Shear-wave splitting observations from local and teleseismic earthquakes recorded in Alaska

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Description of files

figure	description	file name
–	this file	scholarworks_aksplit.pdf
Figure Lmap1–	stations maps for local S splitting	scholarworks_aksplit_Lmap.pdf
Figure Tmap1–	station maps for SKS splitting	scholarworks_aksplit_Tmap.pdf
Figure Lmeas1–	local S splitting measurements from MFAST	scholarworks_aksplit_Lmeas.pdf
Figure Tmeas1–	SKS splitting measurements from MFAST	scholarworks_aksplit_Tmeas.pdf
–	comma-delimited text file containing parameters for each local measurement. See Table 1.	scholarworks_aksplit_Lmeas.summ
–	comma-delimited text file containing parameters for each SKS measurement. See Table 1.	scholarworks_aksplit_Tmeas.summ

Within each set of figures, the figures are in alphabetical order by station name.

1 Station maps of splitting measurements

The figures contain ray path cross sections and splitting maps for every station used in the study.

1.1 Local splitting maps

For the local splitting data set we show two maps per station. The first is midpoint projection where the measurement is plotted at the midpoint of the ray. The second is event location projection where the measurement is plotted at the epicenter of the event.

Caption for local S splitting maps (Figures Lmap1–):
The following figures comprise the local spitting data set. Each figure contains: Splitting measurements from local intraslab earthquakes in this study. (top) Ray paths for all measurements, projected into the cross section shown at bottom. The solid red line is the subduction interface (*Hayes et al.*, 2018). Magenta line is the continental Moho (*Miller and Moresi*, 2018). Blue line is the Cook Inlet sedimentary basin (*Shellenbaum et al.*, 2010). Inverted triangles are stations. Stars are earthquakes colored by depth. Black lines leading from event to station are ray

paths. Dashed red line is the approximate bottom of the subducting oceanic lithosphere. (bottom) Midpont projection of all local splitting measurements. Black bars are individual splitting measurements with orientation parallel to ϕ and length scaled to δt. The red contours indicated the depth to the slab interface and range from 40 km to 180 km. Black and white dashed line represents the cross section seen above. Plate motion vectors: B15 (yellow) spreading alignement (*Becker et al.*, 2015), MM07-M (magenta) modified hotspot (*Morgan and Morgan*, 2007; *Doubrovine et al.*, 2012), NNR (red) no-net-rotation MORVEL (*Argus et al.*, 2011), SKS5 (green) SKS shear-wave splitting (*Becker et al.*, 2015), FNA (blue) fixed North America in MORVEL (*Argus et al.*, 2011).

1.2 SKS splitting maps

For the SKS data set there is one map per station. The SKS measurements are projected to the surface above where their ray path is located when 100 km deep (green dashed line in figures).

Caption for local S splitting maps (Figures Tmap1–):
The following figures comprise the SKS spitting data set. Each figure contains: (Top) Cross section for showing the subduction profile and the ray paths for high quality SKS splitting measurements. The solid red line is the the slab. Pink line is the Moho. Blue line is the Cook Inlet basin. Rough black line is the surface topography. Inverted triangle is the station with its name displayed to the left. Black lines leading to station are ray paths. Dashed red line is the approximate bottom of the subducting oceanic lithosphere. The green dashed line at 100 km depth shows where the splitting measurement is projected to in the map below. (Bottom) Black bars are individual SKS splitting measurements with orientation parallel to ϕ and length scaled to δt. Black and white dashed line represents the cross section seen above. Plate motion vectors: B15 (yellow) spreading alignement (*Becker et al.*, 2015), MM07-M (magenta) modified hotspot (*Morgan and Morgan*, 2007; *Doubrovine et al.*, 2012), NNR (red) no-net-rotation MORVEL (*Argus et al.*, 2011), SKS5 (green) SKS shear-wave splitting (*Becker et al.*, 2015), FNA (blue) fixed North America in MORVEL (*Argus et al.*, 2011).

2 Splitting measurements from MFAST

The measurements and figures were made with software package MFAST (*Savage et al.*, 2010; *Teanby et al.*, 2004; *Wessel*, 2010). Each figure has a corresponding text file that contains all information related to the measurement (Table 1).

Caption for all figures (Figures Lmeas1– and Figures Tmeas1–):
Top left is (TL), etc. The grey boxes in panels (TL), (TR) and (BL) delineate the time window used for the final measurement. (TL) filtered East (BL) North (N) and vertical (Z) waveforms. The solid line is the S arrival. The dashed lines are the minimum start and maximum end times for windows used in the processing, as in (TR). (TR) the waveforms rotated into the SC91-determined (*Silver and Chan*, 1991) incoming polarization direction (p) and its perpendicular value (p $\perp$), for the original filtered waveform (top) and the waveforms corrected for the SC91-determined dt (bottom) for the window shown in grey. (ML) ϕ and dt determined for each measurement window as a function of window number. (MR) all the clusters of 5 or more measurements, with the large

X being the chosen cluster. (BL) waveforms (top) and particle motion (bottom) for the original (left) and corrected (right) waveform according to the final chosen SC91 window. (BR) contours of the smallest eigenvalue of the covariance matrix for the final chosen SC91 measurement.

References

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Table 1: Fields of .summ file output from MFAST. An example is described below this table. Note that not all fields are used in this study, but we include them to stay consistent with the format of MFAST.

1)	event	21)	δt s
2)	stat	22)	Dδt s
3)	slat °	23)	ϕ °
4)	slon °	24)	Dϕ °
5)	CUSPID	25)	anginc °
6)	year	26)	anginccorr °
7)	doy det	27)	type ini
8)	evla °	28)	timestamp
9)	evlo °	29)	comment
10)	dist (ev stat) km	30)	Nyquist frequency Hz
11)	depth km	31)	grade (A,B,C,N,R,U)
12)	magnitude	32)	filt LO Hz
13)	BAZ °	33)	filt HI Hz
14)	Spol °	34)	Spol - ϕ °
15)	DSpol °	35)	Incidence angle with respect to crack plane
16)	wbeg	36)	Grade in pick header t0
17)	wend	37)	Lamda max
18)	dist Ruap °	38)	Ndf
19)	dist Ruap km	39)	Lambda2 min
20)	SNR	40)	Ttime s
–	–	41)	Maxfreq (dominant frequency in S wave)

1. event: Name of the event and base name of the files. (2016335022859.XX.HLC5.HH.0.2-1.fb1)
2. stat: Station name. (HLC5)
3. slat: Latitude of the station in degrees. (60.7407)
4. slon: Longitude of the station in degrees. (-154.033)
5. cuspid: event identification number. (2016335022859)
6. year: Calendar year in which the event occurred. (2016)
7. doy det: Julian day on which the event occurred, with decimal digits giving the fraction of the day. (355.104)
8. evla: Latitude of the event hypocentre in degrees. (60.9031)
9. evlo: Longitude of the event hypocentre in degrees. (-152.459)
10. dist (ev-stat): Distance between event hypocentre and station in km. (124.39)
11. depthkm: Epicentral depth of the event in km. (105.565)
12. mag: Event magnitude. For local data this is a local magnitude ML. (4.04)
13. BAZ: Back azimuth in degrees. This is the azimuthal angle at which the signal arrives at the station. (149.087)
14. spol: Initial polarisation of the shear wave in degrees. (41.805)
15. Dspol: Error of Spol in degrees, one standard deviation. (1.685)
16. wbeg: Start time of the selected measurement window in seconds, relative to the start of the seismogram at t =0 (25.652000)

17. wend: End time of the selected measurement window in seconds, relative to the start of the seismogram at t =0 (26.353741)
18. dist ruap km: Distance of the event hypocentre from Mt. Ruapehu in kilometres. (N/A)
19. dist ruap deg: Distance from Mt. Ruapehu in degrees. (N/A)
20. SNR: Signal to noise ratio for this event. (5.43038)
21. tlag: Delay time between fast and slow shear wave in seconds. (0.670000)
22. dtlag: Error of δt in seconds, one standard deviation. (0.028125)
23. fast: Angle of the orientation of the fast shear wave, in degrees from North. (-89)
24. dfast: Error of ϕ in degrees, one standard deviation. (5.250)
25. anginc: Angle of incidence at the station, measured against a horizontal plane in degrees, where 0 means vertical incidence. (20.8)
26. anginc corr: Angle of incidence corrected for topography slope at the area around the station. (20.8)
27. type ini: Type of measurement. This field contains the measurement code that is used (ass), the number of measurement window start times nbeg and the number of window end times nend. (ass 5 25)
28. timestamp: Date at which the measurement was performed and the log file (.ilog.ass) was created. (Nov)
29. comment: Any additional information or comment that can be added manually or set in mfast config. (N/A)
30. nyquist: Nyquist frequency of the event in Hz. The Nyquist frequency fnyquist depends on the sampling rate of an event (f, in Hz), where fnyquist = f/2.
31. gradeABCNR: Evaluation of the measurement quality.
32. filt LO: Lower corner frequency of the bandpass filter in Hz. (0.2)
33. filt HI: Higher corner frequency of the bandpass filter in Hz. (1)
34. spol-fast: Angle between the initial polarization and the fast orientation in degrees. This value is used to detect null measurements. (76.195)
35. Incidence angle with respect to the crack planes. (N/A)
36. Grade in pick header t0. This is the grade that the analyst gave to the S arrival pick. (N/A)
37. Lamda max. The maximum value of the eigenvalue of the corrected covariance matrix. Higher values have more distinct differences between the best and worst splitting values and indicate higher quality measurements.
38. ndf. The number of degrees of freedom in the measurement. Not used yet, but will be necessary for certain cases in which correct error bars for averaging multiple measurements is desired.
39. lambda2 min. The minimum value of the eigenvalue of the covariance matrix before it was scaled to have the 95% confidence level set to 1. This is the value that was used to do the scaling. This value may be important in later error analysis.
40. ttime. The S-wave travel time between the earthquake and the station. Determined from the SAC headers 0 and t5.
41. maxfreq. The dominant frequency in the S wave, determined from the frequency at the maximum spectral amplitude.