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SUPPLEMENTARY INFORMATION

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Hyperdiverse archaea near life limits at the polyextreme geothermal Dallol area

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Supplementary Information

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This PDF file includes:

Supplementary Tables 1 to 4.
Supplementary Figures 1 and 2.

Other Supplementary Materials for this manuscript include the following:

Supplementary Table 5 (excel file) | Identification, phylogenetic affinity and relative abundance of prokaryotic OTUs.

Supplementary Table 6 (excel file) | Identification, phylogenetic affinity and relative abundance of eukaryotic OTUs from Dallol area samples.

Supplementary Data 1 | Full tree of archaeal 16S rRNA gene sequences in Newick format.

Supplementary Data 2 | Full tree of bacterial 16S rRNA gene sequences in Newick format.

Supplementary Table 1. Chemical composition of samples from the multi-extreme area of Dallol. For details about chemical analyses, see Methods. Data about organic compounds and identified in Dallol samples are listed in Supplementary Table 2.

Liquid samples

Element	Concentration (mg/l)																												
	DAL4.00	**DAL4.0**	**DAL4A**	**DAL4D**	**DAL6A**	**DAL9A**	**DAL9C**	**7DAL4-W1**	**7DAL4-W2**	**7DAL7**	**7DAL7-N1**	**7DAL7-N2**	**7DAL9**	**7DAL10**	**7DAL12**	**7DAL13-W1**	**7DAL14**	**BL**	**7BL-W1**	**7BL-W2**	**YL1**	**YL1-2 (YL2)**	**7YL-W1**	**7YL-W2**	**7YL-W3**	**PS3**	**7Gt**	**8GT**	**8Ass**
Cl	105190	111510	22610	99430	126750	123950	136920	170680	144790	201890	192280	179610	149770	170150	191470	161980	172310	194550	208200	220160	285390	373800	283480	255200	325980	149280	146110	230449	248886
Na	93210.36	105537.04	85029.17	81641.76	107204.75	95246.84	114638.67	39699.19	54954.80	51558.63	56742.29	59563.51	64186.60	69668.23	87876.56	85356.59	61908.40	1764.03	1541.54	1607.32	2616.01	2375.56	1441.97	5149.17	1652.79	93924.71	89081.01	144416.34	112833.19
Ca	2263.99	2867.06	2788.01	3388.86	1055.45	2390.61	3059.76	7937.79	6169.13	4301.43	4767.66	3892.18	6084.12	3774.66	1158.84	6123.51	6707.38	13436.28	8071.31	8306.92	163132.50	192095.04	175942.77	111085.94	162942.51	20316.50	6929.85	4037.16	23148.69
Mg	3764.86	4550.75	4387.41	6127.92	4538.48	6269.98	6268.84	9790.36	6348.22	6440.81	7206.49	5872.36	4249.59	3099.97	3131.56	2123.95	5260.42	145295.05	108652.70	112683.58	53922.80	60599.66	41427.89	37276.85	42199.86	10953.71	1914.20	1778.91	4148.39
Fe	26445.16	33578.06	32990.09	44030.37	32940.60	41621.88	40293.36	46182.85	29064.79	45206.84	47342.72	39815.45	23675.95	23107.07	26107.32	5337.40	24115.73	2719.04	1505.35	1488.73	91.65	74.52	81.98	418.42	324.10	0.00	2.18		0.09
K	9047.00	17096.11	16445.10	22355.01	16684.14	22301.91	21746.24	28073.69	17451.30	23683.71	24945.93	21539.29	13469.45	12000.32	12859.23	4421.73	14975.34	820.22	2323.18	2213.50	6186.46	4735.97	3834.52	24950.94	4617.63	7047.53	4737.88	2729.60	4759.99
S	2027	2077	2529	2984	3479	3111	3070	1836	2306	1240	1180	881	1560	1112	1840	2340	1543	1648	ND	ND	2427	3092	660	410	450	1384	351		
Mn	673.24	853.16	847.55	1141.84	858.47	1121.10	1129.63	1551.99	1023.92	1281.68	1343.48	1169.53	773.03	696.02	691.42	283.56	860.66	393.63	206.67	208.93	381.84	442.58	362.36	251.53	385.35	89.69	1.54	1.61	5.11
Sr	68.06	85.09	84.34	108.12	41.38	72.39	81.61	188.87	124.26	104.78	117.33	98.58	122.28	93.31	40.41	77.33	118.49	331.62	186.03	186.68	3042.29	3462.02	2885.69	2032.27	2747.67	439.81	159.94	98.52	372.42
B	353.15	456.40	457.15	608.86	369.37	470.06	504.49	899.60	591.48	529.14	607.12	486.72	491.64	379.03	297.55	233.89	547.38	146.22	125.20	98.88	190.02	215.02	179.76	148.99	187.95	47.31	28.48	14.79	48.57
Al	280.02	355.55	357.62	460.10	190.25	356.38	387.96	1113.20	722.04	544.99	614.45	516.50	689.24	354.23	132.78	297.94	641.44	0.71	0.00	0.00	0.72	0.89	0.00	0.00	0.00	1.32	0.00	0.03	
V	21.71	26.94	27.36	37.71	27.23	35.55	35.95	45.56	28.15	46.14	47.10	40.62	25.00	20.86	21.93	6.08	25.82	0.15	0.10	0.08	0.05	0.06	0.03	0.02	0.05	0.01	0.02	0.05	0.08
Si	30.58	28.07	14.89	20.88	21.31	23.81	30.95	23.55	13.79	21.22	23.17	17.47	24.29	12.20	23.16	28.98	25.02	13.85	4.30	2.31	5.65	8.46	9.62	0.00	8.15	9.30	10.87	3.00	11.12
P	16.50	27.10	29.26	33.31	14.99	14.65	14.31	52.04	23.41	56.09	40.18	28.93	14.28	26.25	24.02	4.07	11.22	0.00	3.01	2.05	0.00	0.00	2.45	0.76	1.11	0.00	1.56	6.88	7.81
Li	10.92	14.88	15.07	21.52	14.54	18.62	18.99	23.61	15.08	19.26	22.51	16.66	10.42	10.24	12.84	4.10	11.66	15.81	6.93	8.24	29.13	33.94	23.99	15.18	20.27	3.53	4.02	3.23	4.67
Cu	31.27	24.94	7.53	17.89	15.90	19.80	33.21	50.64	28.91	41.85	30.21	31.27	42.91	19.86	11.51	2.63	51.25	0.88	0.00	0.00	1.05	2.72	0.65	0.00	0.01	4.54	0.00	0.02	0.00
Zn	52.21	68.71	67.28	91.20	60.50	82.24	87.23	140.51	86.32	105.22	105.98	88.93	77.46	57.62	49.60	35.56	79.77	33.77	22.67	21.01	14.07	13.73	14.90	14.19	14.77	6.47	10.94	9.14	4.15
Kr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.82	0.00	17.09	13.01	0.00	19.95	19.58	0.00	20.09	4.39	0.00	17.17	0.00	19.20	0.00	0.00	27.20	0.00	0.00		
Rb	14.74	17.33	16.36	22.00	15.57	21.92	22.42	42.29	26.14	30.13	30.78	27.10	19.45	15.43	13.56	8.33	21.92	0.29	1.64	1.66	6.24	3.85	3.40	20.05	2.54	5.93	6.16	3.32	6.97
Ba	5.84	5.88	3.27	5.05	2.61	2.77	7.55	3.00	3.05	6.77	9.71	7.26	11.94	4.49	3.25	6.33	12.64	35.36	25.23	26.06	26.46	31.44	26.46	17.01	24.50	7.67	0.82	0.61	2.71
Tl	1.73	1.46	1.86	2.41	0.76	1.05	1.37	6.17	4.43	1.93	1.43	1.24	2.13	1.39	0.46	2.87	1.89	0.00	1.46	0.86	0.00	0.00	39.93	0.00	0.00	0.00	0.83	1.71	8.48
Au	3.90	34.93	12.83	7.89	4.56	3.01	2.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.29	0.00	0.00	3.62	2.59	0.00	0.00	0.00	0.00	0.00		
Ni	0.10	10.48	0.20	11.60	0.02	11.14	12.20	0.53	0.34	0.35	0.51	0.39	11.29	10.95	0.00	2.46	0.33	0.84	0.00	0.00	0.18	0.14	0.07	0.00	0.04	0.09	0.00	0.03	0.08
Cr	0.92	1.19	1.14	1.37	0.69	1.12	1.37	3.05	1.98	1.77	1.84	1.62	1.78	1.11	0.69	0.68	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.03	0.02
Se	0.00	0.44	0.00	1.30	0.07	0.73	0.11	0.20	1.66	0.02	0.68	0.20	0.41	0.00	0.33	0.21	1.45	0.43	1.97	3.96	3.00	1.66	0.00	0.20	0.26	2.49	0.01		
Co	0.60	0.73	0.77	1.15	0.19	0.90	1.00	1.89	1.22	2.08	2.51	2.13	0.93	0.50	0.06	0.36	1.37	0.00	0.01	0.01	0.06	0.07	0.05	0.02	0.06	0.32	0.02	0.01	0.01
Sn	0.90	0.80	0.31	0.51	0.47	0.44	0.69	0.84	0.48	0.61	0.51	0.46	0.63	0.48	0.37	0.04	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Ga	0.34	0.57	0.43	0.61	0.34	0.43	0.55	1.13	0.64	0.61	0.75	0.69	0.21	0.05	0.32	0.24	0.41	0.00	0.02	0.00	0.01	0.02	0.01	0.00	0.03	0.00	0.00		
Pb	0.07	0.21	0.17	0.00	0.46	0.29	0.33	0.01	0.00	0.00	0.33	1.15	0.06	0.31	1.33	0.64	0.00	0.97	0.50	0.51	0.10	0.11	0.00	0.13	0.03	0.00	0.00	0.20	0.20
As	0.20	0.15	0.08	0.15	0.28	0.15	0.07	1.84	0.86	0.83	0.42	0.51	0.49	0.38	0.75	0.04	0.21	0.02	0.05	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00		
Cs	0.26	0.31	0.32	0.42	0.28	0.39	0.41	0.82	0.53	0.53	0.56	0.46	0.37	0.27	0.23	0.18	0.40	0.06	0.07	0.08	0.07	0.06	0.06	0.16	0.07	0.02	0.01		0.03
U	0.25	0.34	0.33	0.46	0.34	0.38	0.38	0.65	0.39	0.58	0.57	0.52	0.58	0.37	0.36	0.12	0.41	0.00	0.00	0.00	0.01	0.01	0.07	0.03	0.02	0.00	0.01	0.03	0.04
Ce	0.34	0.42	0.39	0.41	0.10	0.24	0.34	0.77	0.59	0.36	0.30	0.25	0.53	0.45	0.09	0.45	0.69	0.02	0.02	0.02	0.08	0.10	0.05	0.02	0.06	0.04	0.00		
La	0.35	0.45	0.39	0.48	0.12	0.26	0.39	0.75	0.53	0.40	0.37	0.31	0.51	0.47	0.11	0.29	0.63	0.02	0.02	0.01	0.05	0.06	0.05	0.01	0.03	0.03	0.00		
Xe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.28	0.00	0.00	1.56	1.49	0.00		
Sc	0.04	0.16	0.20	0.22	0.04	0.13	0.13	0.76	0.47	0.19	0.19	0.11	0.43	0.23	0.13	0.16	0.25	0.00	0.00	0.00	0.03	0.01	0.04	0.01	0.02	0.00	0.01		
Th	0.01	0.56	0.23	0.17	0.07	0.08	0.06	0.11	0.10	0.20	0.00	0.01	0.58	0.16	0.00	0.00	0.26	0.01	0.00	0.00	0.01	0.01	0.17	0.00	0.00	0.00	0.00	0.03	0.04
Mo	0.11	0.03	0.01	0.03	0.00	0.00	0.00	0.37	0.28	0.32	0.28	0.28	0.15	0.07	0.03	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.04	0.06	0.13
Sb	0.18	0.12	0.02	0.07	0.06	0.07	0.09	0.36	0.21	0.08	0.06	0.09	0.21	0.11	0.08	0.04	0.28	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00		
Tl	0.06	0.08	0.09	0.11	0.07	0.10	0.10	0.17	0.11	0.10	0.12	0.09	0.10	0.06	0.04	0.05	0.10	0.06	0.00	0.00	0.08	0.08	0.00	0.00	0.00	0.06	0.03		
Be	0.07	0.06	0.07	0.11	0.10	0.06	0.09	0.09	0.13	0.10	0.07	0.04	0.13	0.02	0.02	0.04	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

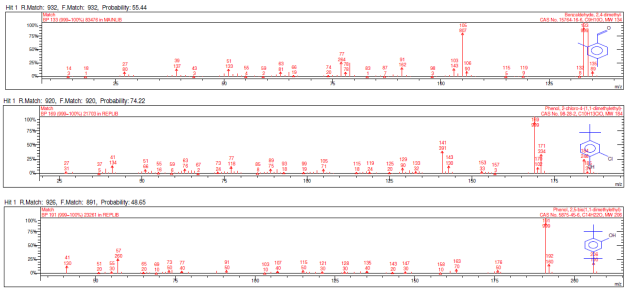
Solid samples

Crystalline phases	Scores			
	7DAL5	**7DAL7-S**	**7YL-S3**	**7YL-w2cryst**
NaCl	44	63	35	
$CaPO_3$ (OH). $2H_2O$	8			
NaAl (CO_3) $(OH)_2$	0			
CaPO3 (OH) 2H2O		41		
$KMgCl_3$. $6H_2O$			60	54
FeS			23	
$MgFe_2O_4$			20	
$Na(NO_3)$			13	
TiO_2			34	
Fe_2Si				25
Ca_3Mg Cr_2 (SiO_4)				18
FeSe				21

Supplementary Table 2 | Organic chromatography analysis of samples from the Dallol dome and surrounding area. Examples of chromatograms obtained are shown on the right.

Sample name	Retention time	Compound	F. Match	Probability	Archive
DAL 4,0	11.086	Benzaldehyde, 2,4-dimethyl-	932	55.44	00981-DAL MS-4.0 11,086min-libreria
	12.06	Phenol.2-chiloro-4-(1,1-dimethylethyl)-	920	74.22	00981-DAL MS-4.0 12,060min-libreria
	13.67	Phenol.2.5-bis(1,1-dimethylethyl)-	891	48.65	00981-DAL MS-4.0 13,677min-libreria
YL-3	10.77	Naphthalene	940	66.36	00981-YL 3 MS-10.77min-libreria
	11.95	Benzocycloheptatriene	934	24.95	00981-YL 3 MS-11.949min-libreria
	12.72	Naphthalene. 2-ethenyl-	948	70.05	00981-YL 3 MS-12.72min-libreria
	12.86	Naphthalene. 1-ethyl-	854	40.94	00981-YL 3 MS-12.86min-libreria
	12.96	Naphthalene. 1,3-dimethyl-	955	19.11	00981-YL 3 MS-12.96min-libreria
	12.100	Benzocycloheptatriene	925	29.71	00981-YL 3 MS-12.100min-libreria
	13.09	Naphthalene. 1,3-dimethyl-	954	24.42	00981-YL 3 MS-13.09min-libreria
	13.36	1,1´Biphenyl, 3-methyl-	894	27.46	00981-YL 3 MS-13.63min-libreria
	14.51	Fluorene	813	66.9	00981-YL 3 MS-14.51min-libreria
BL	13.65	Phenol.2.4-bis(1,1-dimethylethyl)-	925	63.77	00981-BL filtrada 13.65min-libreria
7YL-w3/s	9.87	p-Cresol	667	19.90	01143-7YL-w3-MS-9,87min-libreria
		Phenol. 2-methyl-	666	19.13	
	10.45	Nonanal	825	37.28	01143-7YL-w3-MS-10,45min-libreria
	11.54	Azulene	914	38.22	01143-7YL-w3-MS-11,54min-libreria
		Naphthalene	913	36.73	
	12.56	Tridecane	650	8.88	01143-7YL-w3-MS-12,56min-libreria
	12.66	Naphthalene. 1-metyil-	907	31.85	01143-7YL-w3-MS-12,66min-libreria
		Naphthalene. 2-methyl-	900	24.39	
	12.82	1H-Indene. 1-ethylidene-	892	50.86	01143-7YL-w3-MS-12,82min-libreria
		Naphthalene. 2-methyl-	870	20.10	
	13.44	Biphenyl	913	63.64	01143-7YL-w3-MS-13,44min-libreria
	13.50	Heptadecane. 2,6,10,14-tetramethyl	763	5.05	01143-7YL-w3-MS-13,50min-libreria
		Tetradecane	762	4.86	
	13.70	Naphthalene. 1.5-dimethyl-	849	13.77	01143-7YL-w3-MS-13,70min-libreria
		Naphthalene. 1.3-dimethyl-	846	12.17	
	13.82	Naphthalene. 2.6-dimethyl-	896	12.57	01143-7YL-w3-MS-13,82min-libreria
		Naphthalene. 1.7-dimethyl-	895	12.58	
	13.86	Naphthalene. 1.7-dimethyl-	891	13.66	01143-7YL-w3-MS-13,86min-libreria
		Naphthalene. 1.6-dimethyl-	890	13.13	
	14.37	Naphthalene. 1-(2-propenyl)-	563	15.93	01143-7YL-w3-MS-14,37min-libreria
		1,1´-Biphenyl. 4-methyl-	559	13.45	
	14.70	Dibenzofuran	732	72.01	01143-7YL-w3-MS-14,70min-libreria
	15.26	Fluorene	735	55.49	01143-7YL-w3-MS-15,26min-libreria
7YL-w1	3.98	Toluene	931	50.08	01143-7YL-w1blanco-MS-3,98min-libreria
	8.38	Hexane. 1-chloro-	739	55.55	01143-7YL-w1blanco-MS-8,38min-libreria
	9.92	Octane. 1-chloro-	735	33.46	01143-7YL-w1blanco-MS-9,92min-libreria
	14.45	Buthylated Hydroxytoluene	911	76.92	01143-7YL-w1blanco-MS-14,45min-libreria
	15.11	2.2.4-Trimethyl-1.3-pentanediol disobutyrate	898	86.74	01143-7YL-w1blanco-MS-15,11min-libreria
	16.03	2.2.4-Trimethyl-1.3-pentanediol disobutyrate	756	63.35	01143-7YL-w1blanco-MS-16,03min-libreria
7YL-w1 bis	Same as negative control				
7YL-w2	Same as negative control				
7BL-W1	Same as negative control				
7BL-W2	Same as negative control				
7DAL4-W1	Same as negative control				
7DAL4-W2	Same as negative control				
7DAL7	3.96	Toluene	875	54.24	01143-7DA7-MS-3,96min-libreria
	8.77	Cyclotetrasiloxane. Octamethyl-	927	64.75	01143-7DA7-MS-8,77min-libreria
	12.79	Phenol. 2-chloro-6-(1.1-dimethylethyl)-	783	47.27	01143-7DA7-MS-12,79min-libreria
		4-tert-Butyl-chlorophenol	776	36.20	
	13.30	Carbonic acid. (1-R)-(-)-methyl (1R)-(-)-methyl ester	575	8.01	01143-7DA7-MS-13,30min-libreria
	13.35	N-Ethoxy-2-carbomenthyloxaziridine	668	8.80	01143-7DA7-MS-13,35min-libreria
	14.44	2,4-Di-tert-butylpheno	737	28.82	01143-7DA7-MS-14,44min-libreria
7DAL7N1 and	8.77	Cyclotetrasiloxane, octamethyl-	923	63.13	01143-7DA7N-1 y 2 con blanco-MS-8,77min-libreria
		trisiloxane, 1,1,1,5,5,5-hexamethyl-3-[(trimethylsilyl)oxy]-	905	34.46	
	11.95	Acetonitrile,2-(methylimino)	533	17.29	01143-7DA7N-1 y 2 con blanco-MS-11,95min-libreria
	12.09	2-Octenal, 2-butyl-	524	10.18	01143-7DA7N-1 y 2 con blanco-MS-12,09min-libreria
	12.79	Phenol, 2-chloro-6-(1,1-dimethylethyl)-	756	50.87	01143-7DA7N-1 y 2 con blanco-MS-12,79min-libreria
	13.30	Diazoacetic acid, 2-isopropyl-5-methylcyclohexyl ester	663	9.08	01143-7DA7N-1 y 2 con blanco-MS-13,30min-libreria
	13.35	Diazoacetic acid, 2-isopropyl-5-methylcyclohexyl ester	698	8.60	01143-7DA7N-1 y 2 con blanco-MS-13,35min-libreria
	14.44	2,4-Di-tert-butylphenol	814	49.29	01143-7DA7N-1 y 2 con blanco-MS-14,44min-libreria
7DAL9	Same as negative control				
7DAL10	Same as negative control				
7DAL1-2	11.8	Benzaldehyde, 2,5-dimethyl-	882	31.66	01143-7DA12 -MS-11,80min-libreria
7DAL14	3.96	Toluene	924	55.93	01143-7DA14-MS-3,96min-libreria
	9.44	1,3-Pentanediol, 2,2,4-trimethyl-	743	20.18	01143-7DA14-MS-9,44min-libreria
	10.59	Decane, 2,2,3-trimethyl-	672	26.90	01143-7DA14-MS-10,59min-libreria
7Gt	13.05	2,4,4-Trimethyl-3-(3-methylbutyl)cyclohex-2-enone	674	24.86	01143-7Gt - MS- 13,05-libreria
	15.11	2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	899	87.64	01143-7Gt - MS- 15,11-libreria

DAL 4.0



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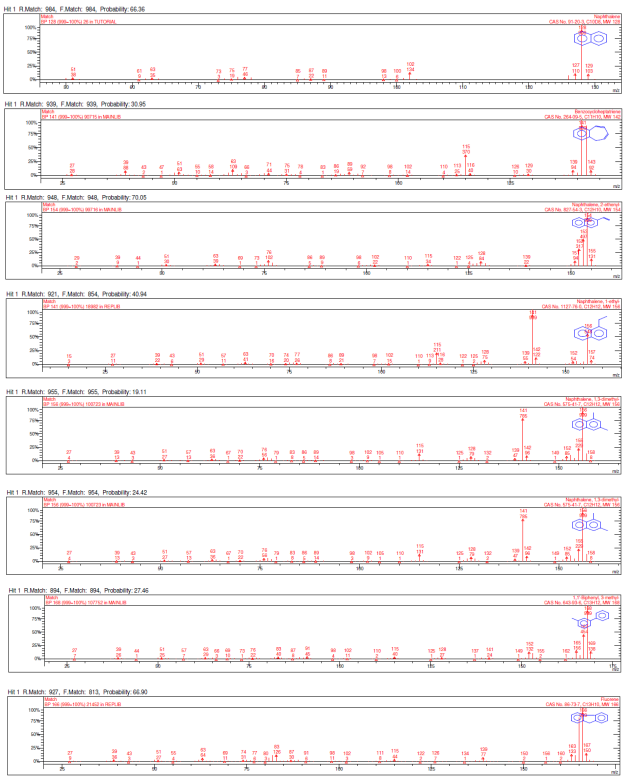

Supplementary Table 3 | Ionic chromatography analysis of samples from the Dallol dome and surrounding area.

Anions				Cations						
Sample	No. replicates	Concentration (mg/l)		Sample	No. replicates	Concentration (mg/l)				
		SO_4^{2-}	Cl^-			Na^+	NH_4^+	K^+	Mg_2^+	Ca_2^+
DAL 4.00	1		39590.46	DAL 4.00	1	80434.52		8644.09	2634.61	2230.54
	2		38625.54		2	80310.19		8635.13	2651.87	2121.88
DAL 4.0	1	6000.98	160650.15	DAL 4.0	1	77123.73	5292.63	10067.27	3045.71	2621.34
	2	8025.28	163804.85		2	77237.93	5237.38	10085.59	3047.92	2668.9
DAL 4A	1		125652.46	DAL 4A	1	61084.58		9025.02	2773.74	2112.02
	2		125026.57		2	60992.65		9029.74	2814.8	2116.38
DAL 4D	1		83507.81	DAL 4D	1	65287.6		13710.25	4431.3	2963.19
	2		83217.31		2	65132.78		13688.87	4431.73	2845.58
DAL 6A	1	41150.03	216467.24	DAL 6A	1	87364.68		10401.45	3072.24	
	2	44643.9	216262.01		2	87434.96		10434.34	3402.22	
DAL 9A	1	20339.49	225756.77	DAL 9A	1	75724.32	2033.28	13440.66	4753.82	2619.49
	2	23550.47	226626.32		2	75783.41	2046.18	13436.01	4745.02	2580.7
DAL 9C	1	49326.17	224100.66	DAL 9C	1	96294.98	2023.41	13731.78	4758	2356.68
	2	49413.8	225851.46		2	96119.49	1918.67	13828.53	4755.68	2396.18
YL 1	1		395384.68	YL 1	1	1886.29		2979.86	30260.73	108142.76
	2		394376.75		2	1758.76		2955.92	30454.4	108594.96
YL 1-2 =(YL 2)	1		494927.66	YL 1-2 =(YL 2)	1	1959.27	1591.76	3185.49	38169.67	139869.91
	2		496940.4		2	1928.74	1541.98	3191.92	38163.71	140007.98
PS 3	1		198309.24	PS 3	1	72361		4772.34	7587.73	16752.29
	2		196633.46		2	72750.2		4807.28	7442.2	16703.57
BL	1		407660.91	BL	1	1603.22			105156.99	21985.6
	2		409362.07		2	1575.24			106004.51	21524.13

Supplementary Table 4. ANOVA analysis carried out for the environmental variables and coordinates of the samples (PC1 and PC2) based on the first 2 principal components.

	Areas (mean± SD)*							
	Dallol	Black Lake	Black Lake area	Yellow Lake	Cave water	Assale (Karum)**	F	p
pH	-0.45±0.22^{a}	3.04±0.66^{b}	3.03±0.54^{b}	1.93±0.44^{c}	6.36±0.16^{d}	6.54	199.14	<0.00
a_w	0.703±0.23^{a}	0.32±0.00^{b}	0.53±0.22^{ab}	0.35±0.11^{b}	0.73±0.00^{a}	0.72	10.97	<0.00
Temperature (°C)	39.25±16.14^{a}	65.30±7.49^{ab}	40.30±0.35^{a}	37.07±3.11^{a}	26.47±4.39^{ac}	21.4	3.59	<0.05
Salinity (% w/v)	40.75±3.85^{a}	76.00±0.00^{b}	48.00±14.05^{a}	56.67±11.55^{ab}	30.00±0.00^{a}	31	12.24	<0.00
TDS+TSS (g/l)	393.43±35.59^{a}	769.02±71.86^{b}	493.72±160.09^{a}	796.67±133.89^{b}	326.19±4.01^{a}	365.6	17.46	<0.00
PC1	-0.424±0.26^{a}	2.025±0.16^{b}	0.158±0.93^{ac}	0.772±0.6^{bc}	-1.201±0.10^{ad}	-1.077	18.95	<0.00
PC2	-1.055±0.28^{a}	0.322±0.10^{b}	0.452±0.12^{b}	0.366±0.11^{b}	1.631±0.14^{c}	1.594	101.51	<0.00

*Different letters indicate significant differences ($p<0.05$) in post-hoc analysis (Bonferroni) between areas.
**Assale sample was not taken into account in the ANOVA because it only included a value.

Supplementary Fig. 1 | Chemical maps obtained from energy dispersive X-ray spectrometry (EDXS) combined to SEM observations of cells and abiotic biomorphs observed in the Dallol area and Lake Assale (Karum). Samples are named as in Extended Data Fig. 3.

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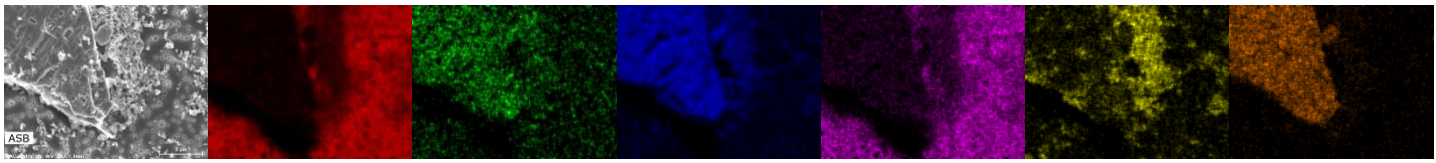

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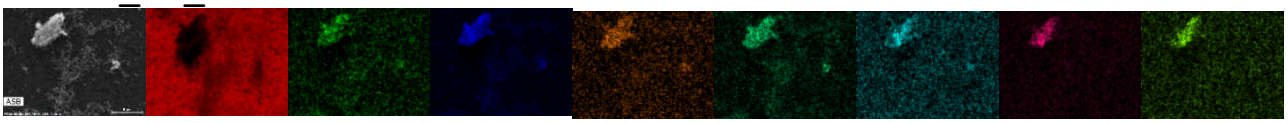

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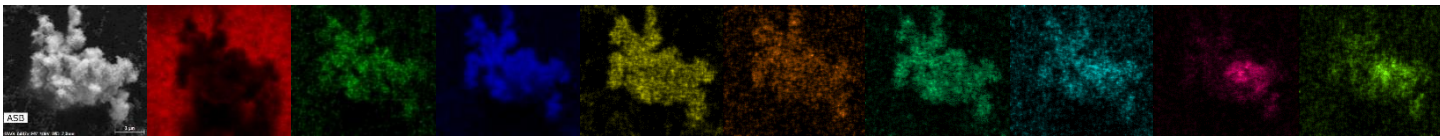

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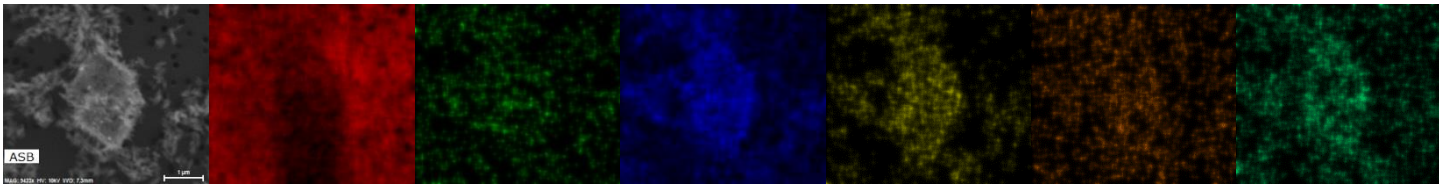

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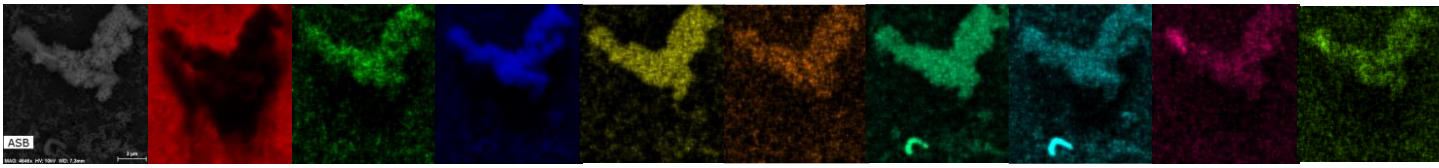

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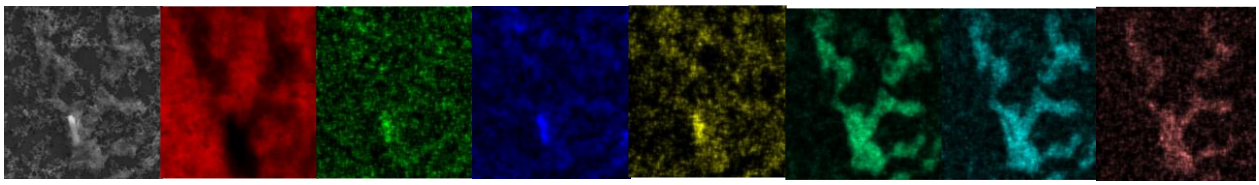

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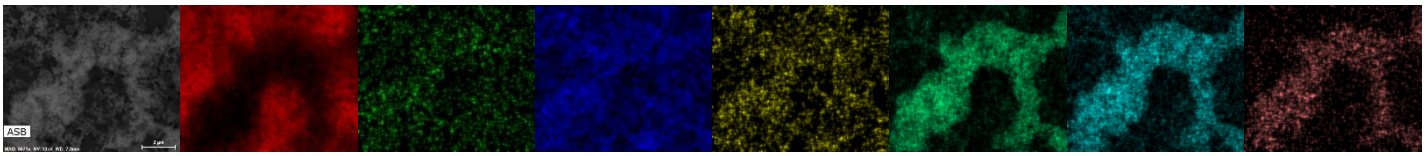
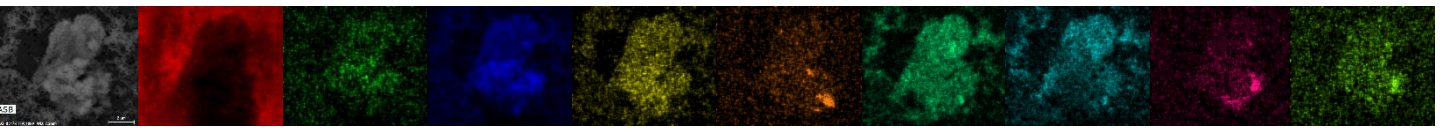


C N O Fe Cl Mg K

BLPS_05_8



C N O Fe S Cl Mg Si Al

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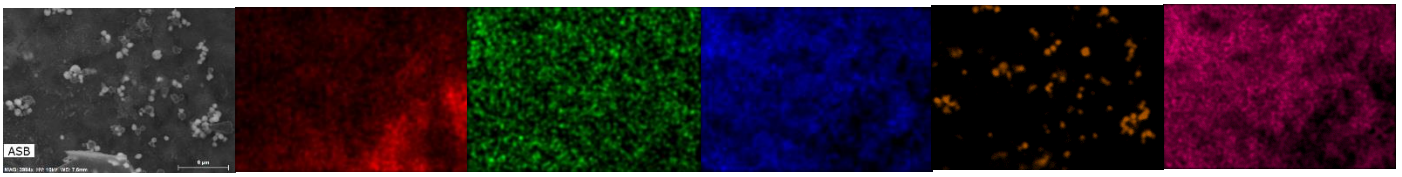

C N O S Si

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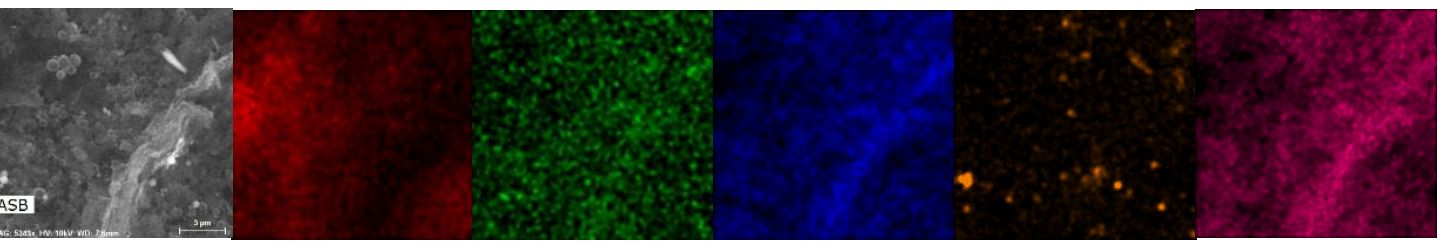

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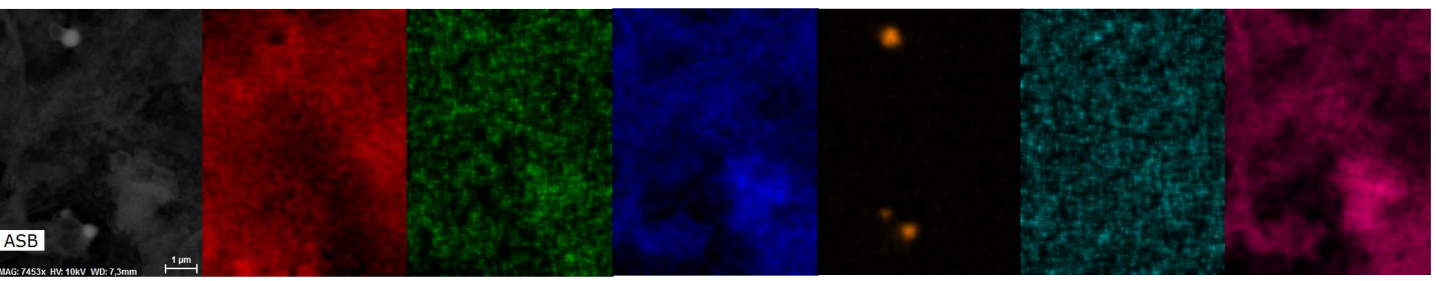

C N O S Mg Si

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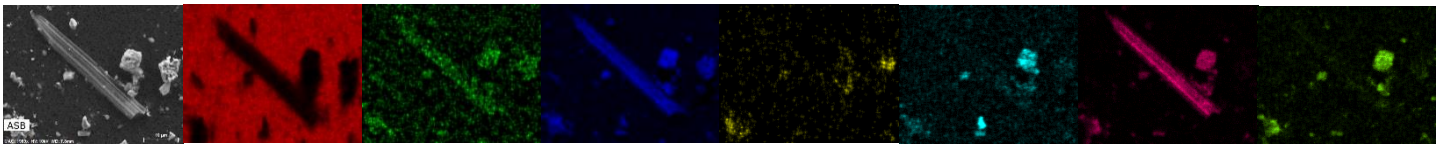

C N O Fe Mg Si

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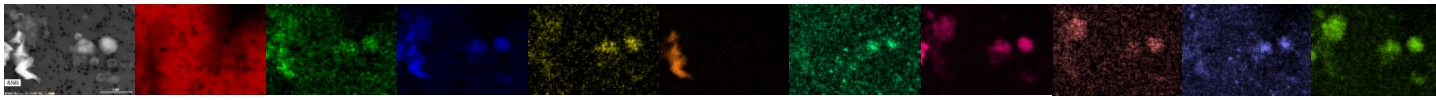
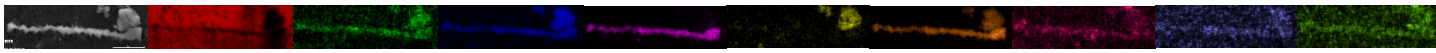
Gt-02



C N O Fe S Cl Si K Na Al

Gt-03



C N O Ca Fe S Si Na Al

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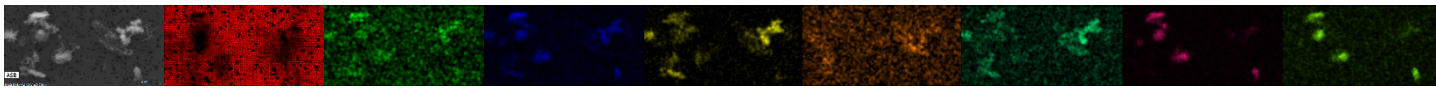

C N O Fe S Cl Si Al

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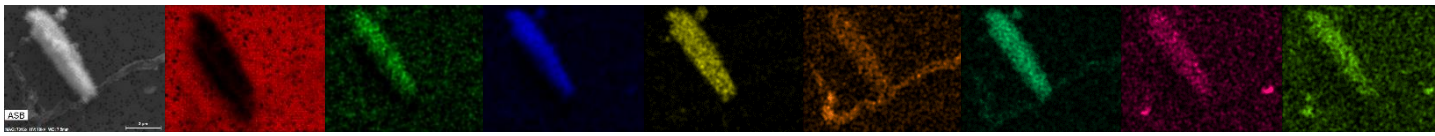

C N O Fe S Cl Si Al

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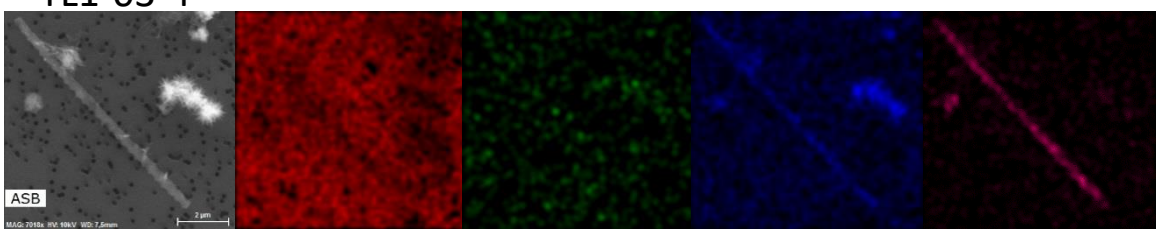

C N O Si

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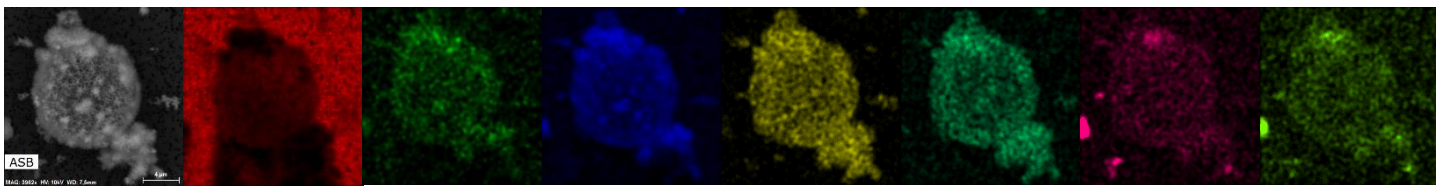

C N O Fe Cl Si Al

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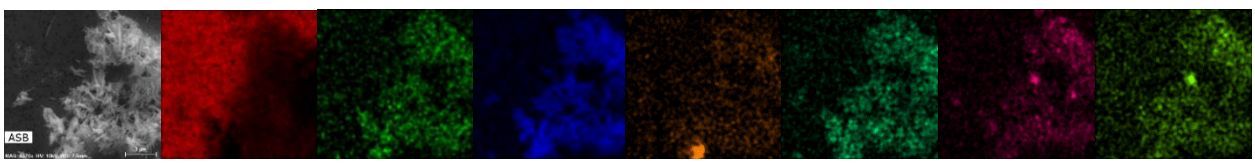

C N O S Cl Si Al

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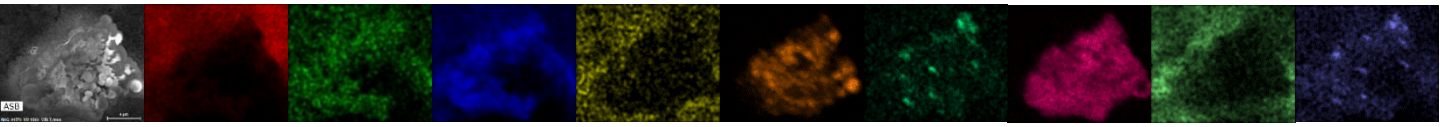
7DA9-P1



C N O Fe S Cl Si P Na

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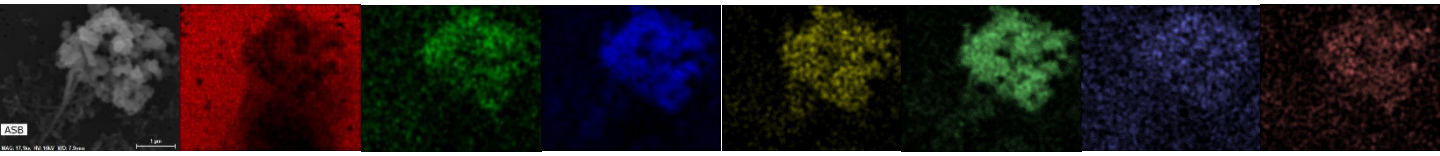

C N O Fe P Na K

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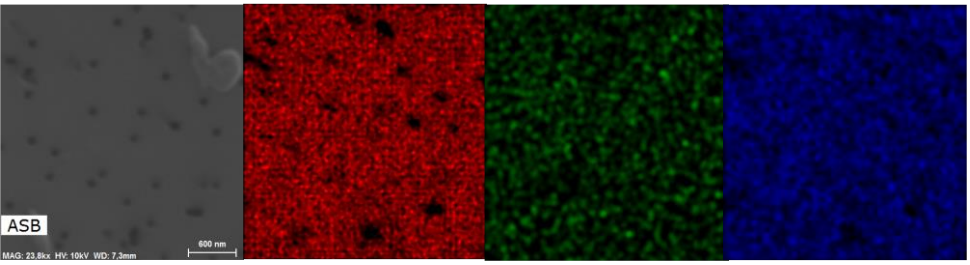
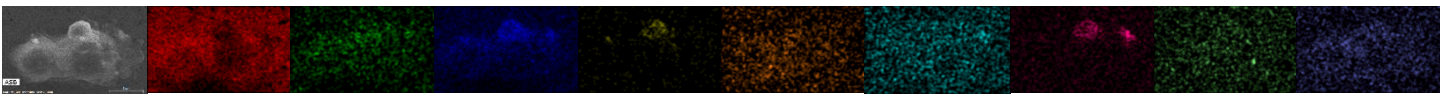


C N O

PS-A-9



C N O Fe S Mg Si P Na

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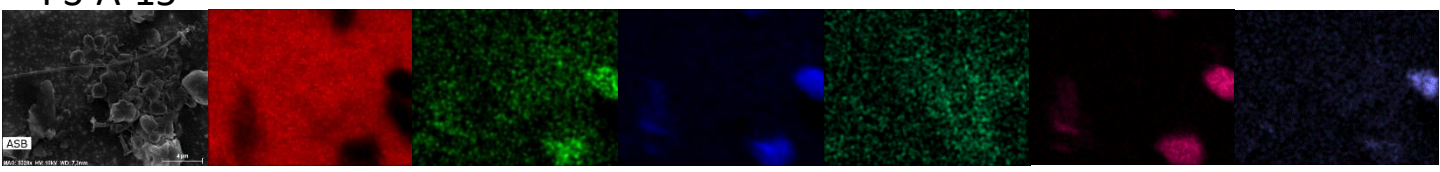
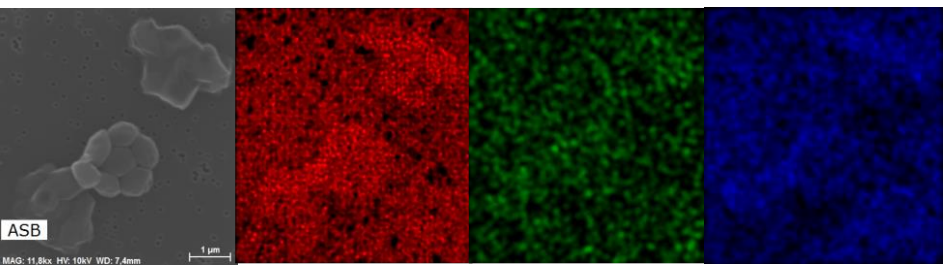


C N O Cl Si Na

PS-B-but-C



C N O

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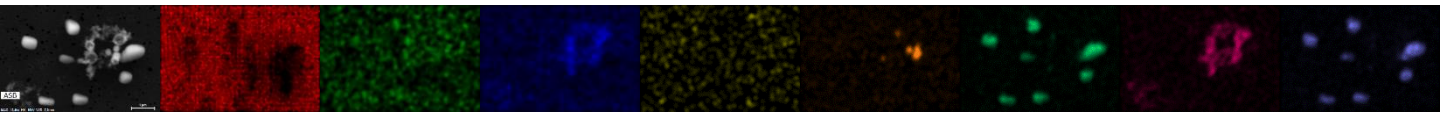

C N O Fe S Cl Si Na

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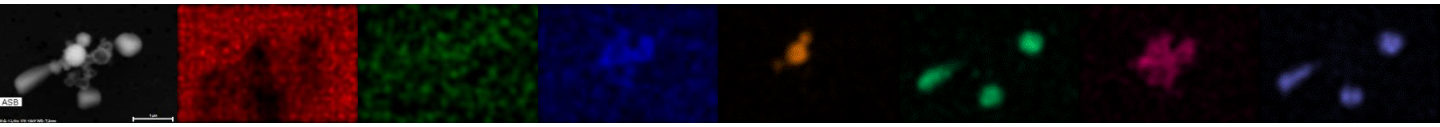

C N O S Cl Si Na

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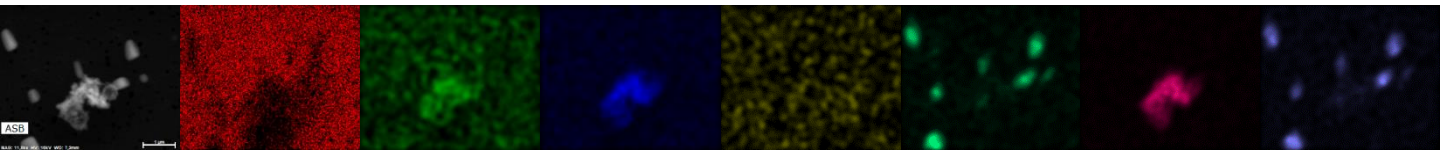

C N O Fe Cl Si Na

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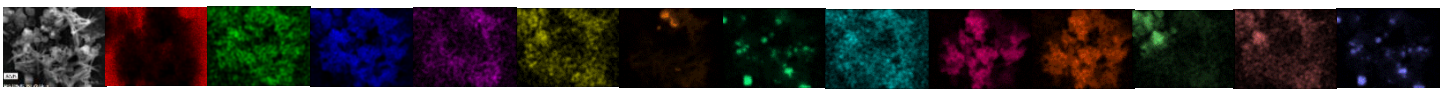

C N O Ca Fe S Cl Mg Si Sr P K Na

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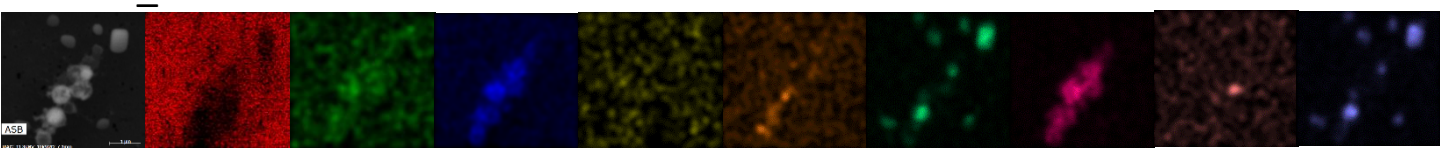

C N O Fe S Cl Si K Na

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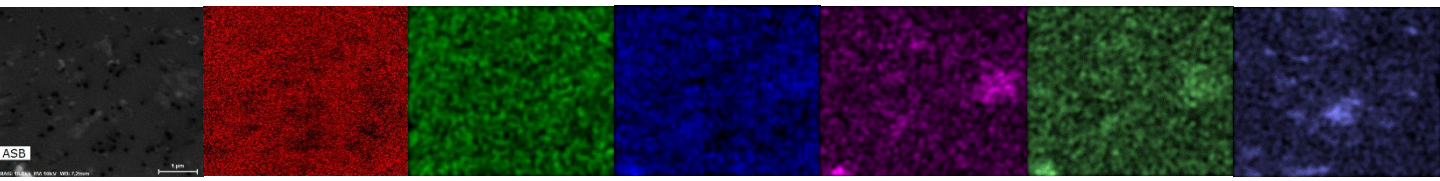

C N O Ca P Na

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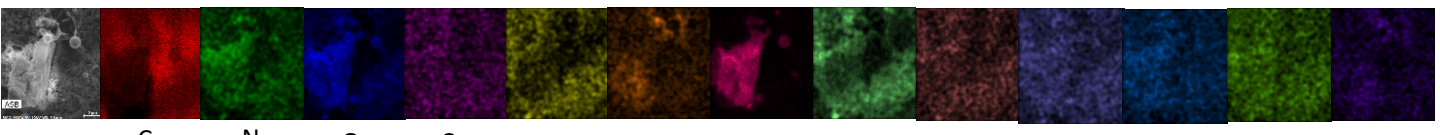

C N O Ca Fe S Si P K Na Cu Al Ba

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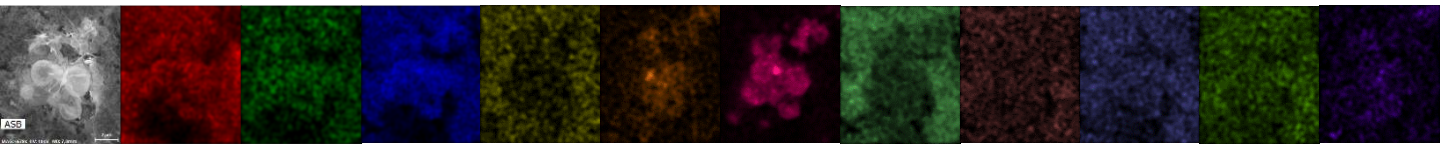
7DA9_P1-5



C N O Fe S Si Cl K Na P Ba

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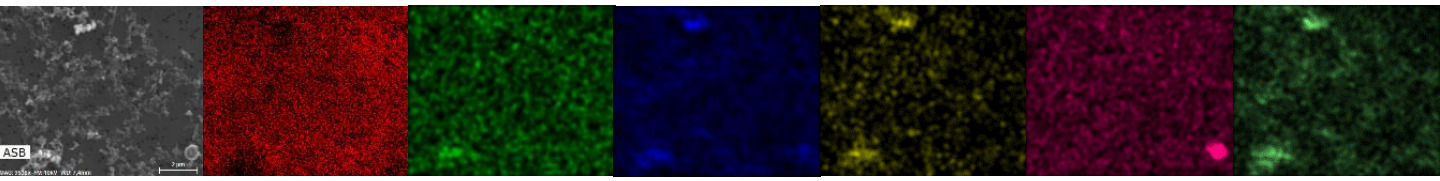

C N O Fe Si P

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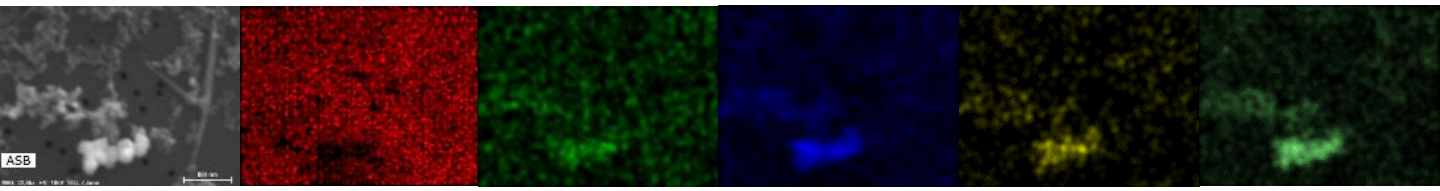

C N O Fe P

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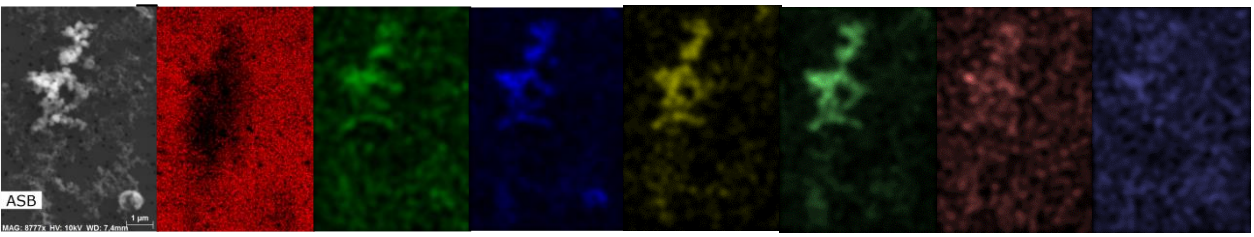

C N O Fe P K Na

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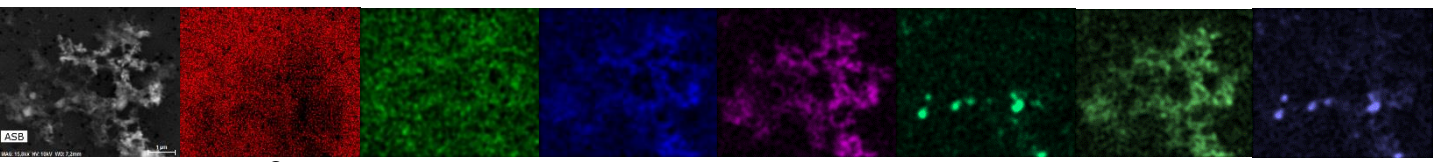
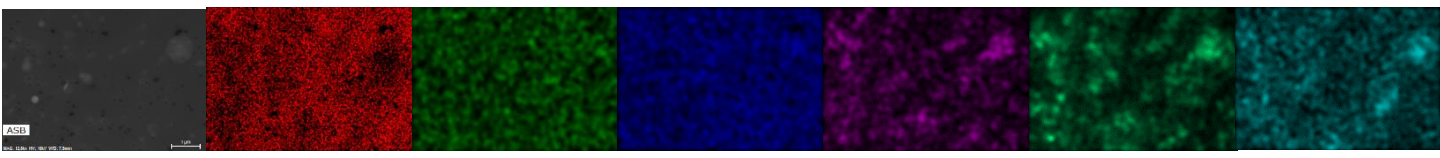


C N O Ca Cl P Na

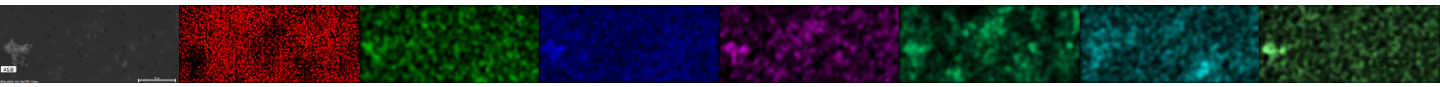
7YL-4



C N O Ca Cl Mg

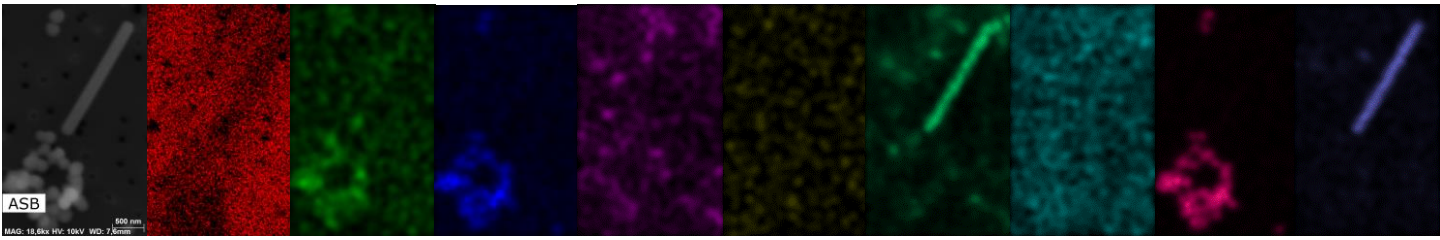
Supplementary Fig.1 _ Belilla et al.

7YL-6



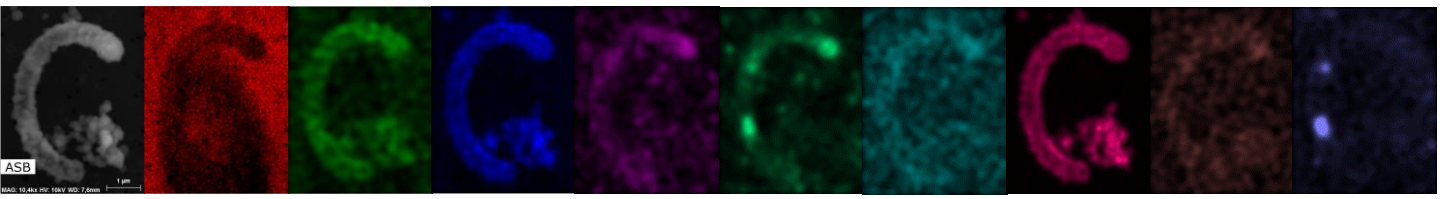
C N O Ca Cl Mg P

8Ass-2



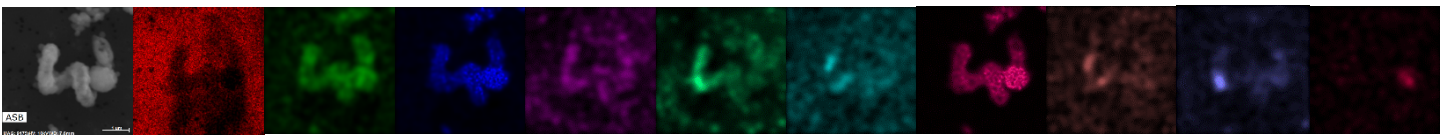
C N O Ca Fe Cl Mg Si Na

8Ass-3



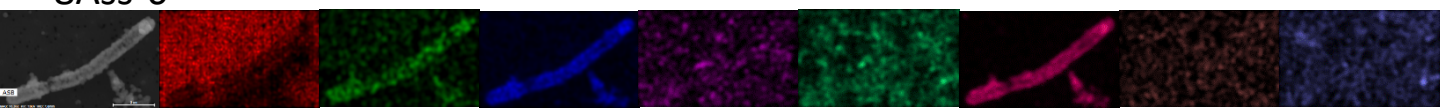
C N O Ca Cl Mg Si K Na

8Ass-4



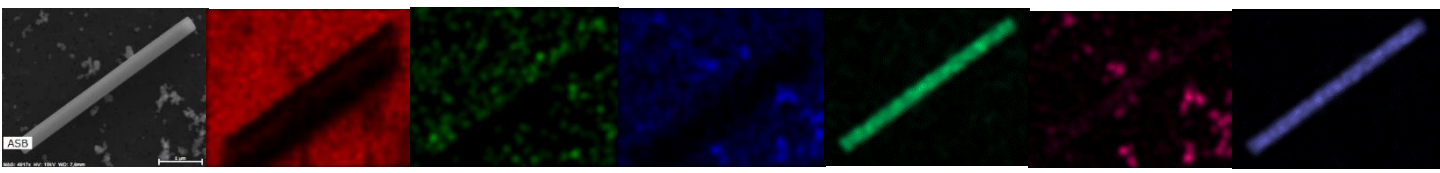
C N O Ca Cl Mg Si K Na Mn

8Ass-6



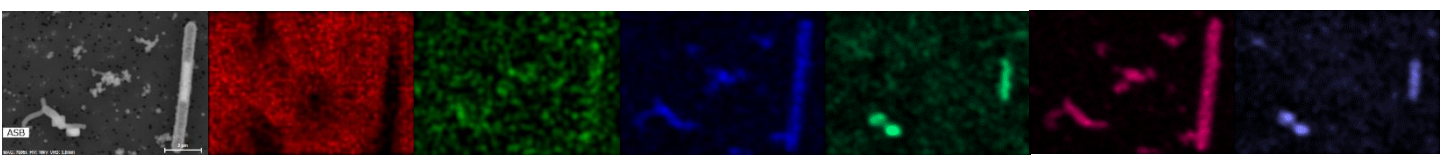
C N O Ca Cl Si K Na

8Ass-7



C N O Cl Si Na

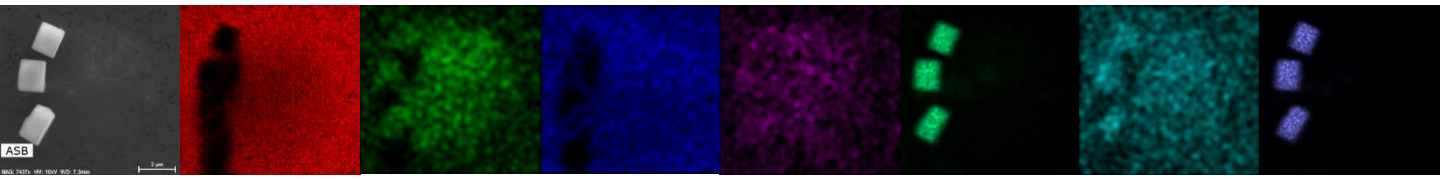
8Ass-8



C N O Cl Si Na

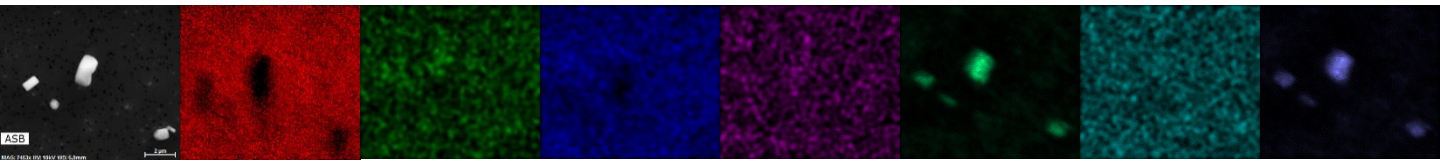
Supplementary Fig.1 _ Belilla et al.

8Gt-1



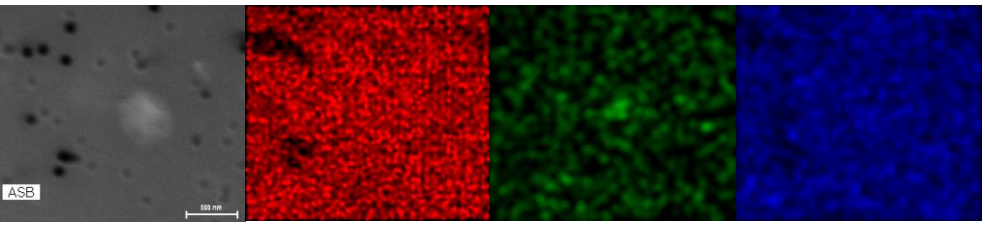
C N O Ca Cl Mg Na

8Gt-11



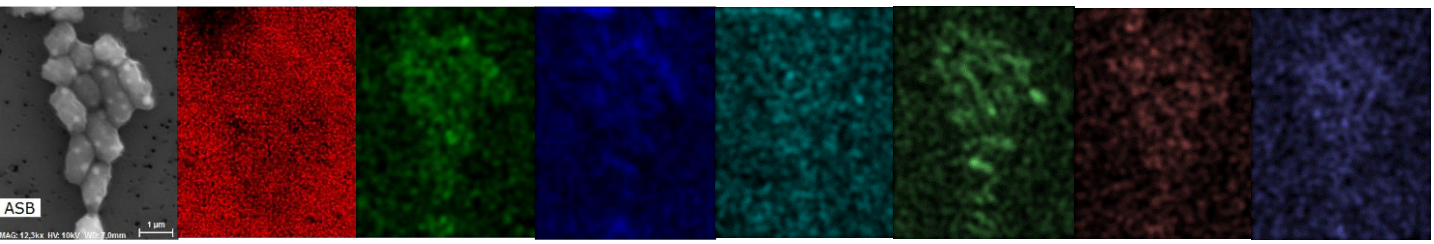
C N O Ca Cl Mg Na

Gt-5



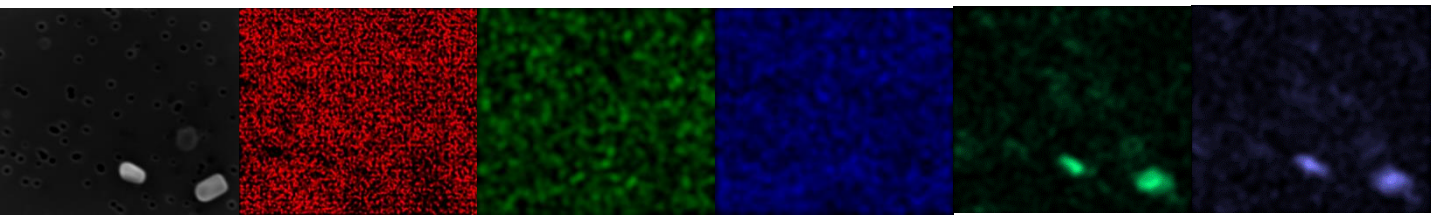
C N O

Gt-6



C N O Mg P K Na

7Gt-7

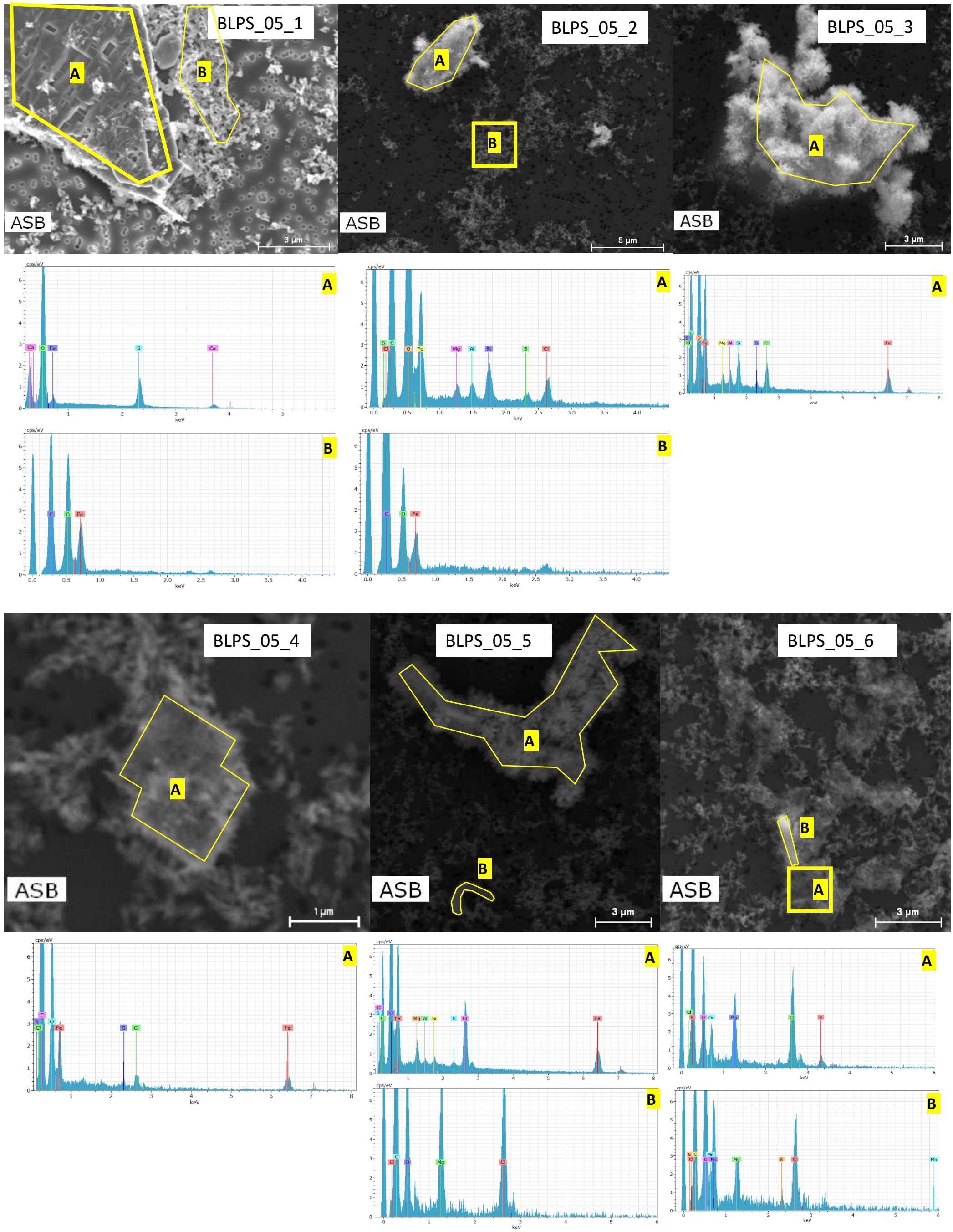


C N O Cl Na

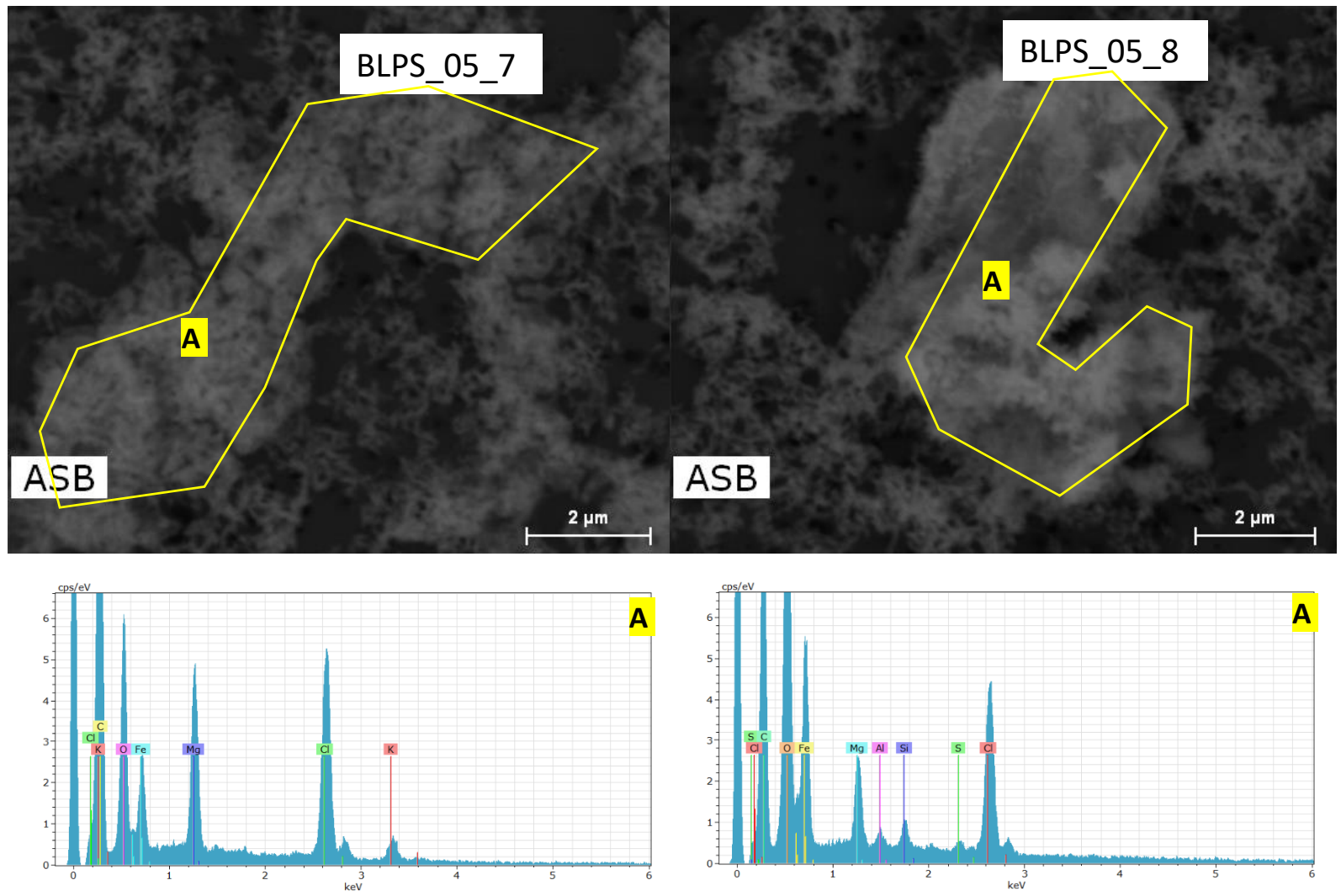
Supplementary Fig.1 _ Belilla et al.

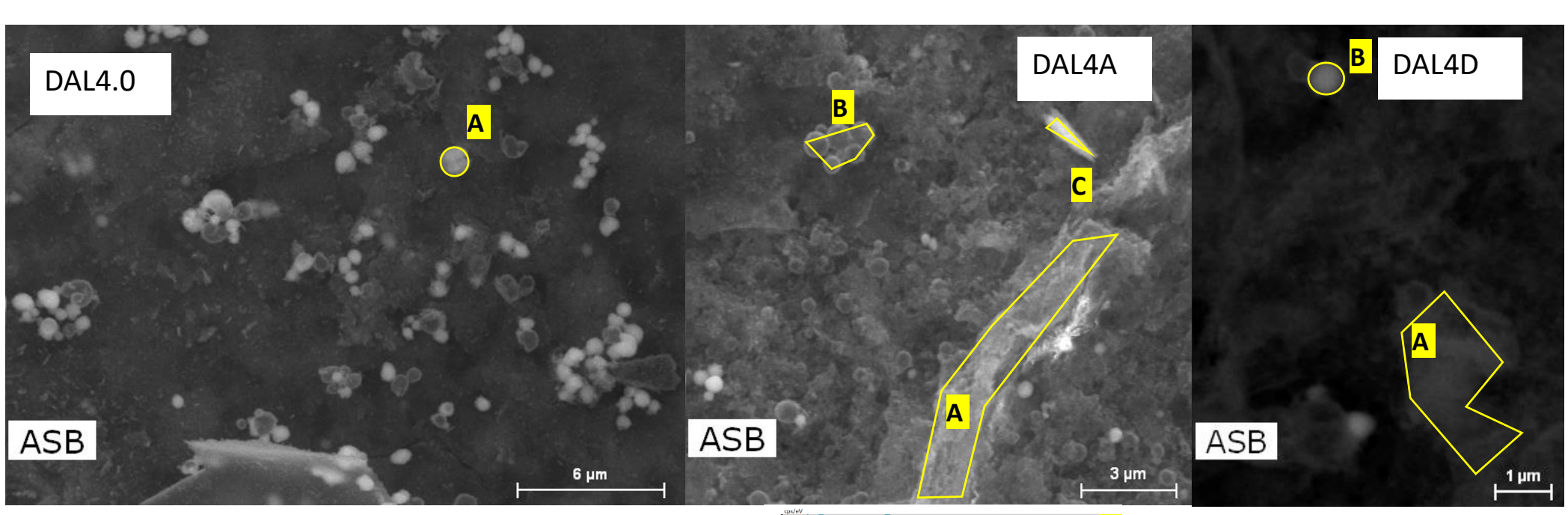
Supplementary Fig 2 | Energy dispersive X-ray spectrometry (EDXS) spectra of different structures observed in samples from the Dallol area. Samples were either observed directly on natural samples or derived from FACS sorting, as indicated. Spectra are located immediately below the corresponding SEM picture. Samples are named as in Extended Data Fig. 3.

SEM / EDXS of natural samples

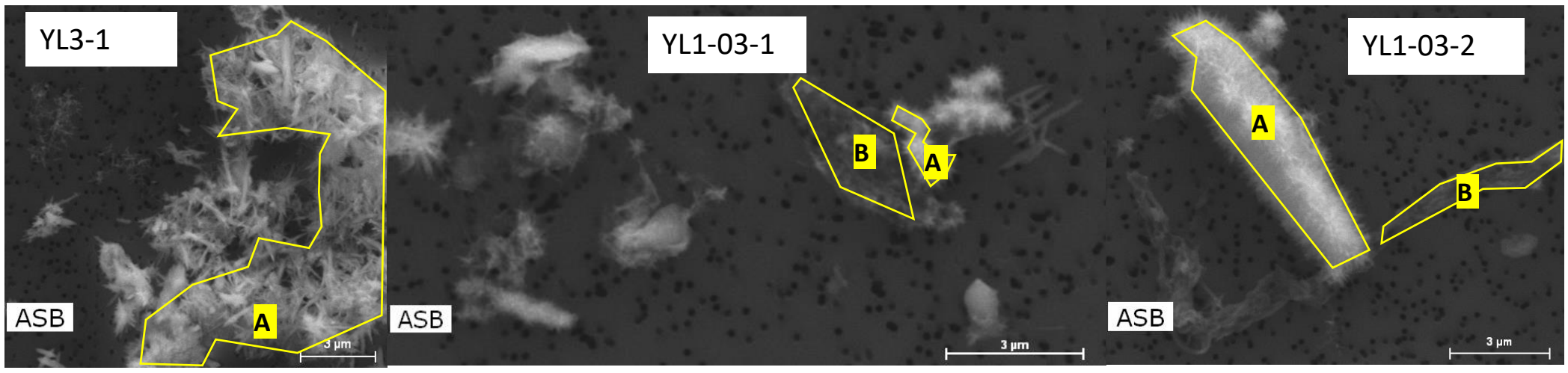


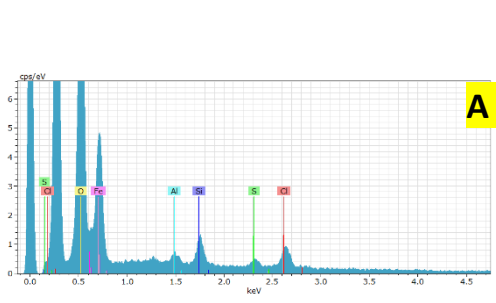
Supplementary Fig. 2. Belilla et al.

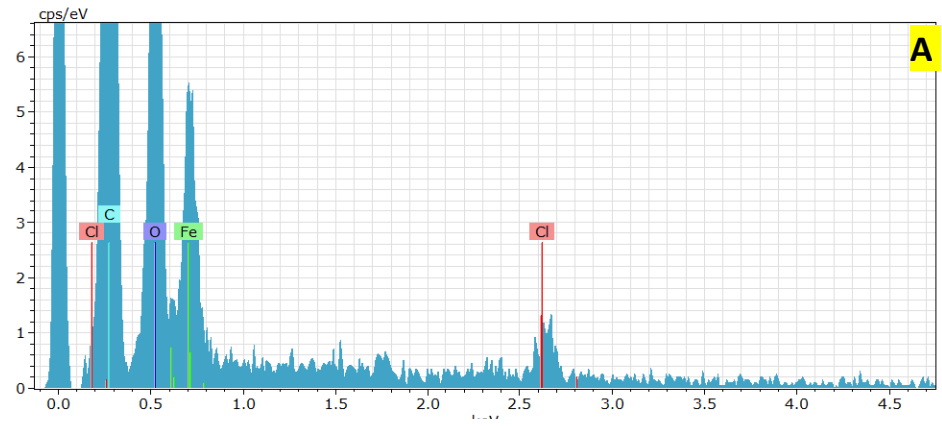


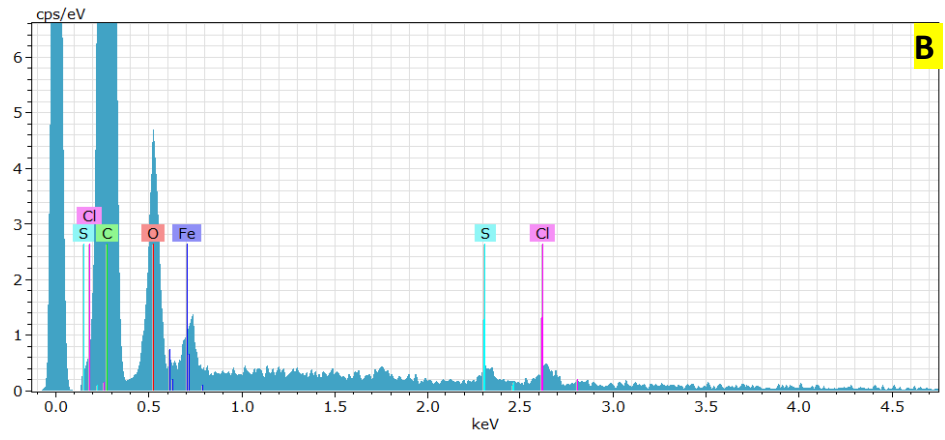


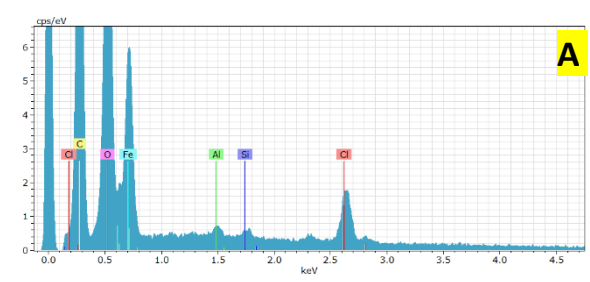
Supplementary Fig. 2. Belilla et al.

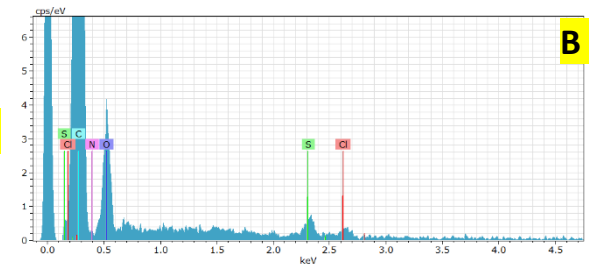


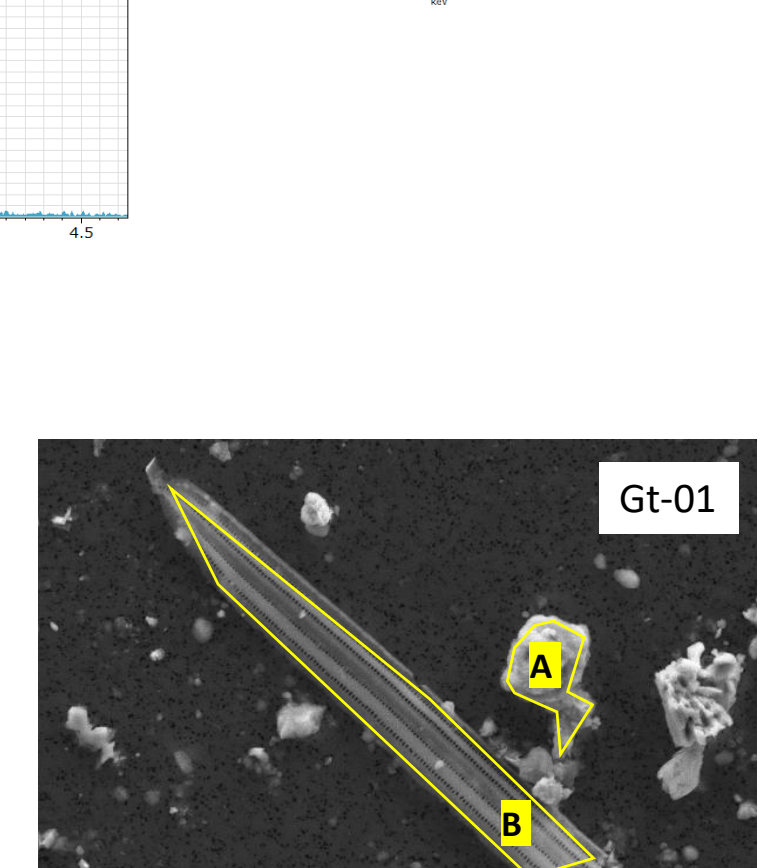






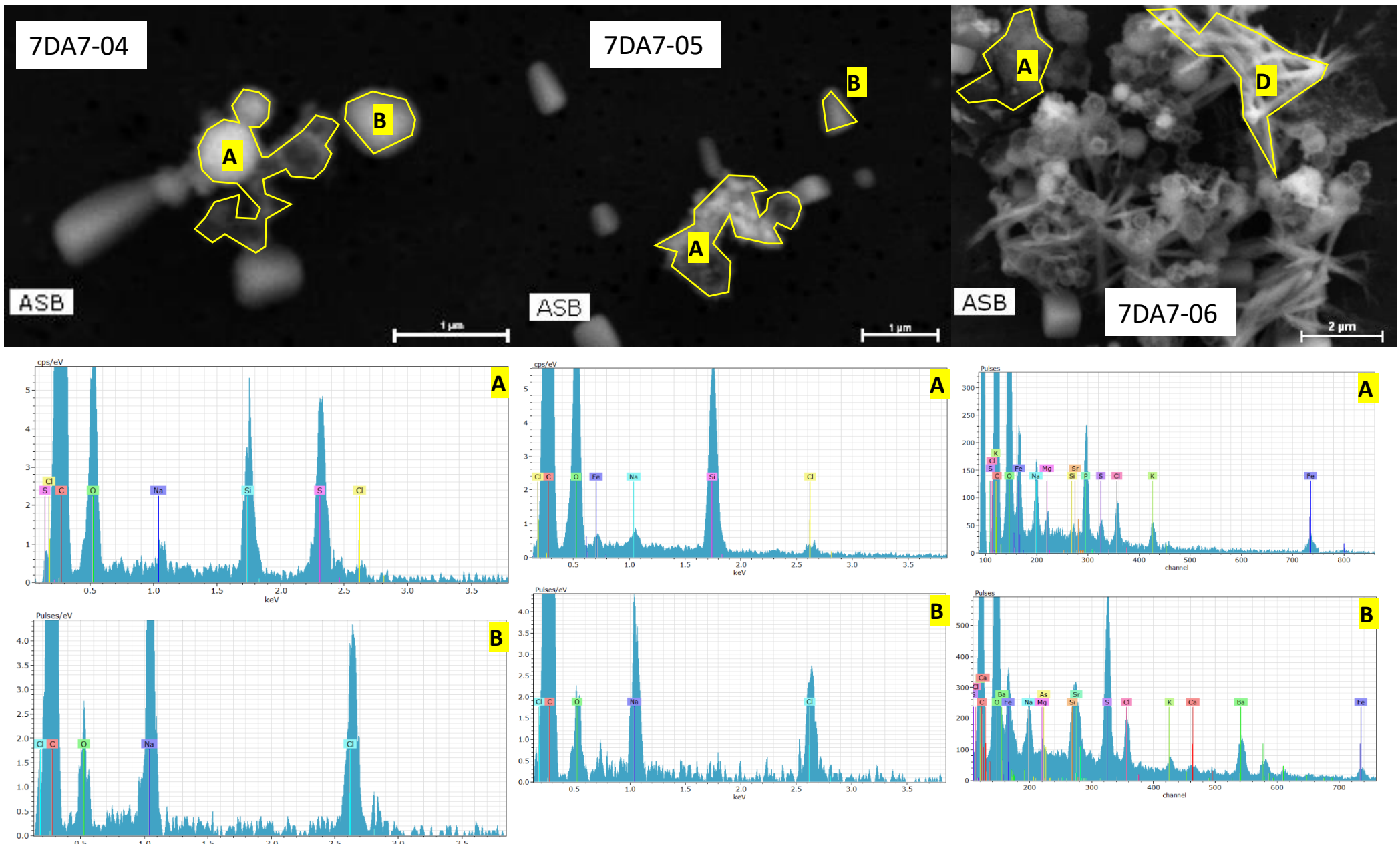


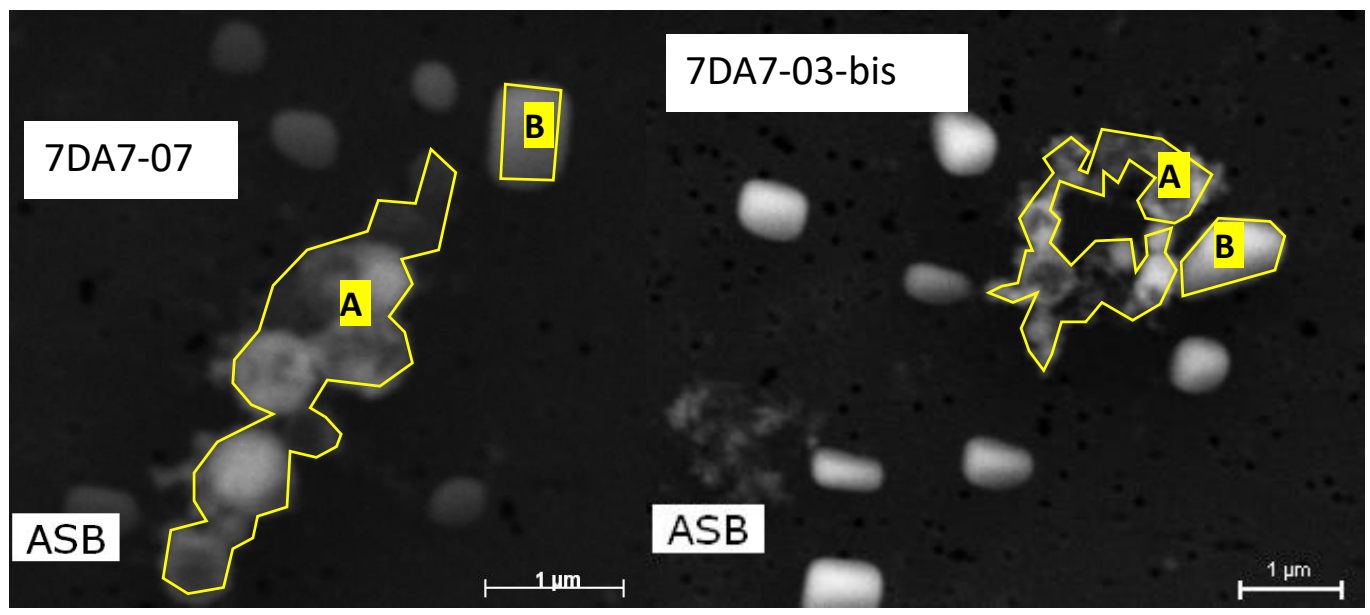




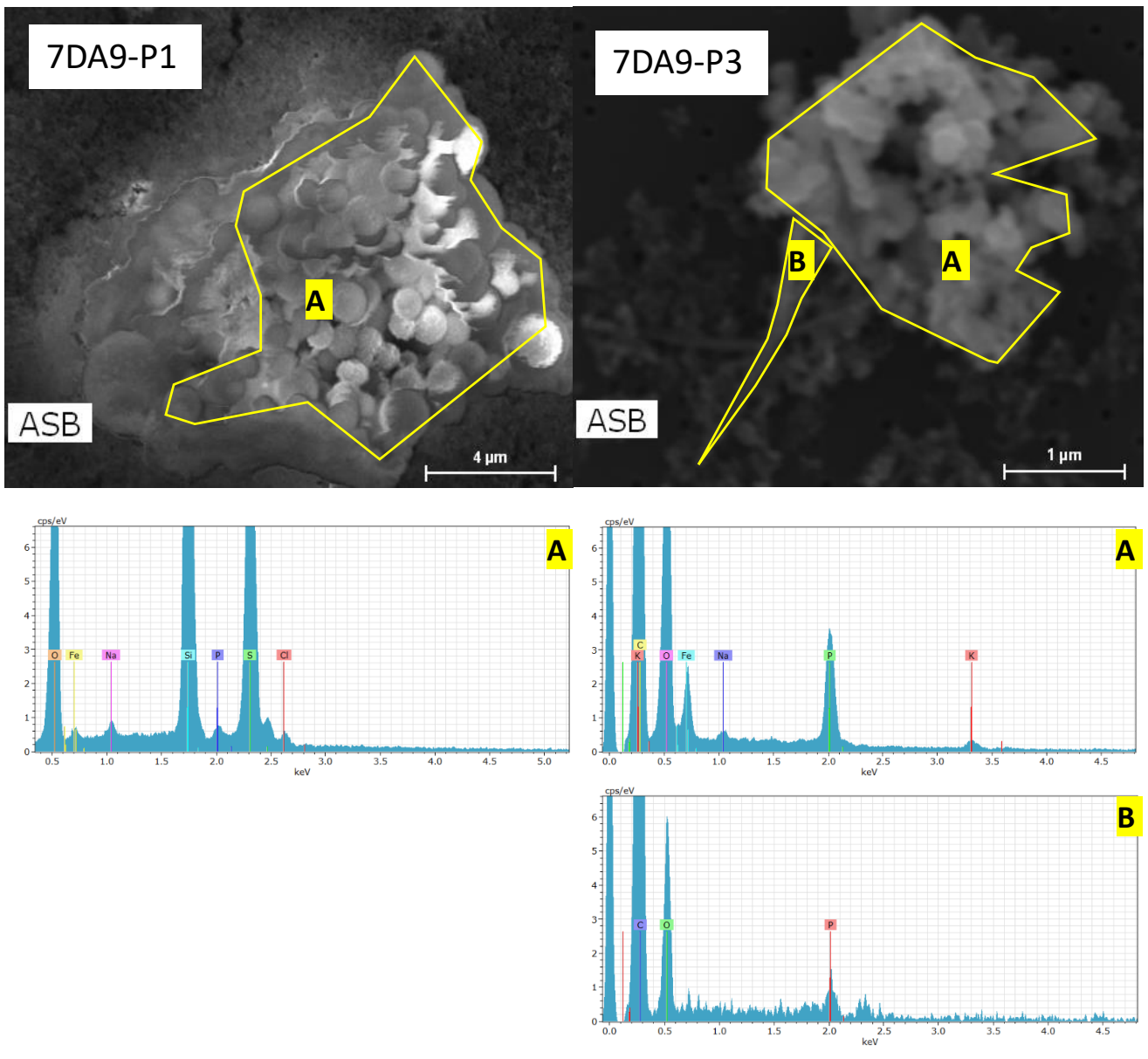
Supplementary Fig. 2. Belilla et al.

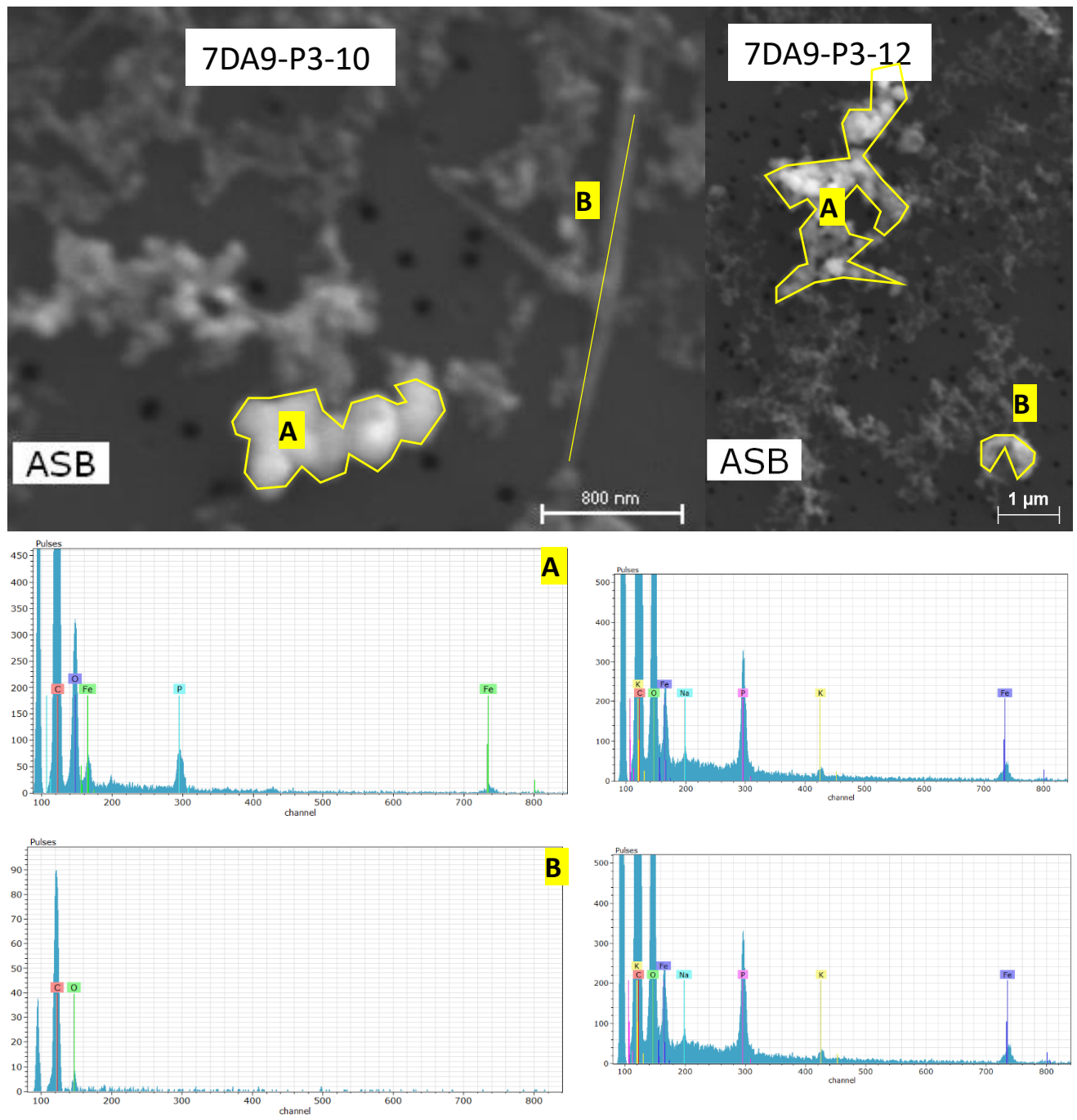
SEM / EDXS of FACS sorted cells/particles



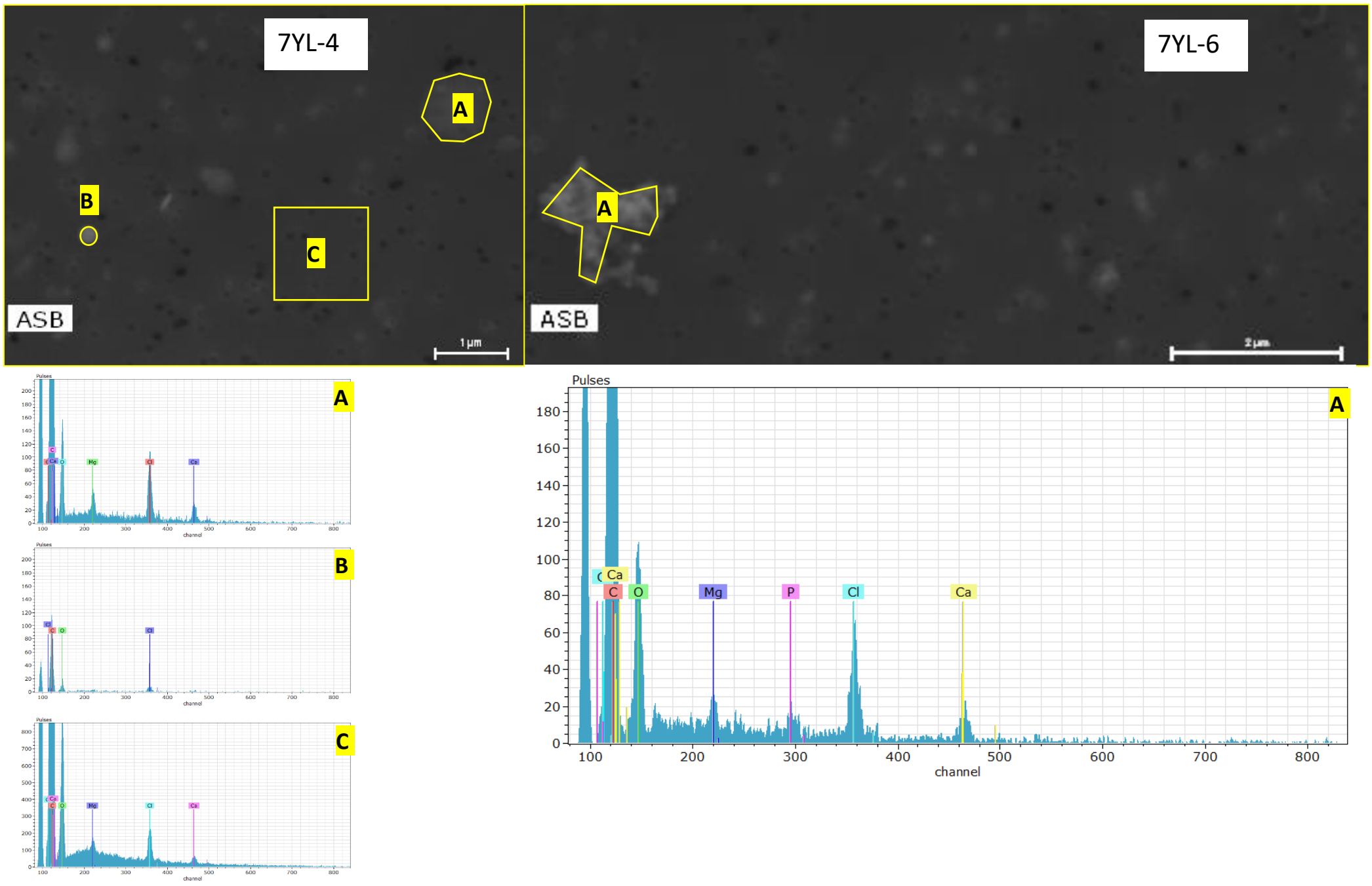


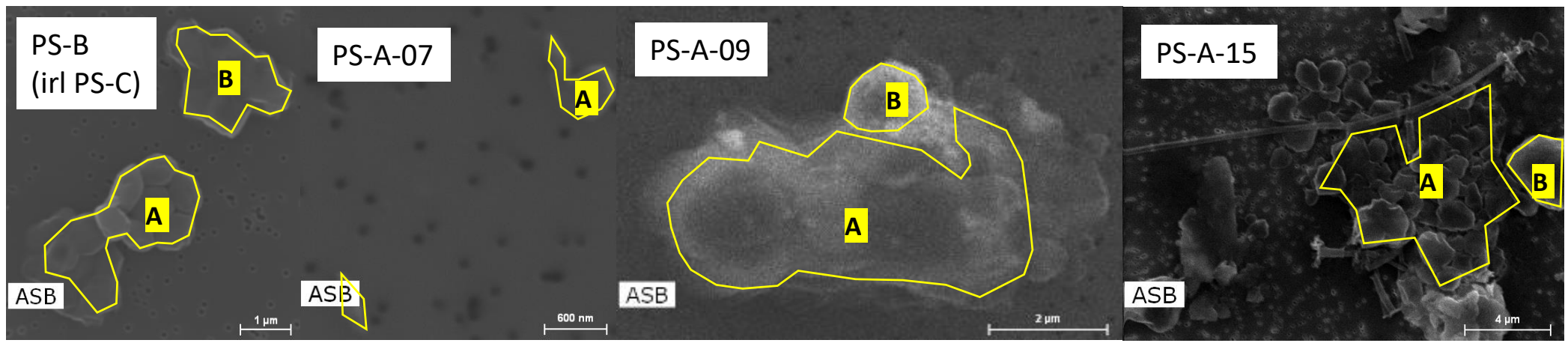
Supplementary Fig. 2. Belilla et al.

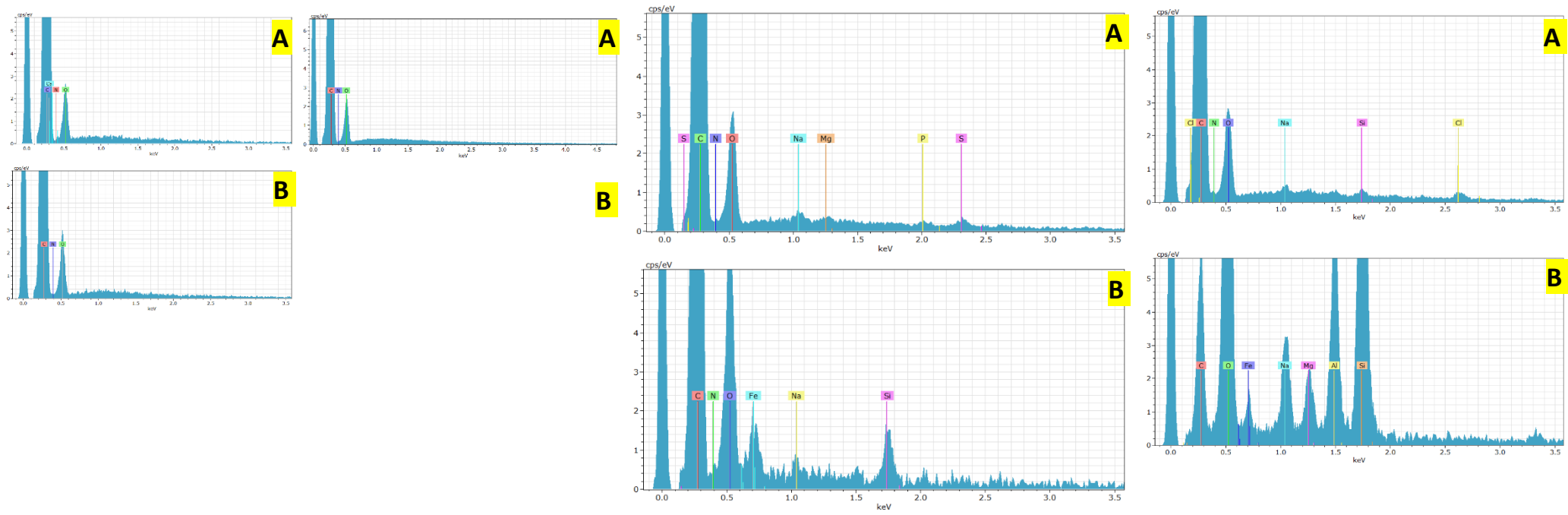




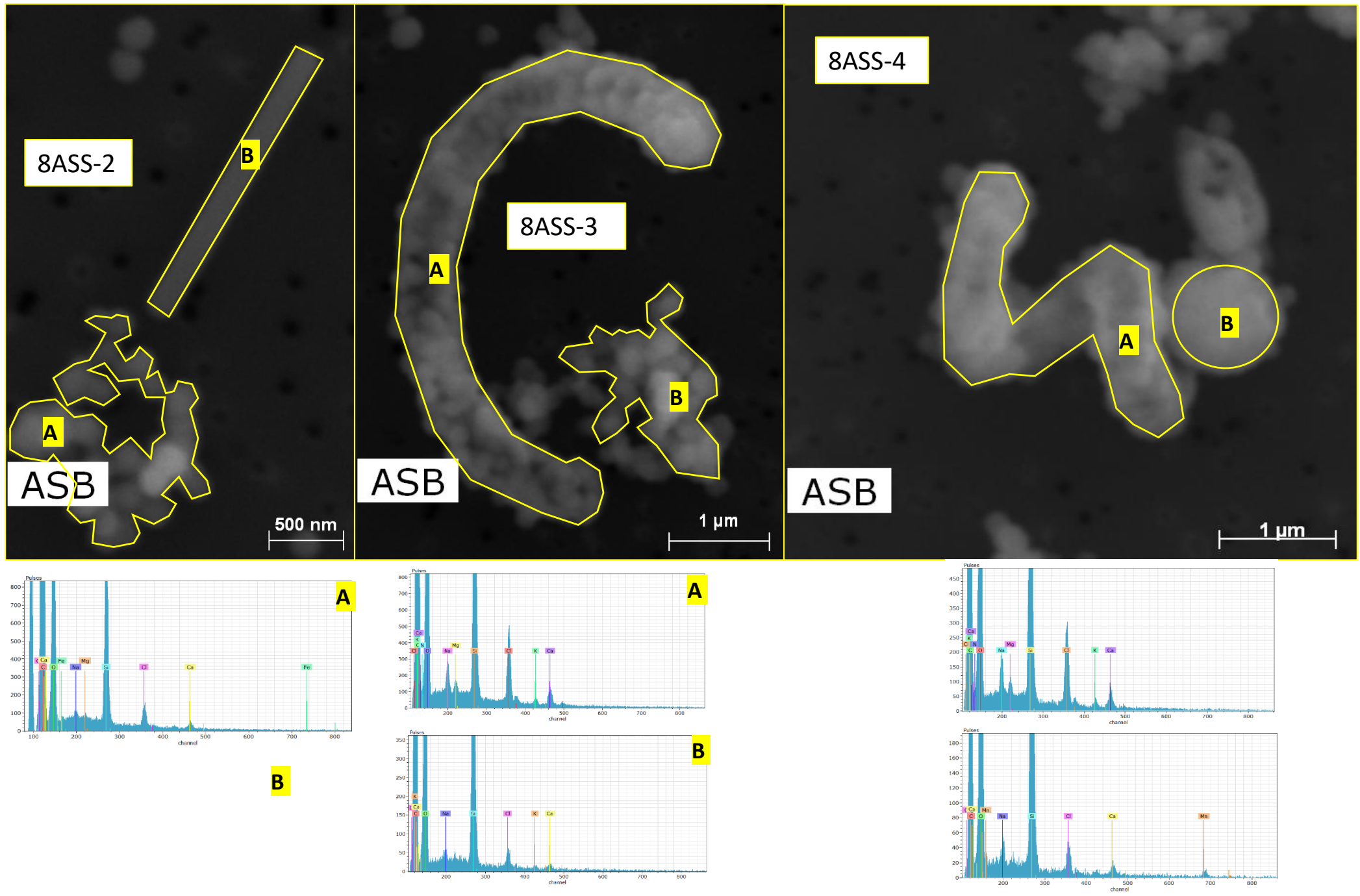
Supplementary Fig. 2. Belilla et al.



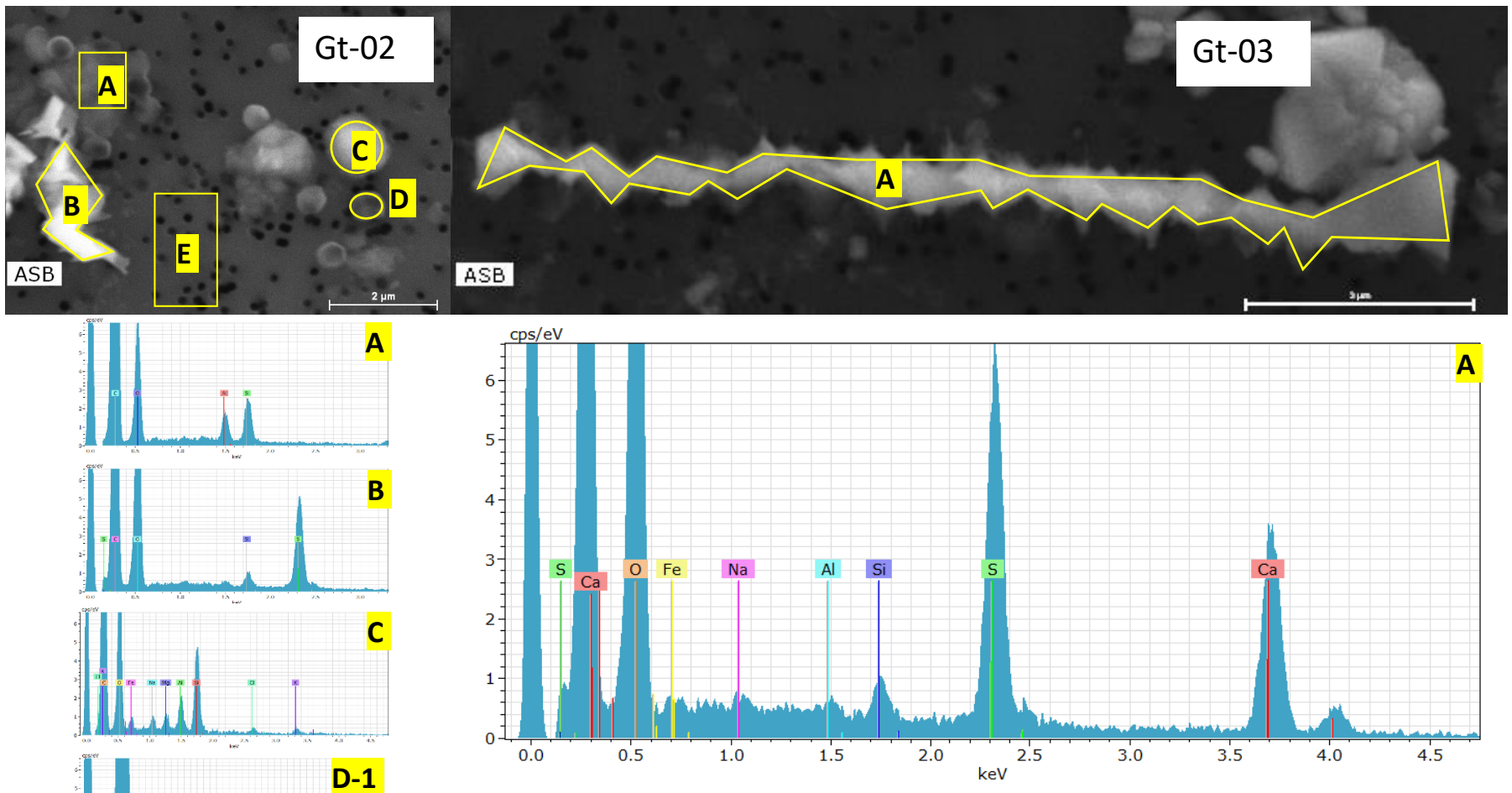


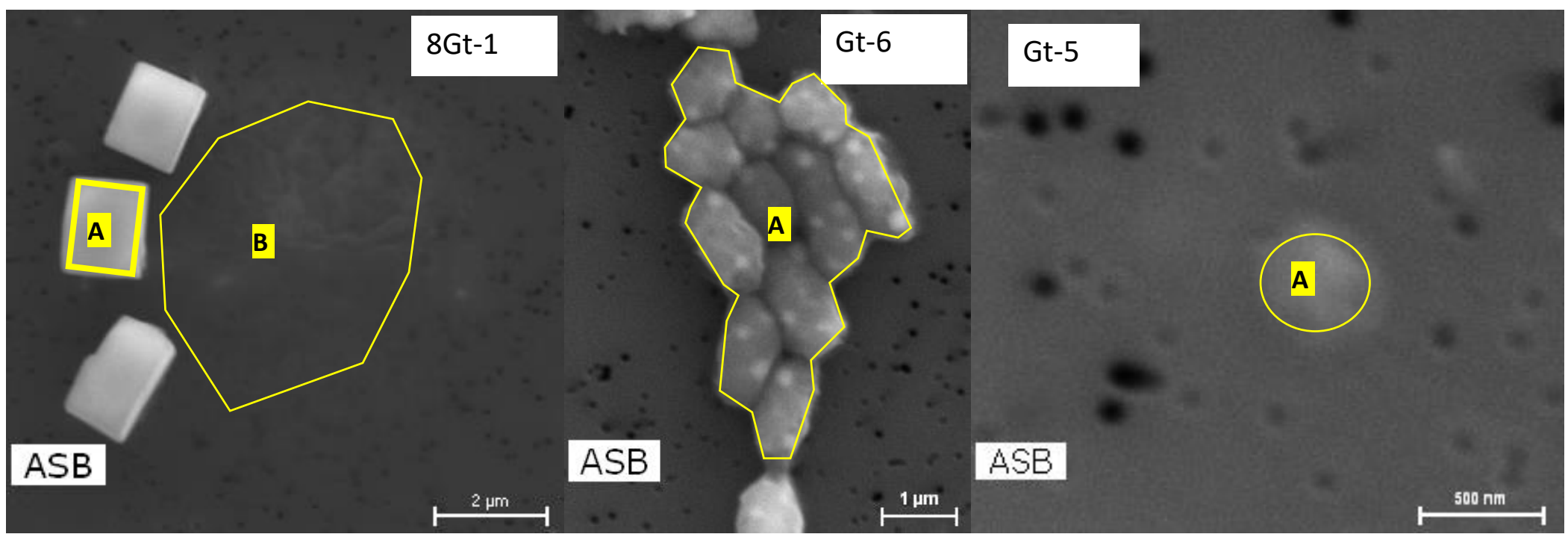


Supplementary Fig. 2. Belilla et al.



Supplementary Fig. 2. Belilla et al.





Supplementary Fig. 2. Belilla et al.