Metadata Workshop:
" Managing Waveform Data and Related Metadata for Seismic Network"

# Moho Depth and Crustal Velocity Structure Beneath Stations RTC, and TAM, from Teleseismic Receiver-Function Analysis

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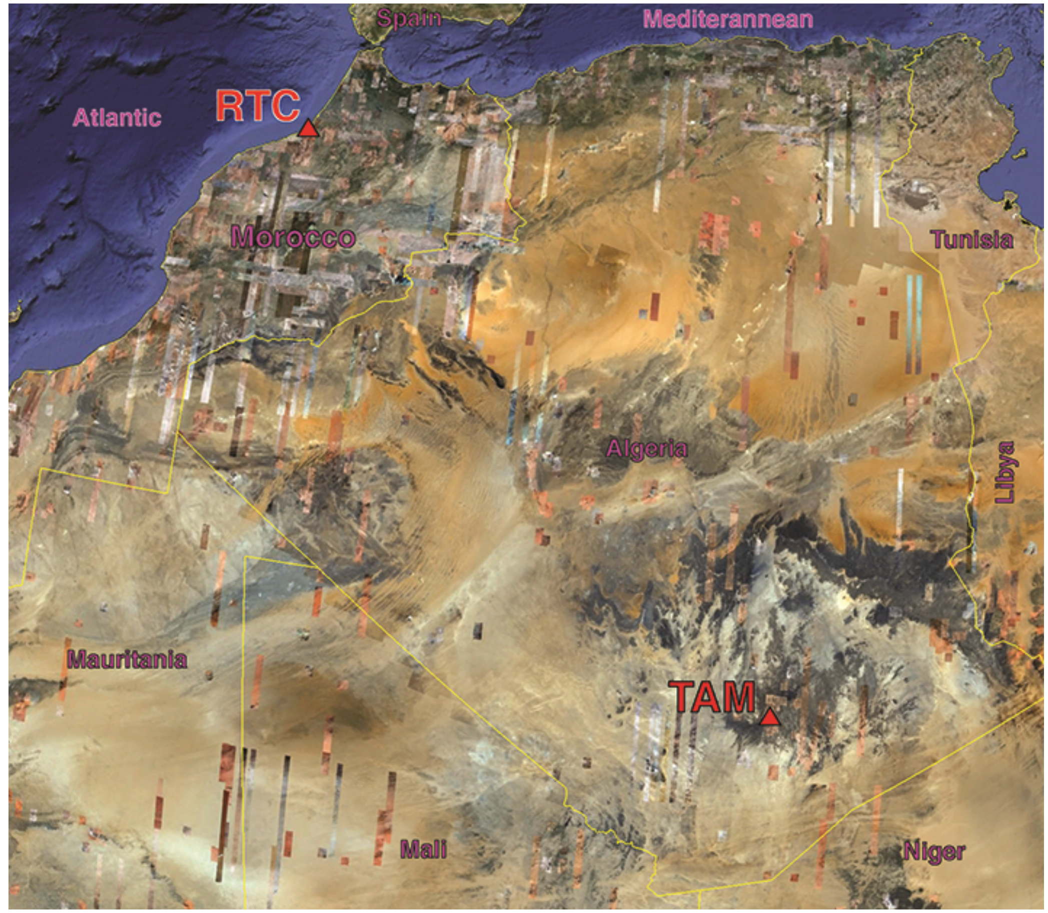
January 14 to 18 2013 Kuweit City,

- Station RTC is installed in the city of Rabat
  (MedNet Network)

- TAM station is sited in Hoggar (Algeria)
  (GEOSCOPE Network)



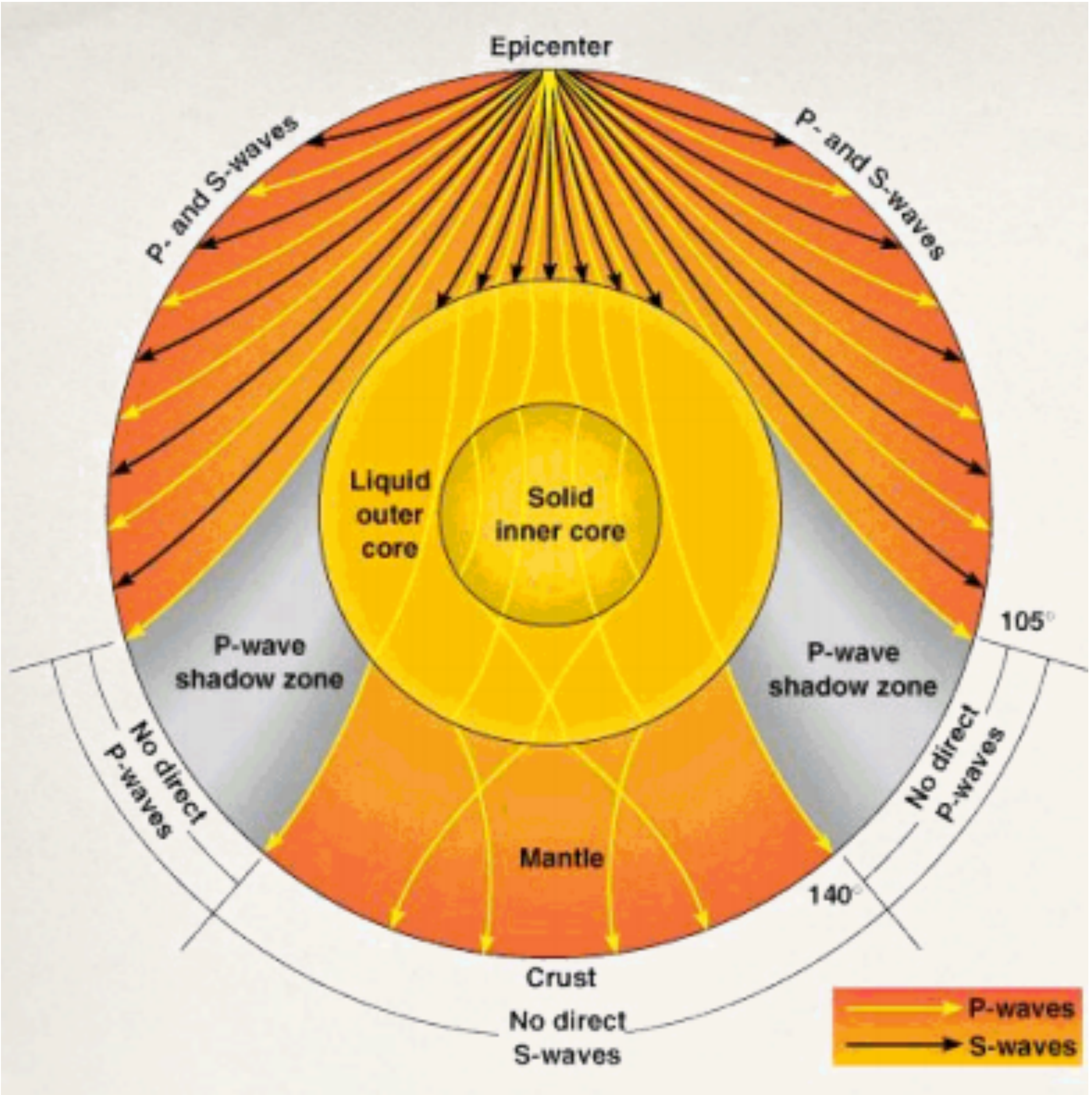

Map showing stations RTC in Morocco and TAM in Algeria.

# Receiver function Analysis: Principe

- wave emission

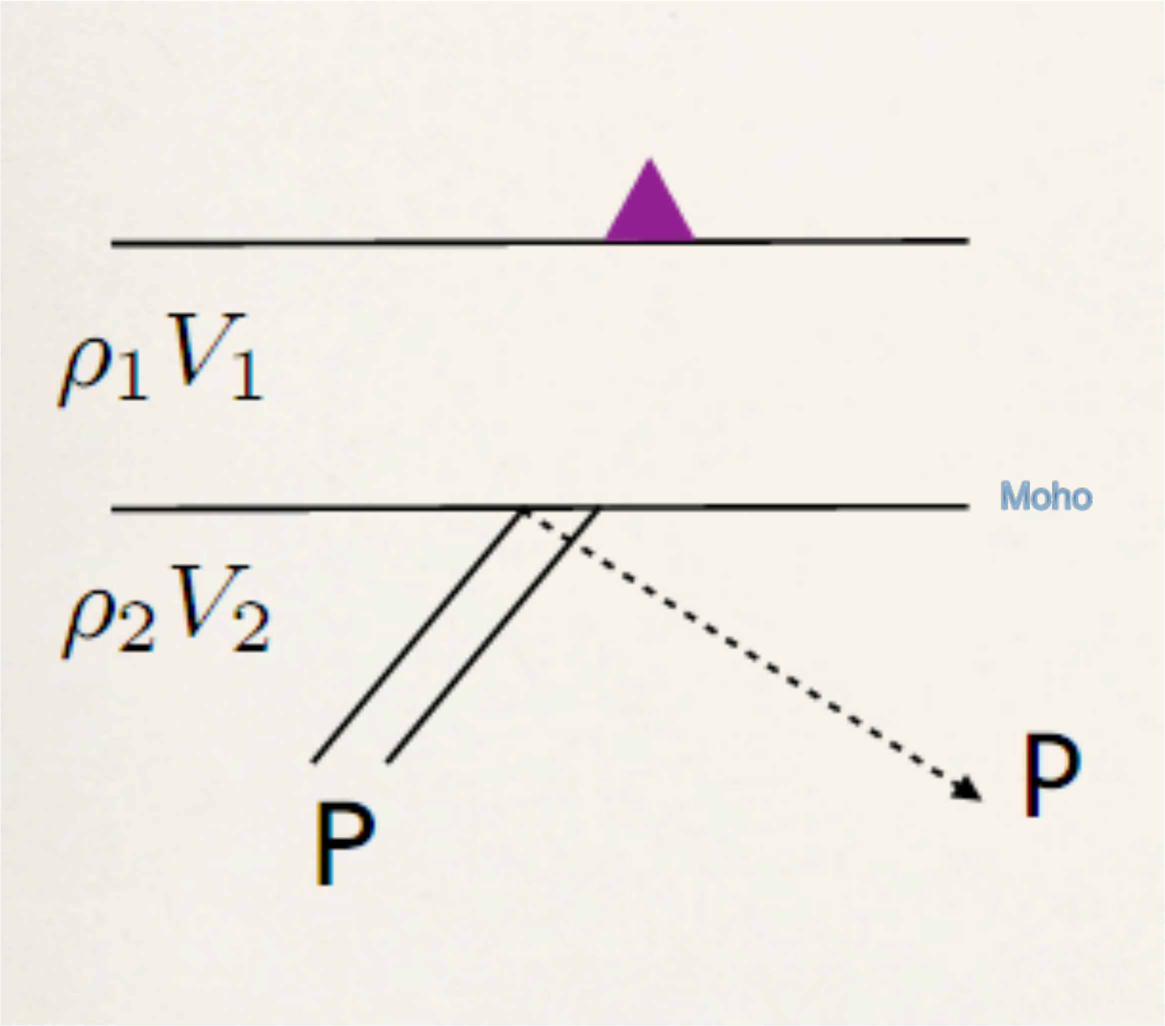
- Propagation in the earth

- Conversion in the banderies



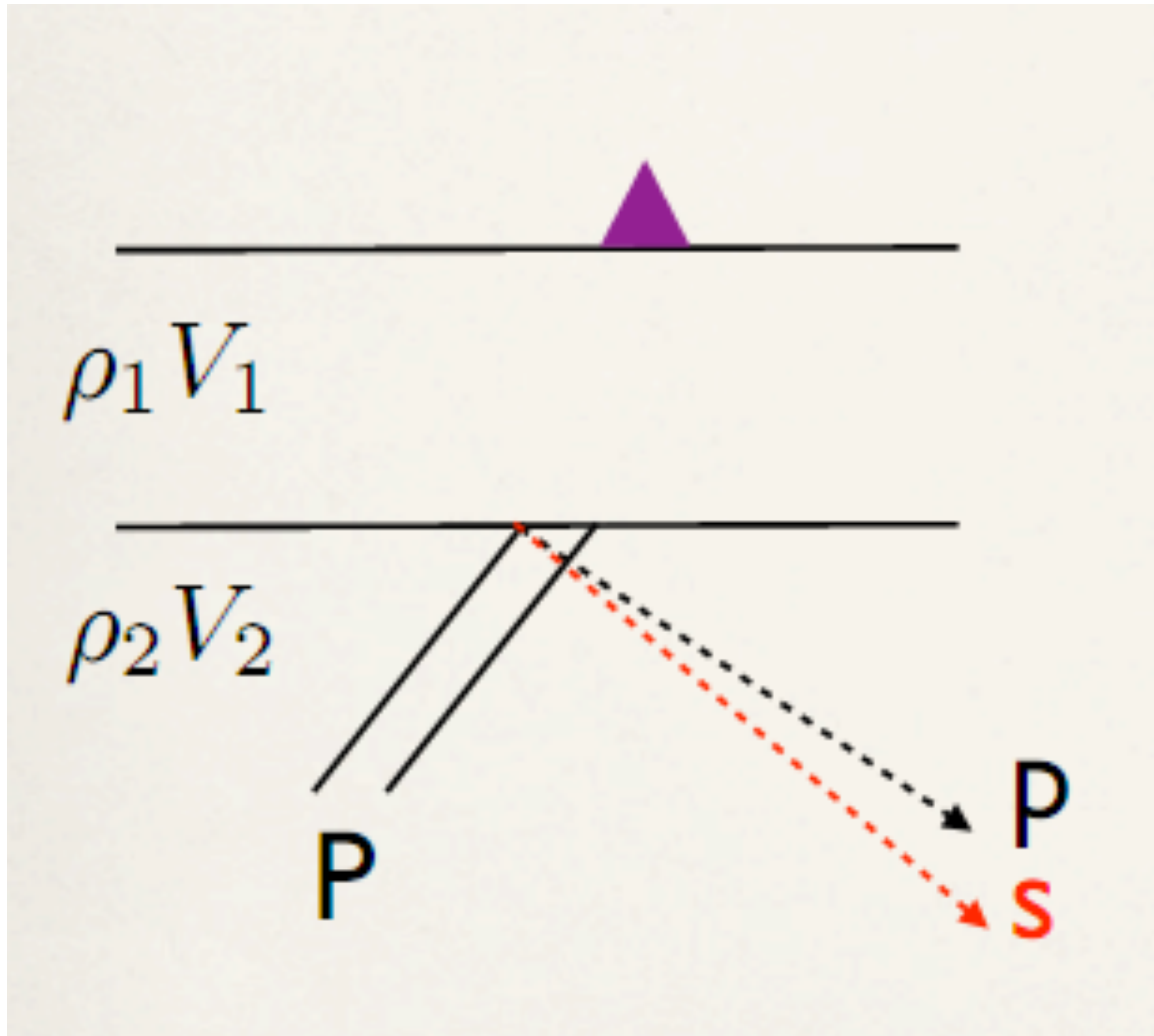
## II-Principe et méthode des fonctions récepteurs

Refraction



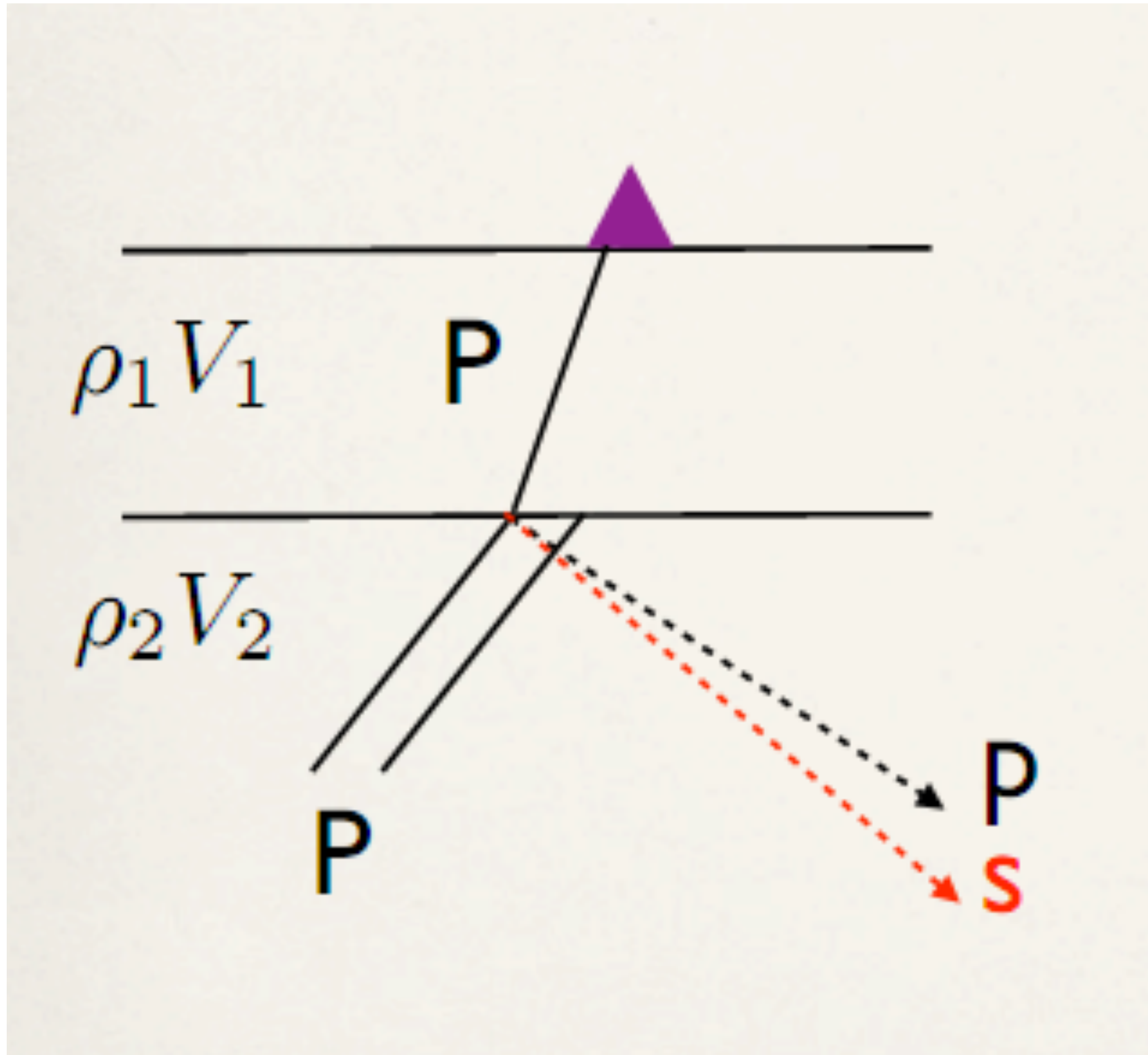
# II-Principe et méthode des fonctions récepteurs

Refraction



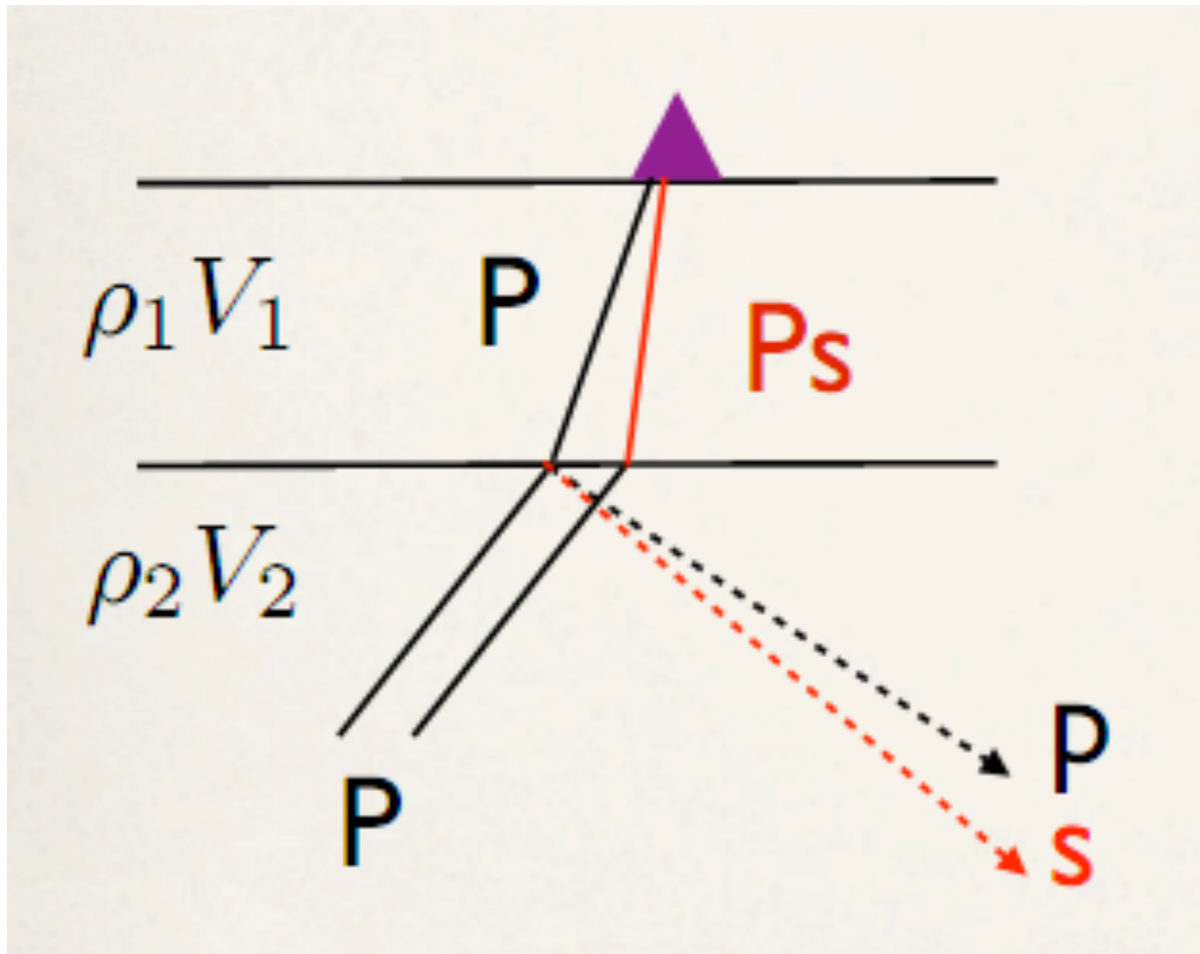
## II-Principe et méthode des fonctions récepteurs

Transmission

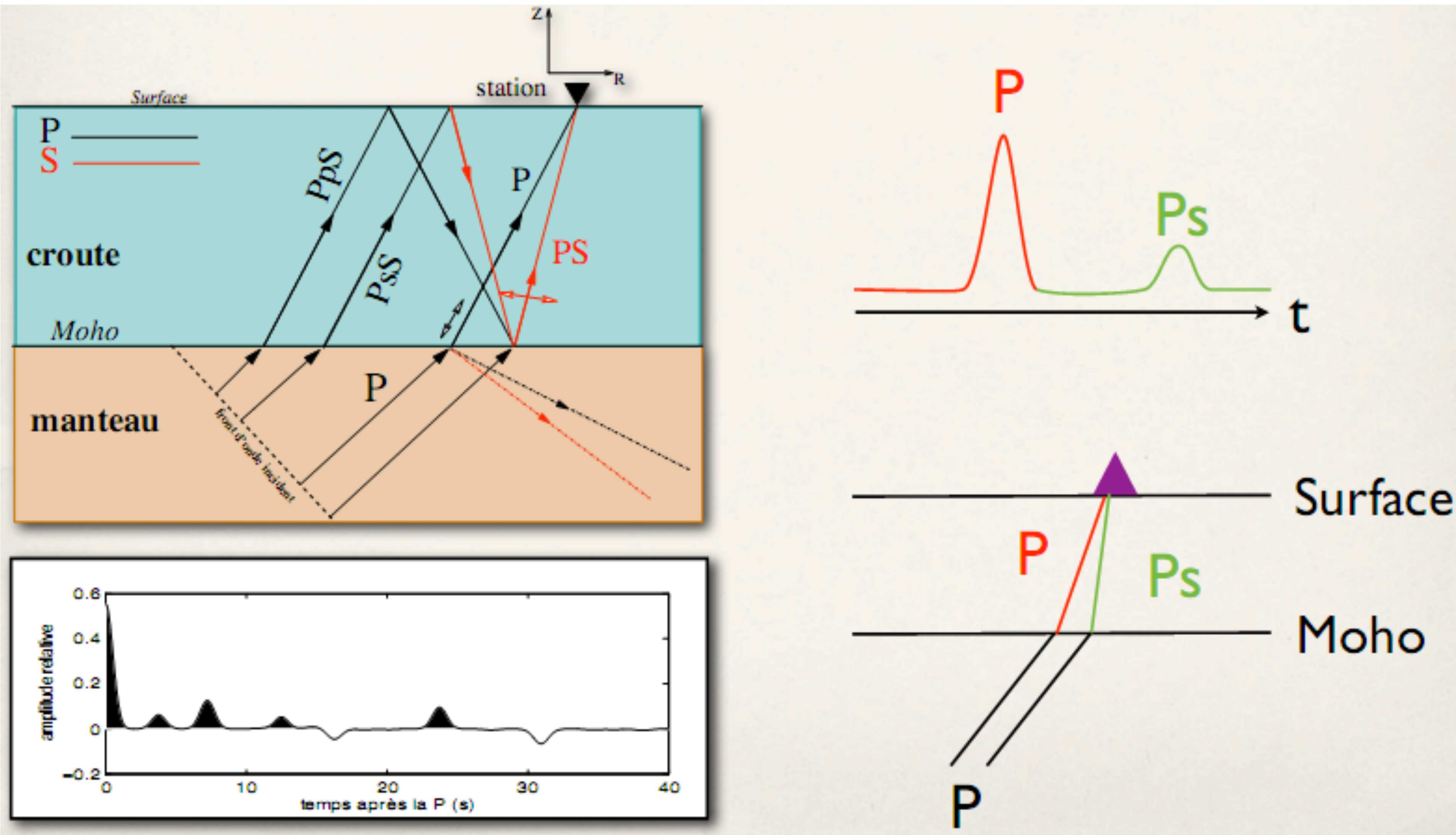


## II-Principe et méthode des fonctions récepteurs

- Transmission

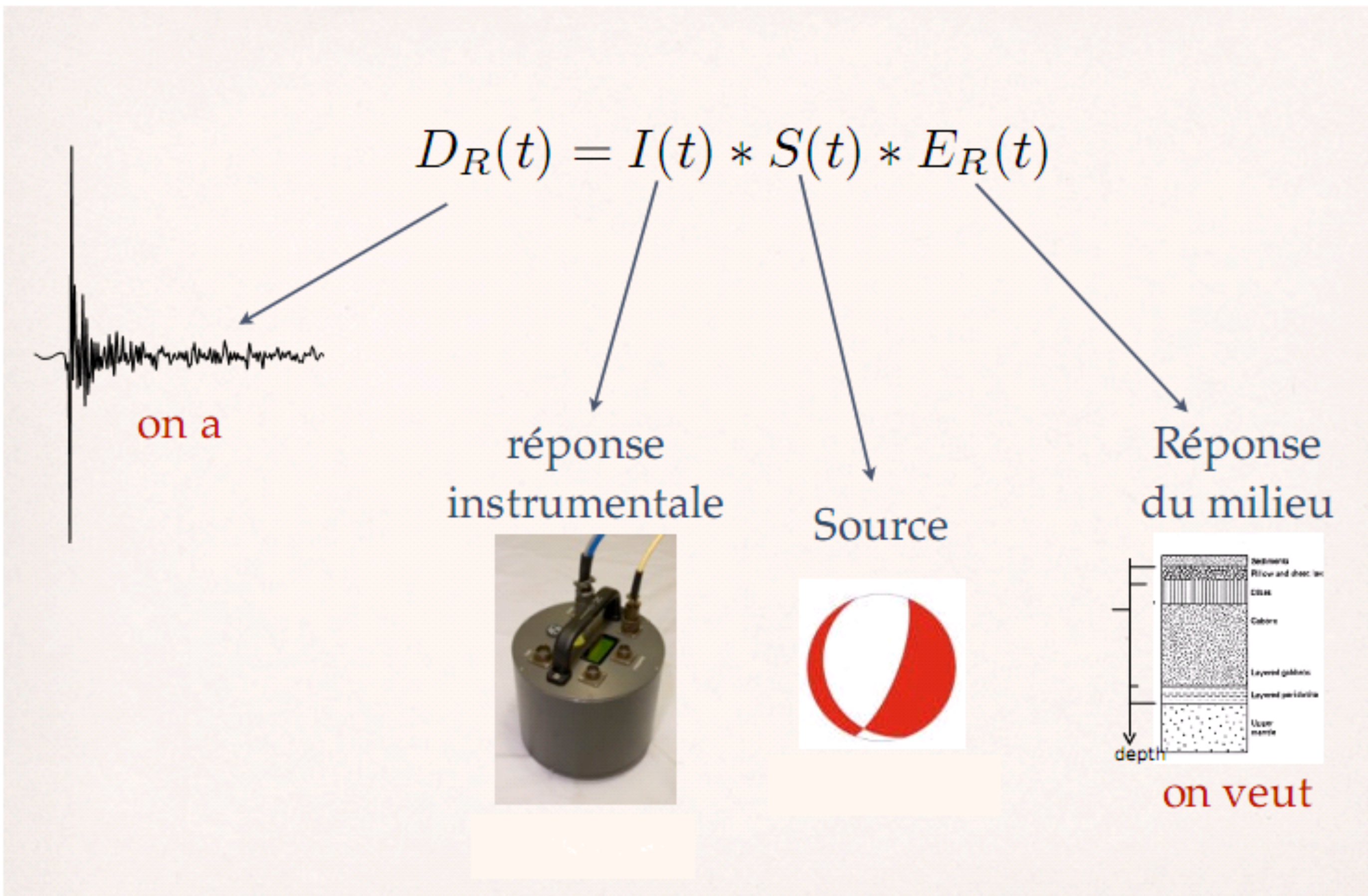


# II-Principe et méthode des fonctions récepteurs



# Principe

## The signal recorded by the station :



# DATA

For both stations, Waveforms and source parameters of the events were obtained from the Wilber II site of IRIS

| | | |
|---|---|---|
| Epicentral distance | 35° and 95° | body-wave phases are nearly perfect plane waves and easily modeled<br>-Below 35° distance, ray triplication complicates the wavefronts<br>-while over 95° they are muddied by core diffractions |
| Time window *we used for each seismogram starts* | -5 s prior to the *P*-wave onset<br>-ends 40 seconds thereafter. | This window includes the *Ps* and the more complex conversions of interest from the crust and the upper mantle. |
| magnitude | *mb* ≥ 5.6 | |

waveform characterized by a clear P-wave onset

# Receiver Functions determination

A variety of receiver function techniques have been developed. In this work, we use the method and software developed by ***Herrmann*** **[2007],** which allows us to generate images of both the crust and upper mantle velocity structure in some detail by iterative waveform fitting.

This package of software (**CPS**: Computer Programs in Seismology) is readily available from the author through the web.

# Receiver Function determination

3 main steps

1. Edit

2. The Rotation, which allows To separate converted *S*-phases from direct *P*

*3.* Deconvolution

# Inversion

- creating clusters of sources according to similar backazimuth (±7.5°) and distance (±7.5°).

- stack receiver functions from these clusters
  - increase SNR
  - decrease the effects of scattering in the upper crust

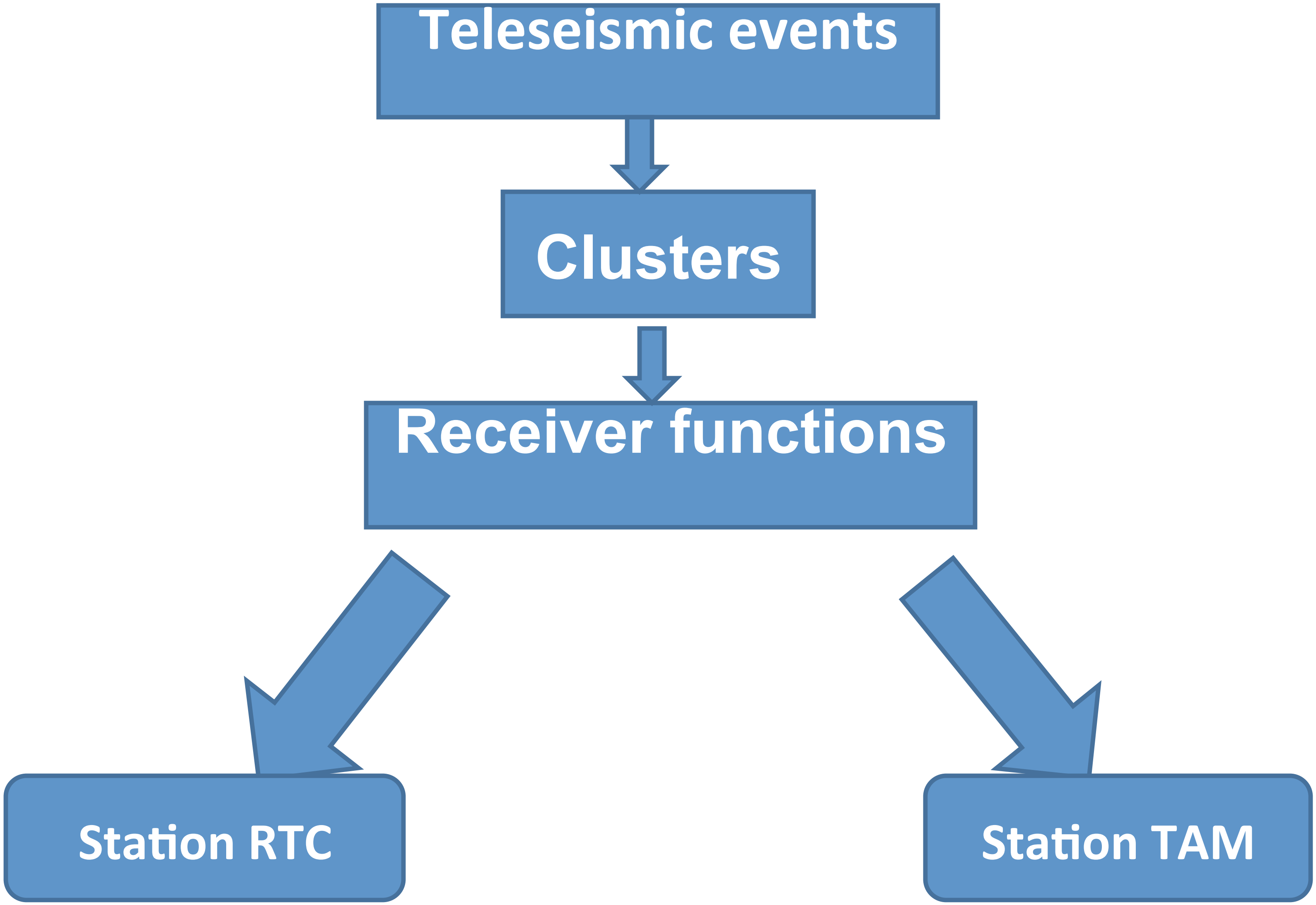
- Inversion is done
  - P-Radial receiver function
  - Gaussian filter parameters a=1.0

  ➔best result

- The velocity model is constraint 300 Iterations

Our results include Moho depth and crustal shear wave velocity models ($V_S$)

# Results – Discussion



# Conclusion
# RTC

Moho of RTC is found **between 20 and 22 km**

Thus, the Moho under RTC shallow and gradational, probably reflecting a transitional zone between continental and oceanic crust.

Shallow Moho is consistent with geologic and isostasy data,which suggest continental and oceanic Moho at 30 and 15 km respectively near Rabat.

# TAM

Moho of TAM is found **between 36 and 38 km**

The differences between the four models are attributable to exogenous (externally driven) structures in the crust and upper mantle.

Because TAM is installed in a complex portion of a craton, its stability is affected by thermal and gravity anomalies from magmatic intrusions that influence wave velocity.

The four clusters exhibit very similar velocities with enough vertical variation to distinguish upper and lower crust and the upper mantle.

Differences in velocity models between Rabat (RTC) and Hoggar (TAM) are consistent with their contrasting tectonic environments

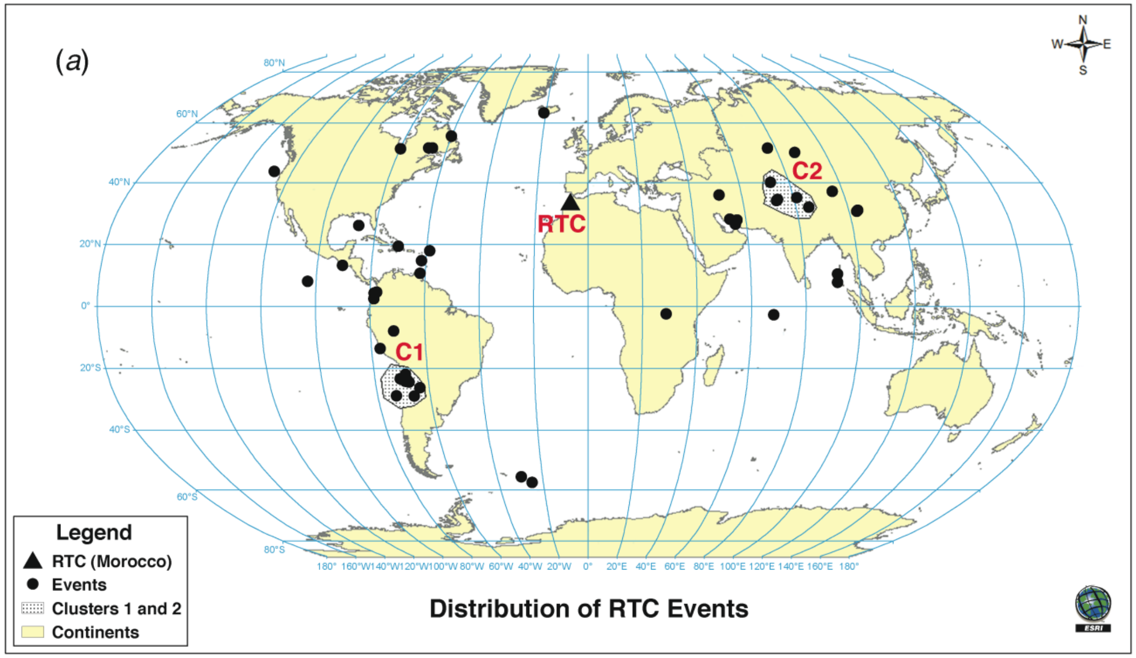
# Thank you

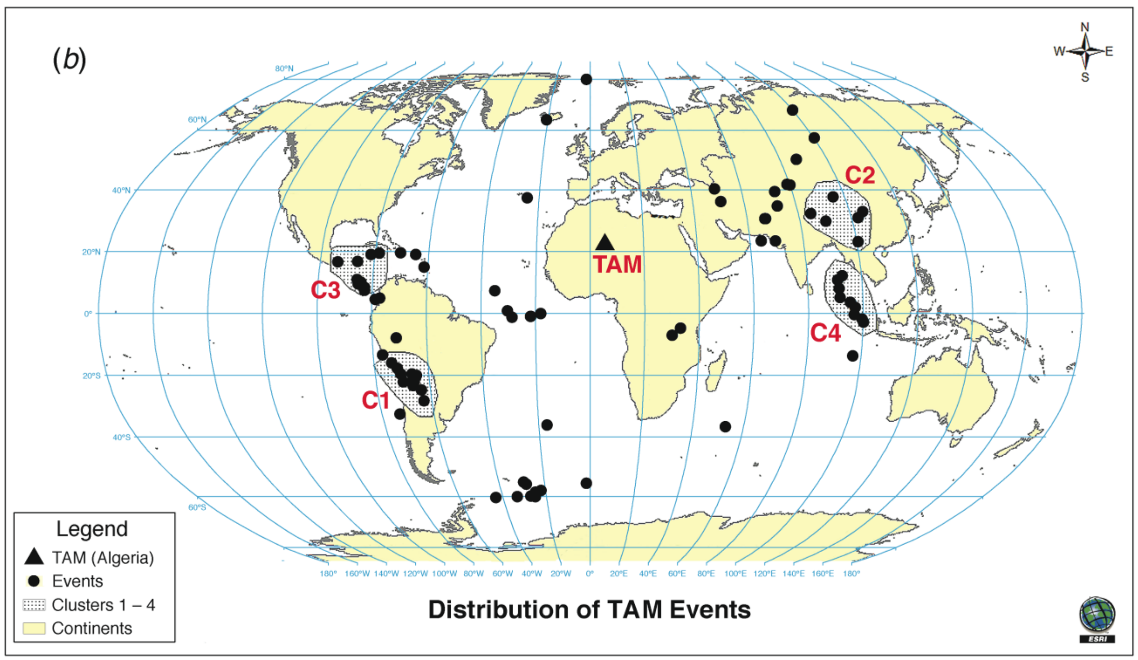
# Introduction

The Moho (Mohorovičić discontinuity) is characterized by major changes in :

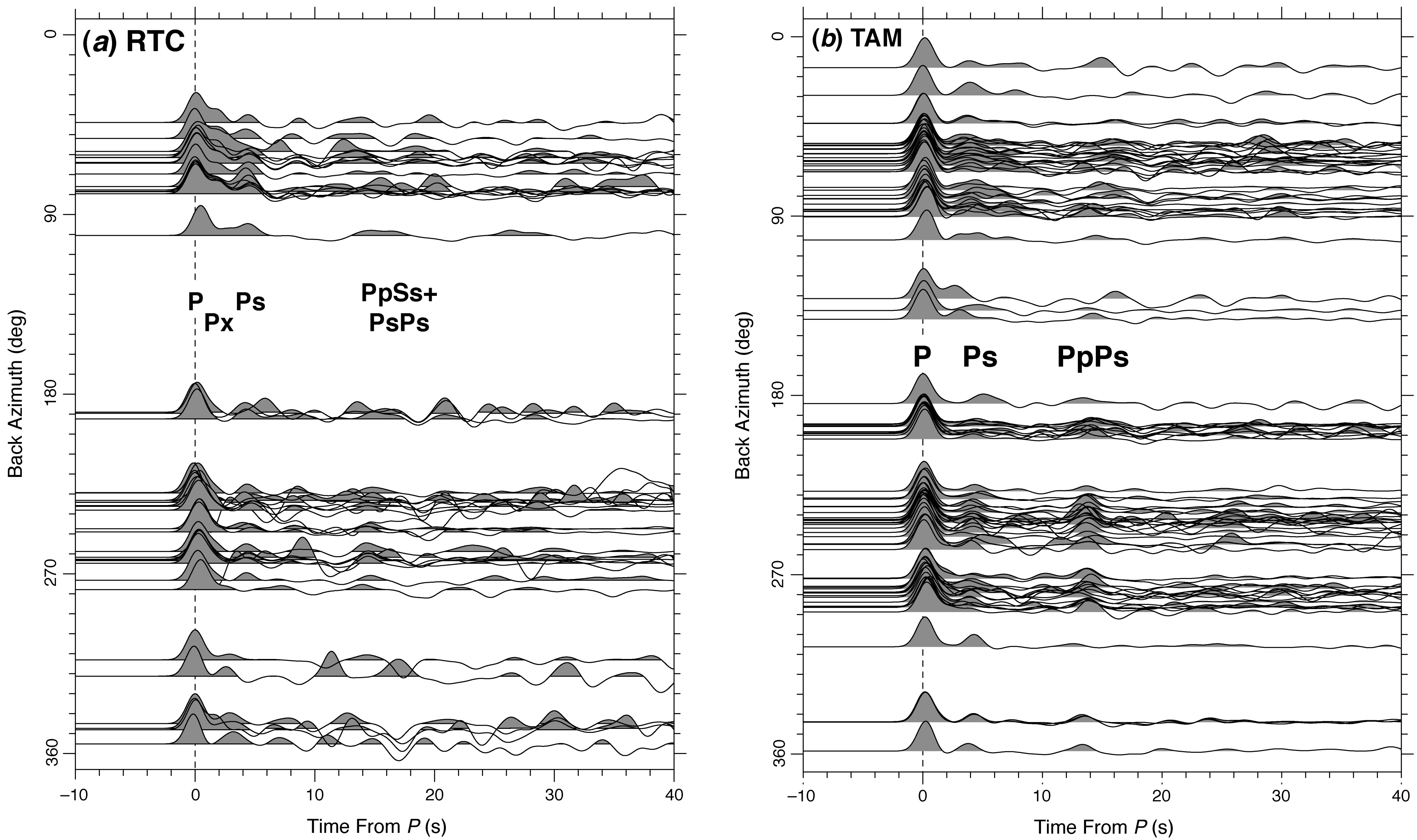
- seismic velocity,
- chemical composition,
- rheology
- and Depth

Depth to Moho is an important parameter for characterizing crustal structure and often can be related to the geo-tectonic evolution of a region


(a)
RTC
C1
C2
Legend
RTC (Morocco)
Events
Clusters 1 and 2
Continents
Distribution of RTC Events

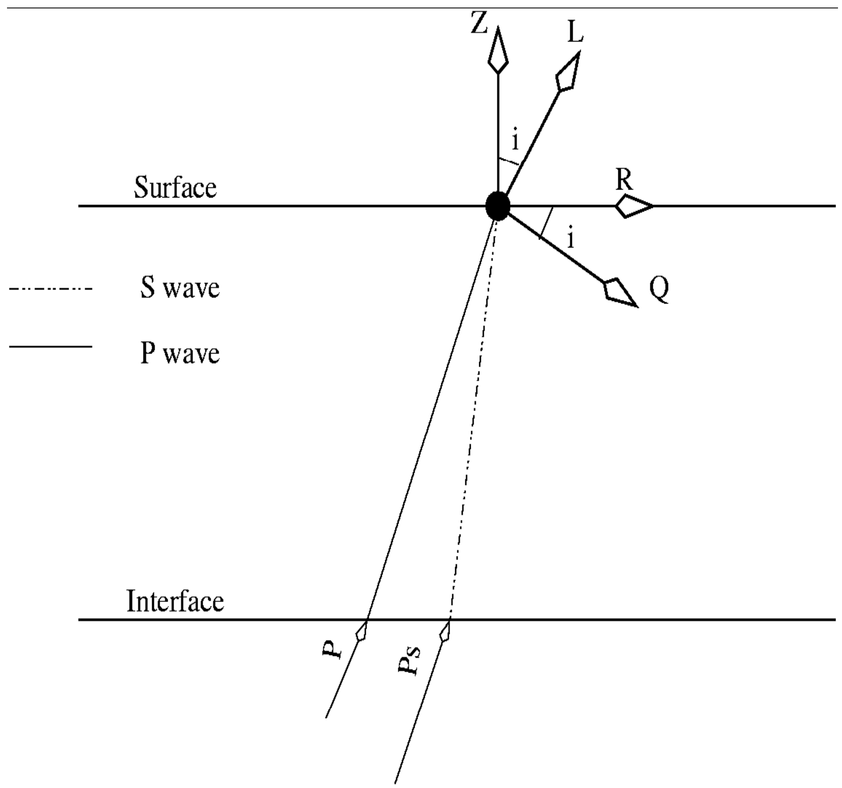

(b)
TAM
C1
C2
C3
C4
Legend
TAM (Algeria)
Events
Clusters 1 – 4
Continents
Distribution of TAM Events

# Receiver functions estimates for (*a*) RTC and (*b*) TAM stations



# Rotation

Each record is rotated from its original (Z, N, E) components into the coordinates of the *P* wavefront and propagation directions (L, Q, R)




Rotation is performed, therefore, using both the backazimuth and the incidence angle of the incoming *P* wave at the station, with backazimuth and incidence angle estimated from hypocentral and station coordinates

# deconvolution

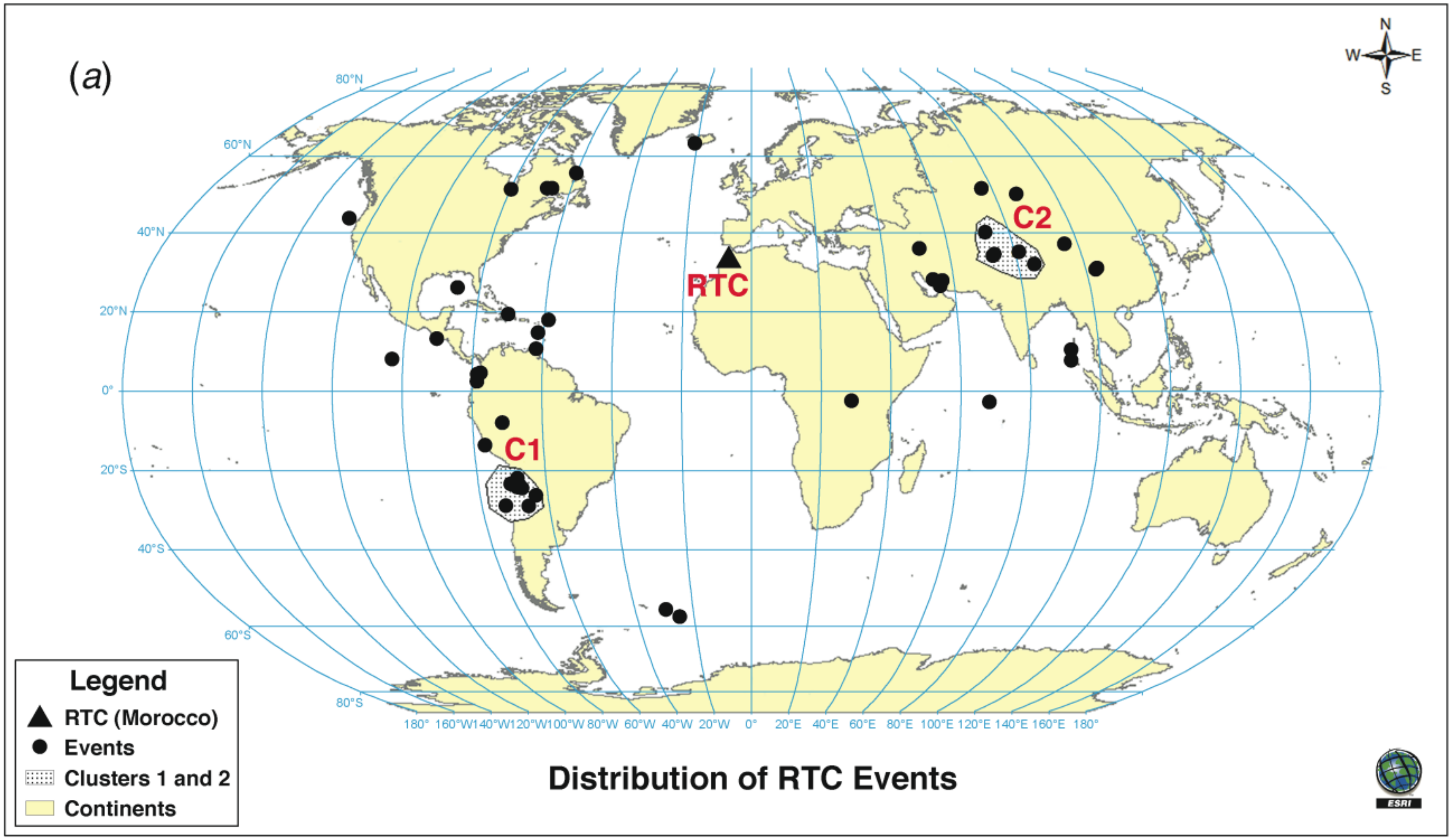
Within the Earth, incoming *P* undergoes a convolution with velocity structure.

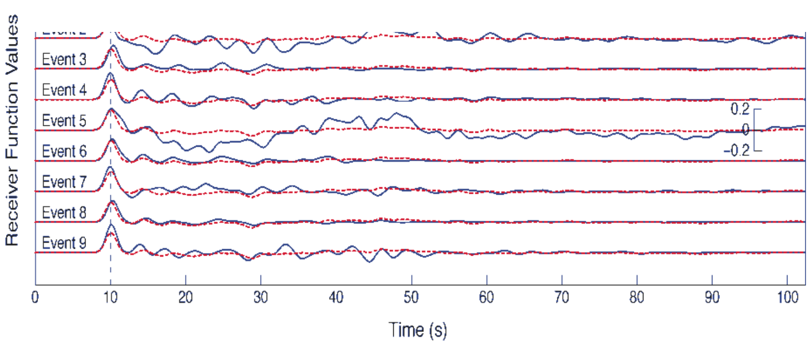
By then, ground displacement can be defined by the convolution of :

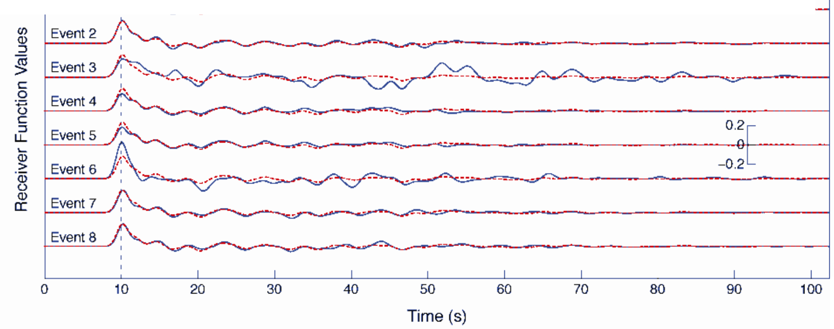
- its source function *S*(*t*),
- the instrument response *I*(*t*)
- and the transfer function *E*(*t*)

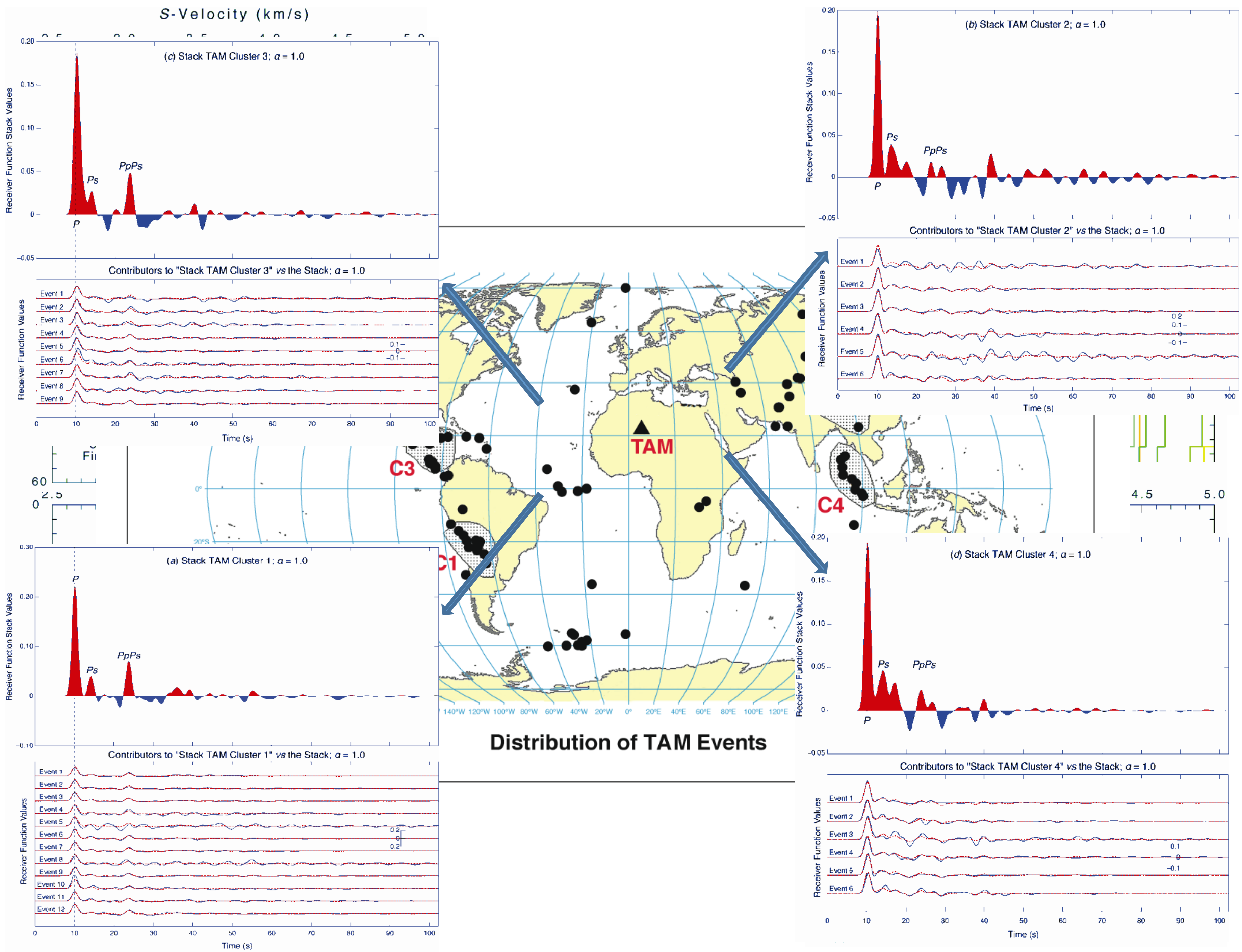
To extract the information on the Earth response encoded by this convolution

Thus, deconvolution removes most of *S*(*t*), *I*(*t*) and those portions of *E*(*t*)


(a)
80°N
60°N
40°N
20°N
0°
20°S
40°S
60°S
80°S
180° 160°W 140°W 120°W 100°W 80°W 60°W 40°W 20°W 0° 20°E 40°E 60°E 80°E 100°E 120°E 140°E 160°E 180°
RTC
C1
C2
N
W
E
S
Legend
RTC (Morocco)
Events
Clusters 1 and 2
Continents
Distribution of RTC Events
ESRI


Receiver Function Values
Event 3
Event 4
Event 5
Event 6
Event 7
Event 8
Event 9
0.2
0
−0.2
0 10 20 30 40 50 60 70 80 90 100
Time (s)


Receiver Function Values
Event 2
Event 3
Event 4
Event 5
Event 6
Event 7
Event 8
0.2
0
−0.2
0 10 20 30 40 50 60 70 80 90 100
Time (s)



S-Velocity (km/s)
(c) Stack TAM Cluster 3; a = 1.0
Receiver Function Stack Values
P
Ps
PpPs
Contributors to "Stack TAM Cluster 3" vs the Stack; a = 1.0
Event 1
Event 2
Event 3
Event 4
Event 5
Event 6
Event 7
Event 8
Event 9
Receiver Function Values
Time (s)
(b) Stack TAM Cluster 2; a = 1.0
Contributors to "Stack TAM Cluster 2" vs the Stack; a = 1.0
(a) Stack TAM Cluster 1; a = 1.0
Contributors to "Stack TAM Cluster 1" vs the Stack; a = 1.0
Event 10
Event 11
Event 12
(d) Stack TAM Cluster 4; a = 1.0
Contributors to "Stack TAM Cluster 4" vs the Stack; a = 1.0
TAM
C1
C3
C4
140°W 120°W 100°W 80°W 60°W 40°W 20°W 0° 20°E 40°E 60°E 80°E 100°E 120°E
Distribution of TAM Events