# A new approach to obtain improved *P* and *S* receiver functions globally : determination of crustal structure below seismological stations in the prospect of global tomography

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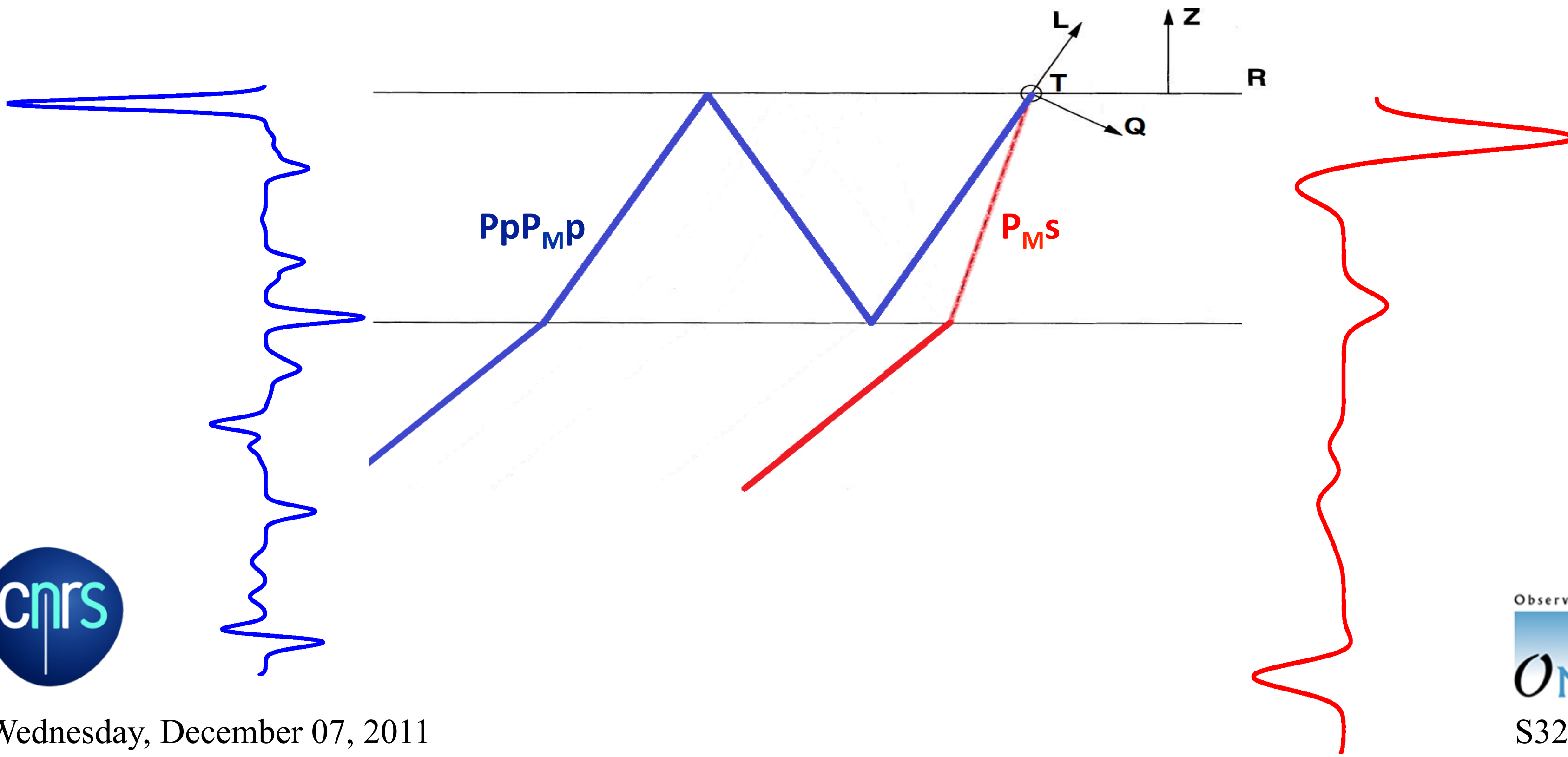


# OUTLINE

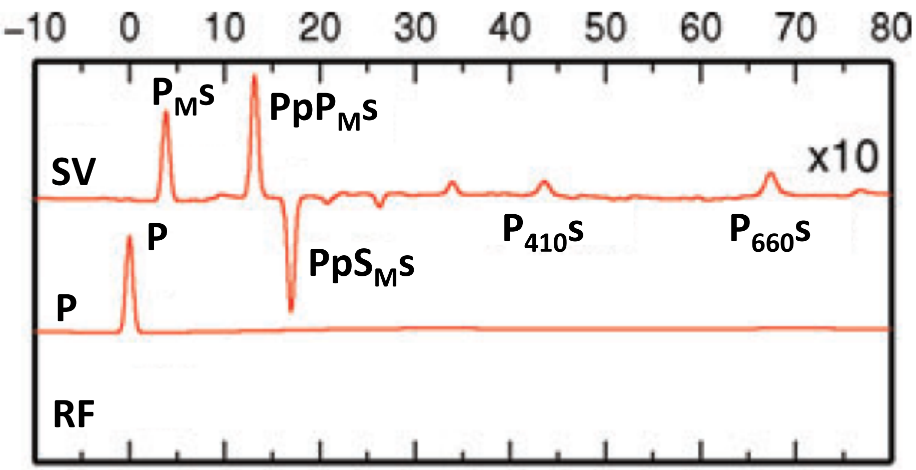
The receiver function approach

A new method for the receiver functions approach

Determination of the receiver structure

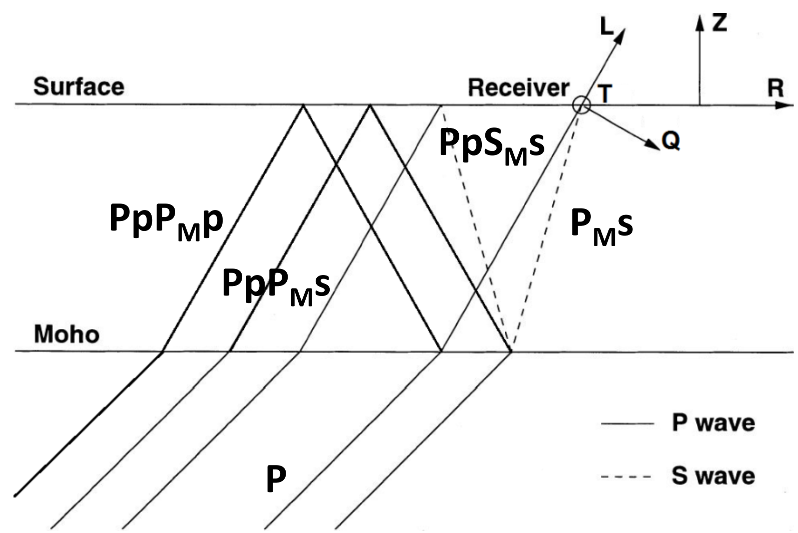
Comparison to other studies

# Receiver functions : a powerful tool to decipher the crustal and upper-mantle structures below seismological stations




Kumar *et al.*, 2010

- ✓ Detection of converted/reflected seismic phases
- ✓ Easy in radial (or *SV*) component receiver functions
- ✓ Cannot exploit the vertical (or *P*) component receiver functions



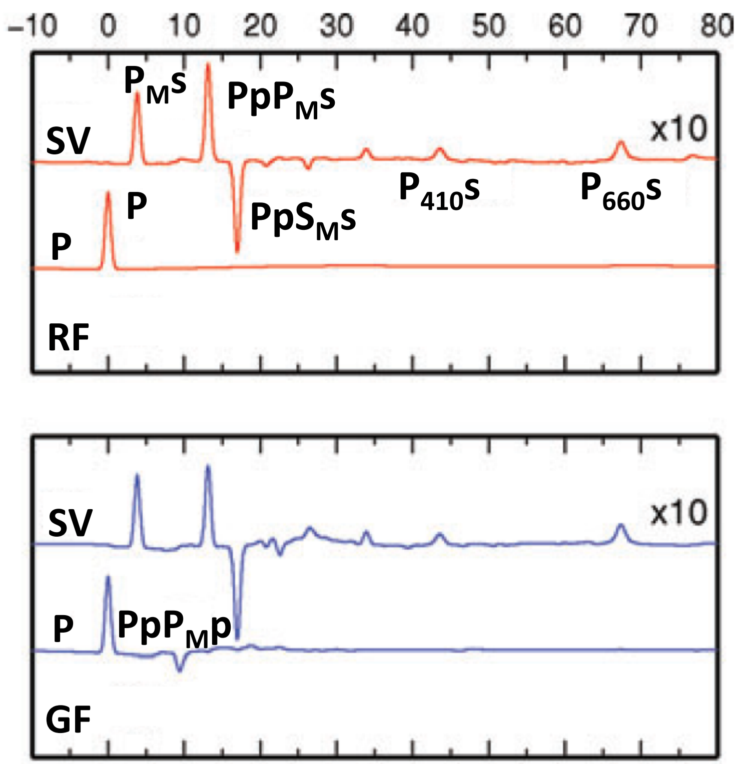

Chevrot & van der Hilst, 2000

- ✓ Interfaces depth
- ✓ Velocities ratios $V_P/V_S$

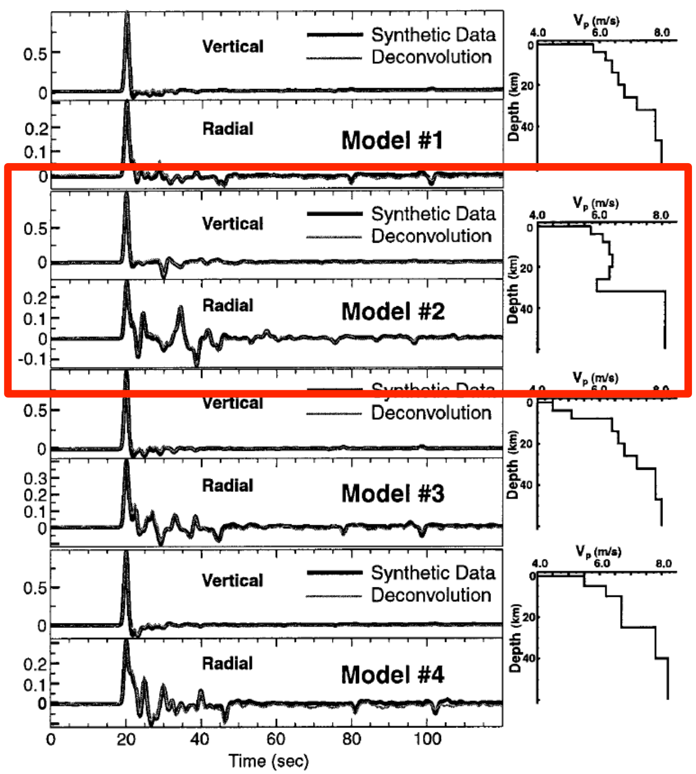
# Vertical component receiver functions : a historical issue

- ✓ Disappearance of any signal but the *P* in vertical component receiver functions after deconvolution
- ✓ Examples to overcome this problem :

Plain summation
(Kumar *et al.*, 2010)

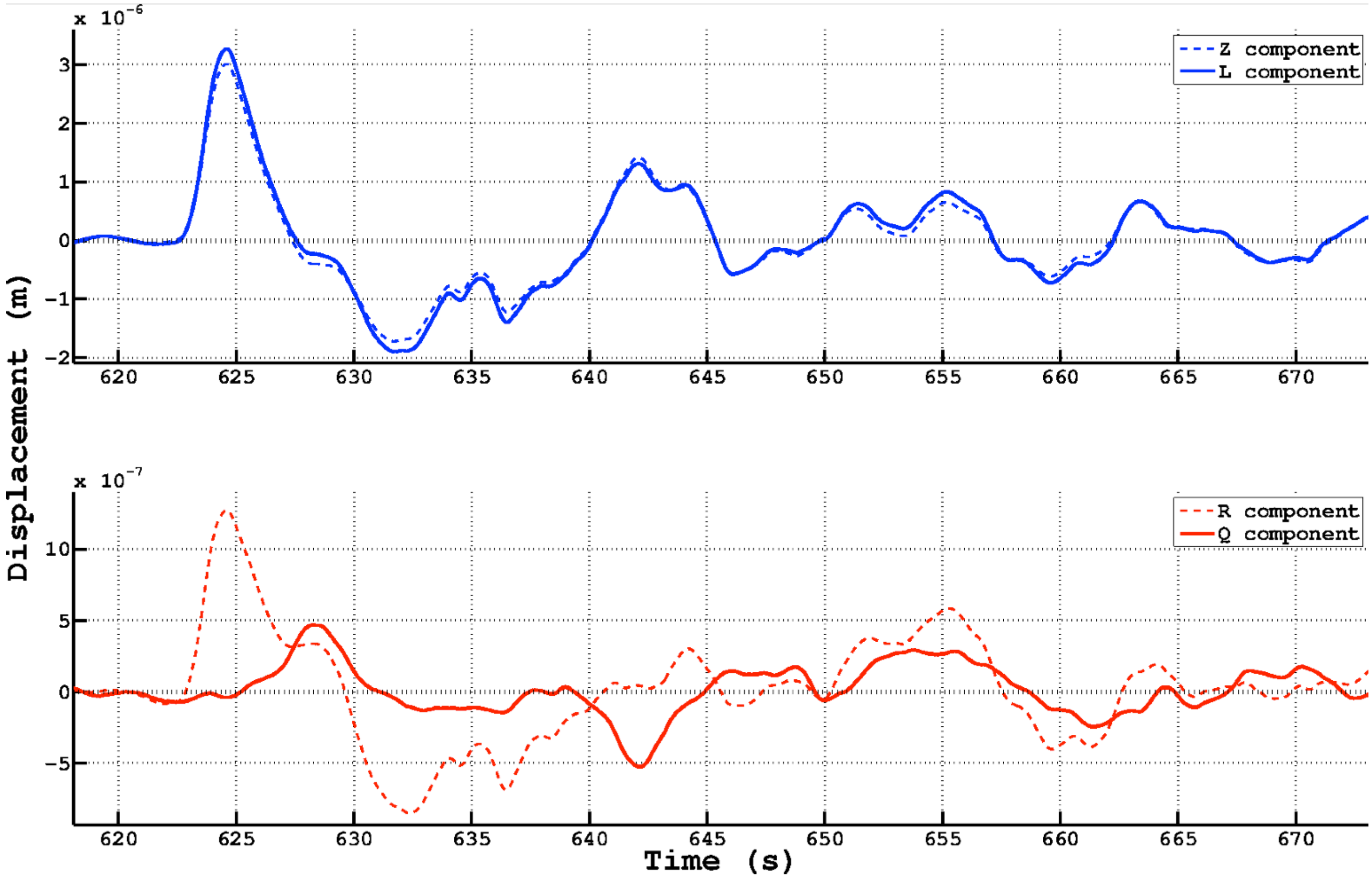



Array deconvolution
(Langston & Hammer, 2001)



# Construction of the receiver functions (1) : rotated seismograms

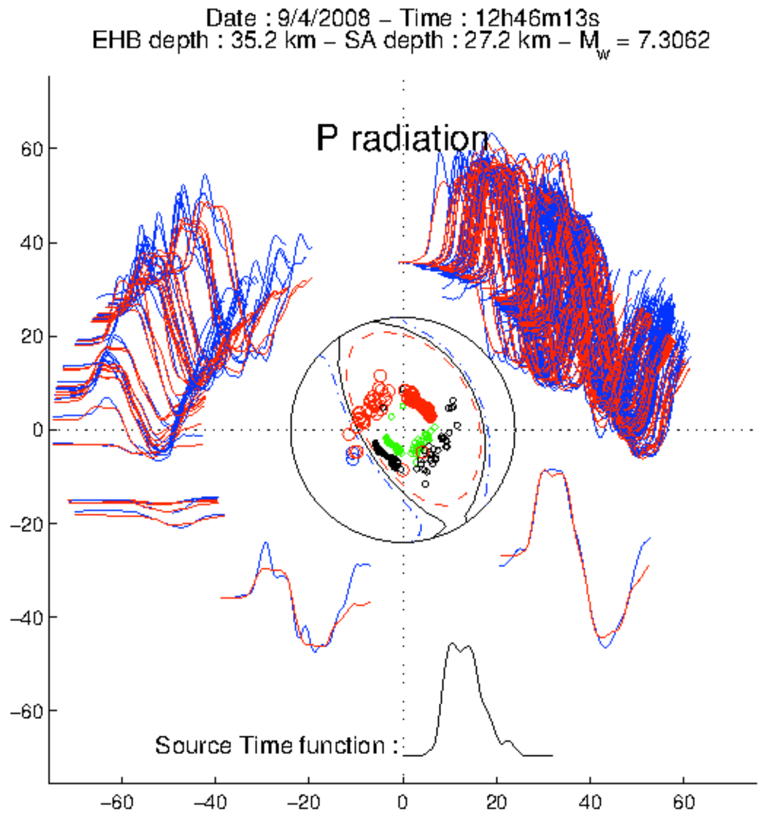
- ✓ Broadband seismograms from IRIS-FARM database in Z-R-T components
- ✓ Rotation to P-SV-SH components to eliminate *P*-wave contributions in SV (or Q) component and to maximize it in P (or L) component

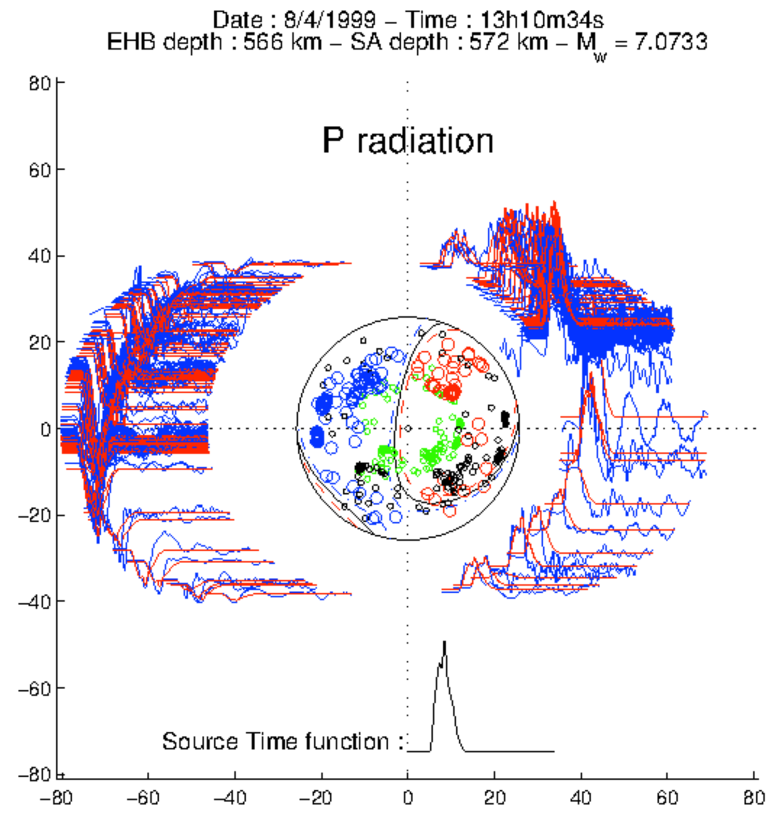



Schardong *et al.*, in prep.

# Construction of the receiver functions (2) : source time function

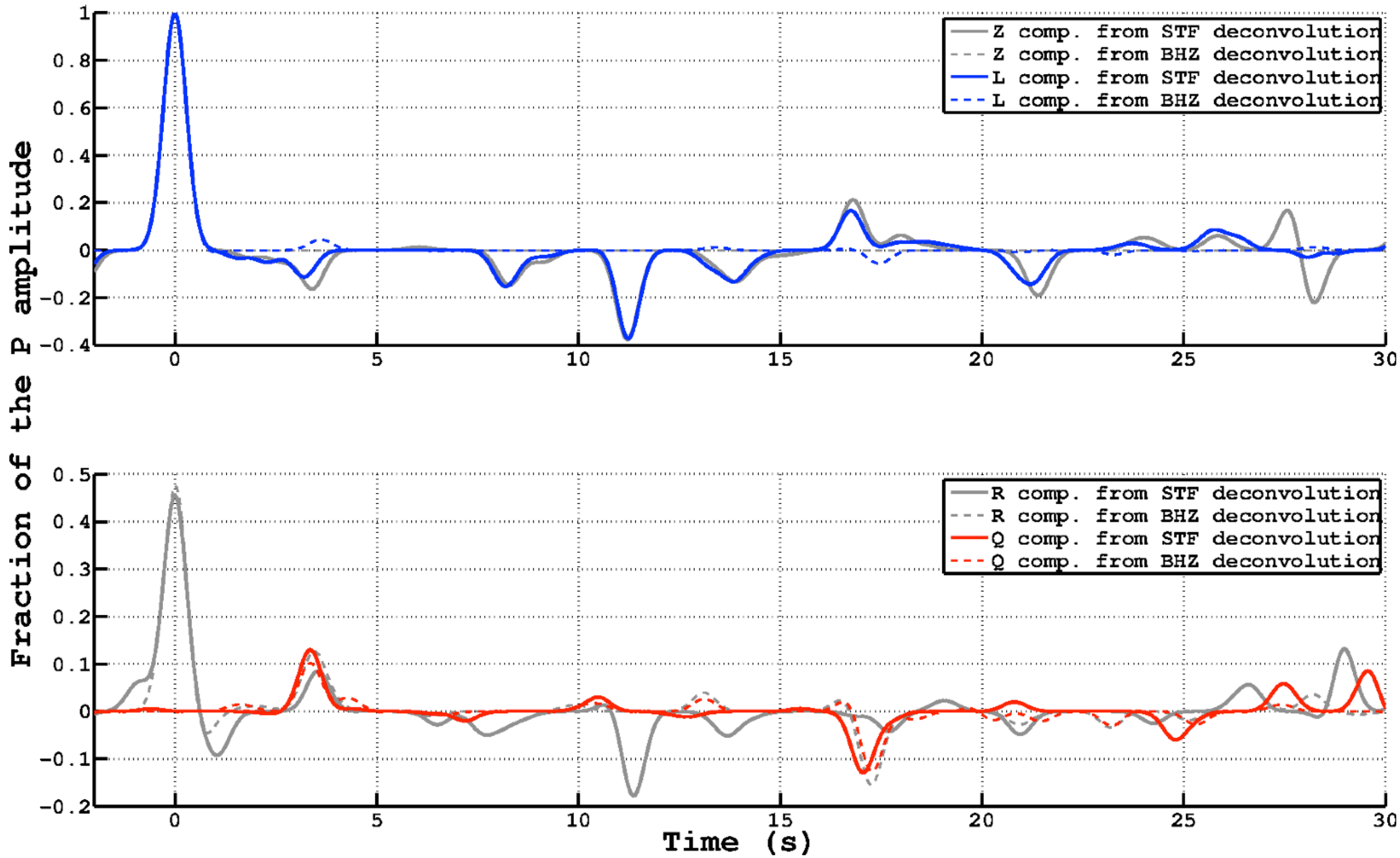
- ✓ Classical approach : vertical component signal contains source information
- ✓ Our approach : H.F. source time functions (STF) are determined by a waveform inversion (Chevrot, 2002 ; Garcia *et al.*, 2006, 2009)
- ✓ ADVANTAGES : no need to use regional arrays ; globally distributed records allow to average receiver structure (Garcia *et al.*, in prep.)



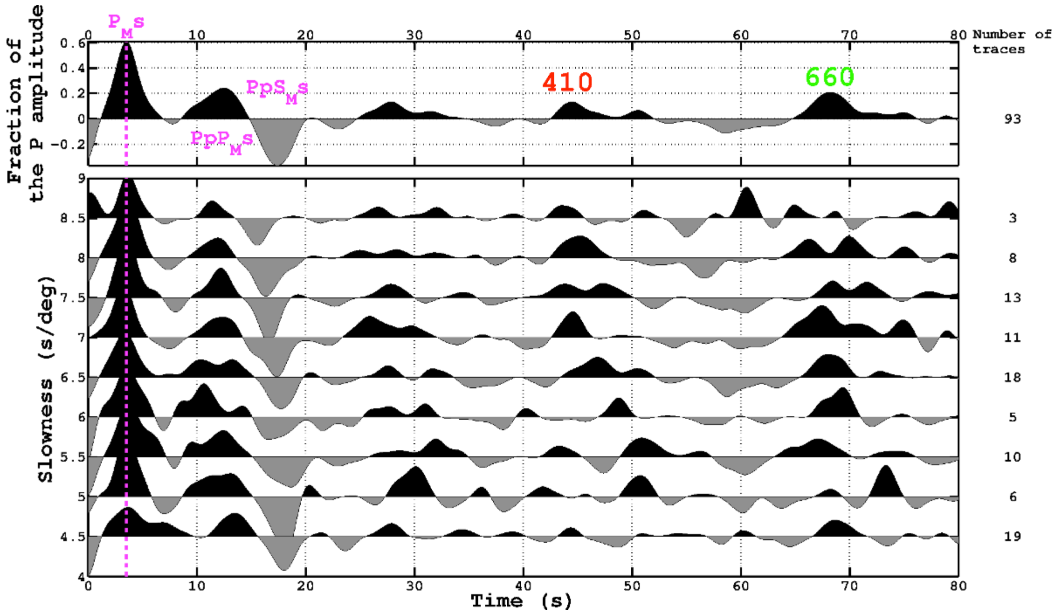
# Construction of the receiver functions (3) : deconvolution

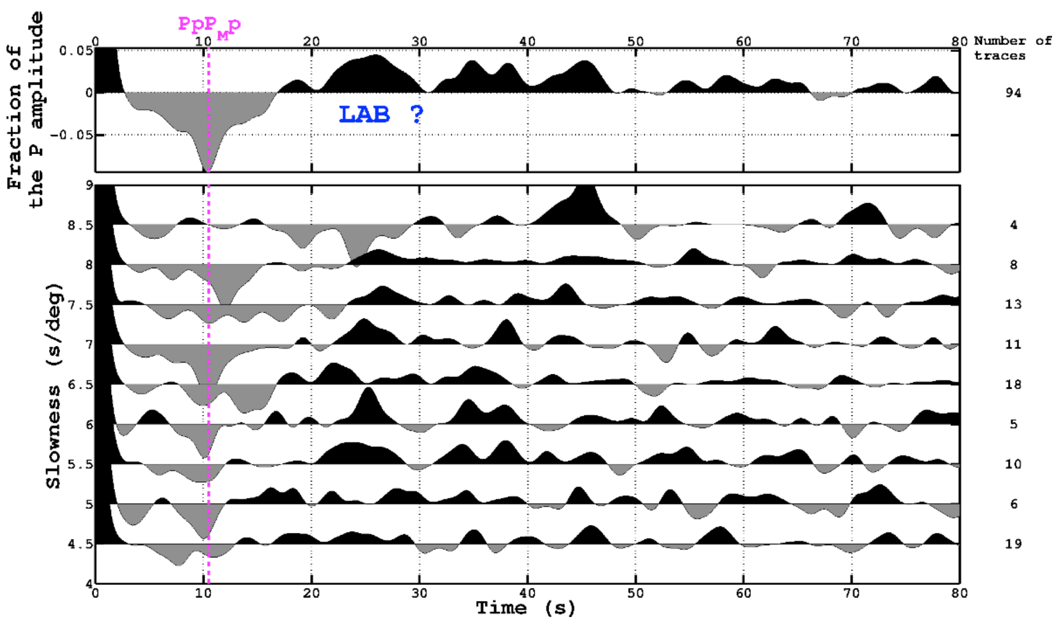
- ✓ Iterative deconvolution process (Ligorria & Ammon, 1999)
- ✓ Computation of two kinds of receiver functions :
  - receiver functions via deconvolution from the vertical component (BHZ)
  - receiver functions via deconvolution from the source time functions (STF)




Schardong *et al.*, in prep.

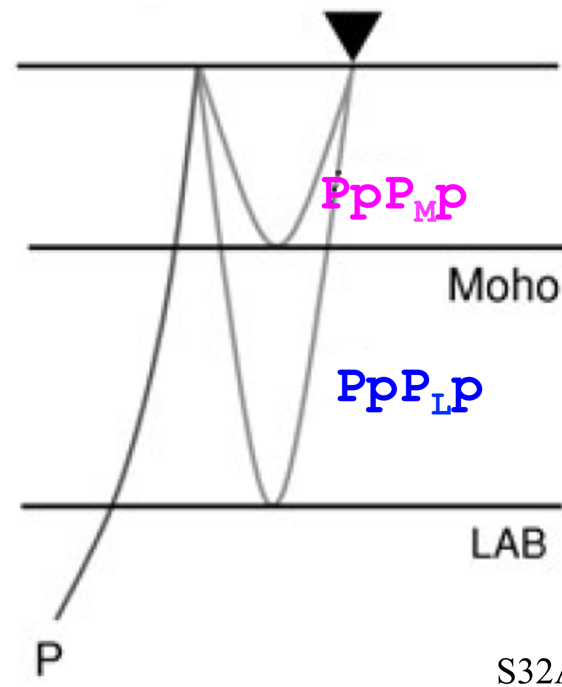
# Construction of the receiver functions (4) : example of HYB



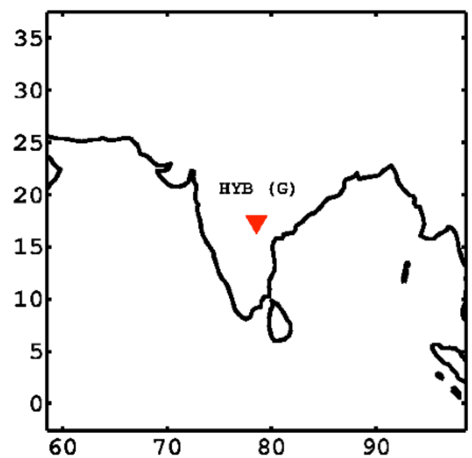

Schardong *et al.*, in prep.

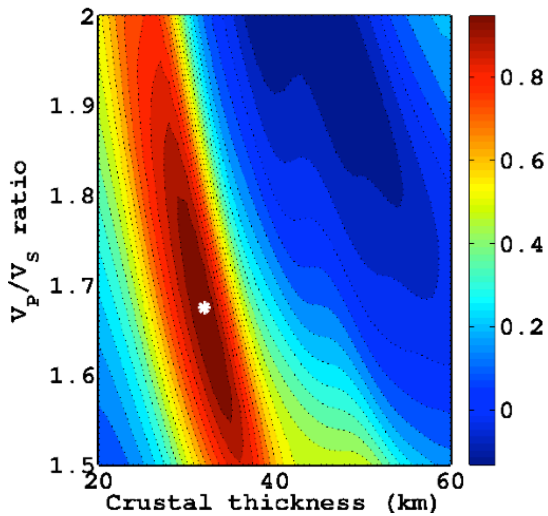
- ✓ Moveout corrections are applied ($p_{ref} = 6.5\ s/deg$) :
  - $P_Ms$ for Q comp. RFs
  - $PpP_Mp$ for L comp. RFs
- ✓ Only good quality records are selected
- ✓ RFs are stacked in slowness windows

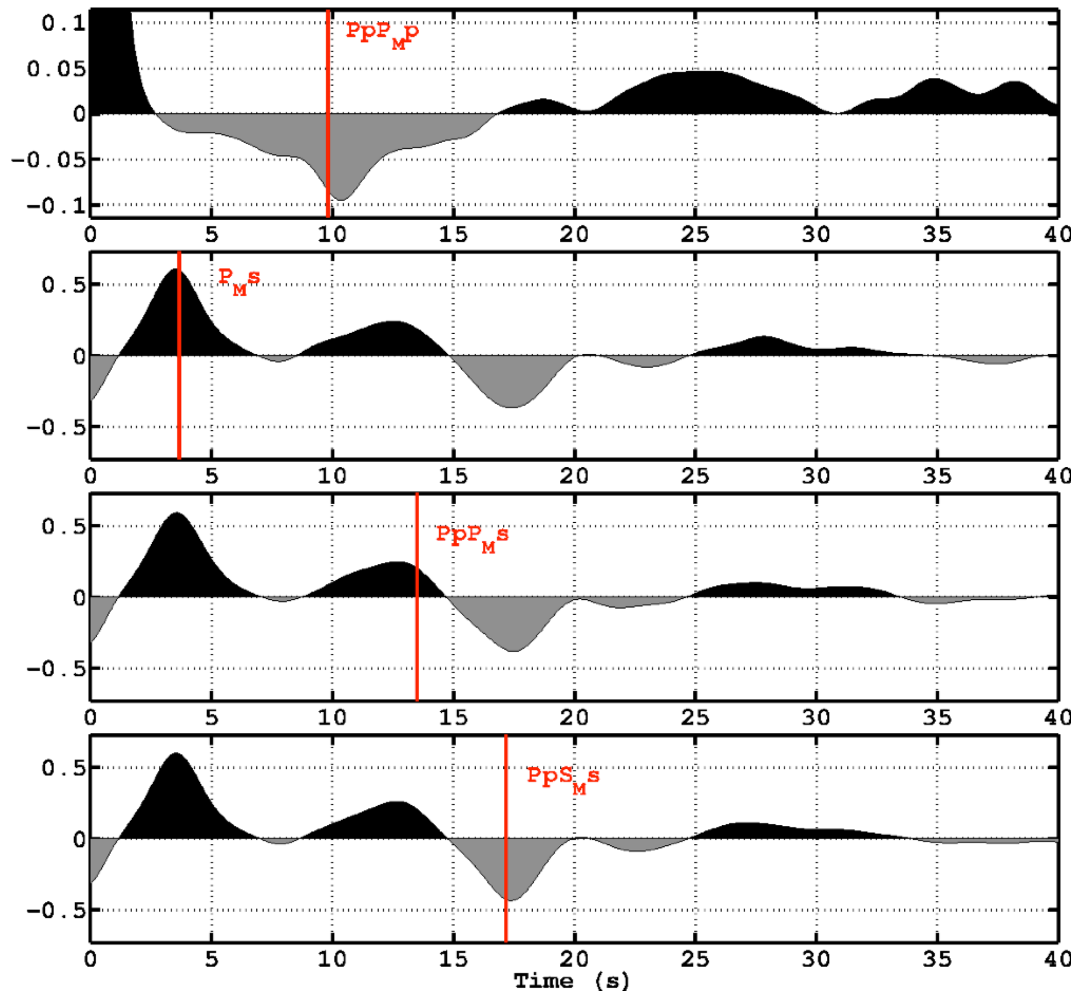


# Applications : the crustal structure beneath HYB

- ✓ Search for crustal thickness $H$ and $V_P/V_S$ ratio that give maximum amplitude along $P_Ms$, $PpP_Ms$ and $PpS_Ms$ traveltime curves ($V_P = 6.1\ km/s$)
- ✓ $H = 32\ km$, $V_P/V_S = 1.67$ ($\sigma = 0.22$)



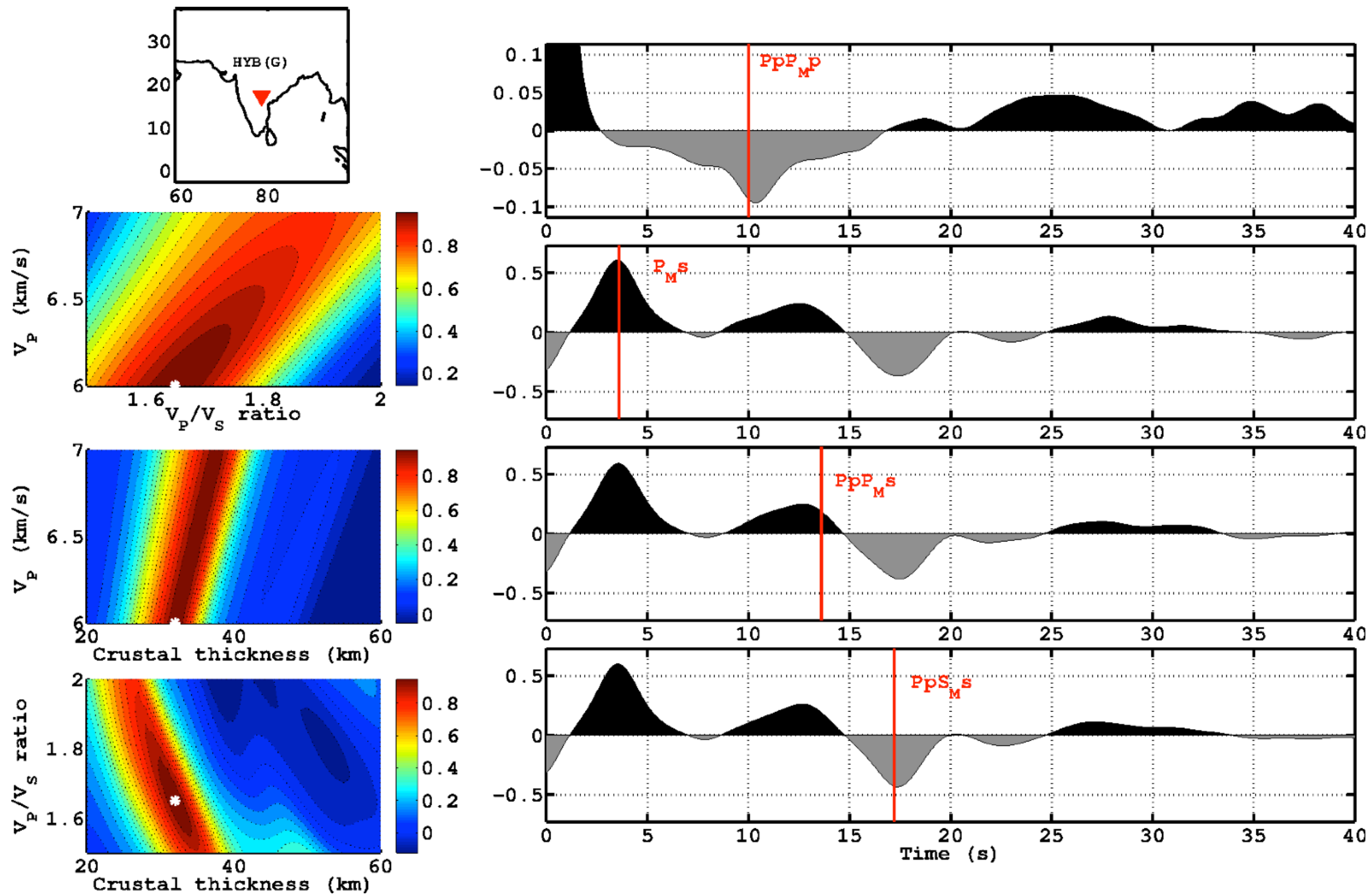




Schardong *et al.*, in prep.

# Applications : determination of absolute $V_P$

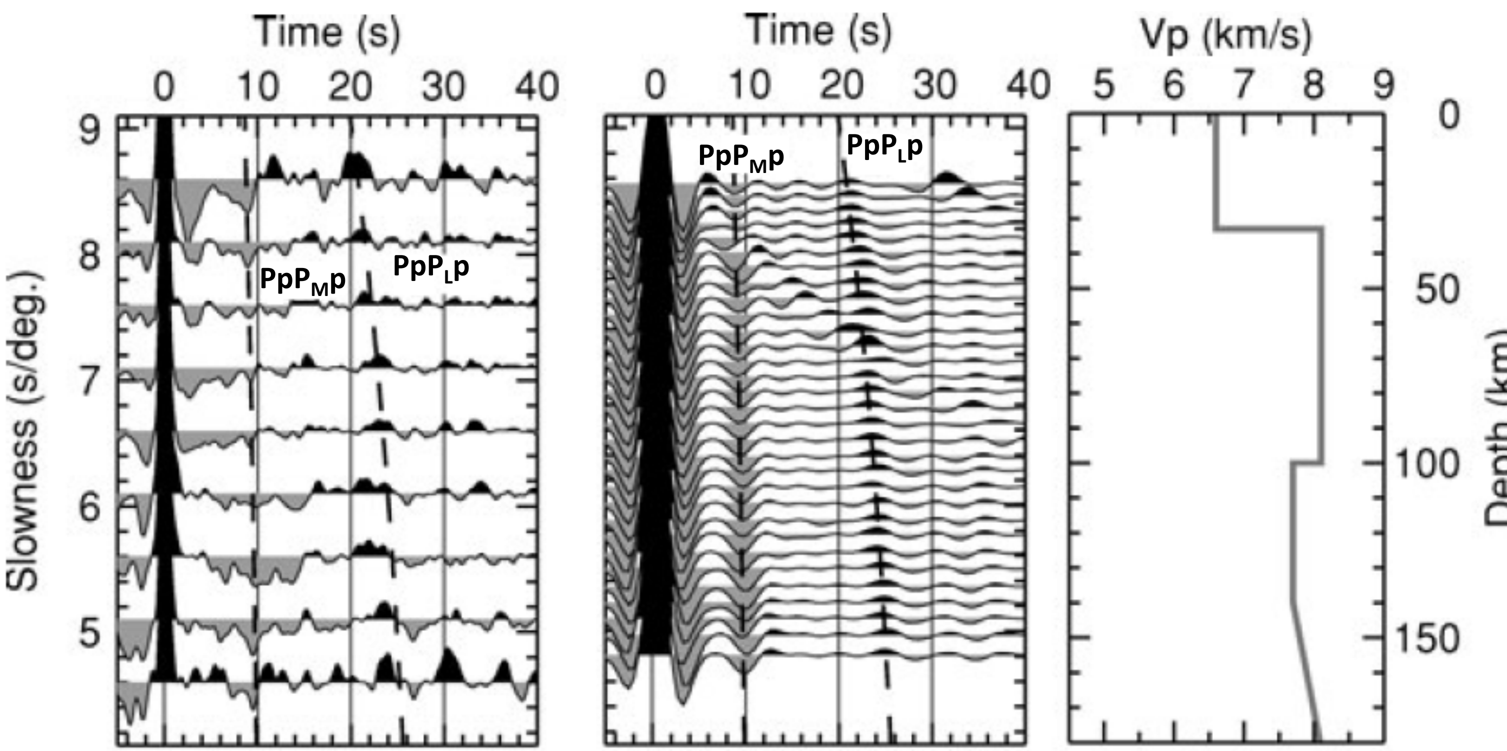
- ✓ Search for crustal thickness *H*, $V_P/V_S$ ratio and absolute $V_P$ that give maximum amplitude along $P_Ms$, $PpP_Ms$, $PpS_Ms$, $PpP_Mp$ traveltime curves
- ✓ $H = 32\ km$, $V_P/V_S = 1.65$ ($\sigma = 0.21$) and $V_P = 6.0\ km/s$




Schardong *et al.*, in prep.

# Comparison with other studies

- ✓ With our approach : $H = 32\ km$, $V_P/V_S = 1.65$, $V_P = 6.0\ km/s$
- ✓ Saul *et al.* (2000) : $H = 33\ km$, $V_P/V_S = 1.73$
- ✓ Kumar & Bostock (2006) : $H = 32\ km$, $V_P = 5.5\ km/s$
- ✓ Kumar & Bostock (2008) : $H = 30.5\ km$, $V_P = 6.1\ km/s$, $V_P/V_S = 1.79$




Kumar *et al.*, 2010

# Conclusions

- ✓ Another method to determine crustal parameters, but original in its use of a new kind of data, not a new computational approach
- ✓ Depends more on data quality rather than on quantity
- ✓ Clear detections of $PpP_Mp$ phases in L (or Z) component receiver functions
- ✓ Possible probing of deeper interfaces
- ✓ Possible constraints on absolute velocities

# Perspectives

- ✓ Apply this method to other discontinuities : upper-lower crust boundary, LAB, 410 and 660 *km* discontinuities
- ✓ Apply Kumar & Bostock (2008) method to determine absolute $V_P$
- ✓ Boot-strap to evaluate uncertainties
- ✓ Correct teleseismic traveltimes from crustal structure below receivers