Online Supplement:

Inversions were run for stations DJJ, MWC, PKD, and RPV three times, varying the inversion parameters to determine if dip alone could adequately explain the signal observed at stations, or if anisotropy is required. These results show that while dip can partially explain the observed signal, it results in a higher misfit than anisotropy. Using dip to explain the signal also requires a steeply-dipping Moho (up to 45°), which is highly unlikely geologically. Inverting for both dip and anisotropy simultaneously generally produces lower misfit values than inversion for either dip or anisotropy individually, but does not significantly change the trend of anisotropy. The disadvantage of the simultaneous inversion is that stability is lost when increasing the number of free parameters. Given how little the anisotropy measurements changed when a dipping layer was included, and the difficulty in explaining the observed signal with just dip, stations were modeled assuming that all tangential energy is the result of anisotropy.

Online Supplement Captions:

Table S1. Inversion results by station. Inversion parameters and their ranges are shown above.

Figure S1. Comparison of inversion results when inversion parameters are varied. Column 1 is the recorded data, column 2 is inversion results for anisotropy, column 3 is inversion results for dip and column 4 shows the inversion results for both dip and anisotropy.

Layer	Thickness (m)	Density (kg/m3)	P Velocity (m/s)	Vp/Vs	Isotropic	% Anisotropy	Anisotropy Trend	Anisotropy Plunge	Strike	Dip
Anisotropy										
1	10000-28000	2700	6400	1.75	Y	0	0	0	0	0
2	2000-15000	2700	6200	1.75	N	-20-0	0-360	0-90	0	0
3	10000	3300	7800	1.74	Y	0	0	0	0	0
4	0	3300	7800	1.74	Y	0	0	0	0	0
Dip										
1	10000-28000	2700	6400	1.75	Y	0	0	0	0	0
2	2000-15000	2700	6200	1.75	Y	0	0	0	0	0
3	10000	3300	7800	1.74	Y	0	0	0	0-360	0-50
4	0	3300	7800	1.74	Y	0	0	0	0	0
Anisotropy + Dip										
1	10000-28000	2700	6400	1.75	Y	0	0	0	0	0
2	2000-15000	2700	6200	1.75	N	-20-0	0-360	0-90	0	0
3	10000	3300	7800	1.74	Y	0	0	0	0-360	0-50
4	0	3300	7800	1.74	Y	0	0	0	0	0

Station Name	Layer 1 Thickness (m)	Layer 2 Thickness (m)	Layer 2 % Anisotropy	Anisotropy Trend	Anisotropy Plunge	Strike (Layer 2/3 Interface)	Dip (Layer 2/3 Interface)	Time Window Start	Time Window Stop	RMS Misfit
Anisotropy										
DJJ	13507	12749	-16.6	1	62	0	0	1	5	1.86E-02
MWC	22385	11931	-20	209	46	0	0	2	5	3.38E-02
PKD	24065	8399	-20	236	31	0	0	2	5	4.11E-02
RPV	18469	8633	-20	228	18	0	0	1	4	3.57E-02
Dip										
DJJ	18465	9724	0	0	0	285	19	1	5	4.01E-02
MWC	21764	7398	0	0	0	284	45	2	5	3.72E-02
PKD	27722	10678	0	0	0	141	39	2	5	4.68E-02
RPV	16587	11639	0	0	0	330	44	1	4	3.79E-02
Anisotropy + Dip										
DJJ	13530	13158	-17	3	56	79	7	1	5	1.85E-02
MWC	21893	12290	-19.4	206	42	277	12	2	5	3.34E-02
PKD	25005	9389	-19.5	249	37	139	28	2	5	3.99E-02
RPV	17105	11036	-15.2	223	51	316	41	1	4	3.51E-02

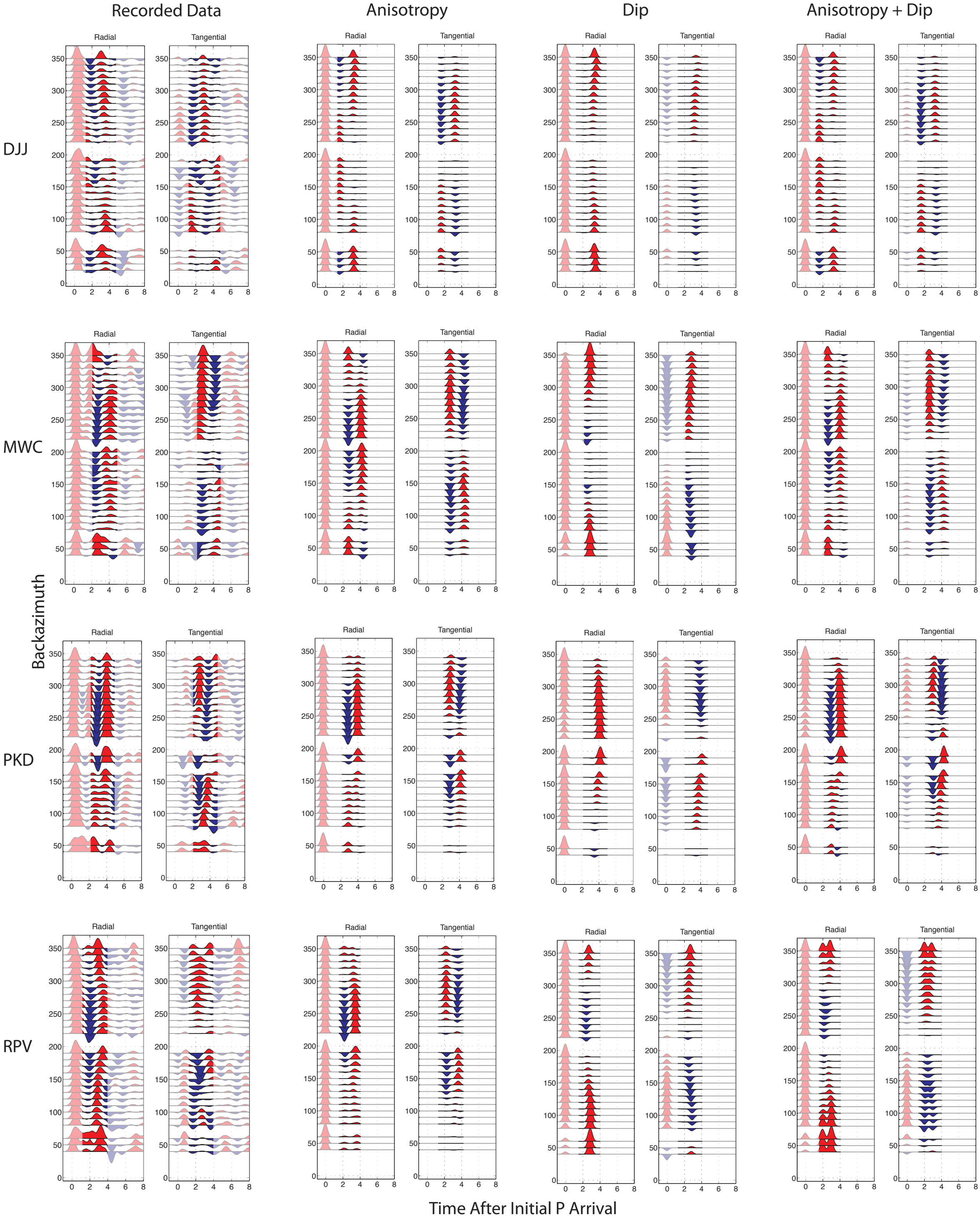

Figure S1. Comparison of inversion results when inversion parameters are varied. Column 1 is the recorded data, column 2 is inversion results for anisotropy, column 3 is inversion results for dip and column 4 shows the inversion results for both dip and anisotropy.