Electronic Supplementary Material (ESI) for Environmental Science: Advances.

Supplementary Information

Viability of Elutriation for the Extraction of Microplastics from Environmental Soil Samples

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Table S1: Soil sample sampling locations, soil textures, and organic matter contents

Sample	Coordinates	Texture			Organic Matter
	(Latitude, Longitude)	% Clay	% Silt	% Sand	% Organic Matter
Arkansas River 2	35.9969810532˚N, -95.9432463466˚W	1.3	2.5	96.3	0.1
Arkansas River 1	36.1042630780˚N, -97.0421747433˚W	8.8	6.3	85.0	2.4
Boomer Creek	36.0911311334˚N, -97.0197627590˚W	16.3	28.8	55.0	5.1
Applied Biosolids 1	36.1340376518˚N, -95.9925524560˚W	32.5	45.0	22.5	8.6
Applied Biosolids 2	36.1340376518˚N, -95.9925524560˚W	50.0	33.3	16.7	6.0

Table S2: p-values for method comparisons. Green cells denote significant values ($p < 0.05$)

Method Comparison	AR2	AR1	BC	AB1	AB2
Sieving+Digestion+Flotation - Elutriation+Digestion+Flotation (Particle count)	0.419	0.258	0.085	0.314	0.123
Sieving+Digestion+Flotation - Elutriation+Digestion+Flotation (concentration)	0.458	0.068	0.097	0.176	0.363
Sieving - Elutriation (concentration)	0.137	0.211	0.248	0.043	0.142
Sieving - Sieving+Digestion+Flotation (concentration)	0.143	0.035	0.009	0.085	0.007
Elutriation - Elutriation+Digestion+Flotation (concentration)	0.199	0.019	0.005	0.001	0.078

Table S3: ATR-FTIR spectra, Control, Sieving

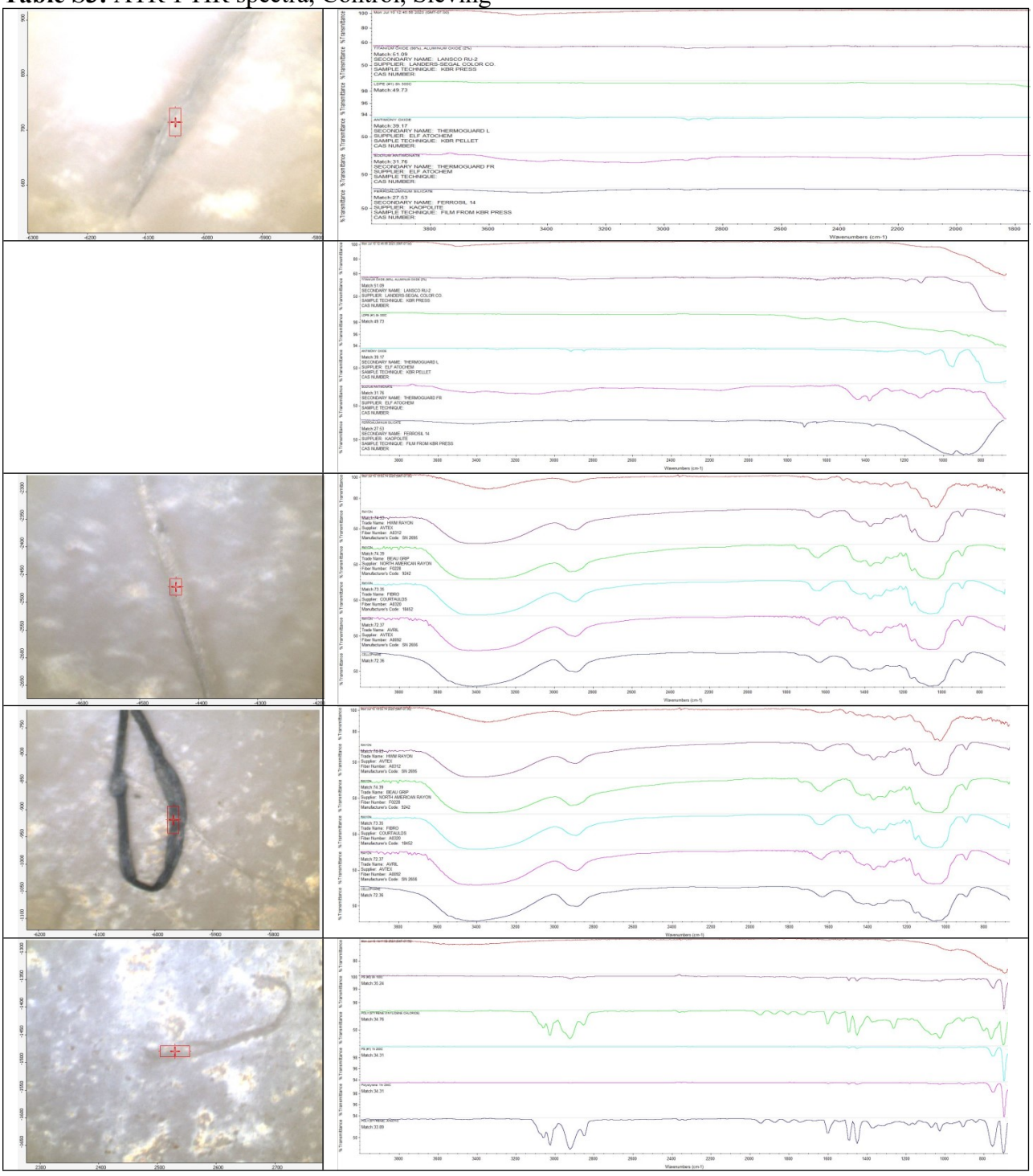


Table S4: ATR-FTIR spectra, Control, Elutriation

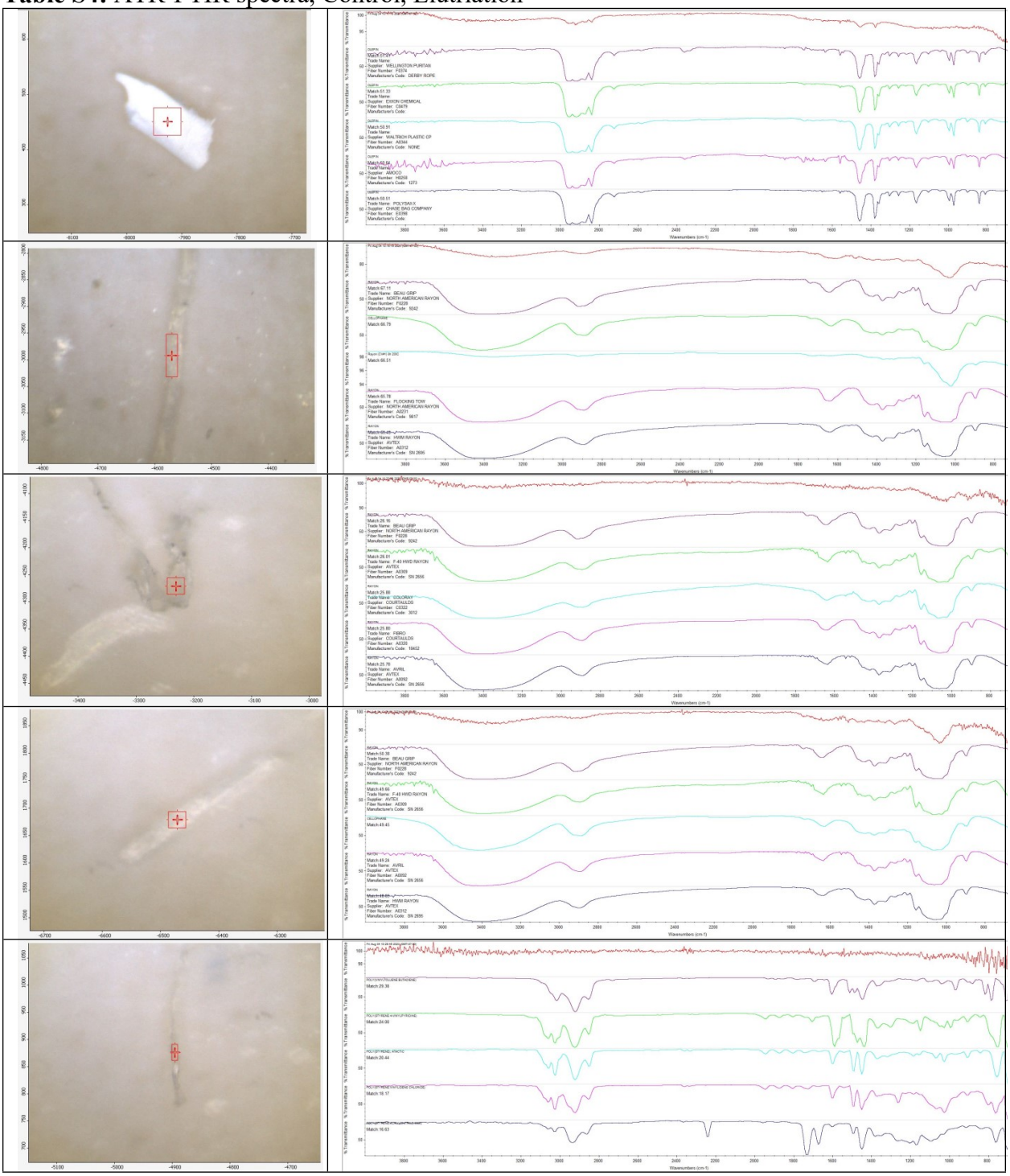


Table S5: ATR-FTIR spectra, Arkansas River 2, Sieving

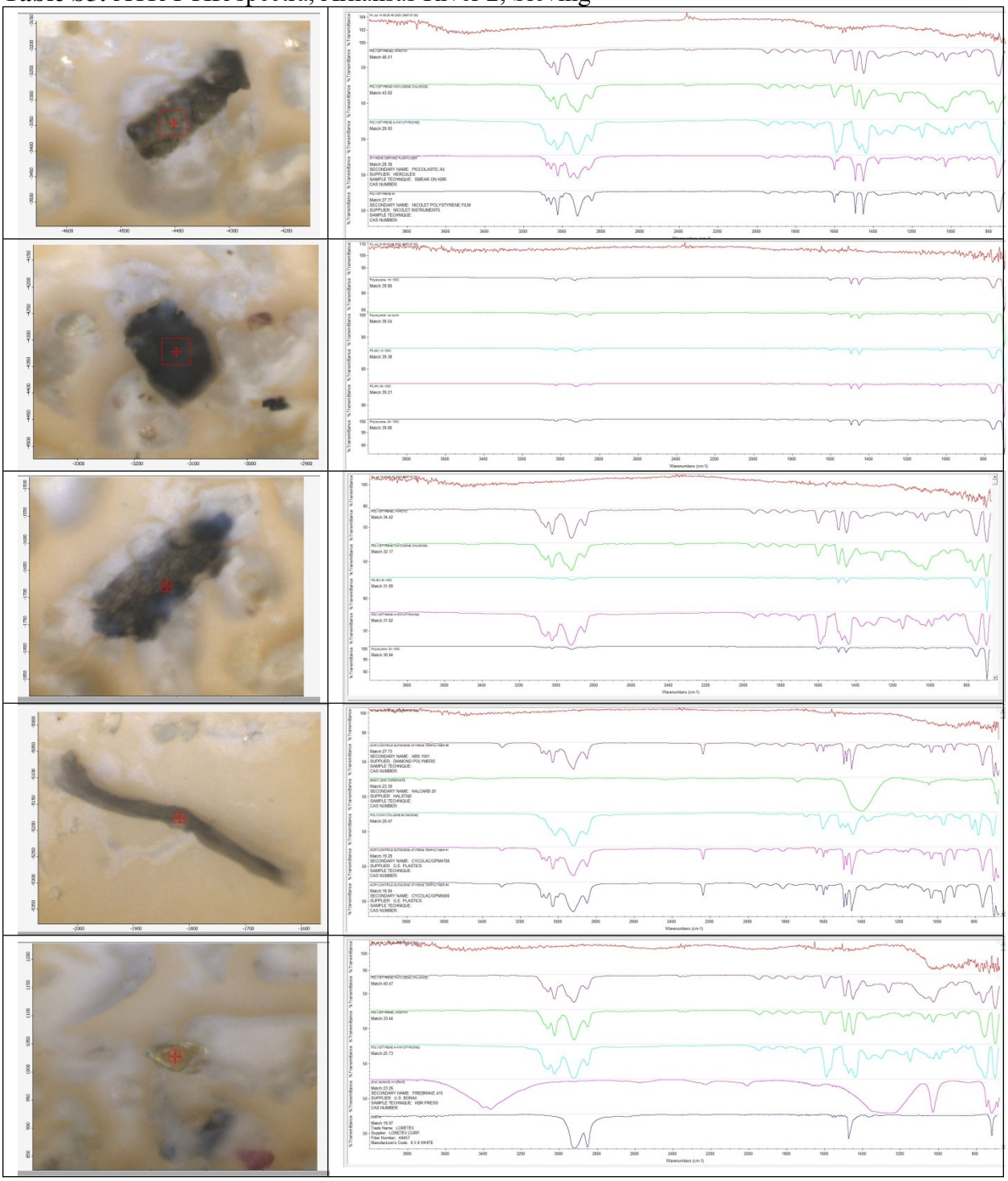


Table S6: ATR-FTIR spectra, Arkansas River 2, Elutriation

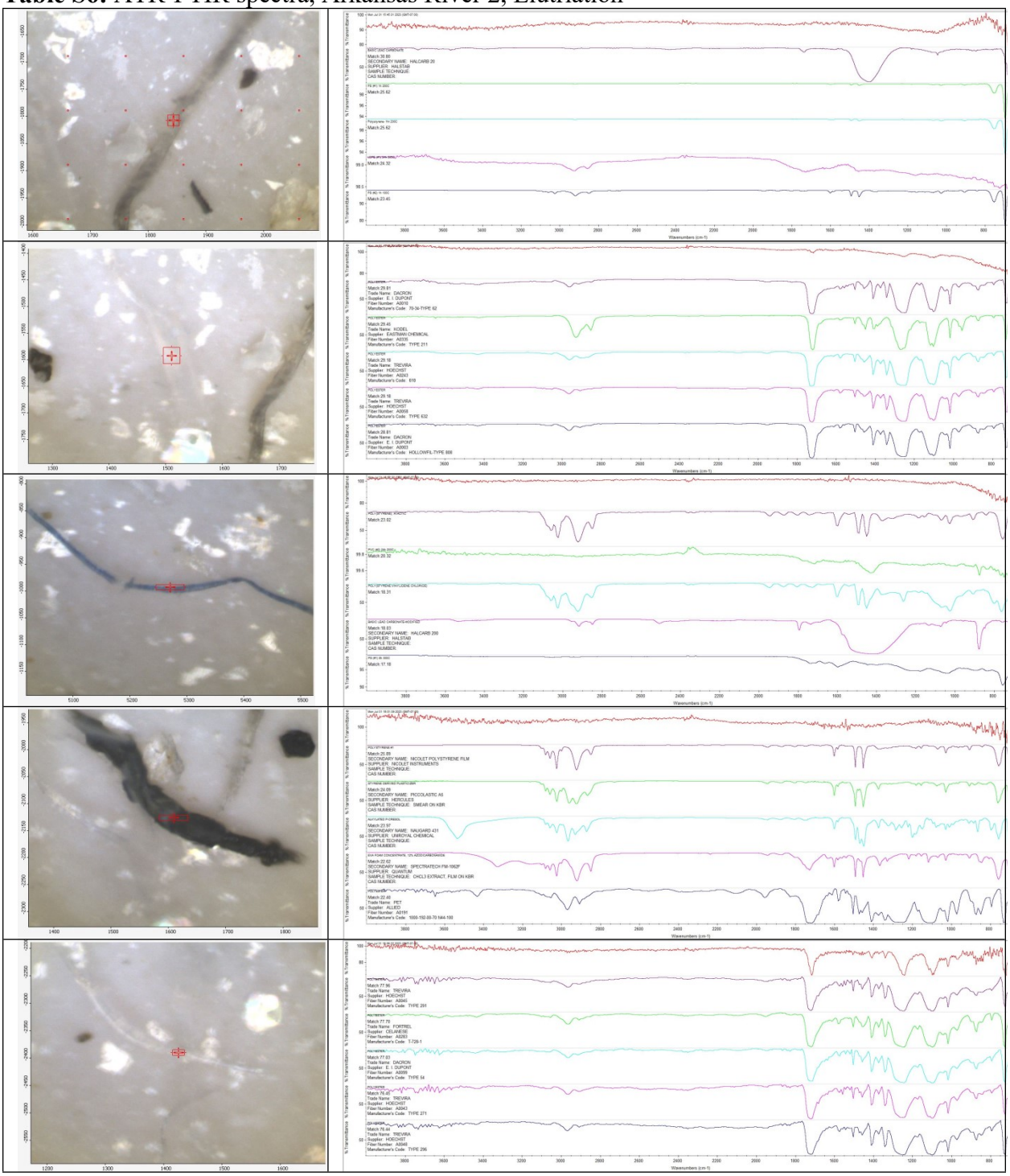
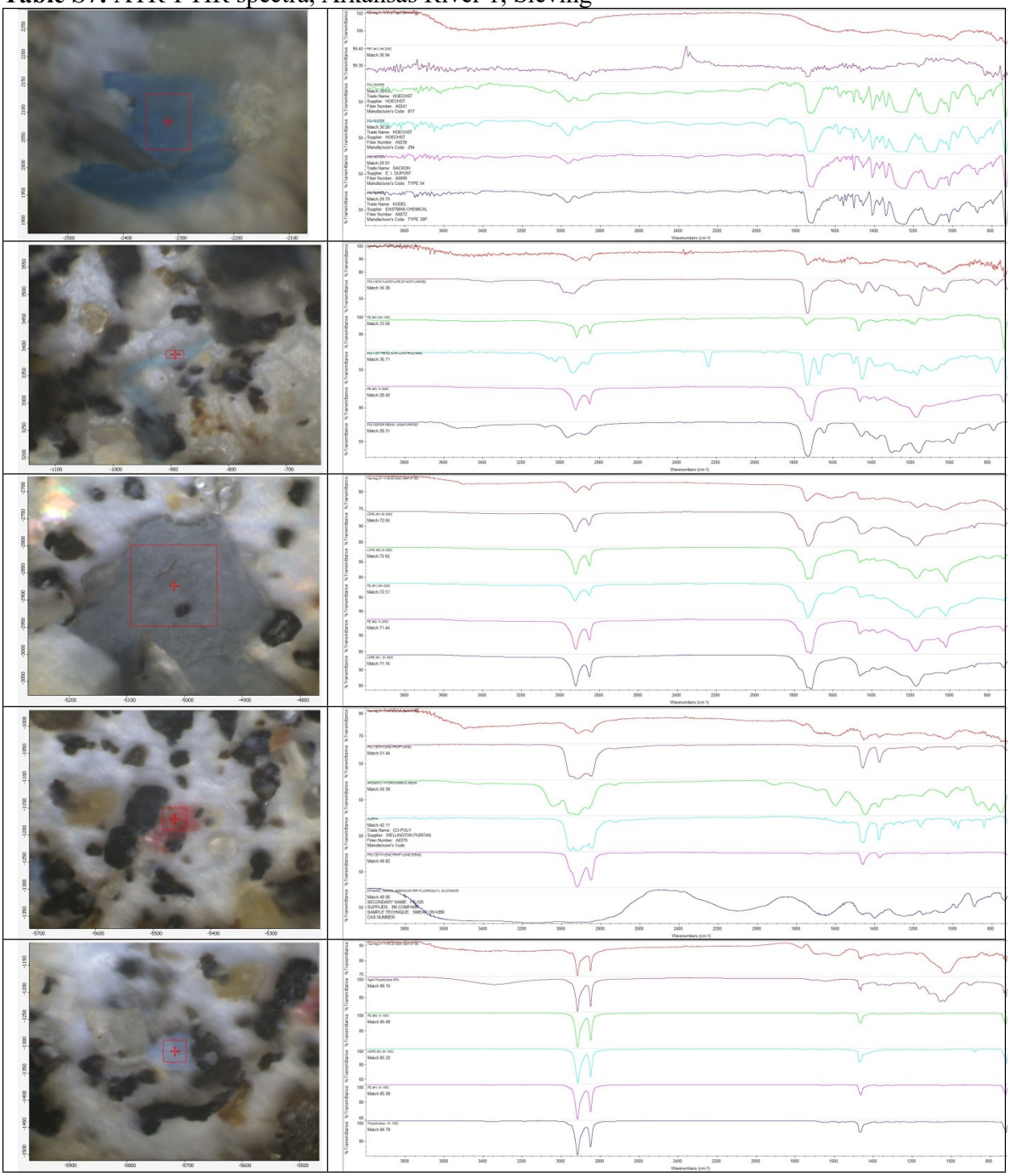
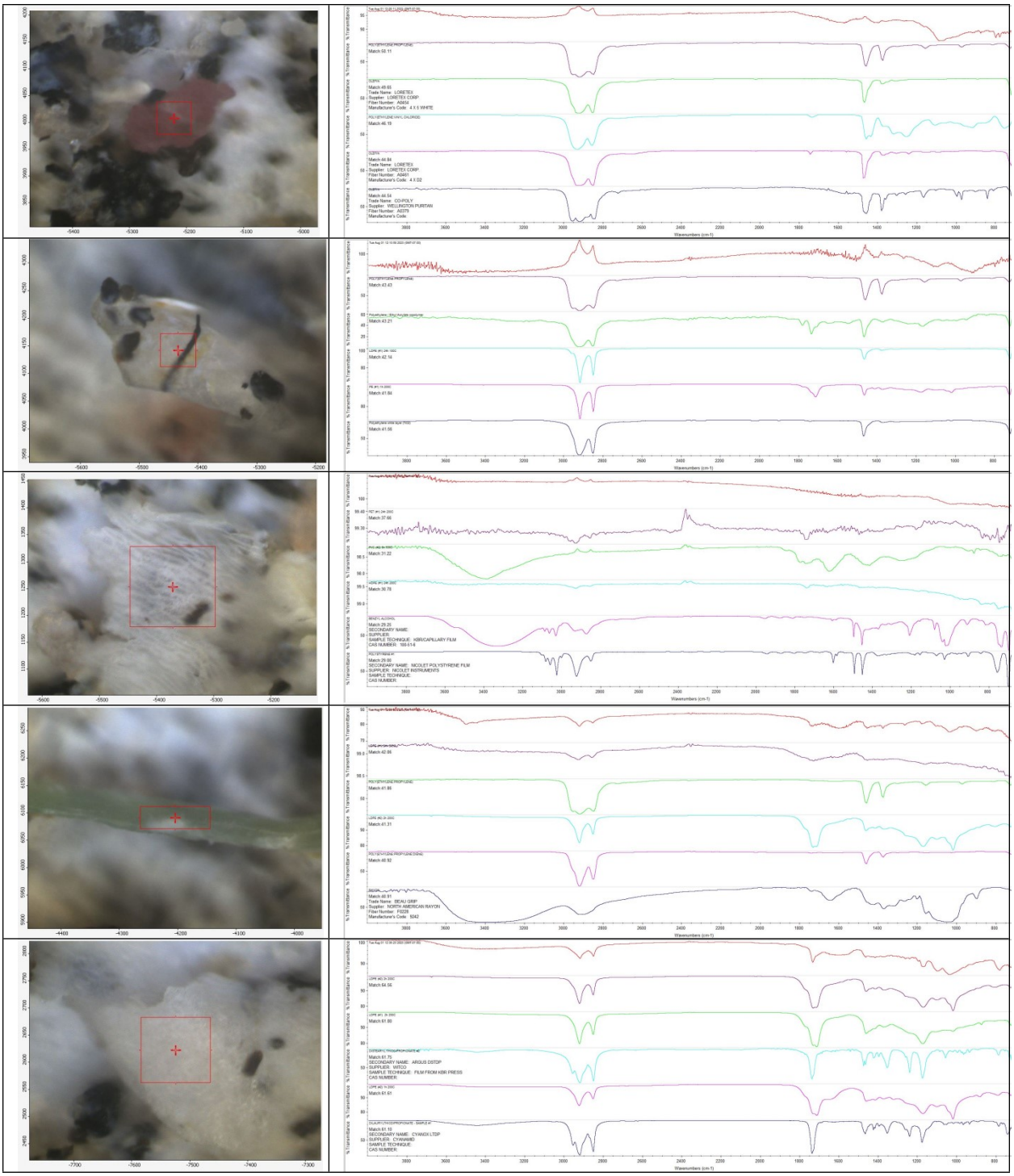
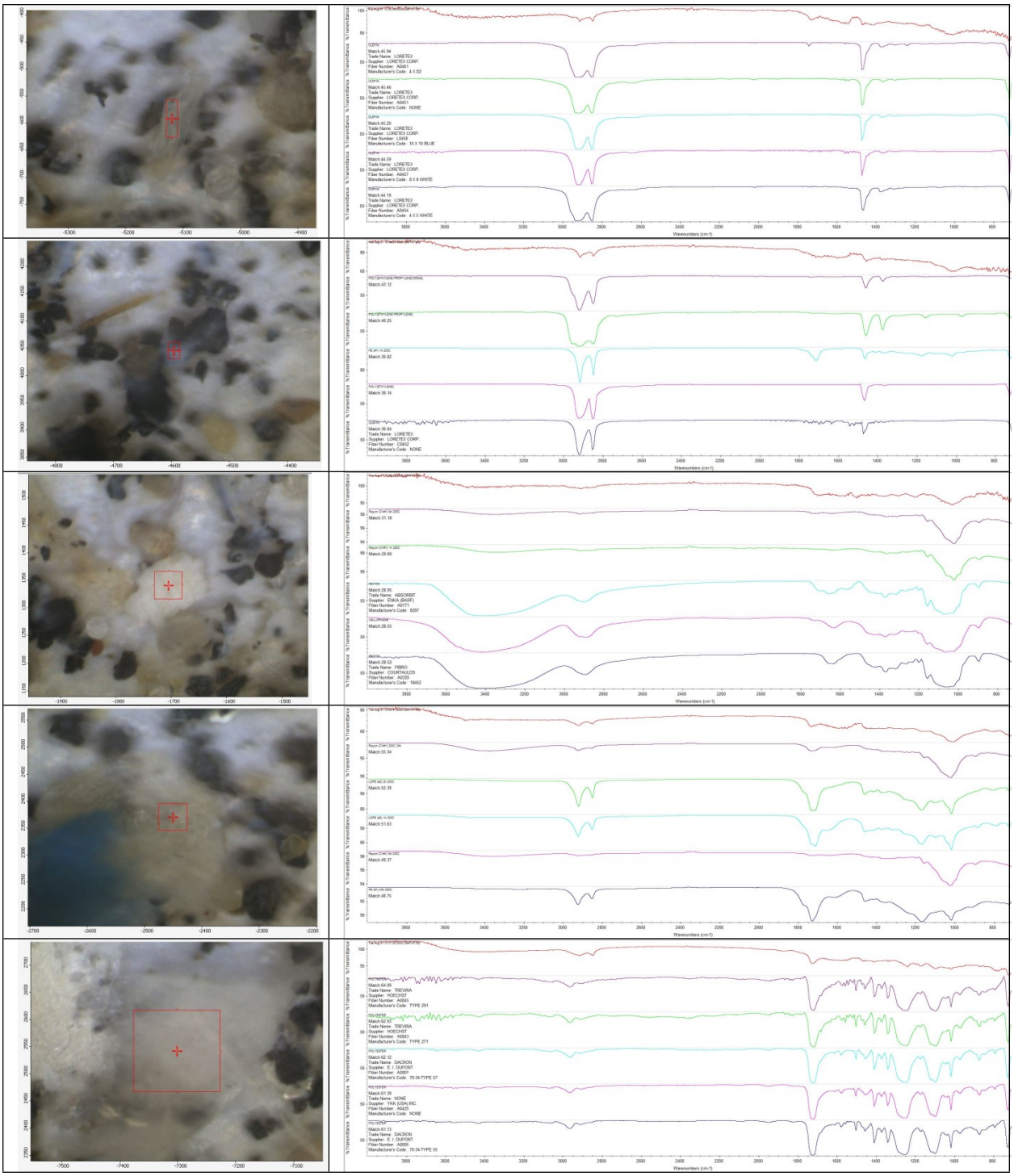
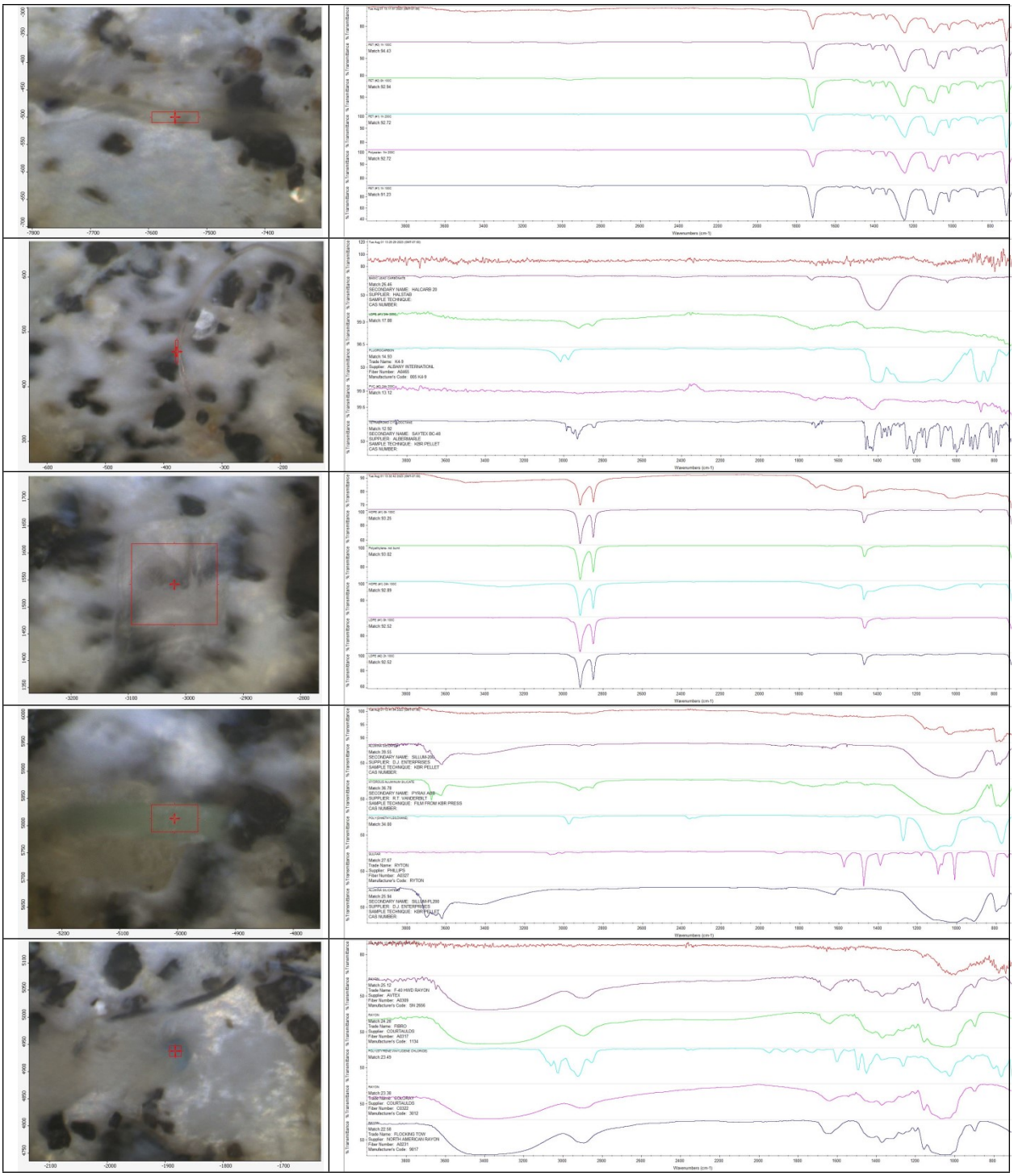


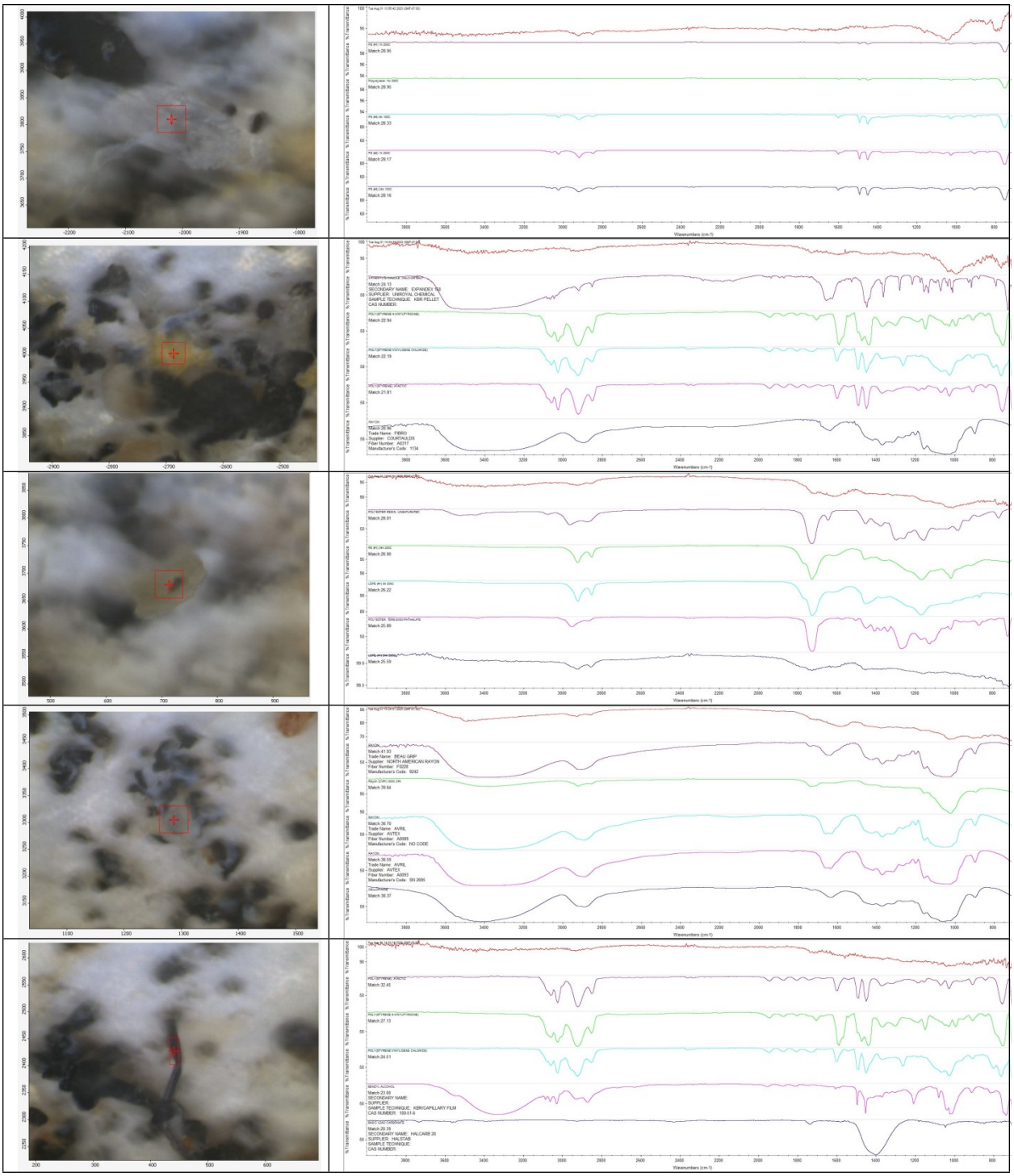
Table S7: ATR-FTIR spectra, Arkansas River 1, Sieving











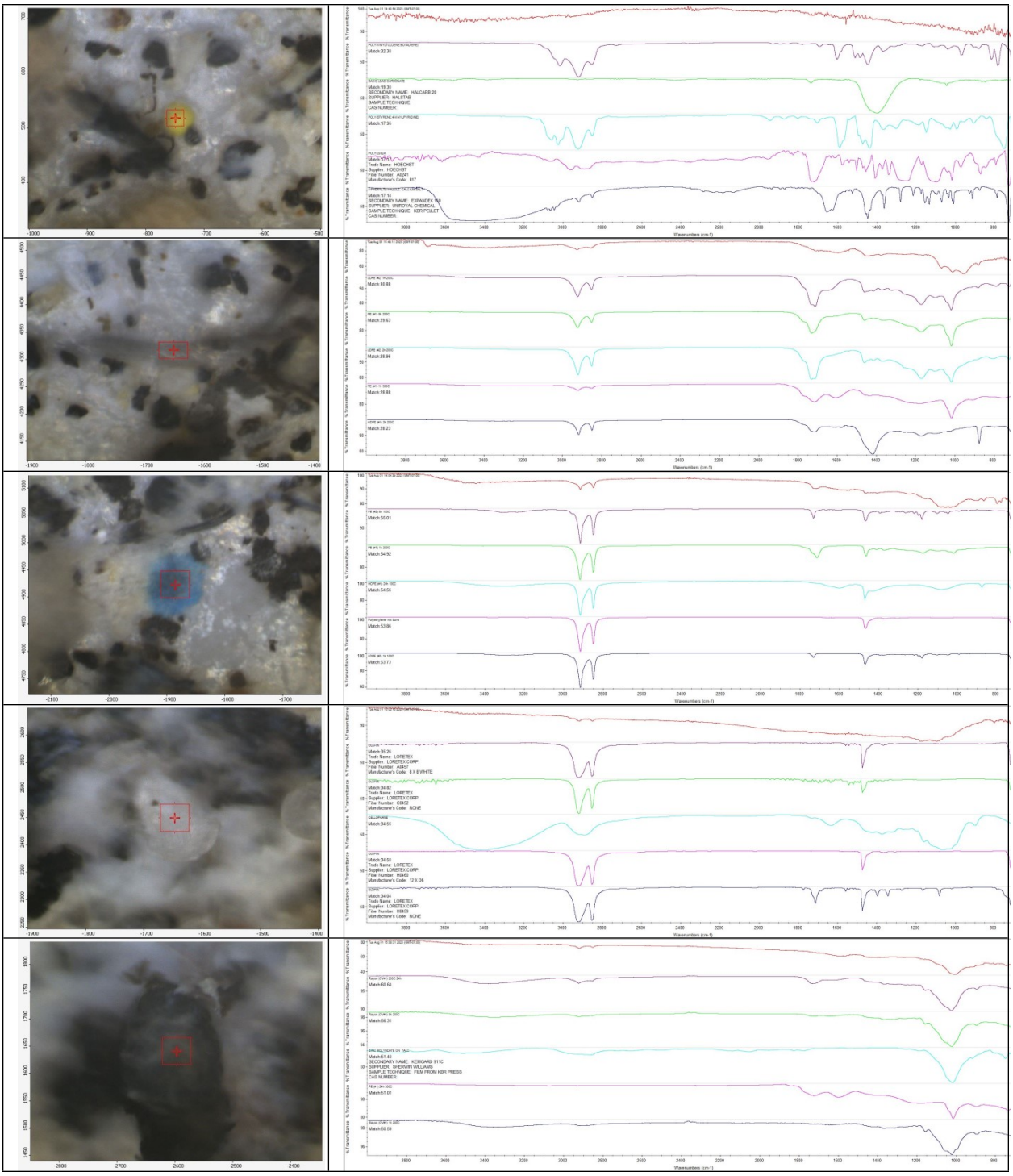
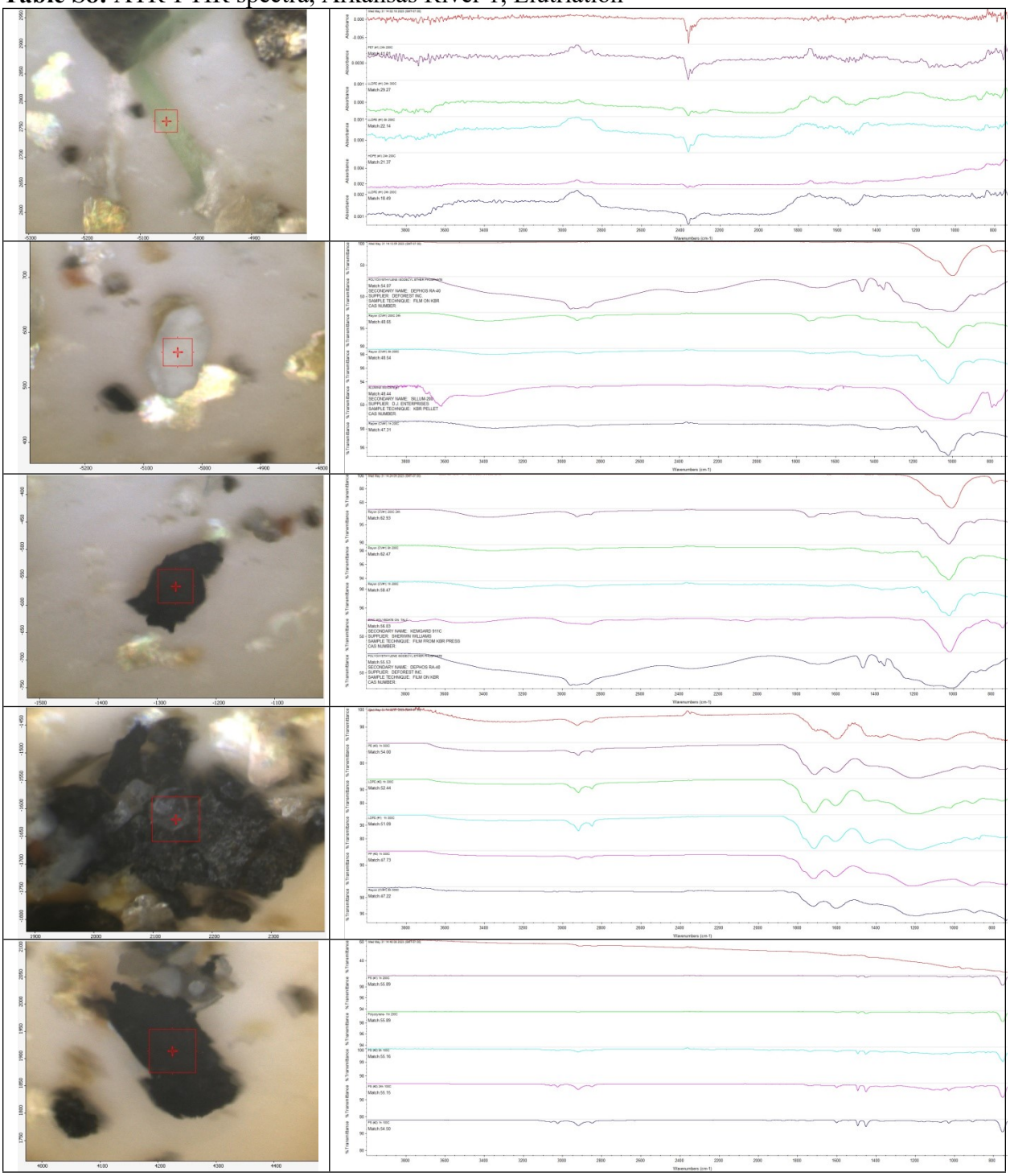
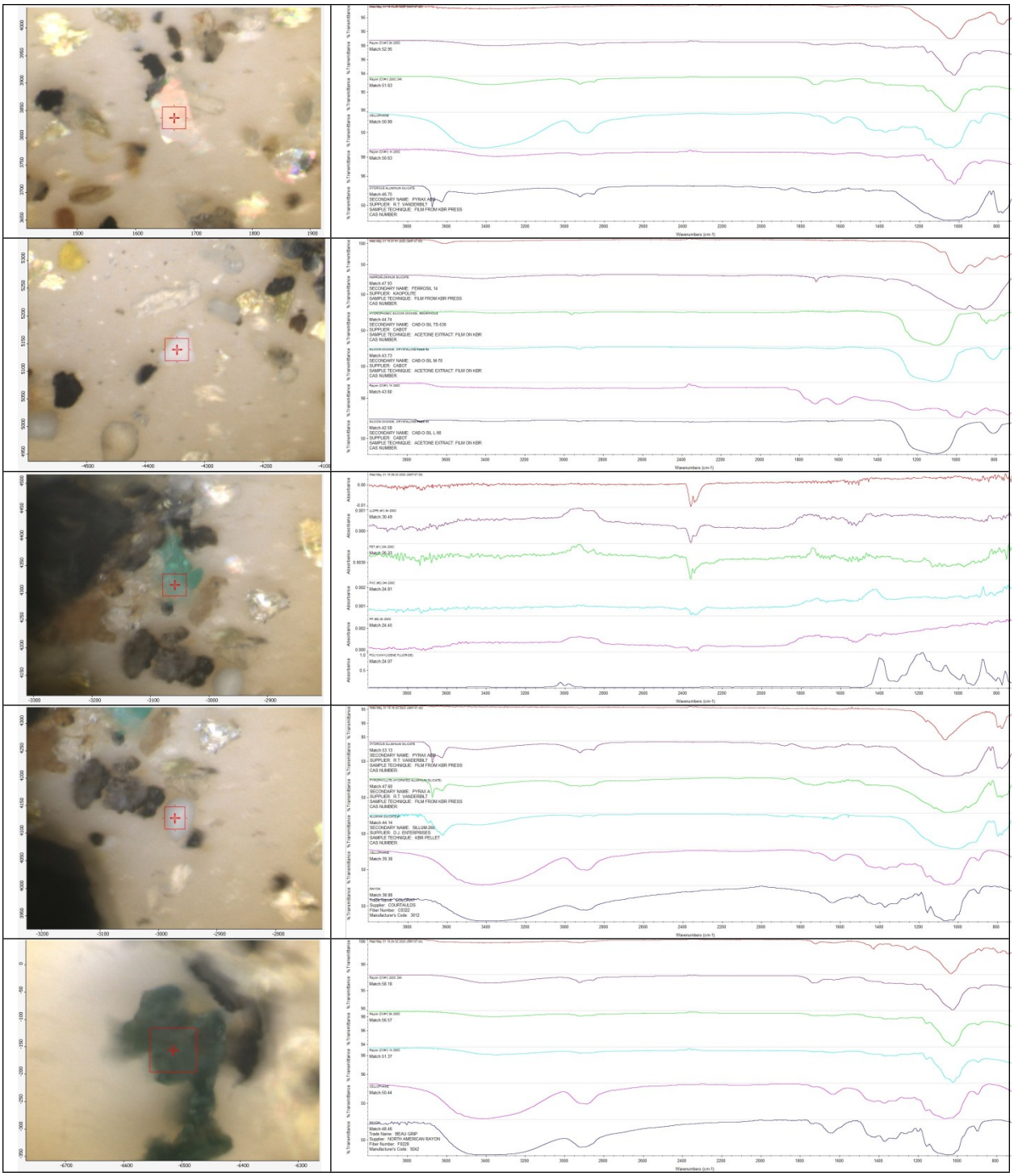
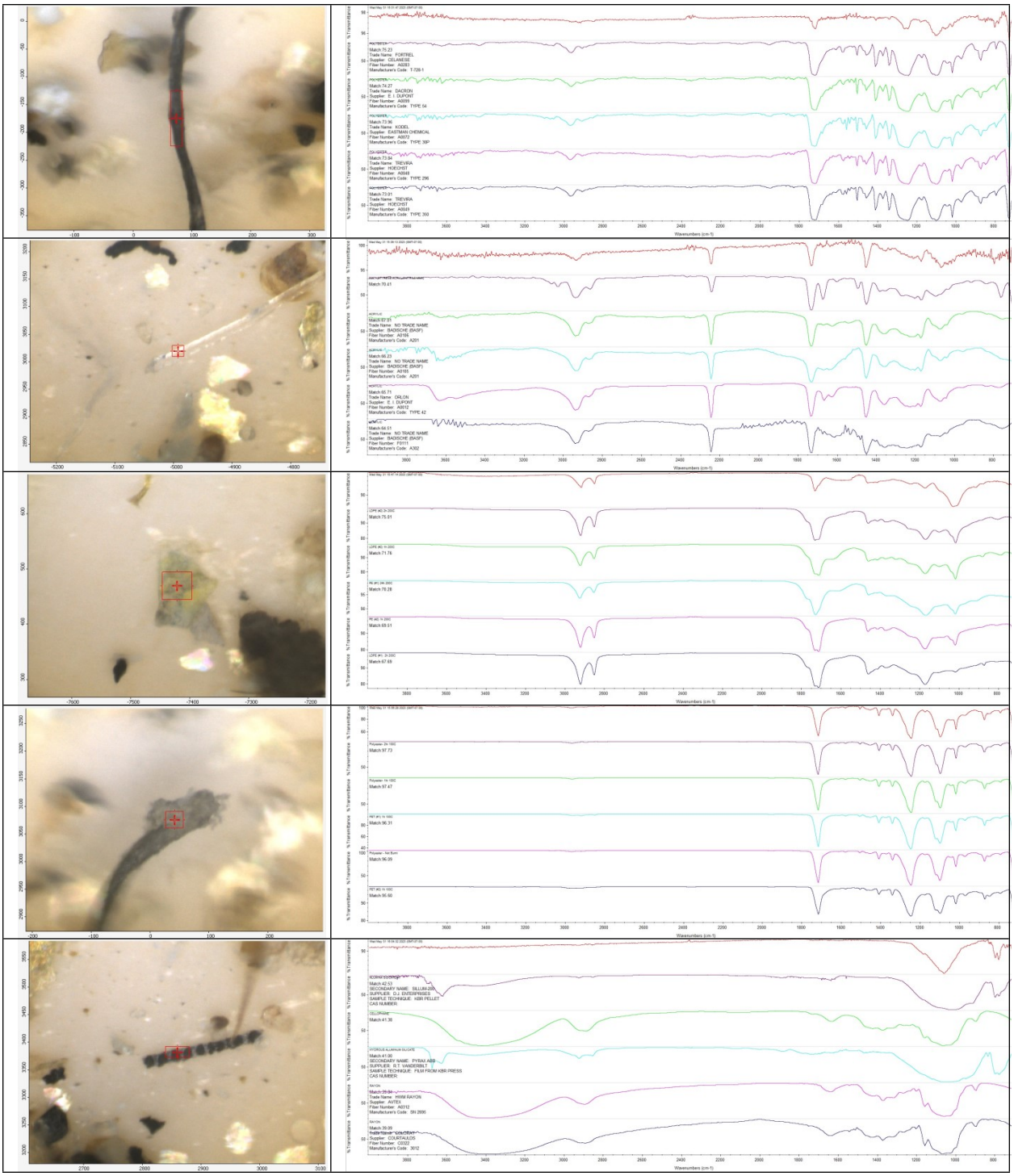
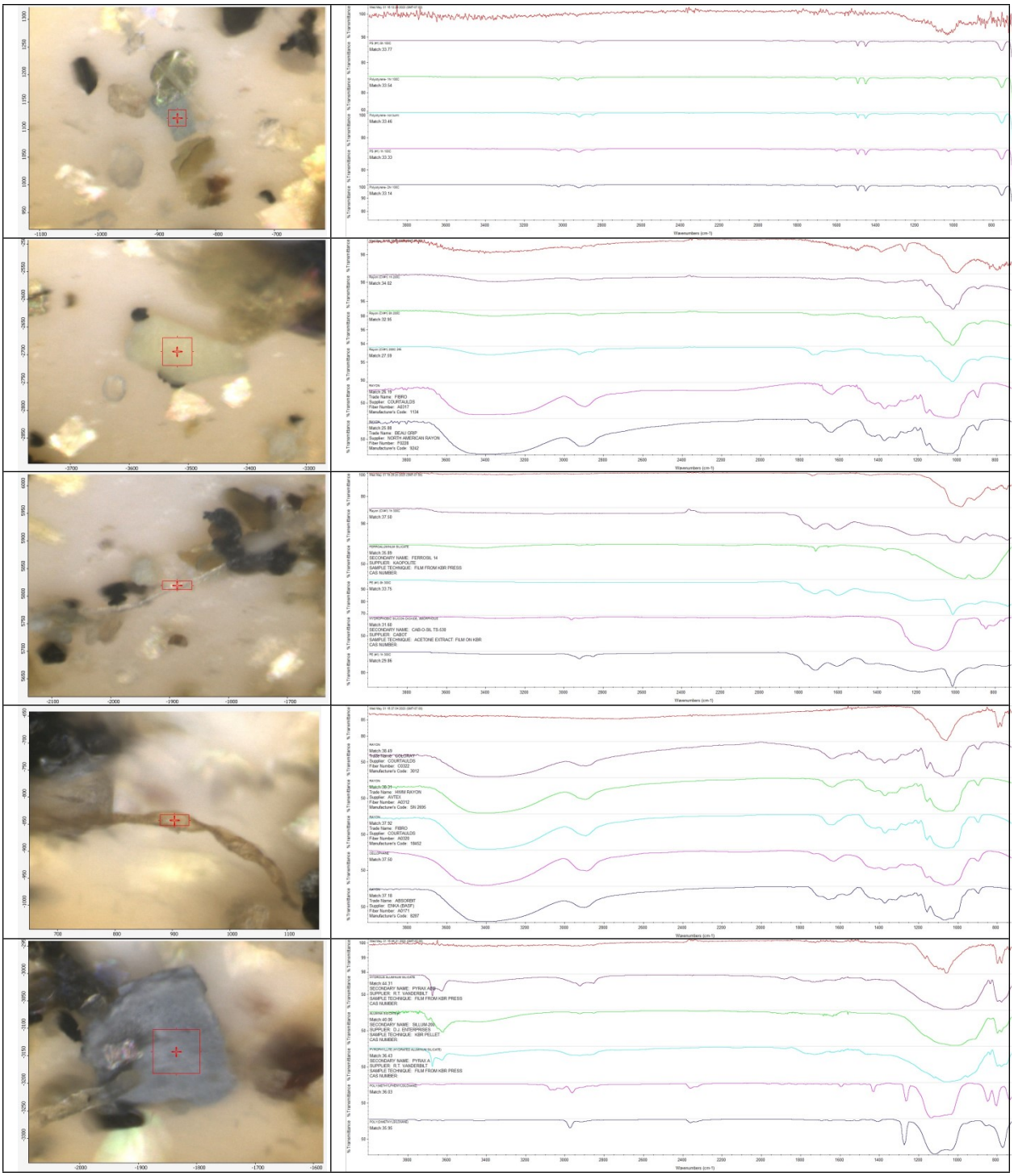


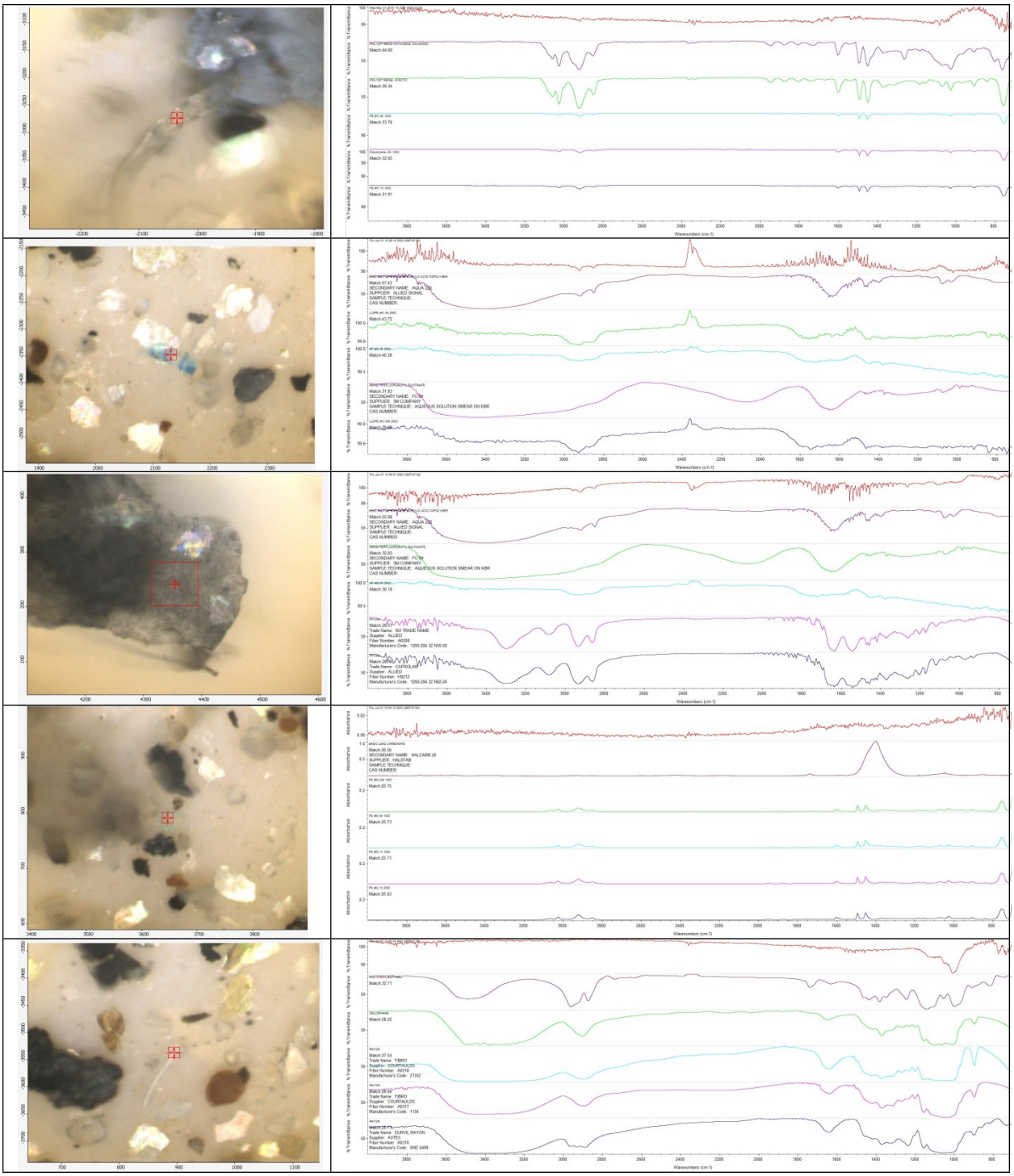
Table S8: ATR-FTIR spectra, Arkansas River 1, Elutriation











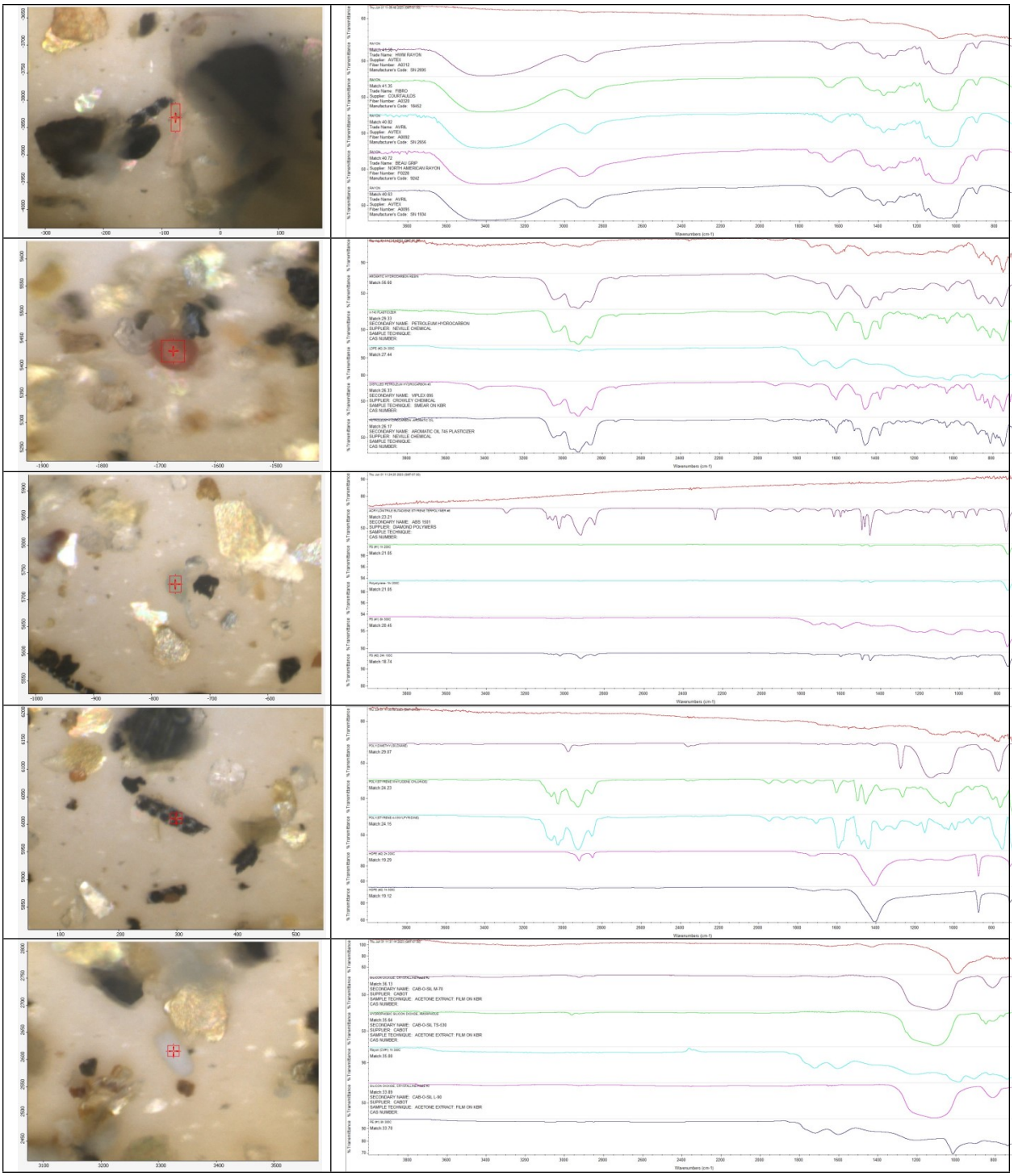
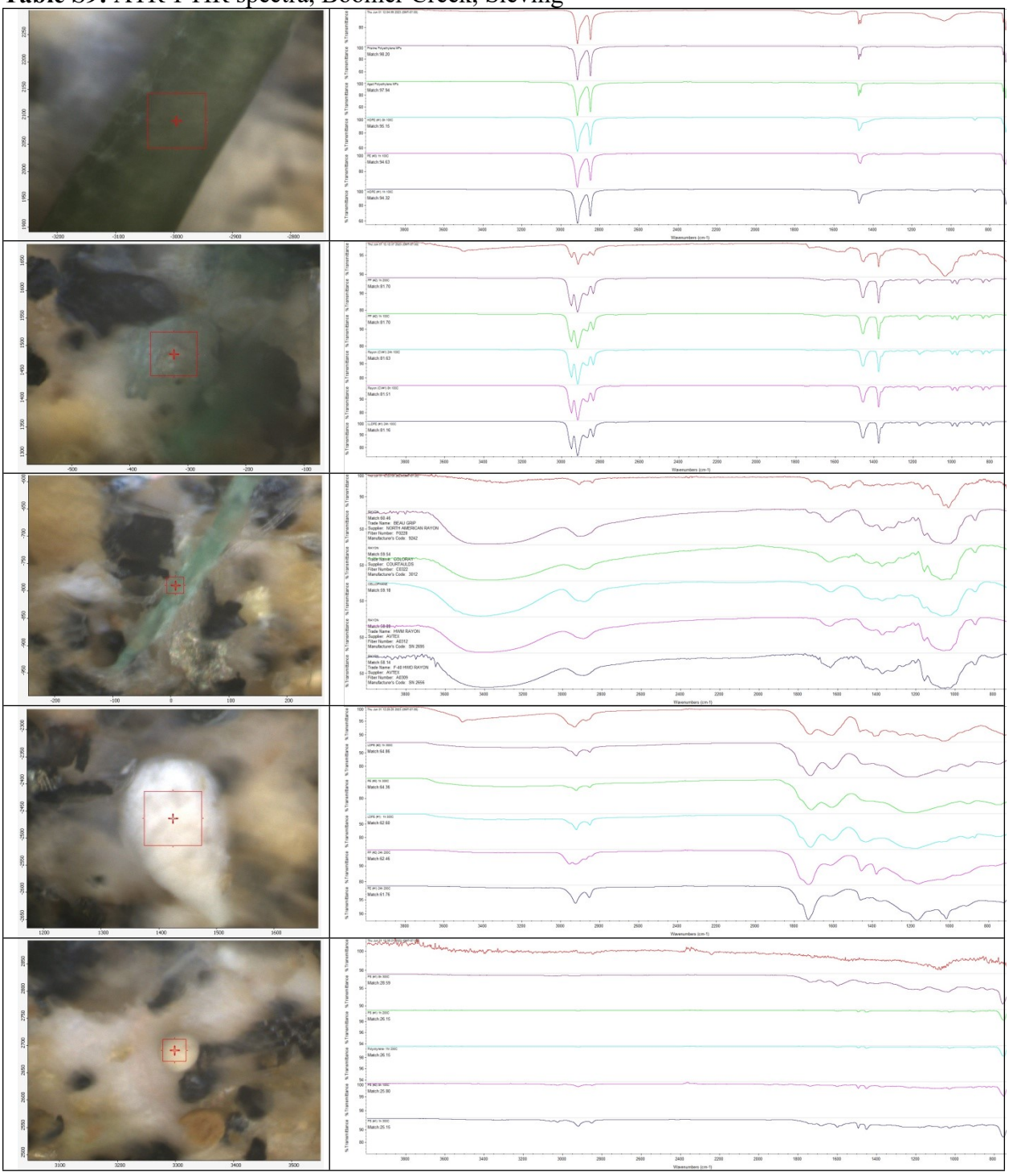
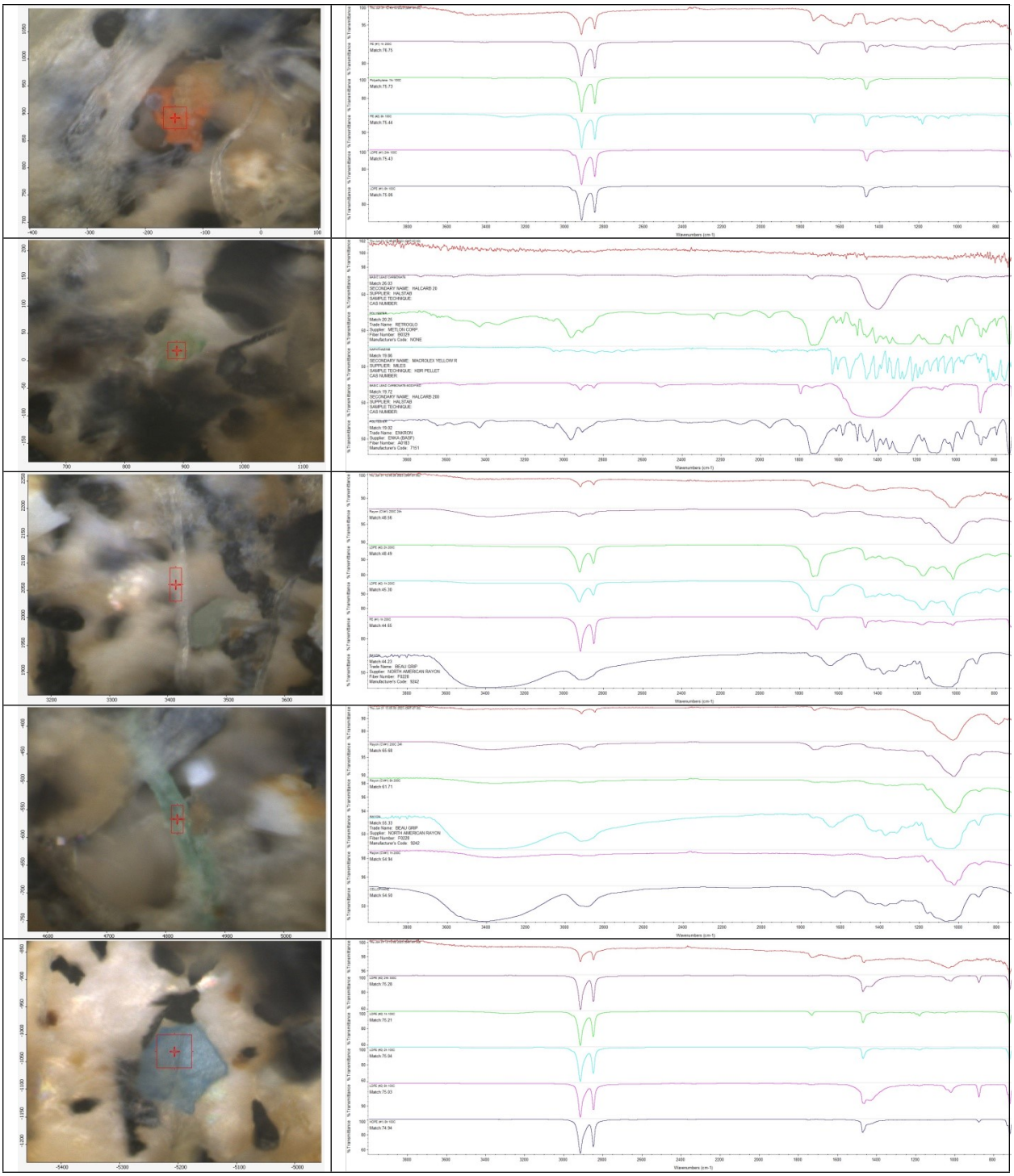
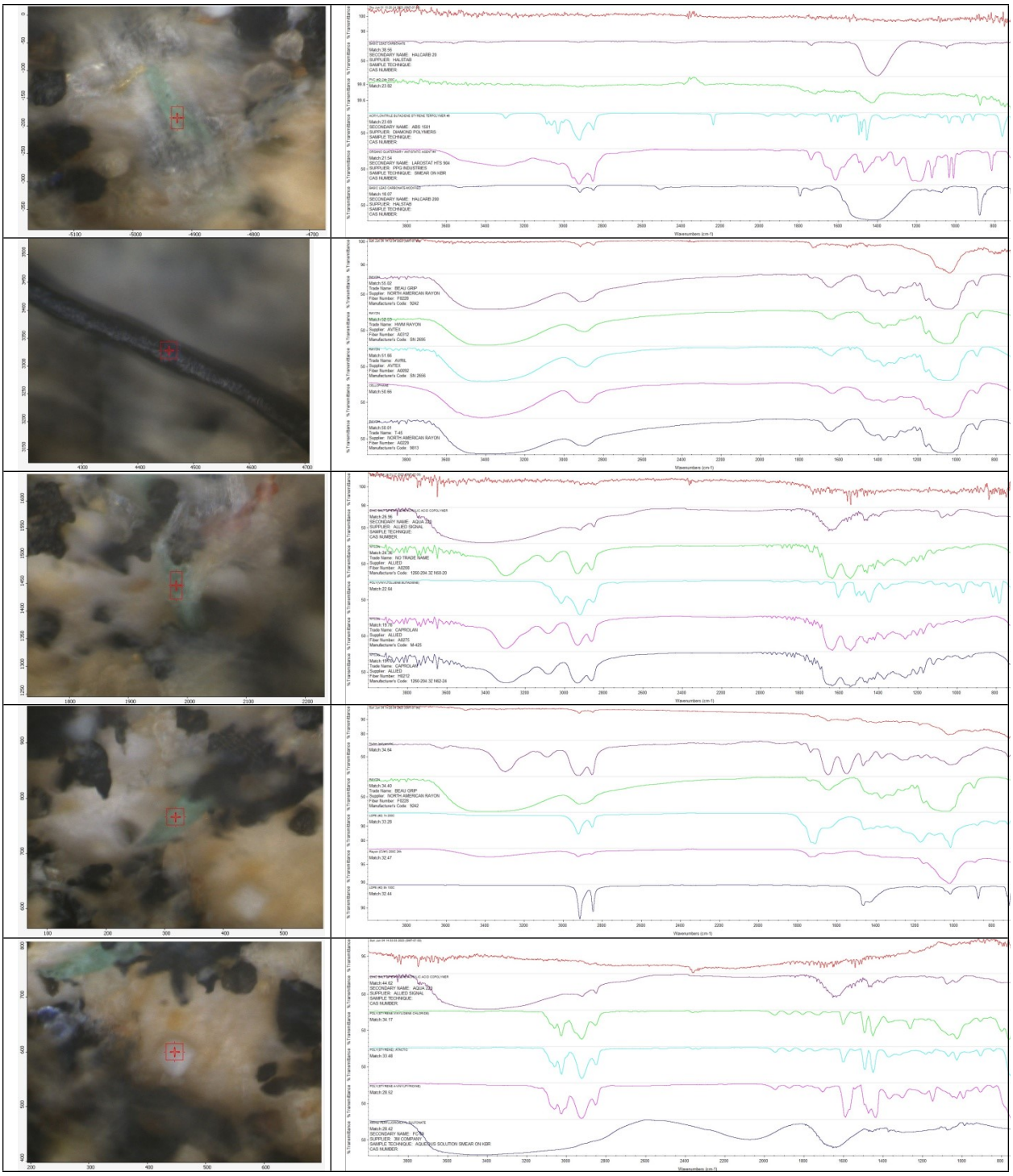
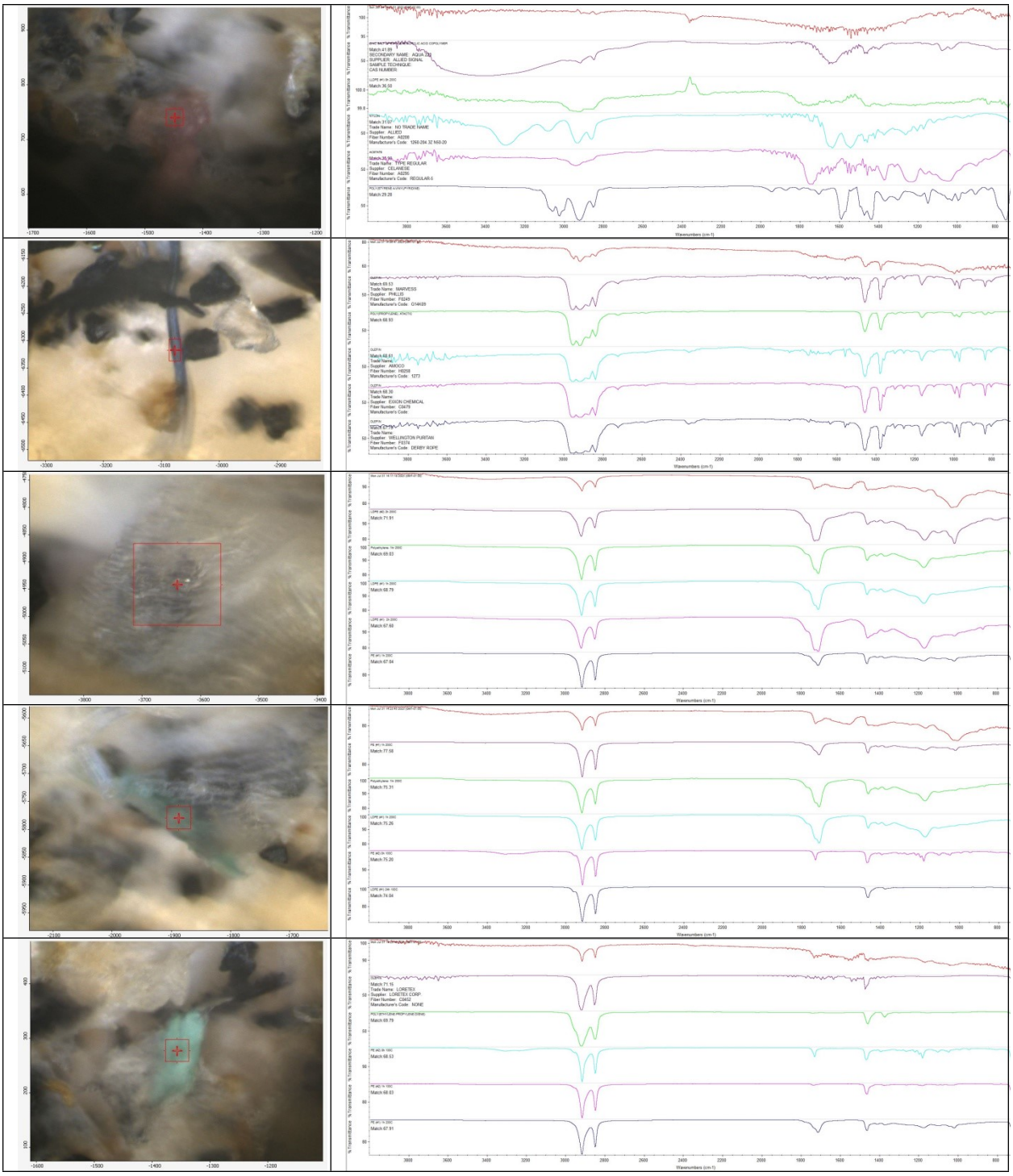


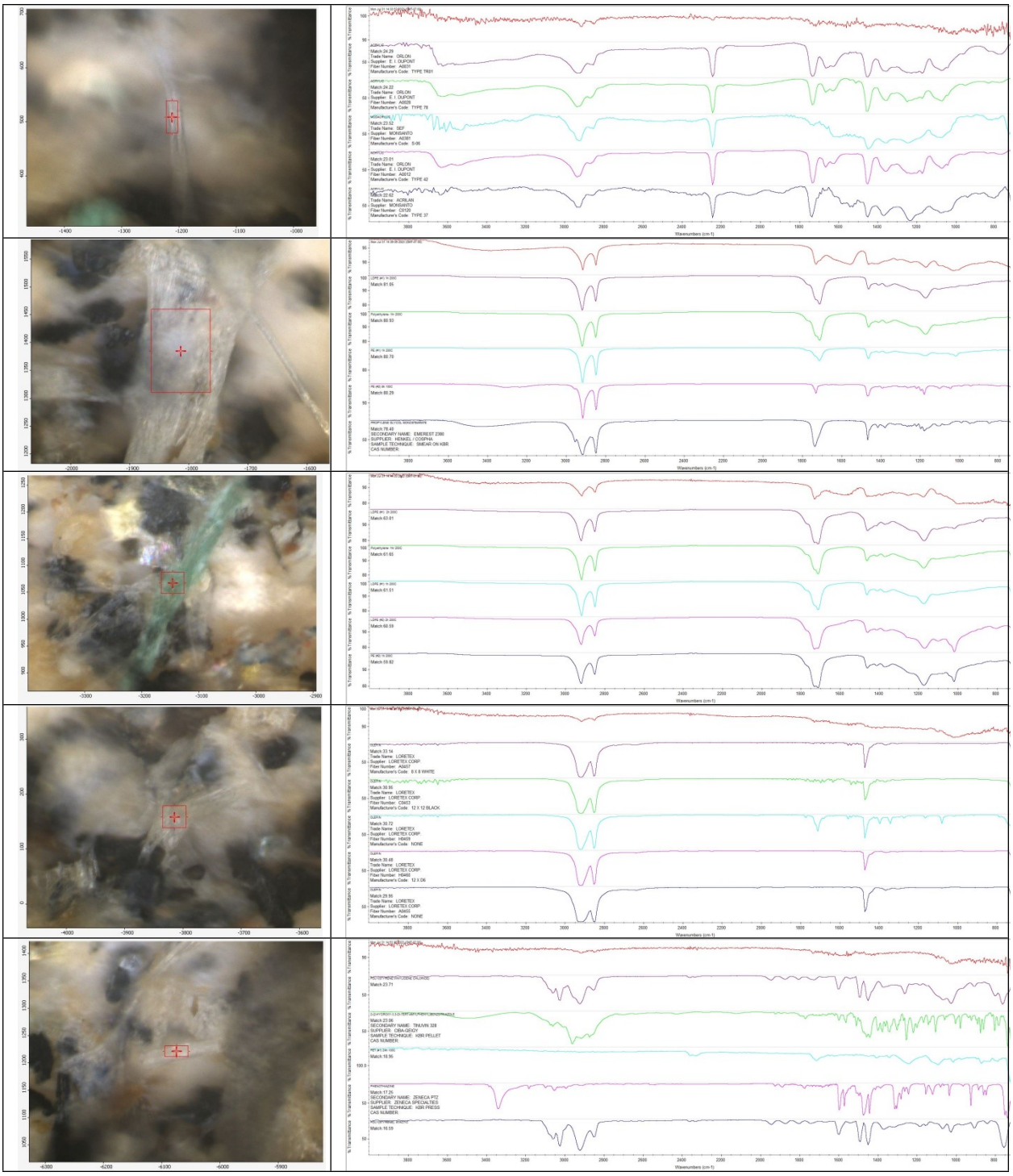
Table S9: ATR-FTIR spectra, Boomer Creek, Sieving











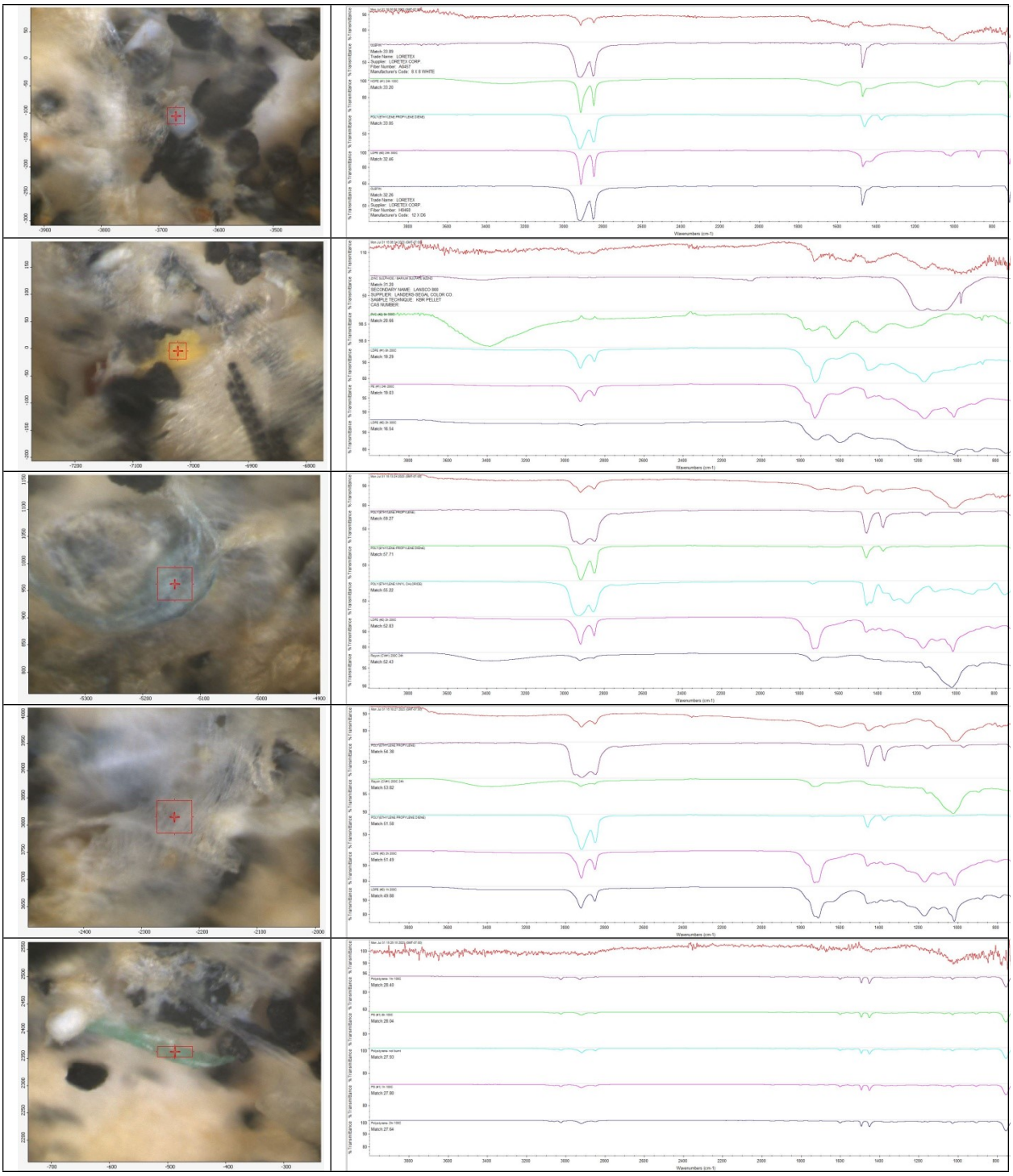
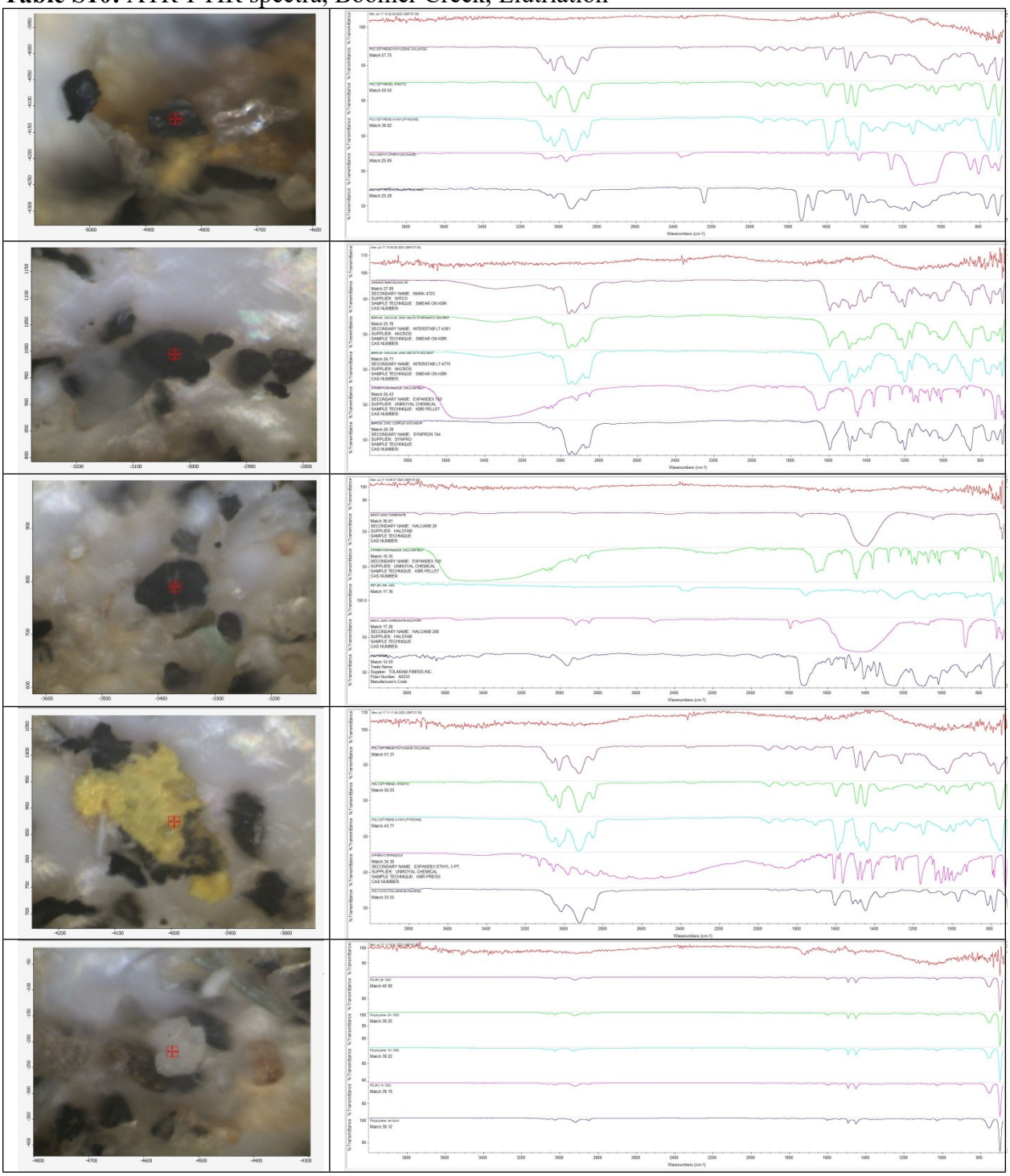
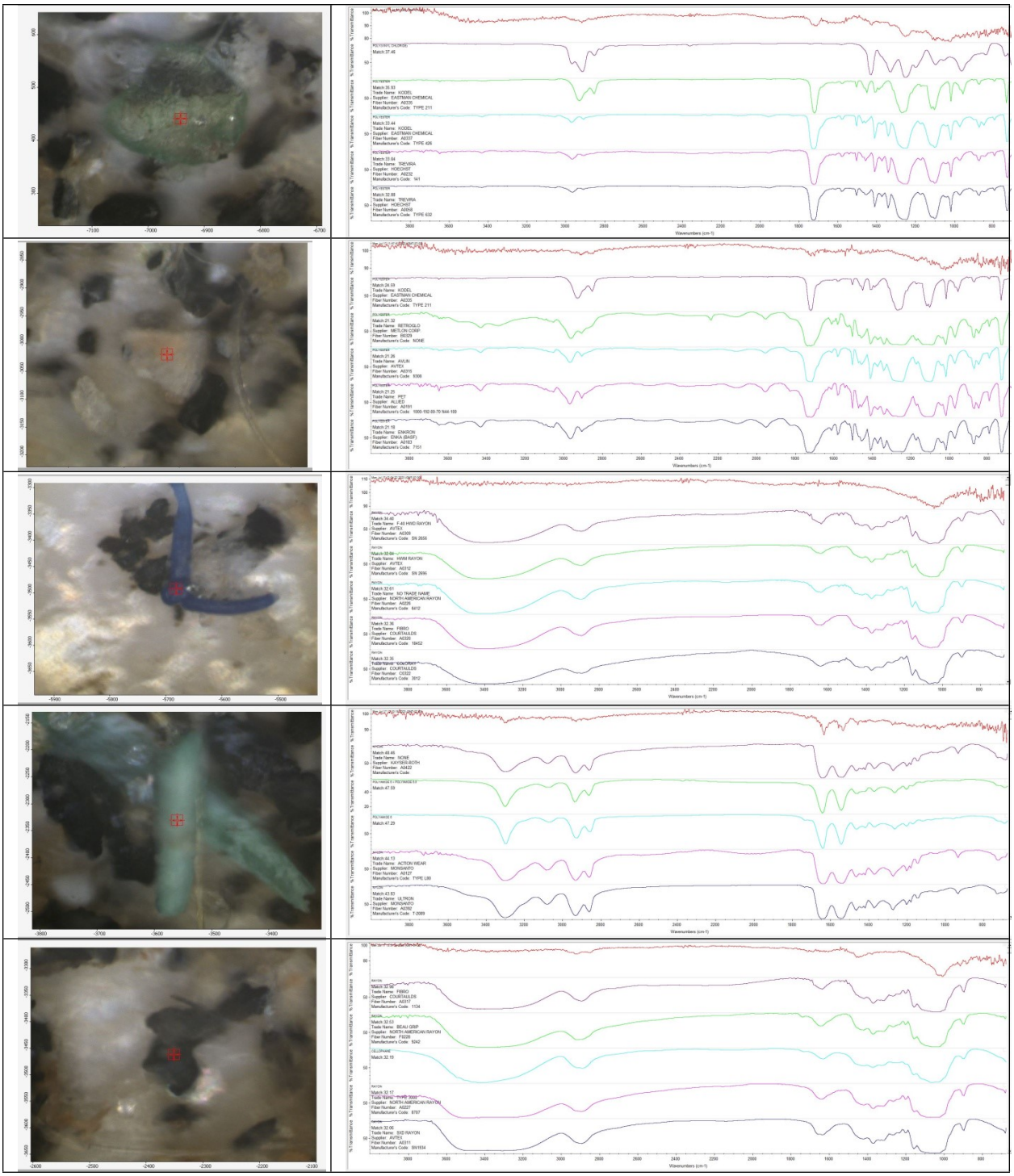
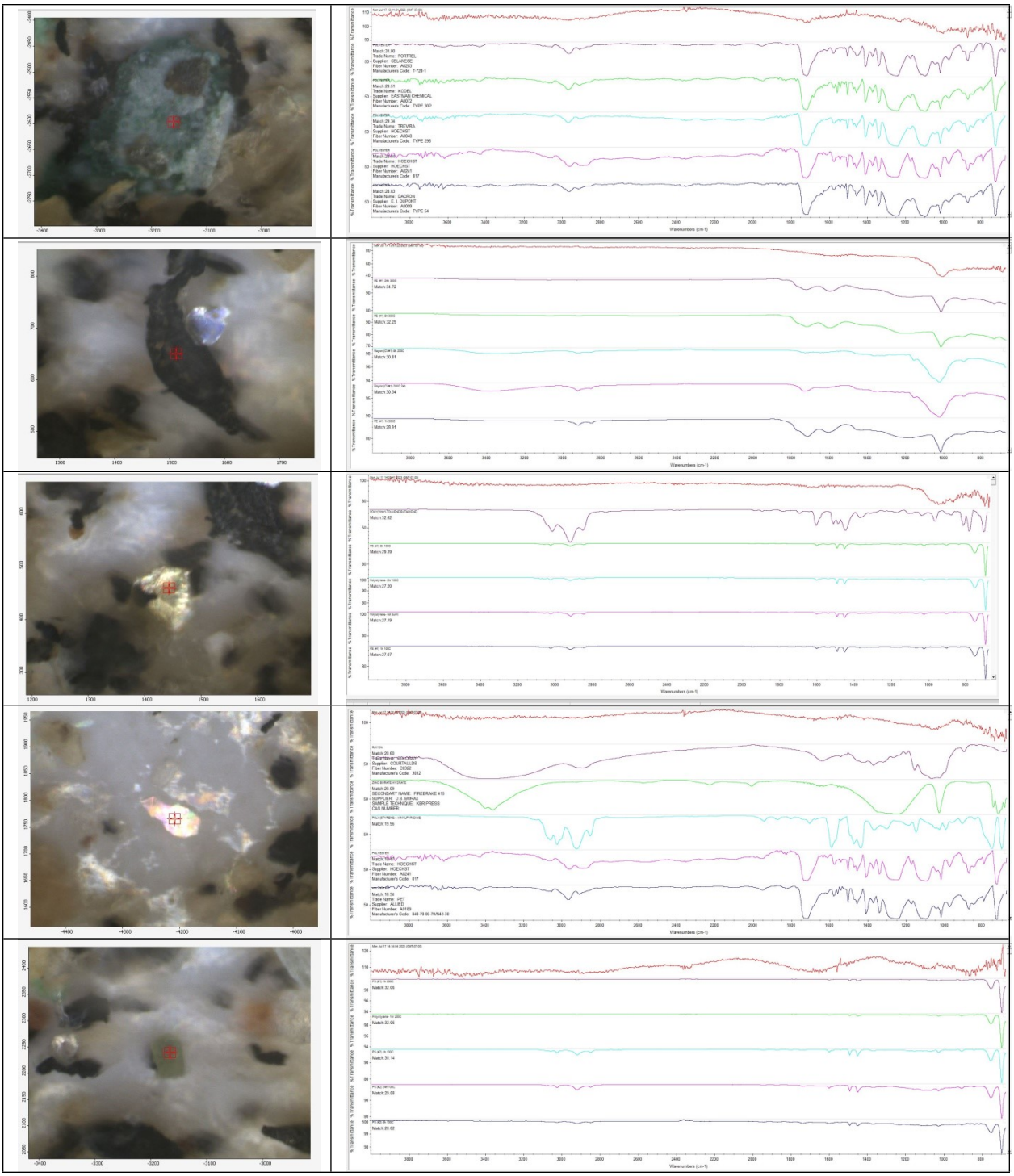
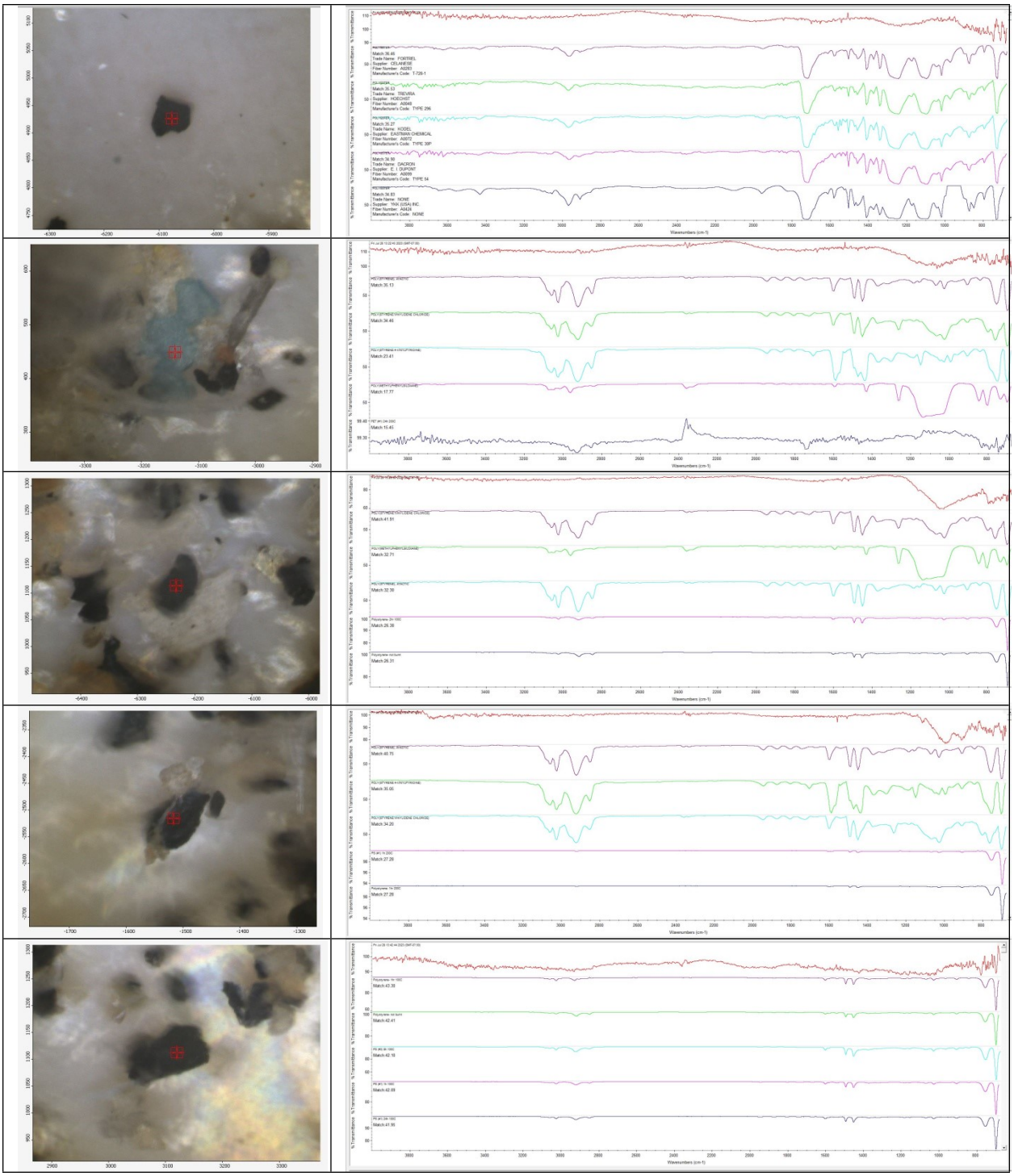


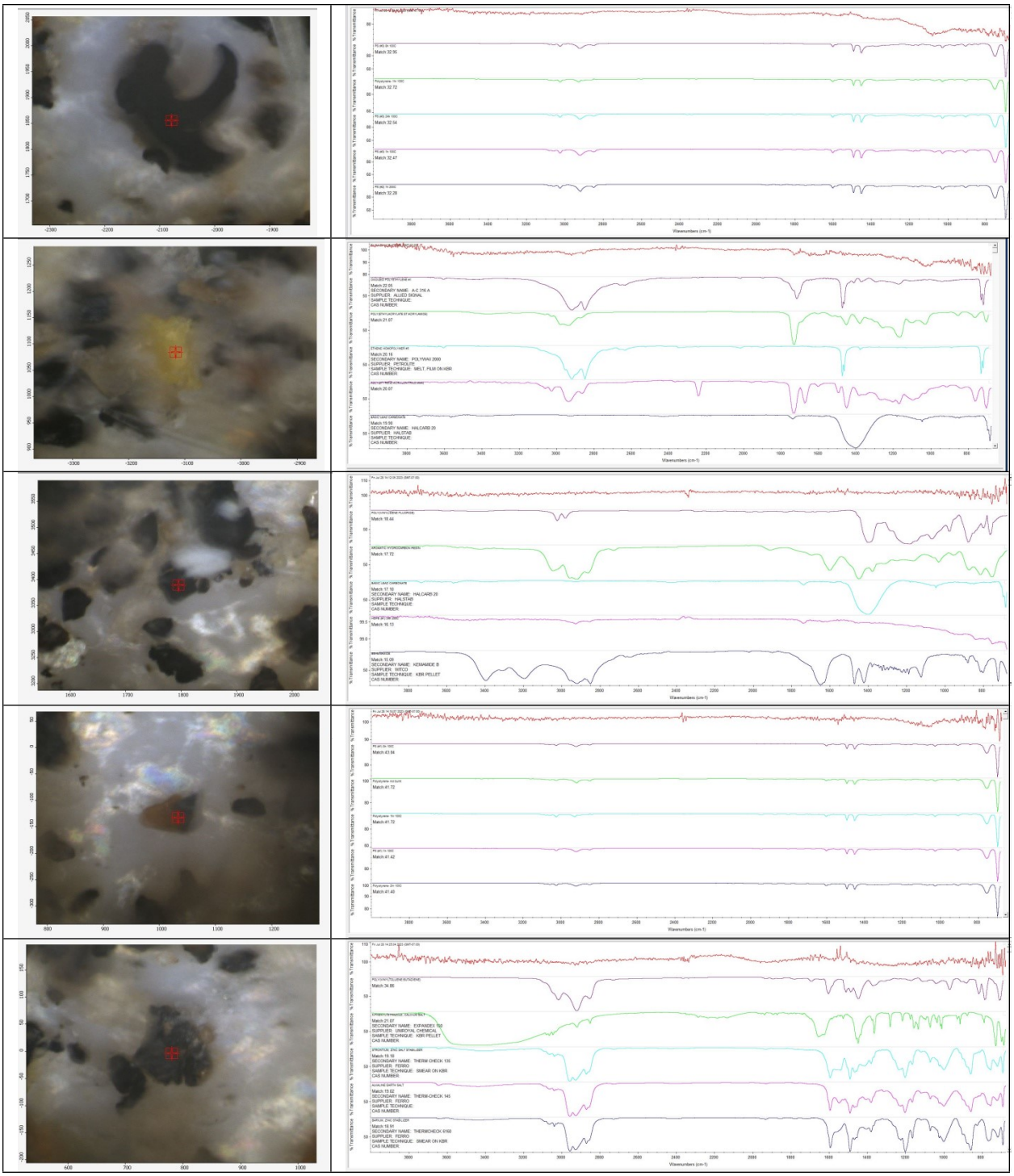
Table S10: ATR-FTIR spectra, Boomer Creek, Elutriation











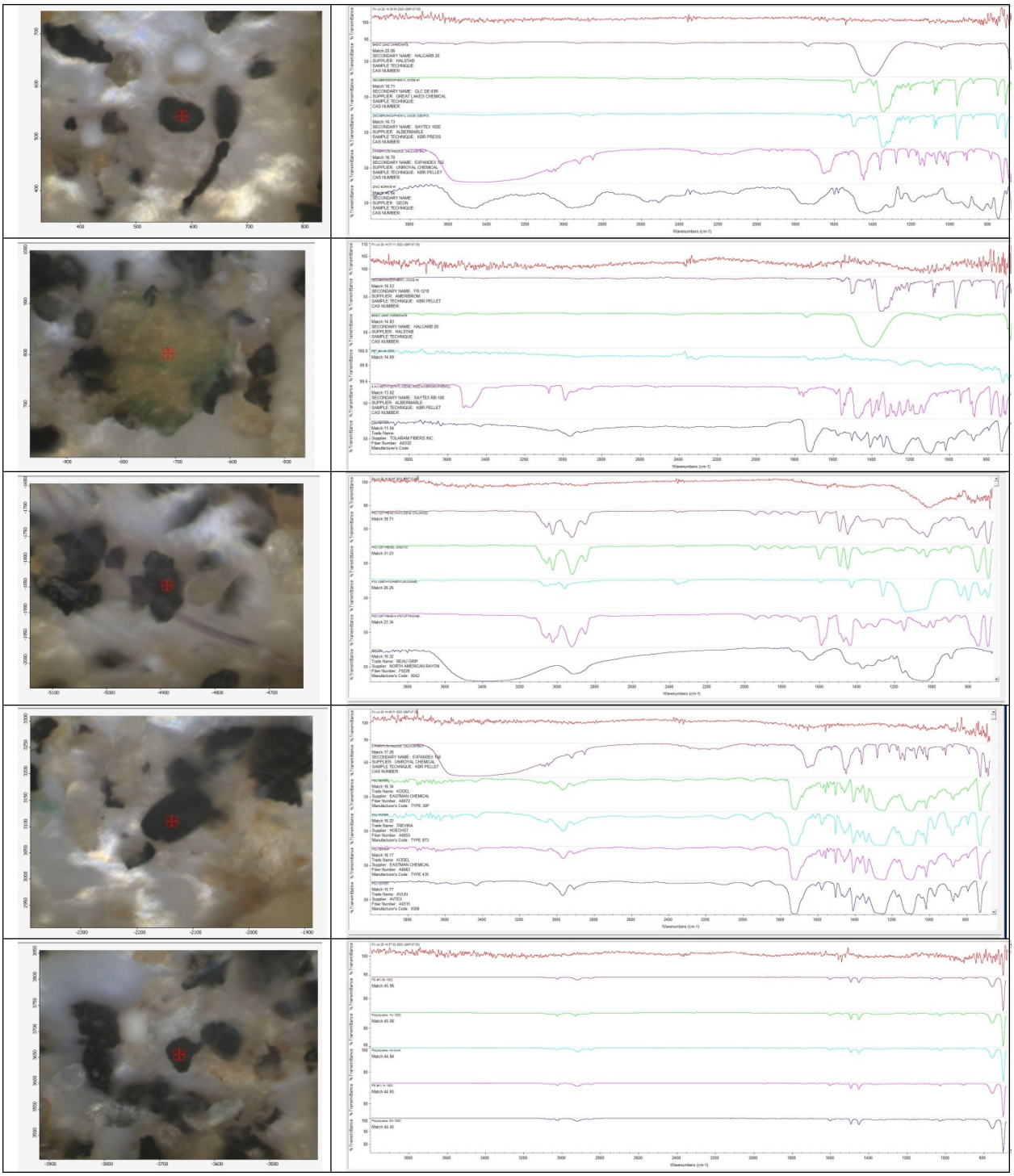
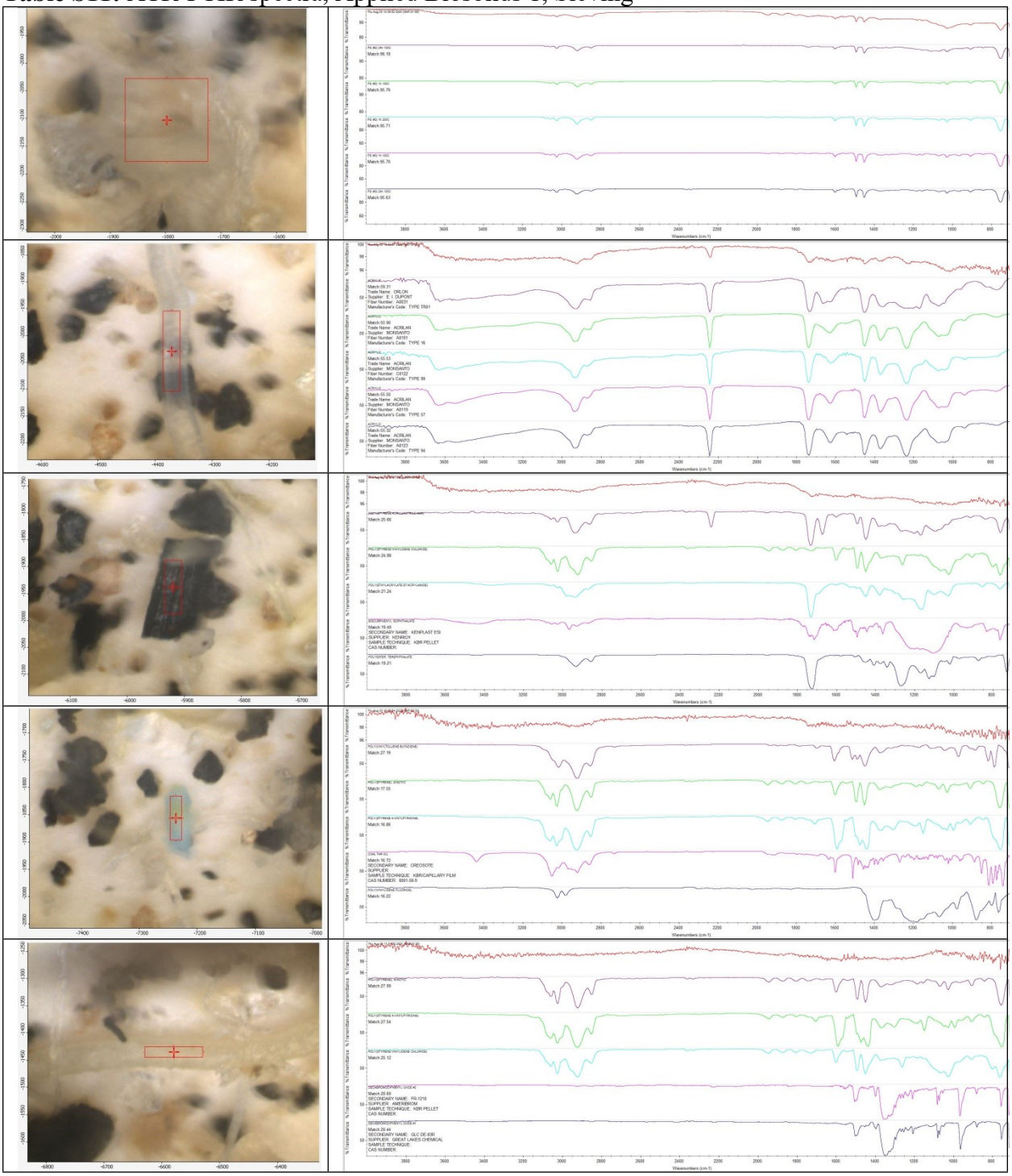
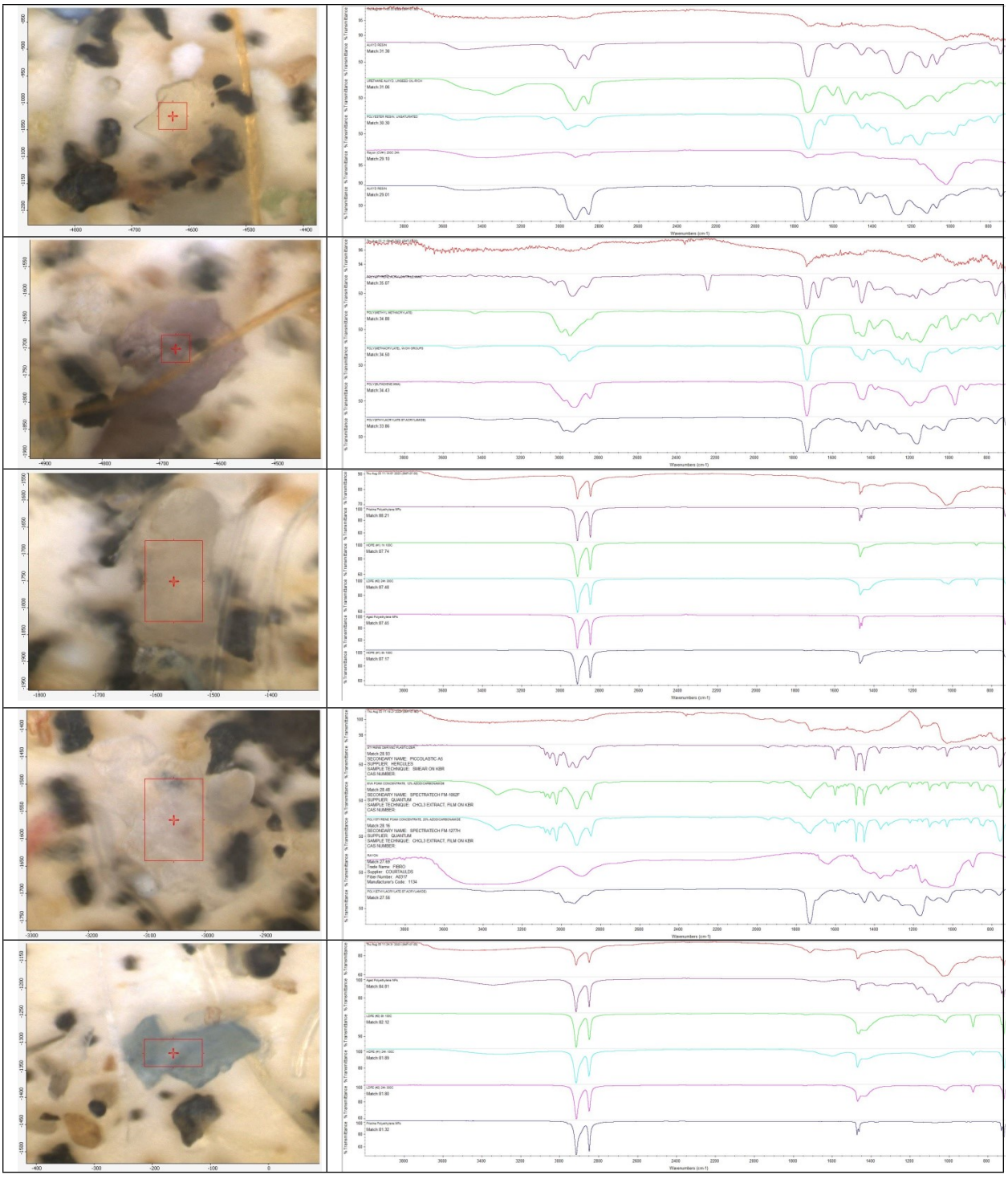
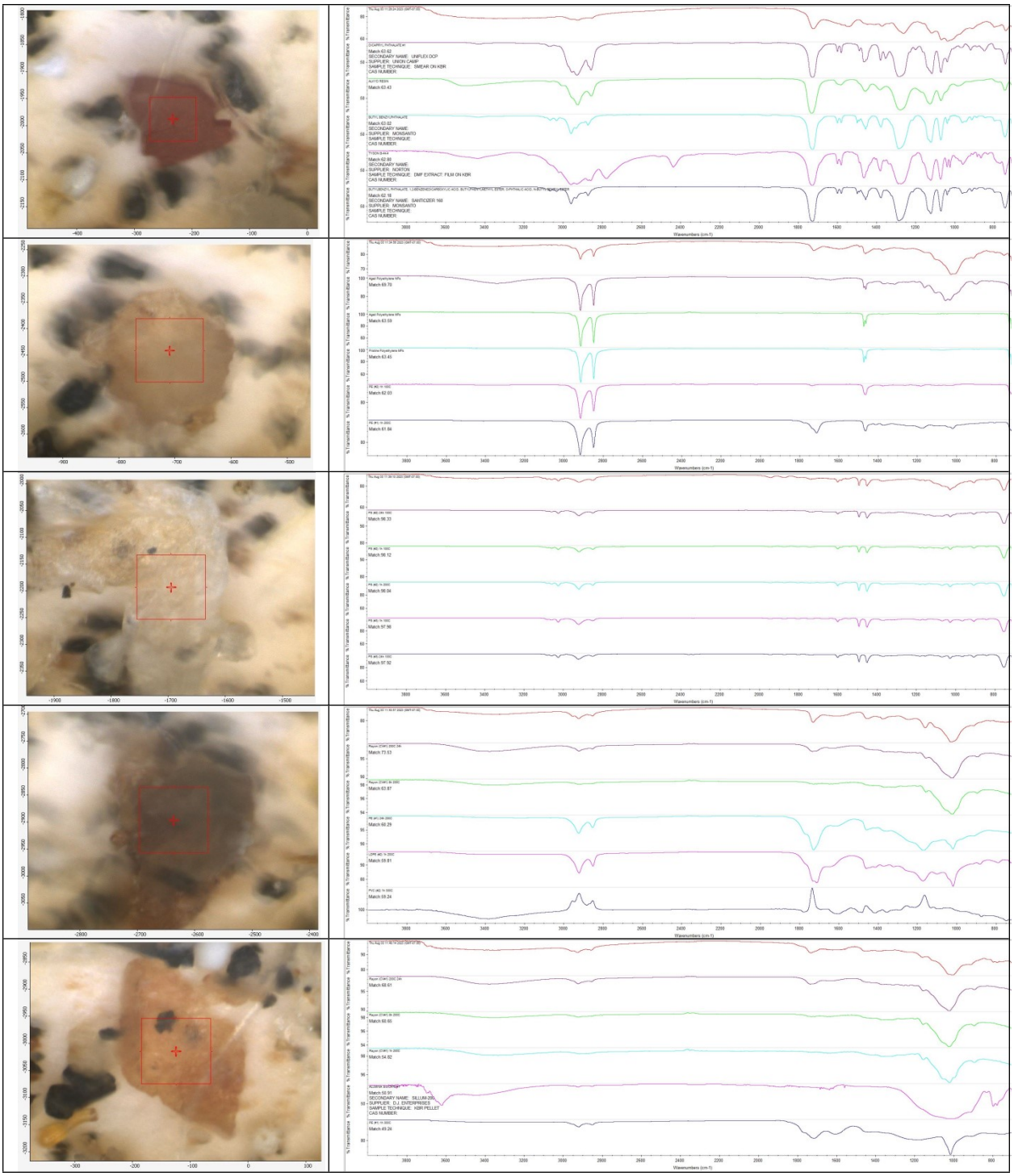
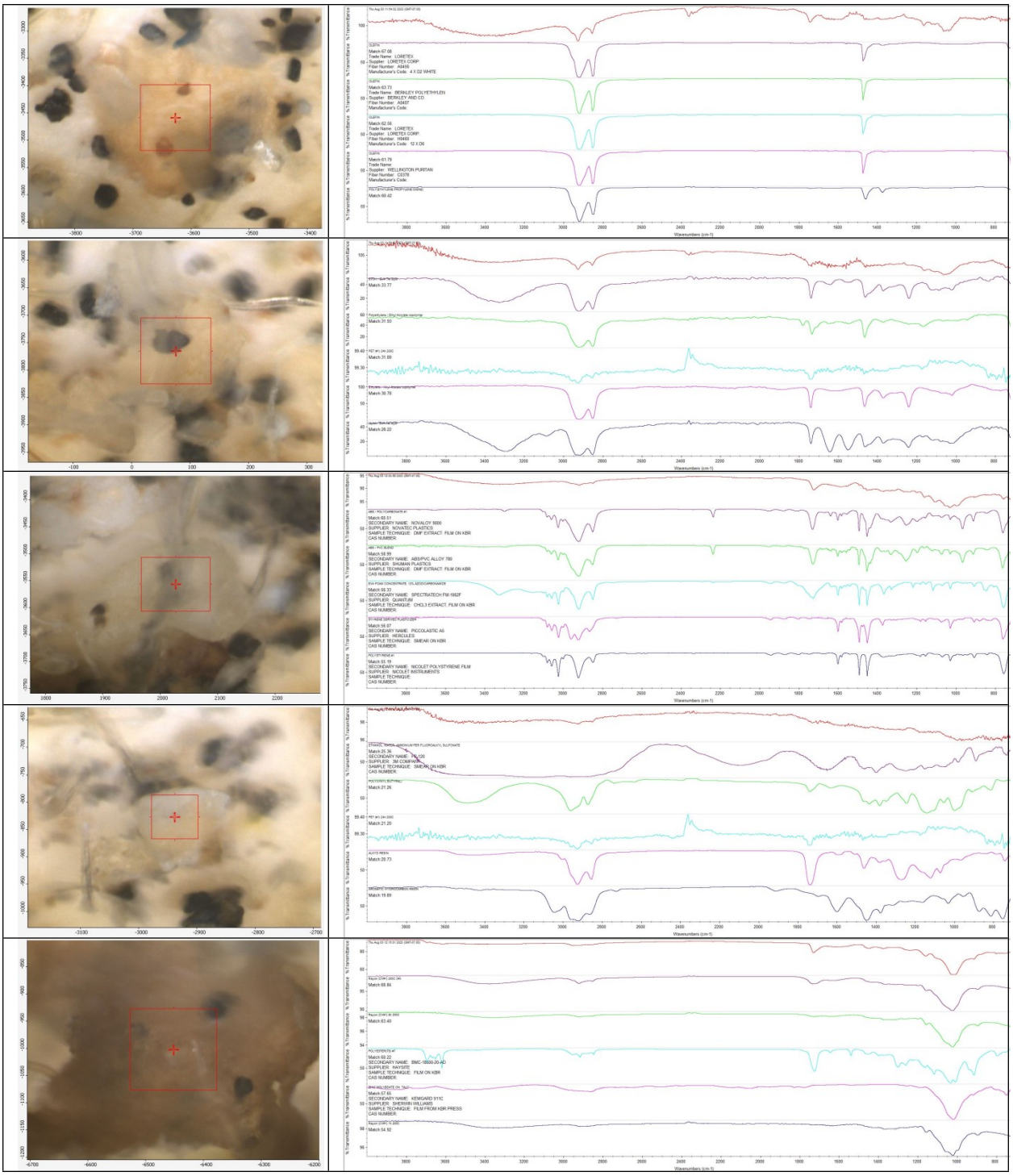


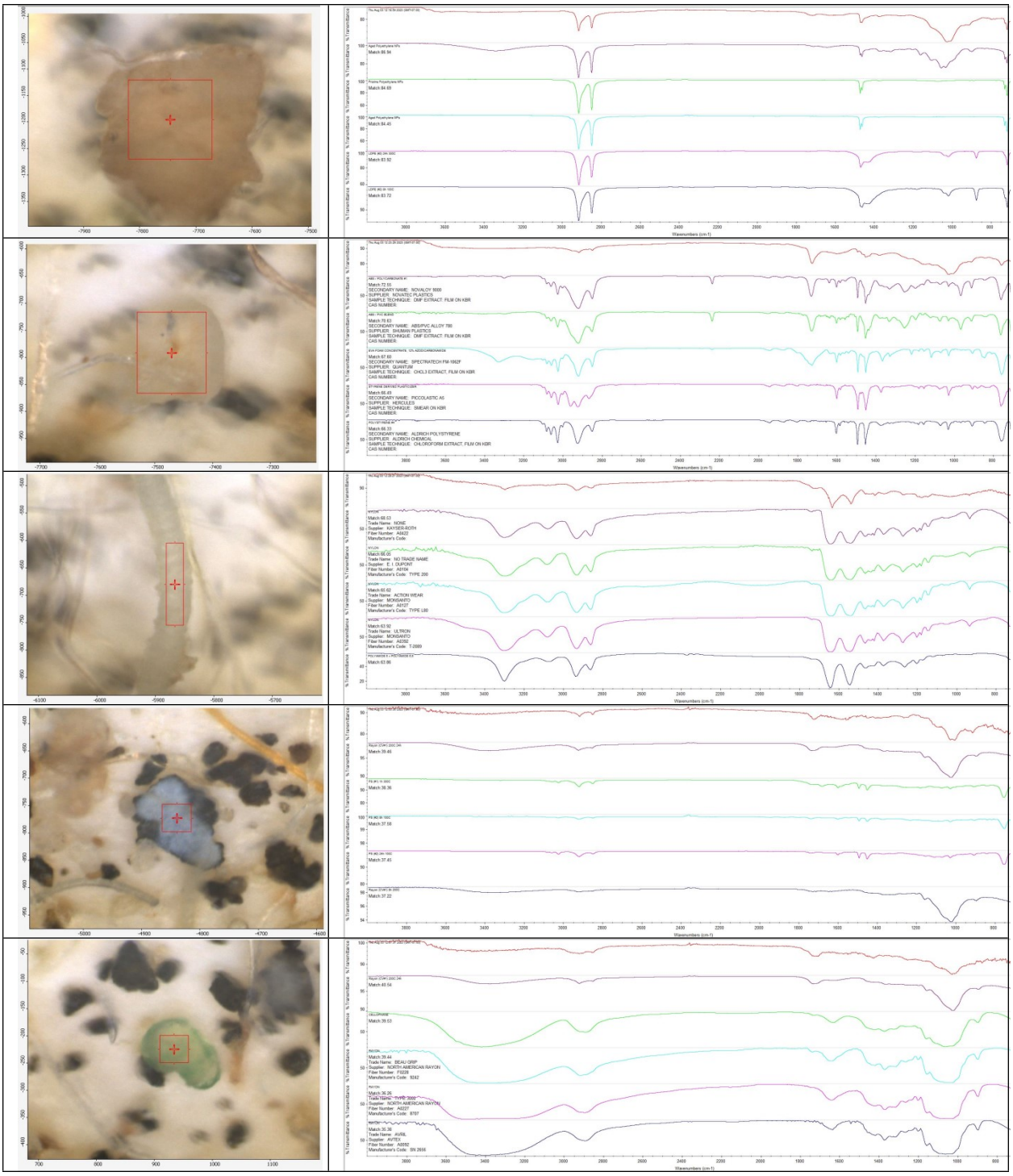
Table S11: ATR-FTIR spectra, Applied Biosolids 1, Sieving











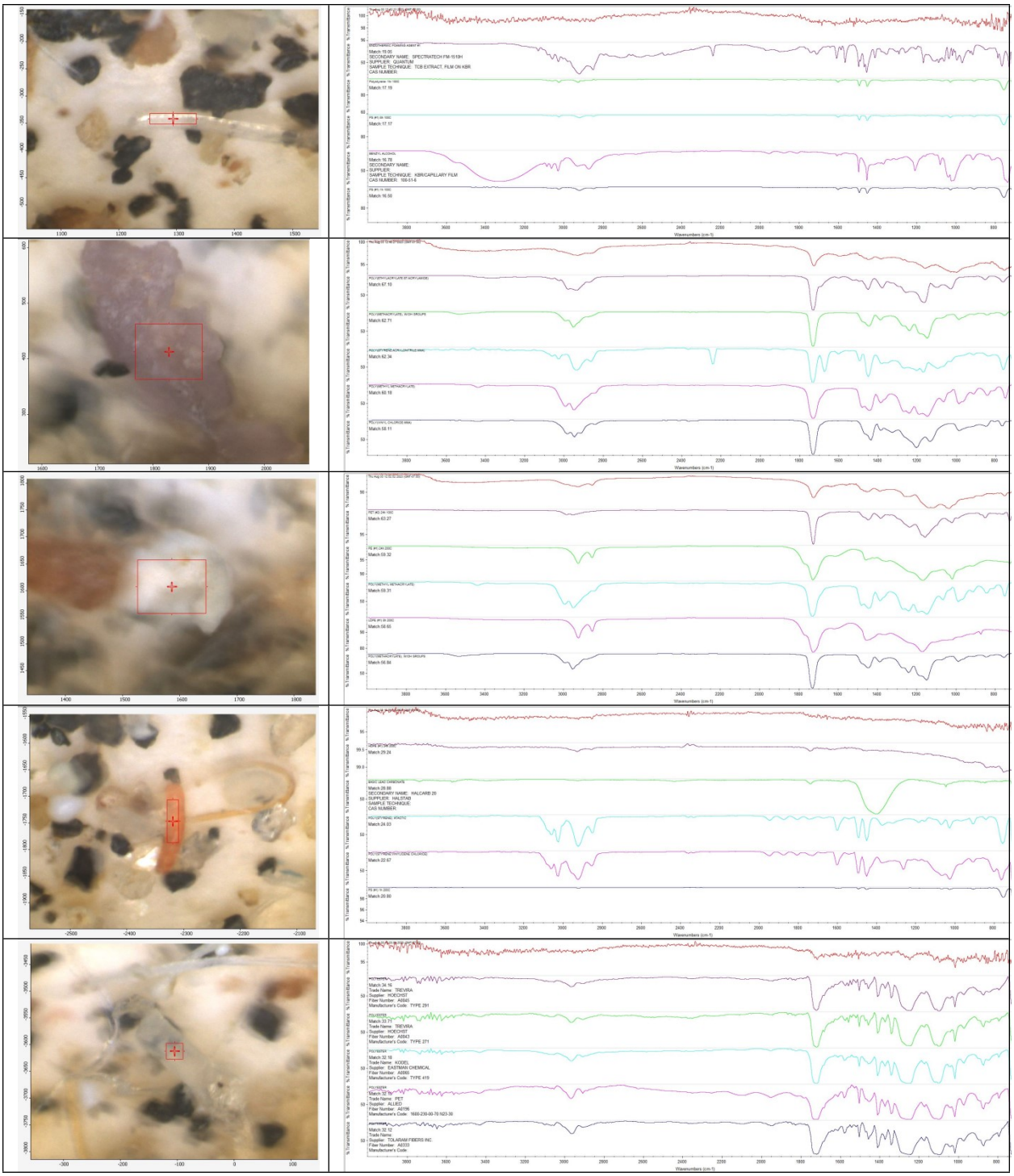
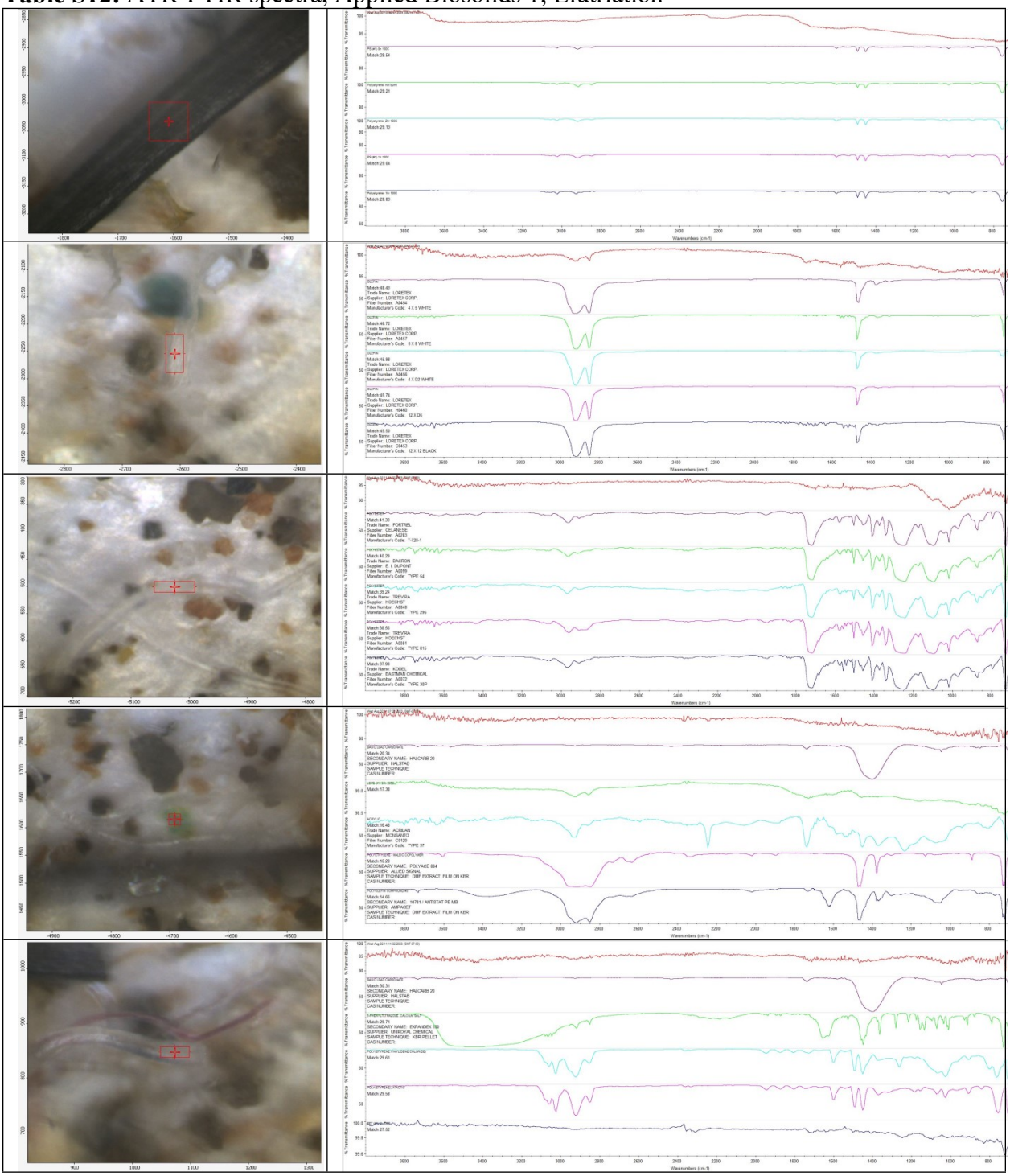
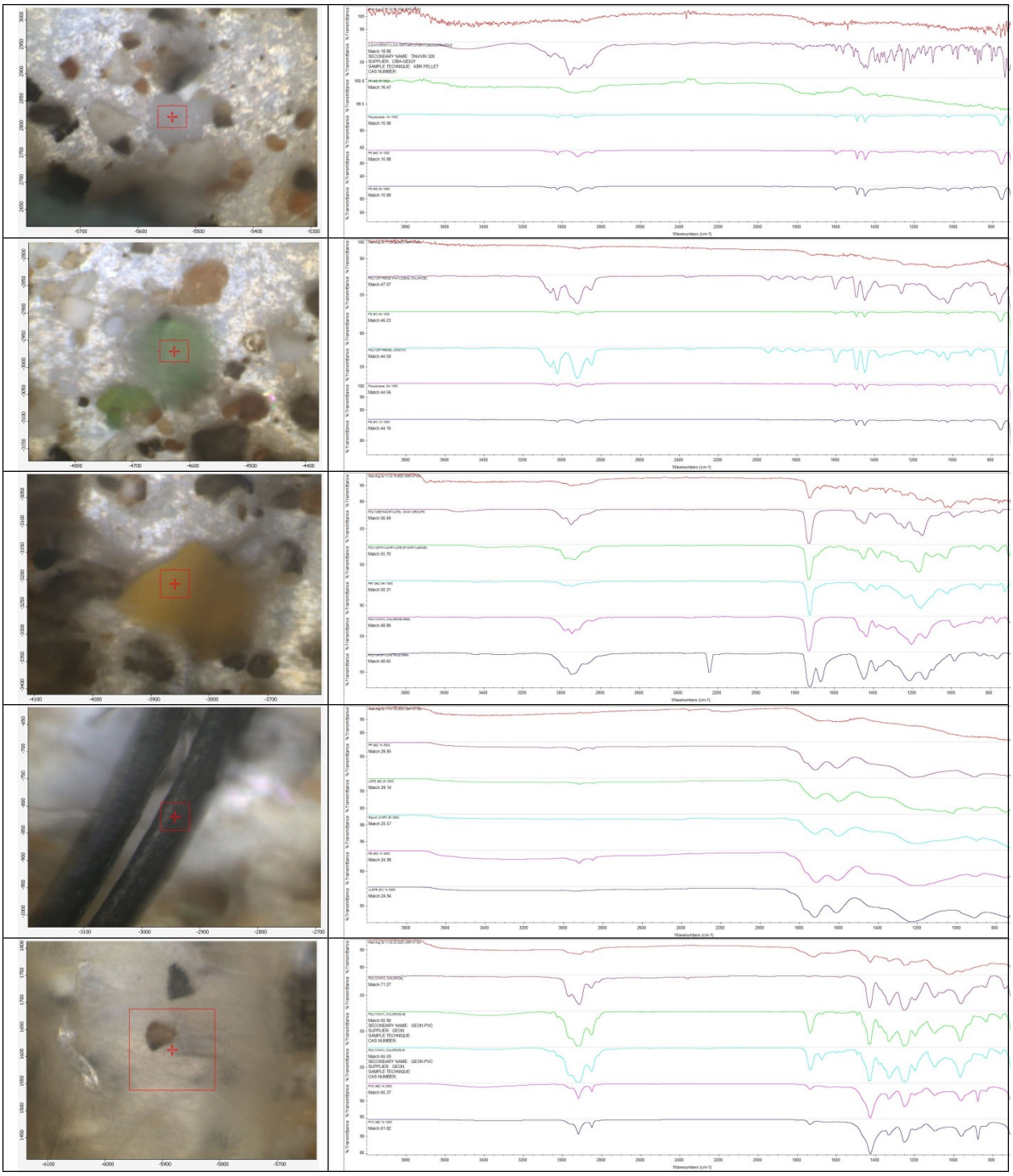
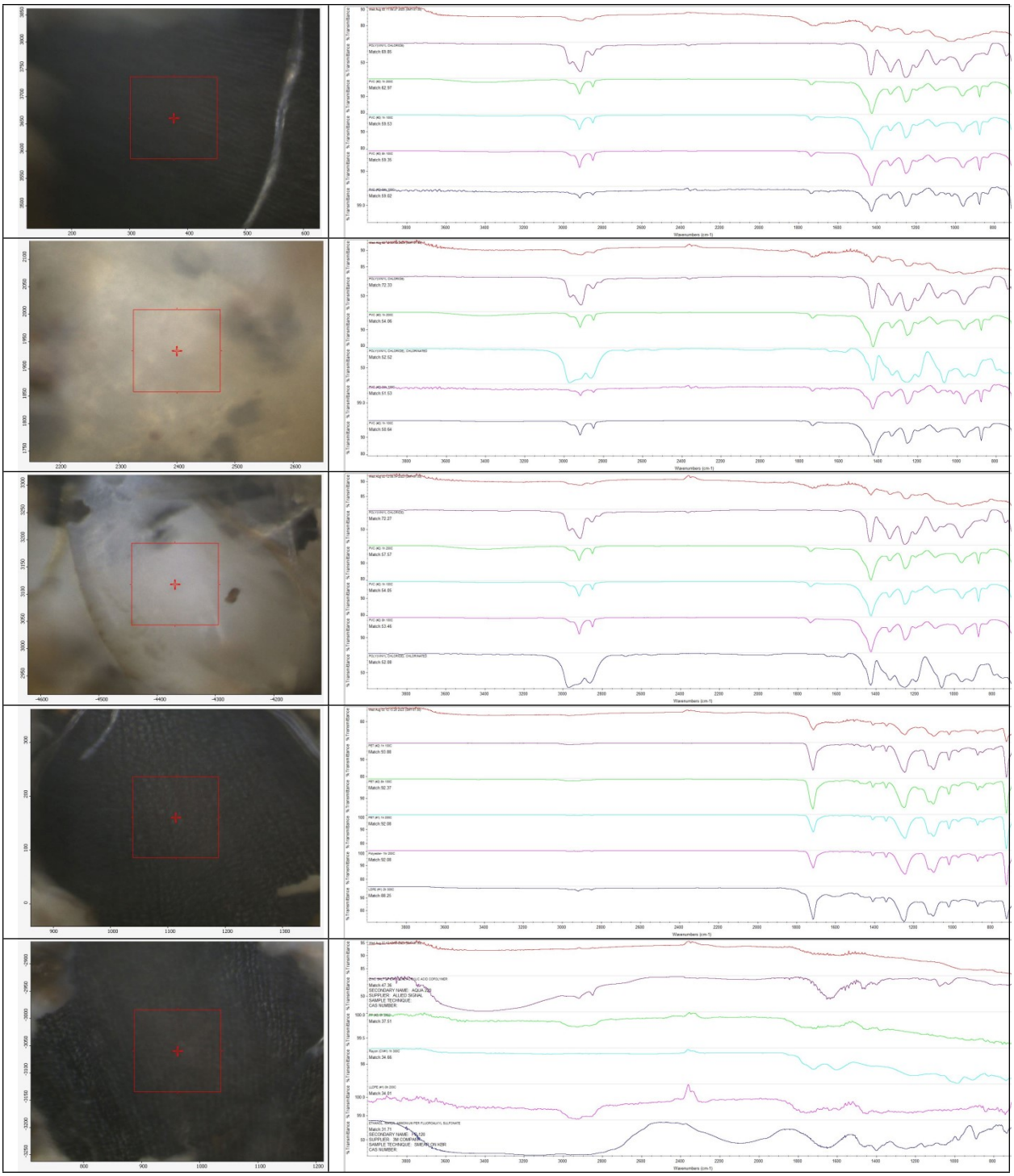
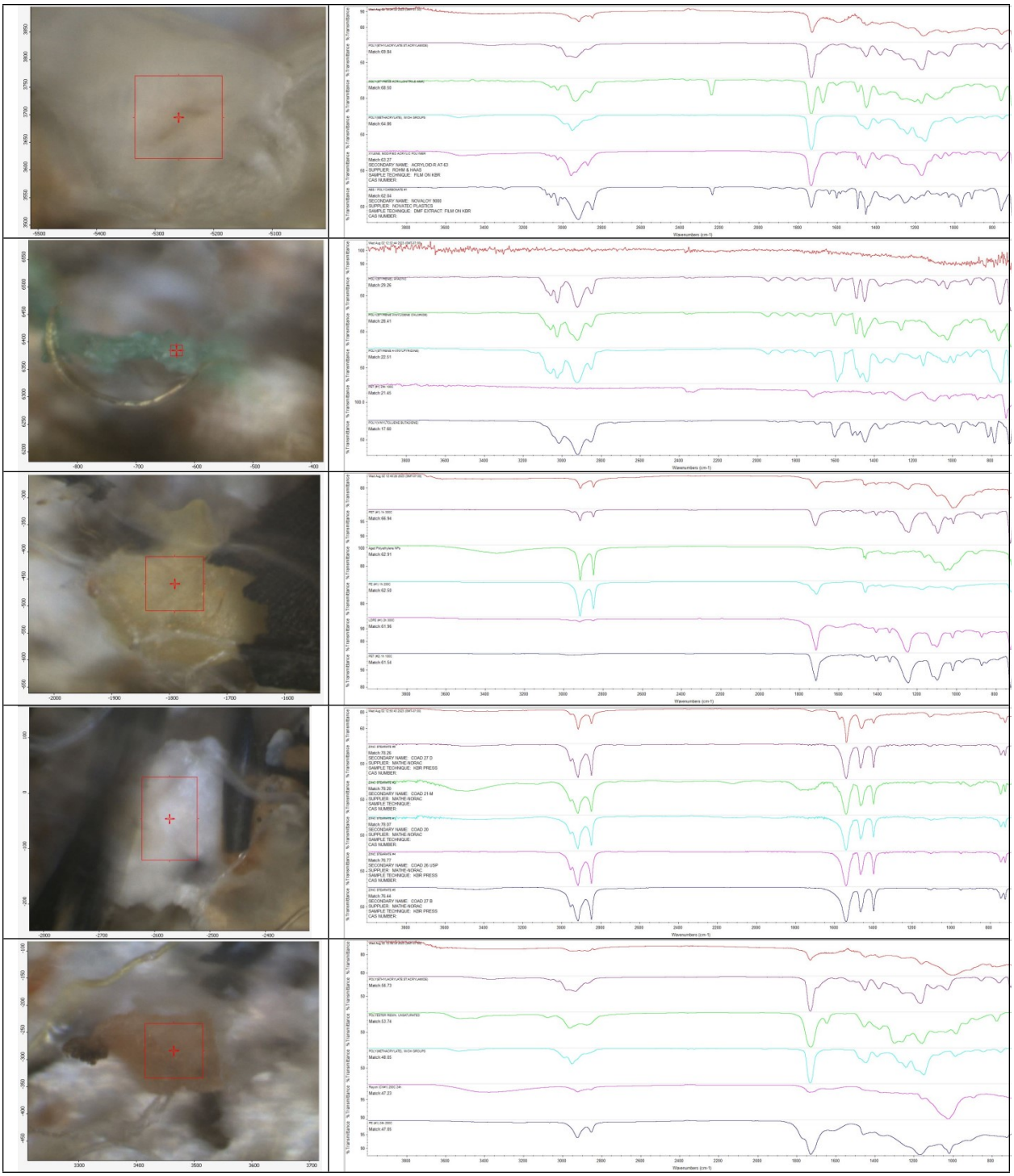


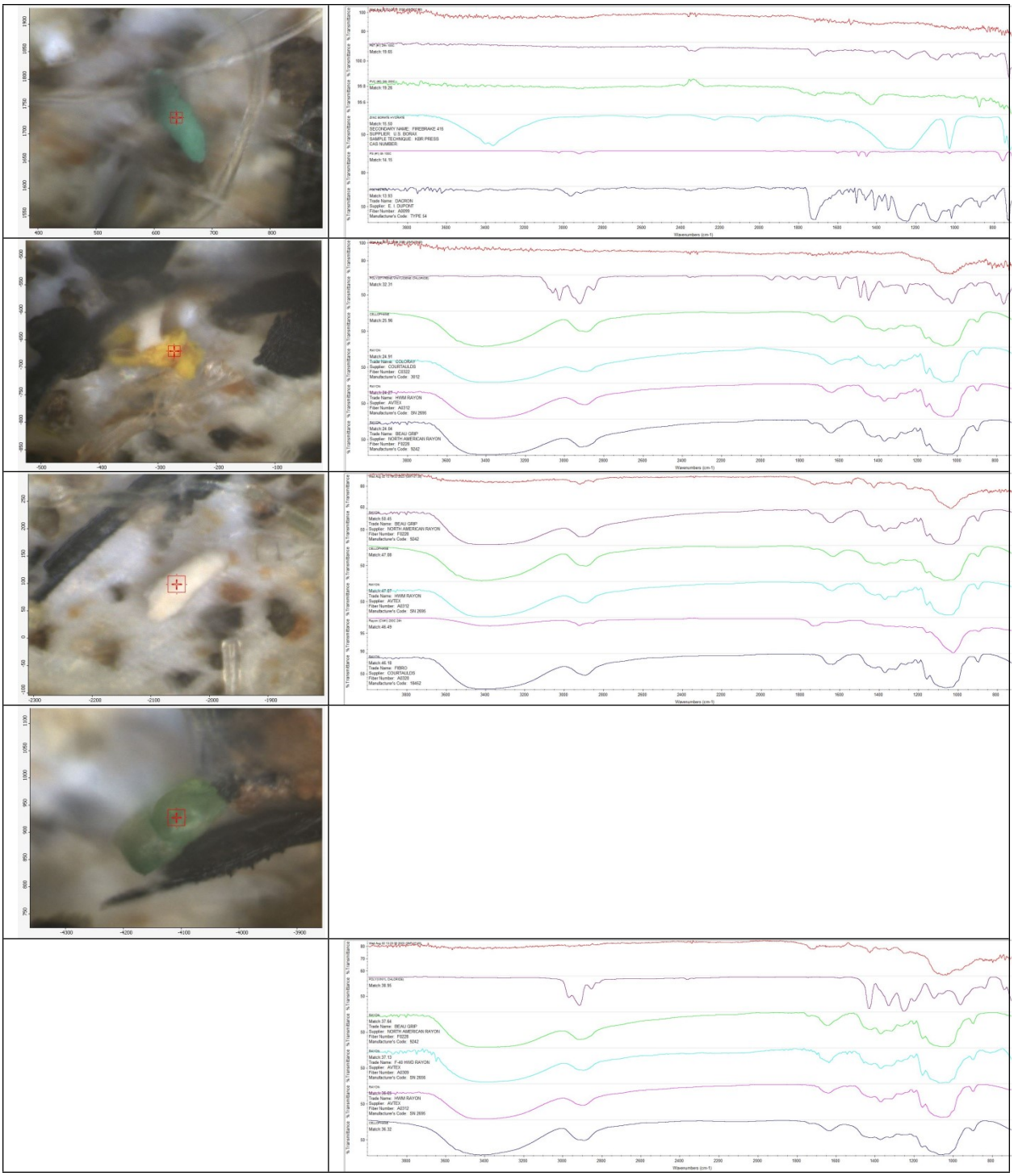
Table S12: ATR-FTIR spectra, Applied Biosolids 1, Elutriation











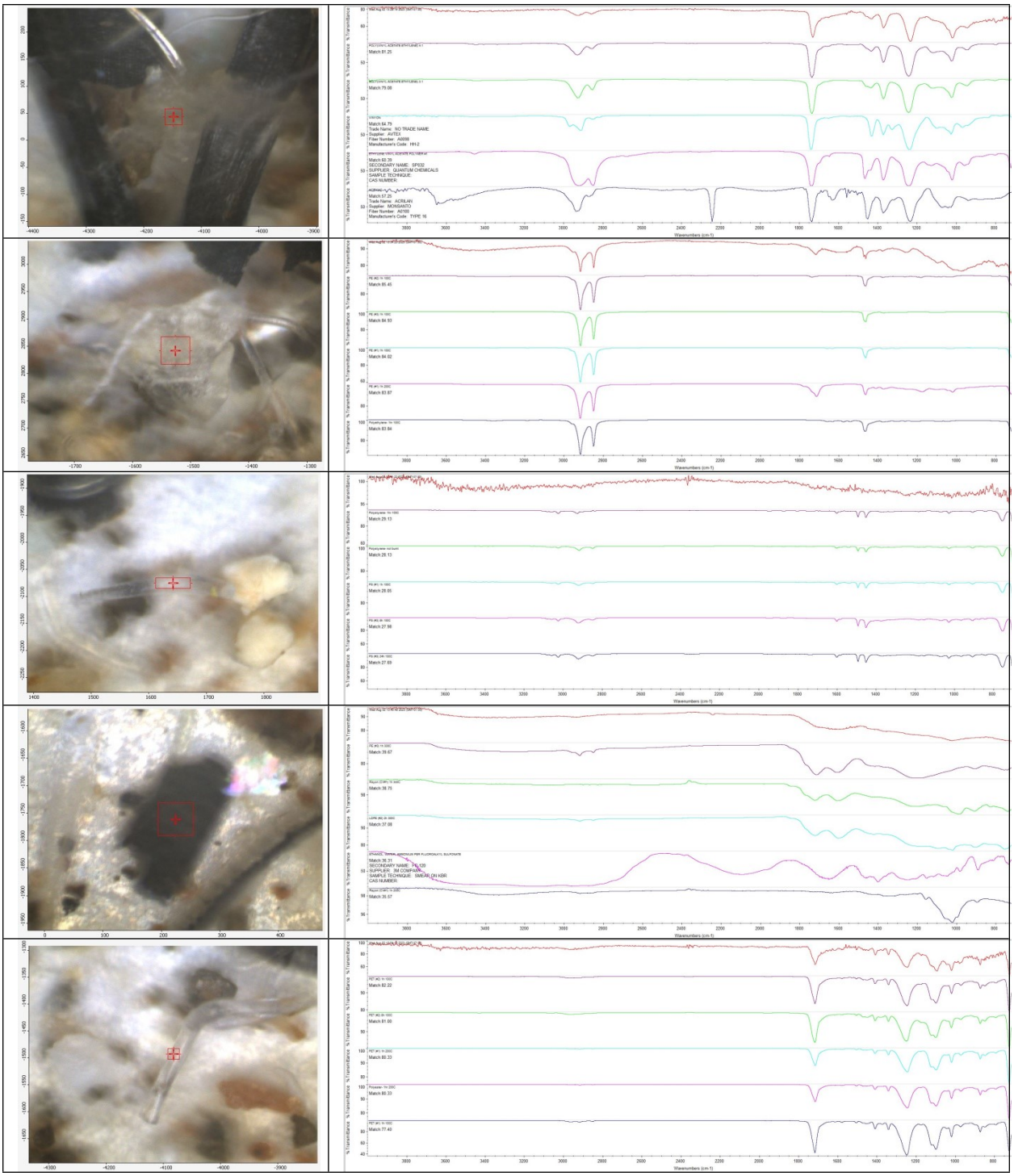
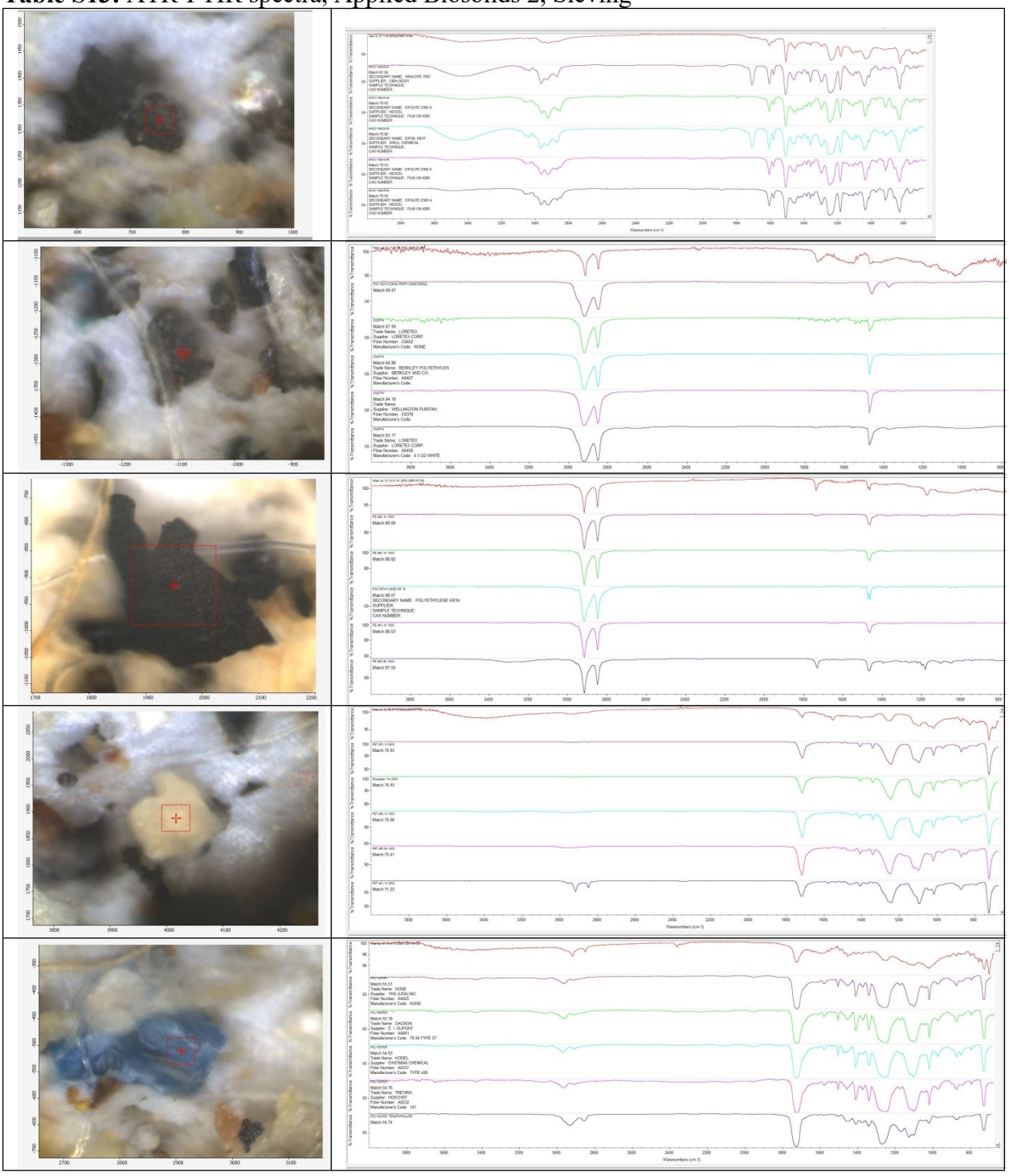
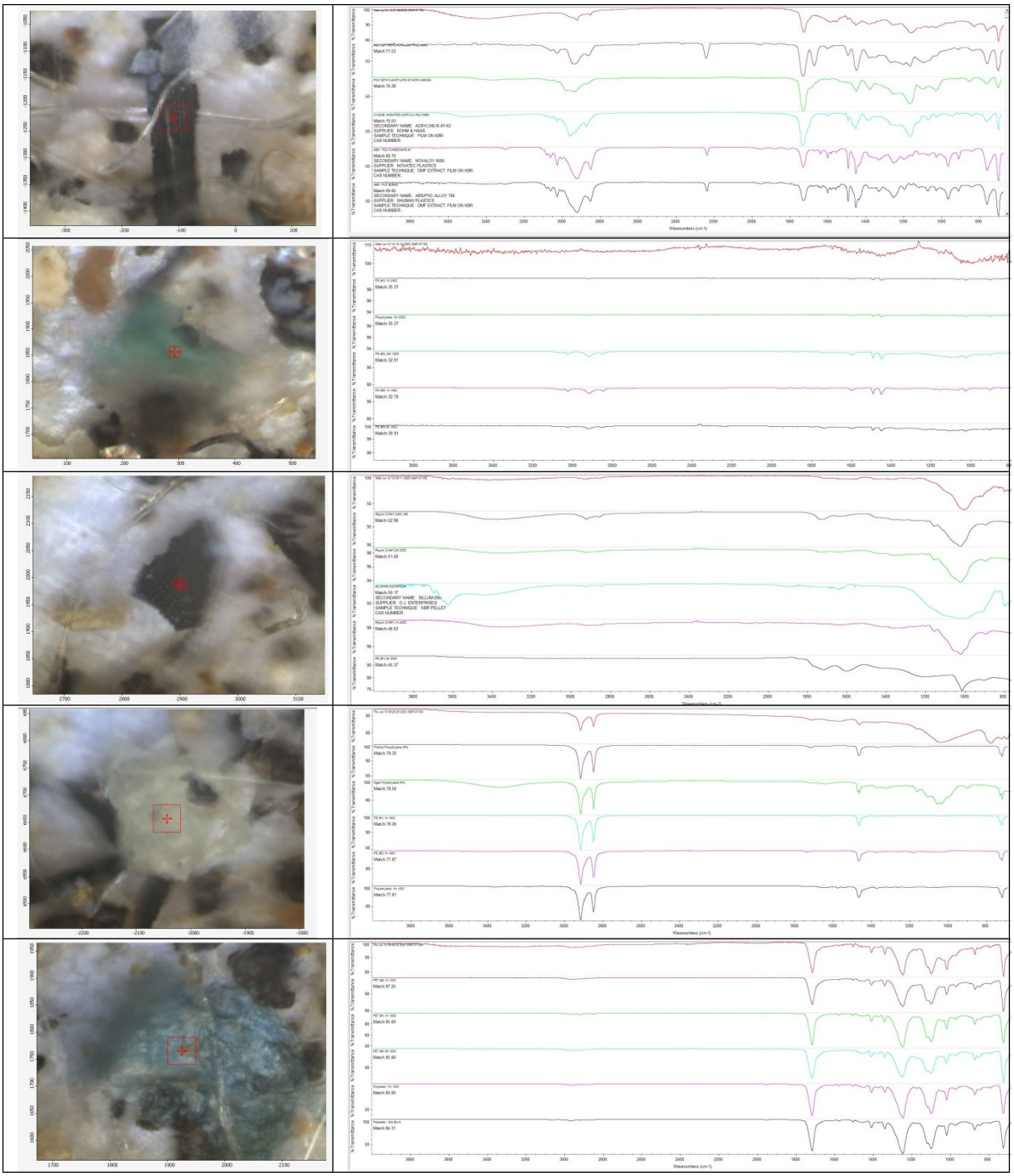
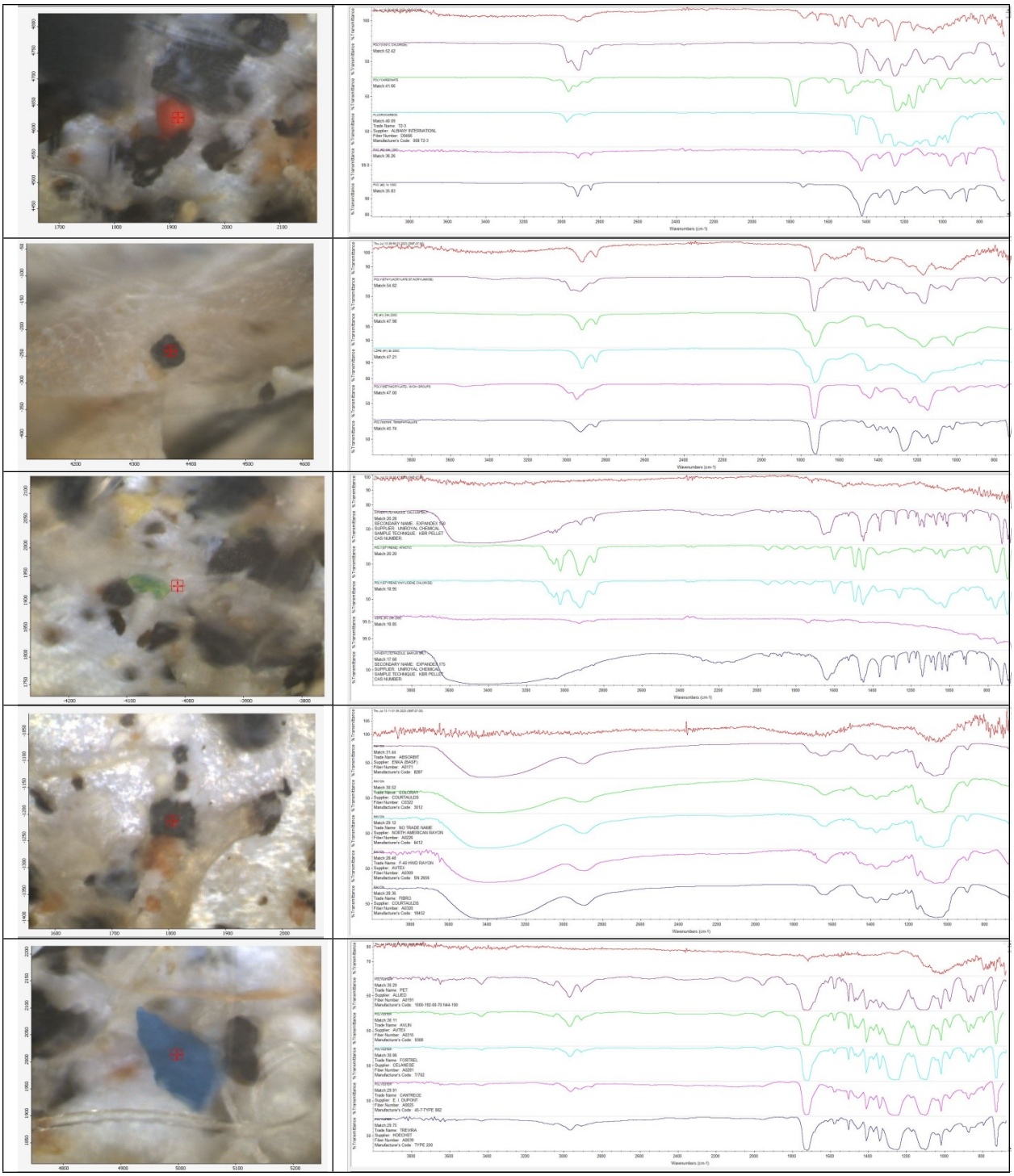
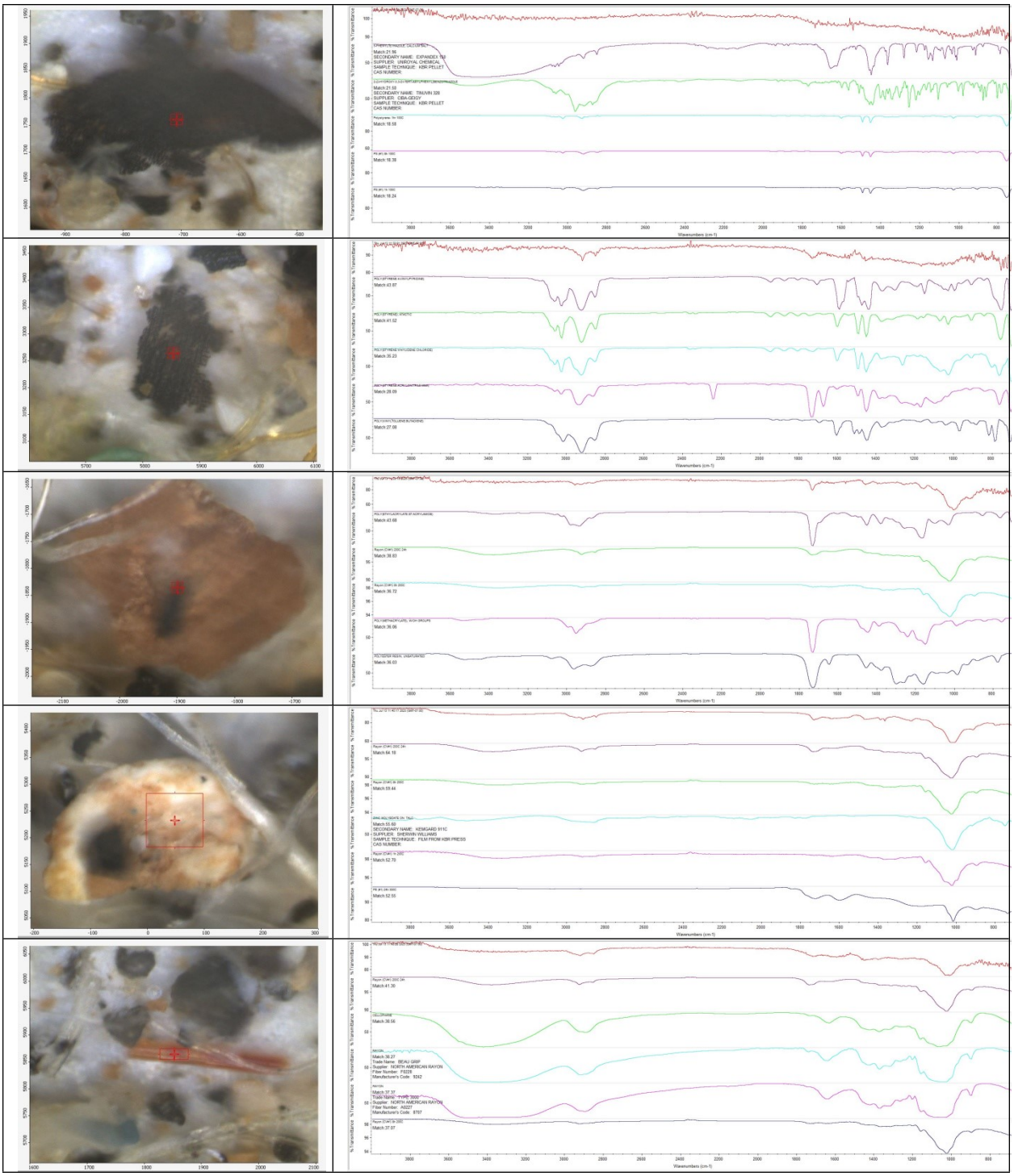


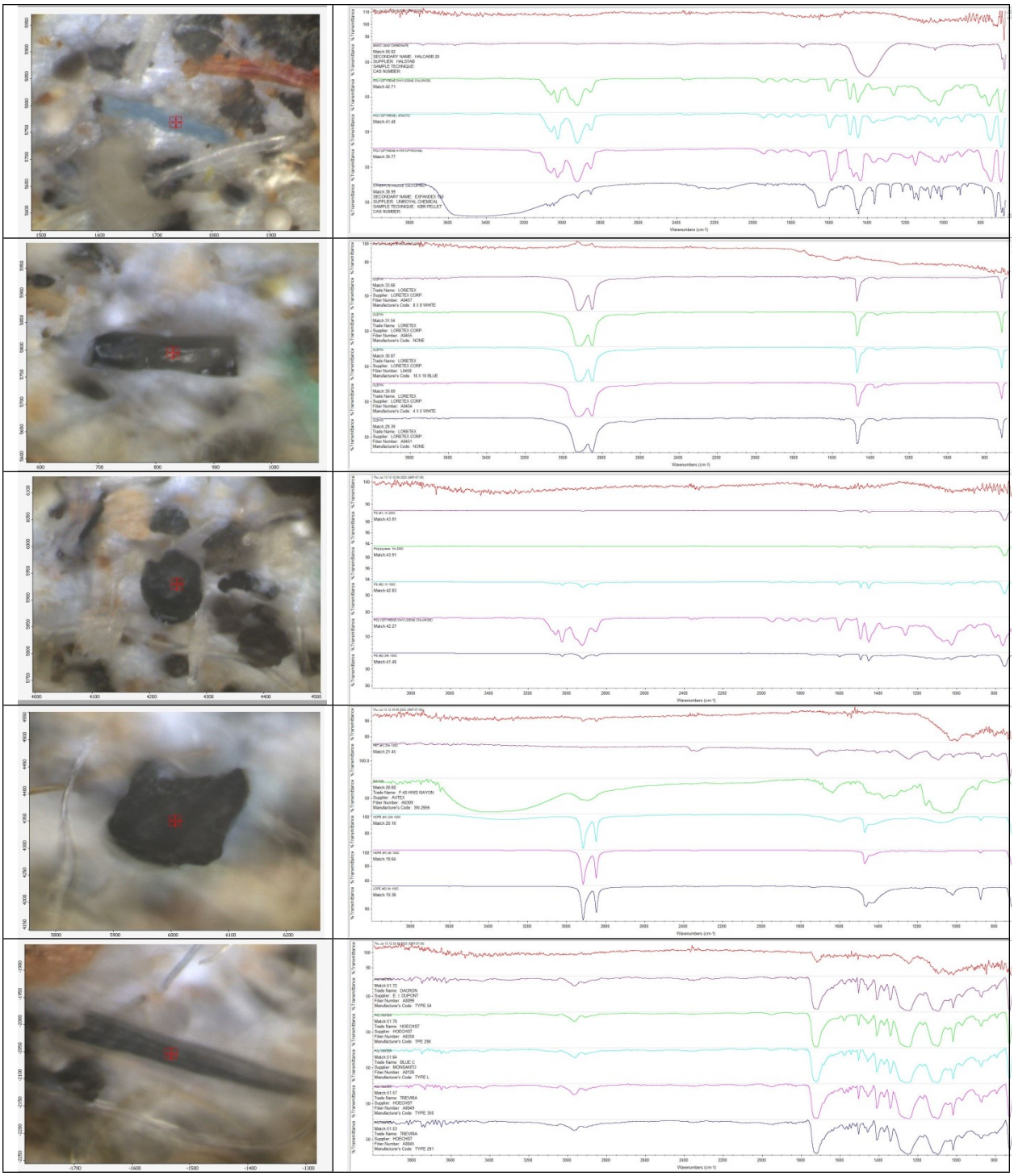
Table S13: ATR-FTIR spectra, Applied Biosolids 2, Sieving











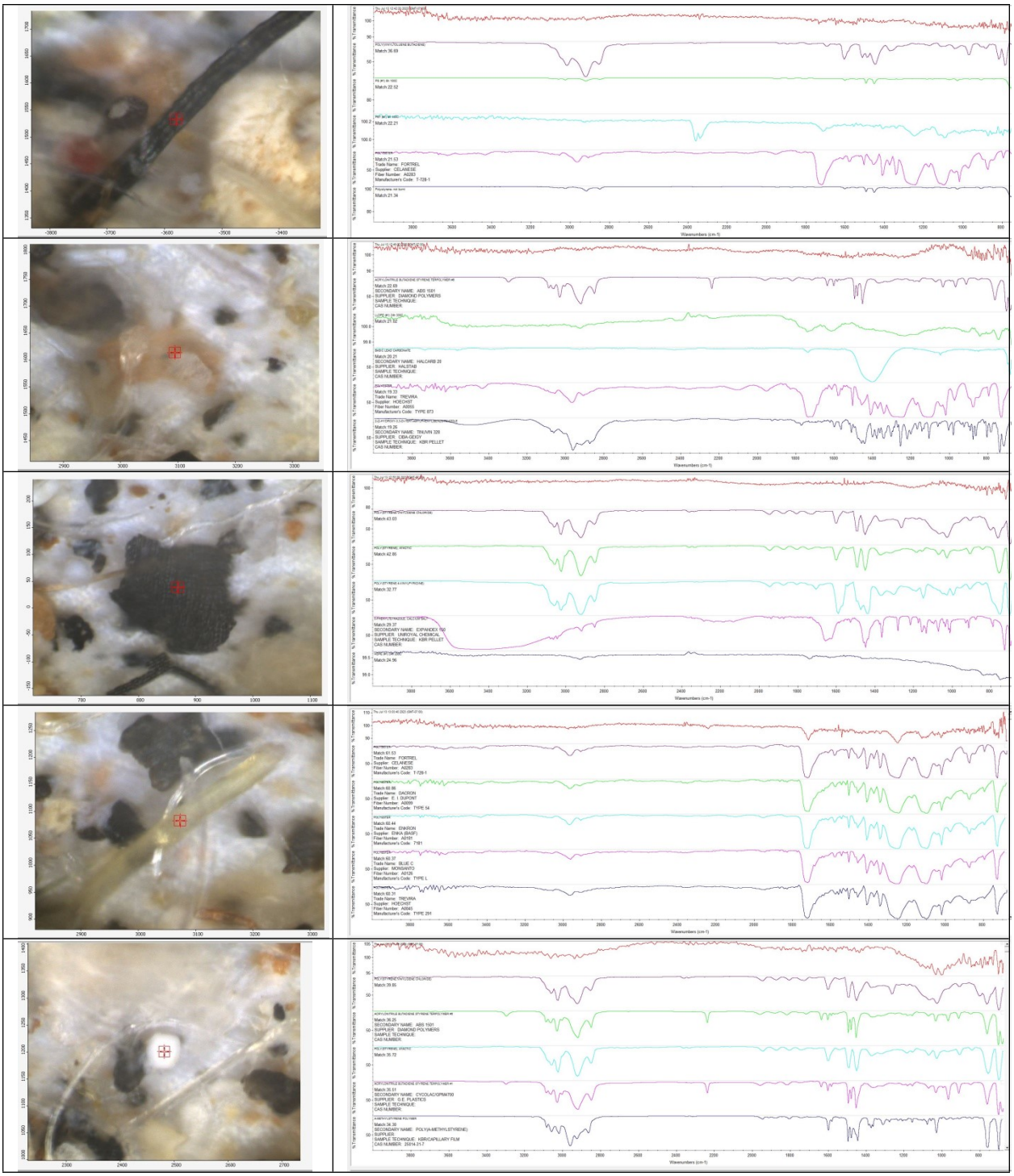
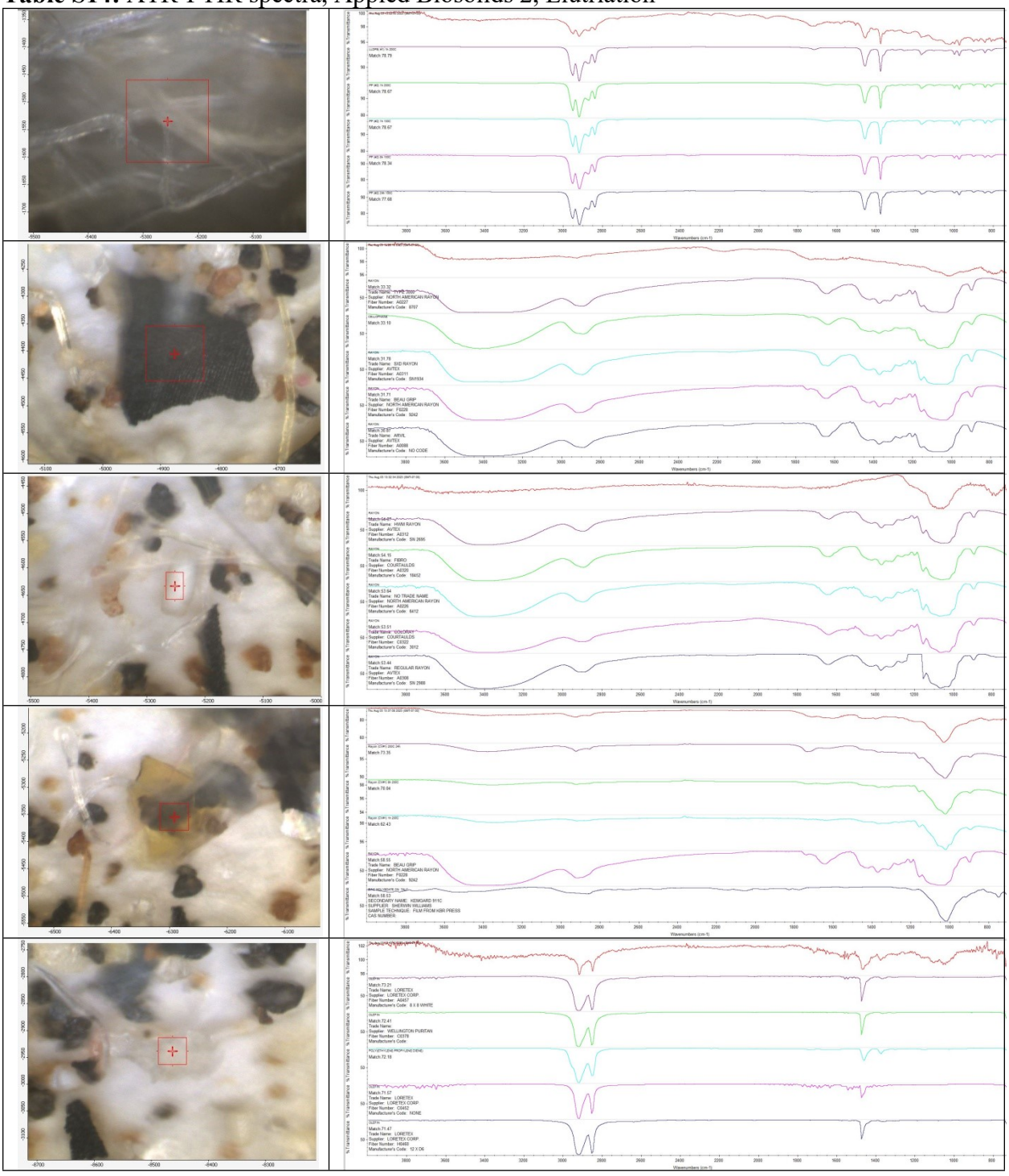
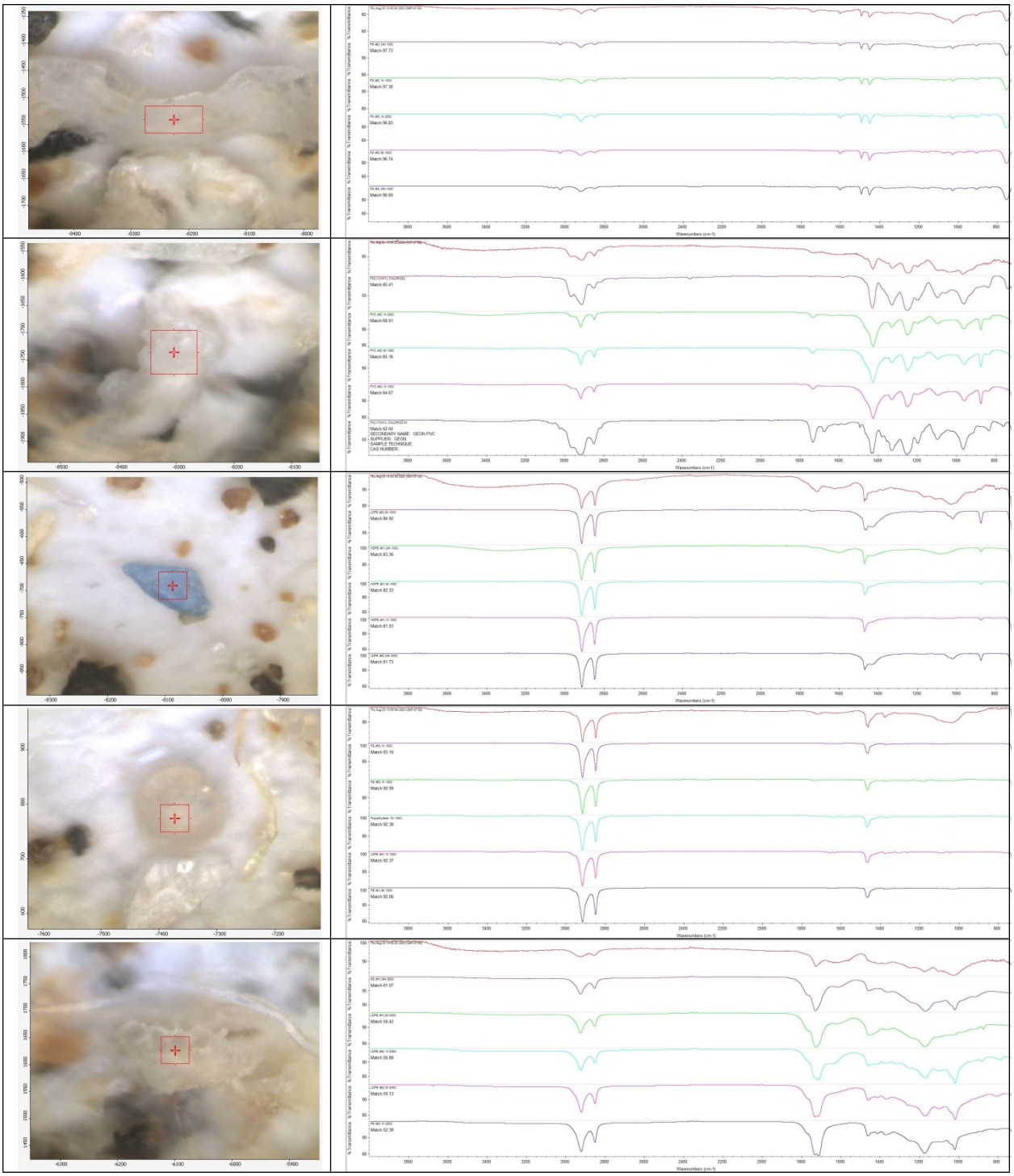
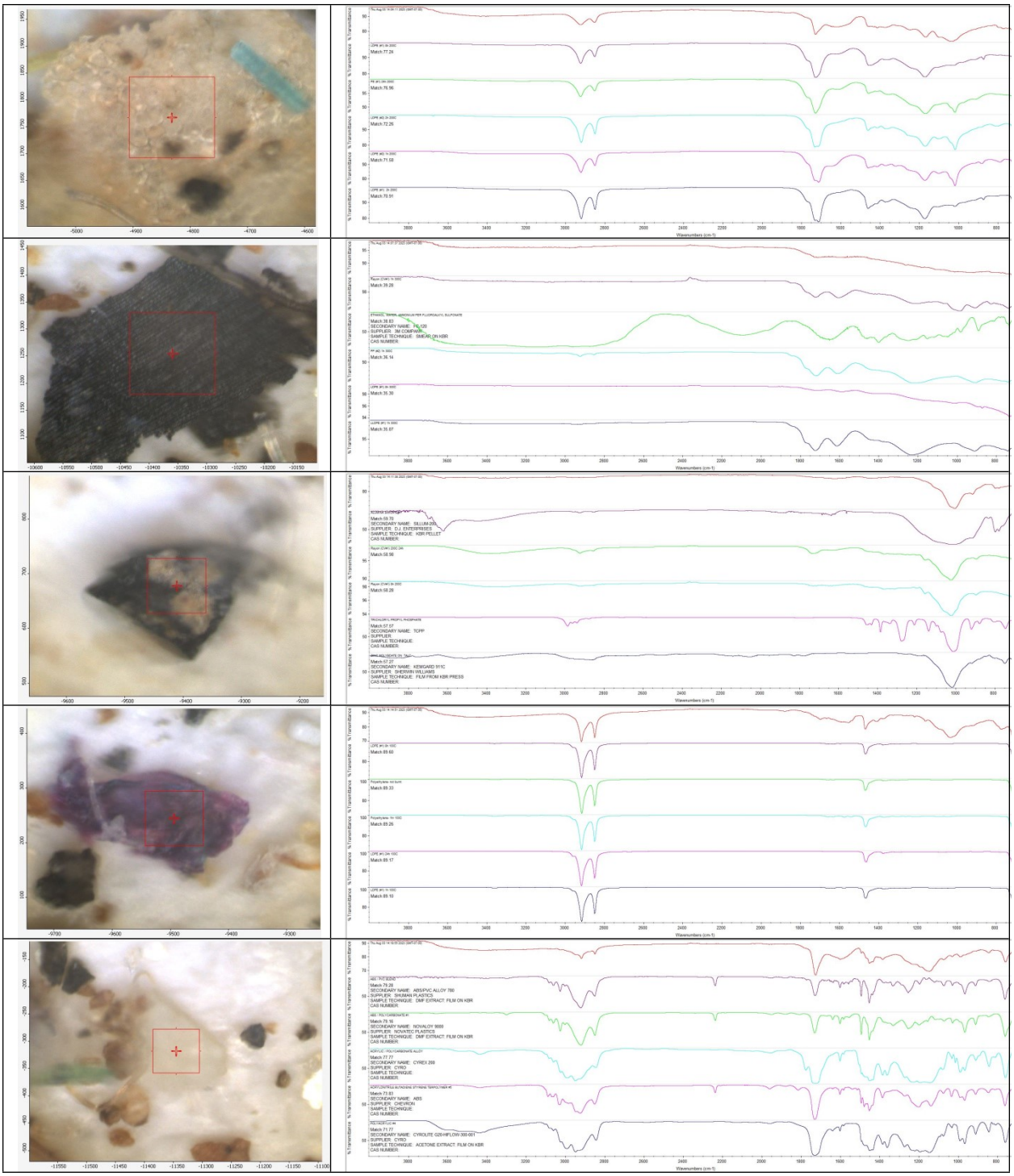
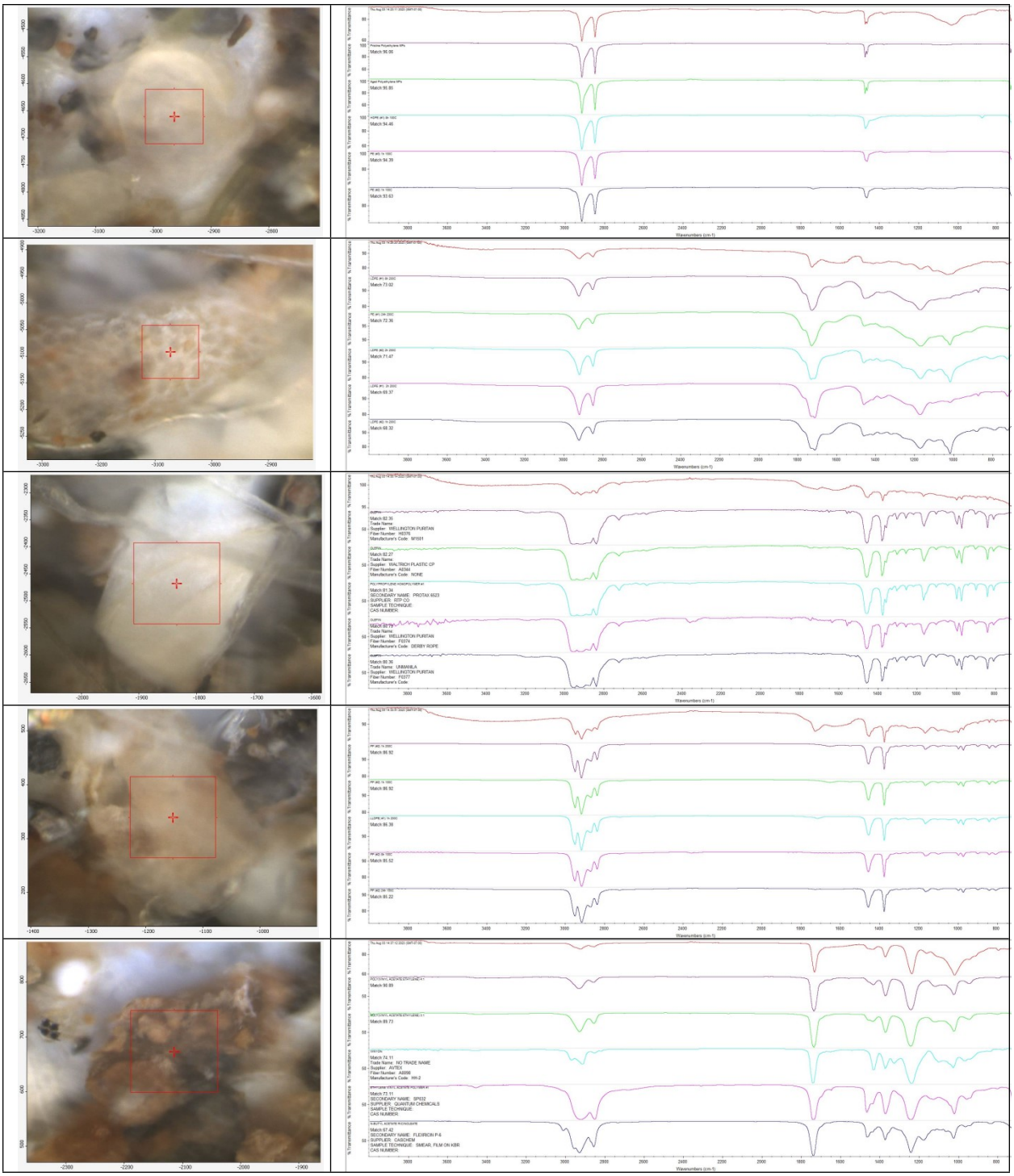


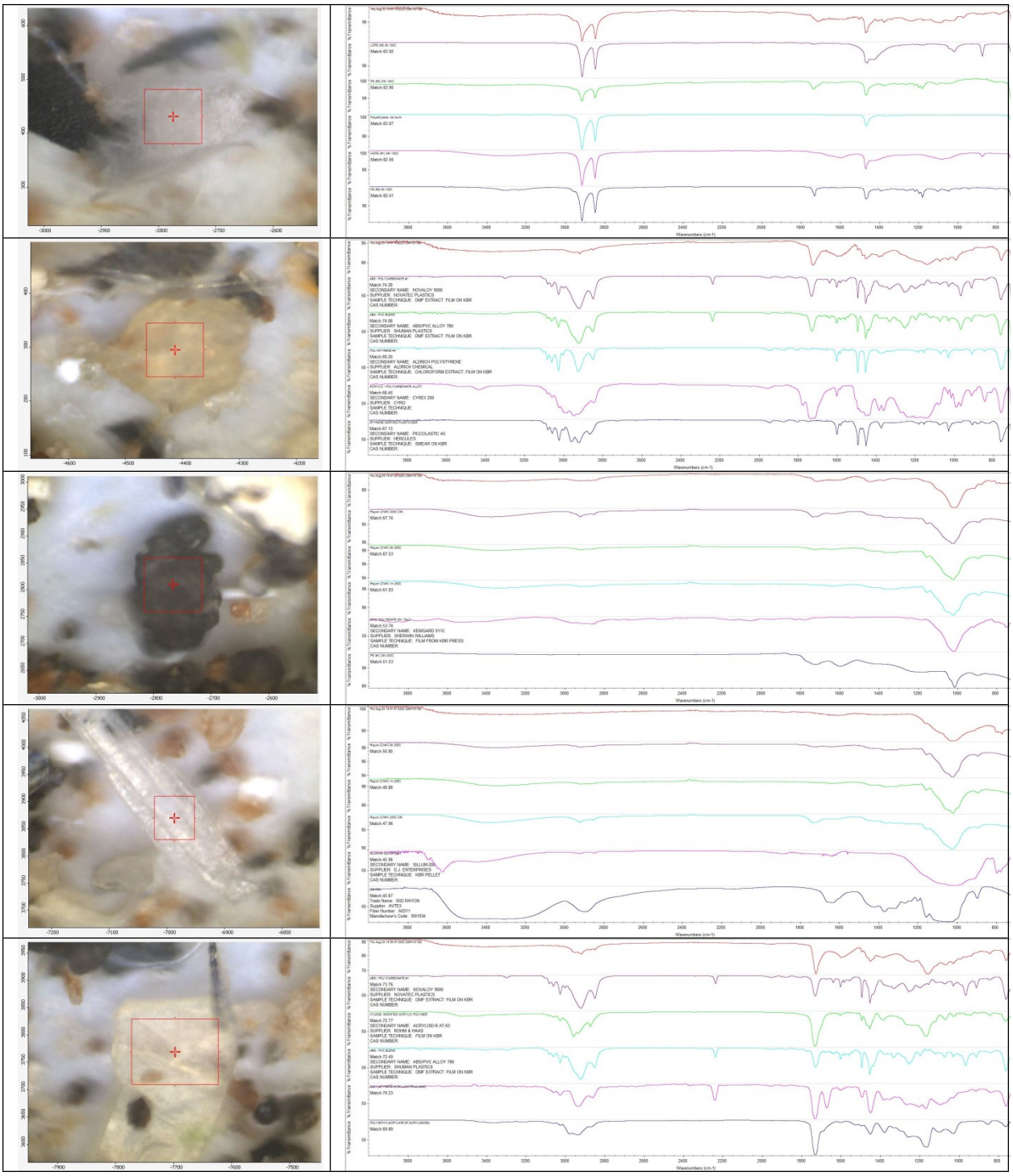
Table S14: ATR-FTIR spectra, Appled Biosolids 2, Elutriation











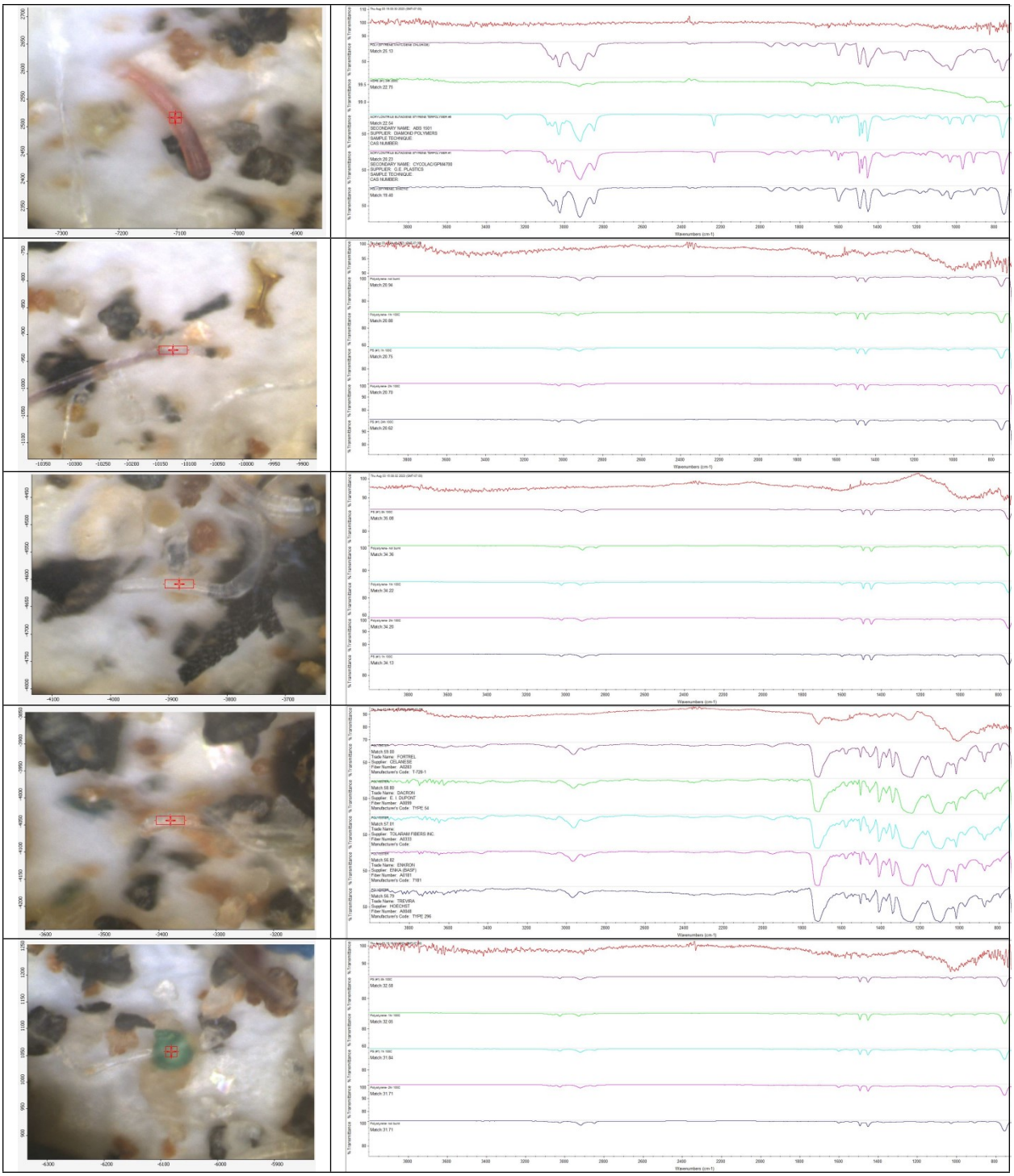


Table S15: FTIR-ATR matches for control (blank) sample

Control, Sieving + Digestion + Flotation			Control, Elutriation + Digestion + Flotation		
Point	ID	Best Match (%)	Point	ID	Best Match (%)
1			1	Olefin	51.41
2	TiO2(98%)/Al2O3(2%)	51.09	2	Rayon	67.11
3	Rayon	74.93	3	Rayon	26.16
4			4	Rayon	50.38
5	PS 8h 100C	35.24	5	Poly(vinyltoluene:butadiene)	29.38

Table S16: FTIR-ATR matches for Arkansas River 2 sample

Arkansas River 2, Sieving + Digestion + Flotation			Arkansas River 2, Elutriation + Digestion + Flotation		
Point	ID	Best Match (%)	Point	ID	Best Match (%)
1	PS, atactic	46.51	1	Basic lead carbonate	30.8
2	PS 1h 100C	39.8	2	PET	29.81
3	PS, atactic	34.42	3	PS, atactic	23.02
4	Acrylonitrile butadiene styrene terpolymer	27.73	4	PS	25.89
5	Poly(styrene:vinyldiene chloride)	40.47	5	PET	77.96

Table S17: FTIR-ATR matches for Arkansas River 1 sample

Arkansas River 1, Sieving + Digestion + Flotation			Arkansas River 1, Elutriation + Digestion + Flotation		
Point	ID	Best Match (%)	Point	ID	Best Match (%)
1	PET 24h 200C	30.94	1	PET 24h 200C	41.01
2	Poly(ethylacrylate:st:acrylamide)	34.38	2	Polyoxethylene isodecyl ether phosphate	54.07
3	LDPE 8h 200C	72.64	3	Rayon 24h 200C	62.93
4	Poly(ethylene:propylene)	51.44	4	PE 1h 300C	54
5	Aged PE	86.1	5	PS 1h 200C	55.89
6	Poly(ethylene:propylene)	50.11	6	Rayon 8h 200C	52.95
7	Poly(ethylene:propylene)	43.43	7	Rerroaluminum silicate	47.93
8	PET 24h 200C	37.66	8	LLDPE 8h 200C	30.49
9	LDPE 24h 200C	42.06	9	Hydrous aluminum silicate	53.13
10	LDPE 2h 200C	64.56	10	Rayon	58.18
11	Olefin	45.94	11	PET	75.23
12	Poly(ethylene:propylene:diene)	43.12	12	Poly(styrene:acrylonitril:MMA)	70.41
13	Rayon 8h 200C	31.18	13	LDPE 2h 200C	75.01
14	Rayon 24h 200C	55.34	14	PET 2h 100C	97.73
15	PET	64.09	15	Alumina silicate	42.53
16	PET 1h 100C	94.43	16	PS 8h 100C	33.77
17	Basic lead carbonate	26.46	17	Rayon 1h 200C	34.02
18	HDPE 8h 100C	93.25	18	Rayon 1h 300C	37.5
19	Alumina silicate	39.55	19	Rayon	38.49
20	Rayon	25.12	20	Hydrous aluminum silicate	44.31
21	PS 1h 200C	28.95	21	Poly(styrene:vinyldiene chloride)	44.69
22	5-phenyltetrazole calcium salt	24.13	22	Zinc salt	57.43
23	Polyester resin, unsaturated	28.01	23	Zinc salt	55.68
24	Rayon	41.03	24	Basic lead salt	26.56
25	PS, atactic	32.45	25	Poly(vinyl butyral)	32.71
26	Poly(vinyltoluene:butadiene)	32.38	26	Rayon	41.56
27	LDPE 1h 200C	30.88	27	Aromatic hydrocarbon resin	56.6
28	PE 8h 100C	55.01	28	Acrylonitril butadiene styrene teropolymer	23.21
29	Olefin	35.26	29	Poly(dimethylsiloxane)	29.07
30	Rayon 24h 200C	60.64	30	SiO2, crystaline	36.13

Table S18: FTIR-ATR matches for Boomer Creek sample

Boomer Creek, Sieving + Digestion + Flotation			Boomer Creek, Elutriation + Digestion + Flotation		
Point	ID	Best Match (%)	Point	ID	Best Match (%)
1	PE, pristine	98.2	1	Poly(styrene:vinyldiene chloride)	57.75
2	PP 1h 200C	81.7	2	Organo barium-zinc	27.89
3	Rayon	60.46	3	Basic lead carbonate	36.81
4	LDPE 1h 300C	64.86	4	Poly(styrene:vinyldiene chloride)	51.31
5	PS 8h 300C	28.59	5	PS 8h 100C	40.9
6	PE 1h 200C	76.75	6	PVC	37.46
7	Basic lead carbonate	26.03	7	PET	24.59
8	Rayon 24h 200C	48.56	8	Rayon	34.4
9	Rayon 24h 200C	65.68	9	Nylon	48.46
10	LDPE 24h 300C	75.28	10	Rayon	32.98
11	Basic lead carbonate	38.56	11	PET	31.8
12	Rayon	55.02	12	PE 24h 300C	34.72
13	Zinc salt	26.96	13	Poly(vinyltoluene:butadiene)	32.62
14	Nylon	34.64	14	Rayon	20.6
15	Zinc salt	44.62	15	PS 1h 200C	32.06
16	Zinc salt	41.89	16	PET	36.46
17	Olefin	69.53	17	PS, atactic	35.13
18	LDPE 2h 200C	71.91	18	Poly(styrene:vinyldiene chloride)	41.91
19	PE 1h 200C	77.58	19	PS, atactic	40.75
20	Olefin	71.15	20	PS 1h 100C	43.3
21	Acrylic	24.29	21	PS 8h 100C	32.95
22	LDPE 1h 200C	81.05	22	PE, oxidized	22.05
23	LDPE 2h 200C	63.01	23	Poly(vinyldiene fluoride)	18.44
24	Olefin	33.14	24	PS 8h 100C	43.04
25	Polystyrene:vinyldiene chloride)	23.71	25	Poly(vinyltoluene:butadiene)	34.86
26	Olefin	33.89	26	Basic lead carbonate	22.06
27	Zinc sulfide/barium sulfate	31.2	27	Decaromodiphenyl oxide)	16.53
28	Poly(ethylene:propylene)	59.27	28	Poly(styrene:vinyldiene chloride)	39.71
29	Poly(ethylene:propylene)	54.38	29	5-phenyltetrazole calcium salt	17.28
30	PS 1h 100C	28.4	30	PS 8h 100C	45.96

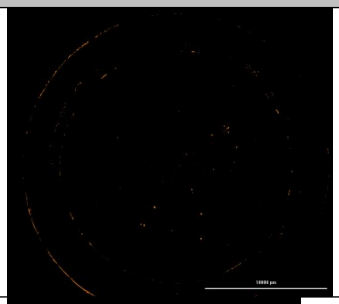
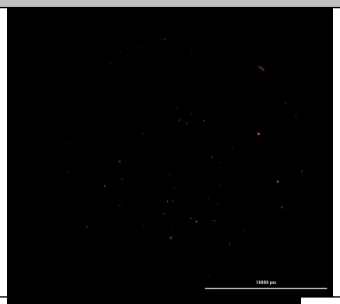
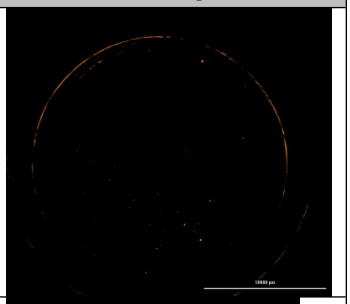
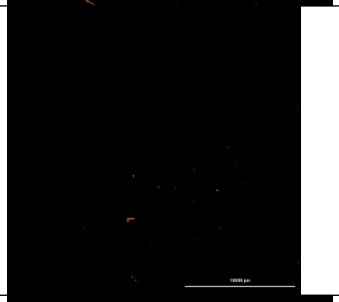
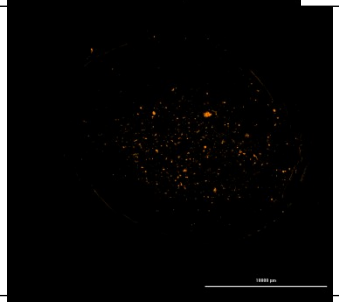
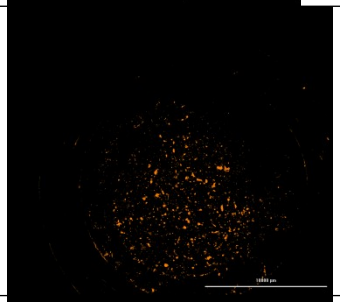
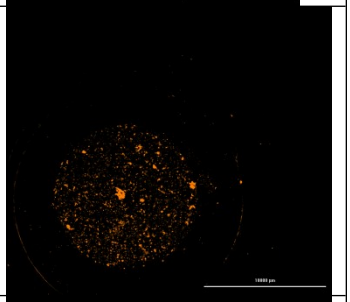
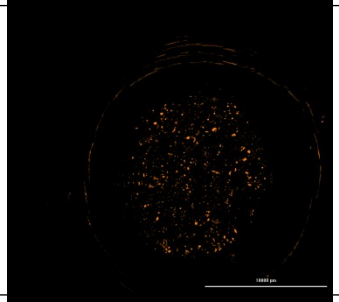
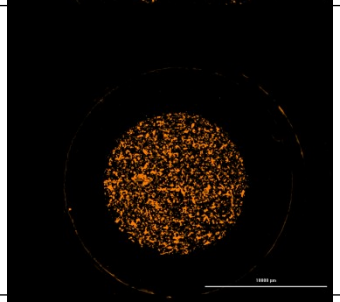
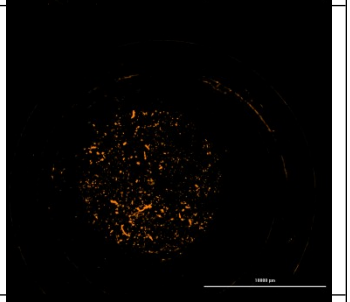
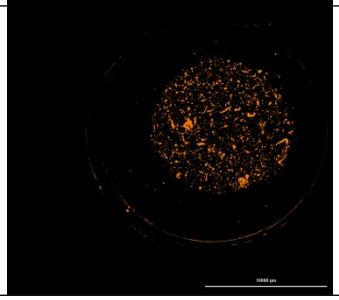
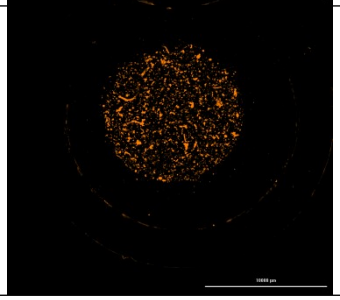
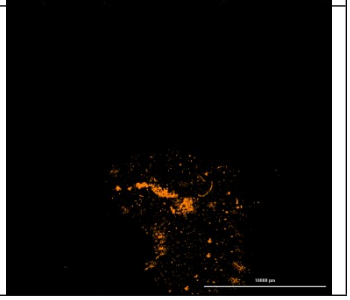
Table S19: FTIR-ATR matches for Applied Biosolids 1 sample

Applied Biosolids 1, Sieving + Digestion + Flotation			Applied Biosolids 1, Elutriation + Digestion + Flotation		
Point	ID	Best Match (%)	Point	ID	Best Match (%)
1	PS 24h 100C	96.18	1	PS 8h 100C	29.54
2	Acrylic	59.31	2	Olefin	48.43
3	Poly(styrene:acrylonitrile:MMA)	25.66	3	PET	41.33
4	Poly(vinyletoluene:butadiene)	27.19	4	Basic lead carbonate	20.34
5	PS, atactic	27.99	5	Basic lead carbonate	30.31
6	Alkyl resin	31.38	6	PP 8h 200C	16.47
7	Poly(styrene:acrylonitrile:MMA)	35.07	7	Poly(styrene:vinyldiene chloride)	47.07
8	PE, pristine	88.21	8	Poly(methacrylate) w/OH groups	56.48
9	Styrene derived plasticizer	28.93	9	PP 1h 300C	26.85
10	PE, aged	84.81	10	PVC	71.27
11	Dicapryl phthalate	63.62	11	PVC	69.85
12	PE, aged	69.7	12	PVC	72.33
13	PS 24h 100C	98.33	13	PVC	72.27
14	Rayon 24h 200C	73.53	14	PET 1h 100C	93.88
15	Rayon 24h 200C	68.61	15	Zinc salt	47.36
16	Olefin	67.08	16	Poly(ethylacrylate:st:acrylamide)	69.84
17	EVOH	33.77	17	PS, atactic	29.26
18	ABS/Polycarbonate	60.51	18	PET 1h 300C	66.94
19	PFOS	25.36	19	Zinc stearate	78.26
20	Rayon 24h 200C	68.84	20	Poly(ethylacrylate:st:acrylamide)	56.73
21	PE, Aged	86.94	21	PET 24h 100C	19.65
22	ABS/Polycarbonate	72.55	22	Poly(styrene:vinyldiene chloride)	32.31
23	Nylon	68.53	23	Rayon	50.45
24	Rayon 24h 200C	39.46	24		
25	Rayon 24h 200C	40.54	25	PVC	38.95
26	Endothermic foaming agent	19.05	26	Poly(vinyl acetate:ethylene) 4:1	81.25
27	Poly(ethylacrylate:st:acrylamide)	67.1	27	PE 1h 100C	85.45
28	PET 24h 100C	63.27	28	PS 1h 100C	29.13
29	HDPE 24h 200C	29.24	29	PE 1 300C	39.67
30	PET	34.16	30	PET 1h 100C	82.22

Table S20: FTIR-ATR matches for Applied Biosolids 2 sample

Applied Biosolids 2, Sieving + Digestion + Flotation			Applied Biosolids 2, Elutriation + Digestion + Flotation		
Point	ID	Best Match (%)	Point	ID	Best Match (%)
1	Epoxy resin	81.64	1	LLDPE 1h 200C	78.79
2	Poly(ethylene:propylene:diene)	69.07	2	Rayon	33.32
3	PE 1h 100C	89.09	3	Rayon	54.67
4	PET 1h 200C	76.93	4	Rayon 24h 200C	73.35
5	PET	55.51	5	Olefin	73.21
6	Poly(styrene:acrylonitrile:MMA)	71.53	6	PS 24h 100C	97.73
7	PS 1h 200C	35.37	7	PVC	85.41
8	Rayon 24h 200C	52.96	8	LDPE 8h 100C	84.92
9	PE, pristine	79.33	9	PE 1h 100C	93.16
10	PET 1h 100C	97.25	10	PE 24h 200C	61.07
11	PVC	52.42	11	LDPE 8h 200C	77.24
12	Poly(ethylacrylate:acrylamide)	54.62	12	Rayon 1h 300C	39.28
13	5-phenyltetrazole calcium salt	20.28	13	Alumina silicate	59.7
14	Rayon	31.44	14	LDPE 8h 100C	89.6
15	PET	30.29	15	ABS/PVC blend	79.28
16	5-phenyltetrazole calcium salt	21.96	16	PE, pristine	96.06
17	Poly(styrene:4-vinylpyridine)	43.87	17	LDPE 8h 200C	73.02
18	Poly(ethylacrylate:st:acrylamide)	43.68	18	Olefin	82.35
19	Rayon 24h 200C	64.18	19	PP 1h 200C	86.92
20	Rayon 24h 200C	41.3	20	Poly(vinyl acetate:ethylene) 4:1	90.89
21	Basic lead carbonate	56.02	21	LLDPE 8h 100C	83.92
22	Olefin	33.66	22	ABS/polycarbonate	74.28
23	PS 1h 200C	43.91	23	Rayon 24h 200C	67.74
24	PET 24h 100C	21.45	24	Rayon 8h 200C	50.8
25	PET	51.72	25	ABS/polycarbonate	73.76
26	Poly(vinyltoluene:butadiene)	36.69	26	Poly(styrene:vinyldiene chloride)	25.13
27	Acrylonitrile butadiene styrene terpolymer	22.69	27	PS, pristine	20.94
28	Poly(styrene:vinyldiene chloride)	43.03	28	PS 8h 100C	35.08
29	PET	61.53	29	PET	59
30	Poly(styrene:vinyldiene chloride)	39.85	30	PS 8h 100C	32.58

Table S21: Fluorescent images, Sieving

Sample	Trial 1	Trial 2	Trial 3
Control			
Arkansas River 2			
Arkansas River 1			
Boomer Creek			
Applied Biosolids 1			

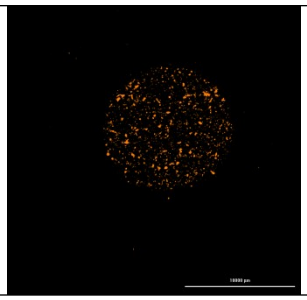
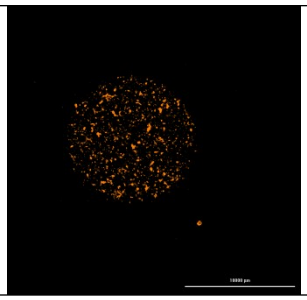
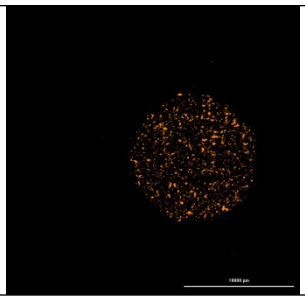
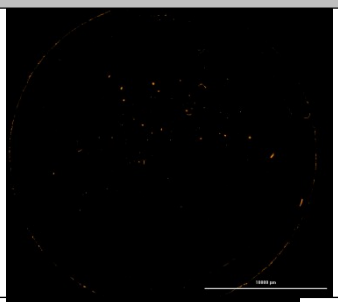
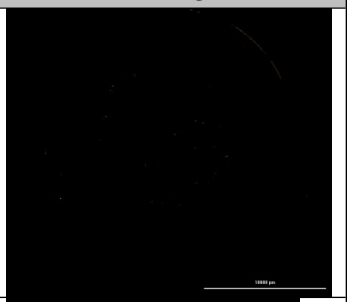
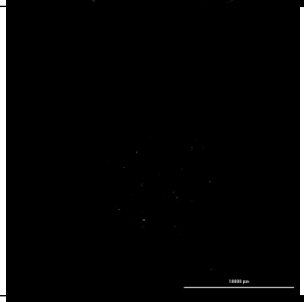
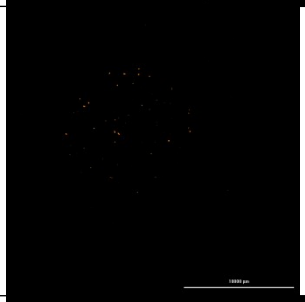
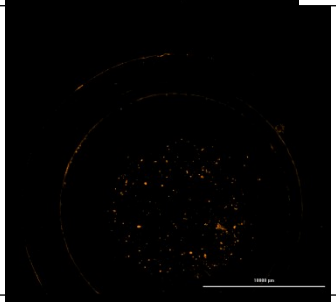
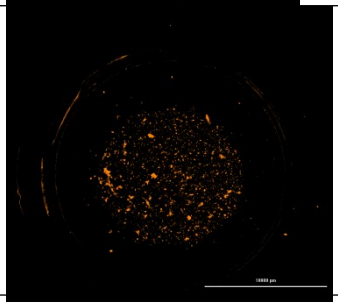
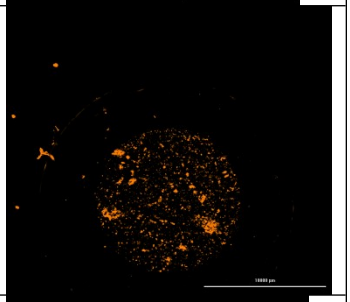
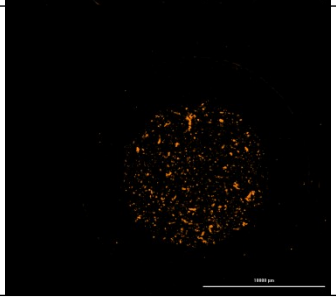
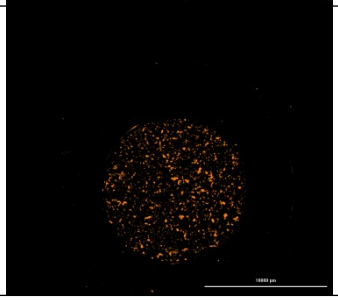
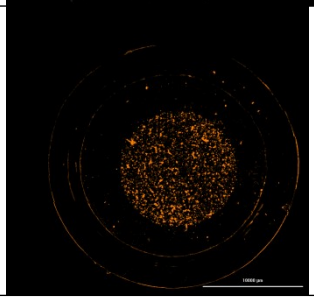
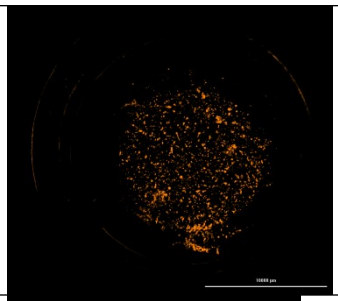
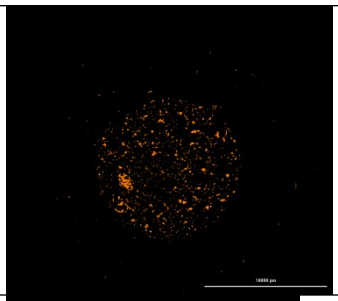
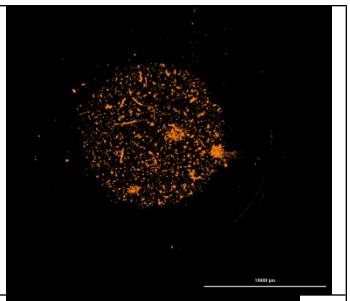
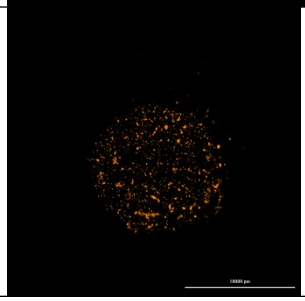
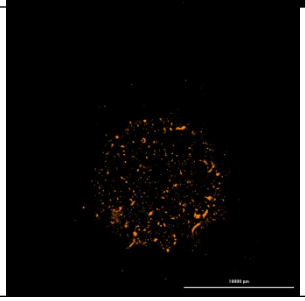
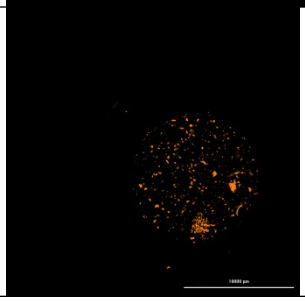
Applied Biosolids 2			

Table S22: Fluorescent images, Elutriation

Sample	Trial 1	Trial 2	Trial 3
Control			
Arkansas River 2			
Arkansas River 1			
Boomer Creek			

Applied Biosolids 1			
Applied Biosolids 2			

Supporting Figures

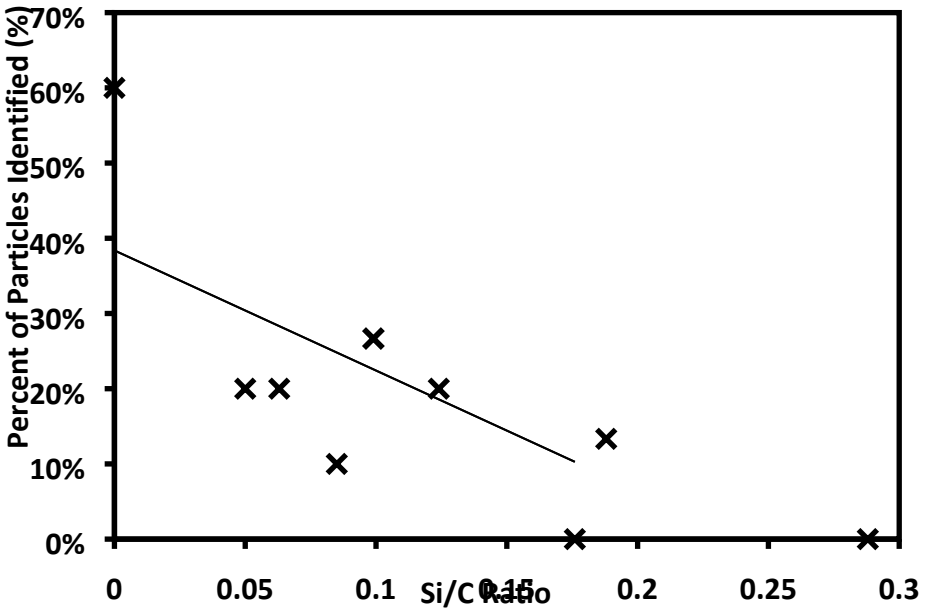


Fig. S1: Plot of percentage of identified particles (positive identifications of $R^2 > 70\%$ divided by total particles tested) for all samples (n=10).

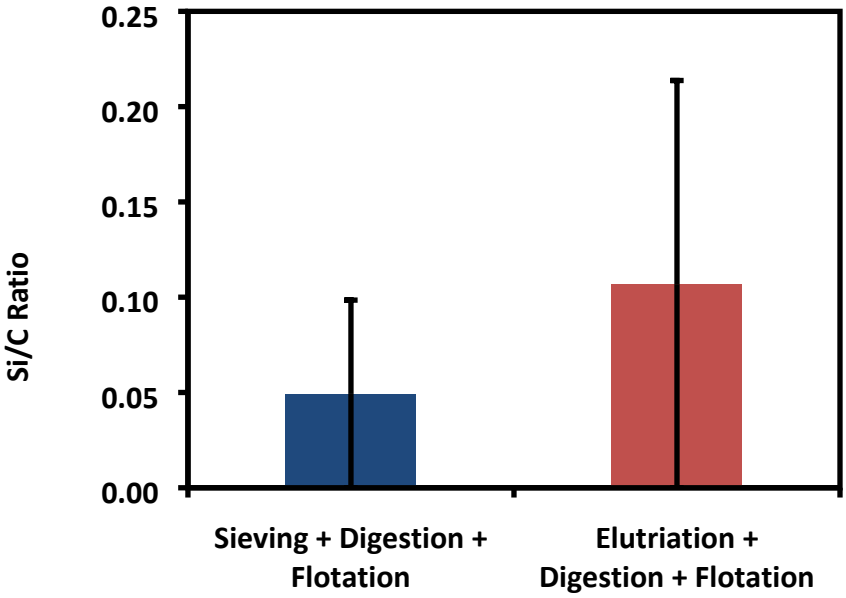


Fig. S2: Silicon to carbon ratio (%Si / %C) averaged across all soil samples for each method. Error bars denote ±1 standard deviation.