Solid Earth

Supplement of

Extensional exhumation of cratons: insights from the Early Cretaceous Rio Negro–Juruena belt (Amazonian Craton, Colombia)

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S1: Radial plots

The radial plot was introduced as a more appropriate data visualisation tool for showcasing single grain age AFT data dispersion **(Galbraith**, **1988**, **1990)**, by mapping y against x, with:

$$x_j = 1/\sigma_j$$

$$y_j = (A_j - A_r)/\sigma_j,$$

where σ_j is the precision of the age estimate A_j, and A_r is some reference age (typically the mean age of all grains).

On a radial plot, the more precise data plot farther from the origin, all data have a common normalized error, and a line joining a given data point to the origin has a slope (y/x) equivalent to the age (or age-reference age). Consequently, the plot exhibits distinct patterns: a line from the origin indicates a constant fission track age, and the precision of each grain age is indicated by the x value. This layout allows for the identification of precise grains on the right side of the plot (high x, low error). The age scale, delineated radially around the plot's perimeter in millions of years, provides a comprehensive view of age distribution. Any deviation of data points beyond certain limits (+2 and -2 standard deviations) signifies a considerable spread in individual grain ages, corroborated by indicators of age dispersion.

Galbraith RF. 1988. Graphical display of estimates having different standard errors. Technometrics 30:271–81

Galbraith RF. 1990. The radial plot: graphical assessment of spread in ages. Nucl. Tracks 17:207–14

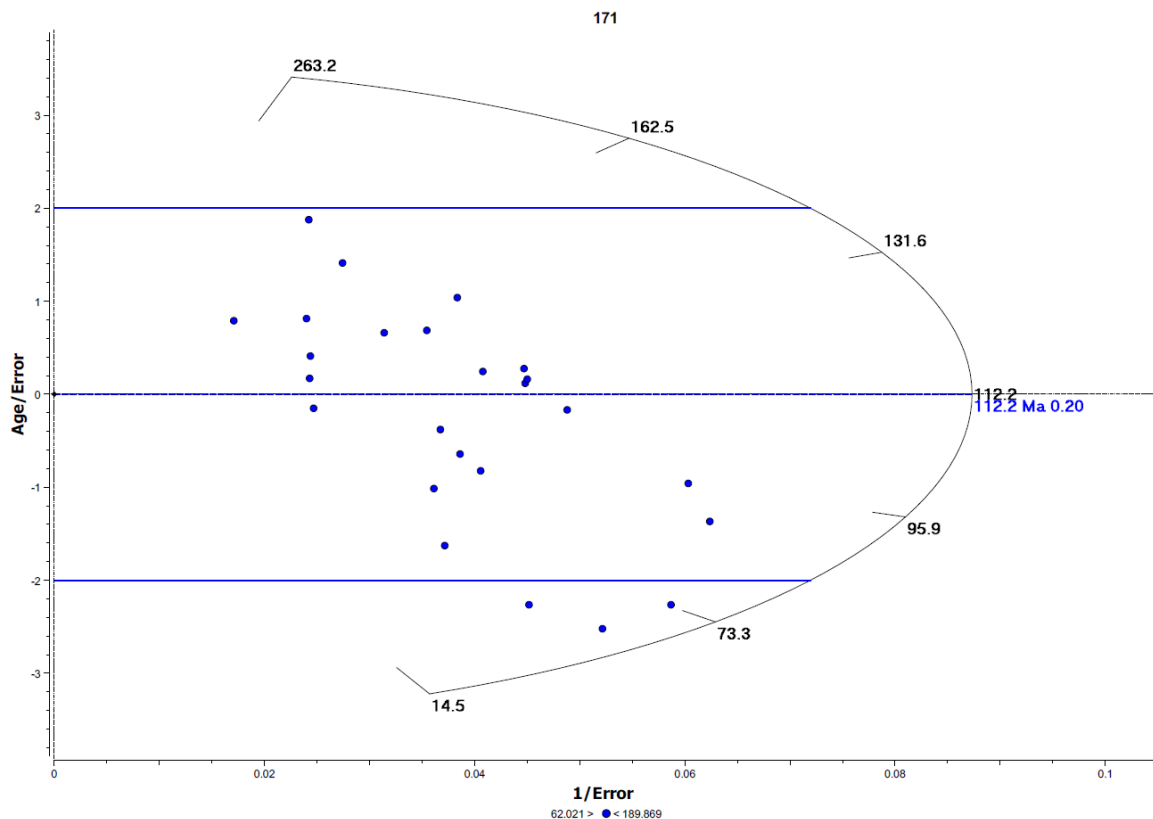**Figure S1.** Radial plot for sample 171, constructed using QTQt (Gallagher, 2012).

Figure S2. Radial plot for sample 175, constructed using QTQt (Gallagher, 2012).

Figure S3. Radial plot for sample 176, constructed using QTQt (Gallagher, 2012).

Figure S4. Radial plot for sample 180, constructed using QTQt (Gallagher, 2012).

Figure S5. Radial plot for sample 182, constructed using QTQt (Gallagher, 2012).

Figure S.6. Radial plot for sample 164, constructed using QTQt (Gallagher, 2012).
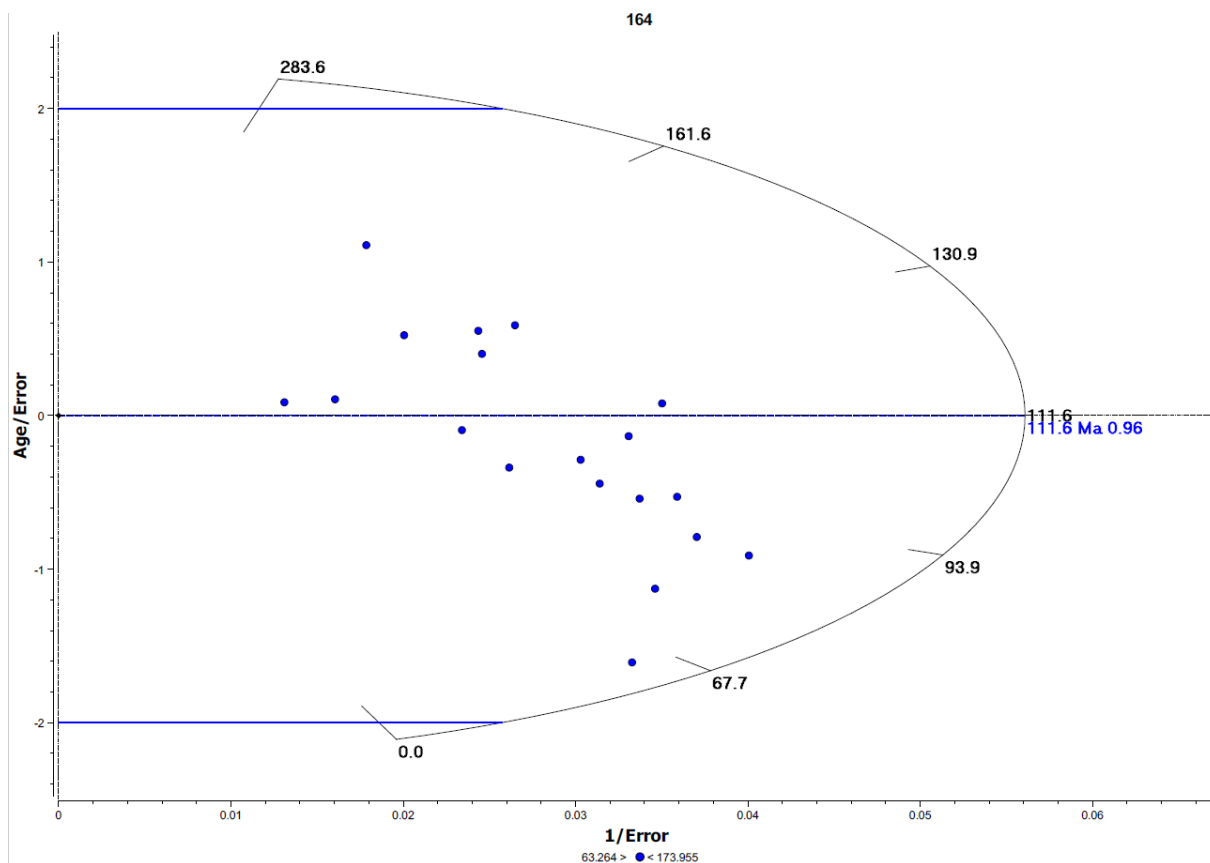
Figure S.7. Radial plot for sample 168, constructed using QTQt (Gallagher, 2012).
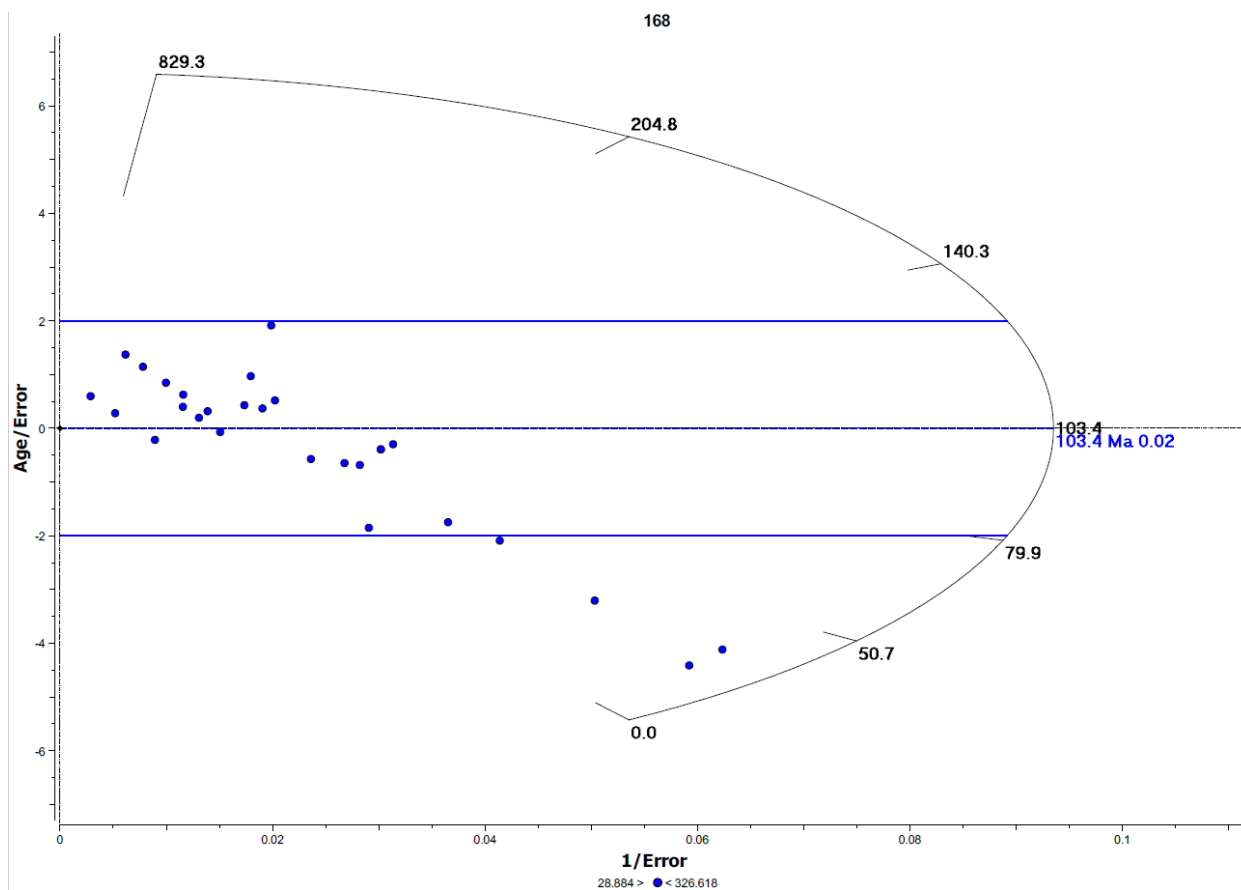
Figure S.8. Radial plot for sample 170, constructed using QTQt (Gallagher, 2012).
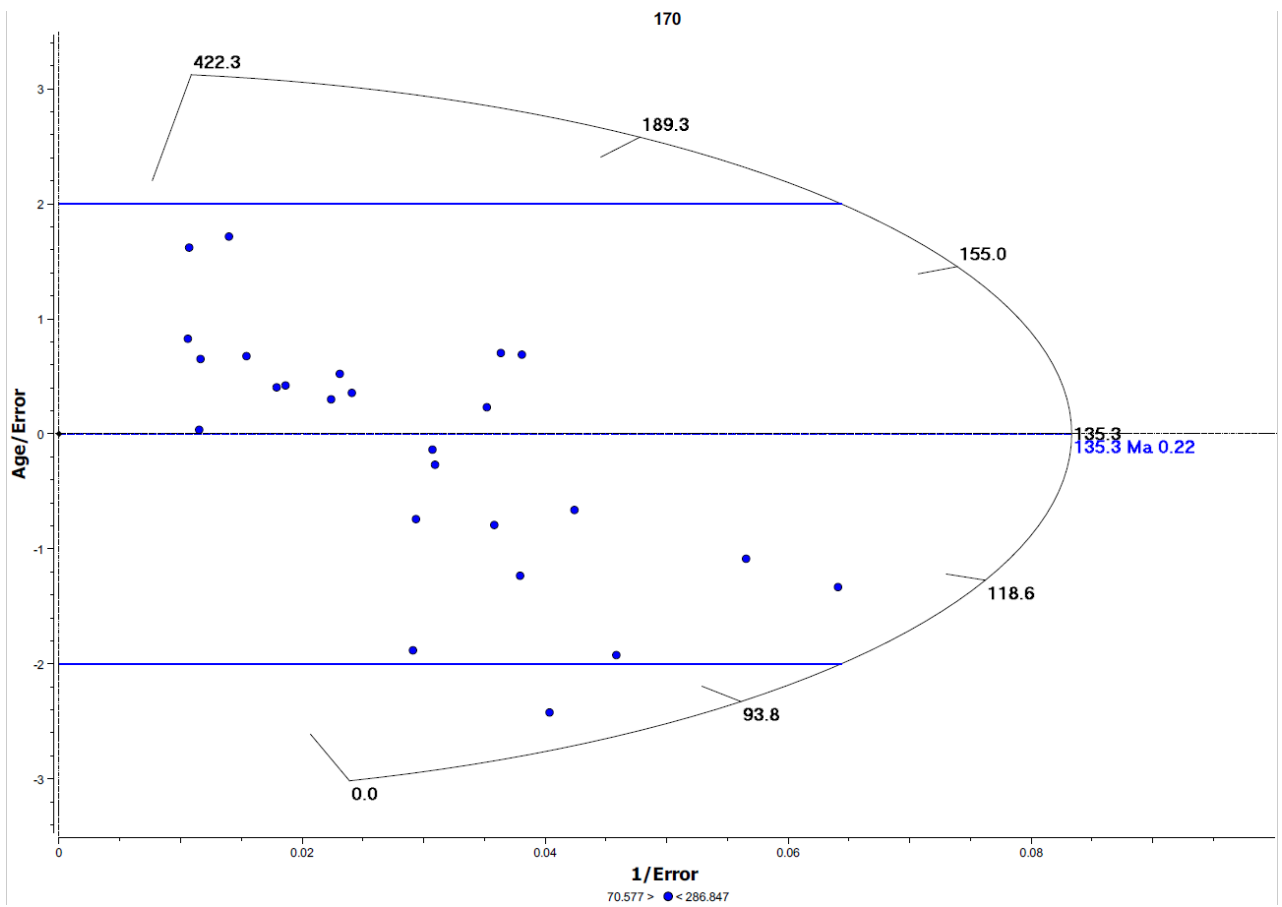
Figure S.9. Radial plot for sample 501, constructed using QTQt (Gallagher, 2012).
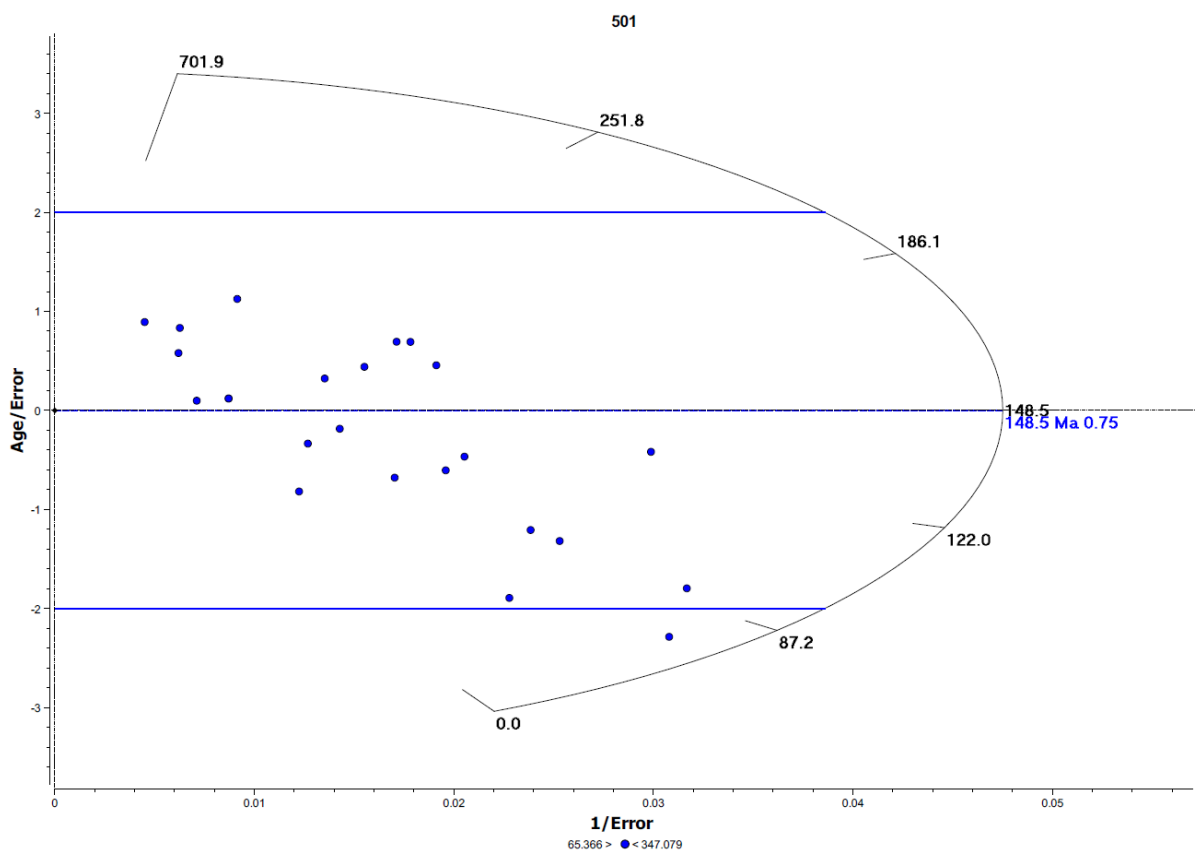
Figure S.10. Radial plot for sample 502, constructed using QTQt (Gallagher, 2012).
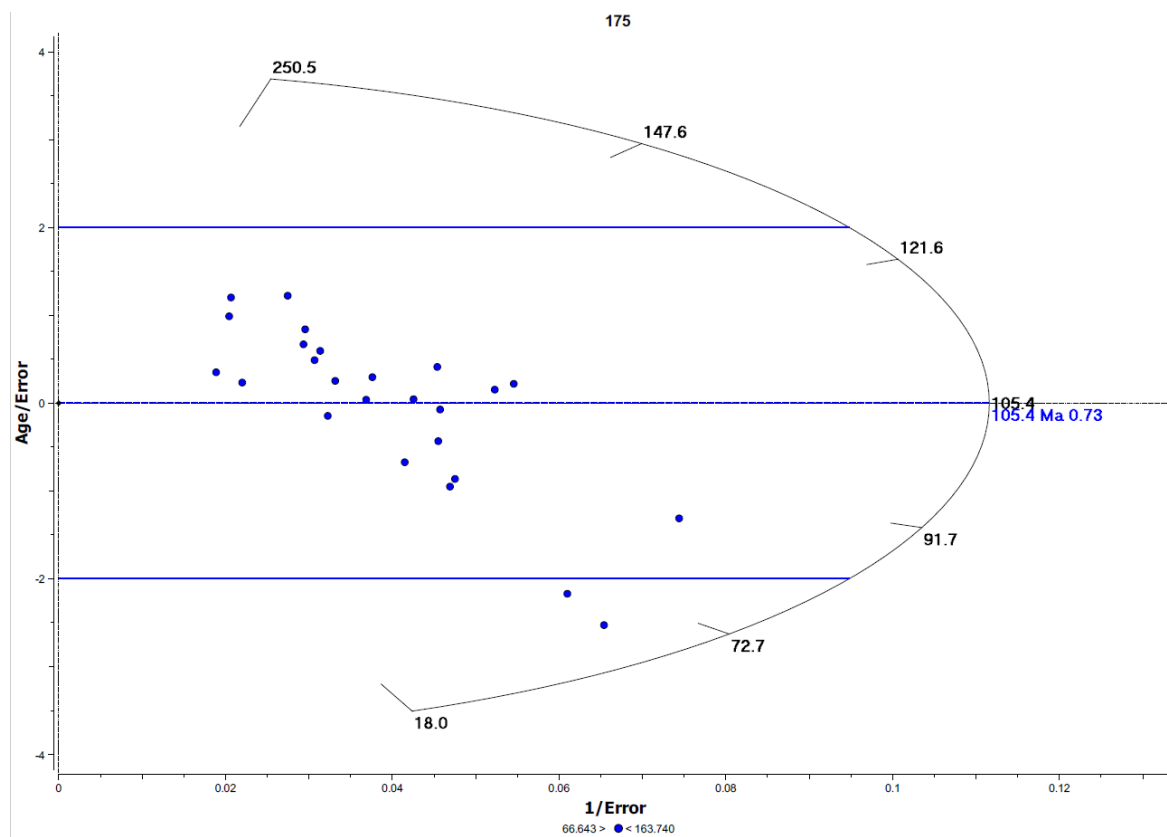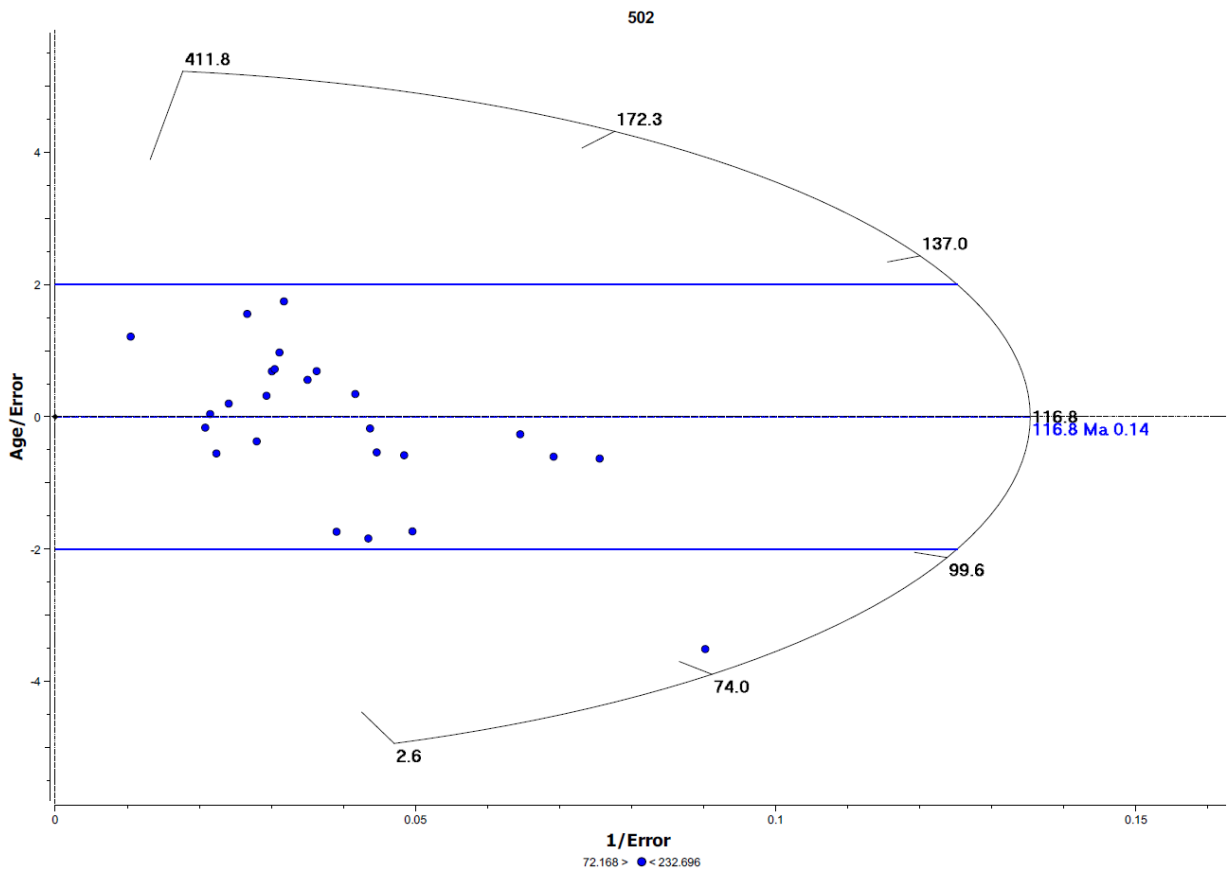

Figure S.11. Radial plot for sample 505, constructed using QTQt (Gallagher, 2012).
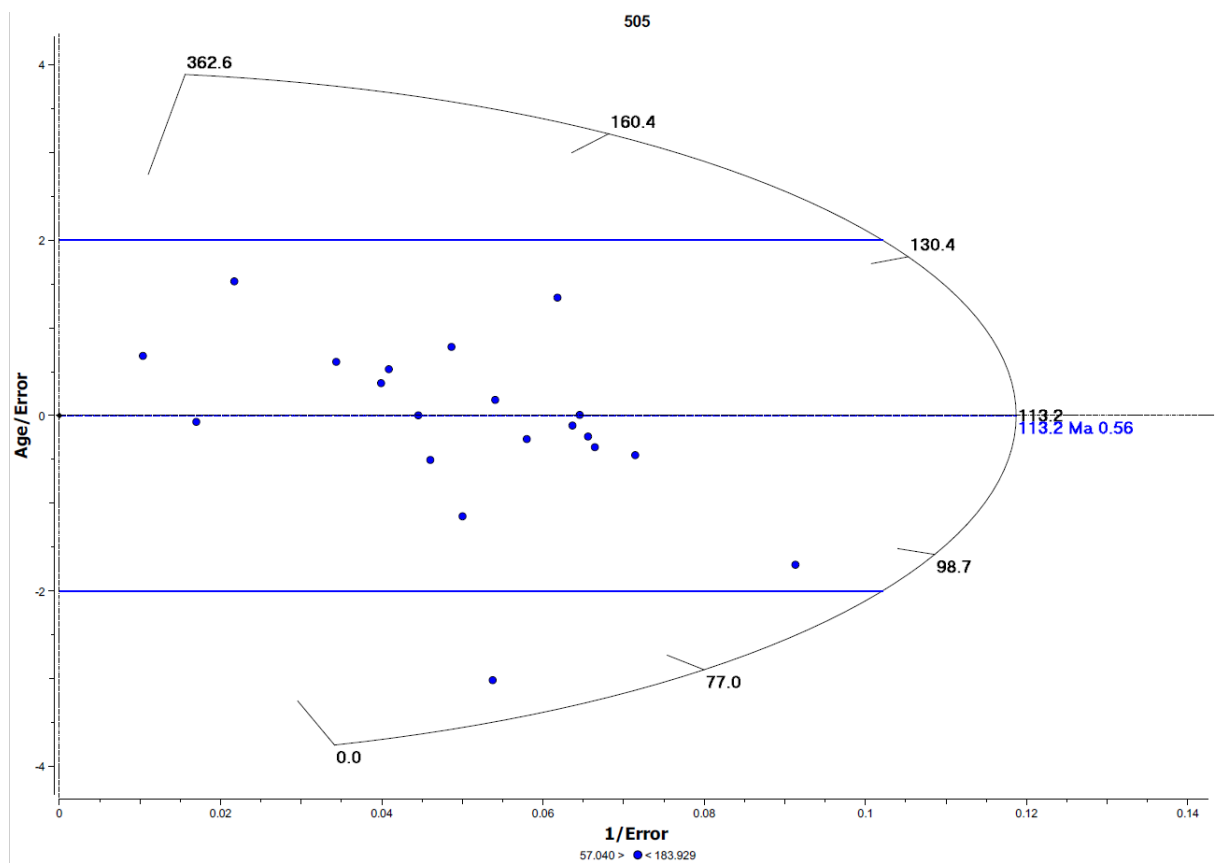
Figure S.12. Radial plot for sample 506, constructed using QTQt (Gallagher, 2012).
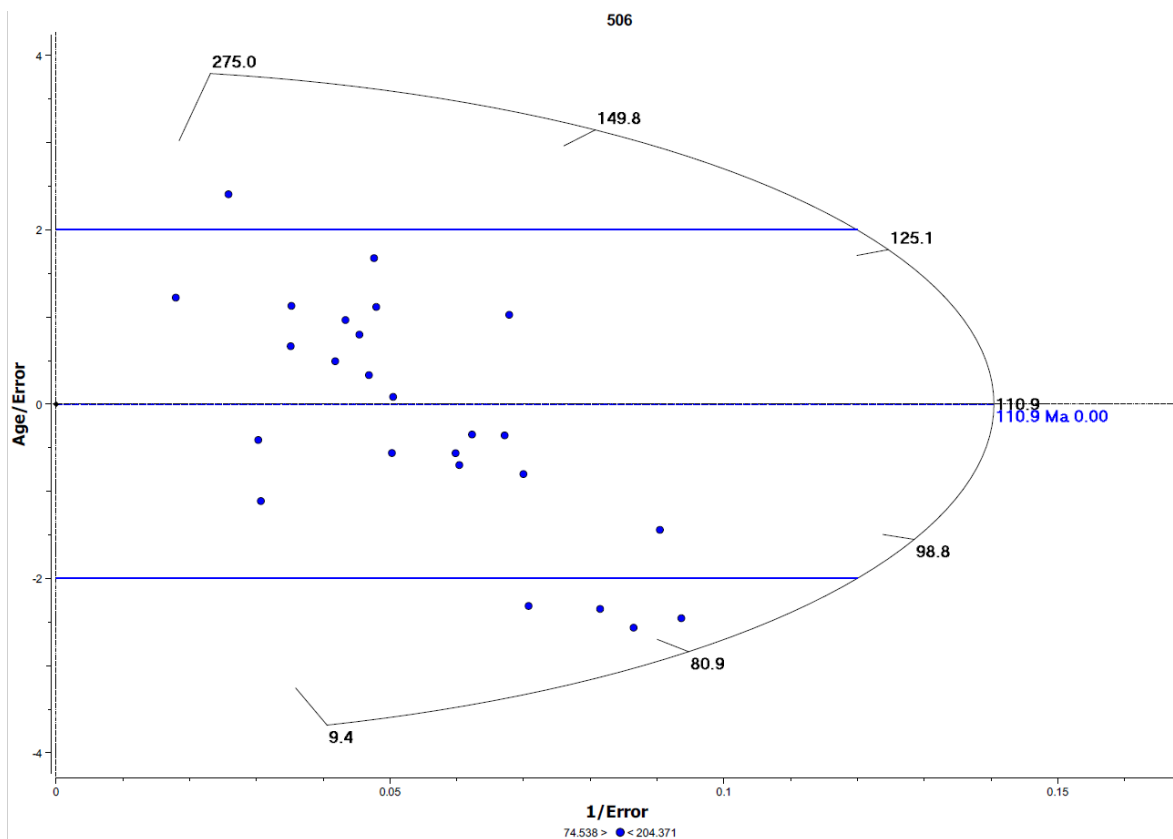
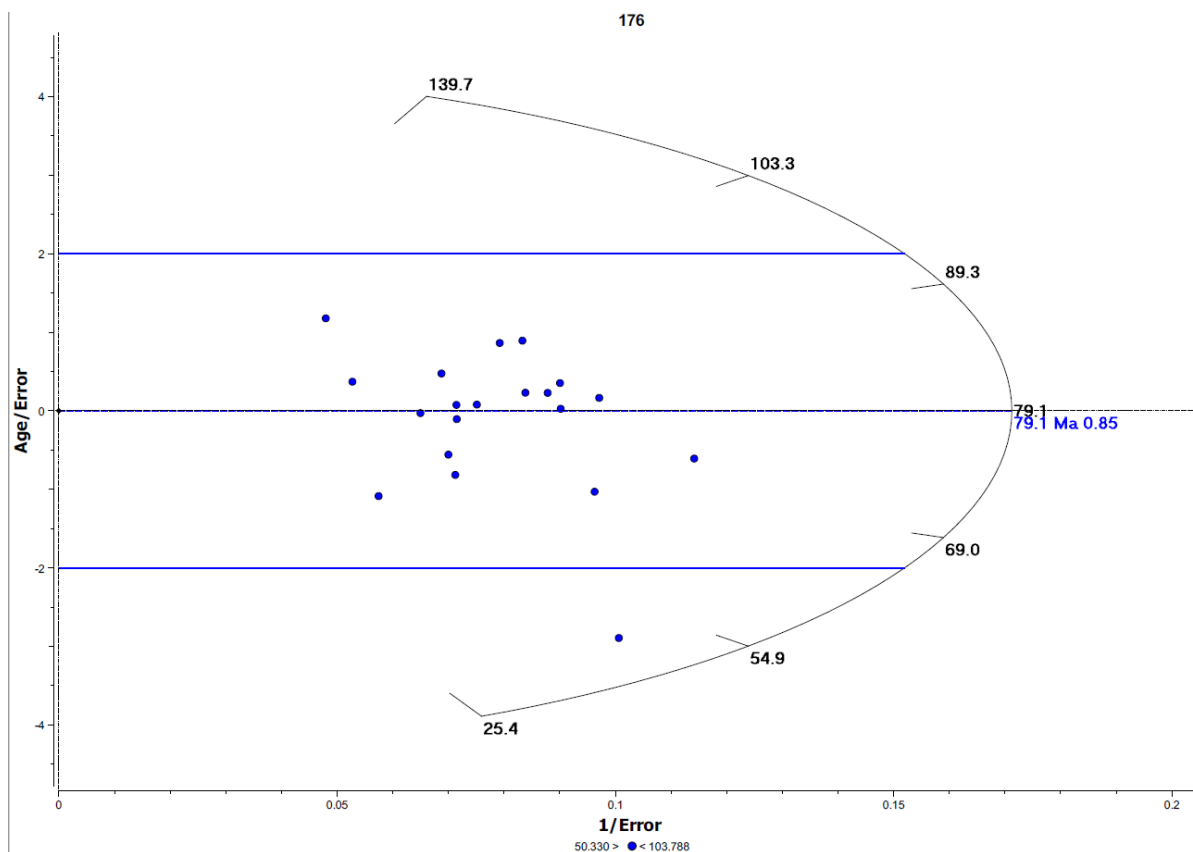**Figure S.13.** Radial plot for sample 510, constructed using QTQt (Gallagher, 2012).
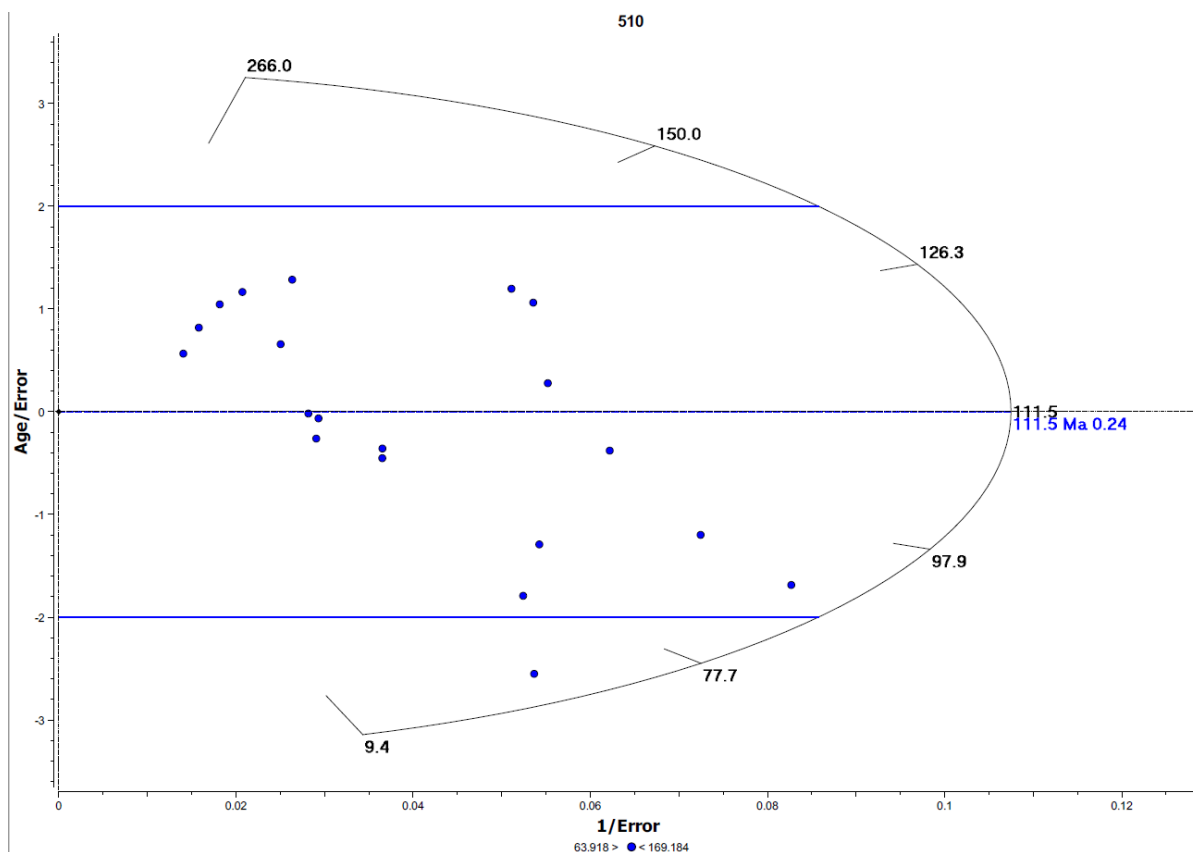
Figure S.14. Radial plot for sample 512, constructed using QTQt (Gallagher, 2012).

Figure S.15. Radial plot for sample 515, constructed using QTQt (Gallagher, 2012).
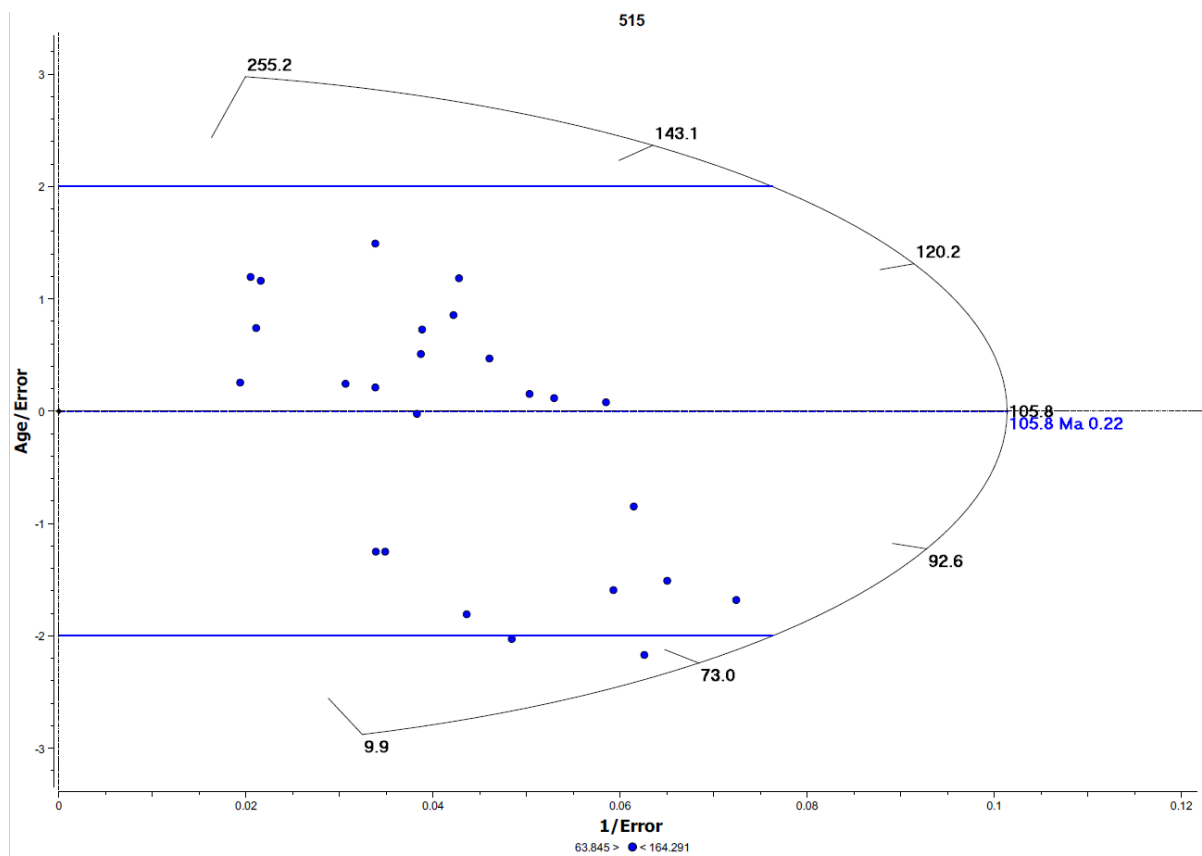
Figure S.16. Radial plot for sample 516, constructed using QTQt (Gallagher, 2012).
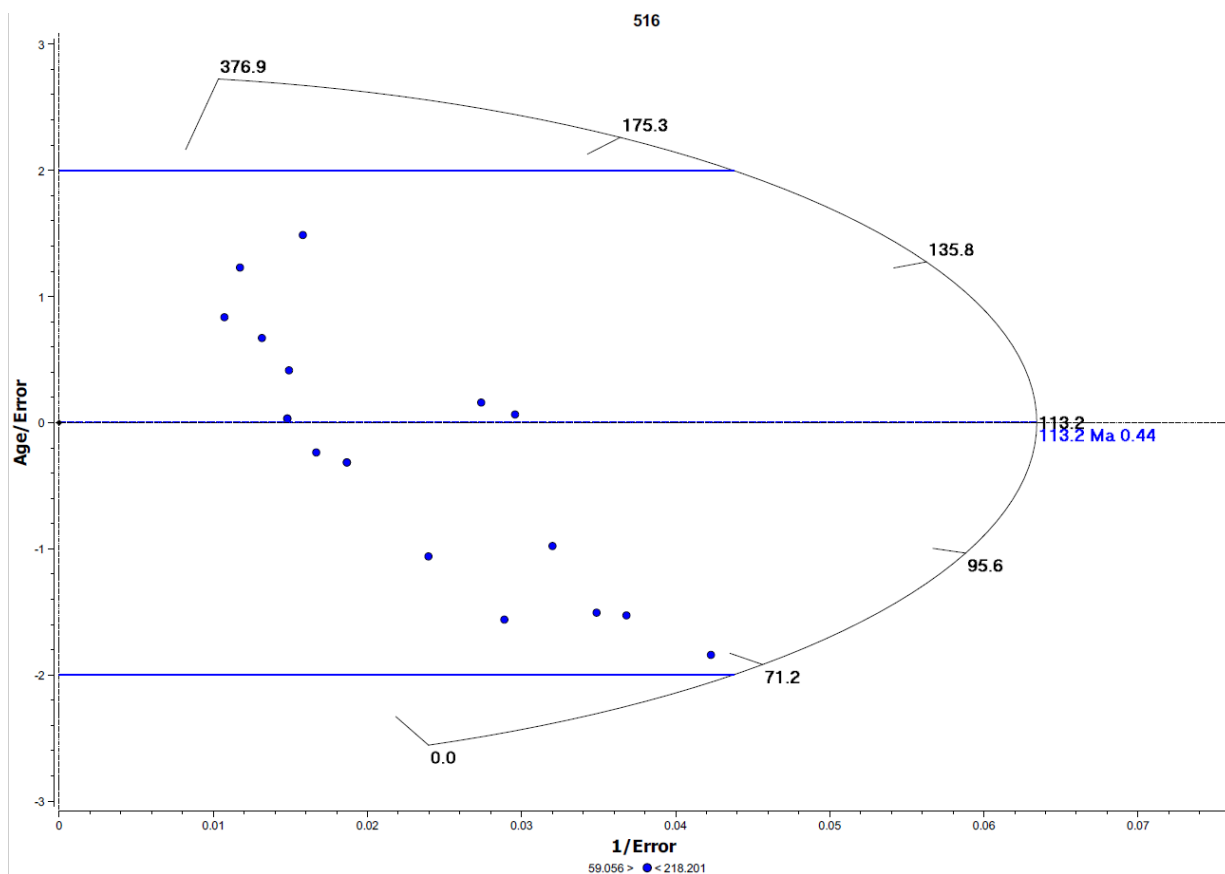
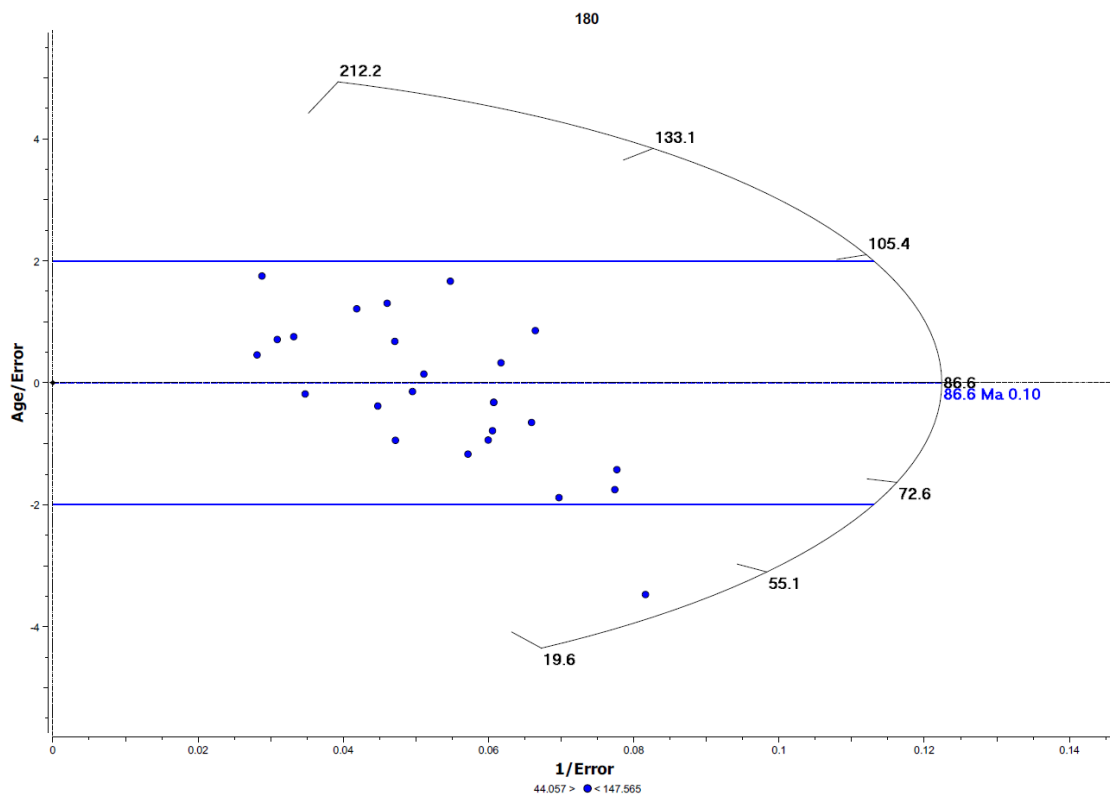**Figure S.17.** Radial plot for sample 192, constructed using QTQt (Gallagher, 2012).
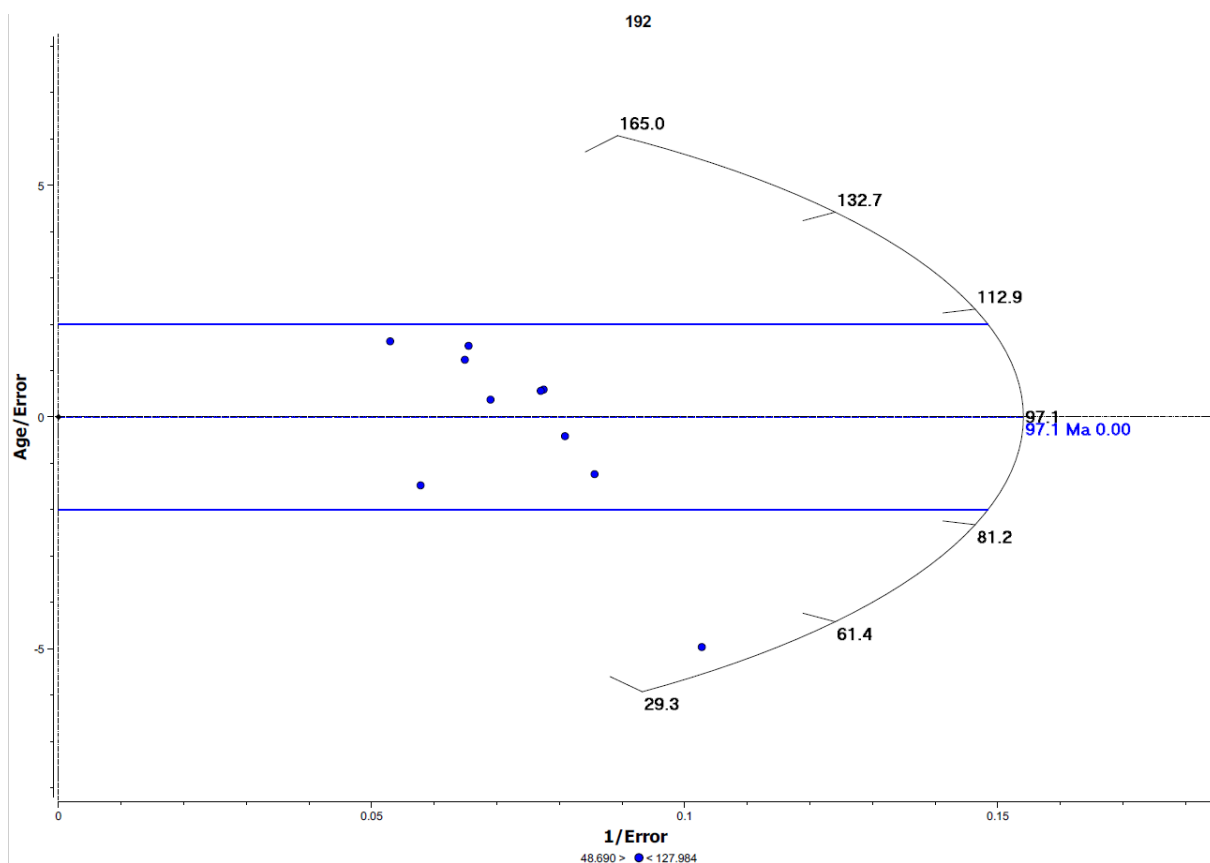
Figure S.18. Radial plot for sample 124, constructed using QTQt (Gallagher, 2012).
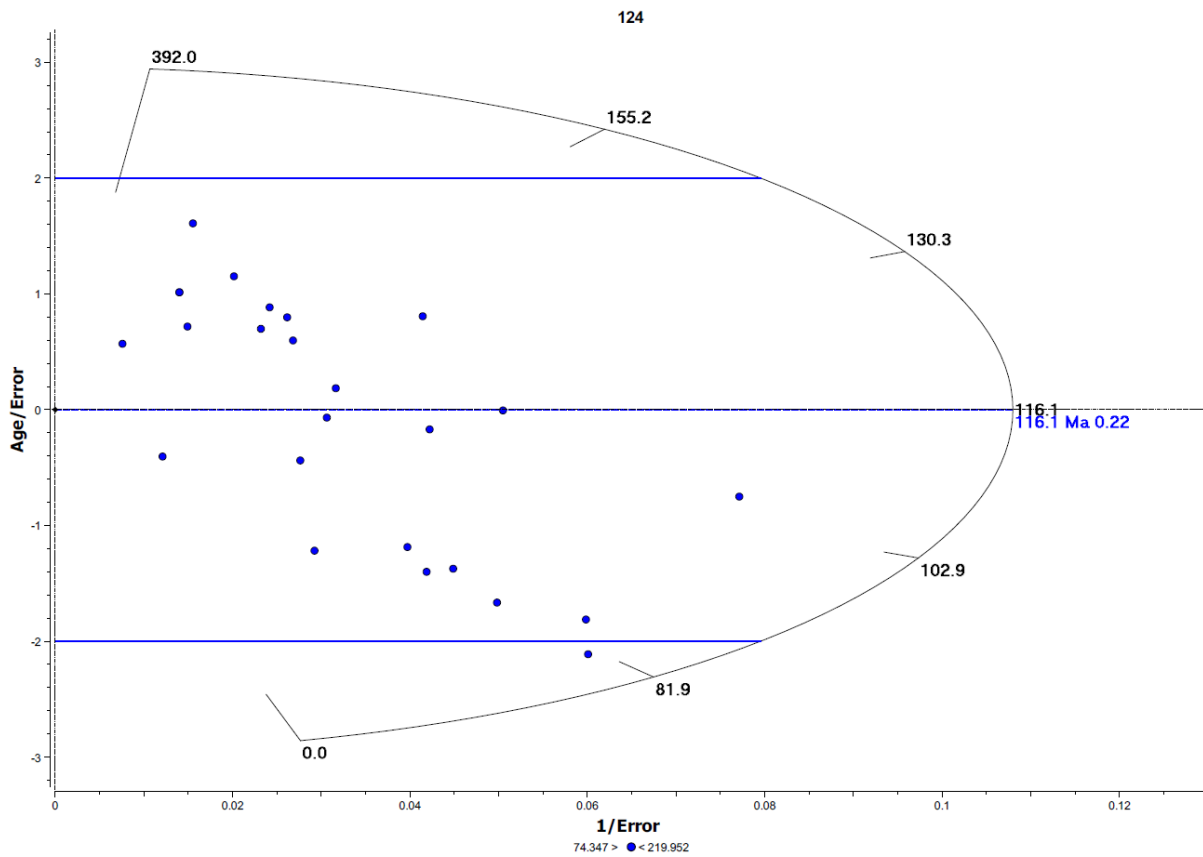
Figure S.19. Radial plot for sample 134, constructed using QTQt (Gallagher, 2012).
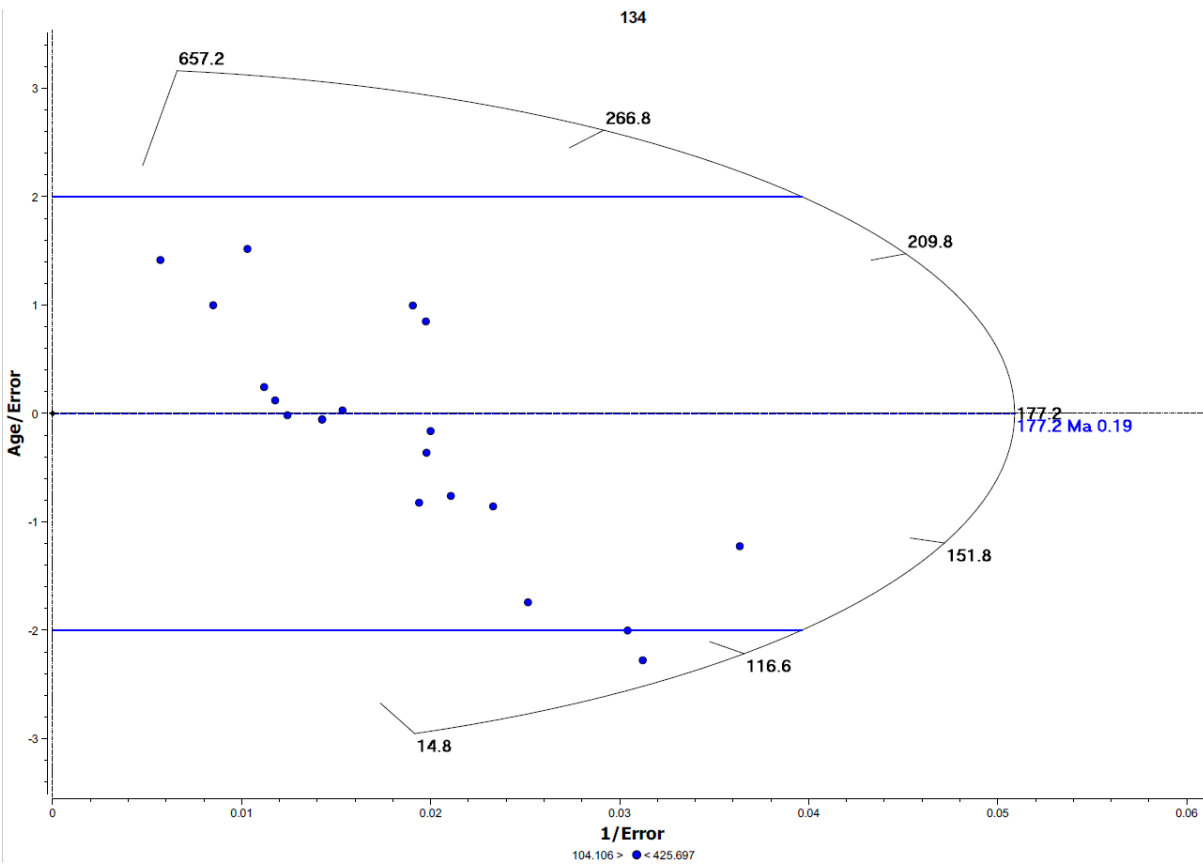
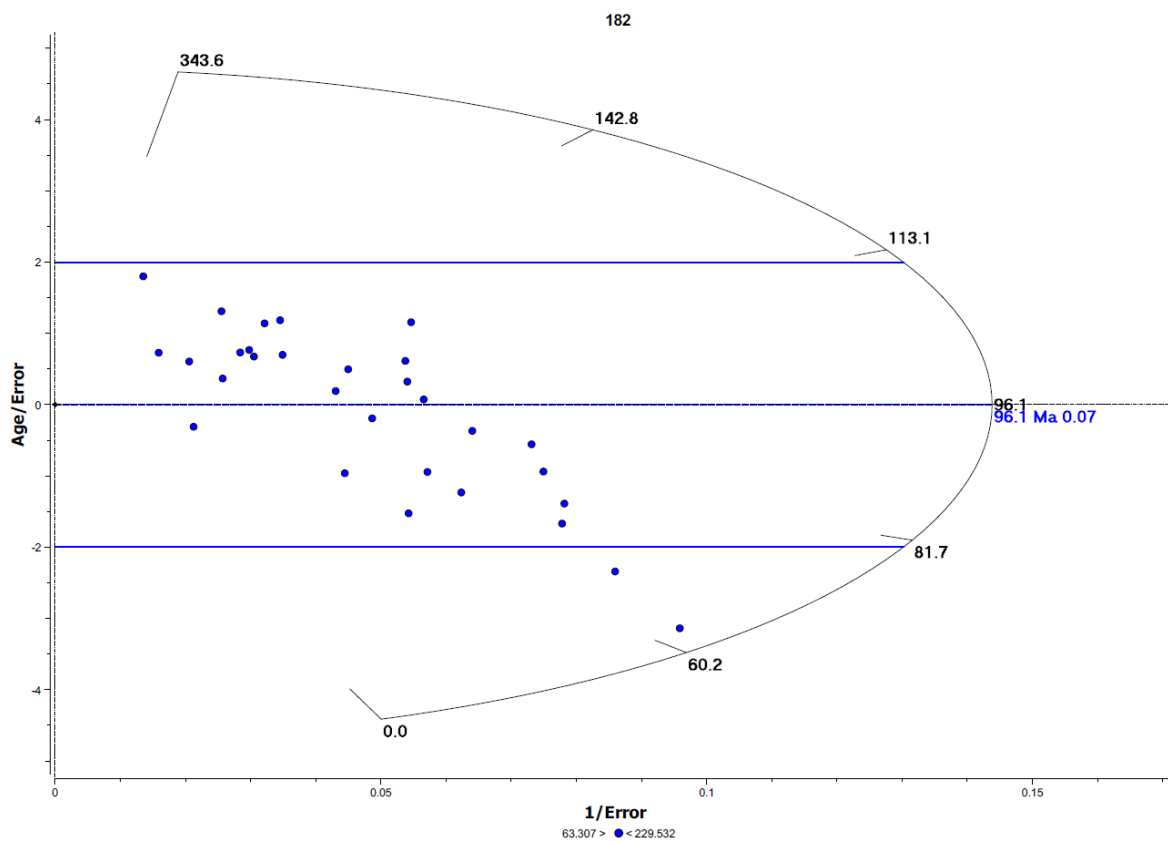**Figure S.20.** Radial plot for sample 135, constructed using QTQt (Gallagher, 2012).
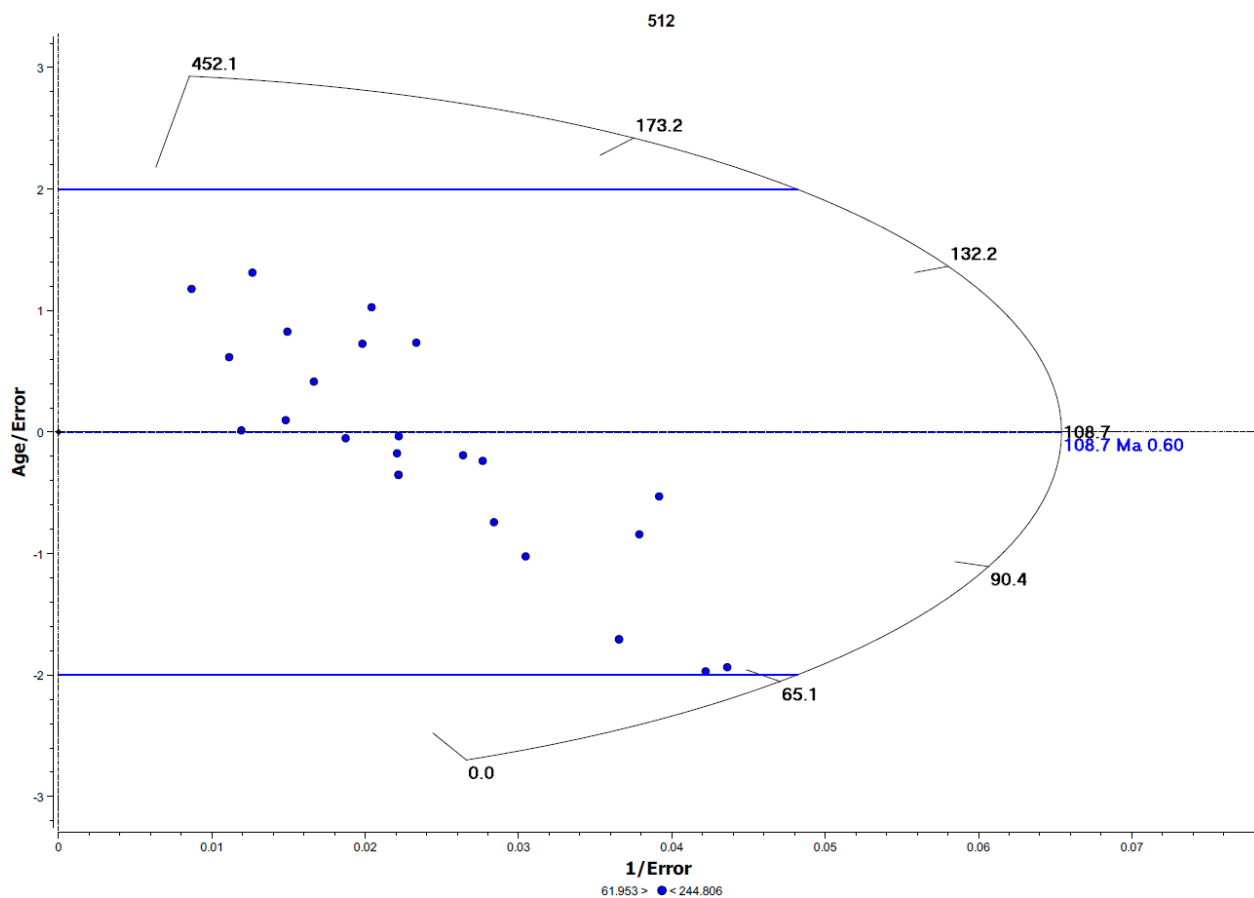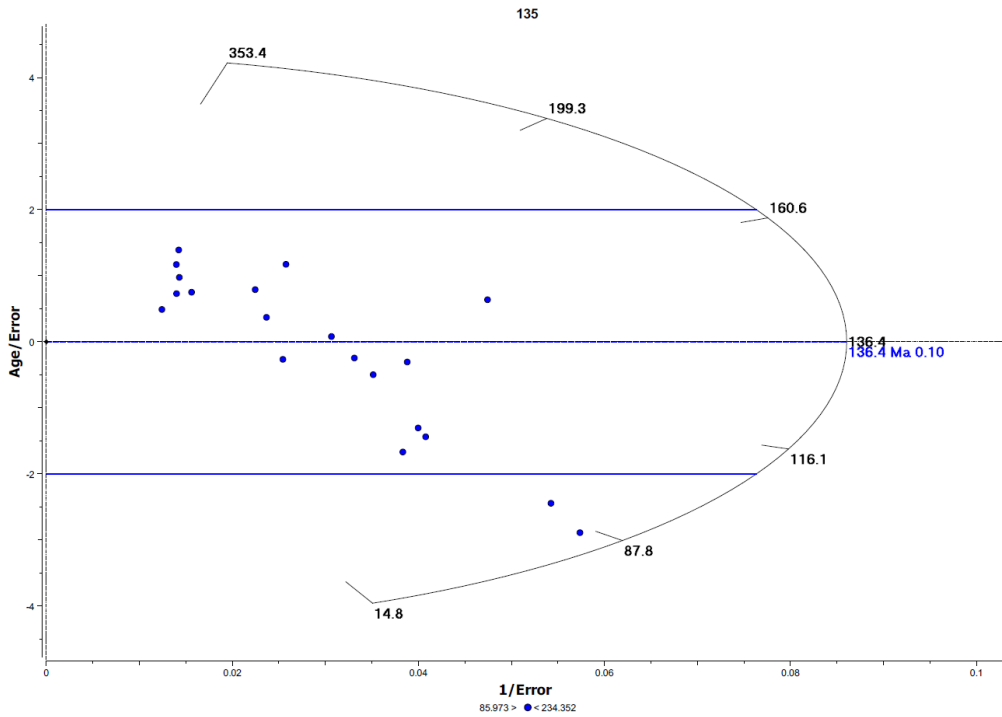

S2: Length data

Here we make available the raw data for sub-horizontal confined apatite fission-tracks (length and angle with c-axis) and supporting graphs. Measurements were done using TrackFlow (Van Ranst et al., 2020) using a Nikon Eclipse Ni-E microscope equipped with a DS-Ri2 camera and set to a magnification of 1000x.

Figure S.21. Raw track lengths (L) in μm and angle with c-axis (A) for sample 171.

ID	L	A	ID	L	A	ID	L	A
1	13.6	57.0	35	10.7	60.0	69	11.9	24.0
2	9.4	75.0	36	14.0	37.0	70	6.1	60.0
3	12.4	73.0	37	11.0	54.0	71	11.3	64.0
4	13.6	53.0	38	8.1	76.0	72	10.1	84.0
5	13.8	78.0	39	12.9	69.0	73	9.2	66.0
6	13.2	25.0	40	10.6	68.0	74	10.6	64.0
7	10.7	53.0	41	9.4	80.0	75	8.5	78.0
8	10.7	79.0	42	10.8	27.0	76	12.6	44.0
9	9.9	74.0	43	5.2	84.0	77	11.4	87.0
10	10.1	74.0	44	11.8	63.0	78	12.7	64.0
11	10.0	62.0	45	9.6	24.0	79	12.2	89.0
12	12.4	31.0	46	11.5	36.0	80	10.2	79.0
13	11.6	27.0	47	11.0	60.0	81	9.6	68.0
14	13.0	21.0	48	8.6	36.0	82	13.9	32.0
15	12.7	34.0	49	14.5	41.0	83	10.9	67.0
16	13.1	50.0	50	14.3	63.0	84	8.8	50.0
17	10.6	79.0	51	12.1	72.0	85	13.8	1.0
18	12.0	48.0	52	11.5	58.0	86	12.1	47.0
19	8.8	62.0	53	12.2	17.0	87	12.6	61.0
20	11.6	53.0	54	11.4	75.0	88	12.9	68.0
21	9.8	69.0	55	10.9	50.0	89	9.0	34.0
22	12.1	54.0	56	10.0	56.0	90	8.4	63.0
23	14.0	42.0	57	13.6	80.0	91	13.9	49.0
24	15.1	70.0	58	9.6	34.0	92	12.3	78.0
25	11.4	55.0	59	16.8	48.0	93	12.7	48.0
26	13.8	2.0	60	13.5	24.0	94	12.4	77.0
27	13.4	22.0	61	8.5	84.0	95	16.2	68.0
28	11.2	87.0	62	15.0	50.0	96	9.9	44.0
29	11.6	87.0	63	13.1	37.0	97	13.8	53.0
30	12.6	7.0	64	13.7	29.0	98	12.1	33.0
31	9.0	29.0	65	9.0	62.0	99	11.1	66.0
32	11.6	50.0	66	11.9	86.0	100	10.2	52.0
33	11.3	72.0	67	12.4	84.0			
34	11.1	49.0	68	13.9	55.0			

Metric	Result
Mean	11.5753
Median	11.6
Std Dev	2.00414
Skewness	-0.2757
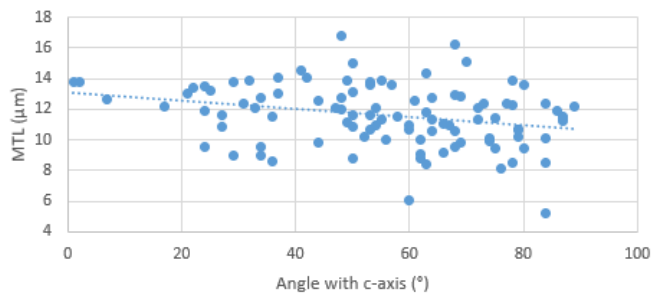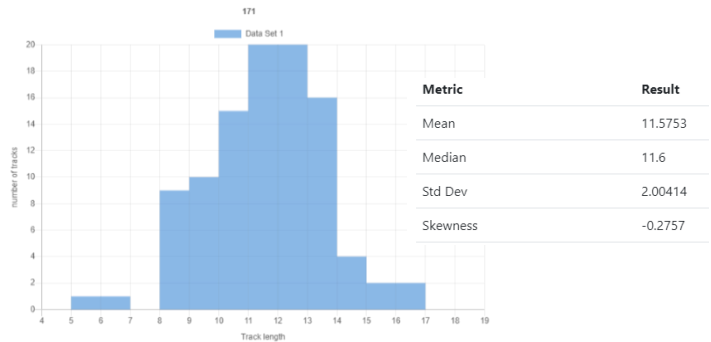
Figure S.22. Raw track lengths (L) in µm and angle with c-axis (A) for sample 175.

ID	L	A	ID	L	A	ID	L	A
1	9.6	70	35	14.4	73	69	10.8	78
2	14.7	69	36	9.7	29	70	14.1	21
3	12.7	56	37	12.7	88	71	11.4	57
4	9.4	2	38	14.0	60	72	9.3	19
5	10.0	21	39	13.3	74	73	12.1	62
6	12.7	47	40	12.8	77	74	9.7	35
7	13.3	24	41	13.2	24	75	11.2	40
8	13.4	46	42	11.9	70	76	13.9	72
9	8.7	39	43	8.5	58	77	10.4	42
10	13.1	59	44	10.3	73	78	10.3	28
11	14.6	48	45	9.0	71	79	12.9	26
12	13.1	61	46	9.0	71	80	14.5	80
13	14.6	76	47	12.1	57	81	9.5	35
14	12.4	73	48	11.7	34	82	8.5	81
15	13.6	49	49	13.7	30	83	14.8	61
16	11.6	53	50	10.9	80	84	13.3	67
17	13.4	30	51	14.2	62	85	9.1	41
18	9.3	55	52	9.3	73	86	10.4	24
19	14.3	82	53	13.2	38	87	12.5	36
20	13.1	57	54	10.8	36	88	14.0	71
21	13.0	49	55	10.8	44	89	11.1	60
22	13.4	22	56	11.4	68	90	12.8	39
23	12.6	68	57	13.4	57	91	12.1	69
24	11.5	36	58	13.7	28	92	11.9	13
25	13.0	87	59	12.9	30	93	13.6	63
26	12.5	77	60	11.4	45	94	12.4	59
27	10.9	39	61	12.7	53	95	11.8	20
28	14.3	58	62	8.0	5	96	12.8	3
29	9.7	61	63	8.5	22	97	11.9	14
30	13.3	48	64	12.0	73	98	11.3	43
31	11.5	73	65	13.4	54	99	8.7	27
32	10.3	61	66	12.0	42	100	11.6	66
33	13.3	35	67	11.9	78			
34	12.0	68	68	9.8	30			

Metric	Result
Mean	11.9263
Median	12.065
Std Dev	1.73497
Skewness	-0.43986
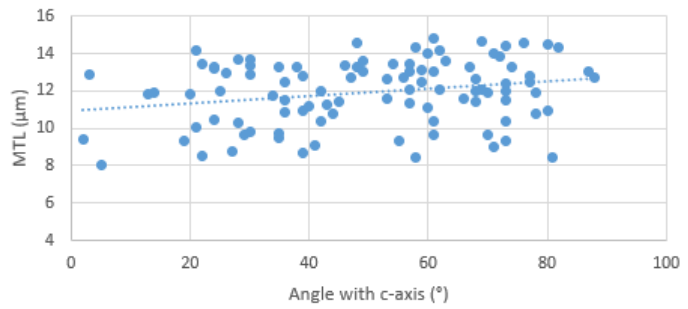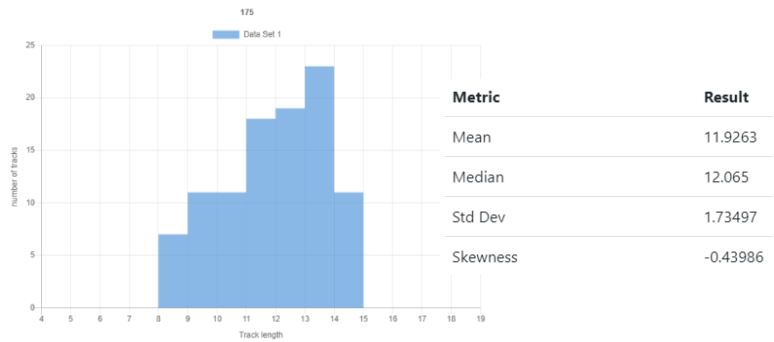
Figure S.23. Raw track lengths (L) in µm and angle with c-axis (A) for sample 176.

ID	L	A	ID	L	A	ID	L	A
1	11.3	53	35	13.2	75	69	12.5	84
2	14.8	54	36	12.2	64	70	12.5	77
3	10.9	55	37	13.4	48	71	11.0	55
4	14.1	70	38	11.9	59	72	13.3	41
5	10.6	46	39	8.1	53	73	11.9	46
6	10.7	37	40	11.7	79	74	8.4	62
7	12.8	79	41	10.8	85	75	9.5	49
8	8.2	33	42	12.0	88	76	13.2	40
9	11.3	25	43	13.0	21	77	14.5	70
10	14.4	70	44	12.2	60	78	13.4	78
11	11.7	58	45	12.2	69	79	9.7	45
12	10.9	88	46	13.8	26	80	10.5	75
13	11.5	76	47	12.8	55	81	12.2	42
14	14.4	19	48	13.2	82	82	12.5	74
15	11.6	51	49	12.6	55	83	10.7	60
16	13.4	24	50	13.4	50	84	15.1	56
17	10.3	66	51	10.5	90	85	11.4	74
18	13.2	32	52	15.1	40	86	11.1	62
19	8.6	77	53	12.6	52	87	12.1	75
20	11.4	66	54	10.7	86	88	10.6	44
21	9.2	46	55	12.7	60	89	12.1	70
22	10.5	78	56	13.5	62	90	13.2	83
23	12.6	85	57	12.7	70	91	10.8	81
24	12.9	72	58	11.6	58	92	13.6	60
25	12.2	76	59	9.4	73	93	13.4	20
26	11.9	59	60	10.3	56	94	11.3	51
27	10.1	19	61	12.0	54	95	11.0	83
28	10.7	34	62	9.0	46	96	12.3	53
29	9.8	76	63	10.2	87	97	13.2	54
30	13.6	50	64	13.6	46	98	12.2	66
31	10.5	84	65	9.7	51	99	14.5	46
32	8.1	38	66	10.3	50	100	14.0	41
33	14.0	81	67	14.5	60			
34	11.9	72	68	9.8	78			

Metric	Result
Mean	11.8561
Median	12.0
Std Dev	1.66155
Skewness	-0.24839
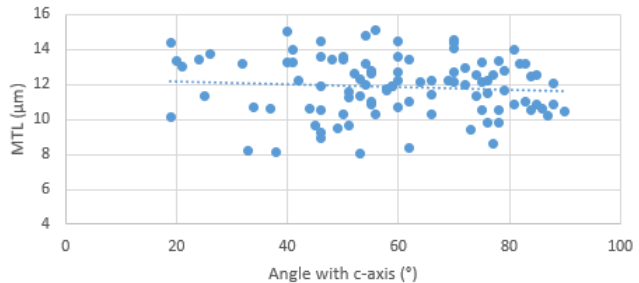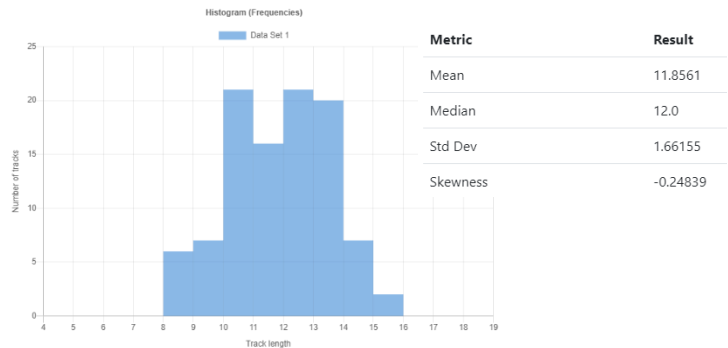
Figure S.24. Raw track lengths (L) in µm and angle with c-axis (A) for sample 180.

ID	L	A	ID	L	A	ID	L	A
1	9.1	41.00	35	8.8	73	69	13.5	73
2	11.2	50.00	36	9.2	71	70	12.8	39
3	12.6	67.00	37	11.0	53	71	13.2	30
4	13.4	69.00	38	10.6	13	72	13.8	30
5	9.2	56.00	39	10.0	66	73	11.0	74
6	9.0	43.00	40	10.5	61	74	13.1	50
7	12.2	30.00	41	13.9	77	75	15.5	34
8	11.2	55.00	42	13.6	29	76	11.8	73
9	9.2	45.00	43	13.5	76	77	11.8	67
10	10.7	51.00	44	12.6	11	78	14.3	74
11	10.8	66.00	45	14.0	74	79	13.9	33
12	10.4	71.00	46	12.1	58	80	12.8	25
13	7.9	82.00	47	12.0	50	81	10.0	68
14	9.7	28.00	48	13.9	23	82	11.1	64
15	9.3	67.00	49	10.8	87	83	12.0	53
16	8.4	70.00	50	10.5	49	84	11.7	39
17	12.8	50.00	51	12.9	55	85	12.0	40
18	12.9	58.00	52	11.8	85	86	12.9	67
19	12.5	56.00	53	9.5	49	87	12.9	65
20	12.1	36.00	54	12.7	86	88	10.1	60
21	11.3	42.00	55	13.7	29	89	12.9	86
22	12.0	45.00	56	10.9	69	90	5.6	77
23	9.8	86.00	57	10.2	58	91	13.8	67
24	11.2	68.00	58	14.2	43	92	12.4	57
25	13.9	11.00	59	12.3	65	93	9.1	84
26	12.3	75.00	60	12.3	86	94	13.4	56
27	12.4	47.00	61	12.8	1	95	11.9	35
28	12.8	42.00	62	12.6	57	96	12.1	34
29	12.1	62.00	63	13.9	32	97	14.4	25
30	11.6	82.00	64	12.4	79	98	10.2	62
31	11.4	40.00	65	11.5	63	99	12.3	48
32	8.7	60.00	66	9.9	49	100	8.7	68
33	12.1	65.00	67	13.9	72			
34	13.2	53.51	68	10.9	27			

180

Metric	Result
Mean	11.7143
Median	12.035
Std Dev	1.73896
Skewness	-0.62792
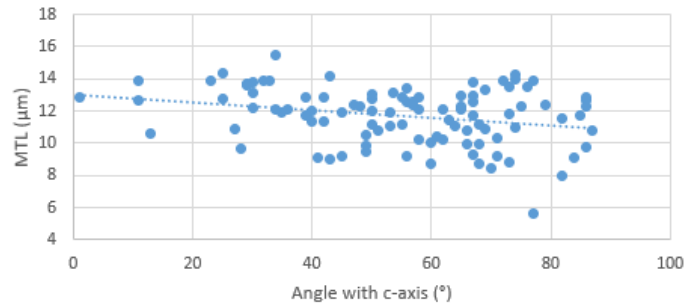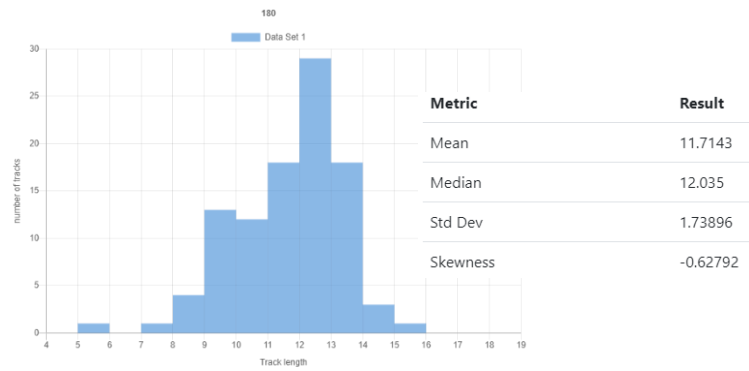
Figure S.25. Raw track lengths (L) in µm and angle with c-axis (A) for sample 182.

ID	L	A	ID	L	A	ID	L	A
1	11.2	46	35	11.5	84	69	12.3	60
2	12.0	12	36	13.5	60	70	14.4	40
3	12.5	44	37	12.3	82	71	13.5	31
4	12.2	52	38	12.5	80	72	12.3	15
5	10.7	58	39	13.9	74	73	13.9	43
6	13.3	43	40	9.7	70	74	10.8	56
7	14.3	62	41	14.1	84	75	12.9	60
8	11.7	85	42	10.5	80	76	11.5	53
9	12.7	73	43	11.9	62	77	12.2	59
10	14.4	30	44	12.9	79	78	12.4	64
11	11.4	50	45	14.1	66	79	7.8	79
12	12.7	76	46	13.7	23	80	7.8	64
13	13.1	56	47	12.9	47	81	13.2	50
14	13.9	47	48	10.4	50	82	15.7	34
15	12.2	78	49	14.2	60	83	12.5	62
16	13.4	27	50	12.2	77	84	13.3	41
17	12.4	50	51	10.9	32	85	12.2	64
18	12.6	39	52	12.8	56	86	12.8	43
19	12.5	54	53	11.6	54	87	12.7	41
20	14.0	49	54	12.7	68	88	14.8	39
21	11.9	44	55	13.2	50	89	12.7	65
22	10.3	63	56	13.6	38	90	10.1	71
23	11.8	40	57	9.2	68	91	7.7	76
24	11.2	57	58	8.3	80	92	14.6	54
25	13.3	36	59	12.2	69	93	13.1	66
26	11.9	88	60	12.8	70	94	12.9	48
27	13.7	60	61	12.9	35	95	12.2	55
28	11.3	70	62	14.8	68	96	13.0	45
29	12.7	19	63	14.6	36	97	12.2	39
30	11.9	75	64	11.4	68	98	14.3	46
31	13.6	77	65	9.5	39	99	13.1	27
32	13.6	45	66	15.7	36	100	13.1	44
33	13.6	81	67	12.0	71			
34	13.0	67	68	12.4	67			

Histogram (Frequencies)

Metric	Result
Mean	12.4567
Median	12.665
Std Dev	1.56189
Skewness	-0.92921
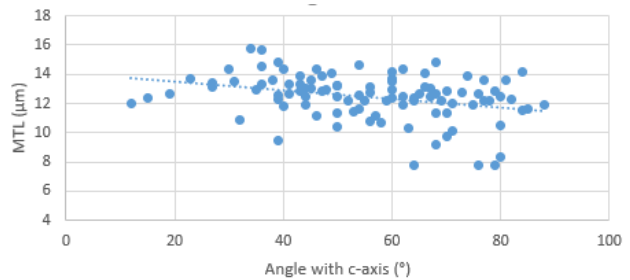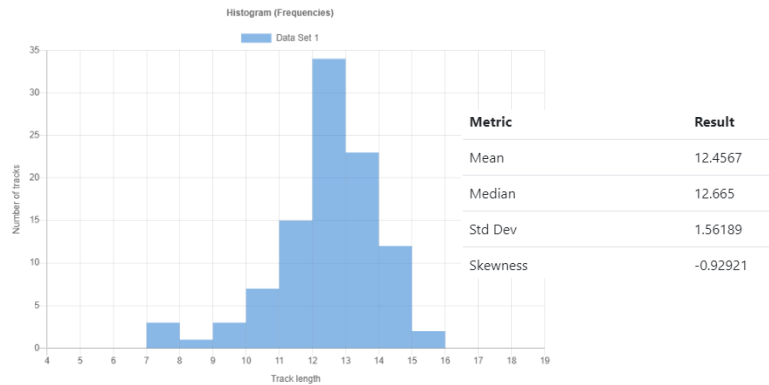
Figure S.26. Raw track lengths (L) in µm and angle with c-axis (A) for sample 164.

ID	L	A
1	11.1	54
2	10.3	71
3	12.3	75
4	11.0	73
5	8.0	54
6	9.2	89
7	6.7	51
8	10.2	45
9	13.8	83
10	13.3	60
11	12.7	29
12	11.8	86
13	13.3	52
14	8.8	68
15	13.7	73
16	12.2	77
17	12.8	61
18	8.8	71
19	14.7	64
20	13.5	41
21	14.2	33

Metric	Result
Mean	11.54286
Median	12.2
Std Dev	2.2489
Skewness	-0.59463
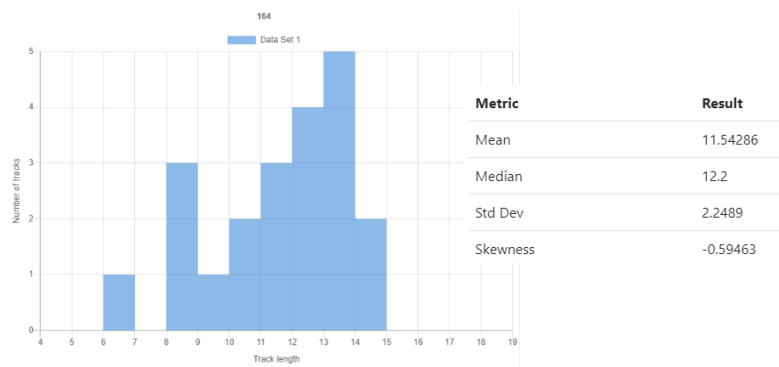
Figure S.27. Raw track lengths (L) in µm and angle with c-axis (A) for sample 168.

ID	L	A
1	12.5	63
2	14.5	66
3	13.5	17
4	12.1	47
5	13.3	86
6	14.2	48
7	13.5	74
8	13.1	53
9	13.2	45
10	14.5	58
11	12.7	63
12	13.7	51
13	12.5	71
14	12.0	8
15	12.6	16
16	12.9	37
17	10.1	52
18	12.5	45
19	11.9	35
20	13.5	1
21	11.5	64
22	15.0	37
23	13.0	16
24	13.9	36
25	11.0	34
26	14.5	45
27	11.6	20

Metric	Result
Mean	12.93704
Median	13.0
Std Dev	1.15896
Skewness	-0.37612
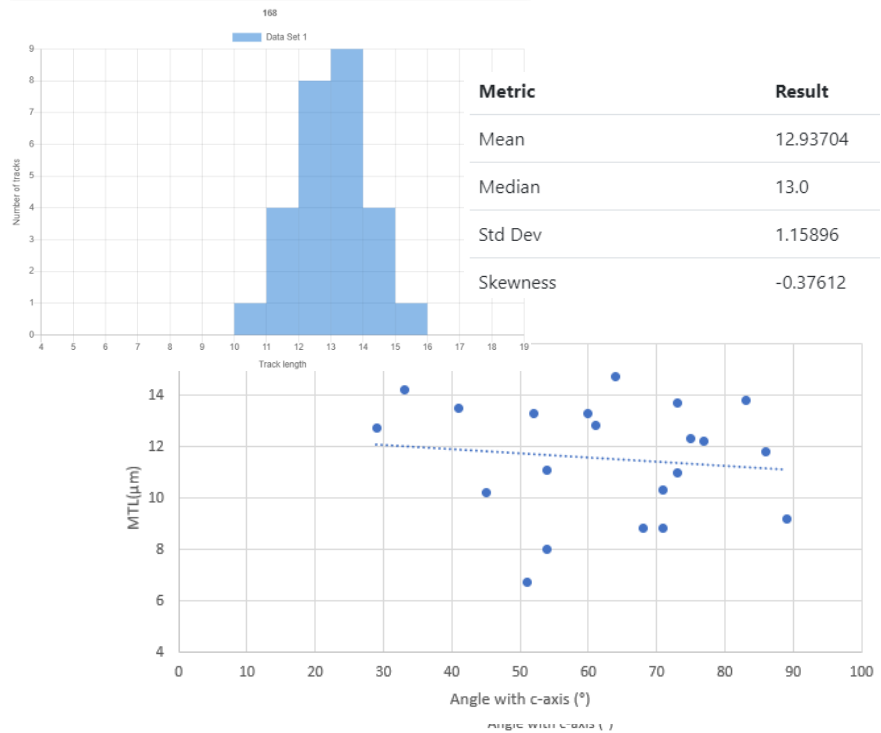
Figure S.28. Raw track lengths (L) in μm and angle with c-axis (A) for sample 170.

ID	L	A	ID	L	A
1	14.3	49	35	13.6	54
2	11.6	66	36	12.7	86
3	13.4	9	37	12.4	75
4	9.5	62	38	9.6	68
5	9.9	47	39	10.9	22
6	12.5	10	40	10.9	84
7	12.9	87	41	12.1	70
8	13.3	72	42	11.3	34
9	13.3	54	43	13.9	68
10	13.6	89	44	10.6	61
11	12.2	46	45	12.6	74
12	9.5	72	46	9.5	35
13	11.2	72	47	12.1	45
14	13.9	61	48	13.9	37
15	11.9	43	49	12.9	7
16	14.8	74	50	12.4	55
17	9.9	48	51	12.2	75
18	10.3	28	52	9.5	76
19	12.2	40	53	12.4	61
20	13.0	62	54	11.6	29
21	10.1	82	55	12.7	87
22	11.1	58	56	12.8	40
23	9.7	73	57	12.2	72
24	13.5	59	58	9.3	53
25	11.3	40	59	10.9	43
26	12.1	58	60	11.0	50
27	11.4	36	61	15.0	57
28	13.7	23	62	14.3	73
29	13.3	32	63	10.1	31
30	11.1	14	64	11.5	59
31	14.0	54	65	8.5	72
32	14.6	37	66		
33	13.0	23	67		
34	13.1	72	68		

Metric	Result
Mean	12.06672
Median	12.21
Std Dev	1.5252
Skewness	-0.14746
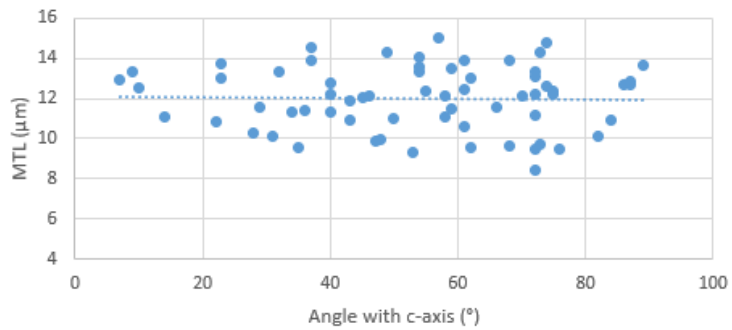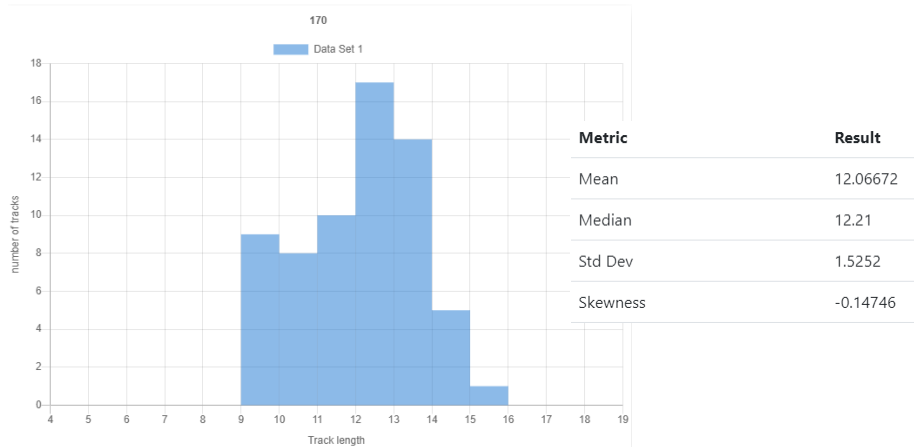
Figure S.29. Raw track lengths (L) in μm and angle with c-axis (A) for sample 501.

ID	L	A	ID	L	A
1	12.5	83	35	9.1	77
2	8.1	42	36	12.4	59
3	11.3	11.85	37	13.5	69
4	11.9	60	38	9.6	9
5	12.0	34	39	13.1	71
6	6.8	59	40		
7	10.1	27	41		
8	14.8	57	42		
9	10.5	59	43		
10	12.9	71	44		
11	14.4	50	45		
12	13.6	70	46		
13	11.3	33	47		
14	12.8	28	48		
15	13.3	64	49		
16	14.3	84	50		
17	12.9	73	51		
18	13.8	30	52		
19	11.4	67	53		
20	11.5	50	54		
21	13.5	85	55		
22	13.1	33	56		
23	14.7	71	57		
24	14.9	23	58		
25	14.0	53	59		
26	13.4	89	60		
27	14.8	84	61		
28	14.9	82	62		
29	10.4	37	63		
30	8.9	62	64		
31	12.3	8	65		
32	12.2	31	66		
33	14.2	6	67		

Metric	Result
Mean	12.34737
Median	12.85
Std Dev	2.01558
Skewness	-0.89904
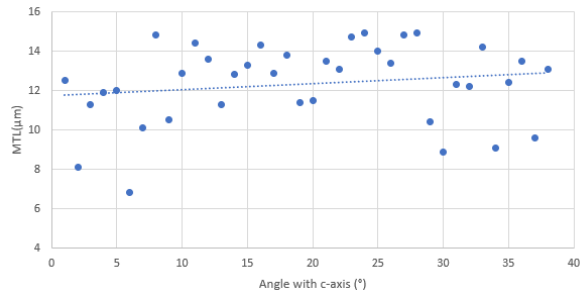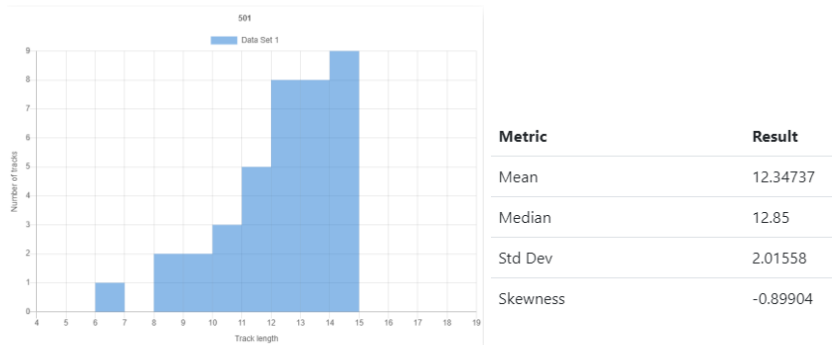
Figure S.30. Raw track lengths (L) in μm and angle with c-axis (A) for sample 502.

ID	L	A	ID	L	A	ID	L	A
1	14.2	45	35	12.4	26	69	10.7	80
2	9.9	75	36	9.1	65	70	10.1	37
3	7.9	48	37	14.0	45	71	12.2	41
4	13.0	54	38	13.7	65	72	12.6	47
5	10.7	56	39	15.1	54	73	11.8	77
6	13.5	76	40	11.8	42	74	13.1	48
7	10.6	65	41	11.6	45	75	12.3	45
8	9.2	75	42	11.9	48	76	13.7	9
9	9.9	57	43	13.1	21	77	13.5	23
10	10.5	73	44	13.2	31	78	12.2	12
11	13.7	58	45	13.5	88	79	12.5	31
12	12.3	54	46	11.3	49	80	9.7	43
13	11.3	78	47	12.8	89	81	11.8	35
14	11.4	61	48	11.4	66	82	12.0	36
15	11.9	77	49	10.8	80	83	12.6	54
16	11.5	64	50	9.6	48	84	11.7	52
17	9.6	49	51	13.3	88	85	11.8	74
18	13.3	50	52	12.1	73	86	13.6	54
19	10.4	73	53	10.9	57	87	12.4	68
20	10.0	62	54	12.0	52	88	12.8	42
21	13.8	56	55	12.5	88	89	11.6	71
22	12.8	71	56	11.6	86	90	14.1	41
23	11.0	59	57	10.4	42	91	12.5	72
24	12.5	45	58	11.0	85	92	11.5	70
25	11.0	79	59	13.3	69	93	12.3	80
26	11.0	76	60	12.8	62	94	11.4	80
27	10.1	52	61	14.4	48	95	11.5	69
28	14.8	73	62	11.9	85	96	11.5	40
29	12.1	61	63	14.4	44	97	14.5	53
30	12.0	56	64	7.7	74	98	11.3	30
31	13.0	51	65	8.9	28	99	12.8	50
32	7.6	60	66	13.1	49	100	9.0	73
33	10.2	31	67	11.6	47			
34	13.2	19	68	12.3	34			

Metric	Result
Mean	11.8601
Median	11.94
Std Dev	1.56127
Skewness	-0.47297
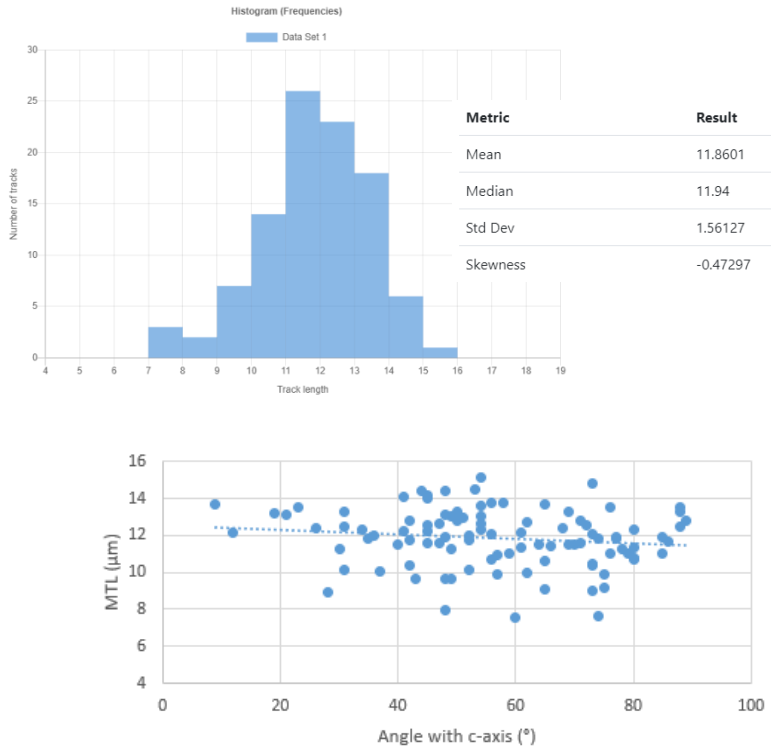
Figure S.31. Raw track lengths (L) in μm and angle with c-axis (A) for sample 505.

ID	L	A	ID	L	A	ID	L	A
1	10.1	77	35	12.6	55	69	11.2	32
2	10.0	81	36	8.7	41	70	11.0	42
3	12.0	61	37	9.1	79	71	10.6	66
4	12.1	47	38	11.4	76	72	11.1	61
5	9.9	66	39	12.4	61	73	9.6	51
6	11.4	85	40	12.4	70	74	9.6	78
7	10.0	86	41	12.5	53	75	11.1	53
8	12.0	90	42	12.6	80	76	12.0	59
9	9.1	78	43	12.4	47	77	9.2	52
10	7.6	39	44	8.3	35	78	8.1	10
11	11.8	62	45	13.1	63	79	11.9	66
12	8.3	58	46	8.1	75	80	10.8	34
13	9.0	53	47	9.3	73	81	10.7	82
14	10.7	49	48	10.0	79	82	9.5	42
15	11.7	39	49	12.1	17	83	6.9	35
16	11.3	70	50	11.8	69	84	10.9	19
17	10.7	61	51	12.6	55	85	11.7	51
18	12.8	78	52	9.5	45	86	11.7	63
19	13.0	52	53	10.9	43	87	10.5	23
20	12.5	54	54	7.7	45	88	8.0	80
21	13.2	44	55	9.2	66	89	10.3	36
22	9.3	71	56	9.1	71	90	11.8	58
23	12.3	74	57	11.5	75	91	10.1	79
24	10.1	70	58	8.7	41	92	9.9	59
25	9.2	60	59	10.1	55	93	7.5	29
26	11.4	63	60	8.0	33	94	12.2	75
27	11.7	78	61	12.4	43	95	9.3	30
28	10.7	42	62	10.0	38	96	8.5	75
29	11.1	74	63	11.2	83	97	12.0	71
30	10.2	79	64	12.3	49	98	13.9	76
31	9.2	73	65	10.4	49	99	12.1	78
32	11.9	33	66	12.5	51	100	10.5	33
33	7.0	57	67	11.2	59			
34	9.1	68	68	10.5	35			

Metric	Result
Mean	11.7334
Median	11.9
Std Dev	1.41542
Skewness	-0.09343
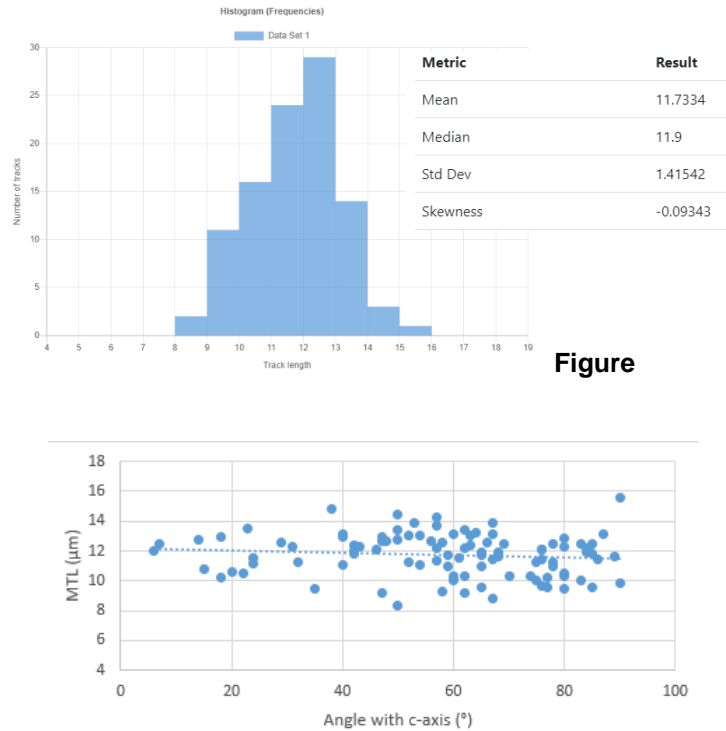
Figure

S.32. Raw track lengths (L) in µm and angle with c-axis (A) for sample 506.

ID	L	A	ID	L	A	ID	L	A
1	13.7	17	35	12.2	68	69	13.0	74
2	9.8	62	36	12.8	29	70	10.4	82
3	9.1	60	37	11.6	71	71	10.3	33
4	7.3	38	38	14.1	80	72	14.0	29
5	11.6	48	39	11.6	60	73	11.2	55
6	8.4	59	40	9.6	63	74	10.6	46
7	11.5	82	41	11.4	49	75	13.4	46
8	9.7	49	42	10.4	39	76	13.3	40
9	13.9	28	43	15.8	73	77	11.1	21
10	11.9	39	44	10.8	70	78	12.7	69
11	10.9	49	45	12.3	63	79	13.1	28
12	13.4	39	46	12.7	31	80	14.0	62
13	10.7	26	47	10.1	60	81	11.7	78
14	14.8	36	48	12.2	78	82	12.2	70
15	12.0	19	49	14.0	30	83	11.7	75
16	13.8	69	50	12.9	25	84	12.9	58
17	11.8	59	51	13.8	34	85	9.0	58
18	11.0	83	52	14.0	49	86	14.3	19
19	13.7	45	53	11.6	35	87	12.4	74
20	14.3	41	54	13.3	20	88	12.1	74
21	12.1	66	55	14.4	50	89	12.7	76
22	12.3	58	56	11.5	83	90	9.7	38
23	10.8	2	57	13.0	60	91	12.6	57
24	13.7	75	58	12.3	54	92	11.4	60
25	10.8	73	59	12.5	53	93	13.2	51
26	12.1	70	60	11.6	40	94	10.1	67
27	14.8	37	61	14.2	74	95	13.5	72
28	12.4	66	62	12.1	57	96	13.4	43
29	14.4	35	63	12.5	69	97	13.9	83
30	14.6	74	64	11.2	57	98	13.3	23
31	12.4	77	65	14.0	26	99	14.4	15
32	14.0	23	66	12.6	69	100	12.7	65
33	8.2	50	67	13.1	64			
34	11.6	24	68	11.5	84			

Metric	Result
Mean	12.2487
Median	12.355
Std Dev	1.61276
Skewness	-0.55435
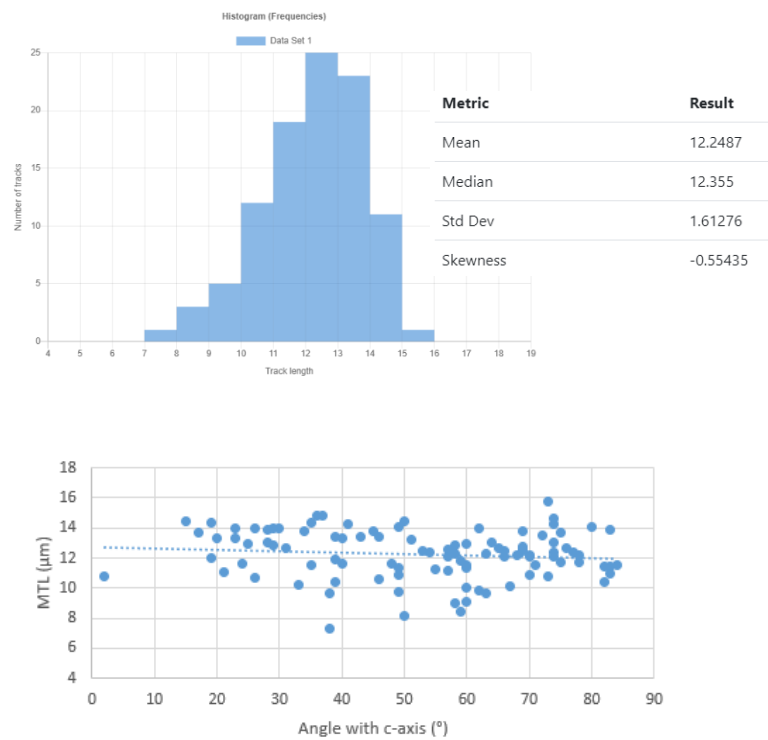
Figure S.33. Raw track lengths (L) in µm and angle with c-axis (A) for sample 510.

ID	L	A	ID	L	A	ID	L	A
1	11.0	64	35	12.4	67	69	8.7	54
2	12.9	51	36	13.2	67	70	13.2	78
3	10.2	56	37	10.8	67	71	13.0	53
4	13.5	50	38	16.8	74	72	12.3	27
5	9.8	56	39	10.1	61	73	14.6	73
6	14.5	45	40	10.5	69	74	15.8	29
7	13.5	56	41	14.5	76	75	11.9	73
8	11.4	41	42	11.2	75	76	14.1	32
9	10.6	37	43	12.5	66	77	11.2	74
10	12.1	39	44	14.4	63	78	13.3	70
11	11.8	51	45	13.6	78	79	10.3	62
12	13.4	49	46	10.9	62	80	10.9	60
13	12.4	53	47	14.2	64	81	10.9	52
14	10.2	83	48	12.5	48	82	13.1	78
15	14.8	55	49	10.4	89	83	10.2	45
16	14.3	75	50	12.2	82	84	12.1	70
17	13.9	52	51	11.2	89	85	13.1	73
18	14.4	48	52	11.7	55	86	13.7	34
19	13.6	36	53	12.4	76	87	13.8	62
20	13.0	74	54	12.9	14	88	12.9	76
21	8.3	71	55	9.8	73	89	11.6	37
22	13.1	73	56	11.5	38	90	11.8	45
23	14.9	53	57	11.4	77	91	11.8	83
24	13.1	85	58	13.3	48	92	10.1	80
25	12.8	71	59	10.9	32	93	12.1	79
26	11.7	72	60	12.6	47	94	12.1	54
27	11.8	82	61	11.4	66	95	14.3	77
28	11.5	64	62	11.6	55	96	12.4	28
29	12.5	63	63	11.1	58	97	13.3	72
30	11.9	75	64	13.4	40	98	13.5	53
31	13.1	82	65	13.2	30	99	12.1	85
32	9.1	44	66	12.0	83	100	14.2	67
33	13.0	59	67	14.3	56			
34	12.3	45	68	11.0	43			

Metric	Result
Mean	12.3472
Median	12.4
Std Dev	1.53424
Skewness	-0.06185
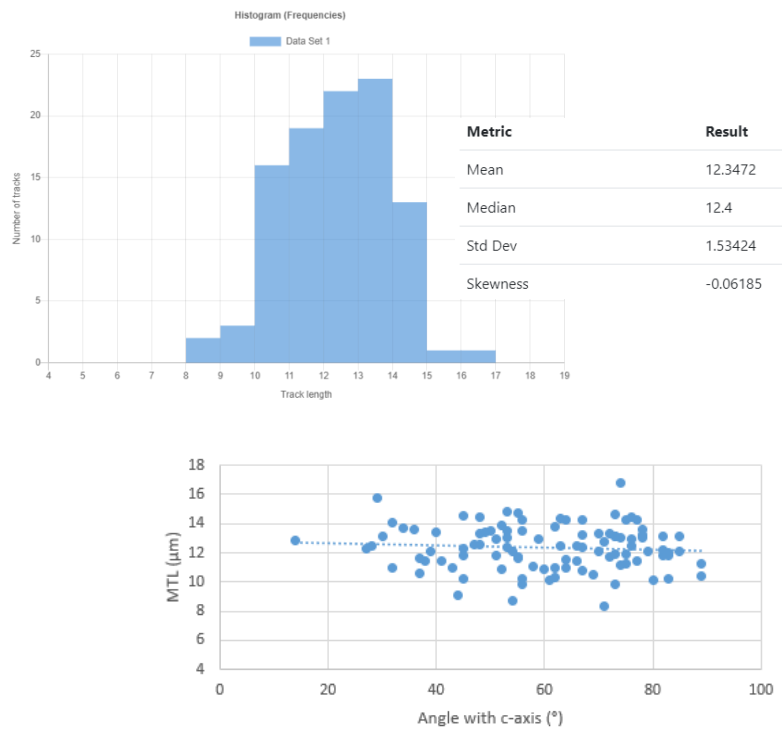
Figure S.34. Raw track lengths (L) in µm and angle with c-axis (A) for sample 512.

ID	L	A	ID	L	A
1	10.2	85	35	13.6	57
2	10.2	79	36	13.1	79
3	12.5	60	37	9.2	88
4	14.4	41	38	13.1	21
5	12.2	55	39	12.1	7
6	11.8	73	40	9.7	66
7	13.3	85	41	11.3	36
8	14.1	57	42	13.2	43
9	14.2	69	43	13.8	53
10	12.0	82	44	11.8	74
11	12.6	85	45		
12	15.9	88	46		
13	12.1	61	47		
14	11.8	82	48		
15	13.4	0	49		
16	12.6	84	50		
17	13.7	87	51		
18	13.5	59	52		
19	10.2	81	53		
20	13.6	12	54		
21	14.9	49	55		
22	10.6	89	56		
23	11.6	49	57		
24	12.2	72	58		
25	13.3	89	59		
26	12.5	44	60		
27	13.2	64	61		
28	13.4	57	62		
29	11.0	84	63		
30	10.8	85	64		
31	12.2	66	65		
32	15.6	55	66		
33	12.2	26	67		
34	13.0	19	68		

Metric	Result
Mean	12.53864
Median	12.55
Std Dev	1.48906
Skewness	-0.10579
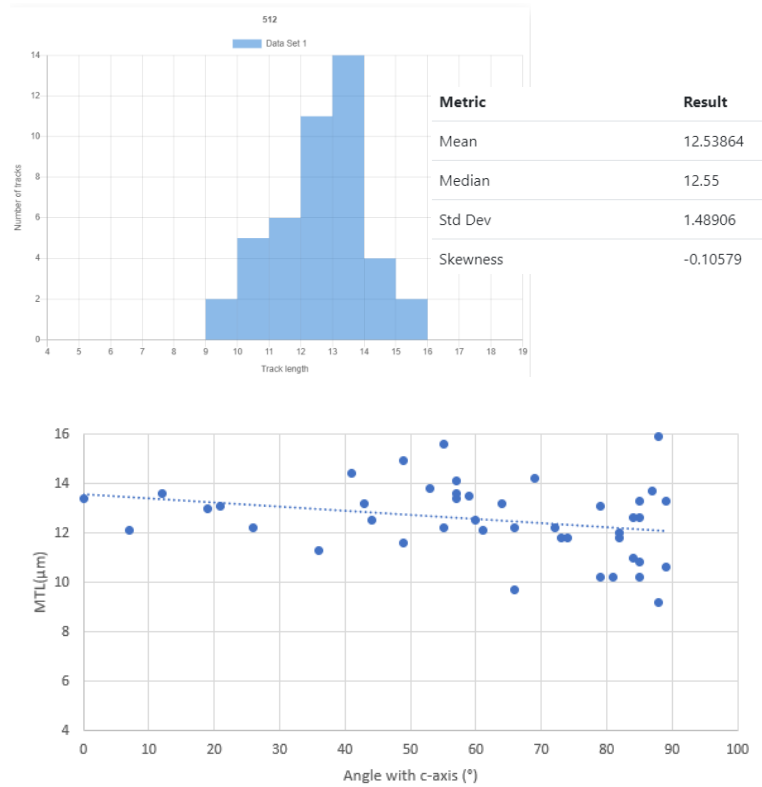
Figure S.35. Raw track lengths (L) in µm and angle with c-axis (A) for sample 515.

ID	L	A	ID	L	A	ID	L	A
1	13.2	44	35	10.9	59	69	13.3	54
2	14.8	33	36	10.6	23	70	11.8	58
3	11.6	73	37	11.9	64	71	13.4	77
4	14.2	70	38	13.2	63	72	7.9	79
5	13.7	17	39	10.9	57	73	11.2	46
6	12.6	56	40	9.2	54	74	14.9	77
7	12.1	82	41	11.7	26	75	12.6	54
8	13.0	63	42	11.2	38	76	12.8	56
9	14.1	50	43	13.5	35	77	13.8	62
10	12.0	32	44	14.6	40	78	12.9	80
11	11.8	38	45	9.1	57	79	13.7	77
12	11.4	46	46	13.7	17	80	13.4	78
13	10.6	59	47	12.3	41	81	13.6	62
14	14.0	58	48	12.0	37	82	12.8	80
15	13.9	59	49	10.4	70	83	9.9	75
16	12.9	54	50	13.3	52	84	13.9	1
17	11.4	34	51	7.7	62	85	12.9	76
18	12.1	56	52	11.7	80	86		
19	11.7	72	53	12.5	75	87		
20	11.3	55	54	13.2	50	88		
21	12.2	45	55	13.8	28	89		
22	13.9	60	56	13.8	61	90		
23	17.1	15	57	12.8	32	91		
24	9.7	28	58	14.6	20	92		
25	12.3	28	59	11.1	65	93		
26	8.6	75	60	12.1	58	94		
27	14.4	35	61	15.4	58	95		
28	8.3	63	62	8.7	40	96		
29	12.7	52	63	13.6	67	97		
30	10.0	89	64	14.3	77	98		
31	14.0	61	65	13.4	21	99		
32	13.6	53	66	14.4	26	100		
33	12.6	60	67	13.1	59			
34	13.0	61	68	11.3	80			

Metric	Result
Mean	12.41788
Median	12.76
Std Dev	1.77141
Skewness	-0.62923
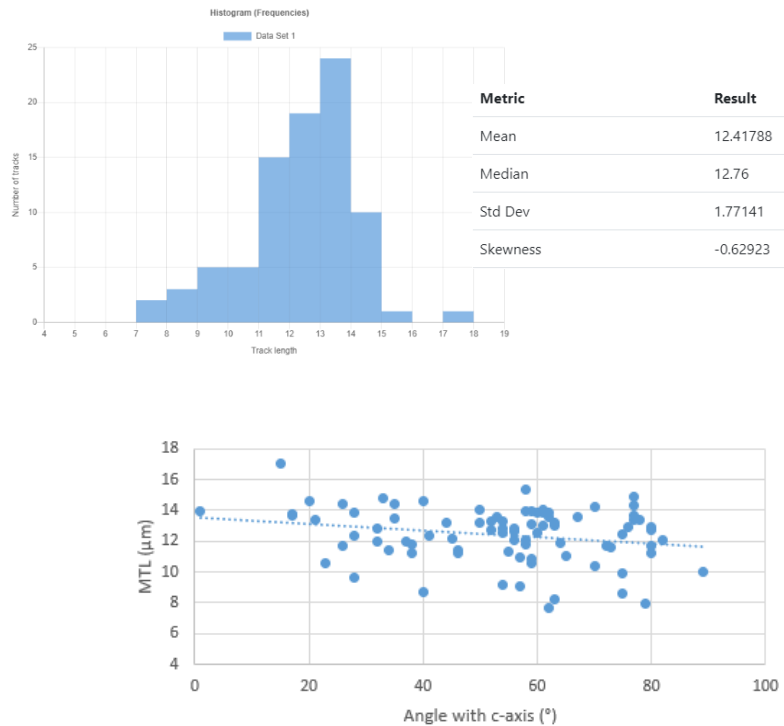
Figure S.36. Raw track lengths (L) in µm and angle with c-axis (A) for sample 516.

ID	L	A
1	13.0	39
2	11.9	39
3	11.1	55
4	7.6	79
5	9.0	79
6	12.0	89
7	10.1	72
8	11.6	61
9	13.3	28
10	12.3	49
11	12.3	40
12	12.8	75
13	12.4	56
14	12.8	44
15	12.3	71
16	10.7	49
17	13.3	78
18	8.9	23
19	10.6	55
20	13.5	60
21	12.5	78
22	13.3	42
23	11.8	42
24	11.8	81
25	12.3	77
26	13.3	63
27	10.6	23
28	14.3	14
29	13.3	82

Metric	Result
Mean	11.88621
Median	12.3
Std Dev	1.5459
Skewness	-1.09642
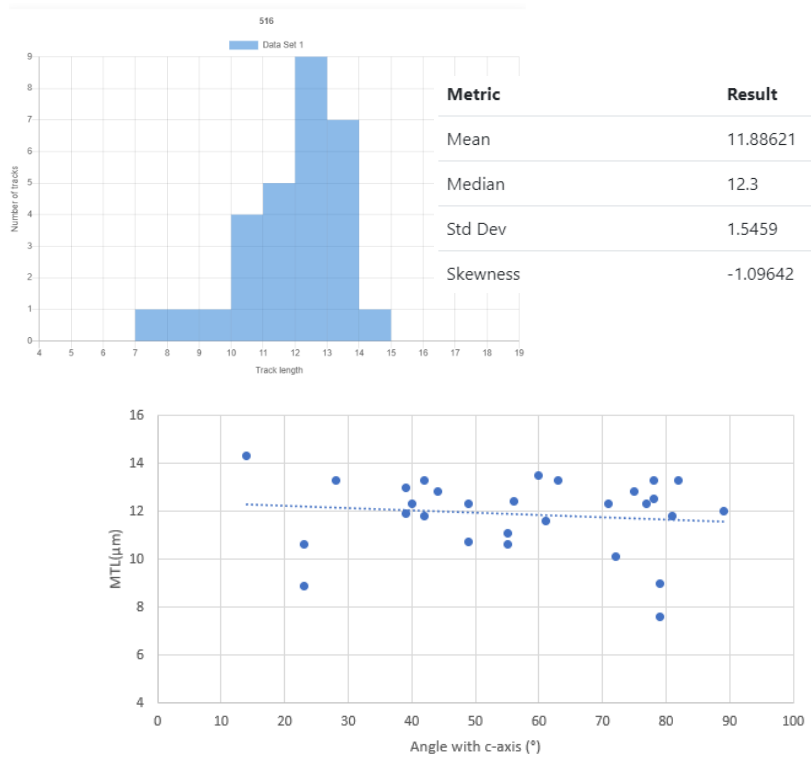
Figure S.37. Raw track lengths (L) in µm and angle with c-axis (A) for sample 192.

ID	L	A	ID	L	A
1	10.2	44	35	11.6	81
2	11.8	64	36	11.8	66
3	14.3	26	37	11.7	70
4	14.0	59	38	12.1	2
5	9.6	84	39	13.6	68
6	13.3	41	40	10.0	74
7	14.3	79	41	9.5	2
8	10.1	62	42	13.6	57
9	10.9	81	43	13.4	78
10	11.5	62	44	9.8	23
11	11.4	69	45	11.9	67
12	11.3	37	46	12.5	89
13	12.3	52	47	13.6	50
14	12.7	71	48		
15	12.0	20	49		
16	13.2	14	50		
17	13.0	52	51		
18	11.6	23	52		
19	11.2	67	53		
20	15.0	29	54		
21	11.5	70	55		
22	8.6	53	56		
23	13.3	26	57		
24	10.1	33	58		
25	12.1	39	59		
26	13.4	8	60		
27	12.3	53	61		
28	13.7	5	62		
29	11.4	56	63		
30	14.1	39	64		
31	11.2	8	65		
32	12.6	53	66		
33	15.2	5	67		
34	14.8	56	68		

Metric	Result
Mean	12.19362
Median	12.1
Std Dev	1.57071
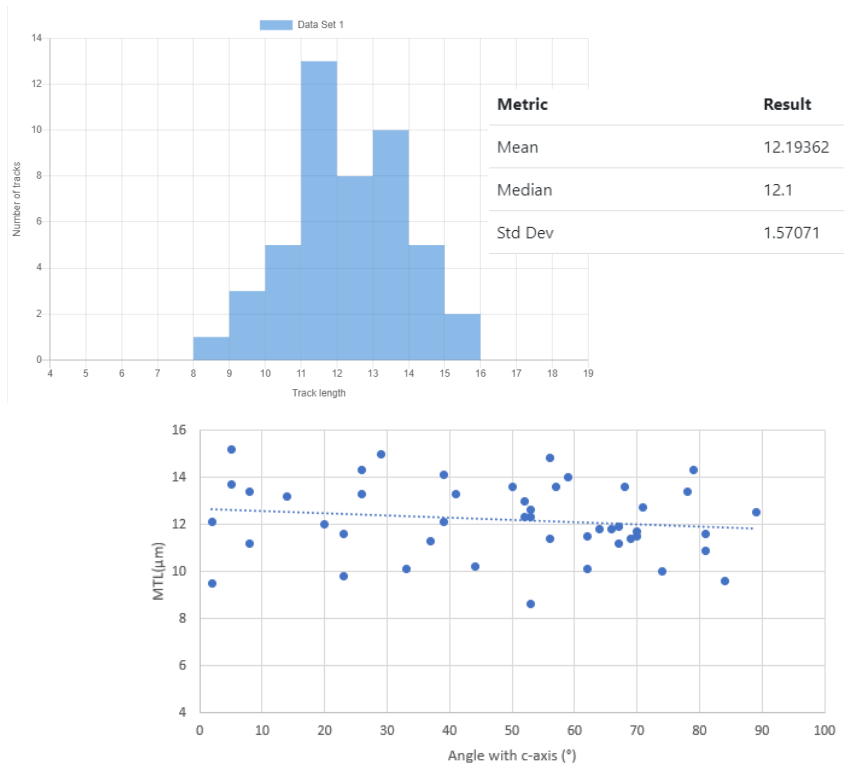
Figure S.38. Raw track lengths (L) in µm and angle with c-axis (A) for sample 124.

ID	L	A	ID	L	A	ID	L	A
1	13.7	51	35	13.2	79	69	12.4	67
2	13.3	49	36	12.3	39	70	14.0	48
3	11.2	18	37	11.3	74	71	13.0	66
4	12.4	41	38	12.7	78	72		
5	10.3	60	39	12.1	50	73		
6	12.4	82	40	13.4	19	74		
7	11.2	70	41	10.2	86	75		
8	11.6	79	42	11.0	45	76		
9	8.3	89	43	12.4	39	77		
10	12.5	47	44	11.9	60	78		
11	12.2	72	45	9.2	50	79		
12	13.8	44	46	10.2	70	80		
13	13.7	73	47	13.7	62	81		
14	14.9	67	48	8.0	78	82		
15	14.7	59	49	11.3	54	83		
16	11.0	84	50	14.6	57	84		
17	12.9	71	51	12.5	33	85		
18	12.6	14	52	12.3	36	86		
19	11.0	25	53	12.2	70	87		
20	13.0	89	54	11.5	37	88		
21	14.1	73	55	11.9	28	89		
22	13.0	77	56	12.2	45	90		
23	12.4	36	57	12.6	81	91		
24	11.0	36	58	11.5	55	92		
25	12.4	39	59	13.7	61	93		
26	8.9	61	60	10.1	22	94		
27	10.7	61	61	13.9	45	95		
28	9.3	72	62	12.7	62	96		
29	11.9	52	63	11.0	22	97		
30	11.2	39	64	11.0	60	98		
31	14.9	61	65	9.4	51	99		
32	10.2	61	66	13.1	31	100		
33	9.4	72	67	12.8	6			
34	13.9	52	68	12.3	70			

124

| Metric	Result
Mean	12.02493
Median	12.32
Std Dev	1.56435
Skewness	-0.44319
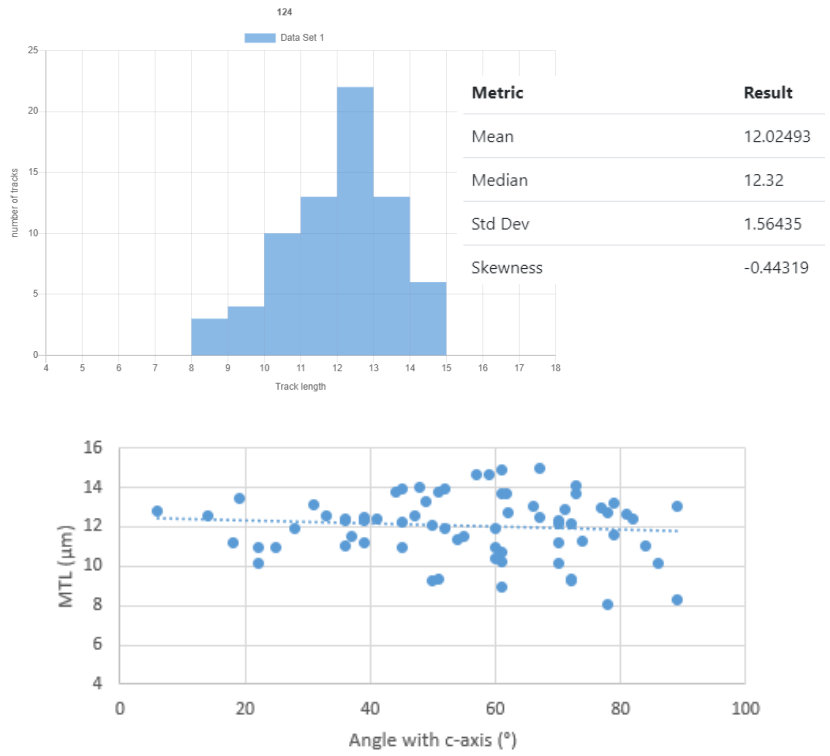
Figure S.39. Raw track lengths (L) in µm and angle with c-axis (A) for sample 134.

ID	L	A
1	11.9	70
2	13.7	41
3	13.5	71
4	13.3	42
5	11.7	73
6	12.8	68
7	13.0	52
8	13.1	69
9	14.2	44
10	10.1	32
11	10.3	63
12	12.2	38
13	11.1	71
14	11.9	78
15	12.8	41
16	12.9	77
17	14.0	65
18	10.6	63
19	11.4	74
20	12.8	77
21	13.0	46

134

Metric	Result
Mean	12.39524
Median	12.8
Std Dev	1.18553
Skewness	-0.51008
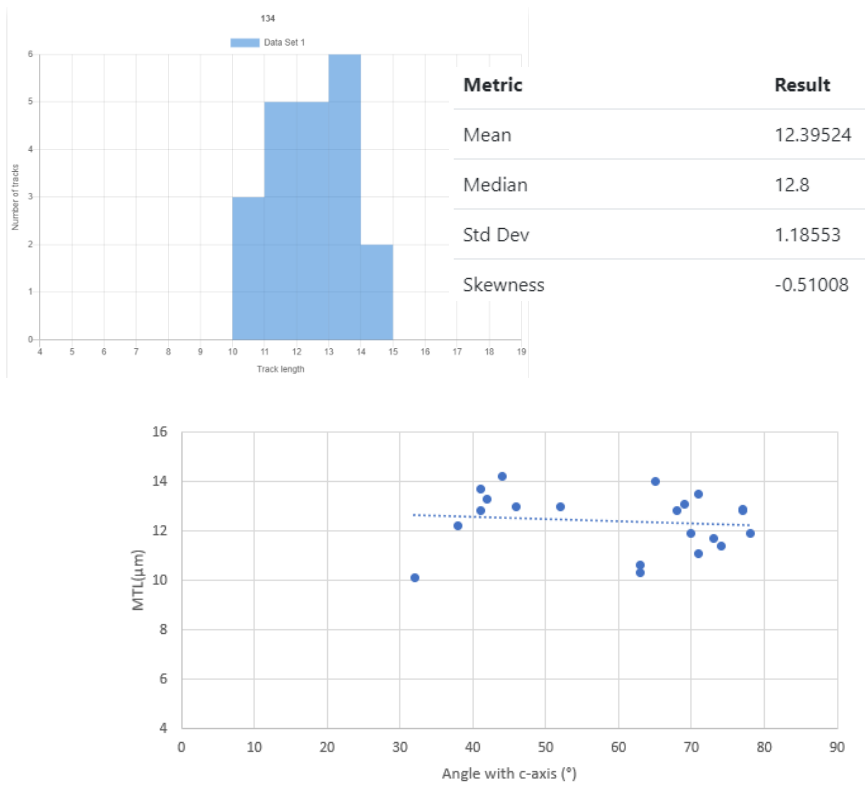
Figure S.40. Raw track lengths (L) in μm and angle with c-axis (A) for sample 135.

ID	L	A	ID	L	A
1	14.3	33	35	12.1	78
2	14.5	9	36		
3	14.2	24	37		
4	13.8	60	38		
5	10.9	89	39		
6	11.4	45	40		
7	14.4	57	41		
8	13.0	86	42		
9	13.8	60	43		
10	12.7	54	44		
11	12.5	41	45		
12	14.5	67	46		
13	11.6	46	47		
14	11.6	42	48		
15	14.1	52	49		
16	10.6	52	50		
17	13.4	51	51		
18	12.7	40	52		
19	11.6	41	53		
20	16.0	14	54		
21	11.1	51	55		
22	12.1	52	56		
23	15.0	54	57		
24	14.9	51	58		
25	13.4	67	59		
26	14.3	53	60		
27	13.7	61	61		
28	13.4	42	62		
29	13.1	55	63		
30	12.4	67	64		
31	12.8	53	65		
32	13.0	61	66		
33	16.0	42	67		
34	13.0	55	68		

Metric	Result
Mean	13.19714
Median	13.1
Std Dev	1.36844
Skewness	0.06462
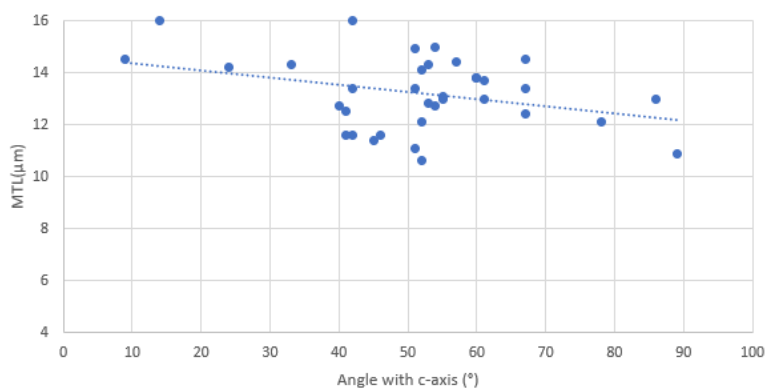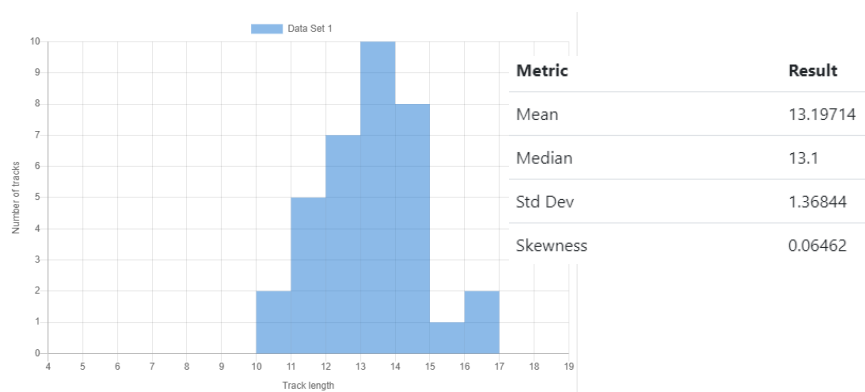
S3: Supporting graphs

Graphs to investigate potential relationships between mean track length (MTL) and apatite fission track (AFT) central age, and AFT central age and D_{par}.

Figure S.41. MTL vs. AFT central age.
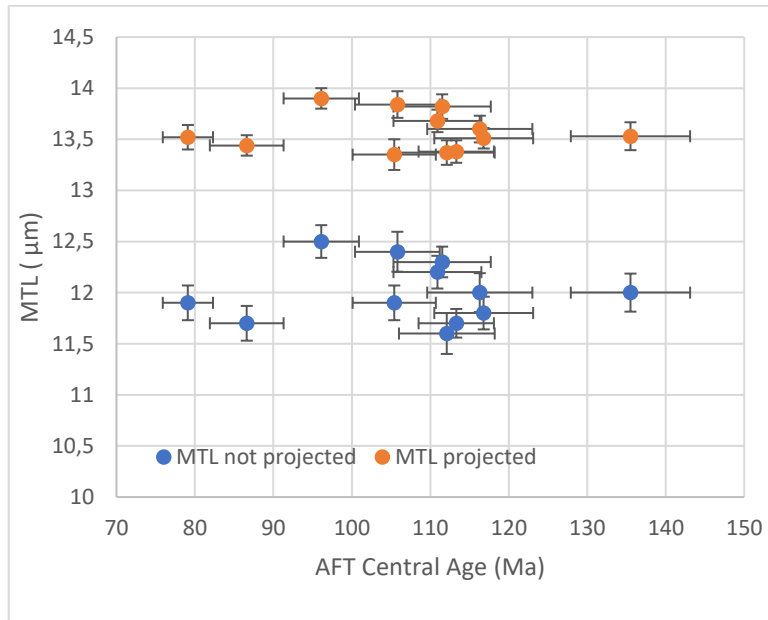
Sample	Central age	Erro Age	MTL	Erro MTL	MTL c-axis	Erro MTL c-axis
124	116.3	6.7	12.0	0.2	13.6	0.1
170	135.5	7.6	12.0	0.2	13.5	0.1
171	112.1	6.1	11.6	0.2	13.4	0.1
175	105.4	5.3	11.9	0.2	13.4	0.2
176	79.1	3.2	11.9	0.2	13.5	0.1
180	86.6	4.7	11.7	0.2	13.4	0.1
182	96.1	4.8	12.5	0.2	13.9	0.1
502	116.8	6.3	11.8	0.2	13.5	0.1
505	113.3	4.8	11.7	0.1	13.4	0.1
506	110.9	5.6	12.2	0.2	13.7	0.1
510	111.5	6.2	12.3	0.2	13.8	0.1
515	105.8	5.4	12.4	0.2	13.8	0.1

Figure S.42. AFT central age vs. mean D_{par}.
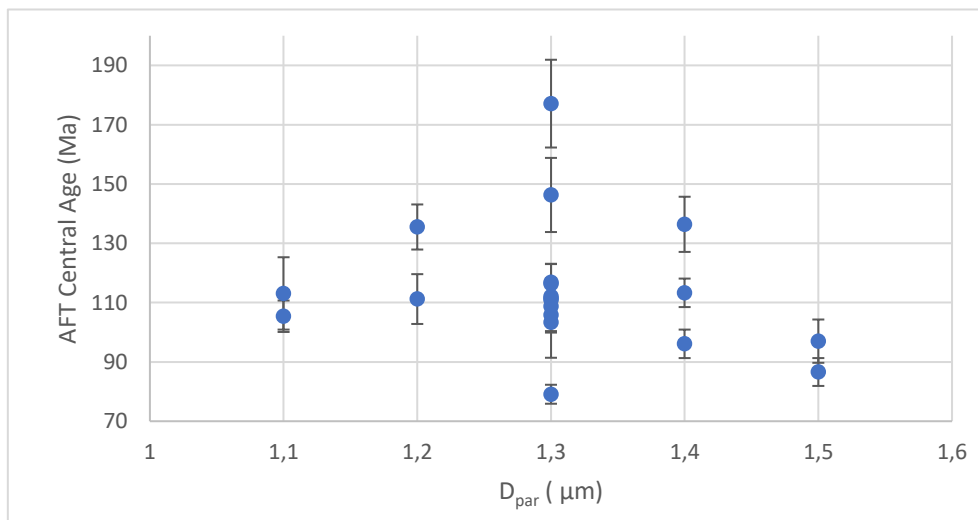
S4: Modeling

Here we describe the modeling parameters we have used in QTQt (Gallagher, 2012). Details can be found in the paper.

<u>Modeling Strategies:</u>

Modeling all samples separately:
- **M1:** C-axis projected lengths, constrained in one box (1250 ± 50 Ma; 350 ± 50°C), default priors. Present-day temperature set to 30 ± 5 °C.

Modeling one representative samples (171):
- **M2:** C-axis projected lengths, constrained in one box (1250 ± 50 Ma; 350 ± 50°C), default priors. Present-day temperature set to 30 ± 5 °C.
- **M3:** C-axis projected lengths, constrained in one box (1250 ± 50 Ma; 350 ± 50°C), wider priors (300 ± 300 Ma; 150 ± 150°C). Present-day temperature set to 30 ± 5 °C.
- **M4:** C-axis projected lengths, constrained in two boxes (1250 ± 50 Ma; 350 ± 50°C and 200 ± 20 Ma; 200 ± 20°C) , default priors. Present-day temperature set to 30 ± 5 °C.
- **M5:** C-axis projected lengths, constrained in two boxes (1250 ± 50 Ma; 350 ± 50°C and 200 ± 20 Ma; 50 ± 5°C) , default priors. Present-day temperature set to 30 ± 5 °C.
- **M6:** No c-axis projected lengths, no constraints, default priors. Present-day temperature set to 30 ± 5 °C.

Modeling ALL samples together:
- **M7:** C-axis projected lengths, constrained in one box (1250 ± 50 Ma; 350 ± 50°C), default priors. Present-day temperature set to 30 ± 5 °C.
- **M8:** No c-axis projected lengths, constrained in one box (1250 ± 50 Ma; 350 ± 50°C), default priors. Present-day temperature set to 30 ± 5 °C.

Table S.1: Table with result parameters of the modeling. According to Gallagher (2012) the acceptance rate for the time and temperature should be between ~20% and 60%, and the "birth" and "death" should have a similar value. The table show the values in green, if these conditions are reached. Ac: acceptance rates.

171	M2	M3	M4	M5	M6
Ac(Time)	0.5546	0.6214	0.6167	0.6560	0.6871
Ac(Temperature)	0.1741	0.1746	0.3378	0.2987	0.4129
Birth	0.0385	0.0236	0.0800	0.0766	0.2205
Death	0.4566	0.6483	0.0996	0.1668	0.2219

ALL together	Ac(Time)	Ac(temp.)	Birth	Death
M7	0.3737	0.2688	0.0783	0.0774
M8	0.3345	0.3150	0.0502	0.498

<u>Why is acceptance rate important?</u>

Acceptance rates in the context of modeling evaluation are crucial for several reasons. They serve as a metric for assessing the efficiency of proposed moves within the specified proposal time and temperature parameters in the modeling process. The acceptance rate, ideally targeted between approximately 20% to 60%, indicates the scale of the distribution for each model parameter from which iterative sampling occurs. This rate is essential as it ensures a balanced ratio between the addition ("birth") and removal ("death") of new t-T points, maintaining equilibrium within the model. By adjusting the proposal move values, one can observe a reciprocal effect on the acceptance rate. Modifying these values impacts the rate at which proposed iterations are accepted, thus influencing the overall efficiency of the model's parameter sampling. Moreover, stability assessments of crucial metrics such as the log likelihood function (indicating data fit), posterior probability log, and the number of time-temperature points across iterations are pivotal. Stability in these metrics, as reflected in likelihood chains and acceptance rates, indicates that there are no discernible trends or significant value fluctuations across most iterations (Gallagher, 2012). This stability signifies a converged Markov Chain Monte Carlo (MCMC) simulation, a fundamental prerequisite for obtaining a reliable ensemble of accepted thermal histories that contribute to constructing the posterior distribution. In the context of research publications (Abbey et al., 2022), it is strongly encouraged to report the acceptance rates for the MCMC parameters. This reporting facilitates transparency and ensures reproducibility of the modeling process.

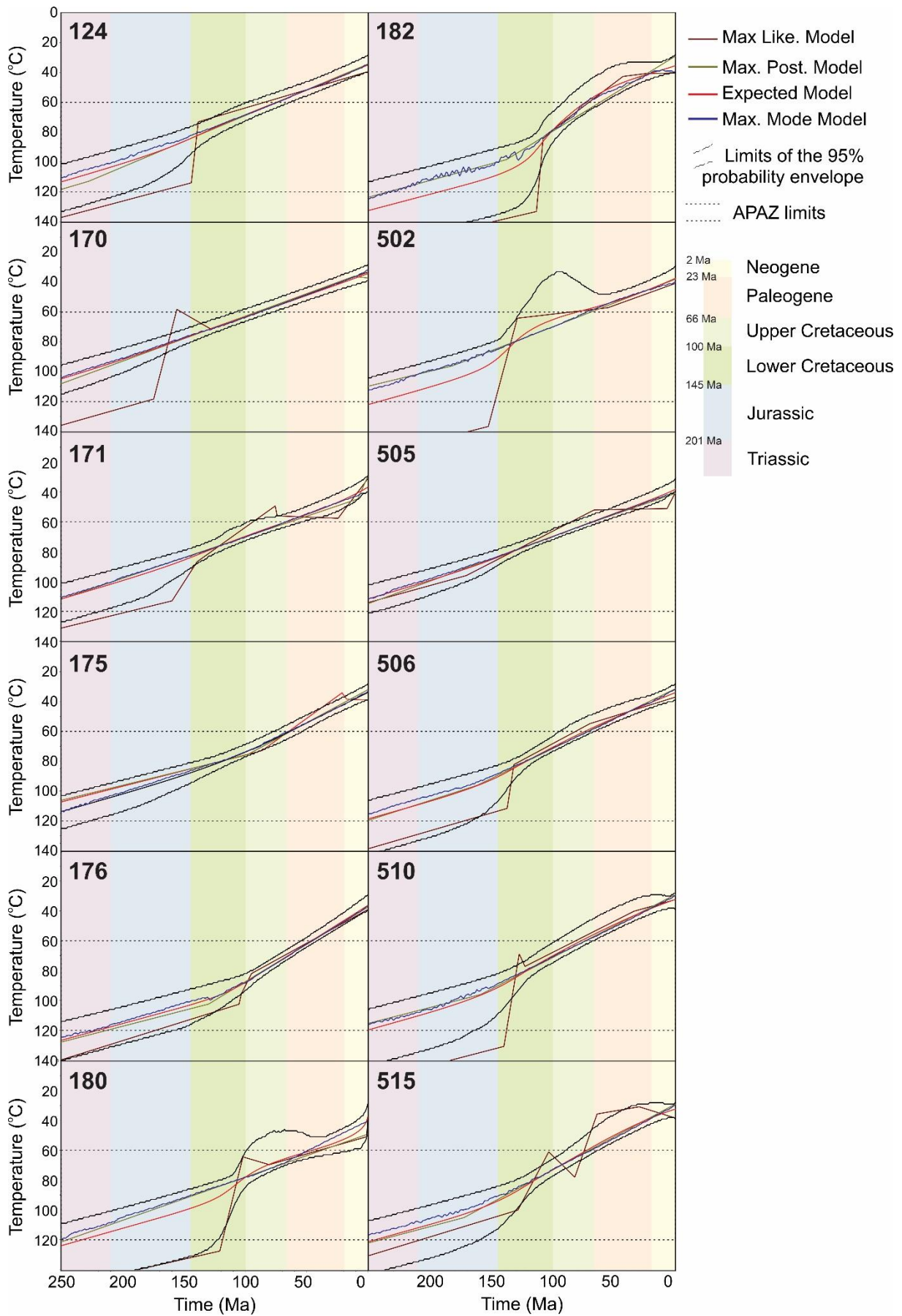**Figure S.43**: Graphic results for every sample in modeling setting M1.

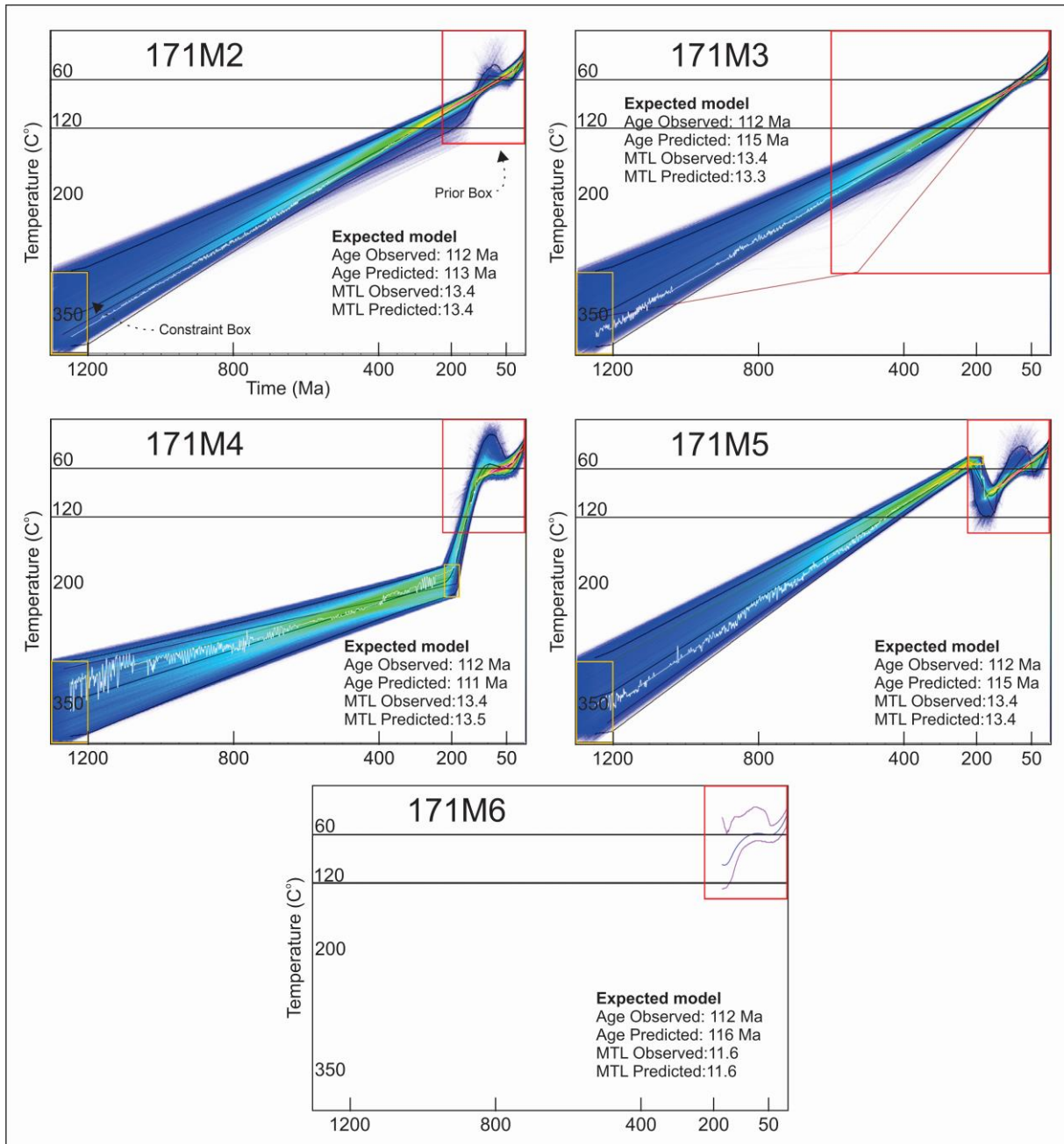**Figure S.44**: Graphic results for sample 171 in modeling setting M2, M3, M4, M5, and M6.

Figure S.45: Graphic results for all samples modeled together in setting M7. The graphs on the right display the relationship between Predicted and Observed ages, evaluating the model's performance in predicting ages compared to the actual recorded ages. 'Predicted age' refers to the estimated ages generated by the model, while 'Observed age' represents the true ages observed in the dataset. The scatter plot graphically represents each sample as points. In an ideal modeling scenario, perfect alignment between predicted and observed values forms a 45-degree straight line from the bottom left to the top right of the plot. Deviation from this line indicates disparities between predicted and observed ages, with points moving farther away implying greater differences between the model's predictions and the actual observed ages.
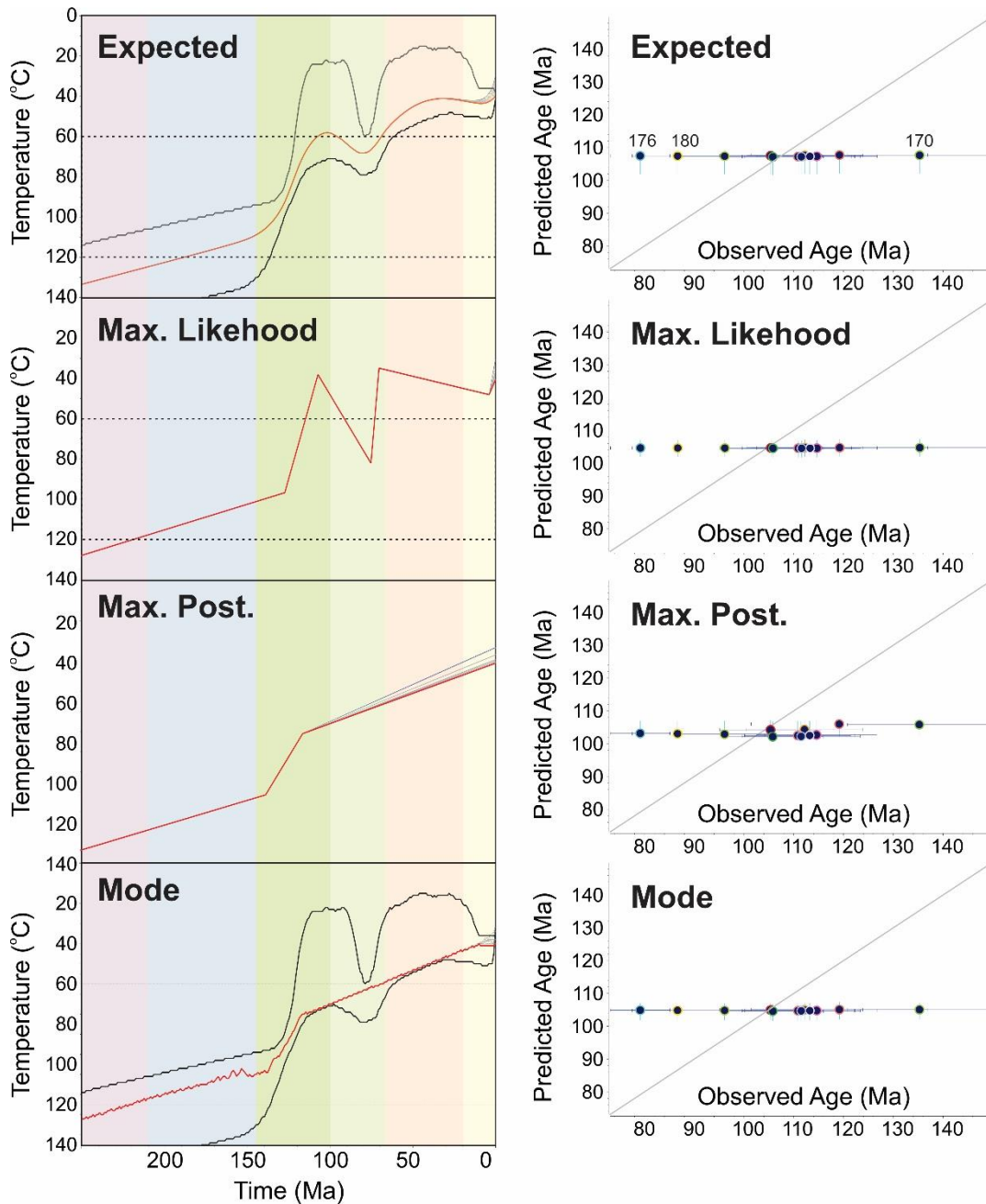
Figure S.46: Graphic results for all samples modeled together in setting M8. The graphs on the right display the relationship between Predicted and Observed ages, evaluating the model's performance in predicting ages compared to the actual recorded ages. 'Predicted age' refers to the estimated ages generated by the model, while 'Observed age' represents the true ages observed in the dataset. The scatter plot graphically represents each sample as points. In an ideal modeling scenario, perfect alignment between predicted and observed values forms a 45-degree straight line from the bottom left to the top right of the plot. Deviation from this line indicates disparities between predicted and observed ages, with points moving farther away implying greater differences between the model's predictions and the actual observed ages.