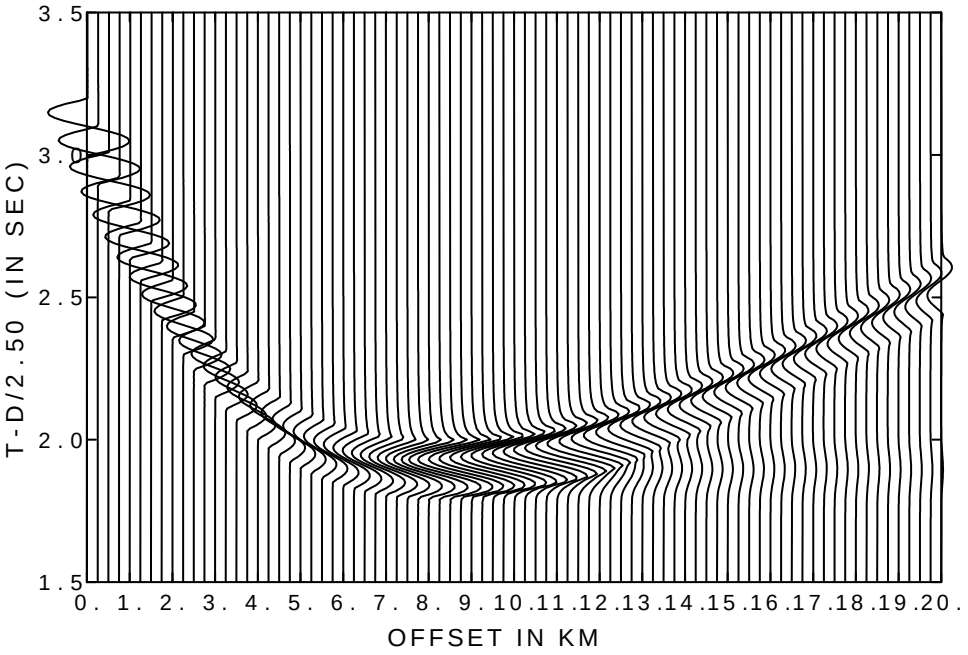
f =**10 Hz**, f =**20 Hz**, f =30 Hz





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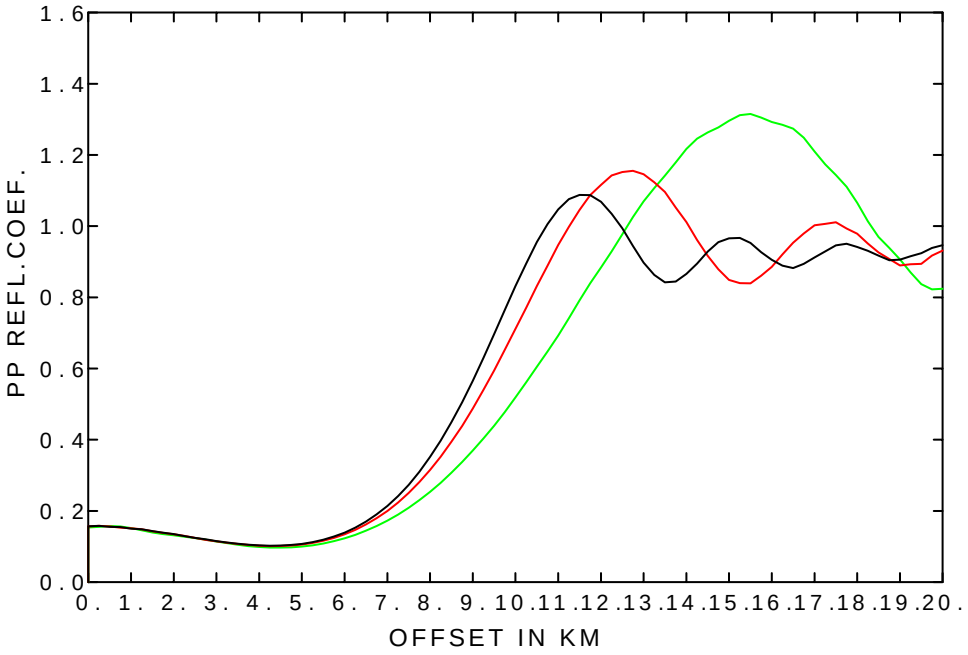
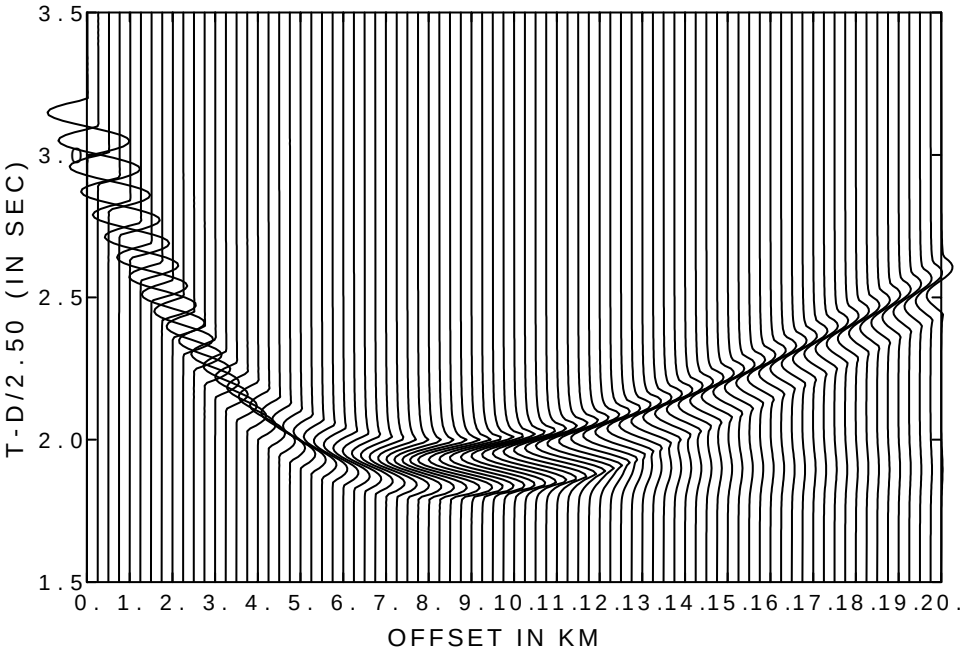
α_2 =2.5 km/s, β_2 =1.445 km/s, ρ_2 =1.1 km/m^3, Q_2 =50

f =**10 Hz**, f =**20 Hz**, f =30 Hz





Numerical examples

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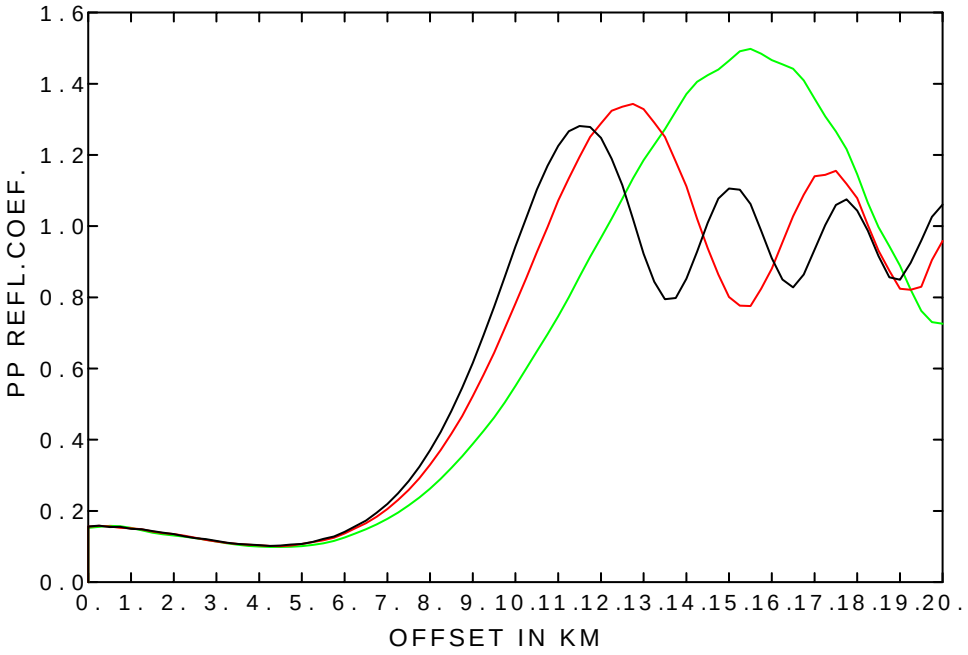

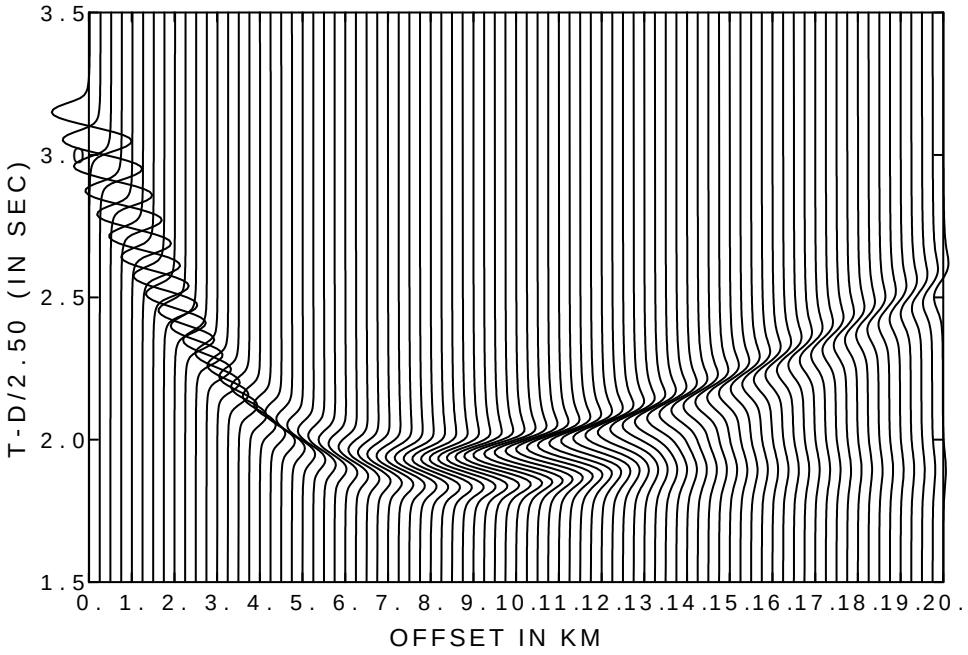

Numerical examples

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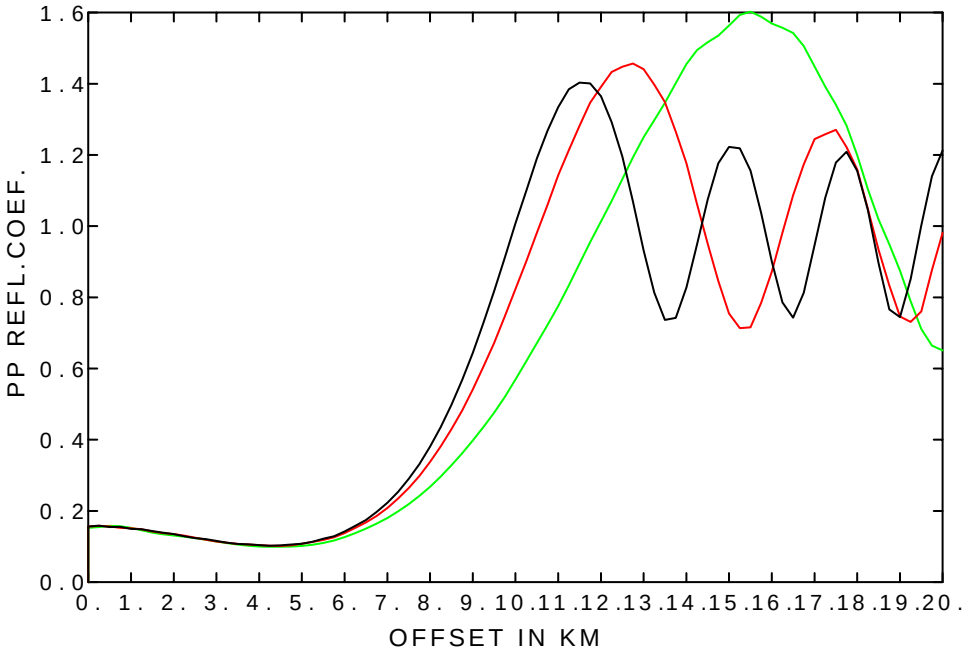
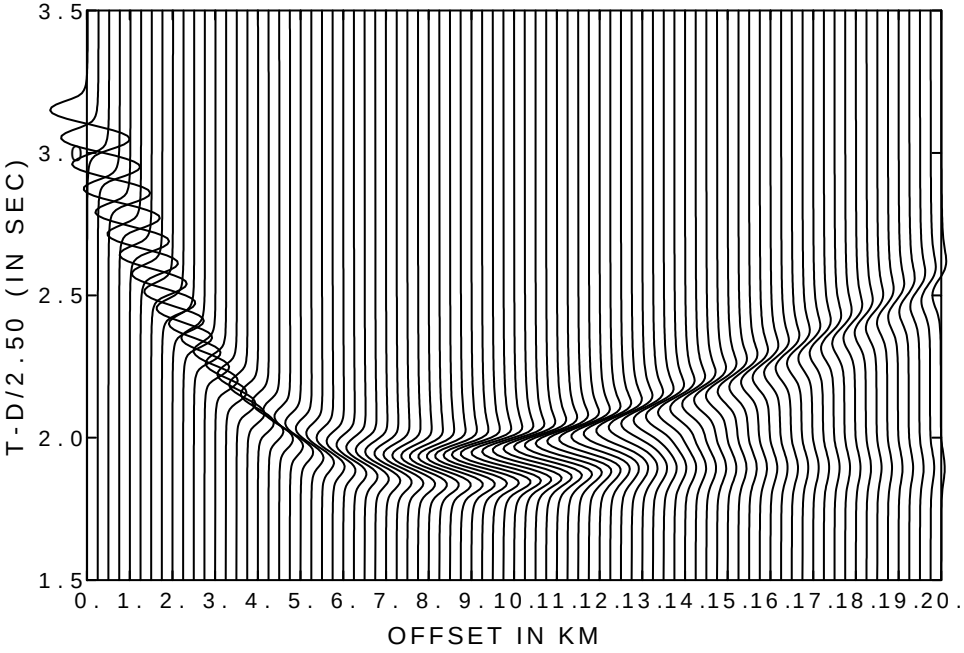




Conclusions

- plane-wave PP coefficients in viscoelastic media difficult to use

- spherical-wave PP coefficients in viscoelastic media without problems

- spherical-wave seismograms Fourier transformed

$\Rightarrow$ amplitudes and phases for chosen frequencies

- weak dependence of maximum amplitude position on Q

- dependence of maximum of amplitude on Q

Possible future steps

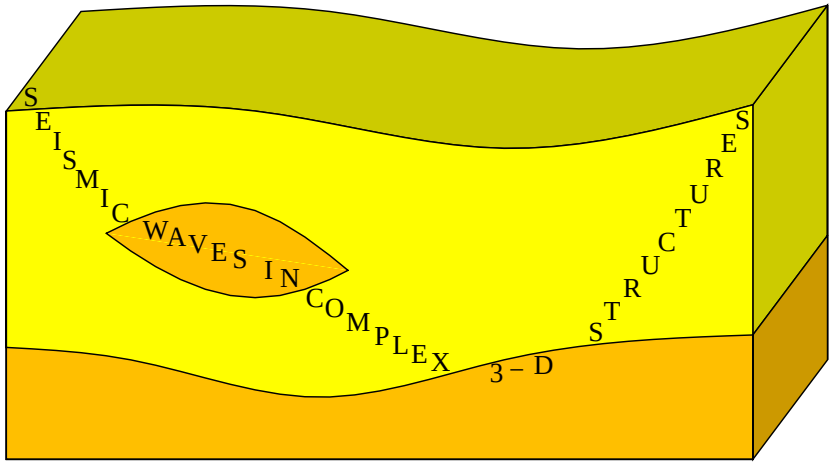
- more extensive numerical tests

- use of viscoelastic anisotropic media

- determination of r^* from the position of the maximum r^M
  and from the frequency (Červený, 1965)

- use of phases (Zhu & McMechan, 2012)

Acknowledgements



Rongjiang Wang for his reflectivity code (Wang, 1999)

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