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Receiver Functions

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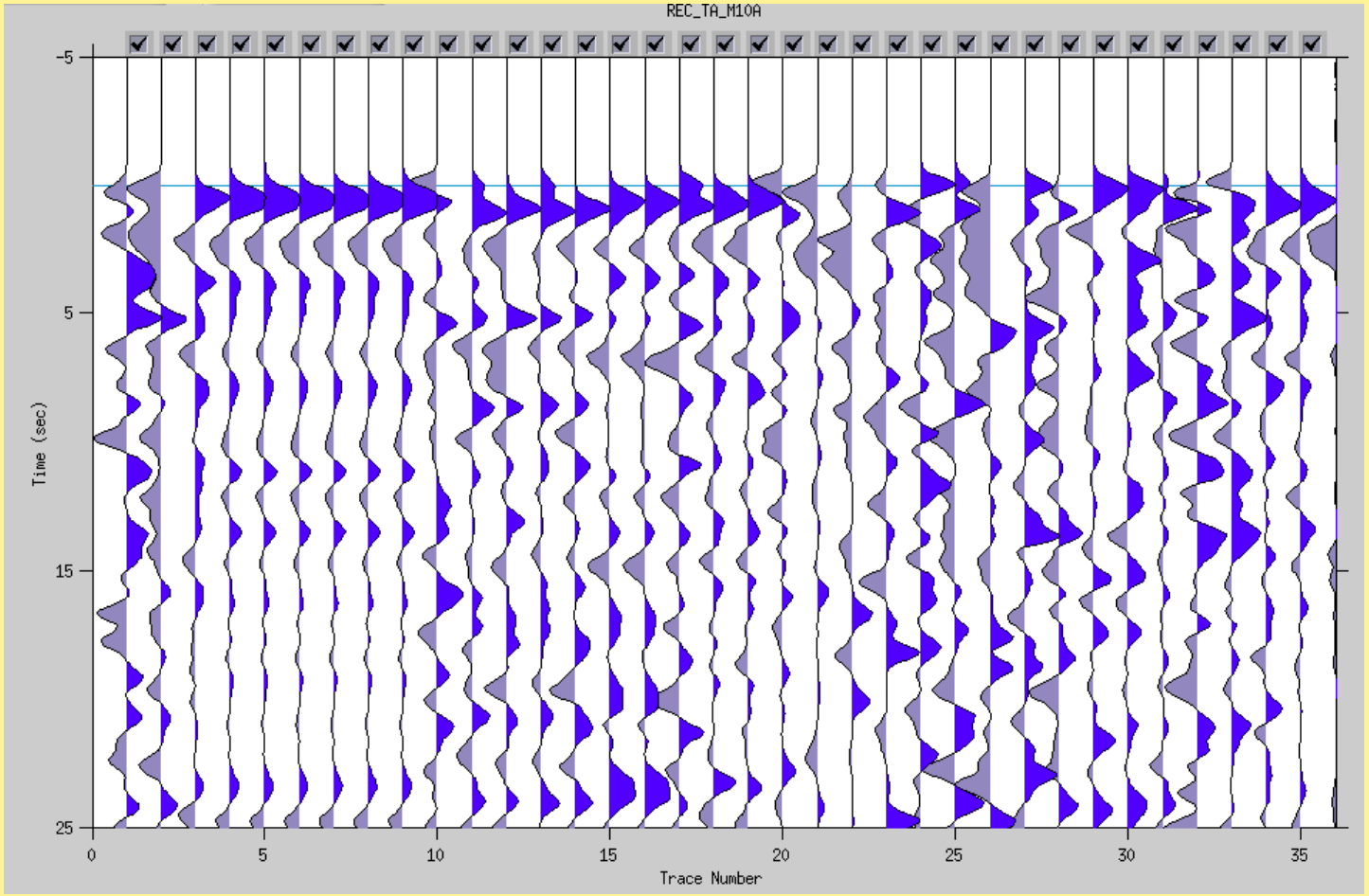
EarthScope Seminar

Figures and References from various sources.

What do receiver functions look like?



Screenshot of receiver functions in Funclab in Matlab by Eun-Sun Chong

- Blue vs. Gray and selected vs. unselected
  - Blue is the positive side. All selected Rfs are expected to have a blue bump lead.
  - Blue is the negative side. All Rfs starting with a gray bump lead are left out.

But what are they?

Definition:

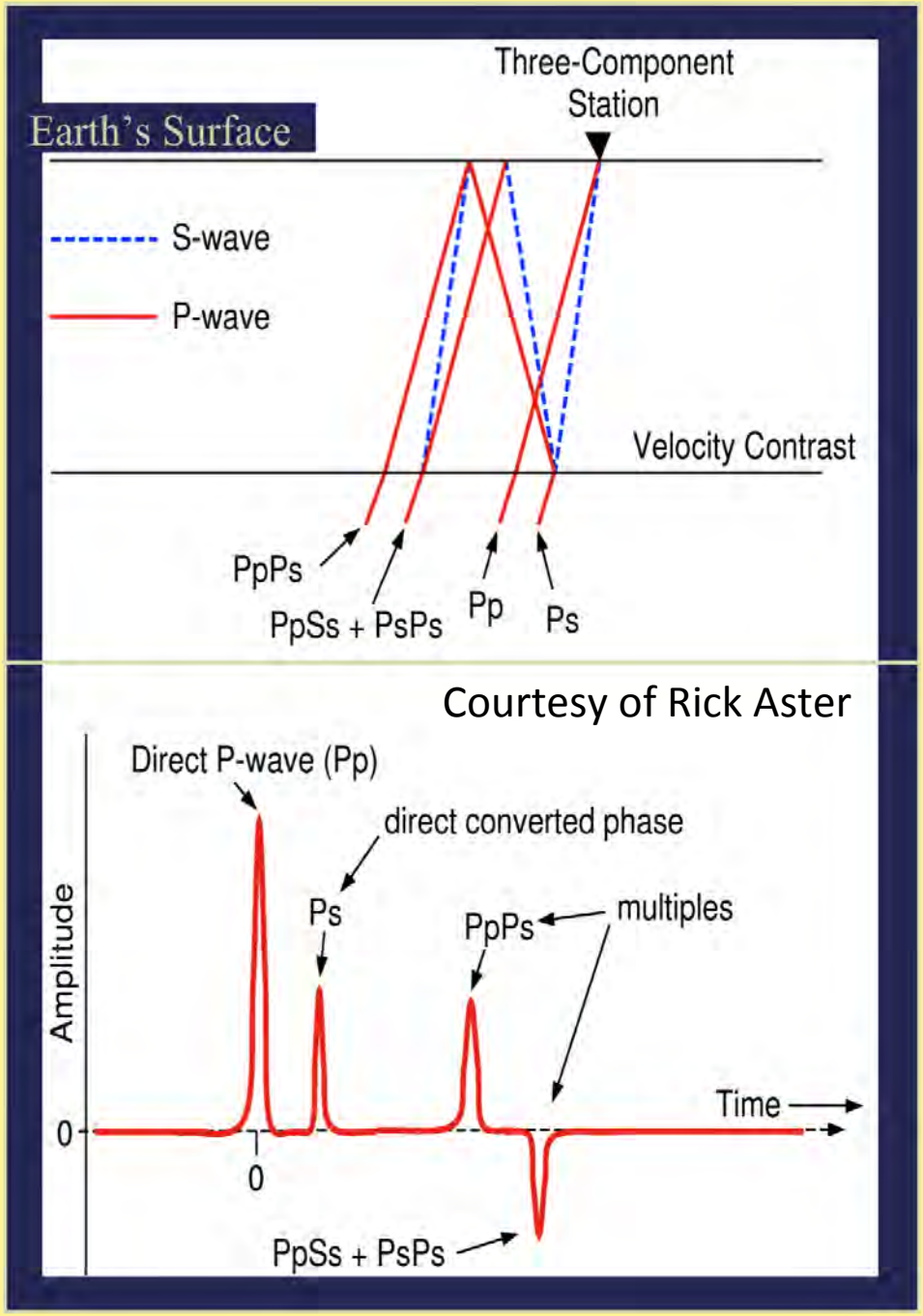
The representation of Earth's structure under a seismic station or the receiver that is derived from an incoming teleseismic wavefield.

The term "receiver function" has been used to define a time series that represents arrivals of P-to-S converted phases from sharp velocity boundaries. One of the strongest of these boundaries is the Moho.

P-wave energy partially converted to S at discontinuities.

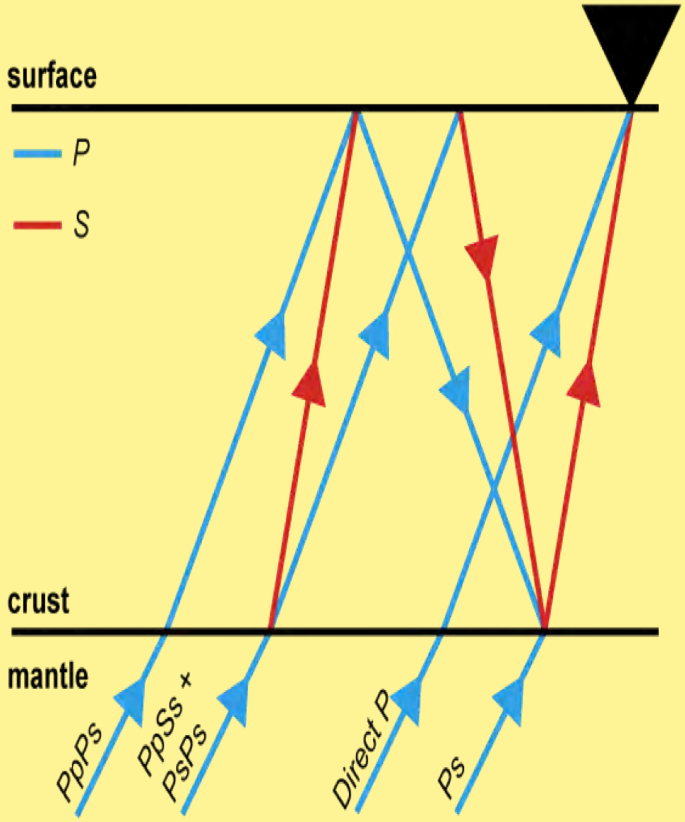
Same goes for S to P conversions.

There are various stacking techniques employed and trends are usually not clear on individual traces.

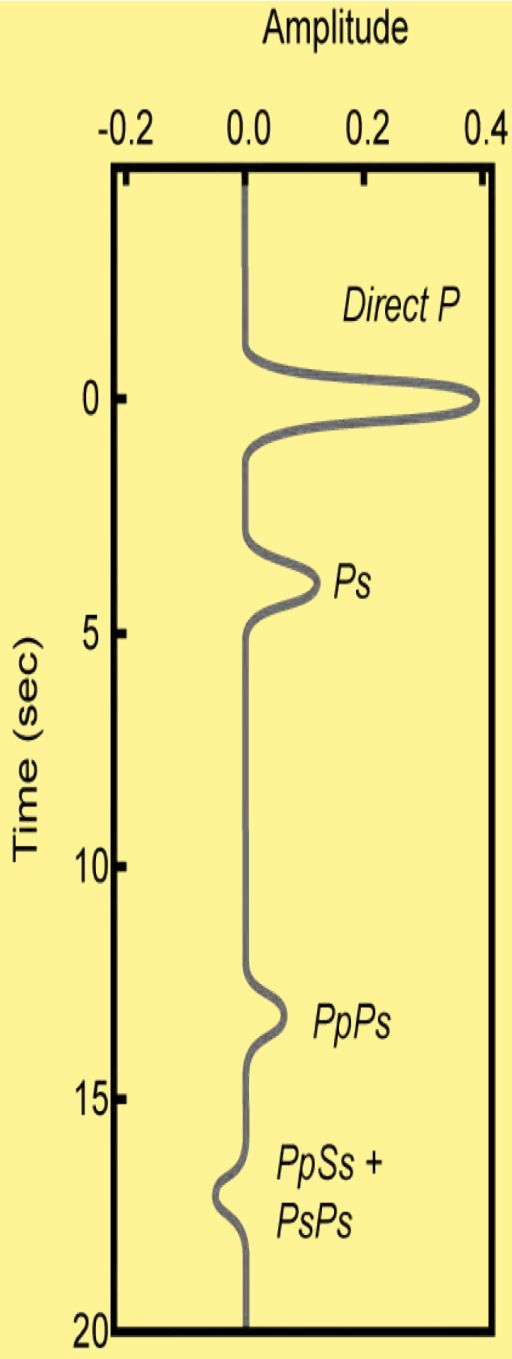


Ray paths of each of these important phases.

Simple 1-layer crustal model.



Courtesy of Kevin Eagar



This diagram shows a typical receiver function. Time is relative to the P wave and is expressed vertically.

Ps is the Primary arrival and is the conversion from the moho.

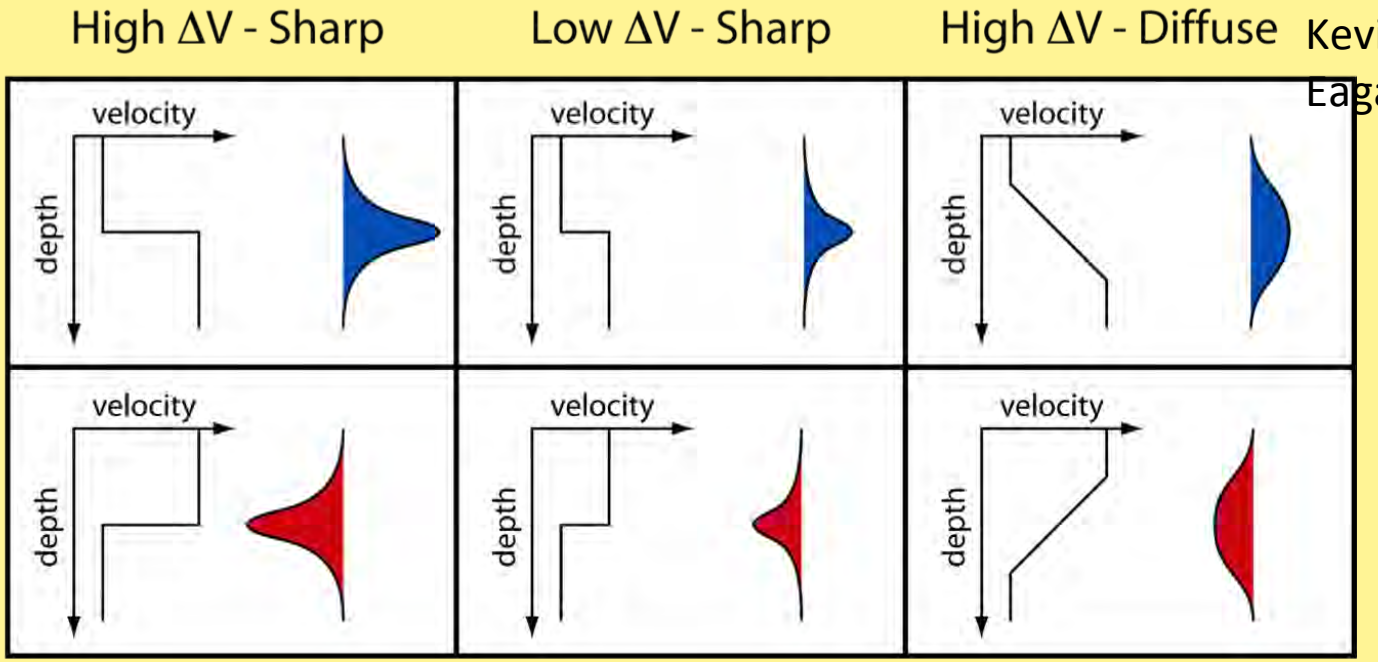
PpPs and PpSs+PsPs are internal crustal multiples or reverberations.

How to interpret RFs (the time series)

- Many bumps correspond to waveform phase changes and are likely noise.
- In order to decipher whether a data is a signal or noise, many are needed for stacking.
- Data processing side: Deconvolve vertical from radial seismogram

How to look at the RFs

Courtesy of Kevin Eagar



RFs are not seismograms though they look similar.

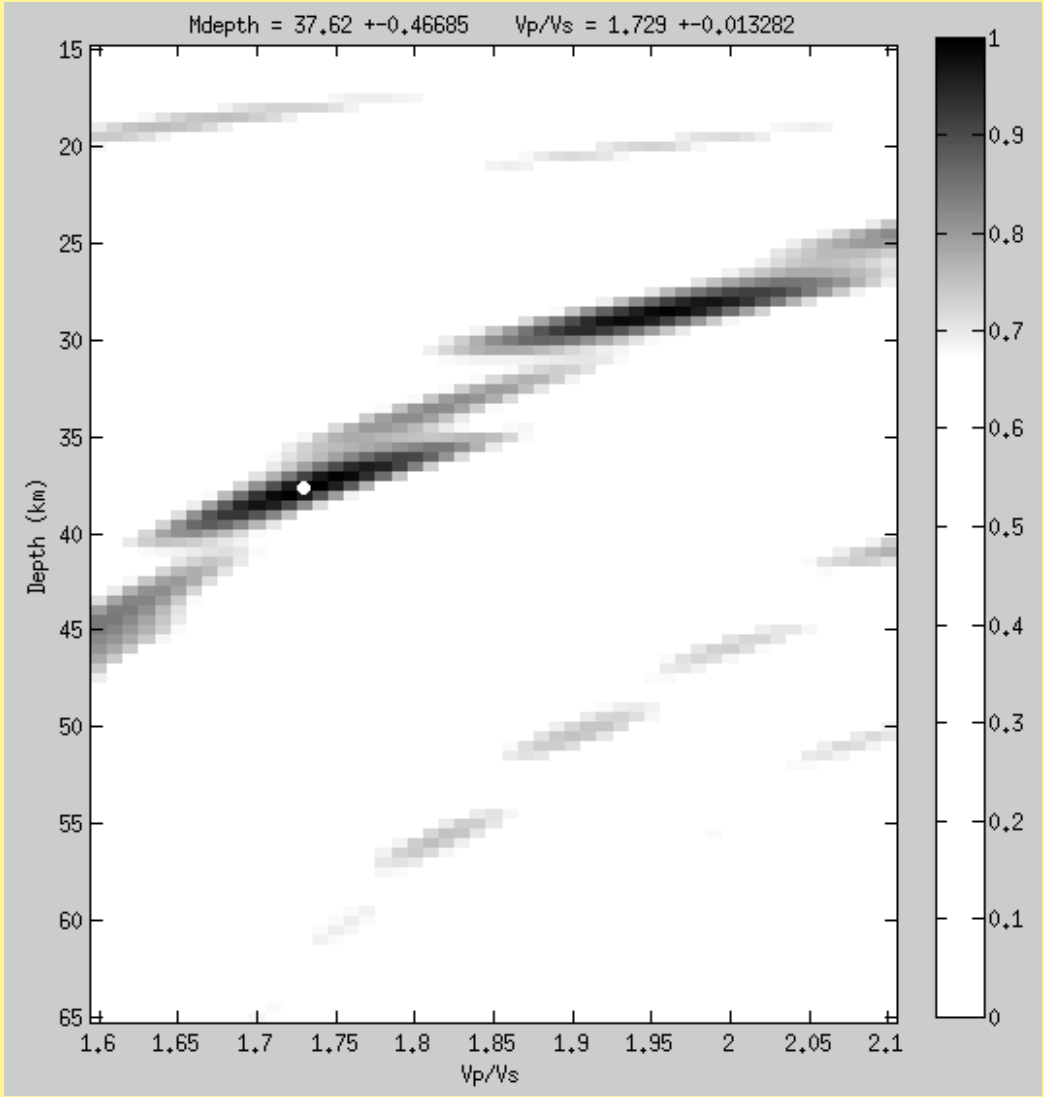
They are a time series that show bumps that represent converted P-to-S waves at the interfaces in the earth where there is a large velocity jump.

Start from high velocity to low velocity, going up. You will see a positive bump. If we go from low velocity to high velocity, you will see a negative bump. If the boundary is sharp, then you will see a longer wavelength bump and lower amplitude.

Stacking example

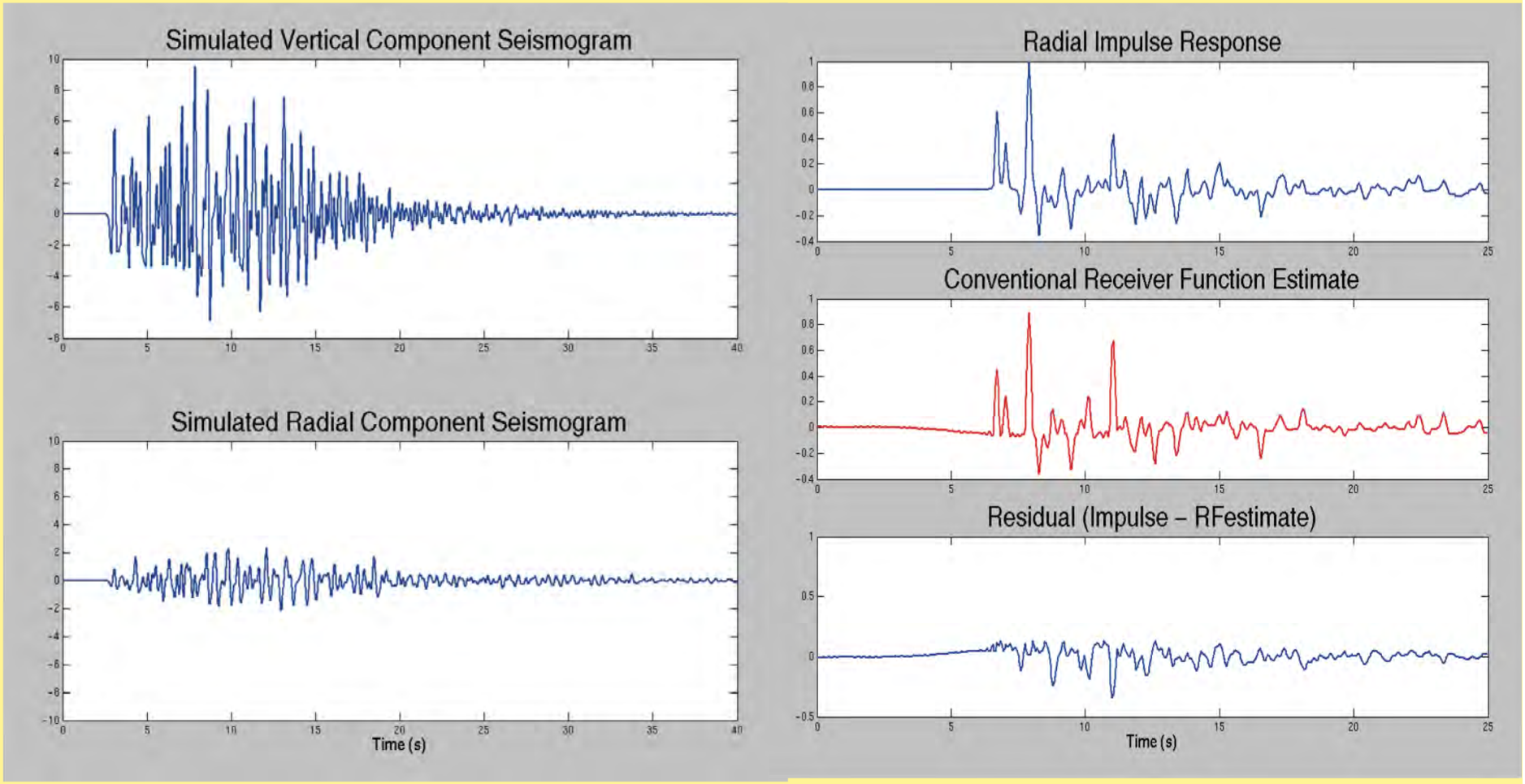
- H-k stacking is one of many ways to sum multiple RFs.
- H = depth of conversion or moho.
- k(Kappa) = Vp/Vs (tells the compositional variations)
- Tradeoffs between two in converting RFs (time series) to depth, thus grid search across range of both values

Paper (Gilbert): assumes a Vp/Vs and Vp and converts time to depth



H-k stacking of TA-P09A, courtesy of Eun-Sun

Treated as noise.



Courtesy of Kevin Eagar

Gilbert paper summary I

- Thick crust under Colorado plateau.
- Thin crust under basin and range.

EarthScope EARS

- South Carolina EarthScope Automated Receiver Survey
  - There has been effort towards configuring crustal receiver function.
  - This program is useful for “simple” stations.
  - But is bad for stations with crustal complexity.

EarthScope RF efforts underway

- Surprisingly, not a lot of papers published yet.
- Many in the works:
  - Eagar (crust and upper mantle discontinuities)
  - Miller (lithosphere-asthenosphere boundary)
  - Gilbert (crust)
  - Gao (upper mantle discontinuities)