Origin of scattered phases in the coda of the core phases PKP(BC) and PKP(BC_{diff})

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European Research Council
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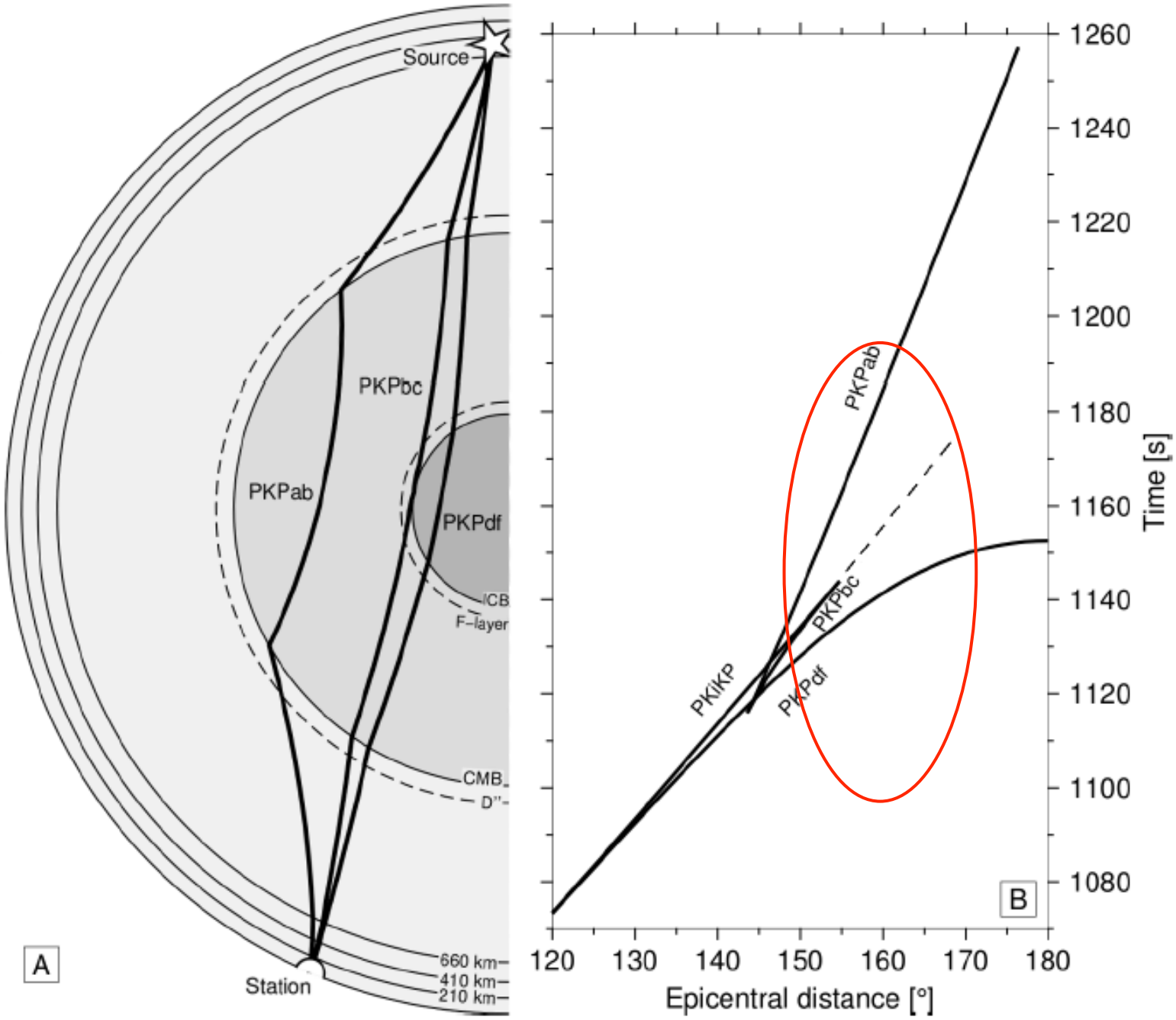
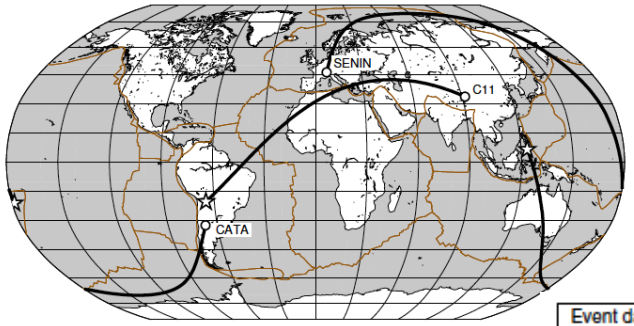
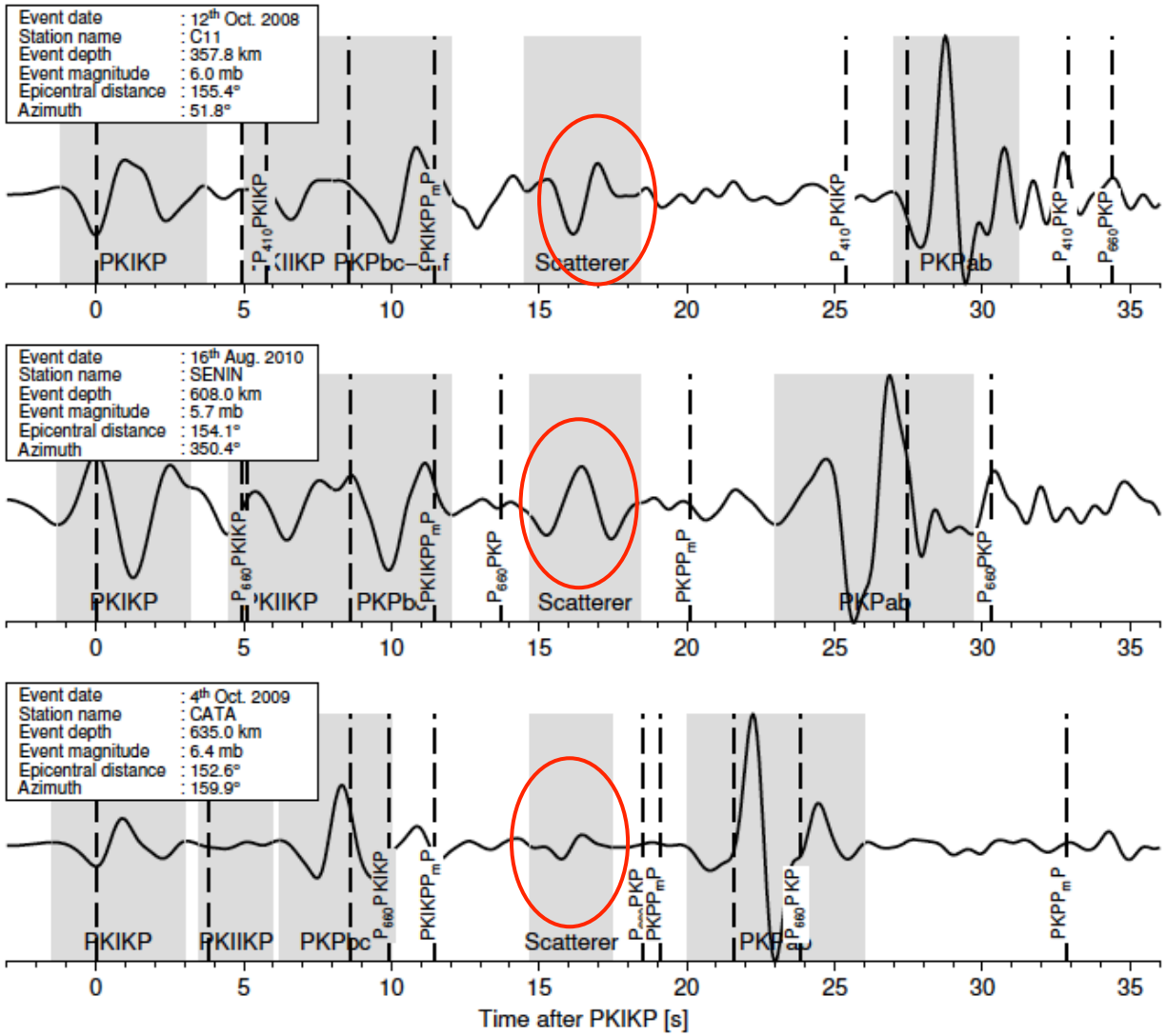
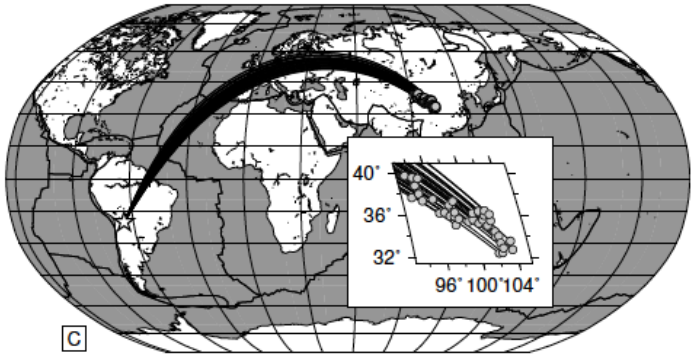

Source
PKPbc
PKPab
PKPdf
ICB
F–layer
CMB
D''
660 km
410 km
210 km
Station
A
PKPab
PKPbc
PKIKP
PKPdf
B
120
130
140
150
160
170
180
1260
1240
1220
1200
1180
1160
1140
1120
1100
1080
Time [s]
Epicentral distance [°]



Filter (corners): 0.7 -1.5 Hz

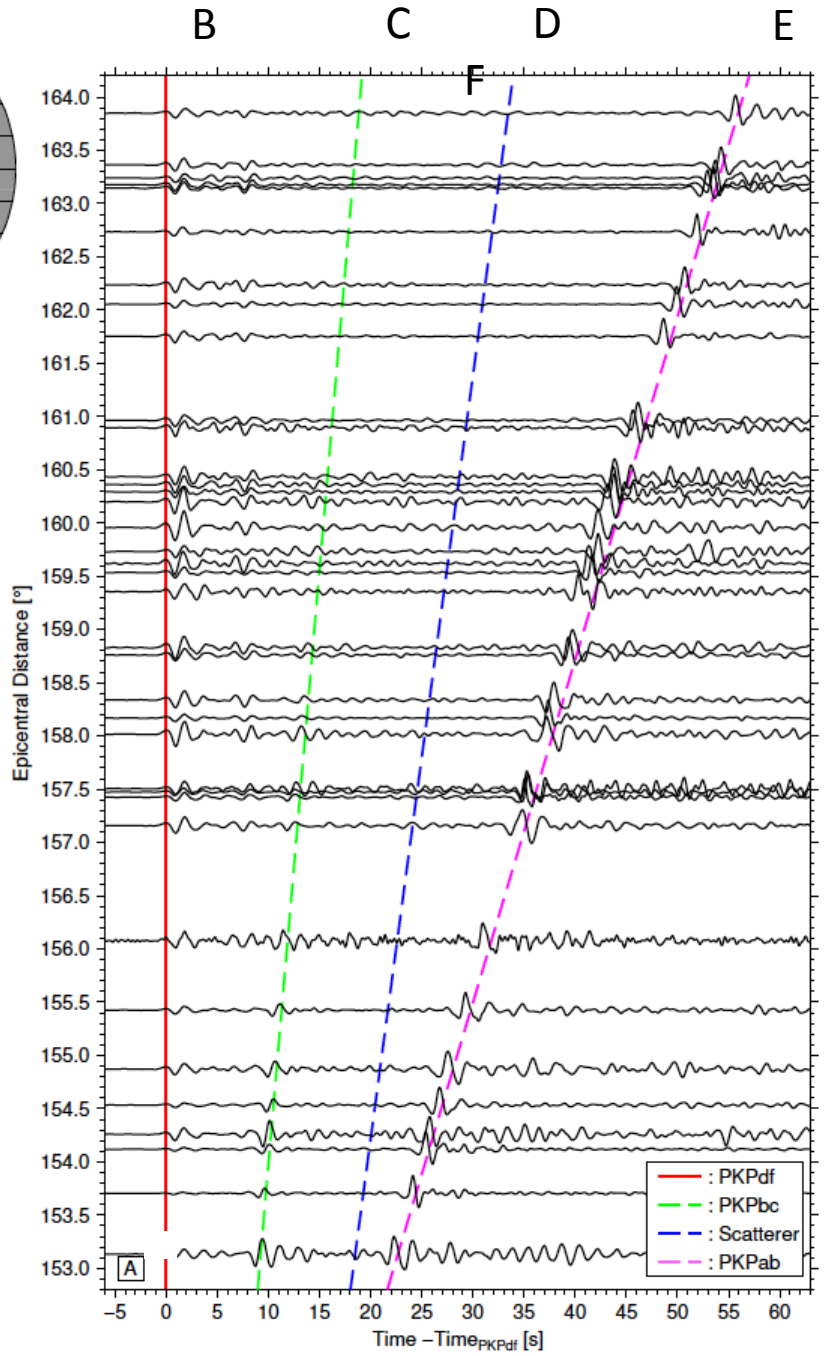
M ?

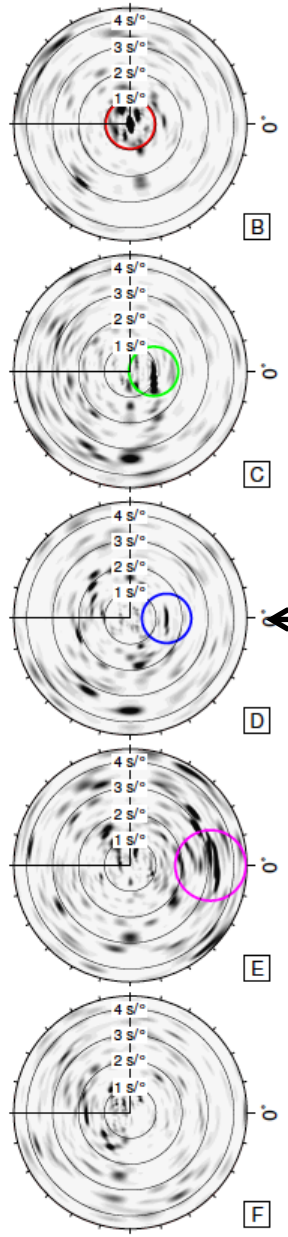




Event:

S. Bolivia 10/12/08 Mw 6.18
Depth 351 km
Observed in China

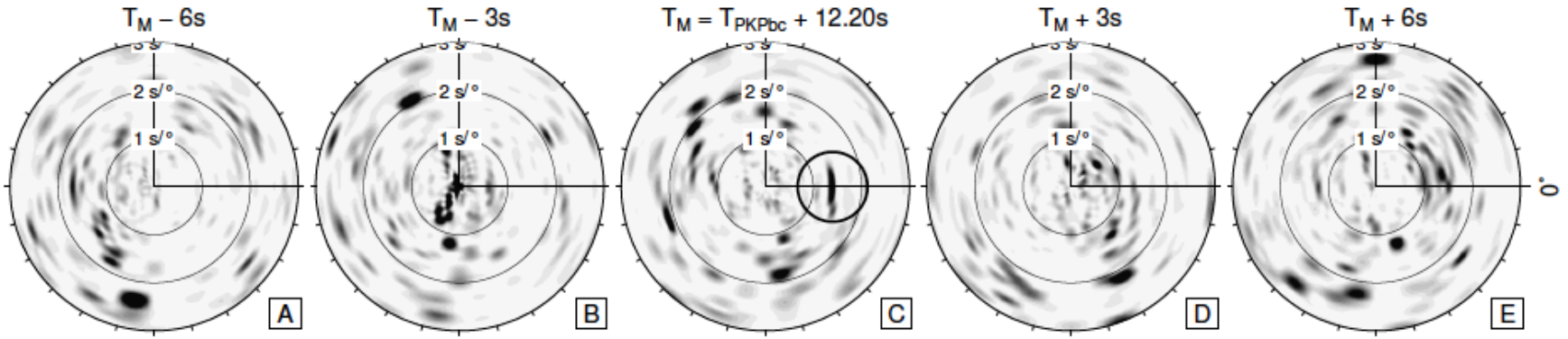




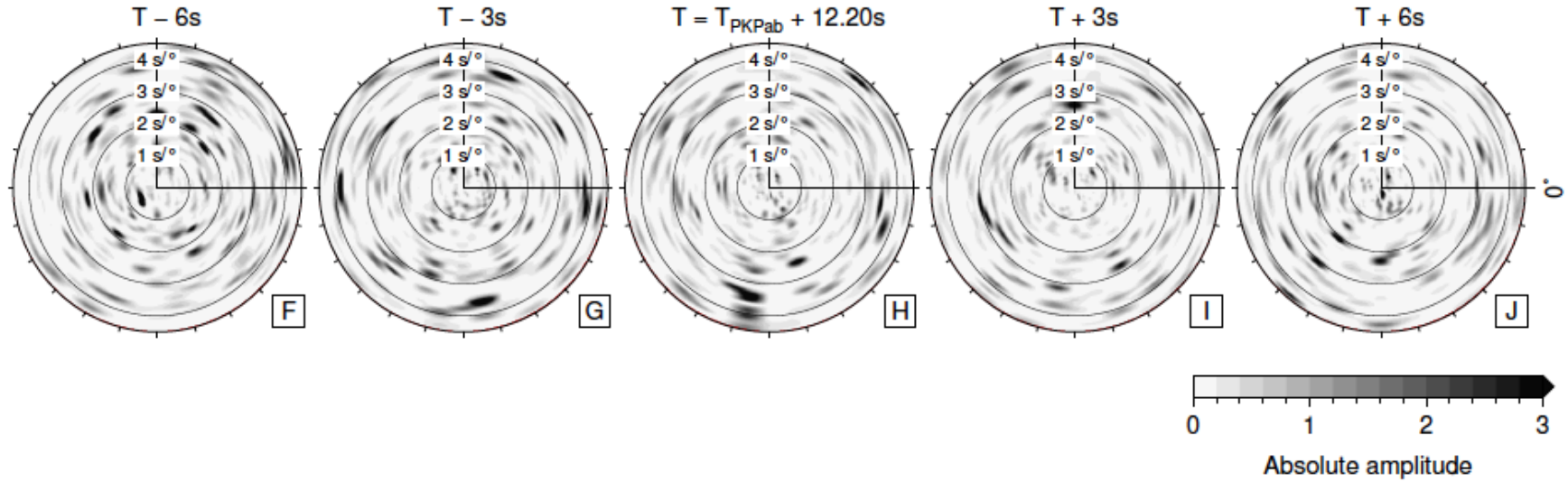
Adam and Romanowicz, PEPI, in press

S. Bolivia 10/12/08 to China
Phase weighted stack beamforming at different times

Behind PKPbc



Behind PKPab



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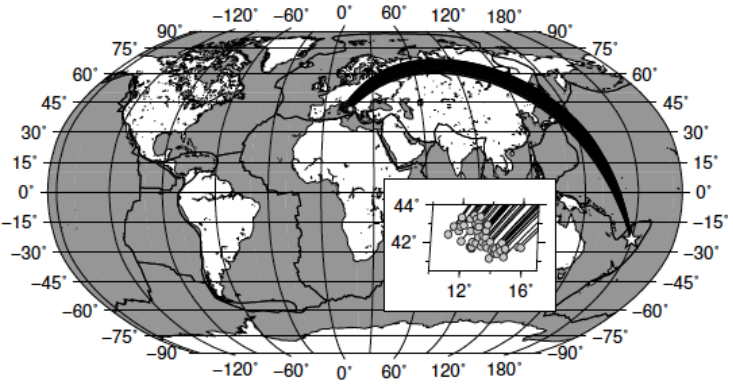
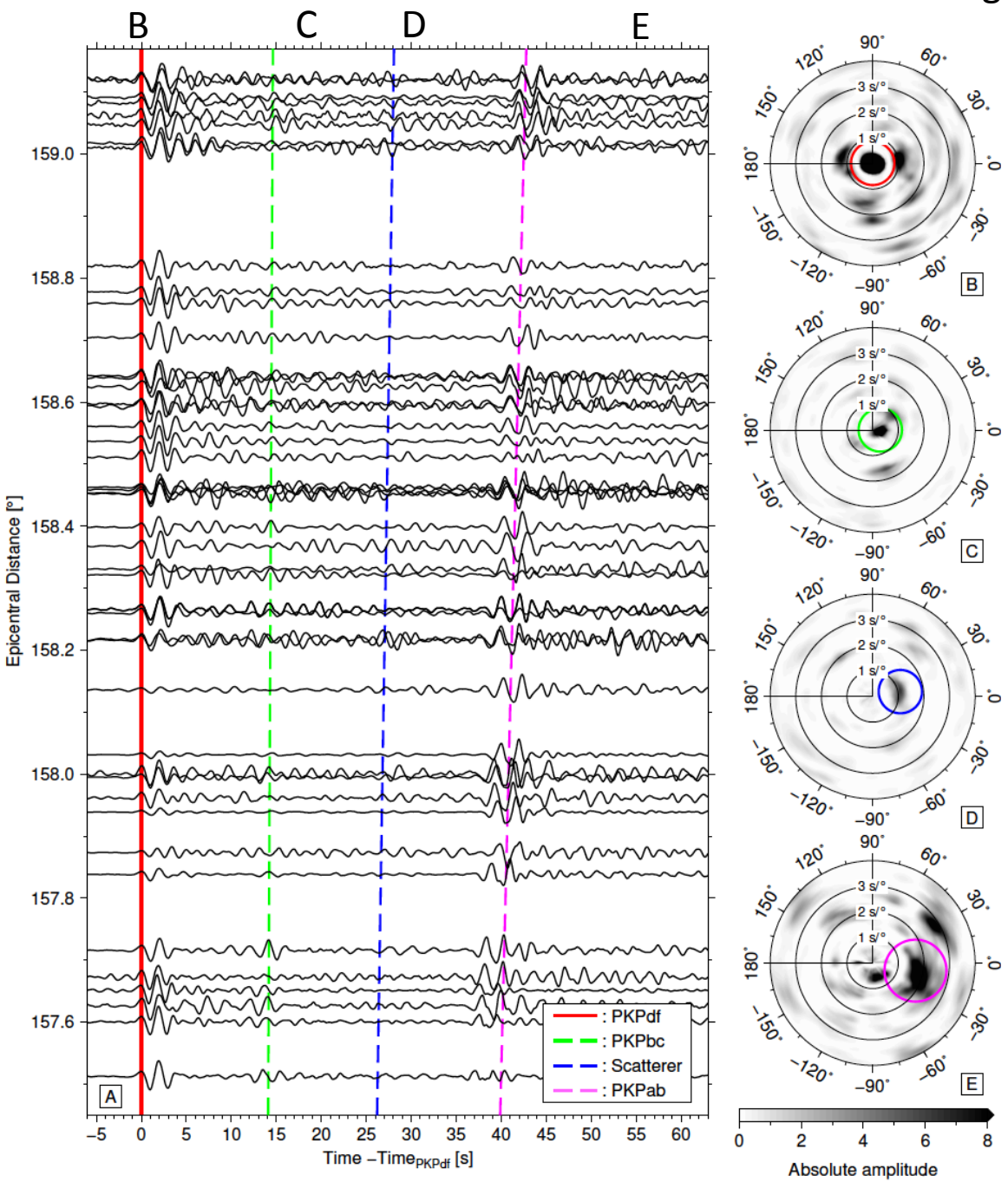


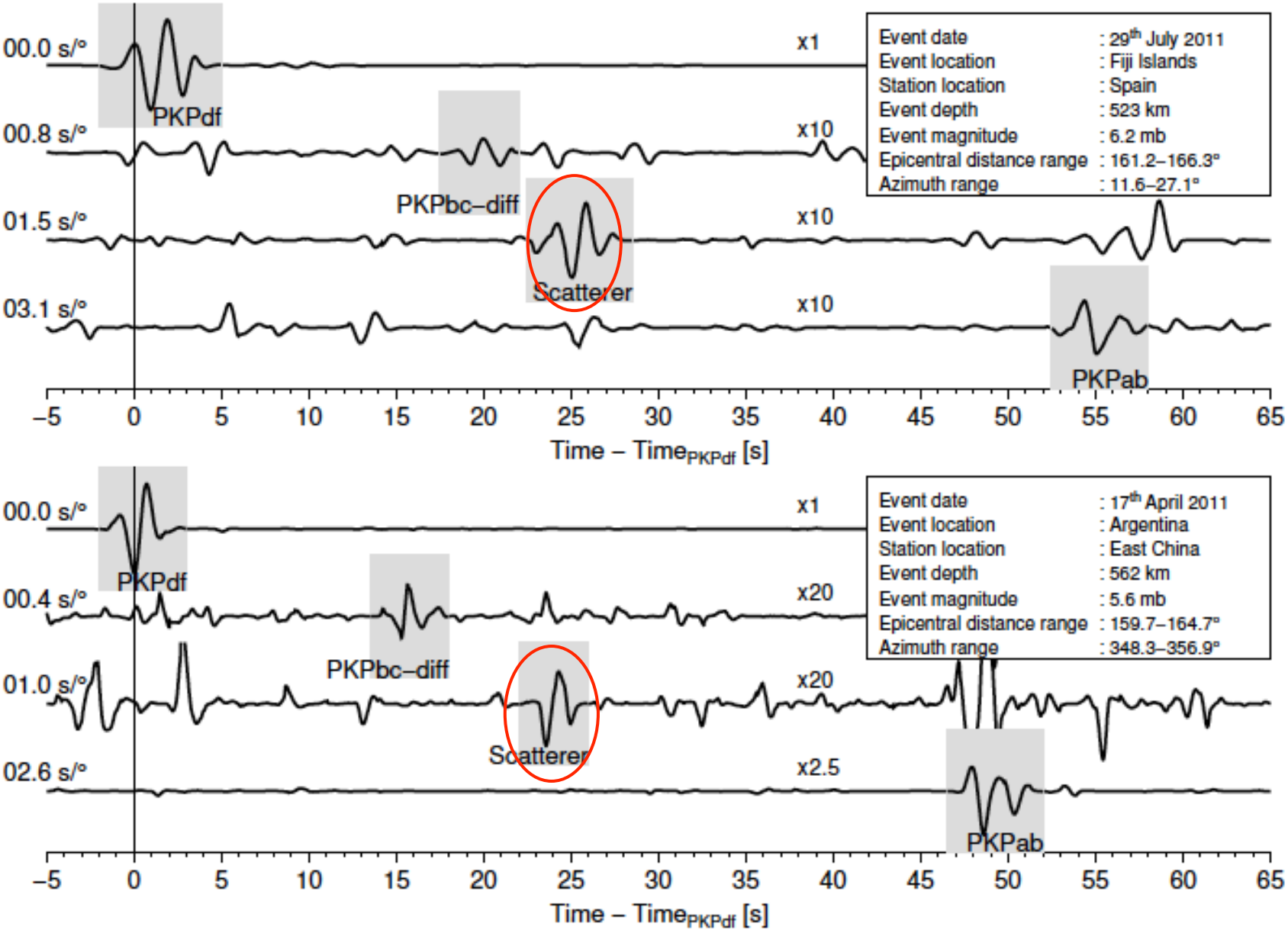
Event:

Fiji Islands 07/29/2011
Depth: 529.2, Mw 6.73
Observed in Italy

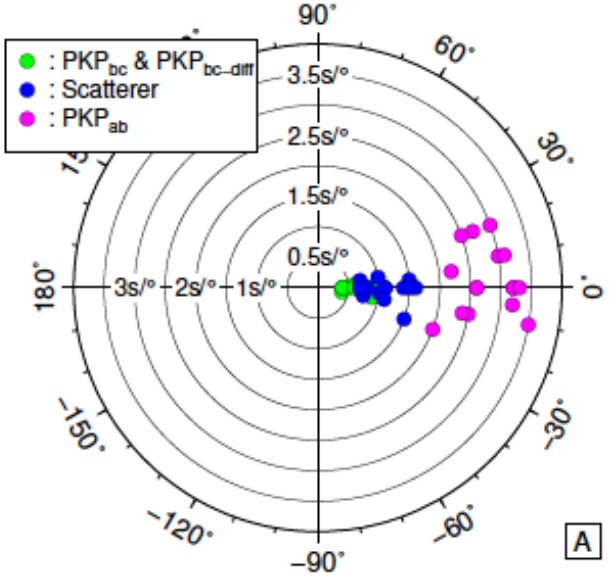


Adam and Romanowicz, PEPI, in press

Examples of waveform stacks for slownesses corresponding to DF, BC-diff, M and AB



Result of beamforming analysis for 11 events in South America and Fiji.

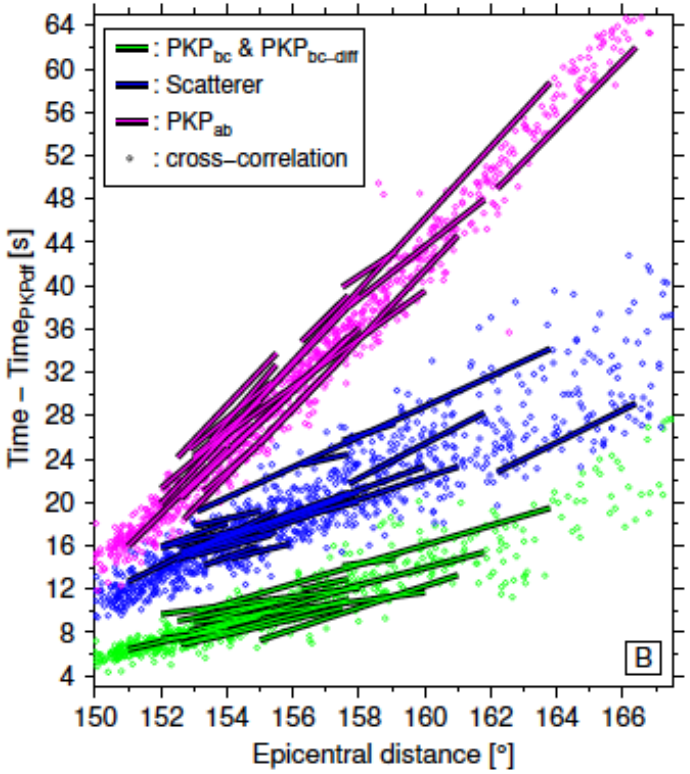


Along the great circle path

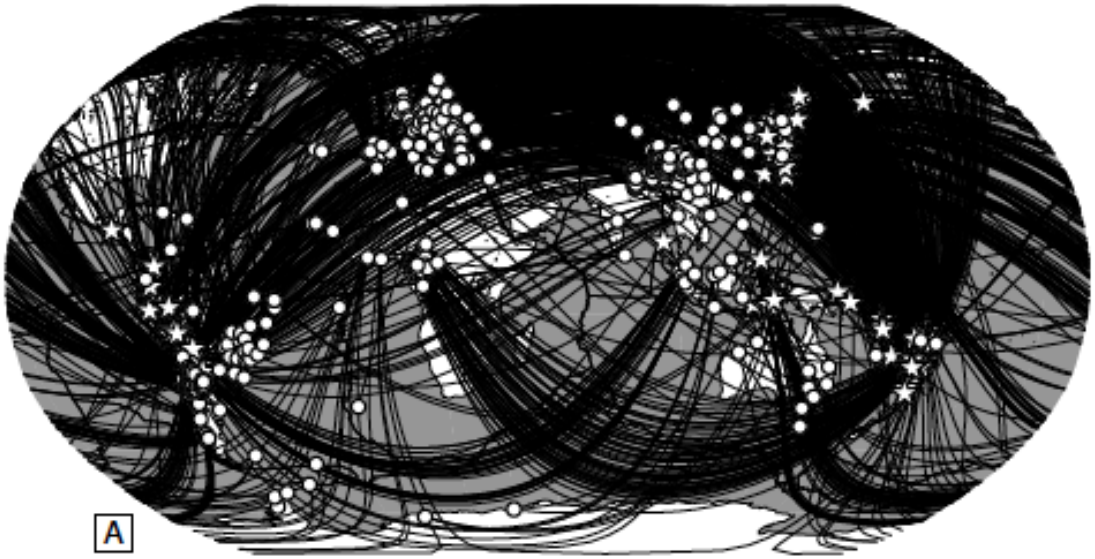
Comparison of travel times (relative to DF):

1) Predicted from beamforming analysis

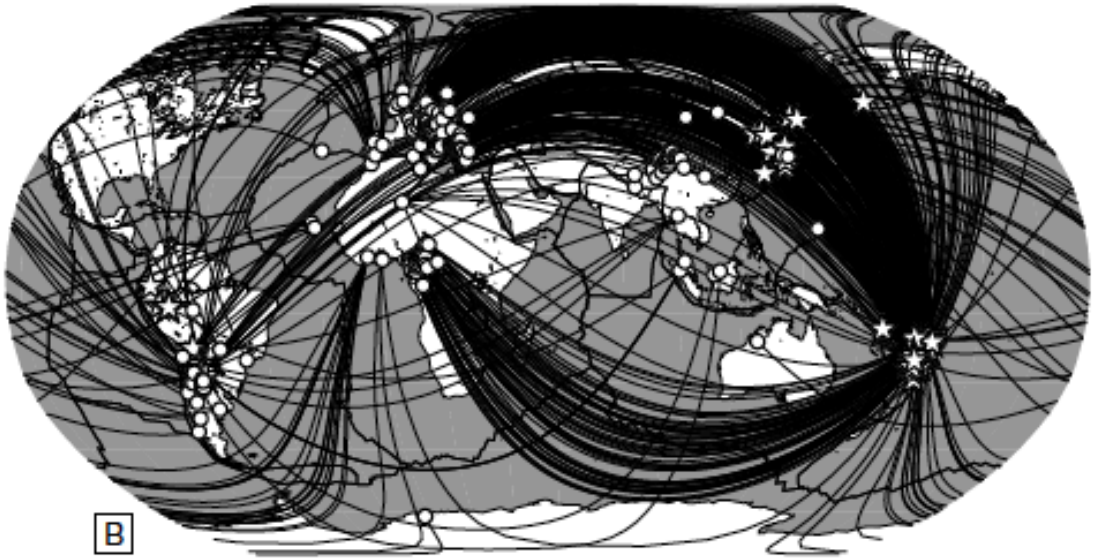
2) By cross-correlation with PKPdf



Paths with detected M phase



Paths without detection



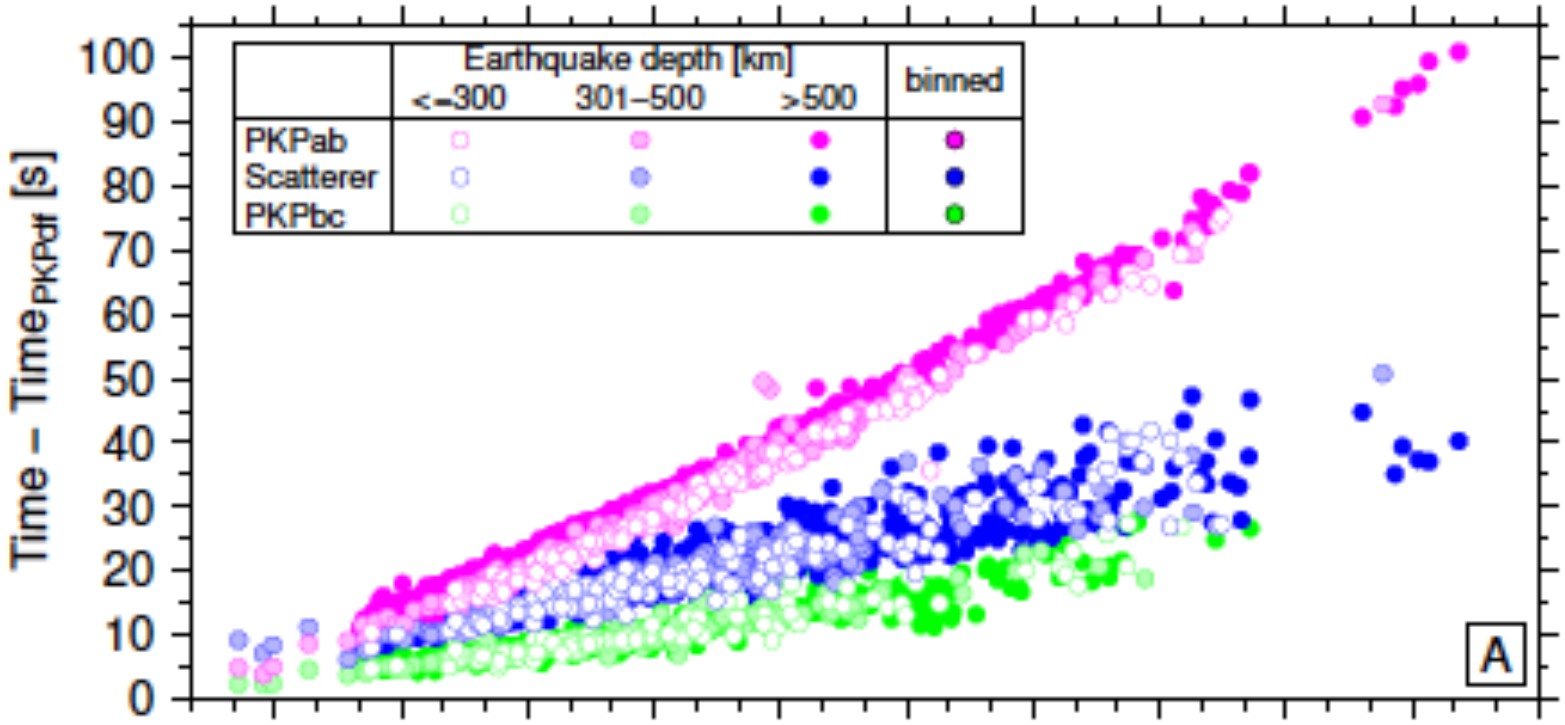
No clear geographical Pattern:

- No hemispherical pattern

- No variation with angle with respect to the rotation axis

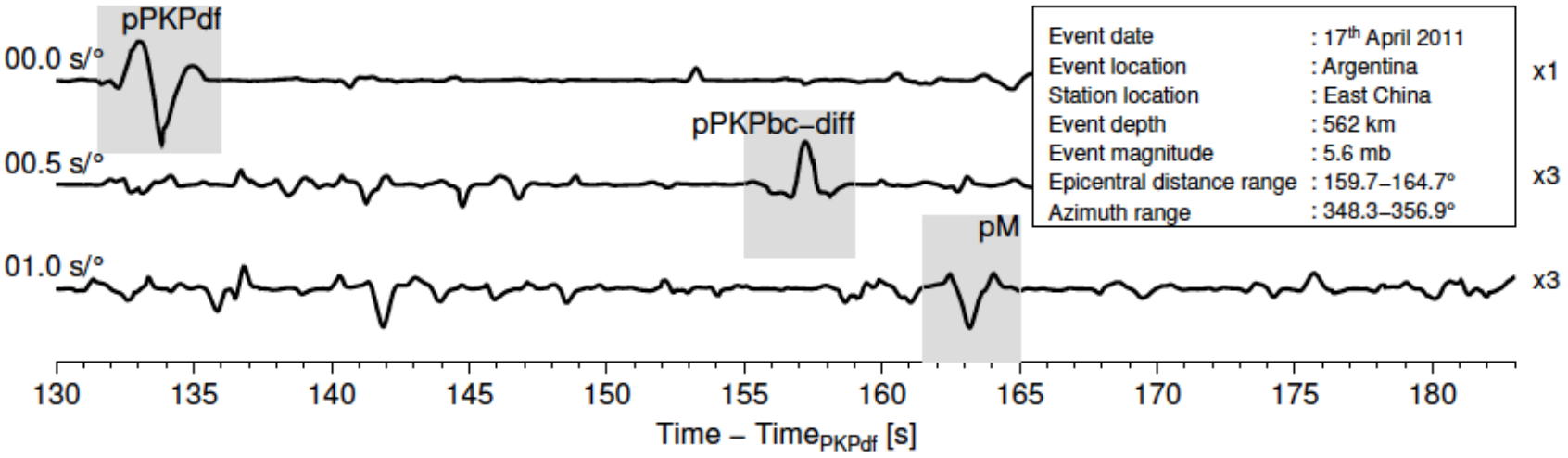
- Travel time delay with
- Respect to PKP(DF) >10

Travel time trend: no particular relation to earthquake depth



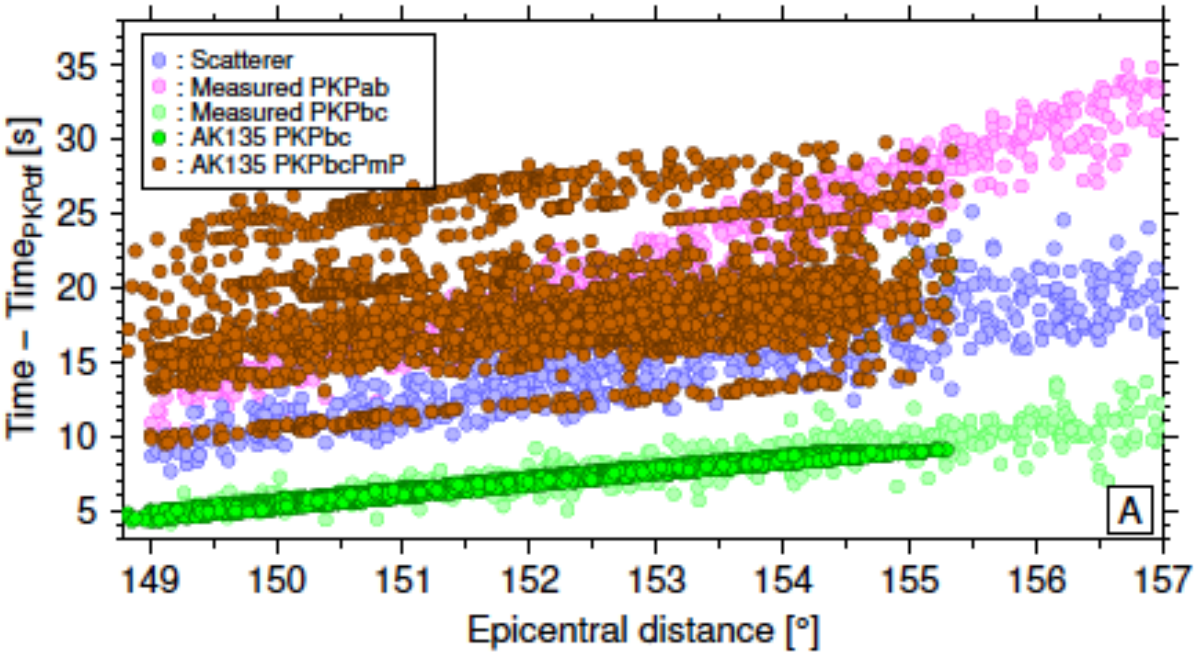
=> Unlikely origin in the source region

The depth phase pM is also detected…..

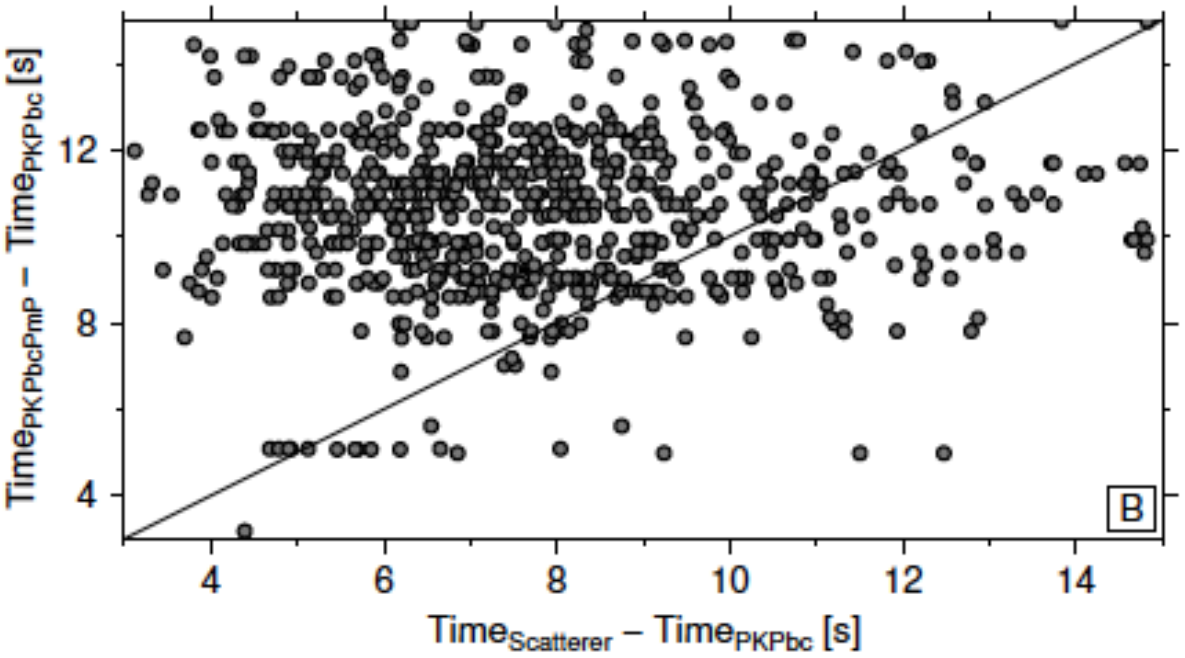


Relation to PKPbcPmP on station side?

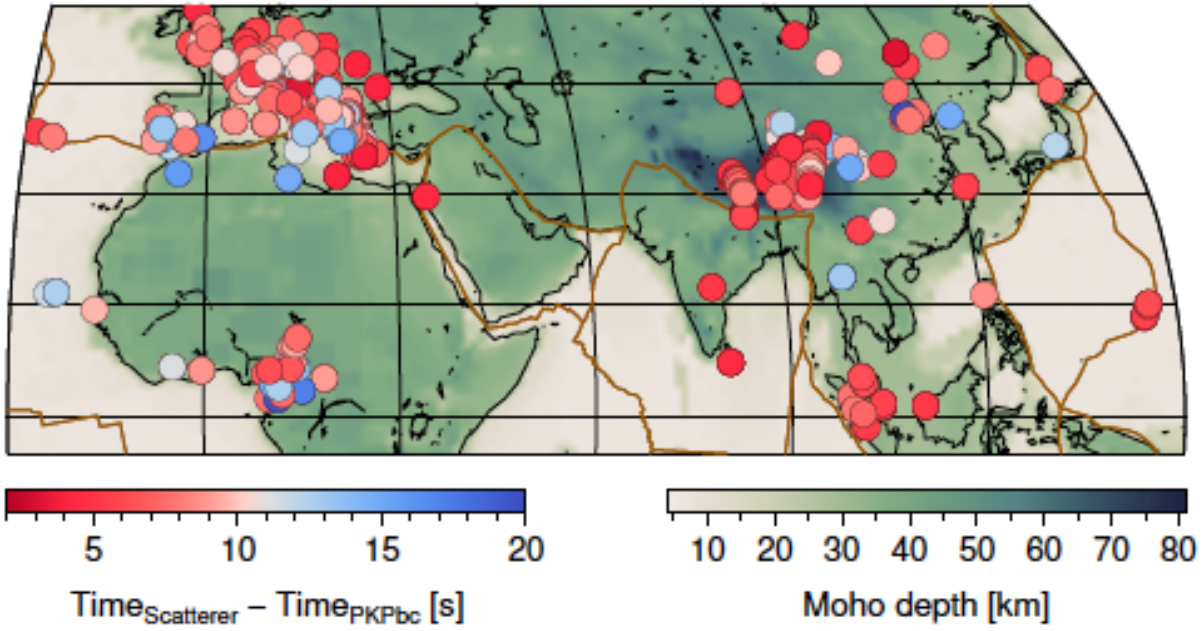
Slowness does not match

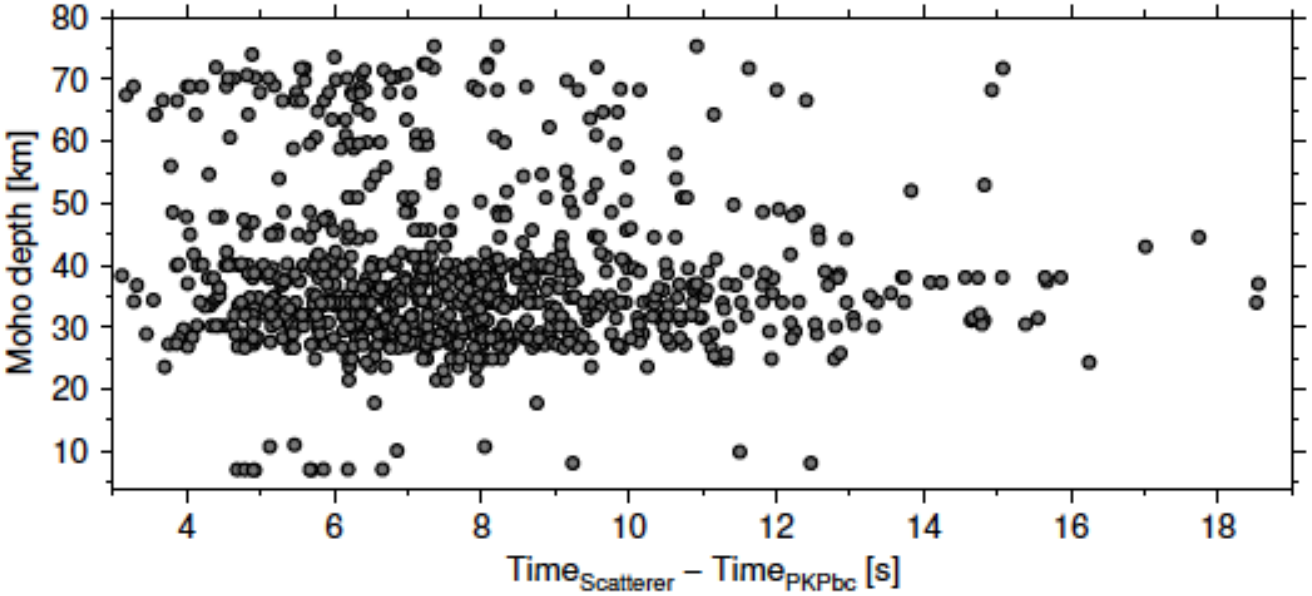


No correlation in travel time between PKPbcPmP and the M phase

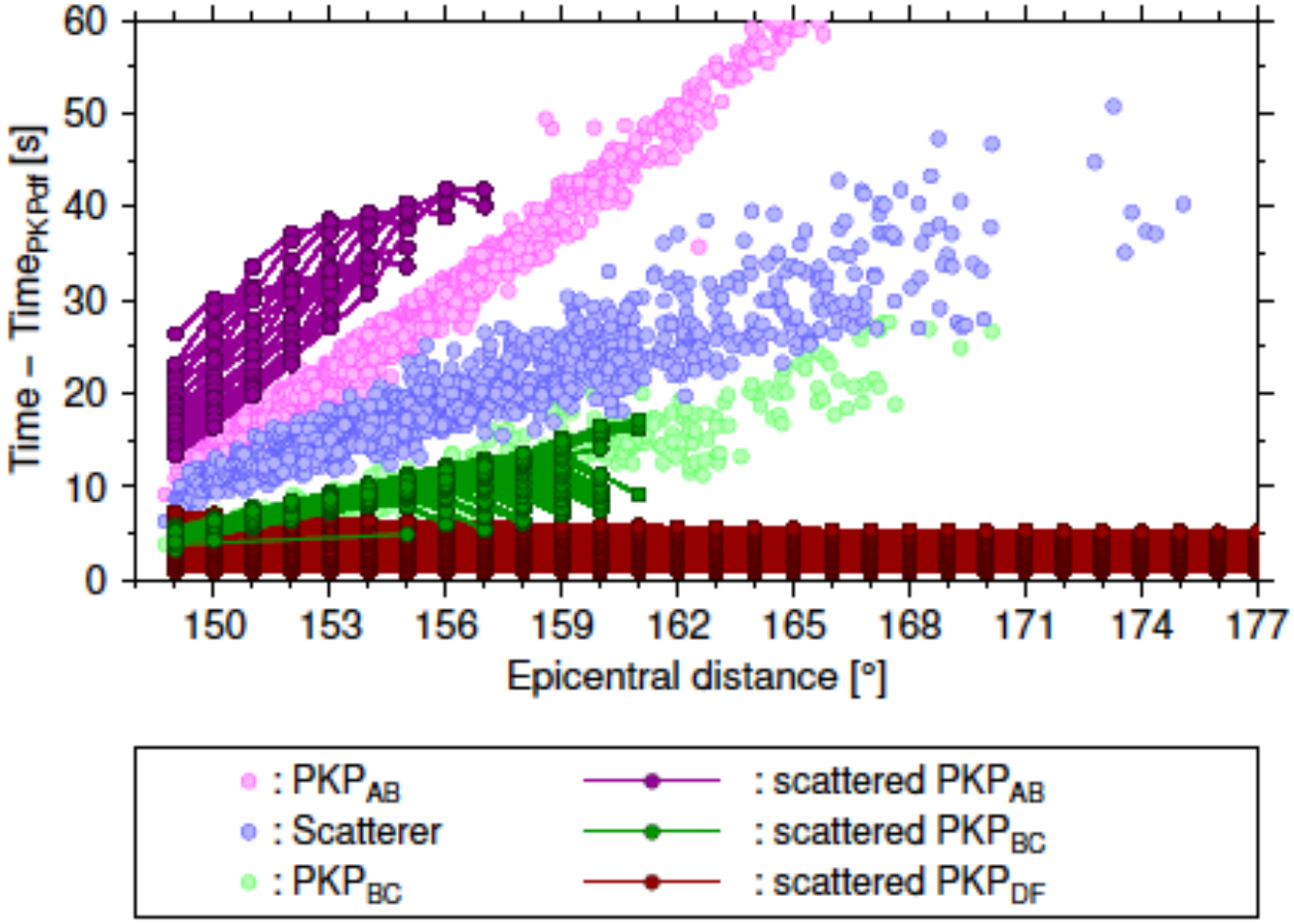


No correlation with Moho depth on the station side



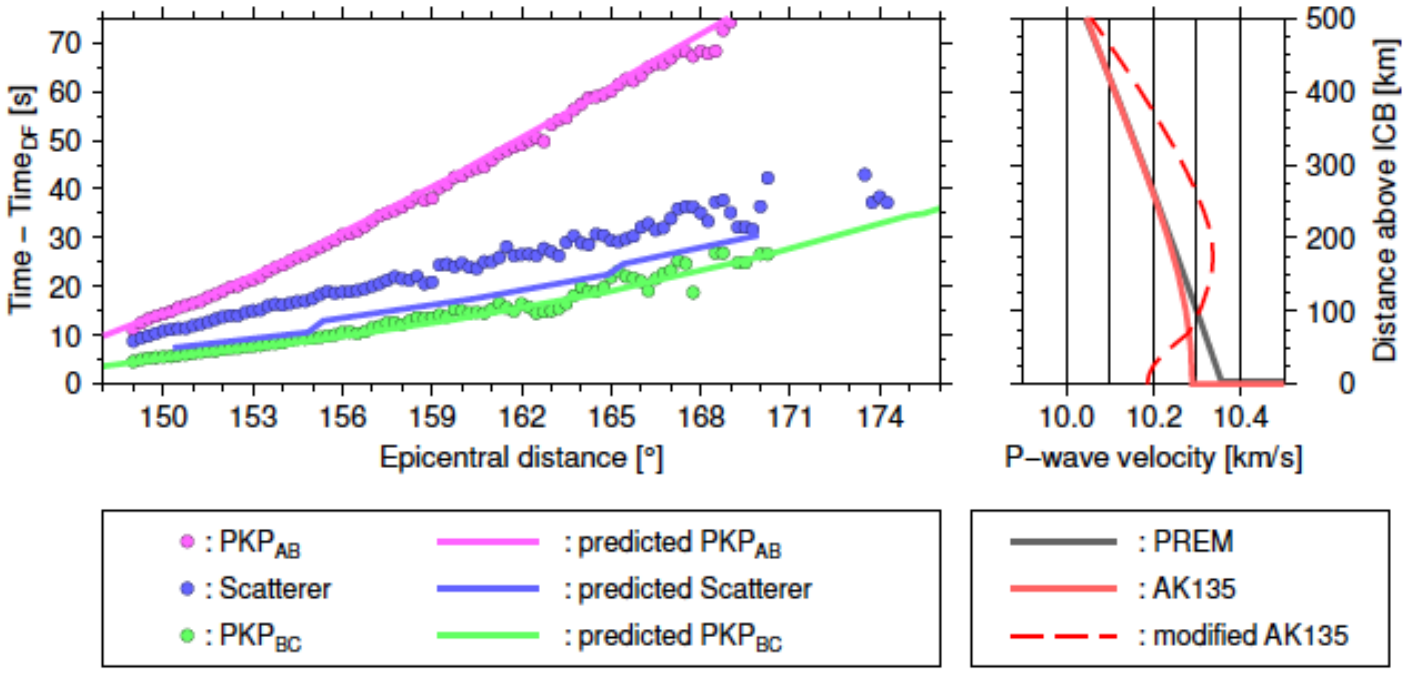


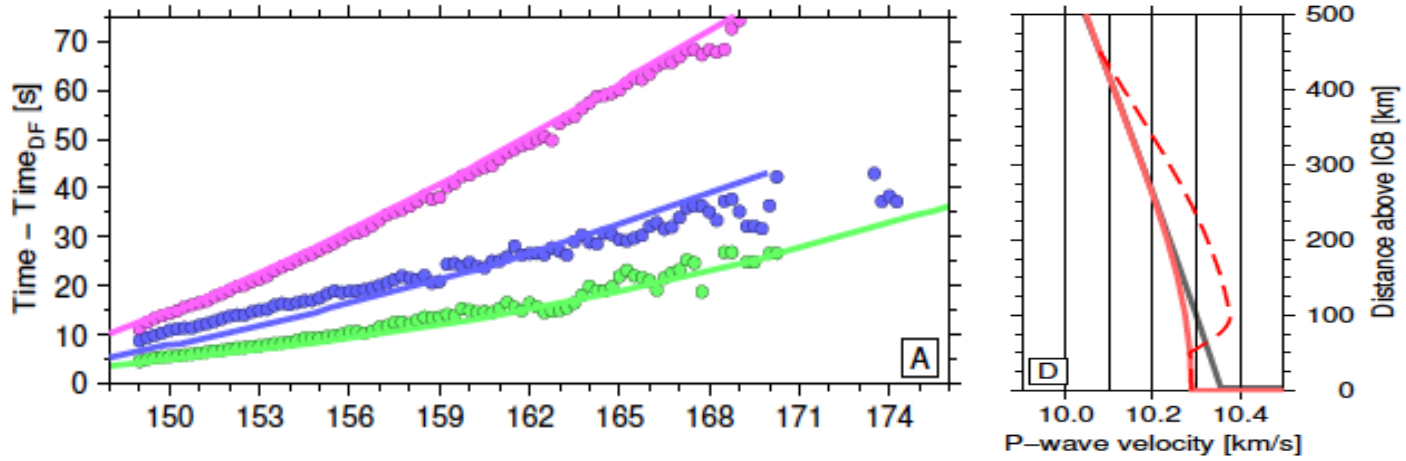
Single scattering theory: predicted travel times (with respect to DF) for scatterers located 0-400 km above or below the CMB, on source or station side.



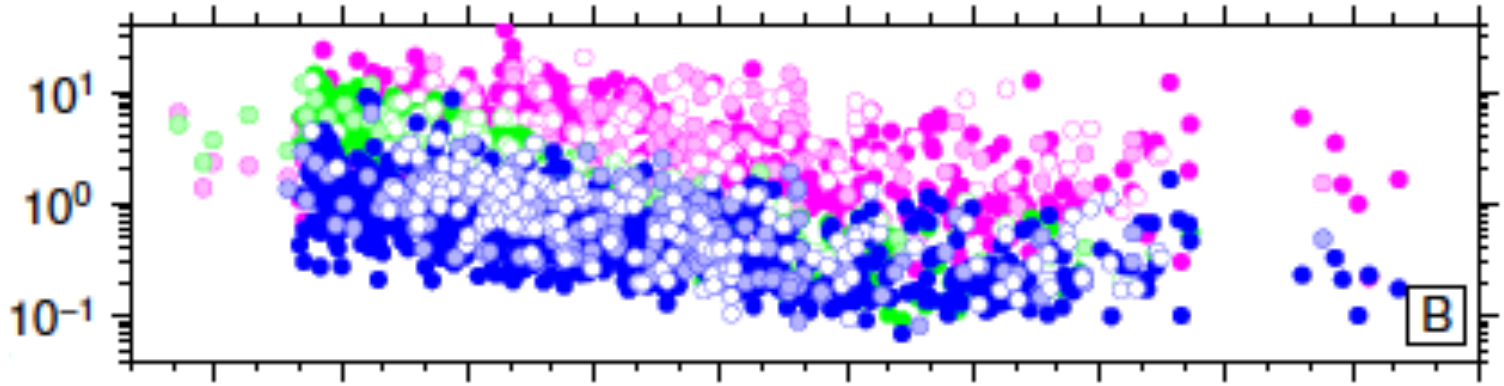
Note: Scatterers considered correspond to slowness between 0.7 and 1.6s/° to be consistent with PWS results for M phase

Modified P wave velocity models near the Inner Core Boundary

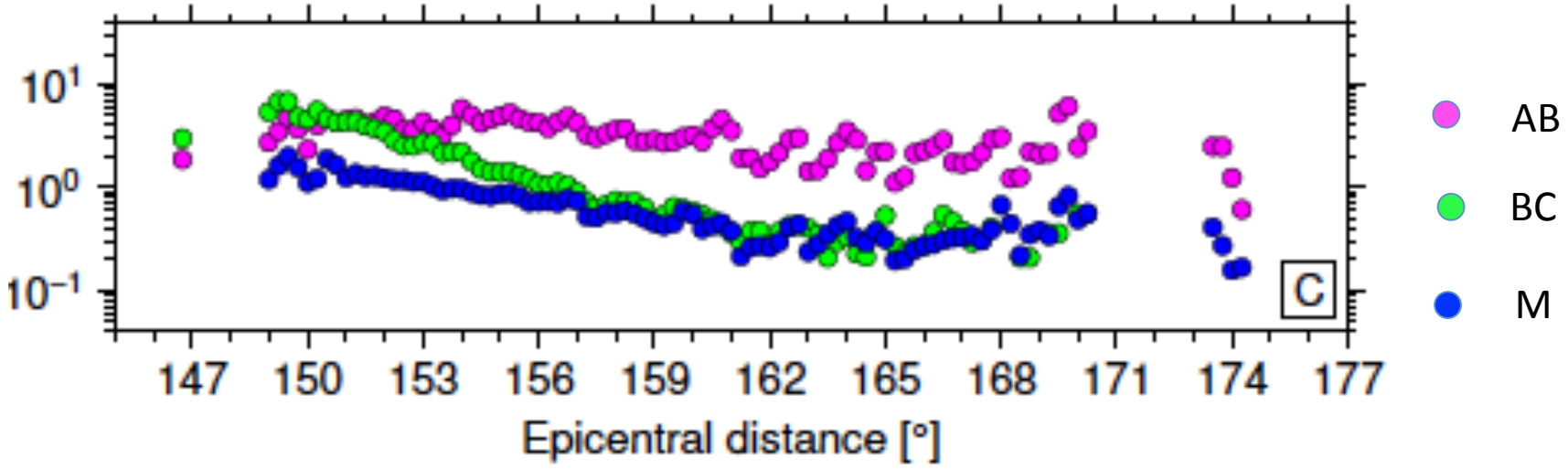




Amplitude ratios with respect to PKPdf as a function of epicentral distanc



Binned over sliding windows of 0.5deg in distance with 0.25deg step:



	Earthquake depth [km] <=300	301–500	>500	binned
PKPab				
Scatterer				
PKPbc				

Conclusions

- We have identified scattered energy ("M phase") which arrives 5-20 s after PKP(bc) or PKP(bc-diff) not predicted by 1D reference seismic models
- Array analysis allows us to determine that this energy arrives along the great circle path in a narrow range of ray parameters (~ 1s/° with respect to PKP(df)
- Ruling out other causes, most likely originates at the base of the outer core
  - Structure causing earlier diffraction in a single scattering sense
    - Thin low velocity layer above the ICB?
    - ICB topography?